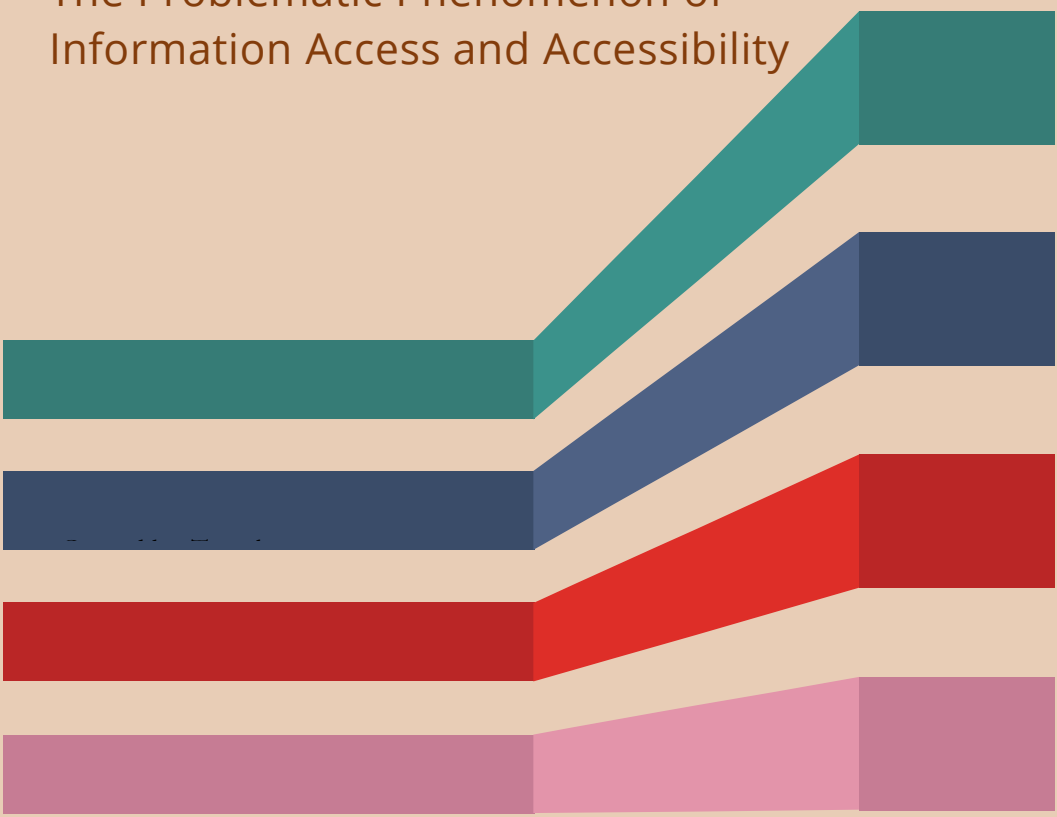
Papers on Information and Archival Studies III

The Accessibility Conundrum

The Problematic Phenomenon of
Information Access and Accessibility



DR. GEERT-JAN VAN BUSSEL

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Papers on
Information and Archival Studies

III

The Accessibility Conundrum

The Problematic Phenomenon of Information Access and Accessibility

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The author

Geert-Jan van Bussel (1960) is an independent consultant, researcher and auditor specializing in information governance, digital archiving and compliance. He is a leading auditor of records management and archiving standards (ISO 15489, ISO 16175, ISO 23081 and ISO 16363). As a strategic consultant, he is sought after by many (international) business and governmental organizations. He is a senior lecturer and researcher at the University of Applied Sciences in Amsterdam and an assistant professor at the University of Amsterdam. He is a guest lecturer at several universities in Europe and one of the leading archival scholars in the Netherlands. He was a member and president of the Special Commission for Archives (1998–2002; 2009–2011), a commission of the Cultural Council, the most important advisory body of the Dutch government in the field of culture. He has been a (keynote) speaker at a number of (international) seminars and conferences, mostly on the impact and influence of information processing and information management on the work of people. He has published extensively on information management, governance, audit, compliance and digital archiving.

Writing style

Regarding the text's redaction, I have employed AI-assisted technologies to enhance readability, spelling, and grammar. However, I have not utilized AI to supplant my own insights or to assess data. I have adhered to the conventions of Oxford English while maintaining all citations and annotations in the language style employed by the original authors.

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INTRODUCTION

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Over the course of several years, I have written a series of texts on information access and accessibility in relation to the 'Archive-as-Is' framework that I developed in 2017. [1] I have revised these individual texts for the purpose of publication in this book, in order to align the footnotes, reduce the instances of overlapping information, and occasionally cross-referencing. They are linked by a focus on access to and accessibility of information, its meaning, importance, theoretical underpinnings, bottlenecks, and requirements. In mid-2024, I authored a new text that addressed artificial intelligence and the future of information access. The book concludes with a synthesis of the preceding arguments, which is presented in the form of a conclusion.

The central thesis of this book is that access to information represents a vital aspect of contemporary society, encompassing participation, accountability, governance, transparency, the production of products, and the delivery of services. This view is widely shared, with commentators and scholars agreeing that access to information is a key factor in maintaining societal and economic stability. [2] However, having access to information does not guarantee its accessibility. Assuming that information is (cognitively) interpretable is incorrect, as many practical examples illustrate.

It is possible to distinguish between two levels of information access and accessibility. The initial level of analysis concerns *access to information*

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[1] For the framework: G.J. van Bussel (2017). 'The theoretical framework of the 'Archive-as-Is.' An organization-oriented view on archives. Part I. Setting the stage: enterprise information management and archival theories. Part II. An exploration of the 'Archive-as-Is' framework,' F. Smit, A. Glaudemans, and R. Jonker (eds.), *Archives in Liquid Times*, SAP, 's-Gravenhage, pp. 16–41, pp. 42–71.

[2] OECD (2019). *Enhancing Access to and Sharing of Data. Reconciling Risks and Benefits for Data Re-use Across Societies,* OECD Publishing, Paris, especially Chapters 2 (pp. 23–58) and 3 (pp. 59–76).

as a social phenomenon. It concerns the distinction between public (government and/or legally disclosed) information and non-public (individual or corporate) information. Access to public information is considered a fundamental human right and is enshrined in Article 19 of the Universal Declaration of Human Rights. It is a *fundamental* right, as without access to information it is impossible to exercise other human rights, including the right to political participation (Article 21), a fair trial (Article 10), freedom of conscience (Article 18) and health (Article 25.1). These rights are reaffirmed in international treaties such as the International Covenant on Civil and Political Rights and the American Convention on Human Rights. [3] This does not imply that public information will be immediately accessible in its entirety; rather, the majority of such information will become accessible over time, even if it is initially classified as secret or confidential. Access to private information, whether belonging to an individual or a corporation, is not as straightforward. Access to this information is contingent upon the following conditions: [1] an organization or individual may grant access to information at their own discretion and as a gesture of goodwill; [2] an organization may permit (commercial) access to information on its website(s) for as long as it allows it to be online (or is obliged to keep it accessible); [3] the law may permit (limited) access to (certain types or parts of) this information, possibly on the basis of payment of a fee. This permits, for example, government

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[3] *Universal Declaration of Human Rights* (1948). Online source, retrieved 1 November 2024, from: https://www.un.org/en/about-us/universal-declaration-of-human-rights. *The International Covenant on Civil and Political Rights* (1966), 19.2. Online source, retrieved 1 November 2024, from: https://www.ohchr.org/en/professionalinterest/pages/ccpr.aspx. *The American Convention of Human Rights* (1969), 13.1. Online source, retrieved 1 November 2024, from: https://www.cidh.oas.org/basicos/english/basic3.american%20convention.htm.

investigators into alleged tax fraud to access business information, or individuals to access personal information (as defined in the GDPR). [4]

The second level concerns access to *information as an organizational phenomenon*. The importance of access to public information for citizens cannot be overstated. However, access to organizational information is equally crucial for employees. The ability to access information is of benefit to customers, as it allows them to receive better service. It fosters trust between employees and their employers. It enables organizational leaders to identify trends and bottlenecks, focus on the most serious issues, and gain the insight to make informed decisions. This, in turn, determines whether an organization succeeds or fails. There are numerous impediments to effective information management, including behavioural and governance issues that can impede access and accessibility. [5]

The two levels are inextricably linked. Nevertheless, access to information as a societal phenomenon exerts a significant influence on access to and accessibility of information within organizations. My objective is to examine information access and accessibility in the context of a highly digitalized world. This book provides an overview of these concepts, their context, and their requirements.

The book comprises of seven units, an introduction followed by six chapters which offer insights into the challenge of access to information in a digitalized world. The initial chapter, which is relatively brief, addresses the concepts of access and accessibility, elucidating their mean-

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[4] *General Data Protection Regulation* (GDPR), article 15, and recitals 63 and 64. Online source, retrieved 1 November 2024, from: https://gdpr-info.eu/art-15-gdpr/. Archived at: https://gdpr-info.eu/art-15-gdpr/

[5] G.J. van Bussel (2020). *A Sound of Silence. Organizational Behaviour and Enterprise Information Management*. Papers on Information and Archival Studies, I, Van Bussel Document Services, Helmond; and G.J. van Bussel (2021). *An Accountability Puzzle. Organizations, Organizational Governance, and Accountability*. Papers on Information and Archival Studies, II, Van Bussel Document Services, Helmond.

ings and delineating the ways in which they are influenced by the exponential growth of information. Furthermore, it examines how information technology introduces a novel access paradox. The second chapter examines the challenges to access to and accessibility of information in a digitalized, hybrid world where code may be law, where there is an inescapable loss of privacy, where doing business opens and restricts access, where literacy is a necessity to survive 'digital divides,' and where environmental concerns may have an adverse effect on high expectations. The third chapter presents a review of theoretical approaches to access and accessibility from seven different research perspectives: information access disparity, information seeking, information retrieval, information quality, information security, information management, and archives management. My analysis of this research leads me to identify six approaches to information access and accessibility: [1] social, economic, and political participation; [2] 'smart' and evolving technology; [3] power and control; [4] sense-making; [5] knowledge representations, and [6] information survival. The fourth chapter addresses the bottlenecks and requirements for information access and accessibility, culminating in a checklist for organizations to assess these requirements within their own business processes. In the fifth, relatively brief chapter, I present some perspectives on artificial intelligence and the future of information access. The sixth chapter represents my attempt to draw conclusions and to bring this book to a close.

Although I have tried my best to discuss the broad range of access and accessibility, I have no illusions that I have succeeded. There may be aspects that I was not aware of or approaches that I overlooked. Nevertheless, I believe that I have covered the most important aspects of access to and accessibility of information, and that I have provided a solid and well-founded description of the problems involved. I only hope that the reader enjoys these texts as much as I enjoyed researching and writing them.

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The Paradoxes of Information Access

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A PROBLEM OF MASS

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Neglect

Since the 1990s, organizations have been faced with the transformation to an information society and have had to manage technology-related issues such as organizational chains, interorganizational data warehouses, cloud computing, trusted computing, ecommerce, computer mediated exchange, linked data, green computing, blockchains, big data, data lakes, data analytics, machine learning, and artificial intelligence. Organizations were (and still are) reorganizing themselves in continuous waves of hypes and technologies to meet new challenges and expectations in changing environments. They have used successive generations of information technology to try to align their business processes. They captured more structured data in their databases than ever before and improved the way business transactions were documented. As a result, the quality of the structured data improved. However, even in the face of increasing information overload, they neglected the access of the unstructured data they generated (some 80 to 95% of all their information). Similarly, the information behaviour of employees and the challenges of lifelong learning to address the literacy problems created by these waves of technological innovation and the resulting information overload have been ignored. [6]

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[6] Van Bussel (2020), pp. 59–71. 80%: S. Grimes (2008). 'Unstructured data and the 80 percent rule,' *Clarabridge Bridgepoints newsletter*, Q3, Experts Corner, Reston (Va.). Online source, retrieved 1 September 2024, from: http://breakthroughanalysis.com/2008/08/01/unstructured-data-and-the-80-percent-rule/. Archived at: https://archive.fo/jQ87U. 95%: A. Gandomi and M. Haider (2015). 'Beyond the hype. Big data concepts, methods, and analytics,' *International Journal of Information Management*, Vol. 35, No. 2, pp. 137–144.

Access to and accessibility of information

There has been a long history of research into information access — how people find, obtain and accept (useful) information. In 2004, Leah Lievrouw noted that 'access is rarely explicitly defined, even by experts,' a statement that is still true today. [7] Peter Lor and Johannes Britz noted that 'the right of access to information has become a dominant right in the information and knowledge age.' [8] Michael Buckland noted that 'access is emerging as a recurring theme' in information studies. [9] It has been said that 'exploration of the conceptual nature of access to information has been limited.' [10] Buckland states that the concept of information access is about six aspects: identification, availability, user prices, provider costs, cognitive access (understanding the information), and acceptability (accepting the credibility of the source or content). The first four aspects are relevant to 'information-supplying systems,' systems that retrieve potentially informative things (information-as-thing), and all six aspects are necessary for 'systems that inform,' systems that people use to become informed and successful (information-as-knowledge). [11] Gartner's interpretation of these aspects is primarily in terms of the tech-

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[7] L. Lievrouw (2004). 'Integrating the research on media access. A critical overview,' E. Bucy and J. Newhagen (eds.), *Media Access. Social and Psychological Dimensions of New Technology Use*, Lawrence Erlbaum Associates Publishers, London, Chapter 13, pp. 269–279, p. 269.

[8] P.J. Lor and J.J. Britz (2007). 'Is a knowledge society possible without freedom of access to information?,' *Journal of Information Science*, Vol. 33, No. 4, pp. 387–397, p. 392.

[9] M.K. Buckland (1991). *Information and Information Systems*, Greenwood Publishing Group, Westport, p. 72.

[10] G. Burnett, P.T. Jaeger, and K.M. Thompson (2008). 'Normative behavior and information. The social aspects of information access,' *Library & Information Science Research*, Vol. 30, No. 1, pp. 56–66, p. 56.

[11] Buckland (1991), pp. 78–80. Quoations: p. 80. I use 'information' as general term for data, records, and information based on this typology.

nological capabilities and requirements of information systems, as was the 'common' interpretation of access. [12] Cognitive access was seen by Gartner as the knowledge of how to use technology for access, since one must rely on technology for access to information. This is a limited understanding of Buckland's concept of cognitive access.

'Access' to information is defined in the Merriam-Webster as the 'freedom or ability to obtain or make use of something' and in the Cambridge Dictionary as 'the right or opportunity to use or look at something.' [13] Accessibility is defined as a 'capability' or a 'quality' of information in being reached, obtained, or used. [14] Kay Mathiesen clarified that information access is not primarily about access to information systems or services that organize and present information (information-as-thing) but to information itself (information-as-knowledge.) [15]

In my view, both access and accessibility have two meanings: [1] access to information is about (a) the organizational and/or societal way

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[12] W. Andrews (2009). *Magic Quadrant for Information Access Technology*, Gartner RAS Core Research Note G00169927, Gartner, Inc., Stamford (Ct.). This resource is not available online. Based on: D. Satterthwaite (2010). 'Emerging technologies to speed information access,' *Information Services and Use*, Vol. 30, No. 3–4, pp. 99–105.

[13] Respecively: Merriam-Webster (2024). 'Access.' Online source, retrieved 1 November 2024, from: https://www.merriam-webster.com/dictionary/access, and Cambridge Dictionary (2024). 'Access.' Online source, retrieved 1 November 2024, from: https://dictionary.cambridge.org/dictionary/english/access.

[14] Merriam-Webster (2024). 'Accessible.' Online source, retrieved 1 November 2024, from: https://www.merriam-webster.com/dictionary/accessibility, and Cambridge Dictionary (2024). 'Accessibility.' Online source, retrieved 1 November 2024, from: https://dictionary.cambridge.org/dictionary/english/accessibility.

[15] K. Mathiesen (2014). 'Facets of access. A conceptual and standard threats analysis,' M. Kindling and E. Greifeneder, *Proceedings of the iConference 2014, March 4-7, 2014, Berlin*, iSchools, pp. 605–611, p. 607.

of finding and obtaining information using the technologies, methods and skills available, and (b) the way in which users are enabled to cognitively access information; and [2] accessibility of information is about (a) the quality of information in terms of being easily found and obtained, and (b) the quality of information in terms of its content being (cognitively) interpretable by users. The two concepts are closely related but distinct. Cognitive access and cognitive interpretation are, as Mathiesen (and Buckland) claimed, mostly neglected. Both information-as-thing and information-as-knowledge are acknowledged in this description.

As Mathiesen points out, access can be characterized as a *relationship* between an individual (or a group of individuals) and a piece (or a set of pieces) of information. Changes in this relationship can be achieved by influencing the quality of information to make it more accessible (e.g. making it easier to understand or verify) or by influencing individuals or the environment to make it easier to access (e.g. learning information seeking and computer skills or using better technology). [16]

The definitions of access *assume* (but do not mention) this second meaning. Buckland implies this meaning in his fifth and sixth aspects: 'cognitive access' (understanding information), and 'acceptability' (accepting the credibility of the information). [17] Mathiesen does so as well in her definition of access: 'the freedom or opportunity to obtain, make use of, and benefit from that information.' [18] Adding 'benefit' emphasizes the added value the (cognitive) interpretability of information offers. The assumption that accessibility is implied when access is realized is widespread in (academic) literature.

My description of access ('how people can find, obtain and accept (useful) information') needs to be adapted to a more detailed definition that tries to combine both meanings of access and accessibility. I am

[16] Mathiesen (2014), p. 607.

[17] Buckland (1991), pp. 78–80.

[18] Mathiesen (2014), p. 607.

defining information access as the way in which people's rights, opportunities, and/or abilities to find and obtain information are realized in such a way that they benefit from the added value that accessibility of information (= having both the quality of being easily obtained and being (cognitively) interpretable) provides.

Opportunities, abilities, rights, and accessibility are not self-evident. Access is affected by 'how it is used, organizational policies around access, and applicable laws governing access and disclosure,' the literate abilities of the individuals trying to gain access, and changes in (cognitive) interpretability over time, caused by, for instance, deteriorating file formats. [19] My definition of access considers the difference between *public* ('right') and *private* information ('opportunity.')

A growing mass of information

We are confronted with an overwhelming quantity of information. IDC predicted that the amount of information will increase from 33 zettabytes in 2018 to 181 zettabytes by 2025. [20] The digital universe doubles every two years due to the possibilities of internet publishing, wireless sensor networks, global communications, mobile devices, cameras, and the large-scale digitization of cultural heritage objects. [21] The examples

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[19] Quotation: G. Kozak (2015). 'Access/Accessibility,' L. Duranti and P.C. Franks (eds.), *Encyclopedia of Archival Science*, Rowman & Littlefield, Lanham, p. 1. There is no definition of access in this article.

[20] D. Reinsel, J. Rydning, and J.F. Gantz (2021). *Worldwide Global Datasphere Forecast, 2021–2025. The World Keeps Creating More Data. Now, What Do We Do With It All?,* IDC, Framingham (Ms.). The summary used is an online source, available in a webarchive. Archived at: https://archive.ph/wip/C2d0i.

[21] J. Gantz and D. Reinsel (2012). *The Digital Universe in 2020. Big Data, Bigger Digital Shadows, and Biggest Growth in the Far East*, IDC, Framingham (Ma.), pp. 1. Online source, retrieved 1 November 2024, from: https://www.cs.princeton.edu/courses/archive/spring13/cos598C/idc-the-digital-universe-in-2020.pdf.

presented serve to illustrate the quantity of information that has been created. It was not possible to find recent estimates for older examples. However, it is certain that the amounts have increased in recent years.

In 2014, eBay processed a total of 100 petabytes. [22] In a single flight of approximately 30 minutes, a jet engine generates 10 terabytes of data. Given that thousands of daily flights are conducted, the data generated exceeds petabytes. [23] In order to study dark matter, 20 terabytes of images are captured every night by the Vera C. Rubin Observatory. In the 10 years of operation, the data set will reach a size of 500 petabytes. [24] In December 2023, over 28 billion shares were traded on the NASDAQ stock market in 5 days. [25] The University of Ontario's Artemis cloud platform facilitates the real-time streaming and analysis of data from neonatal bedside monitors, with the potential to generate millions of data points per patient per day. As an illustration, this results in the generation of more than 1 gigabyte of drug infusion data from a single patient on a

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[22] C. Saran (2014). 'Case study. How big data powers the eBay customer journey,' *ComputerWeekly.com*, 29 April. Online Source, retrieved 1 November 2024, from:
https://www.computerweekly.com/news/2240219736/Case-Study-How-big-data-powers-the-eBay-customer-journey. Archived at:
https://archive.fo/teeXW.

[23] I.J. Donaldson, S.C. Hom, T. Housel, I. Mun, and T. Silkey (2018). 'Part A. Visualization of big data. Current trends,' A.B. Badiru and L. Racz (ed.), *Handbook of Measurements. Benchmarks for Systems Accuracy and Precision*, CRC Press, Boca Raton, Chapter 17, pp. 316–330, p. 317.

[24] G. Beckett (2022). 'Preparing for an unprecedented astronomical data set.' *Epcc website*. Online source, retrieved 1 November 2024, from:
https://www.epcc.ed.ac.uk/whats-happening/articles/preparing-unprecedented-astronomical-data-set. Archived at: https://archive.ph/wip/NXJGs.

[25] *Nasdaq Daily Market Summary, 4-8 December 2023*. Online source, retrieved 10 December 2023, available in a webarchive.
Archived at: https://archive.ph/nxUBi.

daily basis. [26] CERN manages 340 petabytes of information on tape, which is equivalent to the storage capacity required to record 2000 years of 24/7 high-definition video. In 2023, the organization's tape archive is estimated to contain 1 exabyte of information. [27] Google is processing more information than the already staggering 24 petabytes per day in 2008. [28] In 2016-17, Google Photos stored approximately 14 petabytes of images. [29] It was more (but not specified) in 2020, storing more than 4 trillion images. [30] YouTube is said to manage approximately 33 petabytes of videos. [31] In 2024, the number of images and videos uploaded per day on Instagram is estimated at approximately 95 million. [32]

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[26] H. Khazaei, C. McGregor, M. Eklund, K. El-Khatib, and A. Thommandram (2014). 'Toward a big data healthcare analytics system. A mathematical modeling perspective,' *Proceedings of the IEEE World Congress on Services, July 2014, Barcelona*, IEEE, New York, pp. 208–215, p. 208.

[27] T. Smith (2023). 'An exabyte of disk storage at CERN.' Online source, retrieved 1 November 2024, from: https://home.web.cern.ch/news/news/computing/exabyte-disk-storage-cern. Archived at: https://archive.is/0H33s.

[28] J. Dean and S. Ghemawat (2008). 'MapReduce. Simplified data processing on large clusters,' *Communications of the ACM*, Vol. 51, No. 1, pp. 107–113, p. 107.

[29] A. Sabharwal (2016). 'Google Photos, One year, 200 million users, and a whole lot of selfies,' *The Keyword Google Blog*. Online source, retrieved 1 November 2024, from: https://blog.google/products/photos/google-photos-one-year-200-million/. Archived at: https://archive.ph/1csJt.

[30] S. Ben-Yair (2020). 'Updating Google Photos' storage policy to build for the future,' *The Keyword Google Blog*. Online source, retrieved 1 November 2024, from: https://blog.google/products/photos/storage-changes/. Archived at: https://archive.ph/PZZdS.

[31] 'Estimate total storage capacity for all videos on YouTube,' *PMExercises*, 30 December 2021. Online source, available in a webarchive. Archived at: https://archive.fo/D6JAS.

[32] J. Wise (2023). 'How many pictures are on Instagram in 2023?, *EarthWeb*. Online source, retrieved 1 November 2024, from: https://earthweb.com/how-many-pictures-are-on-instagram/.

These examples are impressive, but do not illustrate growth. Researchers, however, concur that the growth rate of information (as-things) is remarkable. In 2002, the global storage capacity reached five exabytes, while the distribution of information via radio, television, telephone, and the Internet reached an additional eighteen exabytes. The quantity of stored information was increasing at an annual rate of approximately 30%. [33] In 2007, IDC estimated that the total amount of information in existence had exceeded the available storage capacity. The figure had reached 800 exabytes by the year 2009. IDC anticipated a compound annual growth rate of 40% through 2020. As previously stated, IDC expects that 181 zettabytes will be generated in 2025, representing a 148 zettabyte increase from 2018. [34] In 2011, Martin Hilbert and Priscila López found an average annual growth in storage of 23% from 1986 to 2007 (when it was at 290 exabytes.) The information storage capacity has doubled every 40 months since the 1980s, while computing capacity has grown by 58% per year. In 2000, 25% of all infor-

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Archived at: https://archive.ph/wip/eWQsy.

[33] P. Lyman and H.R. Varian (2003). *How much information?* Berkeley, School of Information Management and Systems, University of California. Website. Online source, available in a webarchive. Archived at: https://webarchive.loc.gov/all/20200101194406/http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/printable_report.pdf.

[34] J.F. Gantz, D. Reinsel, and C. Chute (2007). *The Expanding Digital Universe. A Forecast of Worldwide Information Growth Through 2010*, IDC, Framingham (Ms.). Online source, available in a webarchive. Archived at: https://web.archive.org/web/20230228180256/https://issuu.com/mpagaza/docs/expanding-digital-universe. See also: J.F. Gantz and D. Reinsel (2009). *As the Economy Contracts, the Digital Universe Expands*, IDC, Framingham (Ms.). Online source, available in a webarchive. Archived at: https://perma.cc/V76L-ZFNL; Gantz and Reinsel (2012); and Reinsel, Rydning, and Gantz (2021).

mation was stored digitally, in 2007 it was 94%. [35] This illustrates the evolution of digitalization from 2000 to 2010. The growth of the information mass is undeniable, although it is difficult to provide precise figures. It seems probable that this considerable growth is also affecting access to information-as-knowledge. [36]

One consequence of the growing volume of information is the increasing expenditure on storage systems. According to IDC, the market for cloud resources and enterprise infrastructure grew by 34% between April 2017 and March 2018. [37] As previously stated, this vast quantity of information is influencing the manner in which organizations manage and operate their business processes, engage with customers, create economic value, analyse their markets, identify business trends, and deliver value to their stakeholders. The expansion of regulatory frameworks around the globe is placing increasing demands on the secure and transparent processing of information, the protection of privacy, the generation of trusted information, and the realization of information access. In the context of this information overload, organizations are confronted with a deluge of data, which presents a significant challenge.

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[35] M. Hilbert and P. López (2011), 'The world's technological capacity to store, communicate, and compute information,' *Science*, Vol. 332, No. 6025 (april), pp. 60–65, and table 1, p. 63.

[36] H.M.B. Feroz, S. Zulfiqar, S. Noor, and C. Huo (2021). 'Examining multiple engagements and their impact on students' knowledge acquisition. The moderating role of information overload,' *Journal of Applied Research in Higher Education*, Vol. 14, No. 1, pp. 366–393.

[37] BusinessWire (2018). 'Worldwide enterprise storage market grew 34.4 % during the first quarter of 2018 according to IDC.' Online source, retrieved 1 November 2024, from: https://www.businesswire.com/news/home/20180605006706/en/Worldwide-Enterprise-Storage-Market-Grew-34.4. Archived at: https://archive.is/C33qE.

Paradoxes

Those who are citizens and consumers of public information face similar challenges. The expansion of the quantity of public information available serves to reinforce the paradoxes of information access that are already inherent in the system. The first paradox, which is designated as Paradox 1.0, is that despite the potential for individuals to access an increasing amount of online public information, they are unable to do so due to a lack of resources (for accessing technology) or skills (for accessing the Internet, software, or information). The second paradox, Paradox 2.0, is that in order to combat the phenomenon of information overload, information consumers accept ever-shrinking portions of accessible information. Individuals select information that closely aligns with their personal views and values, with the assistance of curation services that filter content according to their observed preferences. Consequently, individuals are exposed to an ever-narrowing range of ideological perspectives. The isolation of information bubbles, characterized by the ideologies of groups or individuals, fragments societies and renders them increasingly vulnerable to misinformation. [38] However, there is a third, unacknowledged paradox: Paradox 3.0, which refers to the situation where, even if access to information is possible, even if a piece (or pieces) of information can be accessed and obtained by an individual (or group of individuals), it may still be inaccessible. This may be due to the information being in a degraded file format, or in a format that lacks the software to make it accessible. It may be a victim of 'bit rot.' It may be

[38] For paradox 1.0: W.A. Kellogg and A. Mathur (2003). 'Environmental justice and information technologies. Overcoming the information-access paradox in urban communities,' *Public Administration Review*, Vol. 63, No. 5, pp. 573–585. For paradox 2.0: T. Abdelzaher, H. Ji, J. Li, C. Yang, J. Dellaverson, L. Zhang, C. Xu, and B.K. Szymanski (2020). 'The paradox of information access. Growing isolation in the age of sharing.' *arXiv preprint*. Online source, retrieved 1 November 2024, from: https://doi.org/10.48550/arXiv.2004.01967.

on a website that has been removed or rebuilt, with hyperlinks no longer functional and not stored in a web archive. It may be part of an unindexed dataset of images in file formats that make intelligent character recognition difficult or impossible. It may be that the information is accessible, but that parts of it have been deleted, legally or not, or are inaccessible due to legal considerations. It is possible that the information is accessible, but that its meaning is difficult to discern due to it being written in code or in an incomprehensible language. Access to information does not necessarily imply that 'cognitive access' and 'acceptability' (two of Buckland's six aspects) are feasible. Most accessibility issues can be attributed to deficiencies in the information value chain, which is responsible for ensuring that the conditions for access are met. [39] Access and accessibility are inextricably linked, but the assumption that access implies (cognitive) interpretability, is not correct. [40]

Several examples. In 2004, Science Direct responded to a query about missing pages in scientific journals by saying that at least 2% of its electronic journal content was missing. No one seems to know what content is missing from which journals. [41] Almost 11% of social media resources and 10% of tweets about the Arab Spring in 2010-11 did not survive their first year of existence. Almost 8% of shared social media resources disappeared from web archives before 2014. [42] Equally dis-

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[39] Van Bussel (2017), pp. 52–57.

[40] See also: L. Jaillant (2022). 'How can we make born-digital and digitised archives more accessible? Identifying obstacles and solutions,' *Archival Science*, Vol. 22, No. 3, pp. 417–436.

[41] D. Warner and J. Buschman (2005). 'Studying the reader/researcher without the artifact. Digital problems in the future history of books,' *Library Philosophy and Practice*, Vol. 7, No. 1. Online source, retrieved 1 November 2024, from: https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1056&context=libphilprac.

[42] H.M. SalahEldeen and M.L. Nelson (2014). 'Resurrecting my revolution. Using social link neighborhood in bringing context to the disappearing web,' T.

turbing is a study by Paul Conway, who in 2013 assessed the accuracy and authenticity of volumes in the Hathi Trust repository. Conway found that 25% of the 1000 digitized volumes examined contained at least one page that was 'illegible.' Only 65% of the volumes, he found, were accurate and complete enough to be considered 'reliably intelligible surrogates.' [43] In a blog post in December 2013, Alex Wellerstein, an associate professor at the Stevens Institute of Technology in Hoboken, New Jersey, noted the disappearance of three web databases that were crucial to his research on the history of nuclear technology in the United States. The first database, which disappeared around September 2013, was the Marshall Islands Document Collection. This was a collection of civilian and military reports and correspondence about nuclear testing in the Pacific. The other two web databases that disappeared (almost simultaneously) were the Hanford Declassified Document Retrieval System (with security records from the Manhattan Project) and the Department of Energy's Digital Photo Archive (with photographs from the Manhattan Project). The databases still exist, somewhere within the Department of Energy's infrastructure, but they have been deemed too costly, too vulnerable in terms of security, or too politically dangerous. Whatever the reason, they are still classified and have not reappeared online. [44] The Chesapeake Digital Preservation Group's analysis of link rot, in its 2013

Aalberg, C. Papatheodorou, M. Dobreva, G. Tsakonas, C.J. Farrugia (eds.), *Research and Advanced Technology for Digital Libraries. TPDL 2013*. Lecture Notes in Computer Science, vol 8092. Springer, Berlin-Heidelberg, pp. 333–345.

[43] P. Conway (2013). 'Preserving imperfection. Assessing the incidence of digital imaging error in Hathi Trust,' *Preservation, Digital Technology and Culture*, Vol. 42 No. 1, pp. 17–30.

[44] A. Wellerstein (2013). 'The year of the disappearing websites,' *Restricted data. The Nuclear Secrecy blog*, 27 December. Online source, retrieved 1 November 2024, from: https://blog.nuclearsecrecy.com/2013/12/27/year-disappearing-websites/. Archived at: https://archive.is/oUSwO.

report, found that 44% of URLs from the original dataset (2007-08) were no longer accessible. In their 2014 analysis, the number of non-accessible URLs increased to 51%. [45] More than 70% of URLs within three Harvard law journals and 50% of URLs within US Supreme Court opinions suffer from reference rot, meaning that the information originally cited is no longer accessible. [46] Peter Burnhill, Muriel Mewissen, and Richard Wincewicz assessed reference rot in a corpus of 6,400 theses from five American universities published between 2003 and 2010. Of the 46,000 URIs that pointed to the web at large, a third were subject to link rot and were no longer available. Of these, only half were found to have archived copies of their content in web archives. It is estimated that 18% of references are no longer accessible, as they are either not available online or there is no evidence that they have been archived. [47] In 2022, Marshall Miller's research identified a percentage of total broken

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[45] Ironically, the reports are only available in a webarchive: Chesapeake (2013). *'Link Rot' and Legal Resources on the Web. A 2013 Analysis*, Chesapeake Digital Preservation Group, Washington. Online source. Archived at: https://web.archive.org/web/20160315140329/http://cdm16064.contentdm.oclc.org/cdm/linkrot2013/. Chesapeake (2014). *'Link Rot' and Legal Resources on the Web. A 2014 Analysis*, Chesapeake Digital Preservation Group, Washington. Online source. Archived at: https://web.archive.org/web/20161109144504/http://cdm16064.contentdm.oclc.org/cdm/linkrot2014/.

[46] J. Zittrain, K. Albert, and L. Lessig (2014). 'Perma. Scoping and addressing the problem of link and reference rot in legal citations,' *Legal Information Management*, Vol. 14, No. 2, pp. 88–99; R. Liebler and J. Liebert (2012). 'Something rotten in the state of legal citation. The life span of a United States Supreme Court citation containing an Internet link (1996-2010),' *Yale Journal of Law & Technology*, Vol. 15, No. 2, Article 2. Online source, retrieved 1 November 2024, from: http://digitalcommons.law.yale.edu/yjolt/vol15/iss2/2/.

[47] P. Burnhill, M. Mewissen, and R. Wincewicz (2015). 'Reference rot in scholarly statement. Threat and remedy,' *Insight*, Vol. 28, No. 2, pp. 55–61.

links of 36%, ranging from 44% in business publications to 23% in science, mathematics and technology, 42% in arts and humanities, 40% in social sciences, and 33% in health and medicine. A cause for concern is that 37% of links to a Digital Object Identifier are broken. [48] In summary, an explanation of access cannot be provided without also explaining accessibility. It is possible to have access to websites, datasets or data stores without having the desired information being accessible.

There are many similar examples: the 1960 United States census, a database on combat air operations in Vietnam, a database of archaeological and artistic information on Pompeii, Mount Vesuvius and Naples, and the 1960 Dutch census. [49] There are many lesser known examples, as Steve Knight mentioned in 2015. An engineer receives a request for data stored on a 7-inch floppy disk, but there is no drive to run it on. A search fails to find one and the data remains inaccessible. In a government organization, information systems were configured to store email in a proprietary file format. After migrating to a new software environment, the files turned out to be unreadable. They could only be opened in an expensive legacy environment. And so on. [50]

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[48] M.A. Miller (2022). *The Putrefaction of Digital Scholarship. How Link Rot Impacts the Integrity of Scholarly Publishing*, Doctoral dissertation, Southeastern University, Lakeland (Fl.). Online source, retrieved 1 November 2024, from: https://firescholars.seu.edu/cgi/viewcontent.cgi?article=1142&context=coe.

[49] D. Waters and J. Garrett (1996). *Preserving Digital Information. Report of the Task Force on Archiving of Digital Information*, Washington DC, Commission on Preservation and Access; S. Ross and A. Gow (1999). *Digital Archaeology. Rescuing Neglected and Damaged Data Resources. A JISC/NPO study within Electronic Libraries (eLib) Programme on the Preservation of Electronic Materials*, Library Information Technology Centre, London; and M.P.M. van den Berk and P.K. Doorn (2004). *The Reconstruction of the Digital Dutch Population Census of 1960*, NIWI, Amsterdam.

[50] S. Knight (2015). 'Digital preservation as a service' (March 30). Online source, retrieved 1 November 2024, from: https://natlib.govt.nz/blog/posts/digital-preservation-as-a-service. Archived at: https://archive.is/w0ziq.

These examples are often used to illustrate the failure of information technology systems to preserve digital information and ensure its future accessibility. This, it is said, could lead to a 'digital black hole' or a 'digital dark age' resulting in a relative lack of written records in our time. [51] Vint Cerf, vice-president of Google, fears that digital information is in danger of disappearing once their current programs and computer formats are obsolete. [52] Accessibility to information could be short-lived.

In 2008, Ross Harvey argued that the examples mentioned were about recovery, not about loss. In almost all cases, the information was recovered, albeit with considerable effort and expense. [53] The reasons for the 'disappearance' of information are not (primarily) technological. In 2014, David Rosenthal claimed that the main causes of data loss are operator error, external attack, insider attack, economic failure, and organizational failure. Accessibility problems mainly result from organiza-

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[51] A. Bernhard (2023). 'Shining a light on the Digital Dark Age,' *Ideas. A living archive of long-term thinking*, Long Now.org. Online source, retrieved 1 November 2024, from: https://longnow.org/ideas/shining-a-light-on-the-digital-dark-age/. Archived at: https://archive.is/DOUWB.

[52] K. Noyes (2015). 'Vint Cerf fears a digital dark age, and your data could be at risk,' *Computerworld*. Online source, retrieved 1 November 2024, from: https://www.computerworld.com/article/2883759/vint-cerf-fears-a-digital-dark-age-and-your-data-could-be-at-risk.html. Archived at: https://archive.ph/UBA5v.

[53] R. Harvey (2008). 'So, where's the black hole in our collective memory? A provocative position paper.' Online source, retrieved 1 September 2024, from: https://digitalpreservationeurope.eu/publications/position/Ross_Harvey_black_hole_PPP.pdf. Archived at: https://web.archive.org/web/20220924152943/https://digitalpreservationeurope.eu/publications/position/Ross_Harvey_black_hole_PPP.pdf. Confirmed by: L. Roland and D. Bawden (2012). 'The future of history. Investigating the preservation of information in the Digital Age,' *Library & Information History*, Vol. 28, No. 3, pp. 220–236.

tional failures in the information management process. [54] Surprisingly, these errors are rarely reported, not even anonymously.

EVALUATION

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A wide variety of media, including bone, stone, clay, papyrus, parchment, silk, and paper record the heritage of our societies. All these writing materials and the information recorded on them have their own accessibility challenges, but none of them require a different interpretive, technological setting to enable access. This has changed in computerized environments: information exists in digital form and always requires a software environment to render it. The rapid pace of development and change in information systems presents a significant challenge to the continuity of access to information. Storage media, file formats, hardware, and software become obsolete over time and present a significant threat to the survival of information access, particularly when information management practices do not consider human behaviour in maintaining information accessibility. Although this problem is acknowledged in many organizations, it is usually only recognized once an organization has experienced access and accessibility problems. [55] It takes advance planning, deliberate action, and investment to keep information

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[54] D. Rosenthal (2014). 'What could possibly go wrong?,' *DSHR's Blog* (7 April). Online source, retrieved 1 November 2024, from: https://blog.dshr.org/2014/04/what-could-possibly-go-wrong.html. Archived at: https://archive.is/CKjB6. Also: Van Bussel (2020), pp. 61–65.

[55] A.R. Kenney and N.Y. McGovern (2003). 'The five organizational stages of digital preservation,' P. Hodges, M. Sandler, M. Bonn, and J.P. Wilkin (eds.), *Digital libraries. A Vision for the 21st Century. A Festschrift in Honor of Wendy Lougee on the Occasion of her Departure from the University of Michigan*, Ann Arbor (Mi.), University of Michigan Library, Ann Arbor, pp. 122–153.

accessible over time. It requires rigorous information governance, directing information management in aligning information systems, performance, and accountability to ensure access and accessibility of information, now and in the future. [56]

The paradoxes of access have a profound impact on information access and accessibility. The first paradox is an ongoing challenge for many users who lack the requisite resources or skills to make use of the vast amount of accessible information. Those lacking the requisite resources or skills to identify, assess, interprete and utilize information are unable to access the information they require. The second paradox concerns the use of software and tools to combat the information overload caused by the problem of mass. This results in the definition of individual access filters based on one's own preferences, which can lead to the creation of information bubbles in which users, convinced that the information within the bubble is correct, will find a significant amount of necessary information invisible. Even if resources and skills are available and access is possible, there is no guarantee that the information itself is accessible (the third paradox.) The paradoxes of access are more challenging to resolve (if they can be resolved at all) due to the problem of mass.

[56] Van Bussel (2021), pp. 31–35.

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Information Access in a Hybrid World

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This chapter is partly based on: G.J. van Bussel (2018). 'Archivos institucionales en el 'Mundo 2.0.' El marco de actuación para el 'Archive-as-Is' [Archivo-como-es],' L. Esteve Casellas I Serra and L. Hernández Olivera (eds.), *Espacios de Memoria. Estrategias y Discursos para Archivos Históricos*. Tabula. XII. Estudios Archivísticos de Castilla y Léon, Asociación de Archiveros de Castilla y León, Salamanca, pp. 41–79.

THE EFFECTS OF DIGITALIZATION

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The nature of society is undergoing a process of continuous change and transformation. In recent times, the rate of change appears to have accelerated, potentially as a consequence of the digitalization process. This refers to the process of socio-economic change triggered by the introduction of digital technology, the application systems based on it, and their production networks. This process has profound implications for socio–economic systems. [57]

The process of digitalization can be divided into two distinct phases. The first phase reached its zenith in the early 2000s, particularly in those economic sectors that rely on intangible transactions and the utilization of information (e.g. the entertainment industry or financial services). Concurrently, the second phase of digitalization was in its nascent stages, as evidenced by the previous chapter, and resulted in a rapidly increasing amount of digital information that gradually threatened to overwhelm the storage and processing capacities of existing technologies. [58]

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[57] H. Hirsch-Kreinsen (2016). 'Digitization of industrial work. Development paths and prospects,' *Journal for Labour Market Research*, Vol. 49, No. 1, pp. 1–14; R. Avant (2014). 'The third great wave,' *The Economist*, 4 October. Online source, retrieved 1 November 2024, from: https://www.economist.com/special-report/2014/10/02/the-third-great-wave. Archived at: https://archive.ph/kFRoh. I use 'digitalization' in stead of 'digitization,' which is defined as 'the action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form.' See: J.S. Brennen and D. Kreiss (2016). 'Digitalization,' K.B. Jensen, E.W. Rothenbuhler, J.D. Pooley, and R.T. Craig (ed.), *The International Encyclopedia of Communication Theory and Philosophy*, John Wiley and Sons, Chichester, pp. 1–11.

[58] Hirsch-Kreinsen (2016), p. 2.

This second phase is the realization of the digitization of physical objects of all kinds (i.e., information-as-thing.) Shoshana Zuboff views digitalization as a second wave mutation of technological and socio-economic changes in the capitalist system. [59] The emergence and accelerated growth of this phase can be illustrated by the conclusions of Martin Hilbert and Priscila López in 2011, as previously mentioned. This acceleration has been stimulated by the emergence of cyber-physical systems, which can be defined as the 'information technology interaction between physical systems with embedded software on the one hand and global data networks with distributed and interactive application systems on the other.' This has led to the creation of the 'internet of things.' [60] Such systems facilitate the interconnection of a diverse array of 'smart' objects, including medical devices, intelligent highways, and robotic systems, to global networks. This process, which can be described as the 'datafication' of 'real-life social action,' results in the generation of 'big data.' [61]

In 2024, the majority of information is generated digitally. However, prior to the outbreak of the Covid-19 pandemic, the transition to paper substitutes was still an accepted practice in many organizations. [62] The

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[59] S. Zuboff (2010). 'Creating value in the age of distributed capitalism,' *McKinsey Quarterly*, Vol. 4, No. 3, pp. 45–55, especially pp. 50–53.

[60] Hirsch-Kreinsen (2016), p. 2. The internet of things is 'the networked interconnection of everyday objects, which are often equipped with ubiquitous intelligence.' F. Xia, L.T. Yang, L. Wang, and A. Vinel (2012). 'Internet of things,' *International Journal of Communication Systems*, Vol. 25, No. 9, pp. 1101–1102.

[61] U.A. Mejias and N. Couldry (2019). 'Datafication,' *Internet Policy Review*, Vol. 8, No. 4. Online resource, retrieved 1 November 2024, from: https://doi.org/10.14763/2019.4.1428. See: V. Mayer-Schönberger and K. Cukier (2013). *Big Data. A Revolution That Will Transform How We Live, Work and Think*, John Murray, London, Chapter 5, pp. 73–97.

[62] M. O'Mara (2021). 'How much paper is used in one day?' (Update.) Online source, retrieved 1 November 2024, from:

pandemic served as an accelerator for technologies that potentially alter lifestyles, work patterns and business strategies. It served as a catalyst for the acceptance and increasing use of digitization in organizations, although this was tempered by external interests and opportunism, as well as the impact on employee wellbeing and work-life balance. [63] There are many reasons why a physical form (paper) is important, and why people use it (despite technologies they cannot work or live without). [64]

CODE IS LAW, LAW IS CODE

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Business practices and existing technologies, ways and methods of communication are changing. Information and communication technologies are constantly in and out of fashion. Lorenzo Magnani fears that the morphing nature of technology is changing the understanding of moral values. [65] This is possible, as is Lawrence Lessig's hypothesis that

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https://www.recordnations.com/2016/02/how-much-paper-is-used-in-one-day/. Archived at: https://archive.ph/xAkY2. Accepted practice: Adobe Communications Team (2021). 'Exploring documentation-heavy industries in a digital world,' *Adobe Blog*. Online source, retrieved 1 November 2024, from: https://blog.adobe.com/en/publish/2021/11/17/exploring-documentation-heavy-industries-in-a-digital-world#gs.m5ww9j. Archived at: https://archive.ph/wip/zcGFl.

[63] J. Amankwah-Amoah, Z. Khan, G. Wood, and G. Knight (2021). 'COVID-19 and digitalization. The great acceleration,' *Journal of Business Research*, Vol. 136, November, pp. 602–611.

[64] A. Amir-Reza (2021). 'Human-paper interaction in the digital era. Directions for human-information interaction design,' *EAI Endorsed Transactions on Creative Technologies*, Vol. 8, No. 29, Article e2. Online resource, retrieved 1 November 2024, from: https://eudl.eu/doi/10.4108/eai.12-10-2021.171250.

[65] L. Magnani (2009). *Morality in a Technological World. Knowledge as Duty*, Cambridge University Press, Cambridge, p. xiii.

changes in information technology are leaving law and policy processes behind. In Lessig's view, the code, software and hardware that define information systems, constitute the regulator of 'cyberspace.' This regulator determines how 'cyberspace' is experienced, how privacy is protected, how speech is censored, how access to information is organized and permitted, and how users are monitored. It is the process of regulation that allows private actors to embed their values into technological structures and artefacts, thereby constraining user actions, limiting anonymity, freedom of speech, and individual control. [66] This represents a threat to democratic values, given that popular platforms have a user base that is significantly larger than that of nation states. In April 2024, Facebook had three billion monthly users, followed by YouTube, Instagram and WhatsApp with over two billion, and WeChat and TikTok with almost one and a half billion. The algorithms employed by these platforms determine the actions that users are able to take. [67]

In accordance with Lessig's proposal, governments utilize software algorithms to define code-based rules that are enforced by the underlying technology in advance of the occurrence of the event in question, or as I previously termed it, pre factum. [68] Governments are increasingly

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[66] L. Lessig (2006). *Code, and Other Laws of Cyberspace, Version 2.0.*, Basic Books, New York, second edition, especially Chapters 1 (pp. 1–8) and 5 (pp. 61–82), as well as Part III, pp. 157–280.

[67] S. Kemp (2024). 'Digital 2024 April Global Statshot Report,' *Dataportal*, 24 April. Online source, retrieved 1 November 2024, from: https://datareportal.com/reports/digital-2024-april-global-statshot. Archived at: https://archive.ph/XuNtx.

[68] I used it in an organizational context, not in a social or legal one. In such a context, the arrangement of law (or rules) in code (and thus in information systems) pre factum will have even more drastic effects: Van Bussel (2020), pp. 88–92. My interpretation is based on: R.L. Heidelberg (2017). 'Political accountability and spaces of contestation,' *Administration & Society*, Vol. 49, No. 10, pp. 1379–1402, p. 1387.

using code as a regulatory mechanism. Algorithms (in artificial intelligence, machine learning, and blockchain) are being applied to regulation, law enforcement, transport, and land registration. [69] Nevertheless, it is imperative to recognize that code cannot be considered neutral, as it is inherently imbued with political and value-laden implications. It has the potential to have societal implications, as it can support certain political structures or facilitate certain actions and behaviours. [70] With the introduction of machine learning, some of the limitations of regulation by code can be circumvented by using dynamic and adaptive code-based rules. [71] Nevertheless, even with the advent of machine learning, the value-laden nature of code remains, and the potential for bias to influence data-driven decision-making persists. The implementation of laws derived from machine learning may result in the undermining of universal principles, the erosion of freedom, and the perpetuation of discriminatory practices. [72] The practice of embedding law in code, as Lessig proposes, is not without its own set of challenges and may ultimately result in the very effects it is designed to prevent. That will be a challenge

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[69] E. Medina (2015). 'Rethinking algorithmic regulation. *Kybernetes*, Vol. 44, No. 6/7, pp. 1005–1019, and Z. Engin and P. Treleaven (2019). 'Algorithmic government. Automating public services and supporting civil servants in using data science technologies,' *The Computer Journal*, Vol. 62, No. 3, pp. 448–460. Online source, retrieved 1 November 2024, from: https://academic.oup.com/comjnl/article/62/3/448/5070384.

[70] C. Aradau and T. Blanke (2022). *Algorithmic Reason. The New Government of Self and Other*, Oxford University Press, Oxford. Also: K.E. Martin (2019). 'Ethical implications and accountability of algorithms,' *Journal of Business Ethics*, Vol. 160, No. 4, pp. 835–850.

[71] S. Hassan and P. De Filippi (2017). 'The expansion of algorithmic governance. From code is law to law is code,' *Field Actions Science Reports*, Special Issue 17, pp. 88–90. Online source, retrieved 1 November 2024, from: https://journals.openedition.org/factsreports/4518.

[72] Hassan and De Filippi (2017), p. 90.

in a cultural environment that is evolving into a hybrid environment, an amalgam of tangible and intangible artefacts, interactivity, and connectivity, where physical and online presences are (almost) inevitable.

HYBRID AMALGAMATION

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Individuals, communities, and organizations engage in interactions with each other in both physical and digital spaces. These interactions include the creation of knowledge, the sharing of information, the design, sale, and purchase of products, the sending of emails, the writing of blogs, the sharing of images, the downloading of music, the creation of videos, podcasts, and other forms of media, the playing of games, and the gathering of news. Organizations and communities also establish internet presences to complement their existing activities in the physical world. Business organizations are developing platforms and business models to expand their markets in cyberspace, in addition to their existing ones. To benefit from both markets, they are integrating physical and online marketing programmes. Hybrid customer/user information is analysed to personalize advertisements, improve services, or sell this information to partners. Start-up companies launch online activities specializing in renting out bedrooms, parking cars, buying and selling stocks, and entertainment. Archives, libraries, and museums are digitizing their collections and making them available online. Universities are disseminating recorded courses or developing online learning environments. Television is accessible on mobile devices, multiple screens, and on demand. News is disseminated through numerous news sites. The integration of real life and cyberspace into the personal lives of almost everyone has become a reality. In the academic literature on the information soci-

ety, internet use is presented as a universal prerequisite for participation in society and as a dividing line between success and exclusion. [73]

Research questions this universal indispensability of the internet. Many non-users claim they do not need it, and some users state that their skillset is sufficient for their job performance despite lacking complex digital skills. [74] Especially when only 67% of the world's population is online, a universal requirement for participation seems unlikely. Even in the most highly digitalized regions of the world, such as Europe, the Commonwealth of Independent States, and the Americas, where between 71% and 91% of the population use the internet, universal use, which is defined by the International Telecommunication Union as internet penetration of at least 95%, has not been achieved. [75] The internet is a crucial information and communication channel, but its use appears to be more situation-specific and contextually determined than previously assumed. Internet and social media platforms are very important means of communication, participation, collaboration, and innovation but they are not yet pervasive in *every* aspect of life. [76] This partly explains

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[73] See: P. Lupač (2018). *Beyond the Digital Divide. Contextualizing the Information Society*, Emerald Publishing Limited, Bingley, Chapters 2 (pp. 7–16), 3 (pp. 17–44), and 4 (pp. 45–131).

[74] E.J. Helsper and A.J.A.M. van Deursen (2017). 'Do the rich get digitally richer? Quantity and quality of support for digital engagement,' *Information, Communication & Society*, Vol. 20, No. 5, pp. 700–714. Also M. Pellizzari, F. Biagi, and B. Brecko (2015). *E-skills Mismatch. Evidence from International Assessment of Adult Competencies (PIAAC)*, Institute for Prospective Technological Studies, Digital Economy Working Paper 10, Luxembourg. Online source. Archived at: https://web.archive.org/web/20220122051247/https://ec.europa.eu/jrc/sites/default/files/JRC98228.pdf.

[75] ITU (2023). *Measuring Digital Development. Facts and Figures*, ITU Publications, Geneve, pp. 1–2. Online source, retrieved 1 November 2024, from: https://www.itu.int/itu-d/reports/statistics/facts-figures-2023/index/

[76] Lupač (2018), Chapter 6, pp. 159–174.

why the cultural environment is a hybrid, combining both virtual and physical elements.

This puts Fahri Karakas's model of 'World 2.0' as a 'digital ecosystem' into perspective. He identified five shifts between an 'old' and a 'new' world, his five Cs. [77] They are not specific to a 'digital' ecosystem, however, but to a hybrid cultural environment in which they are integrated into both the virtual and physical lives of most people. These five Cs highlight the possibilities of this hybrid reality: [1] *Creativity*, finding new hybrid ways to address social issues; [2] *Connectivity*, the ability to connect to hybrid global information resources; [3] *Collaboration*, people working and participating in hybrid projects; [4] *Convergence*, the merging of new technologies and the hybrid connectivity these technologies enable; and [5] *Community*, using media for hybrid community benefits to educate, organize, communicate, lobby, protest, raise funds, democratize information, and raise social awareness.

The interpretation of World 2.0 as a hybrid amalgamation is reinforced by the ideal-type model of 'Society 5.0.' This is a human-centred society that, through a fusion between cyberspace and physical space, will balance economic progress with the resolution of social problems. This will be achieved by providing goods and services that granularly address latent needs, regardless of location, age, gender or language. The objective is to ensure that all citizens can enjoy a high quality of life. This concept defines an ideal situation towards which each country should evolve in order to take advantage of the technological changes for the benefit of its citizens. [78] In the context of cyberspace, people, things and

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[77] F. Karakas (2009). 'Welcome to World 2.0. The new digital ecosystem,' *Journal of Business Strategy*, Vol. 30, No. 4, pp. 23–30, pp. 24–27.

[78] A. Deguchi and O. Kamimura (2020). 'Introduction,' Hitachi-UTokyo Laboratory, *Society 5.0. A People-Centric Super-Smart Society*, Springer Open, Singapore, pp. xi–xiv, p. xii. Also: S. Serpa and C. Ferreira (2018). 'Society 5.0 and social

cyber-physical systems are connected and exchange information, which is analysed by artificial intelligence. The results of this analysis are then fed back into physical space, where they are used for the benefit of people. All of Karakas's Cs are reinforced in this ideal type of society. [79] The concept of 'Society 5.0' is predicated on the premise of facilitating access to cyber-physical information for artificial intelligence and 'deep learning' software, as well as 'smart' systems that are directly integrated into the environments of individuals and the operations of government institutions. In order to achieve its stated objectives, 'Society 5.0' will require access to information that can be considered personal. The model could be perceived as a threat to privacy, despite its stated idealistic goal of 'serving the people.'

AN INESCAPABLE LOSS OF PRIVACY

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Society has always relied on communication media to disseminate information. Media (or information) richness is used to describe the ability of communication media to convey information in a way that changes understanding. Traditionally, face-to-face interaction has been considered the most 'information rich.' [80] Information richness is an important part of Buckland's 'systems that inform,' systems used to gain an understanding of what is being communicated (information-as-knowledge).

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development. Contributions to a discussion,' *Management and Organizational Studies*, Vol. 5, No. 4, pp. 26–31.

[79] Something like 'Society 5.0' has been described by D.C. Korten (1984). 'Strategic organization for people centered development,' *Public Administration Review*, Vol. 44, No. 4, pp. 341–352.

[80] R.L. Daft (2013). 'Information richness theory,' E.H. Kessler (ed.), *Encyclopedia of Management Theory*, SAGE, Los Angeles-London, Vol. 1, pp. 369–372.

The better this ability, the richer the medium (and the information). The expansion of technology is having a positive impact on the richness of digital media. Individuals in the present era are more reliant on such media, and are less inclined to engage in personal interaction, even in the presence of others. [81] As early as 1997, Maha El-Shinnaway and Mary Lynne Markus concluded that, contrary to media (information) richness theory, people use the leaner medium of email instead of the richer medium of voice mail. [82] In 2017, Ina Blau, Orli Weiser and Yoram Eshet-Alkalai concluded that face-to-face classrooms are not superior to online classrooms, contrary to what media (information) richness theory predicts. [83] Other research has indicated that there are no significant differences between virtual and face-to-face teams in terms of performance. However, virtual teams have been found to be more prone to conflict, are perceived as less satisfying, and seem to have inferior decision-making abilities. [84] These findings appear to indicate that digital information is becoming increasingly capable of delivering meaningful information

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[81] E. Drago (2015). 'The effect of technology on face-to-face communication,' *Elon Journal of Undergraduate Research in Communications*, Vol. 6, No. 1. Online source, retrieved 1 Novemmber 2024, from: http://www.inquiriesjournal.com/a?id=1137 (2 pages.)
Archived at: https://archive.ph/VQwMs and https://archive.ph/njKLF.

[82] M. El-Shinnaway and M. Lynne Markus (1997). 'The poverty of media richness theory. Explaining people's choice of electronic mail vs. voice mail,' *International Journal of Human-Computer Studies*, Vol. 46, No. 4, pp. 443–467.

[83] I. Blau, O. Weiser, and Y. Eshet-Alkalai (2017). 'How do medium naturalness and personality traits shape academic achievement and perceived learning? An experimental study of face-to-face and synchronous e-learning,' *Research in Learning Technology*, Vol. 2017. Online source, retrieved 1 November 2024, from: http://dx.doi.org/10.25304/rlt.v25.1974.

[84] S. Gera, G. Aneeshkumar, S. Fernandez, G. Gireeshkumar, I. Nze, and U. Eze (2013). 'Virtual teams versus face-to-face teams. A review of literature,' *IOSR Journal of Business and Management*, Vol. 11, No. 2, pp. 1–4.

that can alter understanding and perceptions. However, one potential drawback of richer media is that it may necessitate the collection and use of personal information, which could raise concerns about privacy. [85]

Nowadays, information is easily and mostly automatically captured, recorded, and stored for later retrieval. However, this can become problematic when collection, recording, and use of information occurs without the knowledge or consent of users, potentially resulting in a loss of individual privacy. [86] When browsing the internet, visits to websites are recorded by browsers. Websites store information on user visits and leave data on their computers for future use. It is possible to track which websites or web pages users have visited and for how long. Social media platforms record all posted messages. The organizations behind these platforms use this information to enhance communication, personalize advertising, and contextualize user experience. The information collected and stored by 'smart' systems and devices is shared with the business organizations that designed and produced them, governments, other paying organizations, and artificial intelligence initiatives (such as 'Society 5.0'). This process occurs behind the scenes on a continuous basis, without the user's knowledge or consent. The information is stored in order to be analysed and used to create profiles or identify pat-

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[85] B. Plomion (2022). 'Lost Art. Why digital advertisers should swap their data addiction for a new wave of creative flair,' *Forbes*, 24 February. Online source. Archived at: https://archive.ph/wip/iUdrA.

[86] The problem of personal privacy in an information age is a much-debated subject. As an introduction: H. Nissenbaum (2010). *Privacy in Context. Technology, Policy, and the Integrity of Social Life*, Stanford University Press, Stanford; K.K. Stylianou (2010). 'Hasta la vista privacy, or how technology terminated privacy,' C. Akrivopoulou and A. Psygkas (eds.), *Personal Data Privacy and Protection in a Surveillance Era. Technologies and Practices*, IGI Global, Hershey (Pa.), Ch. 3, pp. 44–57; J. van de Pas and G.J. van Bussel (2015). 'Privacy lost — and found? The information value chain as a model to meet citizens' concerns,' *Electronic Journal of Information Systems Evaluation*, Vol. 18, No. 2, pp. 199–209.

terns and trends. [87] In China, for example, a network of monitoring and big data analysis systems is used to monitor and identify individual citizens. Facial recognition software is employed to record instances of jaywalking and cyclists breaking traffic rules. [88]

The storage of information on remote servers operated by third parties is a defining feature of cloud computing. This may result in a reduction in the connection that users have with their information. When a user's personal information is being hacked, sold, shared, or made public, this would constitute a severe violation of privacy. Third-party cloud service providers must acknowledge their obligation to protect this information. Individuals permit organizations to use their personal information in exchange for relationships based on trust, integrity, and ethical behaviour. The failure to fulfil these obligations will inevitably result in a loss of trust that will be difficult to repair. [89]

New technologies may enhance the capabilities, richness, and influence of media. Nevertheless, there is a potential for breaches of privacy as a consequence of inappropriate or unethical use of information. Organizations must assume responsibility for the algorithms employed by third parties in their operations. In the event that these algorithms are found to be biased and result in discrimination, accountability needs to be established: to whom should the blame be attributed? [90]

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[87] M. Westerlund, D.A. Isabelle, and S. Leminen (2021). 'The acceptance of digital surveillance in an age of Big Data,' *Technology Innovation Management Review*, Vol. 11, No. 3, pp. 32–44. Online source, retrieved on 1 November 2024, from: http://doi.org/10.22215/timreview/1427.

[88] J.P. Cabestan (2020). 'The state and digital society in China. Big brother Xi is watching you!,' *Issues & Studies*, Vol. 56, No. 1, 2040003, pp. 1–30.

[89] G. Davies and I. Olmed-Cifuentes (2016). 'Corporate misconduct and the loss of trust,' *European Journal of Marketing*, Vol. 50, No. 7–8, pp. 1426–1447.

[90] Martin (2019), pp. 835–837; Aradau, and Blanke (2022), Chapter 7, pp. 160–181.

DOING BUSINESS

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The subject of the 'digital economy' is a topic frequently discussed in management research literature. It is believed that the digital economy grows rapidly and enhances the efficiency and productivity of traditional industries. However, a recent report indicates that the evidence supporting this claim is limited, despite not widely observable indications of productivity growth. [91] Deloitte defines the digital economy as the economic activity resulting from billions of everyday online connections among people, businesses, devices, information, and processes. [92] The economy in question is a hybrid phenomenon that incorporates both the real and virtual worlds. It is more accurate to refer to this hybrid phenomenon as a 'digitalized' or 'hybrid economy,' in which the physical and virtual components merge to create economic value. This economy challenges many traditional ideas about organizational interactions and consumer access to services, information, and goods.

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[91] B. van Ark, K. de Vries, and A. Erumban (2019). *Productivity & Innovation Competencies in the Midst of the Digital Transformation Age. A EU–US Comparison.* European Economy-Discussion Papers 2015-119, Luxembourg. Online source, retrieved 1 November 2024, from: https://economy-finance.ec.europa.eu/system/files/2019-10/dp119_en.pdf.

[92] Deloitte (2021) 'What is Digital Economy? Unicorns, transformation and the internet of things,' *Deloitte.* Online source, retrieved 1 November 2024, from: https://www.deloitte.com/mt/en/Industries/technology/research/mt-what-is-digital-economy.html. Archived at: https://archive.ph/Wrb5D. For definitions: R. Bukht and R. Heeks (2017). *Defining, Conceptualising and Measuring the Digital Economy.* Development Informatics Working Paper no. 68, Centre for Development Informatics and Global Development Institute, SEED, University of Manchester. Online source, retrieved 1 November 2024, from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3431732.

Information technology has the capacity to change economic structures, a phenomenon that has been observed many times in economic history. [93] The advent of writing, printing, and mass media has had an impact on economic and social structures, influencing the formation of value chains and the emergence of products and services. [94] This digitalized economy is sustained by two elements: hyperconnectivity, the interconnectedness of people, organizations and machines, and access to and accessibility of information. These factors stimulate the development of distinctive characteristics that distinguish the digitalized economy from its predecessors. These characteristics include the mechanization of the information process, the establishment of distributed virtual environments, the development of new 'infotainment' products, and the shift from production management to communication management. [95]

In 1996, Donald Tapscott defined twelve characteristics of this economy. [96] He began with 'knowledge' as the most important characteristic, largely based on access to and accessibility of information. A second characteristic, 'digitization,' enables the transformation of physical information into digital substitutes, facilitating a real-time global flow of information. 'Virtualization' is changing social relationships, business models and the nature of economic activity, along with the next five

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[93] Hirsch-Kreinsen (2016).

[94] A. Reamer (2014). *The Impacts of Technological Invention on Economic Growth. A Review of the Literature*, The George Washington University, Washington, Chapter 2, pp. 6–30. Online source, retrieved 1 November 2024, from: https://gwipp.gwu.edu/sites/g/files/zaxdzs2181/f/downloads/Reamer_The_Impacts_of_Invention_on_Economic_Growth_02-28-14.pdf.

[95] B.F. Schmid (2001). 'What is new about the digital economy?,' *Electronic Markets*, Vol. 11, No. 1, pp. 44–51.

[96] D. Tapscott (1996). *The Digital Economy. Anniversary Edition. Rethinking Promise and Peril in the Age of Networked Intelligence*, McGraw Hill, New York, Chapter 2, pp. 51–82.

characteristics: 'disintermediation' (the 'end of the middleman'), 'convergence' (the interactive increase in computing, communication, and information), 'molecularization' (agile, smaller, and flexible organizations), 'integration' (of suppliers, customers, and competitors) and 'prosumption' (the overlapping of producers and consumers). The ninth and tenth characteristics, 'innovation' (the development and creation of new products and services) and 'immediacy' (the shortening of the time between order and delivery), are linked to 'convergence.' The eleventh characteristic, 'globalization,' recognizes that there is only one global economy, even if organizations continue to operate at a local level. The twelfth characteristic is 'discordance,' which refers to resistance and slow adaptation to change. Tapscott recognized that privacy and security would become critical priorities in an age of global access to information.

But instead of becoming smaller, more flexible, and more agile, many organizations are becoming bigger, inflexible, and bureaucratic. They are using information technology not to transform and innovate, but to reinforce existing structures and outdated practices. Resistance to change is strong and slows down the impact of information technology. [97] The transformation to a *digital* economy (as with the transformation to a *digital* society) has not yet been fully realized.

One of the most significant impacts of digitalization is the ability to conceal and manipulate information due to the disregard for information behaviour. [98] Although the concept of the digitalized economy is widely accepted, organizations engage in self-interested information behaviour in their day-to-day operations. It is not acceptable to hinder access and accessibility, or to manipulate, hide, modify, or destroy information for

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[97] S.I. Akbar (2017). 'Business process reengineering and change management strategy to overcome the resistance to change.' Online source, retrieved 1 November 2024, from:
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3502035.

[98] Van Bussel (2020), pp. 61–71.

colleagues, clients, governments, or the public, while pretending to meet public expectations of transparency and accountability. Unfortunately, these principles have been violated many times in the past decades, resulting in a global increase in the number of regulations, guidelines, and standards to enforce them. Kimberly Barata and Piers Cain demonstrated that transparency and accountability cannot be achieved without access to trusted information as evidence of past organizational policies, decisions, products, actions, and transactions. [99]

Most organizations try to meet public expectations of accountability, transparency, information access, security, and privacy. According to Lauren Edelman and Shauhin Talesh, organizations comply with the *meaning* they have constructed of public expectations, laws, and regulations. Because organizational governance is concerned with society's conception of the scope of organizational responsibility and accountability, governance is based on *institutionalized interpretations* of society's beliefs about legality, morality, and rationality. Such interpretations may differ from one organization to another and may lead to different implementations of governance structures and accountability mechanisms. [100]

Significant costs arise from the 'three lines of defence': owning and managing risk, overseeing compliance and risk management, and providing independent assurance. [101] The validity of information is critical to

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[99] K. Barata and P. Cain (2001). 'Information, not technology, is essential to accountability. Electronic records and public-sector financial management,' *The Information Society*, Vol. 17, pp. 247–258.

[100] L.B. Edelman and S.A. Talesh (2011). 'To comply or not to comply – that isn't the question. How organizations construct the meaning of compliance,' C. Parker and V. Lehmann Nielsen (eds.), *Explaining Compliance. Business Responses to Regulation*, Edward Elgar Publishing, Cheltenham, Chapter 5, pp. 103–122.

[101] The Institute of Internal Auditors (2021). *The IIA's Three Lines Model. An Update of the Three Lines of Defense*, Lake Mary (Fl.), IIA. Online source, retrieved 1 November 2024, from:

the effectiveness of any line of defence. Without access to and accessibility of information, it is impossible to assess its validity and the lines of defence will fail. Transparency, accountability and public trust can be irreparably damaged. [102]

BEING LITERATE

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Divide(s)

The digititalization of society is evolving and creates paradoxes. Despite the growing possibilities for accessing technology and information, the amount of information created, the pace of innovative technologies, and the challenges posed by failing organizational behaviour make access and accessibility difficult. Research into information access is concerned with the resulting economic, social, and technological disparities. The unequal distribution of information and communication technology has an impact on social, economic, political, and cultural factors. This research concentrates on access to technology and access disparities in society, but hardly on the (cognitive) interpretability of information itself. It is assumed but not discussed.

Martin Hilbert highlights that research on diffusion inequality has long been a part of innovation diffusion research. [103] Innovations gradually spread through society via social networks, with each innovation

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https://www.theiia.org/globalassets/site/about-us/advocacy/three-lines-model-updated.pdf. Archived at: https://perma.cc/7RBS-9SXX.

[102] A. Dikopoulou and A. Mihiotis (2012). 'The contribution of records management to good governance,' *The TQM Journal*, Vol. 24, No. 2, pp. 123–141.

[103] M. Hilbert (2015). 'Digital Divide(s),' R. Mansell and P.H. Ang, *The International Encyclopedia of Digital Communication and Society*, Wiley Blackwell, Hoboken (NJ), Vol. 1, pp. 141–147. Also: E.M. Rogers (1962). *Diffusion of Innovations*, Free Press, New York. Used in its fifth edition, Free Press, New York, 2003.

creating a divide (or divides) between actors in the network. [104] Hilbert argues that such a divide is a 'permanent structural social characteristic' of our societies, which 'reopens with each digital innovation.' [105] The study of inequality as problems of access to technology and the Internet, and as differences between those who benefit from technologies and those who do not, emphasizes the relationship with the diffusion of innovation. Bridging inequalities refers to efforts to provide access to internet infrastructure, applications, and services for the benefit of economic and social (information) equality. This includes technologies such as artificial intelligence, robotics and the internet of things. [106]

Innovation adoption is a process in which some individuals are more inclined or better equipped to adopt an innovation than others, resulting in a divide between social network participants. Each innovation creates a new divide that may also apply to other network participants. Multiple innovations may occur simultaneously, each creating a divide among network participants that may or may not overlap with other divides. Carl Cuneo identifies twelve different theoretical perspectives for studying a divide: geographical, demographic, gerontological, feminist, psychological, educational, economic, sociological, labour, cultural, disability and political. Each perspective can create its 'own' divides and develop its 'own' definitions of what a divide is. [107]

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[104] Rogers (2003), Chapters 1 and 5.

[105] Quotation: Hilbert (2015), p. 146.

[106] S. Mann and M. Hilbert (2020). 'AI4D. Artificial intelligence for development,' *International Journal of Communication*, Vol. 14, pp. 4385–4405; É. Berde (2019). 'Digital divide and robotics divide,' D. Gu and M. Dupre (eds.), *Encyclopedia of Gerontology and Population Aging*, Springer, Cham, pp. 1434–1438; A.J. van Deursen and K. Mossberger (2018). 'Any thing for anyone? A new digital divide in internet-of-things skills,' *Policy & Internet*, Vol. 10, No. 2, pp. 122–140.

[107] C. Cuneo (2002). *Globalized and Localized Digital Divides Along the Information Highway. A Fragile Synthesis Across Bridges, Ramps, Cloverleaves, and Ladders*. Univer-

These observations apply to the concept of the 'digital divide,' which was introduced in the 1990s to highlight the problems of access to information technology for groups such as the elderly, the socially disadvantaged, and the disabled. The result was a divide between those who had access and those who did not. It refers to the gap reinforced by Lawrence Lessig's 'code,' which is the regulation of cyberspace infrastructure dominated and controlled by private actors such as Facebook. This regulation restricts users' actions and access to information.

The 'digital divide' is a concept that is difficult to define. According to Martin Hilbert, there are four classes of variables that have been used to define the concept: [1] the *subject*: individuals, organizations, countries, in short: *who?*; [2] the *characteristics*: income, education, geography, age, gender, type of ownership, etc., in short: *which?*; [3] the *sophistication of access and use*: the tangible impact of technology, based on user skills and capabilities, cultural attitudes, strategic choices, and social reorganization, in short: *how?*; and [4] the *type of technology*: phone, internet, computer, etc., in short: *what?* [108]

The 'digital divide' is a term that encompasses multiple divides created by technological innovation, such as the divide between early and late adopters of technology, between developed and developing countries, between people with and without the skills to use technology, between people with and without the skills to use information, or between people with and without the financial means to pay for access. The concept is a cascade of many 'digital divides,' a 'multi-divide' concept encompassing many access divides resulting from technological innovation. The denominator of the concept focuses on access to information

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sity of Saskatchewan 33rd Annual Sorokin Lecture. Delivered 31 January 2002. Online source, retrieved 1 November 2024, from: https://artsandscience.usask.ca/sociology/documents/33rd-annual-sorokin-lecture.pdf.

[108] Hilbert (2015), pp. 141–143.

technology and the ways in which it is used to combat inequalities and realize participation in society. [109] It concentrates primarily on information access as societal phenomenon, and on information-as-things.

Benjamin Compaine argues that bridging a divide is an evolving challenge due to the continuous development of information technology. As Hilbert emphasized, an innovation is a structural phenomenon, making a divide a 'moving target.' [110] A 'bridge' may solve the current divide, but a new technology will require a new 'bridge.' Using the same approach to bridge gaps between different issues, characteristics, technologies, or skills will not be effective. The 'bridges' may be related, but they are not identical. [111] For example, a 'bridge' designed to promote equal opportunities will be different from one designed to promote democratic participation, improve health outcomes, or address social inequalities. Each divide requires consideration of different factors: the parties involved ('who'), the characteristics ('which'), the way in which technology is accessed and used ('how'), and the type of technology involved ('what').

According to Amelia Potter, the concept is not helpful. Digital divides are *symptoms*, not *causes* of socio-economic inequalities. They reflect social, cultural, racial, economic, and educational divides. Having access to technology or the internet, which acts as a 'bridge' between the technological 'haves' and 'have nots,' does not solve these much more problematic issues. [112] Efforts to stimulate access to technology have failed to address social inequality because they neglect the preconditions for

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[109] Lupač (2018), Chapters 5, pp. 90–115.

[110] B. Compaine (2001). 'Preface,' B. Compaine (ed.), *The Digital Divide. Facing a Crisis or Creating a Myth?*, MIT Press, Cambridge (Ms.), pp. xiii, 146.

[111] D.J. Gunkel (2003). 'Second thoughts. Toward a critique of the digital divide,' *New Media & Society*, Vol. 5, No. 4, pp. 499–522, p. 504.

[112] A.B. Potter (2006). 'Zones of silence. A framework beyond the digital divide,' *First Monday*, Vol. 11, No. 5. Online source, retrieved 1 November 2024, from: https://doi.org/10.5210/fm.v11i5.1327. Also: Gunkel (2003), p. 504.

successful adoption of technology.[113] This does not diminish the importance of access to information technology. Jan van Dijk established the concept of the 'digital divide' as a key tenet of information and network society theories. The internet and information technology play a crucial role as material infrastructure in the transformation to a network society. However, as Lupač pointed out, this 'pivotal position' may be more situation-specific and contextual than Van Dijk assumed, and may not be a prerequisite for *every* aspect of life.[114] Tim Unwin states a relationship between technology, internet access, and socio-economic inequalities is hardly discussed in inequality discussions and is not self-evident. He highlights the rise of social tensions resulting from the appropriation of new, more expensive technologies by the middle classes.[115] Van Dijk acknowledges that technologies do not *solve* inequalities. There is evidence that they may be *deepening* existing socio-economic inequalities.[116] Van Dijk accepts that unequal skills are rooted in socio-economic inequalities.[117] Recognizing the significance of user skills and capabilities

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[113] Lupač (2018), p. 90.

[114] See p. 32 and note 76. J.A.G.M. van Dijk (2005). *The Deepening Divide. Inequality in the Information Society*, SAGE, Thousand Oaks (Ca.), and J.A.G.M. van Dijk and A.J.A.M. van Deursen (2014). *Digital Skills. Unlocking the Information Society*, Palgrave Macmillan, New York, pp. 45–52.

[115] T. Unwin (2019). 'Can digital technologies really be used to reduce inequalities?,' *OECD Development Matters*, 28 February. Online source, retrieved 1 November 2024, at: https://oecd-development-matters.org/2019/02/28/can-digital-technologies-really-be-used-to-reduce-inequalities/. Archived at: https://archive.ph/wip/1c8VQ.

[116] J.A.G.M. van Dijk (2020). *The digital divide*, Polity, Cambridge, Chapter 8. M. Jiménez, A. Julca, H. Kawamura, M. Kind, Y.F. Lee, J. Perry, and J. Pewitt (eds.) (2020). *World Social Report 2020. Inequality in a Rapidly Changing World*, United Nations Department of Economic and Social Affairs, Washington, Chapter 2, pp. 57–79.

[117] Van Dijk (2005), Chapters 7 and 8.

led to the hypothesis that providing access to information technology constituted a 'first' digital divide, and that a 'second' digital divide was about the effective and efficient use of technology and user skills. [118] Technology-oriented research assumes that access and use of *information technology* resolves the issue of *information* access. This may be true for accessing information-as-things but very unlikely for information-as-knowledge.

Van Dijk's model of access

Most sorts of access to information technology mentioned in 'digital divide' research to bridge the many existing divides are incorporated in a comprehensive model developed by Jan van Dijk as part of his 'resources and appropriation theory,' a theory of technology acceptance as foundation for participation in society. It includes both the 'first' and 'second' digital divides. Van Dijk presents his model as a behavioural model. Firstly, individuals must be *motivated*. Secondly, they must *acquire* technology. Finally, they must *learn to use* technology by developing relevant skills. There is a close relationship with the innovation diffusion theory. Van Dijk's model focuses on individuals within social networks and their *adoption* or *non-adoption* of technological innovations. Van Dijk adheres to largely a technology-oriented view. [119]

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[118] J. Katz and P. Aspden (1997). 'Motives, hurdles, and dropouts,' *Communications of the ACM*, Vol. 40, No. 4, pp. 97–102.

[119] Van Dijk (2005), Chapters 4–7. The model was elaborated and specified in: Van Dijk and Van Deursen (2014), p. 2, and Figures 1.1 and 1.2. Also: Van Dijk (2020), Chapter 2, paragraph 'Theories concerning the digital divide.' Van Dijk argues that inequalities in society produce unequal distribution of resources leading to unequal access to information technology, which as a result, prevents participation in society; A.J. van Deursen and J.A.G.M. van Dijk (2019). 'The first-level digital divide shifts from inequalities in physical access to inequalities in material access,' *New Media & Society*, Vol. 21, No. 2, pp. 354–75, p. 356.

Van Dijk identifies four consecutive levels of access as part of a continuous process, rather than a single activity of obtaining a technology. An individual becomes a user only after passing all levels, and the process is repeated for every new technological innovation, albeit under different circumstances. Van Dijk defines *motivational access* as the desire to own computers or communication devices, or to be connected to the internet. Acceptance of technologies depends on the motivation, attitude, and expectations of potential users towards acquiring, learning, and using them. This mental and behavioural condition determines the adoption of innovations. [120] However, motivation is not a *form of access*, but rather a *prerequisite for access*. This is acknowledged by Van Dijk, who notes that motivation 'is the *initial condition* of the whole process of new media

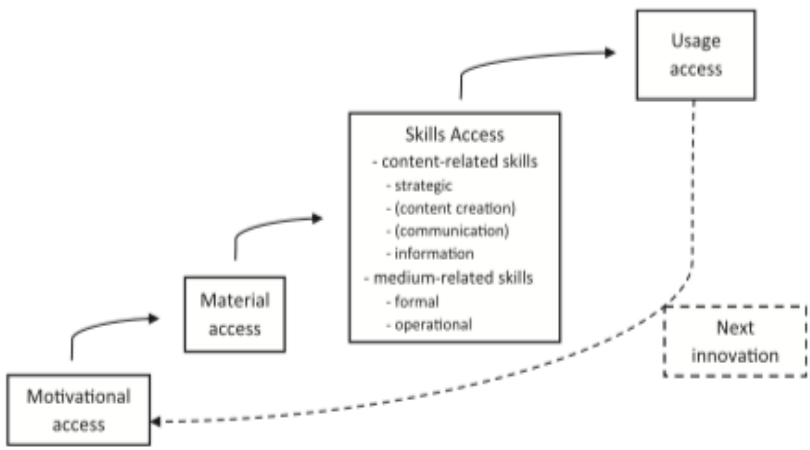

Figure 1. Updated version of Van Dijk's Model of Successive Types of Access. Source: Lupač (2018), p. 98.

[120] J.A.G.M. van Dijk (2006). 'Digital divide research, achievements and shortcomings,' *Poetics*, Vol. 34, No. 4–5, pp. 221–235, p. 226; J.A.G.M. van Dijk (2017). 'Digital Divide. Impact of access,' P. Rössler (ed.), *The International Encyclopaedia of Media Effects*, Wiley, London, pp. 1–11.

access and appropriation of the technology.' [121] It enables different forms of access, ranging from the decision to purchase information technology and an Internet connection (*material access*) to the acquisition of content and media skills (*skills access*) and the use of software applications (*usage access*). Lupač argues that information technologies have become indispensable, depending on context. They are integrated into daily routines and are challenging to avoid due to limited availability and high costs of alternatives. Motivation is no longer the precondition to access technology it used to be. [122] Rather than distinguishing between four *types* of access, however, it is preferable to distinguish between four *factors* of access: motivation, material access, information literacy, and use, which need not be fully sequential. However, the question arises as to whether 'use' can be considered as a *form* or a *factor* of access, or as a *consequence* thereof. The use of software applications could be considered material or skills access. [123]

Skills are a sigificant topic in 'digital divide' research, partly prompted by statements about the skills of the 'net generation' which were assumed to create a generational divide between 'natives' and 'immigrants.'

Natives and immigrants

During the first decade of the 21st century, there were positive comments regarding the familiarity of young people with information tech-

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[121] Van Dijk (2005), p. 43 (my italics.)

[122] Lupač (2018), Chapter 6, especially p. 161, and I. Mariën, R. Heyman, K. Salemink, and L. Van Audenhove (2016). 'Digital by default. Consequences, casualties and coping strategies,' J. Servaes and T. Oyedemi (eds.), *Social Inequalities, Media and Communication. Theory and Roots*, Rowman and Littlefield, London, pp. 167–188.

[123] Following: A. Durand, T. Zijlstra, N. van Oort, S. Hoogendoorn-Lanser, and S. Hoogendoorn (2022). 'Access denied? Digital inequality in transport services,' *Transport Reviews*, Vol. 42, No. 1, pp. 32–57, p. 36–37.

nology and their approbation of hyperconnectivity. The future value of 'digital natives,' 'millennials,' or the 'net generation' for organizational performance has been hyped in popular literature. This generation was described using adjectives such as 'immersed,' 'surrounded,' and 'bathed in bits.' [124] According to Marc Prensky, the younger generation does not differ from its predecessors in terms of values or lifestyles. [125] However, their processing of information is different because they are 'fluent' in the language of computers, video games and the Internet. [126] Prensky argues that young people have technological skills that set them apart from 'older people,' whom he calls 'digital immigrants.' The latter were born before 1985, were introduced to technology later in life, and have adopted its use. The 'immigrants' have limited appreciation for the skills that the natives have acquired and perfected through years of interaction and practice. These skills are almost entirely alien to immigrants, who themselves learned them '... slowly, step by step, one thing at a time, individually, and above all, seriously.' [127]

The notion of 'digital natives' and the arguments put forth by Prensky and popular literature lack empirical or theoretical evidence. Evidence is often based on informal 'anecdotes, conjecture, and specula-

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[124] M. Prenksy (2001a). 'Digital Natives, Digital Immigrants,' *On the Horizon*, Vol. 9, No. 5, pp. 1–6; M. Prenksy (2001b). 'Digital Natives, Digital Immigrants, Part II. Do they really think differently?,' *On the Horizon*, Vol. 9, No. 6, pp. 1–6; N. Howe and W. Strauss (2000). *Millennials Rising. The Next Greatest Generation*, Vintage Books, New York; and D. Tapscott (1998). *Growing up Digital. The Rise of the Net Generation*, McGraw-Hill, New York.

[125] Prensky (2001a), p. 1.

[126] M. Prensky (2005). 'Listen to the natives,' *Educational Leadership*, Vol. 63, No. 4, pp. 8–13, p. 8.

[127] Prensky (2001a), p. 2. According to Danah Boyd (in: *It's Complicated. The Social Lives of Networked Teens*, Yale University Press, New Haven and Londen, 2014, p. 177–178), the notions of 'natives' and 'immigrants' were first used by John Barlow and Douglas Rushkoff in 1996.

tion.' [128] According to Neil Selwyn, commentators who use the term 'digital native' do not document young people's use of information technology. Instead, they focus on the practices that are supported and facilitated by technology in their lives. [129] The provided commentary lacks objectivity and accuracy regarding young people's digital skills. [130]

Self-assessments of multitasking abilities among young people have been proven to be unrealistic. [131] The distribution of digital skills across age groups does not support the existence of a 'digital generation.' [132] The technological engagements of young people are diverse and unremarkable. They are based on 'a misplaced technological and biological determinism.' [133] The issue of such determinism is that it disregards the social context and individual characteristics of the person, treating them as detached learners, unaffected by their surroundings. [134] Eszter Hargittai suggested that the abilities of young people to access technology

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[128] S. Bennett and L. Corrin (2018). 'From Digital Natives to student experiences with technology,' M. Khosrow-Pour (ed.), *Advanced Methodologies and Technologies in Modern Education Delivery*, IGI Global, Hershey, Chapter 29, pp. 356– 366, p. 357.

[129] N. Selwyn (2009). 'The digital native — myth and reality,' *Aslib Proceedings. New Information Perspectives*, Vol. 61, No. 4, pp. 364–379, p. 366.

[130] S. Bennett, K. Maton, and L. Kervin (2008). 'The 'Digital Natives' debate. A critical review of evidence,' *British Journal of Educational Technology*, Vol. 39, No. 5, pp. 775–786.

[131] M.L. Courage, A. Bakhtiar, C. Fitzpatrick, S. Kenny, and K. Brandeau (2015). 'Growing up multitasking. The costs and benefits for cognitive development,' *Developmental Review*, Vol. 35, March, pp. 5–41.

[132] E.J. Helsper and R. Eynon (2010). 'Digital natives. Where is the evidence?,' *British Education Research Journal*, Vol. 3 No. 3, pp. 503–520.

[133] Selwyn (2009), p. 364.

[134] C. Kuhn Hildebrandt (2022). *An Exploration of the Underlying Generative Mechanisms that Shape University Students' Agency in their Educational Digital Practices*. PhD thesis, Bath Spa University, Bath, p. 46.

are determined by socio-economic status, social class, gender, and geography, and are very differentiated in terms of skills. [135]

In terms of access and literacy, there are differences between young people. [136] The use of technology appears to be limited, with a focus on gaming, text messaging, online shopping, online music and movie retrieval, and social media. The interaction of young people with technology is typically passive, sporadic, unspectacular, and often solitary. [137] The use and familiarity with advanced technologies and services, such as virtual worlds and personal web publishing, is low. [138] Despite having technical skills, they may not be information literate. Young people often lack the skills to manage information overload, collaborate effectively, use information legally and ethically, and conduct successful internet research. Additionally, they may not fully understand how to make information work for them. According to relatively recent research, they are incapable of finding, verifying, and utilizing information, often relying on the first piece of information they find and exhibiting a 'snatch and grab' behaviour with little interpretation of search results. [139] The emer-

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[135] E. Hargittai (2010). 'Digital na(t)ives? Variation in internet skills and uses among members of the 'net generation,' *Sociological Inquiry*, Vol. 80, No. 1, pp. 92–113, pp. 106–108. Also in: C. Jones, R. Ramanau, S. Cross, and G. Healing (2010). 'Net generation or digital natives. Is there a distinct new generation entering university?,' *Computers and Education*, Vol. 54, No. 3, pp. 722–732.

[136] Selwyn (2009), p. 372; Bennet, Maton, and Kervin (2008), p. 779; Bennett and Corrin (2018), pp. 358–359.

[137] Selwyn (2009), p. 372; Lupač (2018), p. 118.

[138] J.B. Caruso and R. Kvavik (2005). *ECAR Study of Students and Information Technology 2005. Convenience, Connection, Control, and Learning*, Educause. Online source, retrieved 1 November 2024, from: https://library.educause.edu/-/media/files/library/2005/10/ers0506w-pdf.pdf. Archived at: https://ghostarchive.org/archive/h3SV6.

[139] L.J. Burton, J. Summers, J. Lawrence, K. Noble, and P. Gibbings (2015). 'Digital literacy in higher education. The rhetoric and the reality,' M.K. Harmes,

gence of large language models, such as GPT-4, illustrates a similar tendency towards unthinking replication. This is a common practice among many students, without even mentioning the use of such a model. [140] Although young people may be more *confident* when using information technology, questions and concerns remain regarding their *competence*. [141]

The use of the metaphors natives and immigrants can have unintended consequences. 'It allows some to eschew responsibility for helping youth and adults navigate a networked world.' Metaphors can make it difficult to recognize that young people do not all have the same level of technological and information skills. Not all young people are equally prepared for the digitalized world, and the concept of being a native implies privilege. [142] The assumption that students do not require support, guidance, or education in digital practices due to the 'false belief' of the 'digital native' is flawed. [143] Despite the continued popularity of

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H. Huijser, and P.A. Danaher (eds.), *Myths in Education, Learning and Teaching*, Palgrave Macmillan, London, pp. 151–172; A. Sorgo, T. Bartol, D. Dolnicar, and B.B. Podgornik (2017). 'Attributes of digital natives as predictors of information literacy in higher education,' *British Journal of Educational Technology*, Vol. 48, No. 3, pp. 749–767.

[140] M. Khalil and E. Er (2023). 'Will ChatGPT get you caught? Rethinking of Plagiarism Detection,' *arXiv preprint*. Online source, retrieved 1 November 2024, from: https://doi.org/10.48550/arxiv.2302.04335. Also: A. Basic, A. Banovac, I. Kruzic, and I. Jerkovic (2023). 'Better by you, better than me, ChatGPT-3.5 as writing assistance in students' essays. *arXiv preprint*. Online source, retrieved 1 November 2024, from: https://doi.org/10.48550/arXiv.2302.04536.

[141] L. Kerslake and J. Hannam (2022). 'Designing media and information literacy curricula in English primary schools. Children's perceptions of the internet and ability to navigate online information,' *Irish Educational Studies*, Vol. 41, No. 1, pp. 151–160, p. 151.

[142] Boyd (2014), pp. 179–180. Quotation: p. 197.

[143] Pointed out by H. Jenkins (2007). 'Reconsidering digital immigrants,' *Henry Jenkins Confessions of an ACA–fan*, 4 December. Online source, retrieved November 1, 2023, from:

the term 'digital natives' (with 15,700 results on Google Scholar in 2023), there are well-documented issues with regards to accessing technology and information. [144] Critical knowledge to search, find, and interpret information is more important than familiarity with technology. [145] For both natives and immigrants, lifelong learning is required. For accessing information in today's digitalized world, transliteracy is essential.

The need for literacy

Martin Hilbert notes that despite the staggering amount of information available, the relative dominance of text and images remains. [146] People lead both digital and physical lives, accessing information from digital environments, the physical world, and analogue technologies. Transliteracy, the ability to apply skills, knowledge and competences in different settings and to move from one (textual) context to another, is not new. However, technology has added to its complexity. [147]

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http://henryjenkins.org/blog/2007/12/reconsidering_digital_immigran.html. Archived at: https://archive.ph/I9yeI. Also: R. Eynon (2020). 'The myth of the digital native. Why it persists and the harm it inflicts,' T. Burns and F. Gottschalk (eds.), *Education in the Digital Age. Healthy and Happy Children*, OECD Publishing, Paris, Chapter 9, pp. 131–143.

[144] The concept is detached from its original (metaphorical) meaning and functions as an 'empty signifier' that scholars use and employ for various purposes. See: P. Mertala, S. López-Pernas, H. Vartiainen, M. Saqr, and M. Tedre (2024). 'Digital natives in the scientific literature. A topic modeling approach,' *Computers in Human Behavior*, Vol. 152, March, 108076. Online source, retrieved 1 November 2024, from: https://doi.org/10.1016/j.chb.2023.108076.

[145] Boyd (2014), p. 180.

[146] M. Hilbert (2014). 'What is the content of the world's technologically mediated information and communication capacity? How much text, image, audio, and video?,' *The Information Society*, Vol. 30, No. 2, pp. 127–143, p. 138.

[147] S. Sukovic (2016). *Transliteracy in Complex Information Environments*, Chandos Publishing, Amsterdam, p. 2.

As previously stated, even if an individual succeeds in gaining access (the information can be made available), that still does not mean that the (cognitive) interpretability of the information itself is guaranteed. Eszter Hargittai emphasizes that having access to information technology does not necessarily mean that users can understand and use the information they (possibly) discover. She highlights the significance of skills for 'cognitive access,' suggesting that acquiring skills to understand and use information enables information access. [148] In his later research, Van Dijk agrees with Hargittai's arguments and emphasizes the importance of possessing the necessary knowledge, skills, and competences to access and understand information *itself*. [149] However, these statements ignore the fact that understanding is not self-evident. Understanding information is a consequence of (cognitive) interpretability. Even if information is available, this does not necessarily mean that it is interpretable.

The term 'digital literacy' refers to the ability to read, write, analyse, and understand information, as well as the ability to use the technologies of the time to deal with it. [150] As Paul Gilster noted, literacy is not about technologies, but about the ideas within which skills operate and about

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[148] E. Hargittai (2002). 'Second-level digital divide. Differences in people's online skills,' *First Monday*, Vol. 7, No. 4, pp. 1-20. Online source, retrieved 1 November 2024, from: https://doi.org/10.5210/fm.v7i4.942. See also Mathiesen (2014), p. 607.

[149] Van Dijk and Van Deursen (2014), and: E. van Laar, A.J.A.M. van Deursen, J.A.G.M. van Dijk, and J. de Haan (2017). 'The relation between 21st-century skills and digital skills. A systematic literature review,' *Computers in Human Behavior*, Vol. 72, pp. 577–588.

[150] D. Bawden (2008). 'Origins and concepts of digital literacy,' C. Lankshear and M. Knobel (eds.), *Digital Literacies. Concepts, Policies and Practices*, Peter Lang, New York, pp. 17–32, p. 18. There are many various, often overlapping, terms used, such as informacy, ICT literacy, e-competence, and computer skills. The term 'digital literacy' was common in the debates about skills in the first decades of the 21st century.

information and information resources, in whatever format. [151] Gilster highlights the significance of a discerning approach towards information found on the internet, identifying knowledge assembly, internet searching, hypertextual navigation, and content evaluation as core competencies. [152] Yoram Eshet-Alkalai argues that 'digital literacy' is a mindset, rather than just the ability to use digital information effectively. To be digitally literate, a user needs to create new and meaningful information, construct knowledge through nonlinear and hypertextual navigation, evaluate the quality and validity of information, and understand the 'rules' of a digital environment. [153]

In our hybrid world, knowledge, skills, and competences need to be applied in various settings and contexts, sometimes utilizing technology as a means to an end. According to UNESCO, literacy now goes beyond reading, writing, and counting, and is 'a means of identification, understanding, interpretation, creation, and communication in an increasingly digital, text-mediated, information-rich, and fast-changing world.' [154] Transliteracy combines many concepts of literacy, including digital literacy, information and media literacy, and computer literacy. [155] It is a mul-

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[151] P. Gilster (1997). *Digital literacy*, Wiley, New York, p. 15.

[152] Gilster (1997), p. 230. Also: M. Fieldhouse and D. Nicholas (2008). 'Digital literacy as information savvy,' C. Lankshear and M. Knobel (eds.), *Digital Literacies. Concepts, Policies and Practices*, Peter Lang, New York, Chapter 3, pp. 43–72.

[153] Y. Eshet-Alkalai (2004). 'Digital literacy. A conceptual framework for survival skills in the digital era,' *Journal of Educational Multimedia and Hypermedia*, Vol. 13, No. 1, pp. 93–106.

[154] UNESCO (2022). 'Literacy.' UNESCO Website. Online source, retrieved 1 November 2024, from: https://www.unesco.org/en/literacy/need-know. Archived at: https://archive.ph/90JiM.

[155] I use transliteracy instead of metaliteracy. They are largely identical, but metaliteracy places greater emphasis on self-reflection and self-assessment, as follows from T.P. Mackey and T.E. Jacobson (2014). *Metaliteracy. Reinventing Information Literacy to Empower Learners*, Nael-Schuman, Chicago, p. 2. Metaliteracy as

tiplicity of concepts, making it unnecessary to define new literacies when new technology appears that seems to require new skills. Suzana Sukovic posits a concept of transliteracy that captures dynamic relationships between different types of literacies, technologies, and social and cultural contexts. [156] Transliteracy requires knowledge, skills, and competences to use both analogue and digital technologies, modes, and protocols to [1] search for, evaluate, and work with information, [2] collaborate and participate in social networks, and [3] communicate meanings and knowledge using different genres, tones, and media. Transliteracy involves the ability to identify, evaluate, understand, and contextualize information using various media styles. It enables users to connect and present information for analysis and interpretation. [157] The knowledge, skills, and competences for transliteracy are derived from information and media literacy, as defined by UNESCO: 'the ability to access the media [new and old] and other information sources, to understand and evaluate critically their contents and functions and to critically use them to create communications in a variety of contexts including teaching and learning, self-expression, creativity and civic participation.' [158]

Frameworks for the knowledge, skills, and competences required in a digitalized world are numerous. One of the most frequently cited is

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a not fully developed concept: Sukovic (2016), and S. Thomas, C. Joseph, J. Laccetti, B. Mason, S. Mills, S. Perril, and K. Pullinger (2007). 'Transliteracy. Crossing divides,' *First Monday*, Vol 12, No. 12. Online source, retrieved 1 November 2024, from: https://doi.org/10.5210/fm.v12i12.2060.

[156] Sukovic (2016), p. 7.

[157] M.K. Dunaway (2011). 'Connectivism. Learning theory and pedagogical practice for networked information landscapes,' *Reference Services Review*, Vol. 39, No. 4, pp. 675–685, especially pp. 679, 680–683.

[158] A. Grizzle, P. Moore, M. Dezuanni, S. Asthana, C. Wilson, F. Banda, C. Onumah (2013). *Media and Information Literacy. Policy and Strategy Guidelines*. United Nations Educational, Scientific and Cultural Organization, Paris, p. 175. For information literacy also: Sukovic (2016), pp. 3–5.

Van Dijk's model of successive types of access. However, frameworks for transliteracy skills are scarce. Many studies on transliteracy refer to existing frameworks for digital literacy or information literacy. [159]

In 2014, Jan van Dijk en Alexander van Deursen defined two sets of skills: medium-related skills and content-related skills. The first set of skills comprises *operational* and *formal* skills, technical skills necessary to use a computer and to navigate the internet. The second set of skills consists of four components: *information* skills, *communication* skills, *content-creating* skills, and *strategic* skills. Information skills involve finding, sorting, evaluating, and critically assessing information. Communication skills involve 'the ability to encode and decode messages to construct, understand, and exchange meaning in all interactive applications.' Content-creating skills involve designing and publishing websites, recording or assembling pictures, videos, and audio programs, or compiling a profile and producing messages on a social networking site. Strategic skills are the most complex skills, involving the ability to use a range of available resources such as knowledge, money, rules and laws, social net-

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[159] Sukovic (2016), pp. 4–5, states that the ACRL framework is significant and frequently utilized: Association of College and Research Libraries (2016). *Framework for Information Literacy for Higher Education*, ACRL, Chicago. Online source, retrieved 1 November 2024, from: https://www.ala.org/acrl/standards/ilframework. In addition to this framework, I used three recent papers for my analysis: Van Laar, Van Deursen, Van Dijk, and De Haan (2017) (based on an analysis of 75 articles); C. Iordache, I. Mariën, and D. Baelden (2017). 'Developing digital skills and competences. A quickscan analysis of 13 digital literacy models,' *Italian Journal of Sociology of Education*, Vol. 9, No. 1, pp. 6–30 (analysis of 13 frameworks of digital skills); and T. Durán-Becerra, and J. Lau (2020). 'MIL competency framework. Mapping media and information competencies,' *Anagramas — Rumbos y Sentidos de la Comunicación*, Vol 19, No. 37, pp. 49–67 (an analysis of 21 papers discussing different frameworks of information and media literacy knowledge, skills, and competences).

works, traditions, and technology 'for the general goal of improving one's position in society' and to participate in social processes. [160] The communication and content-creating skills are additional to Van Dijk's basic model, as defined in 2005.

Acquiring content-related knowledge, skills, and competences, particularly information and strategic skills, can be very challenging. However, they are less susceptible to rapid changes compared to medium-related skills, which require lifelong learning to keep up with fast-paced technological advancements. [161]

The analysis conducted by Catalina Iordache, Ilse Mariën, and Dorien Baelden on thirteen digital literacy models revealed 39 indicators, which were divided into 5 categories. These categories were largely identical to Van Dijk's model of successive types of access, including *operational*, *technical* and *formal*, *information and cognition*, *digital communication*, *digital content-creation*, and *strategic* skills. As part of these strategic skills, they recognize the ability to identify gaps in digital competences. For the development of knowledge, skills, and competences, individuals need to take personal responsibility. This requires the ability to reflect on their level of competence and identify areas for development.

The literature review by Ester van Laar, Alexander van Deursen, Jan van Dijk, and Jos de Haan adds core skills related to *collaboration*, *critical thinking*, and *problem solving* to Van Dijk's 2014 model. The review also defines several contextual skills, including *ethical and cultural awareness*, *flexibility*, *self-direction*, and *lifelong learning*. However, strategic skills are not included in this mix of skills, despite their importance in Van Dijk's 'resources and appropriation theory.' This review juxtaposes the technologically inspired frameworks of skills, knowledge and competences with the traditional media and information management inspired frameworks

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[160] Van Dijk en Van Deursen (2014), pp. 6–7. Quotations: p. 30.

[161] Iordache, Mariën, and Baelden (2017), p. 17.

as shown in the literature review by Tomás Durán-Becerra and Jesús Lau. These frameworks relate both to processes of understanding and using information and to the use of information technology. The competences emphasize critical understanding to enable informed decision-making and an understanding of how media and technology work. Durán-Becerra and Lau include the ethical use of media and technology and their potential to empower citizens. The combination of these two frameworks provides an overview of the knowledge, skills and competences needed in a transliterate society (see Table 1).

Dimensions of transliteracy knowledge, skills, and competences	*The skills, knowledge, and competences….*
Technical	To use technology responsibly to accomplish tasks and navigate online environments (understanding technology characteristics, basic application operations, access resources)
Information Management	To efficiently identify information needs, and to (ethically) search, locate, access, select, analyse, organize, systematize, contextualize, evaluate, recover, store, share, and use information to make informed decisions about (1) suitable sources of information, and (2) problems within a given task.
Content-creation and content-monitoring	To efficiently and responsibly use available resources and services to contribute new information (as speech, writing, or any of various arts) to any (digital) media for an end-user/audience (interactive) experience in specific contexts, and monitoring the effects of consumed media and information.
Communication	To transmit efficiently and responsibly information to others (by using communication tools, social networks, or traditional media), ensuring that the meaning is expressed effectively.
Collaboration	To participate in a social network and collaborate in a team, to exchange information, negotiate agreements, and make decisions with mutual respect for each other towards achieving a common goal.
Critical Comprehension	To make informed judgements and choices about obtained information and communications using reflective reasoning and sufficient evidence to support claims.

Table 1 Dimensions of transliteracy skills

Dimensions of transliteracy knowledge, skills, and competences	*The skills, knowledge, and competences….*
Problem Solving	To cognitively process and understand a problem situation in combination with the active use of knowledge (about regulations, the political environment, the social mores, human behaviour, etc.) to find a solution to a problem.
Strategy	To use problem solving and critical thinking to analyse complex situations, solve problems arising from those situations, and plan for the future (including the further development of skills), based on the active use of knowledge about political, socio-economic, and organizational contexts.

Table 1 Dimensions of transliteracy skills

Strategic skills enable the strategic use of information and information technology in society, promoting participation, innovative thinking, and creative problem solving. However, determining a necessary level of knowledge, skills, and competences for real-life situations can be challenging. In 1984, Sylvia Scribner stated that literacy is often assumed to be a personal attribute, according to her research on characterizations of literacy. Table 1 provides such personal attributes. Scribner emphasized that literacy also is a social achievement, a result from cultural transmission. Individuals acquire literacy skills through participation in socially organized activities involving written language. Social literacy practices vary over time and space, and individual literacy varies accordingly. [162] Functional literacy refers to the necessary level of literacy an individual requires to *function* in society. [163] The required knowledge, skills, and competences depend on contextual and situational circumstances. Functional literacy refers to the ability to understand and use communication

[162] S. Scribner (1984). 'Literacy in three methaphors,' *American Journal of Education*, Vol. 93, No. 1, pp. 6–21, p. 7, pp. 7–8.

[163] Scribner (1984), p. 8.

media for searching, using, adapting, creating, and understanding information for action and communication in *daily life*. [164] Learning to apply knowledge in real-life situations is especially important for functional literacy as it forms the foundation for individual competence and competitiveness. [165] Determining the necessary level of transliteracy skills for functional literacy, however, can be challenging. The required skills for job performance differ from those needed for functioning in society, and they are specific to contexts and situations, varying across geographic regions. To be functionally literate today, more than basic reading and writing skills are required for using information-as-knowledge in a digitalized world. This may pose a problem.

The Programme for International Student Assessment (PISA) states that reading is no longer solely about extracting information, but also about constructing knowledge, thinking critically, and making well-founded judgments. As information technology allows for greater access to information, the ability to understand and make sense of it becomes increasingly important. Functionally literate individuals in a digitalized society require higher-level skills. According to the 2018 and 2022 PISA results, less than ten per cent of students worldwide demonstrated these higher-level skills, indicating a potential problem for economic and social participation. [166] While information access requires a range of skills,

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[164] V. Korhonen (2010). 'Dialogic literacy. A sociocultural literacy learning approach,' A. Lloyd and S. Talja (eds.), *Practising Information Literacy. Bringing Theories of Learning, Practice and Information Literacy Together*, N.S.W. Centre for Information Studies, Wagga Wagga, Chapter 10, pp. 211–226

[165] R. Ali, S. Dossanova, K. Kulambayeva, A. Sadykova, and T. Tazhibayev (2020). 'Functional literacy in the context of human capital development,' *Universal Journal of Educational Research*, Vol. 8, No. 3, pp. 1017–1026, p. 1020.

[166] A. Schleicher (2018). *PISA 2018. Insights and Interpretations*, OECD, Paris, p. 14. The definition of 'reading' agrees with the UNESCO definition: see p. 57, 158. The 2022 PISA findings reveal a general decline in mathematics, reading and science scores since 2018, which can be attributed to both the COVID-19

traditional literacy skills remain crucial, particularly in the meaning employed by UNESCO and PISA. In 2019, only 34% of the population in Western Europe, one of the most digitalized regions of the world, had above basic literacy skills. [167] While these individuals possess the digital skills to access information technology and the internet, they may lack the necessary skills to fully understand the information they access, depending on situational context. Transliteracy is crucial for accessing information in today's hybrid, digitalized world and for succeeding in society and employment. And even the most advanced skill level cannot cope with information that can be obtained but is not (cognitively) interpretable. While literacy represents a significant challenge in our hybrid world for information access, it is not the only one.

ENVIRONMENTAL CONCERNS

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The advent of the hybrid world has resulted in an increase in the demand for ores and minerals, accompanied by a rise in energy consumption, greenhouse gas emissions (especially CO_2) and ewaste generation. [168] These developments are caused by the information technology

pandemic and long-term problems within education systems. See: A. Schleicher (2022). *PISA 2022. Insights and Interpretation*, OECS, Paris, p. 8.

[167] R. van Kessel, B.L.H. Wong, I. Rubinić, E. O'Nuallain, and K. Czabanowska (2022). 'Is Europe prepared to go digital? Making the case for developing digital capacity. An exploratory analysis of Eurostat survey data,' *PLOS Digital Health*, Vol. 1, No. 2. Online source, retrieved 1 November 2024, from: https://doi.org/10.1371/journal.pdig.0000013.

[168] H. Molin (2022). *The Impacts of Digitalization in the Water-Energy Nexus*. Technical report, Division of Industrial Electrical Engineering and Automation, Lund University, Lund. Online source, retrieved 1 November 2024, from: https://www2.iea.lth.se/publications/Reports/LTH-IEA-7292.pdf. See also: A. Timchenko, I. Kucheva, and L. Silakova (2024). 'Assessing the negative im-

infrastructures that provide for the dynamism of the hybrid world. This dynamism depends on information access and is determined by three factors: the user equipment, the data centres responsible for storage, and the data transmission networks facilitating dissemination.

Information systems are facing pressure to demonstrate energy efficiency and sustainable manufacturing. The information technology industry is facilitating the energy efficiency of other industries, a process known as 'greening by IT.' It contributes to climate change monitoring, environmental mitigation, the development of intelligent energy grids, climate prediction modelling, energy efficiency, and waste management. However, it is also challenged by environmental issues and it needs to reduce its direct environmental impact ('greening of IT'). [169]

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pact of the IT sector on the environment. A call for sustainable solutions,' D. Nazarov and A. Juraeva (eds.), *Proceedings of the Tenth International Annual Conference Industrial Technologies and Engineering (ICITE 2023), Shymkent, Kazakhstan, November 9–10, 2023*, EDP Sciences, Les Ulis, Vol. 474, No. 03026. Online source, retrieved 1 November 2024, from: https://www.e3s-conferences.org/articles/e3sconf/pdf/2024/04/e3sconf_icite2023_03026.pdf. For greenhouse gas emissions: H. Ritchie, P. Rosado, and M. Roser (2023). 'CO_2 and greenhouse gas emissions,' *OurWorldInData.org*. Online source, retrieved 1 November 2024, from: https://ourworldindata.org/co2-and-greenhouse-gas-emissions. Archived at: https://archive.ph/W1NLx.

[169] For the distinction between 'greening of IT' and 'greening by IT' see: E. Curry and B. Donellan (2014). 'Sustainable IT,' H. Topi and A. Tucker (eds.), *Computing Handbook. II. Information Systems and Information Technology*, Chapman and Hall and CRC, London, Chapter 50, pp. 1–20; M. Rathee, and A. Bala (2024). 'Digital technologies and environmental impact,' *World Journal of Advanced Engineering Technology and Sciences*, Vol. 12, No. 1, pp. 116–120, and D. Al Kez, A.M. Foley, D. Laverty, D.F. Del Rio, and B. Sovacool (2022). 'Exploring the sustainability challenges facing digitalization and internet data centers,' *Journal of Cleaner Production*, Vol. 371, No. 133633. Online source, retrieved 1 November 2024, from: https://doi.org/10.1016/j.jclepro.2022.133633.

Improvements in energy efficiency of computers and other devices have helped to moderate the growth in energy demand from data centres and data transmission networks. [170] In their analysis of the literature, Alexandr Timschenko, Irina Kucheva and Liubov Silakova identified the following figures for the period 2019-21: [1] the global information technology industry's annual electricity consumption is estimated to be approximately 2 trillion kilowatt-hours; [2] data centres and networks account for up to 3% of global electricity consumption; [3] the global water consumption by data centres is approximately 980 million m³ per year, almost 3 million m³ per day; [4] the contribution to global greenhouse gas emissions of the information technology industry is approximately 4%; [5] the amount of annual ewaste is approximately 50 million tons, of which 20% is recycled. [171] In 2019, there were a total of 34 billion user devices in use. The manufacturing of this equipment has the most significant impact on the environment, accounting for 30% of the global energy balance, 39% of the greenhouse gas emissions, and 74% of the water consumption. When the electricity produced for their use is also taken into account, user equipment is responsible for a significant proportion of the environmental impact of the information technology industry, with estimates ranging from 59% to 84%. The manufacturing and power consumption of equipment for users represent the two most significant sources of impact. [172]

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[170] International Energy Agency (2023). 'Data centres and data transmission networks,' *IEA Website*. Online source, retrieved on 1 November 2024, from: https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks.

[171] Timchenko, Kucheva, and Silakova (2024), pp. 3–4.

[172] F. Bordage (2019). *The Environmental Footprint of the Digital World*, GReenIT.fr, p. 11. Online source, retrieved November 1 2024, from: https://www.greenit.fr/wp-content/uploads/2019/11/GREENIT_EENM_etude_EN_accessible.pdf. Archived at:

The development of artificial intelligence initiatives since 2012 has resulted in an increase in energy and water consumption as well as in greenhouse gas emissions.

Several examples to illustrate these environmental effects. The computing power needed to train artificial intelligence models has doubled every 3½ months from 2012 onward, resulting in a notable increase in CO_2 emissions. [173] The training of ChatGPT-3 has been found to require the consumption of 1.3 gigawatt hours of electricity, resulting in the generation of 550,000 kg of CO_2. The energy consumption necessary for training is only 40% of that required for operational purposes. The training process also requires the consumption of approximately 700,000 litres of water for the purpose of computer cooling, equivalent to that which would be required by a nuclear power plant cooling tower. [174] In 2023, data centres operated by Google extracted a total of 24 billion litres of water from the environment, a 14% increase compared to 2022. Two-thirds of this quantity was comprised of potable water. In 2022,

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https://web.archive.org/web/20240529233630/https://www.greenit.fr/wp-content/uploads/2019/11/GREENIT_EENM_etude_EN_accessible.pdf.

[173] D. Amodei and D. Hernandez (2018). 'AI and compute,' *Open AI Blog*, 16 May. Online source, retrieved 1 November 2024: https://openai.com/index/ai-and-compute/#modern. Archive: https://archive.ph/B6Jdc#40%.

[174] S. Ghaffary (2024). 'Big Tech's climate goals at risk from massive AI energy demands,' *Bloomberg Newsletter*, 11 July. Online source, retrieved 1 November 2024, from: https://www.bloomberg.com/news/newsletters/2024-07-11/big-tech-s-climate-goals-at-risk-from-massive-ai-energy-demands. Archived at: https://archive.ph/BCKWu. Also: P. Li, J. Yang, M.A. Islam, en S. Ren (2023). 'Making AI less 'thirsty.' Uncovering and addressing the secret water footprint of AI models.' *arXiv preprint*. Online source, retrieved 1 November 2024, from: https://arxiv.org/pdf/2304.03271; and D. Patterson, J. Gonzalez, Q. Le, C. Liang, L.M. Munguia, D. Rothchild, D. So, M. Texier, and J. Dean (2021). 'Carbon emissions and large neural network training.' *arXiv preprint*. Online source, retrieved 1 November 2024, from: https://arxiv.org/pdf/2104.10350.

Microsoft's CO_2 emissions increased by 34% from 2020-21, while Google's emissions increased by 48% from 2019-24. [175]

This expansion negates a considerable proportion of the gains of the 'greening of IT'-initiatives. There is a pressing need to intensify efforts to limit ecological effects. However, the most effective actions will inevitably affect commercial interests and are therefore likely to be difficult to realize. A number of the following actions have already been implemented, or are currently in the process of being implemented. It is imperative that these actions be intensified in light of the ecological consequences of artificial intelligence initiatives. The most important of these actions are: [1] the implementation of virtualization and clustering of virtual servers, which serves to reduce the physical infrastructure; [176] [2]

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[175] *Google Environmental report, 2023*. Online source, retrieved 1 November 2024, from: https://www.gstatic.com/gumdrop/sustainability/google-2023-environmental-report.pdf. Archived at: https://web.archive.org/web/20240716233656/https://www.gstatic.com/gumdrop/sustainability/google-2023-environmental-report.pdf; *Google Environmental report, 2024*. Online source, retrieved 1 November 2024, from: https://www.gstatic.com/gumdrop/sustainability/google-2024-environmental-report. Archived at: https://web.archive.org/web/20240728112227/https://www.gstatic.com/gumdrop/sustainability/google-2024-environmental-report.pdf. *Microsoft Environmental sustainability report, 2022*. Online source, retrieved 1 November 2024, from: https://news.microsoft.com/wp-content/uploads/prod/sites/42/2023/05/2022-Environmental-Sustainability-Report.pdf. Archived at: https://web.archive.org/web/20240621093848/https://news.microsoft.com/wp-content/uploads/prod/sites/42/2023/05/2022-Environmental-Sustainability-Report.pdf.

[176] K. Hwang, G.C. Fox, and J.J. Dongarra (2012). *Distributed and Cloud Computing. From Parallel Processing to the Internet of Things*, Elsevier-Morgan Kaufmann, Waltham, Chapter 3, pp. 129–187.

the reduction of under-utilization of hardware leading to using more power than necessary; [177] [3] the deployment of energy-efficient chips utilizing multi-core technology, which is of importance for all user devices, including smartphones, tablets and computers; [4] the utilization of low-power hardware, including processors, solid-state drives, and supplies; [5] the implementation of enhanced cooling systems, based on other cooling fluids than potable water; [6] improved data centre locations, where natural, renewable resources can be employed in the generation of electricity or where it is feasible to generate and store electricity; and [7] improving traditional recycling practices to diminish ewaste. [178]

Although challenging, further actions are required. The possibility of extending the scope of recycling practices needs to be considered in order to achieve the objective of 'zero ewaste landfills.' This would reduce the amount of waste produced, an increase in the recovery of resources, and the fostering of a mindset conducive to a circular economy. [179] In manufacturing, there is a need to reduce or eliminate the use of environmentally critical materials. Equipment needs to be designed with longevity in mind, to conserve energy and to implement effective end-of-life

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[177] A. Choudhary, G. Makesh, and K. Pal (2023). 'Energy-efficient load-balanced server consolidation in cloud computing environment.' Online source, retrieved 1 November 2024, from: https://ssrn.com/abstract=4356696.

[178] G.J. van Bussel (2024). 'The ecological footprint of Artificial Intelligence.' *Vbds.nl*. Online source, retrieved 1 November 2024, from: https://www.vbds.nl/2024/07/30/vertalingen-ecological-footprint-en-archiving-in-2050/#more-6274.

[179] M. Chen and O.A. Ogunseitan (2021). 'Zero E-waste. Regulatory impediments and blockchain imperatives,' *Frontiers of Environmental Science & Engineering*, Vol. 15, pp. 1–10. Also: N. Pajunen and M.E. Holuszko (2022). 'Circular economy in electronics and the future of e-waste,' M.E. Holuszko, A. Kumar, and D.C.R. Espinosa (eds.), *Electronic Waste. Recycling and Reprocessing for a Sustainable Future*, Wiley-VCH, Weinheim, Chapter 13, pp. 299–314.

management strategies. The materials used should be easily recycable. [180] The development of 'green software' allows for more environmentally friendly computational efficiency, data efficiency, context awareness, and idle efficiency, based on software sustainability metrics. [181]

Another approach would be to reduce the quantity of stored information based on its informational value, as proposed by Geert–Jan van Bussel, Nikki Smit, and John van de Pas in 2015. Their objective was to investigate a methodical reduction in the quantity of stored information, utilizing retention levels and retention schedules. The term 'retention level' is used to describe the organizational level that is responsible for the collection, processing, analysis, and storage of information as well as the implementation of the retention schedule. This schedule explicitly defines the economic, social, cultural, financial, administrative, fiscal, legal and/or historical value of the information retained at every retention level, which is defined as the time (in years) after which the information should be irreparably destroyed. Duplicate information at other retention levels can be permanently deleted without delay. The utilization of retention levels and the removal of duplicate information does have a significant impact. Case studies demonstrated a reduction in two key areas: firstly, the amount of information was reduced by 45%, and secondly, the electricity consumption for information storage was reduced, resulting in a calculated cost reduction of 35% and a subsequent reduction

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[180] A.P. Kumar and S.S. Kannegala (2012). 'Green devices and hardware,' S. Murugesan and G.R. Gangadharan (eds.), *Harnessing Green IT. Principles and Practices*, John Wiley & Sons, Ltd., Chichester, Chapter 2, pp. 23–38.

[181] B. Steigerwald and A. Agrawal (2012). 'Green Software,' S. Murugesan and G.R. Gangadharan (eds.), *Harnessing Green IT. Principles and Practices*, John Wiley & Sons, Ltd., Chichester, Chapter 3, pp. 39–62; F. Albertao (2012). 'Sustainable software decelopment,' S. Murugesan and G.R. Gangadharan (eds.), *Harnessing Green IT. Principles and Practices*, John Wiley & Sons, Ltd., Chichester, Chapter 4, pp. 63–84.

in CO_2 emissions. [182] Combining this approach with the use of tape storage for long-term preservation would result in a further reduction in the emissions as well as in lower costs of operation. [183] It is questionable whether creation of awareness among users of the more than 34 billion devices in use (computers, tablets, and smartphones) will prove sufficient to address the vast scale of this challenge. However, the energy consumption of these devices is markedly higher than that of all data centres globally. It is important to recognize this effect of global information access.

EVALUATION

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The world around us is not purely digital, but rather a hybrid amalgamation of virtual and physical elements. It can best be described as a world, in which all facets of that physical world are presented in virtual appearances that live a 'life of their own,' that are constantly evolving themselves, and that constantly interact with 'real-life.' People live both virtual and physical lives simultaneously; it is impossible to do otherwise.

This digitalized world has both benefits and drawbacks. Let's start with the benefits. Firstly, it is *convenient* as it enables people to communi-

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[182] G.J. van Bussel, N. Smit, and J. van de Pas (2015). 'Digital Archiving, Green IT and environment. Deleting data to manage critical effects of the data deluge,' *Electronic Journal of Information Systems Evaluation*, vol. 18, No. 2, pp. 187–198. For permanently deleting information see also: Al Kez, et al (2022), pp. 3–6.

[183] J. Koomey, K. Brill, P. Turner, J. Stanley, and B. Taylor (2007). *A Simple Model for Determining True Total Cost of Ownership for Data Centers*. Uptime Institute White Paper, Santa Fe, version 2. Online source, retrieved 1 November 2024, from: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=94b97a8b200a30303c26a2796c039342f089a838.

cate, interact, shop, and access information from anywhere. Secondly, it promotes *connectivity*, allowing people to connect globally, communicate and collaborate worldwide, and facilitate business, cultural exchange, and knowledge sharing. Thirdly, the internet provides people with instant *access to information* through search engines, conversational artificial intelligence, and online libraries, offering unprecedented possibilities for research and education. Fourthly, it has become easier to *innovate and create* by using online platforms to develop new applications, games, services, shops, and online products, which allows for continuous business and technological advancement. Fifthly, email, social media, and instant messaging enable real-time interaction regardless of geographical distances, enhancing personal and professional *communication*. Sixthly, digital technologies facilitate possible *economic growth* by creating a parallel economy through ecommerce, online marketing, and services that are seamlessly integrated with the real-world economy. And, last but not least, a wide range of *entertainment* options, including streaming services, online gaming, social media platforms, and digital art, enrich people's leisure time.

There ar several drawbacks. The first one are *privacy concerns*. Large amounts of user information are collected, which puts personal information in the hands of government and business organizations. Users are often unaware of how this information is managed, processed, used (to build user profiles, for instance), secured, and to whom it is sold. Secondly, the value of (personal) information leads to *information security threats*. Viruses, malware, phishing, and ransom-ware infiltrate information infrastructures to compromise sensitive information, steal personal information, and disrupt services. The third and fourth drawbacks are related to problematic *access to and accessibility of information*. This is where Paradox 2.0 and 3.0 come into play. The sheer volume of information that can be made available leads to information overload. To manage the constant influx of information, individuals use tools to filter information

based on their preferences or search queries. However, this can result in information bubbles and difficulties in accessing accurate information. Information bubbles can make people more susceptible to misinformation, leading to misunderstandings when participating in society. In addition, rapid technological developments can leave information vulnerable to obsolescence, resulting in probable availability without the possibility of interpretation due to poor accessibility. The fifth drawback also affects information access, but its consequences are more far-reaching. It emerges from the *organizational power* of Laurence Lessig's 'code is law' principle. Proprietary 'code,' including architectures, infrastructures, software, and artificial intelligence algorithms, defines how everything people do in the virtual world is experienced, protected, censored, and monitored. It also determines how information access is permitted, managed, and organized. The organizations that own this 'code' integrate their own values into their technological structures, which can constrain user actions and limit information access, anonymity, freedom of speech, and individual control. This can be extremely dangerous for democratic values. Sixth, not everyone has equal access to information and information technologies, leading to *digital divides*. Socio-economic disparities limit access to information, education, jobs, and essential services. Seventh, it could lead to *social isolation* when reliance on digital media leads to a lack of face-to-face interactions and even addiction due to excessive use of digital devices, social media, and online entertainment. This hampers interpersonal relationships and mental and physical health. Eight, there are *economic and legal challenges*. The technological advancements in economic markets have outpaced the regulatory legal framework in terms of content and effectiveness. This is evident in areas such as cross-border business, international trade, taxation, consumer privacy, and security. Economic issues include property rights to information, a shortage of highly qualified personnel, the replacement of medium and low skilled workers with robots and automatic machines, as well as prob-

lematic governance, accountability, and analysis. And lastly, the digitalization of society has resulted in an *acceleration of environmental problems*, largely due to a notable increase in greenhouse gas emissions (especially CO_2), ewaste, and the utilization of potable water for cooling.

Examining the benefits and drawbacks of this hybrid world, it is clear that the advantages primarily relate to *convenience and commercial capabilities*, while the disadvantages primarily concern *societal issues* that are exacerbated by the digititalization of society. As previously stated, technology does not bridge divides but rather exacerbates or creates them. All these issues (probably except social isolation) relate to access and accessibility of information. Privacy concerns not only involve the collection of personal information but also the restriction of access to it. Information security is primarily concerned with safeguarding infrastructures to prevent access to personal and sensitive information. Information overload and technological obsolescence both hinder access to information. The principle of 'code is law' concerns the definition of what individuals are permitted or prohibited from doing, and grants the owners of digital infrastructures the power to permit or deny access to information. Digital divides are predominantly about access to information technology and information. They tear society apart and play different groups off against each other, with the least advantaged falling further and further behind when it comes to acquiring information technology, information access, information skills, and participation in society. Legal and economic issues often revolve around access to information, particularly property rights and governance, accountability, and analysis. The acceleration of environmental problems is largely attributable to the unprecedented growth in the utilization of a multitude of digital devices that demand considerable amounts of power to facilitate information access. The legal frameworks have not kept pace with technological advancements and innovation, leaving business platforms with significant leeway

in their platform regulations. While this is unavoidable, it is also undesirable.

Information access is crucial in a hybrid world. The use of search engines and (conversational) artificial intelligence language models have helped in this regard. Although the hybrid world has made access to information more convenient and has opened up many libraries to consult, the drawbacks are severe and far-reaching. These issues are not easily solved as solutions would interfere heavily with private business practices. Nevertheless, these business practices should comply with existing laws and regulations and be obliged to prove their compliance.

Rapidly evolving technology can make access and accessibility challenging. Therefore, it is crucial for individuals to have transliteracy skills to identify important information that can help solve their problems. Additionally, literacy is crucial for interpreting and understanding the information they have access to. This allows information-as-thing to transform to information-as-knowledge, a concept often overlooked in the issues discussed in this chapter. For this to be realized, the information should be presented in a (cognitively) interpretable format. However, most people and organizations are not aware of the vulnerability of information due to these continuous format changes.

The study of information access and accessibility is a topic of great interest across various disciplines. In the next chapter, I will analyse several theoretical approaches to the access to and the accessibility of information.

3

Theoretical approaches to Information Access

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ACCESS TO 'THINGS'

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Lor and Britz claim that access to information is a 'dominant right.' However, this 'right' is characterized by significant inequalities in access to information within society. Differences in access to information and the necessary facilities lead to information inequality, which is reflected in the digital divide(s) and the associated differences in behaviour, skills and knowledge. This inequality affects both business and government organizations. [184]

This overview of theoretical approaches to information access begins in a different context, that of property management, natural resource analysis, and physical environment. Jesse Ribot and Nancy Peluso combined sociological, anthropological, and geographical approaches to access in a multi-disciplinary one, focusing on access as 'the ability to benefit from things — including material objects, persons, institutions, and symbols.' They assert that 'by focusing on *ability*, rather than *rights* as in property theory, this formulation brings attention to a wider range of social relationships that can constrain or enable people to *benefit* from resources without solely focusing on property relations alone.' [185] Although they focus on natural resources, their theoretical framework can be applied to information access as well. This is because Buckland's concept of information-as-thing can be associated with the 'things' in question.

Ribot and Peluso argue that access emerges within structures of power, focuses on the abilities of actors (individuals and organizations) to benefit from 'things,' and is embedded in social relations of control

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[184] Lor and Britz (2007), p. 392.

[185] J. Ribot and N.L. Peluso (2003). 'A theory of access,' *Rural Sociology*, Vol. 68, No. 2, pp. 153–181, pp. 153–154 (my italics.)

and maintenance. [186] Social access relations are constantly changing, depending 'on an individual's or group's position and power within various social relationships.' [187] Ribot and Peluso suggest locating this power within the social and political-economic contexts that shape abilities of individuals and oganizations to benefit from resources. Power relations are present in all structural and relational mechanisms of access, including technology, capital, markets, labor, knowledge, authority, identity, and social relations. [188]

Ribot and Peluso's explanations regarding access to knowledge, authority, and social identity are noteworthy when considering information access. *Access to knowledge* determines 'who can benefit from resources' and shapes economic, social, and political purposes. Access to information provides (potentially) privileged access to knowledge. However, control over information also limits access and the potential benefits of this resource. [189] *Access to authority* refers to 'an individual's ability to benefit from resources,' from 'things,' which tends to be selective along economic and social lines. Authorities act as nodes of access control, and their approval is necessary to gain and maintain access to resources. [190] *Social identity* plays a crucial role in obtaining approval, and access is mediated by factors such as membership in a community or workforce, or belonging to a specific social stratification. [191]

Authority, knowledge, and social identity are important concepts in the social sciences. These concepts, along with power and ownership (key arguments for access in Ribot and Peluso's paper), are considered central to explaining inequalities in access to information. 'A Theory of

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[186] Ribot and Peluso (2003), pp. 158–159.

[187] Ribot and Peluso (2003), pp. 155–159. Quotation: p. 158.

[188] Ribot and Peluso (2003), pp. 164–172.

[189] Ribot and Peluso (2003), pp. 168–169. Quotation: p. 168.

[190] Ribot and Peluso (2003), pp. 170.

[191] Ribot and Peluso (2003), pp. 171–172.

Access' presents a structural approach while at the same time recognizing the agency of individuals, although it is noted that agency could have been more strongly emphasized. [192] The paper is perceived as very influential (1464 citations), but it has *never* been discussed or cited in (or in relation to) the most important theories of information access. [193] This is surprising given the relationship between access to physical objects and access to information, as described by Buckland's concept of information-as-thing.

Patrick Fougeyrollas and his colleagues developed a conceptualization of access dimensions, focusing on the physical environment (built framework, public spaces, and infrastructure) and social environment (services, attitudes, representations, and social relations). They argue that access and accessibility are used interchangeably, but that they are distinct concepts. 'Access' is a general notion defined by five dimensions: availability, accessibility, acceptability, affordability, and usability. [194] The

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[192] J. Koch (2008). *Perspectives on Access to and Management of Natural Resources*, DIIS Working Paper, Danish Institute for International Studies, Copenhagen, No. 8, p. 6. Online source, retrieved 1 November 2024, from: https://www.econstor.eu/bitstream/10419/44687/1/56526527X.pdf.

[193] R. Myers and C. Pilegaard Hansen (2020). 'Revisiting A Theory of Access. A review,' *Society and Natural Resources*, Vol. 33, No. 2, pp. 146–166, state it has 1600 citations. According to the website of *Rural Sociology*, the paper has been cited 1464 times (1 November 2024).

[194] P. Fougeyrollas, D. Fiset, L. Dumont, Y. Grenier, N. Boucher, and S. Gamache (2019). 'Réflexion critique sur la notion d'accessibilité universelle et articulation conceptuelle pour le développement d'environnements inclusifs,' *Revue Développement Humain, Handicap et Changement Social / Journal of Human Development, Disability, and Social Change*, Vol. 25, No. 1, pp. 161–175, pp. 167–169. Online source, retrieved 1 November 2024, from: https://doi.org/10.7202/1085774ar; and P. Fougeyrollas, L. Noreau, N. Boucher, D. Fiset, Y. Grenier, M. Philibert, D. Hazard (2015). 'Handicap, environnement, participation sociale et droits humains. Du concept d'accès à sa me-

access concept encompasses 'a complete continuum, from the design of measures to their practical application,' including the *way* to gain access and the use of information in real-life. [195] Accessibility is the 'state of the physical, spatial, architectural, and technological components of the environment that enable a person or group of people to carry out their activities, according to their abilities or preferences.' [196] It is a *characteristic* of the object that a group or individual is attempting to access.

In 2023, Marie Michèle Grenon and colleagues applied the concept of physical access to information access, using the definitions and classifications Fougeyrollas, et al presented. They stress the importance of accessibility, stating that information can (and will) be presented in various formats and should be robust to ensure accessibility. Accessibility should be ensured through standards (although there is no consensus on them), by the availability of 'older' technology, and by regularly assessing the accessibility of the information. [197] The acceptance of access and accessibility as different but related concepts, as I have presented earlier in distinguishing between two different meanings of the term, is an important lesson from this brief journey into another domain's interpretation of access and accessibility.

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sure,' *Revue Développement Humain, Handicap et Changement Social / Journal of Human Development, Disability, and Social Change*, Special issue, April, pp. 5–28. Online source, retrieved 1 November 2024, from: https://doi.org/10.7202/1086792ar.

[195] Fougeyrollas (2019), p. 166. Translated from: 'd'un continuum complet, s'amorçant avec la conception de mesures jusqu'à leur utilisation concrète.'

[196] Fougeyrollas (2019), p. 167. Translated from: 'état des composantes physiques spatiales, architecturales et technologiques de l'environnement permettant, selon leurs capacités ou préférences, à une personne ou à un groupe de population de réaliser leurs activités.'

[197] M.M. Grenon, J. Ruel, P. Fougeyrollas, C.L. Normand, A.C. Moreau, A. Romero-Torres, and S. Gravel (2023). 'Conceptualizing access to and understanding of information,' *Universal Access in the Information Society*, Vol. 22, pp. 83–94.

AN OVERVIEW OF RESEARCH ON INFORMATION ACCESS AND ACCESSIBILITY

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Assumptions

In the field of information science, seven research approaches have been identified as being pertinent to the issues of access and accessibility. These are: disparity, seeking, retrieval, quality, security, management and archiving. These approaches encounter, more or less, challenges in accepting the technical, social, and psychological aspects of information access as interdependent parts. [198] They, more or less, focus on access to information-as-things and are based on four assumptions.

The initial assumption is that information is *socially constructed*. It is created by someone for somebody else or collectively, accepted, trusted, believed, and communicated through social network interactions. It is *always* influenced by cultural and social contexts, even if this context is presented as a 'black box.' [199] The second assumption is that information is always created and used within situational contexts, which imbue information with its meaning, and, together with technological factors, influence the dynamics of accessing information, even when a psychologi-

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[198] Based on: 'all the great problems that face our world today have both technical and human content — the one intermingled inseparably with the other.' *The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1978. Herbert A. Simon at the Nobel Banquet*, 10 December 1978. Online source, retrieved 1 November 2024, from: https://www.nobelprize.org/prizes/economic-sciences/1978/simon/speech/. Archived at: https://archive.ph/wip/QyE8i.

[199] C. Castelfranchi (2002). 'The social nature of information and the role of trust,' *International Journal of Cooperative Information Systems*, Vol. 11, No. 3–4, pp. 381–403, especially p. 384. See also: J. Seely Brown and P. Duguid (2017). *The Social Life of Information*, Harvard University Press, Boston, second edition.

cal or cognitive perspective is dominant. [200] The third assumption is that information is *'located' somewhere* and can be 'found' using skills, systems, and tools. [201] The fourth assumption is that when information is found, its (cognitive) interpretability and usability are assured.

These assumptions lead to the conclusion that the *main* concerns of information access are understanding contexts and users, designing information systems for specific contexts, and connecting users to these information systems. However, research on information access should not only focus on *gaining access* using information systems and tools, but also on the accessibility of *information* itself. This research overview indicates that (cognitive) interpretability of information is often overlooked.

Information access disparity research

Access inequalities have various explanations, including structural (social, socio-economic) and human agency. These explanations are not mutually exclusive. Structural explanations also consider human agency, and vice versa. [202]

The structural approach provides four explanations for access disparity. The initial explanation is based on political economy, where cap-

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[200] E. Chatman (2000). 'Framing social life in theory and research,' L. Hoglund and T. Wilson (eds.), *The New Review of Information Behaviour Research. Studies of Information Seeking in Context*, Taylor Graham, Cambridge, Vol. 1, No. 1, pp. 3–17; R. Savolainen (2021). 'Information landscapes as contexts of information practices,' *Journal of Librarianship and Information Science*, Vol. 53, No. 4, pp. 655–667.

[201] M. Lee and B.S. Butler (2019). 'How are information deserts created? A theory of local information landscapes,' *Journal of the Association for Information Science and Technology*, Vol. 70, No. 2, pp. 101–116.

[202] L. Yu, W. Zhou, and J. Wang (2020). 'A structure-agency integrative framework for information access disparity. Rediscovery of practice in dividing society's information rich and poor,' *Journal of Documentation*, Vol. 76, No. 4, pp. 829–848, p. 830.

ital enters the information domain for profit, leading to the privatization of information infrastructures, an alliance between political and economic interests in developing information policies, and a dependence on economic resources for information access. This explanation confirms the *power* of capitalism to control information access and to reduce government support for public information infrastructures, resulting in inequal access. [203] The second explanation is based on social stratification theories. This theory views society as a system that is stratified, with different strata having varying resources and capabilities to access, acquire, and use information. Access to information infrastructures is dependent on individual positions in a stratified system, which explains the existence of knowledge gaps. [204] Expanding on social stratification, the concept of social exclusion provides a third structural explanation for information access disparities. Social participation can be limited by various factors such as poverty, unemployment, health, sexual orientation, and gender. Such individuals are excluded from social networks and events, and/or exist at the margins of society. They may live in social isolation in areas where poverty and crime rates are high and public services are limited. The isolation experienced by these individuals hinders access to information, which in turn strengthens their exclusion. Social exclusion explains access divides and a lack of public support. [205] Lastly, the expla-

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[203] L. Yu (2019). 'Towards structure-agency integrative theories for information access disparity. Lessons from within and beyond LIS,' *Journal of Documentation*, Vol. 75, No. 3, pp. 458–477, p. 461; G. Murdock and P. Golding (1989). 'Information poverty and political inequality. Citizenship in the age of privatized communications,' *Journal of Communication*, Vol. 39, No. 3, pp. 180–195.

[204] D.B. Grusky (2011). 'Theories of stratification and inequality,' G. Ritzer and J. Michael Ryan (eds.), *The Concise Encyclopedia of Sociology*, Wiley-Blackwell, Hoboken, pp. 622–624.

[205] T.S. Molala and J.C. Makhubele (2021). 'The connection between digital divide and social exclusion. Implications for social work,' *Humanities & Social Sciences Reviews*, Vol. 9, No. 4, pp. 194–201.

nation of social networks contends that individuals always participate in networks and depend on them for the exchange of information. Individuals' adoption of technology and acceptance of information are influenced by the networks in which they participate. The diffusion of technology and information is limited without relevant social networks, which restricts information access and participation. [206]

These four explanations are related and share one defining component: an individual's position in society. The effects of social stratification and the socialization of its members are dominant in all explanations. An individual's *habitus*, as introduced by French sociologist Pierre Bourdieu, is largely defined by deeply ingrained habits, feelings, dispositions, and forms of knowledge due to social background, culture, and life experiences, which are offered by the social group to which individuals (and their family) belong. [207] All these explanations are ultimately dependent on social stratification to explain access. An individual's social standing can influence the availability of resources, such as technology or income. This is also true for the issue of social exclusion, which can be caused by prevailing ideas, values, and behavioural norms within

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[206] Yu (2019), pp. 461–462. F. Pichler and C. Wallace (2009). 'Social capital and social class in Europe. The role of social networks in social stratification,' *European Sociological Review*, Vol. 25, No. 3, pp. 319–332.

[207] P. Bourdieu (1972). *Esquisse d'une théorie de la pratique, précéde de trois études d'ethnologie kabyle*, Librairie Droz, Genève, used in de reprint of 2000 by Éditions du Seuil, Paris, pp. 256–300. An 'habitus' is largely developed during primary socialization of children. Also called: 'the software of the mind' according to G. Hofstede, G.J. Hofstede, and M. Minkov (2010). *Cultures and Organizations. Software of the Mind. Intercultural Cooperation and its Importance for Survival*, McGraw Hill, New York, third edition, pp. 4–7. From a different perspective: A.S.R. Manstead (2018). 'The psychology of social class. How socioeconomic status impacts thought, feelings, and behaviour,' *The British Journal of Social Psychology*, Vol. 57, No. 2, pp. 267–291.

certain social strata, as well as the opportunities provided by social networks. [208]

Human agency explanations focus on an individual's ability to control their own goals, actions, and destiny. [209] This research focuses on motivations, interests, values, attitudes, and worldviews as factors that determine information needs and behaviour. It is believed that 'what is within people that determines what they do with information.' [210] As emphasized by Steven Hitlin and Charisse Long, individuals make choices that serve to reproduce social structures with the potential for innovation. [211] William Sewell views agency as a constituent of structure, rather than opposed to it. An individual is 'capable of exerting some degree of control over the social relations in which one is enmeshed, which in turn implies the ability to transform those social relations to some degree.' Agents do have the possibility to act with or against others by using familiar structures. Agency is formed by 'a specific range of cultural schemas and resources available in a person's particular social milieu.' It is inseparable of structures, reproducing them but also transforming and

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[208] Pichler and Wallace (2009), pp. 325–329.

[209] M. Schlosser (2019). 'Agency,' E.N. Zalta, *The Stanford Encyclopedia of Philosophy* (Winter 2019 edition), The Metaphysics Research Lab, Philosophy Department, Stanford University, Stanford (Ca). Online source, retrieved 1 November 2024, from: https://plato.stanford.edu/archives/win2019/entries/agency/; S. Hitlin and G.H. Elder Jr (2007a). 'Time, self, and the curiously abstract concept of agency,' *Sociological Theory*, Vol. 25, No. 2, pp. 170–191, and S. Hitlin and G.H. Elder Jr (2007b). 'Agency. An empirical model of an abstract concept,' R. MacMillan (ed.), *Constructing Adulthood. Agency and Subjectivity in Adolescence and Adulthood*, Advances in Life Course Research, Volume 11, JAI Press, Oxford-Boston, pp. 33–67.

[210] Yu (2019), p. 462.

[211] S. Hitlin and C. Long (2009). 'Agency as a sociological variable. A preliminary model of individuals, situations, and the life course,' *Sociology Compass*, Vol. 3, No. 1, pp. 137–160.

changing them. It is agency that is, for a part, responsible for innovations. [212] Human agency, thus, reproduces structures but allows for behavioural changes that could transform them over time.

Combining structure and agency when considering information access is a challenging task. None of the theories that integrate structures and agency mention Sewell's or Hitlin and Long's research, although they all use Anthony Gidden's structuration theory. Most of them reach the same conclusions in the end. However, accepting Sewell's statement that agency is *implied* by the existence of structures does not necessarily imply an understanding of *how* structure and agency interact, or *which* are the dominant factors. Several studies have attempted to explain the factors that influence the interaction between structure and agency.

Jan van Dijk, for example, has highlighted that networks not only restrict but also facilitate human agency, including the ability to modify aspects of network structures. In his model of access, it is not fully understood how structures and agency interact. [213] Mun-Cho Kim and Jong-Kil Kim identify three levels: media accessibility, information mobilization, and information consciousness, corresponding with three stages of development: opportunity (economic access to media), utilization (social use of information resources), and reception (receiving information to gain knowledge). Three factors influence these stages: economic capital, network capital, and cultural capital. Economic capital

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[212] W.H. Sewell Jr (1992). 'A theory of structure. Duality, agency, and transformation,' *American Journal of Sociology*, Vol. 98, No. 1, pp. 1–29. Quoations: p. 20. Also: Hitlin and Long (2009), pp. 137–160 (following Sewell (1992), pp. 2–3, pp. 22–23.) Sewell follows: A. Giddens (1984). *The Constitution of Society. Outline of the Theory of Structuration*, Polity Press, Oxford, pp. 2–3, pp. 5–16.

[213] Van Dijk (2006), p. 226. S. Hjarvard (2020). 'Networks of change. The sociology of network media,' J. Hunsinger, M. Allen, L. Klastrup (eds.), *Second International Handbook of Internet Research*, Springer, Dordrecht, pp. 239–267, p. 244.

constrains the ability to purchase media, network capital is the participation of individuals in social networks generating different social supports, and cultural capital is the cultural and educational possibilities to utilize information and gain knowledge. The first two stages are characterized by structure, while the third stage is characterized by human agency. Kim and Kim imply interactions between structure and agency, but do not discuss them. [214]

Leah Lievrouw defines information access as a feature of community-based 'information environments.' These are social settings where information resources, communication relations, and enabling technologies are part of a 'structuration-type process of change called informing.' This process involves 'mutually and recursively shaped' relationships between structure and agency. [215] These environments consist of two interacting aspects: institutional and personal/relational. They continuously organize, disorganize, and reorganize knowledge and information. [216] The process of 'informing' ensures the availability, relevance, accessibility, capacity, and usability of information. Institutions determine which information can be made available and which media should be developed or restricted. People decide to adopt certain types of technology while ignoring others. Both choices have an impact on the ability to seek and share information, as well as the decision to remain within

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[214] M.C. Kim and J.K. Kim (2001). 'Digital divide. Conceptual discussions and prospect,' W. Kim, T.W. Ling, Y.J. Lee, S.S. Park (eds.), *The Human Society and the Internet. Internet-Related Socio-Economic Issues. Proceedings of the First International Conference, Human.Society@Internet 2001 Seoul, Korea, 4-6 July*. Lecture Notes in Computer Science 2105, Springer, Heidelberg, pp. 78–91.

[215] L.A. Lievrouw (2000). 'The information environment and universal service,' *The Information Society. An International Journal*, Vol. 16 No. 2, pp. 155–159; L.A. Lievrouw (2001). 'New media and the 'pluralization of life-worlds.' A role for information in social differentiation,' *New Media & Society*, Vol. 3, No. 1, pp. 7–28. Quoations: p. 12.

[216] Lievrouw (2001), p. 13.

or leave the networks created by the information environment. [217] Lievrouw's theory expands on Sewell's by providing an explanation of the interactions between structure and agency, but it does not clarify the *interaction* between their different *factors*.

Liangzhi Yu, Wenbo Zhou, and Junli Wang have rediscovered practices ('organized activities of a group of individuals') as a *structural* force that shapes information access for individuals. [218] They argue that individual behaviour is embedded in social practices, and as a result, information environments will differ between individuals. Practices are influenced by society's material, institutional, and cultural features, structural forces that affect individual behaviour and information access. The way information access is structured by social practices is influenced by factors of *human agency*, including responses to a practice, strategic moves between practices, experiential returns of information, and the individual state of knowing based on subjective understandings and beliefs. [219] Yu, Zhou, and Wang's research contributes to the social stratification theories mentioned earlier and enriches Sewell's theory with an explanation of the interactions between structure and agency. This research confirms the proposition of Hitlin and Long that human agency reproduces social structures. Additionally, there is a link with the concept of 'social identity,' which largely depends on an individual's social standing.

Information disparity research mostly concerns *societal access* to information. Information access in organizational settings is only marginally addressed and is mostly viewed as a direct consequence of existing disparities in society.

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[217] Lievrouw (2001), pp. 15–16.

[218] Yu, Zhou, and Wang (2020), pp. 829–848, p. 829, pp. 833–836, p. 842. For practice theories see: T.R. Schatzki (2001). 'Introduction. Practice theory,' T.R. Schatzki, K.K. Cetina, and E. von Savigny (eds), *The Practice Turn in Contemporary Theory*, Routledge, London, pp. 10–23. Also: Bourdieu (1972), pp. 256–300.

[219] Yu, Zhou, and Wang (2020), pp. 839–842 and pp. 843–844.

Information seeking research

This second research strand focuses on human information behaviour, including 'accidental encountering of, needing, finding, choosing, using, and (even) avoiding information.' [220] It studies 'how people need, seek, give, and use information in different contexts,' aiming to understand group or individual characteristics in information access. [221] This research strand not only considers information as 'things' but also as 'knowledge.' What distinguishes it from disparity research is that, although it overlaps, it is not concerned with differences between social groups in inequalities in access but focuses on understanding patterns of information seeking and use driven by information needs. It does not assume comparability of groups and individuals in access because it emphasizes the situated nature of information needs and criteria for relevance. [222] It emphasizes agency while accepting individuals as parts of larger structures. Numerous theories and models have been proposed regarding information seeking. [223] Early research on information seeking was mostly system-centred, focusing on library use, retrieval system performance, and interface design. [224] From the 1970s onwards, the individual as an information seeker, creator, and user has become increas-

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[220] T.D. Wilson (2000). 'Human information behaviour,' *Informing Science*, Vol. 3, No. 2, pp. 49–55; and D.O. Case and L.M. Given (2016). *Looking for Information. A Survey of Research on Information Seeking, Needs and Behavior*, Emerald, Bingley, 4th edition, p. 4 (quotation.)

[221] K.E. Pettigrew, R. Fidel, and H. Bruce (2001). 'Conceptual frameworks in information behavior,' *Annual Review of Information Science and Technology*, Vol. 35, No. 1, pp. 43–78, p. 44.

[222] Yu (2019), p. 464.

[223] K.E. Fisher, S. Erdelez, and L. McKechnie (eds.) (2005). *Theories of Information Behaviour*, Information Today, Inc., Medford (NJ). Also: Case and Given (2016), pp. 141–176, pp. 190–210, and: N. Ford (2015). *Introduction to Information Behaviour*, Facet Publishing, London, pp. 141–167.

[224] Case and Given (2016), p. 8.

ingly important. [225] This approach aims to comprehend how individuals interact with information. There are two research accentuations: cognitive (or psychological) and contextual (or social). [226]

The research on *cognition* emphasizes individual user attributes when seeking information and examines 'cognitive and emotional motivations for information behaviour that carry across context or are independent of context.' [227] It is concerned with how an individual perceives, interprets, modifies, or transfers information and how 'knowledge templates' are applied to 'processes of needing, seeking, giving, and using information.' [228] This research accentuation has been prevalent in most user–centred studies and has led to many (overlapping) typologies, such as [1] Robert Taylor's typology of information needs, which argues that the perception of need often differs from its expression in words and that questions and answers need to be 'negotiated.' [229] Another example is [2] Marcia Bates' 'berrypicking model,' stating that information is gathered by 'bits and pieces' through various search techniques and reformulated queries, without the use of search strategies. [230] [3] Sandra Er-

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[225] N.K. Agarwal (2017). *Exploring Context in Information Behavior. Seeker, Situation, Surroundings, and Shared Identities.* Synthesis Lectures on Information Concepts, Retrieval, and Services, Morgan & Claypool Publishers, San Rafael (Ca.), p. 5.

[226] Contrary to Pettigrew, Fidel, and Bruce (2001), who recognize three approaches: cognitive, social, and multifaceted. My interpretation based on: Agarwal (2017).

[227] Pettigrew, Fidel, and Bruce (2001), p. 46 (quotation.)

[228] J.P. Walsh (1995). 'Managerial and organizational cognition. Notes from a trip down memory lane,' *Organization Science*, Vol. 6, No. 3, pp. 280–321, p. 281. For quotation: Pettigrew, Fidel, and Bruce (2001), p. 47.

[229] R.S. Taylor (1968). 'Question-negotiation and information seeking in libraries,' *College and Research Libraries*, Vol. 29, No. 3, pp. 178–194.

[230] M.J. Bates (1989). 'The design of browsing and berrypicking techniques for the online search interface,' *Online Review*, Vol 13, No. 5, pp, 407–424, p. 410, p. 421.

delez's theory of 'accidental information encountering' argues that information seeking is an organic process in which most information is encountered accidentally. [231] [4] David Ellis' information seeking process model consists of eight steps: starting, chaining, browsing, differentiating, monitoring, extracting, verifying, and ending. This model is intended for use in information system design and evaluation. [232] [5] Thomas Wilson has developed a series of general models on information seeking behaviour, based on an individual's perception of information needs and influencing factors such as the systems used and available information (sources). [233] [6] Carol Kuhlthau's information search process model in seven steps recognizes the thoughts, feelings of uncertainty and ambiguity, and actions of users. These steps include task initiation, topic selection, prefocus exploration, focus formulation, information collection, presentation, and search assessment. [234] In his analysis, Naresh Agarwal

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[231] S. Erdelez (1997). 'Information encountering. A conceptual framework for accidental information discovery,' P. Vakkari, R. Savolainen, and B. Dervin (eds.), *Information Seeking in Context. Proceedings of an International Conference on Research in Information Needs, Seeking, and Use in Different Contexts, 14-16 August 1996, Tampere, Finland*, Taylor Graham, Los Angeles, pp. 412–421.

[232] For analysis: Case and Given (2016), p. 151–152. The original six steps: D. Ellis (1989). 'A behavioural model for information retrieval system design,' *Journal of Information Science*, Vol. 15, No. 4–5, pp. 237–247. Adding a seventh and eight step: D. Ellis, D. Cox, and K. Hall (1993). 'A comparison of the information seeking patterns of researchers in the physical and social sciences,' *Journal of Documentation*, Vol. 49, No. 4, pp. 356–369.

[233] Pettigrew, Fidel, and Bruce (2001), p. 53. An analysis of Wilson's models: Case and Given (2016), pp. 162–164. Wilson (2000), and T.D. Wilson (2005). 'Evolution in information behaviour modelling. Wilson's model,' K.E. Fisher, S. Erdelez, and L. McKechnie (eds.), *Theories of Information Behaviour*, Information Today, Inc., Medford, pp. 31–36.

[234] C. Kuhlthau (1991). 'Inside the search process. Information seeking from the user's perspective,' *Journal of the American Society for Information Science*, Vol. 42, No. 5, pp. 361–371. The seventh stage: C.C. Kuhlthau, L.K. Maniotes, and A.K.

identifies Kuhlthau's model as an affective model, a perspective that Kuhlthau herself (partly) appears to accept. [235]

Some system-centred models focus on the mismatch between cognition and system-related information retrieval. These models include [1] The hypothesis of Nicholas Belkin regarding the 'anomalous state of knowledge'; [236] [2] Peter Ingwersen's model of 'cognitive information retrieval interaction'; [237] and [3] Tefko Saracevic's 'stratified interaction model of information retrieval.' [238] As the focus is primarily on an individual's cognitive state, this emphasis may not be suitable for examining social aspects of information seeking and use, cooperative information seeking, or the cultural formation of meanings and representations. [239]

The *contextual accentuation* has its focus on 'the way an individual's interaction with information is shaped by social norms, networks, and or-

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Caspari (2007). *Guided inquiry. Learning in the 21st Century*, Libraries Unlimited, Westport, pp. 19–20. Also: Pettigrew, Fidel, and Bruce (2001), pp. 49–50.

[235] Agarwal (2017), p. 5. For Kulthau's view: C. Kulthau (2018?). 'Information Search Process.' Online source, retrieved 1 November 2024, from: https://wp.comminfo.rutgers.edu/ckuhlthau/information-search-process. Archived at: https://archive.ph/vcnUt.

[236] N.J. Belkin (1984). 'Cognitive models and information transfer,' *Social Science Information Studies*, Vol. 4, No. 2–3, pp. 111–129.

[237] P. Ingwersen (1996). 'Cognitive perspectives of information retrieval interaction. Elements of a cognitive IR theory,' *Journal of Documentation*, Vol. 52, No. 1, pp. 3–50.

[238] T. Saracevic (1996). 'Modeling interaction in information retrieval (IR). A review and proposal,' S. Hardin (ed.), *59th Annual Meeting of the American Society for Information Science*, ASIS, Silver Spring, pp. 3–9. Online source, retrieved 1 November 2024, from: https://www.researchgate.net/publication/239054075_Modeling_interaction_in_information_retrieval_IR_A_review_and_proposal.

[239] S.Talja, K. Tuominen, and R. Savolainen (2005). "Isms' in information science. Constructivism, collectivism and constructionism,' *Journal of Documentation*, Vol. 61, No. 1, pp. 79–101, p. 85.

ganizations,' [240] and on understanding 'meanings and values associated with social, sociocultural, and sociolinguistics aspects of information behaviour.' Contexts are not 'black boxes' but 'carriers of meaning.' [241] This differs from the cognitive accentuation of research. The contextual perspective enriches the structural approach to information access disparity. Lievrouw's structuring process of 'informing' (pp. 86–87) bridges the contextual accentuation with information access disparity research.

Elfreda Chatman's theories of 'information poverty,' 'life in the round,' and 'normative behaviour' laid the foundation for this contextual accentuation of research. [242] All these theories demonstrate how social contexts influence and determine information behaviour, and how they define them as normative frameworks. Information value is confined within the norms and attitudes of a social world, which Chatman refers to as a 'small world.' Chatman's framework provides an analysis of how such norms influence or determine access within these 'small worlds.' Regardless of the importance of the information, access will be limited if it comes from an unreliable source, from someone who conflicts with community norms, or from someone perceived as an outsider. [243] Chatman's view of social access and the theory of 'small worlds' are related

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[240] Agarwal (2017), p. 5 (quotation.)

[241] Pettigrew, Fidel, and Bruce (2001), p. 54 (both quotations)

[242] According to: Pettigrew, Fidel, and Bruce (2001), p. 59.

[243] E.A. Chatman (1992). *The Information World of Retired Women*, Greenwood Press, Westport; E.A. Chatman (1996). 'The impoverished life-world of outsiders,' *Journal of the American Society for Information Science*, Vol. 47, No. 3, pp. 193–206, and E.A. Chatman (2000). 'Framing social life in theory and research,' *New Review of Information Behavior Research*, Vol. 1, No. 1, pp. 3–17. Chatman's theory is followed and elaborated upon in: G. Burnett, M. Besant, and E.A. Chatman (2001). 'Small worlds. Normative behavior in virtual communities and feminist bookselling,' *Journal of the Association for Information Science and Technology*, Vol. 52, No. 7, pp. 536–547, Burnett, Jaeger, and Thompson (2008), and Oltmann (2009).

to John Seely Brown and Paul Duguid's theory of the 'social life of information,' in which social conventions determine information technology, information, its usability, and its access. The manner in which individuals interact with information within organizational contexts is largely shaped by affilliated social networks, characterized by their own rules, norms, and behaviours. [244] These behaviours may or may not align with the espoused values, underlying assumptions, behavioural expectations, and norms of an organizational culture. [245]

Many social theories are developed in which contextual influences and structures on information seeking behaviour (including those influences and structures within organizations) are emphasized, like [1] Robert Taylor's model of the 'information use environment,' that determines the flow and use of information and the criteria to judge information value; [246] [2] Brenda Dervin's sense-making approach, developed as 'a philosophically informed methodological approach for attending to (and researching) human sense-making and sense-unmaking.' It involves 'given foundations' used by people to make sense of their environments; [247] [3] Birger Hjørland and Hanne Albrechtsen's domain analysis, considering 'knowledge domains' as discourse communities, influencing information behaviour; [248] [4] the constructionist approach of Kimmo Tuominen and Reijo Savolainen, researching information use as a discursive

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[244] Seely Brown, and Duguid (2017).

[245] Van Bussel (2020), pp. 21–54.

[246] R.S. Taylor (1991). 'Information use environments,' B. Dervin and M. Voigt (eds.), *Progress in Communication Sciences*, Vol. 10, Ablex, Norwich, pp. 217–255.

[247] B. Dervin (2015). 'Dervin's Sense-Making Theory,' M. Al-Suqri and A.S. Al-Aufi (eds.), *Information Seeking Behavior and Technology Adoption. Theories and Trends*, IGI Global, Hershey, Chapter 4, pp. 59–90. Quotation: p. 59.

[248] B. Hjørland and H. Albrechtsen (1995). 'Toward a new horizon in information science: domain-analysis,' *Journal of the American Society for Information Science*, Vol. 46, No. 6, pp. 400–425.

action that can be studied as a real-world action; [249] [5] Reijo Savolainen's 'way of life,' referring to the 'order of things,' activities that take place in daily life, including jobs and tasks such as household care and voluntary activities; [250] [6] Karen Pettigrew's space-related concept of 'information ground'; [251] [7] Kirsty Williamson's ecological model of use, which emphasizes the incidental acquisition of information based on social network theory; [252] and [8] Pamela McKenzie's two-dimensional model of context-bound information practices for seeking, scanning, non-directed monitoring, and proxy-based acquisition. [253] Based on the work of McKenzie, information practices have become a trend, influenced by but distinct from information behaviour. This trend serves as a connection to Yu, Zhou, and Wang's research on 'practice' in disparity research.

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[249] K. Tuominen and R. Savolainen (1997). 'A social constructionist approach to the study of information use as discursive action,' P. Vakkari, R. Savolainen, and B. Dervin (eds.). *Information Seeking in Context. Proceedings of an International Conference on Research in Information Needs, Seeking and Use in Different Contexts, August 14–16, 1996, Tampere, Finland,* Taylor Graham, London, pp. 81–96.

[250] R. Savolainen (1995). 'Everyday life information seeking. Approaching information seeking in the context of 'way of life',' *Library & Information Science Research*, Vol. 17, No. 3, pp. 259–294. Also: R. Savolainen and L. Thomson (2022). 'Assessing the theoretical potential of an expanded model for everyday information practices,' *Journal of the Association for Information Science and Technology*, Vol. 73, No. 4, pp. 511–527.

[251] K.E. Pettigrew (1999). 'Waiting for chiropody. Contextual results from an ethnographic study of the information behaviour among attendees at community clinics,' *Information Processing & Management*, Vol. 35, No. 6, pp. 801–817. About space-related context concepts: Savolainen (2021), p. 655.

[252] K. Williamson (1998). 'Discovered by chance. The role of incidental information acquisition in an ecological model of information use,' *Library & Information Science Research*, Vol. 20, No. 1, pp. 23–40.

[253] P.J. McKenzie (2003). 'A model of information practices in accounts of everyday-life information seeking,' *Journal of Documentation*, Vol. 59, No. 1, pp. 19–40.

Information retrieval research

Information retrieval is studied in both computer science and information science. The former takes an experimental systems approach, while the latter takes a user-oriented (social science) approach. [254] Communication between these two disciplines is limited, possibly because of their different backgrounds and their views on the 'realism' and 'usefulness' of each other's approach. [255] The information retrieval approach that prioritizes the user is largely based on the cognitive, user-oriented accentuation in information seeking research, as previously discussed. This approach focuses on integrating the processes of 'seeking' and 'retrieval' in behavioural models and emphasizes the importance of relevant search results. [256]

Information retrieval research is focused on information-as-things and achieving intelligent access to them. According to Leif Azzopardi and Vishwa Vinay, information retrieval deals with storage, management, organization, and retrieval of information, while retrieval research aims to find better methods to do the same. [257] It is said that information

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[254] P. Vakkari and K. Järvelin (2005). 'Explanation in information seeking and retrieval,' A. Spink and C. Cole (eds.), *New Directions in Cognitive Information Retrieval*, Springer, Dordrecht, Chapter 7, pp. 113–138, p. 113.

[255] Vakkari and Järvelin (2005), p. 113. Also: B.J. Jansen and S.Y. Rieh (2010). 'The seventeen theoretical constructs of information searching and information retrieval,' *Journal of the American Society for Information Science and Technology*, Vol. 61, No. 8, pp. 1517–1534, pp. 1517.

[256] J. Foster (2006). 'Collaborative information seeking and retrieval,' *Annual Review of Information Science and Technology*, Vol. 40, No. 1, pp. 329–356. Also: I. Ruthven (2005). Integrating approaches to relevance,' A. Spink and C. Cole (eds.), *New Directions in Cognitive Information Retrieval*, Springer, Dordrecht, Chapter 4, pp. 61–80.

[257] L. Azzopardi and V.Vinay (2008). 'Accessibility in information retrieval,' C. Macdonald, I. Ounis, V. Plachouras, I. Ruthven, and R.W. White (eds.), *Advances in Information retrieval. Proceedings of the 30th European Conference on IR Research, ECIR*

retrieval is 'the dominant form of information access.' The rise of the World Wide Web led to the invention of retrieval tools such as browsers and search engines. These tools have become primary means of access and 'are able to provide high-quality results within subsecond response times for hundreds of millions of searches a day over billions of web pages.' [258]

Bernard Jansen and Soo Young Rieh combined Wilson's framework on information behaviour, which includes human information behaviour, information seeking behaviour, and information searching behaviour, with their framework of information systems, which includes information systems, information seeking systems, and information retrieval systems. [259] In Wilson's framework the behaviours of individuals using information systems are classified hierarchically. The framework of Jansen and Rieh illustrates the systems that support, afford, and enable these behaviours. Both frameworks are related through three levels of interaction: [1] access and support, where individuals access information and systems that support their behaviour; [2] use and afford, where individuals seek and use information and information seeking systems provide affordances to support this behaviour; and [3] search, browse and enable, where information retrieval systems enable features and functionalities to support those specific types of information search behaviour. [260]

2008 Glasgow, UK, March 30-April 3, 2008, Springer, Berlin-Heidelberg, pp. 482–489, p. 482.

[258] C.D. Manning, P. Raghavan, and H. Schütze (2009). *Introduction to Information Retrieval,* Cambridge University Press, Cambridge, preface, p. xix, p. 1 (quotation), and p. xx (quotation.)

[259] Jansen and Rieh (2010), p. 1518. Wilson (2000), pp. 49–50; and T.D. Wilson (1999). 'Models in information behaviour research,' *Journal of Documentation*, Vol. 55, No. 3, pp. 249–270, p. 263.

[260] Jansen and Rieh (2010), p. 1518.

Jansen and Rieh's framework highlights the connection between retrieval and search, both of which centre on the interaction between people, information and information systems. Both aim to locate and find information. [261] However, the term 'search' refers primarily to the act of *locating* information, [262] while 'retrieval' refers to *finding* predominantly unstructured information within storage systems to satisfy a need, with an emphasis on facilitating search. [263] Information retrieval involves organizing, structuring, and analysing information in retrieval systems, emphasizing its relationship with computer science.

Information retrieval research is about searching and retrieving information that is relevant to a user's query. The challenge lies in processing unstructured queries (based on keywords, prompts or conversational chats) to retrieve relevant information from large collections. Information retrieval systems were originally text-based but have since been designed to be multi-modal, to retrieve non-textual content such as video, images, audio, and music, with or without using metadata.

There are three major research issues: [1] *relevance*, the measure of retrieval performance of information systems for a user. Algorithms statistically match a query to information and provide results they consider relevant. Users derive relevance from a problem at hand, their cognitive state, and other contextual factors, which means that relevance can vary between users. Other information not retrieved by a system may be rele-

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[261] Jansen and Rieh (2010), p. 1517.

[262] D. Nicholas, P. Huntington, H.R. Jamali, and C. Tenopir (2006). 'Finding information in (very large) digital libraries. A deep log approach to determining differences in use according to method of access,' *The Journal of Academic Librarianship*, Vol. 32, No. 2, pp. 119–126, p. 120.

[263] Manning, Raghavan, and Schütze (2009), p. 1, who (in a footnote) declare that 'in modern parlance, the word 'search' has tended to replace '(information) retrieval'; … we use the two synonymously' (p. 1).

vant to their problem; [264] [2] the *query*, which is the formal expression of a user's information needs in the input language of a retrieval system, must be both correct and precise. For many users, this represents a challenge, with many struggling to articulate their query in this way. As a result, the system's answers to these queries may be unsatisfactory; [265] [3] *evaluation* and *experimentation* are necessary to measure a retrieval systems performance, determining its effectiveness (i.e. relevance of results) and efficiency (i.e. query processing). System-based evaluations are less valuable than user-based evaluations, in which actual users interact with a retrieval system in a laboratory setting. These evaluations, despite the value of the results, are very difficult to manage and organize. [266]

Azzopardi and Vinay suggest that evaluation of an information retrieval system should include an assessment of its *accessibility*. They argue that accessibility indicates the *opportunity* or *potential* of information to be retrieved. Retrieval systems are about *the efficiency of accessibility*. [267] Access-

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[264] L. Schamber (1994). 'Relevance and information behavior,' *Annual Review of Information Science and Technology*, Vol. 29, pp. 3–48; T. Saracevic (2007a). 'Relevance. A review of the literature and a framework for thinking on the notion in information science. Part II. Nature and manifestations of relevance,' *Journal of the American Society for Information Science and Technology*, Vol. 58, No. 13, pp. 1915–1933; T. Saracevic (2007b). 'Relevance. A review of the literature and a framework for thinking on the notion in information science. Part III. Behavior and effects of relevance,' *Journal of the American Society for information Science and Technology*, Vol. 58, No. 13, pp. 2126–2144; S. Krishnamurthy and V. Akila (2017). 'Information retrieval models. Trends and techniques,' A. Singh, N. Dey, A.S. Ahour, and V. Santhi (eds.), *Web Semantics for Textual and Visual Information Retrieval*, IGI Global, Herhey, Chapter 2, pp. 17–42.

[265] Krishnamurthy and Akila (2017), pp. 18–19.

[266] P. Borlund (2009). 'User-centred evaluation of information retrieval systems,' A. Göker and J. Davies (eds.), *Information Retrieval. Searching in the 21st century*, John Wiley & Sons, Chichester, Chapter 2, pp. 21–37.

[267] Azzopardi and Vinay (2008), p. 482, p. 485.

ibility is a *characteristic of the retrieval system* that can be measured in evaluation. It pertains to access *to* information rather than accessibility *of* information. It is about the *way* users are facilitated to gain access.

Most studies in information retrieval research focus on the *way* to gain access, but there are retrieval technologies that aim to improve the interpretability of information. Starting with the former, research has focused on access limitations or barriers to information retrieval, including physical impairments, restricted access due to security clearance, inability to crawl parts of the internet, effectiveness and efficiency of retrieval models and internet search, and context awareness for retrieval. [268] For the latter, new technologies (driven by artificial intelligence) are improving access to information, such as natural language processing, neural retrieval, contextual understanding, cross-language retrieval, automated text categorization, semantic search, text summarization, and voice and conversational search. [269] Although the primary concern of information retrieval remains access to information-as-things, the advent of artificial intelligence enables a transformation to intelligent information retrieval, which permits the development of access to information-as-knowledge.

Information quality research

Research in information quality is based on quality research in general. Four approaches can be recognized. Robert Pirsig's *transcendent approach* is subjective and impossible to operationalize ('you know what it

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[268] Based on: G. Berget, A. MacFarlane (2020). 'What is known about the impact of impairments on information seeking and searching?,' *Journal of the Association for Information Science and Technology*, Vol 71, No. 5, pp. 596–611.

[269] For these (and other) developments: D. Hiemstra, M.F. Moens, J. Mothe, R. Perego, M. Potthast, and F. Sebastiani (eds.) (2021). *Advances in Information Retrieval. 43rd European Conference on IR Research, ECIR 2021, Virtual Event, March 28–April 1, 2021, Proceedings, Part I*. Lecture Notes in Computer Science, Vol. 12656, Springer Nature, Cham. See also: p. 119–120, note 330.

is.') In a *product-oriented approach*, quality is inherent to a product and can be determined by the presence or absence of product specifications. Any divergence from these specifications will result in a reduction in quality, which is summarized as 'conformance to specifications.' In a *user-oriented approach* it is believed that quality 'lies in the eyes of the beholder.' Quality is summarized as 'fitness for use.' In an *economic approach*, quality is defined in terms of value, costs, and prices, in short: 'affordable cost.' The information must meet specified product specifications and expectations, be suitable for use, and be available at an acceptable cost. [270]

Larry English distinguished between *inherent* and *pragmatic* information qualities. Inherent quality refers to *the accuracy of the information*, or its conformance to specifications. Pragmatic quality refers to *the degree of usefulness*, or fitness for use, in achieving set objectives. [271] The absence of either of these qualities creates problems. The quality problem is greatest when information has pragmatic quality but lacks inherent quality. In this scenario, the information appears to be crucial for achieving organizational objectives. However, due to uncertain quality, it is impossible to realize these objectives. [272] Users are reluctant to use such information, but in many organizations, they are unaware of these issues. [273]

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[270] R.M. Pirsig (1974). *Zen and the Art of Motorcycle Maintenance. An Inquiry into Values*, William Morrow & Company, New York, p. 213; W.J. Bellows (2004). 'Conformance to specifications, zero defects, and six sigma quality. A closer look,' *International Journal of Internet and Enterprise Management*, Vol. 2, No. 1, pp. 82–95; D.A. Garvin (1988). *Managing Quality. The Strategic and Competetive Edge*, Free Press New York, p. 43; and G.J. van Bussel (2012). *Archiving Should be Just like an Apple™, en Acht Andere, Nuttige (?) Stellingen*, Amsterdam University Press, Amsterdam, p. 19.

[271] L.P. English (1999). *Improving Data Warehouse and Business Information Quality. Methods for Reducing Costs and Increasing Products*, John Wiley & Sons, New York, pp. 22–27.

[272] Van Bussel (2012), p. 19.

[273] Van Bussel (2020), pp. 59–61,

Quality of information has been examined extensively. In general, two research approaches can be identified, which are often combined but each with a different emphasis. The first approach focuses on the quality of the information management environment, while the second approach focuses on the quality characteristics of the information itself. The attention paid to the management environment that ensures quality chacteristics can be realized, will not be discussed here. That part of the information quality system is part of the information value chain, as discussed in the framework of the 'Archive-as-Is.' [274]

My analysis of quality characteristics is based on four recent overviews of such frameworks. I added quality characteristics for the use of information as evidence and memory, excluded from most quality frameworks. An overview of these quality characteristics can be found in Table 2. [275]

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[274] Van Bussel (2017), pp. 55–57.

[275] J. Wang, Y. Liu, P. Li, L. Zhenxing, S. Sindakis, and S. Aggarwal (2023). 'Overview of data quality. Examining the dimensions. Antecedents, and impacts of data quality,' *Journal of the Knowledge Economy*, 10 February 2023. Online source, retrieved 1 November 2024, from: https://doi.org/10.1007/s13132-022-01096-6; C. Cichy and S. Rass (2019). 'An overview of data quality frameworks,' *IEEE Access*, Vol. 7, pp. 24634–24648. Online source, retrieved 1 November 2024, from: https://ieeexplore.ieee.org/abstract/document/8642813; C. Batini and M. Scannpieco (2016). *Data and Information Quality. Dimensions, Principles and Techniques*, Springer, Cham; and L. Bai, R. Meredith, and F. Burstein (2018). 'A data quality framework, method and tools for managing data quality in a health care setting, *Journal of Decision Systems*, Vol. 27, sup1, pp. 144–154. For quality specifications for information as evidence: L. Duranti (1998). *Diplomatics. New uses for an old science*, The Scarecrow Press, Lanham and London; P. Conway (2011). 'Archival quality and longterm preservation. A research framework for validating the usefulness of digital surrogates,' *Archival Science*, Vol. 11, No. 3–4, pp. 293–309, and G.J. van Bussel and F.F.M. Ector (2009). *Op Zoek naar de Herinnering. Verantwoordingssystemen, Content-Intensieve Organisaties en Performance,* Van Bussel Document Services, Helmond, pp. 195–209

Characteristic	*The extent to which information:*
Accessible	Is easily and quickly retrievable
Accurate	Is correct, precise, valid, and reliable (free-of-error or distortion)
Appropriate	Is usable for a given purpose without much filtration
Authentic	Presents and maintains the required (and original) content and structure
Available	Is (physically) available
Believable	Is considered reliable and of good reputation
Complete	Is of sufficient breadth, depth and scope for the task at hand
Consistent	Is presented in the same format as (and compatible with) previous information
Contextual	Is embedded in metadata about its situational and environmental context
Controllable	Can be tested on integrity and authenticity
Current	Reflects the real-world concept that it represents
Integrity	Maintains and assures accuracy and consistency over its entire life-cycle.
Interpretable	Has contents that are (cognitively) interpretable by users
Historical	Has content, context and structure that can be reconstructed at any moment in time
Relevant	Is being useful for the task at hand
Secure	Has [1] assurance of long-term availability, and [2] appropriate restrictions on access and modification
Timely	Is available on time for the task at hand, with as small as possible differences between expected and realized delivery
Traceable	Is appropriately documented, with traceable lineage and provenance

Table 2 Information quality characteristics

Accessibility is a fundamental characteristic of information in most frameworks. It is defined in terms of the first meaning of accessibility recognized before: 'ease of access' to information, or 'ease of attainability.' [276] Accessibility is also a part of the quality characteristic 'secure' as 'access security,' which restricts access to and modification of information. The tradeoff between accessibility and security poses a problem for information quality. Allowing easy access to information can conflict with the need for security, privacy, and confidentiality. However, imposing severe restrictions on access to information may leave employees disgruntled, leading to behaviour that endangers information quality in other ways. [277] The second meaning of access and accessibility, as recognized before, is within information quality research associated with 'interpretable' and 'interpretability.' This refers to the extent to which information can be (cognitively) interpreted by users, whether they are human or machine. It is often referred to as 'understandability.' [278] Interpretability is about personally internalizing the information to evaluate its relevance and make informed decisions. If information is not (cognit-

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[276] Y.W. Lee, L.L. Pipino, J.D. Funk, and R.Y. Wang (2006). *Journey to Data Quality*, The MIT Press, Boston, p. 59.

[277] Lee, Pipino, Funk, and Wang (2006), p. 80, 84. Also: Van Bussel (2020), especially pp. 61–71.

[278] 'Interpretability' is often defined as 'the extent to which information can be understood.' G.L. Rogova and E. Bosse (2010). 'Information quality in information fusion,' *Proceedings of the 13th International Conference on Information Fusion, 26-29 July 2010, EICC, Edinburgh, UK*, IEEE, Piscataway, pp. 1–8. Interpretability has become important within artificial intelligence and machine learning and is defined as 'the degree to which a human can understand the cause of a decision,' or 'the degree to which a human can consistently predict the (mathematical – GvB) model's result.' See: C. Molnar (2022). *Interpretable Machine Learning. A Guide for Making Black Box Models Explainable*. Online source, retrieved 1 November 2024, from: https://christophm.github.io/interpretable-ml-book/. Archived at: https://perma.cc/4X2T-YB84.

ively) interpretable, accessibility of the content of the information is not possible. Information quality research bridges gaps in information disparity, information seeking, and information retrieval research. However, it also adds something important: having access to information does not necessarily mean that it is interpretable.

Information security research

Information security is of utmost importance due to the processing of sensitive information and large amounts of money in networked environments, especially in the cloud. It is essential to ensure the security of organizational processes. However, achieving a balance between information sharing and access, and security is a challenging task.

Research in information security is related to information quality research. Quality research is concerned with defining quality characteristics and developing a management system to monitor and ensure quality. Information security, on the other hand, aims to prevent inappropriate access, illegal use, disclosure, deletion, corruption, and modification of information (systems), using mathematical methods, technology, and risk management procedures to protect both hardware and software infrastructures and communication channels. [279] Success in information security can only be realized by considering both technological and social resources. [280] According to Lizzy Coles-Kemp, in security research and practice both technological and social aspects *must* be considered. [281] Information technologies are contextually situated within organizational

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[279] A. Calder (2020). *The Cyber Security Handbook. Prepare for, Respond to and Recover from Cyber Attacks*, IT Governance Publishing Ltd, Cambridgeshire.

[280] G. Dhillon and J. Backhouse (2001). 'Current directions in IS security research. Towards socio-organizational perspectives,' *Information Systems Journal*, Vol. 11, No. 2, pp. 127–153.

[281] L. Coles-Kemp (2009). 'Information security management. An entangled research challenge,' *Information Security Technical Report*, Vol. 14, No. 4, pp. 181–185.

processes and are influenced by political, cultural, and philosophical structures, shaping social and agentic behaviour. [282] This can result in gaps between security and compliance. [283]

The core principles of information security are summarized in the CIA-triad: confidentiality, integrity and availability, a model designed to guide security policies in organizations. Confidentiality protects information from unauthorized access, based on classifications of the risk level of the information. Integrity involves maintaining the consistency, accuracy and trustworthiness of information throughout its lifetime. Availability means that information should be accessible to authorized users when they need it. [284] This model has been heavily criticized, but is still valid. Many concepts have been proposed as complements to the triad, such as: authenticity, correctness of specification, identity management, human integrity, responsibility, ethics, trust and non-repudiation. Each of these concepts, however, can be assigned to one of the Triad's tenets. [285] The realization of the triad depends on access controls. Restricting access is the only access and accessibility issue that information security research pays attention to. [286]

Access and accessibility have an impact on all aspects of the CIA-triad. Restricting them is an effective way to ensure confidentiality, in-

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[282] M.H. Jarrahi, and S.B. Nelson (2018). 'Agency, sociomateriality, and configuration work,' *The Information Society*, Vol. 34, No. 4, pp. 244–260.

[283] Coles-Kemp (2009), pp. 182–183.

[284] K.Y. Chai and M.F. Zolkipli (2021). 'Review on confidentiality, integrity and availability in information security,' *Journal of ICT in Education*, Vol. 8, No. 2, pp. 34–42, p. 36.

[285] For an analysis: S. Samonas and D. Coss (2014). 'The CIA strikes back. Redefining confidentiality, integrity, and availability in security,' *Journal of Information System Security*, Vol. 10, No. 3, pp. 21–45, pp. 29–30.

[286] M. Chapple (2021). *Access Control and Identity Management*, Jones & Bartlett Learning, Burlington, third edition (ebook), Chapter 13 (Access Control Assurance), pp. 431–432.

tegrity, and availability. Due to the socio-technical nature of security, access control can have unpredictable outcomes, making access and accessibility security risks. [287] Access control policies establish parameters for access management, whether it is discretionary, mandatory, or role-based. [288] The aim of these policies is to restrict user access to information (systems) by defining user roles, collaboration rights, and flexibility to enable an effective separation of roles and responsibilities. [289] These policies, along with the implemented access control framework, promote security awareness and define (and implement) business rules, access procedures, and technical controls to prevent unauthorized access or misuse of information. An access control framework assists employees in understanding the expected information behaviour by the organization and enforces this behaviour with technical controls. Continuous evaluation of employee behaviour, including any misbehaviour, should be a necessary part of security policies and procedures. [290] Access control is a fundamental aspect of information security and a topic of significant research. This research focuses on models, policies, enforcement mechanisms (authentication and authorization), and cloud control.

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[287] Chapple (2021), Chapter 3 (Human Nature and Organizational Behavior), pp. 81–112; M.J. Nigrini and N.J. Mueller (2014). 'Lessons from an $8 million fraud,' *Journal of Accountancy*, Vol. 218, No. 2, pp. 32–37. Online source, retrieved 1 November 2024, from: https://www.journalofaccountancy.com/issues/2014/aug/fraud-20149862.html.

[288] P. Samarati and S.C. de Vimercati (2001). 'Access control. Policies, models, and mechanisms,' R. Focardi and R. Gorrieri (eds.), *Foundations of Security Analysis and Design. FOSAD 2000*. Lecture Notes in Computer Science, vol 2171. Springer, Berlin-Heidelberg, Chapter 3, pp. 137–196.

[289] K.W. Kobelsky (2014). 'A conceptual model for segregation of duties. Integrating theory and practice for manual and IT-supported processes,' *International Journal of Accounting Information Systems*, Vol. 15, No. 4, 304–322.

[290] Van Bussel (2021), pp. 158–160.

Information security involves safeguarding the quality of information, particularly its confidentiality, integrity, and availability. To achieve this, it is necessary to control access and accessibility. This means limiting or restricting access to information to authorized users only. It is important to note that this perspective differs from those used in disparity, seeking, retrieval, and quality research. However, information management research also has a strong relationship with this topic, as information control plays a crucial role in studying organizational power.

Information management research

Management is about achieving organizational objectives through the implementation of an organizational strategy. Information management is focused on an organization's information management processes, while an organizational strategy clarifies how information can be utilized to achieve objectives. [291] Adapting Stewart Clegg and James Bailey's definition of organization and management research, information management research can be defined as the examination of how organizations construct information structures, processes, and practices and how these, following organizational strategies, shape social relations and create communication structures that facilitate decisions, performance, and accountability. [292] Most of the theoretical foundations of information management concern information seeking and use, information retrieval, information quality, and information security. Additionally, in-

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[291] W. Baets (1992). 'Aligning information systems with business strategy,' *The Journal of Strategic Information Systems*, Vol. 1, No. 4, pp. 205–213, and J. Peppard and J. Ward (2016). *The Strategic Management of Information Systems. Building a Digital Strategy*, John Wiley & Sons, Hoboken, fourth edition, Chapter 4, pp. 125–164, and Chapter 6, pp. 207–250.

[292] S.R. Clegg and J.R. Bailey (eds.) (2007). *International Encyclopedia of Organization Studies*, Sage, Thousand Oaks, 4 volumes, volume 1, p. xliii. I have replaced 'organizational structures' with 'information structures.'

formation management research encompasses organizing, governing, and strategically managing information and information behaviour. It concerns topics like organizational climate and culture, power, governance, accountability, behaviour, operations (processing the information value chain to enable business strategies to achieve their objectives), and knowledge and learning. [293] Information access is crucial in all of these areas, but it is governed by the assumption that information is interpretable upon acquisition. I have discussed information culture, information behaviour, governance and accountability, and operations in previous work. Here, I will focus on power, knowledge, and learning. [294]

Information access can be seen as a mechanism of control that defines restrictions on users' rights to participate and/or access information, both in society at large and in organizations. Therefore, power is related to information security's access control, which can be viewed as an expression of societal and organizational power. Benjamin Bates acknowledged the relationship between information access and power in his research on access, bias, and control. Attempts to gain access control occur in every context and interaction. Bates argues that control operates by manipulating content and limiting access. [295] While Bates originally discussed access restrictions in society at large, he acknowledged their significant impact on social systems. [296] Andrew Pettigrew's per-

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[293] Among others, all main categories within Clegg and Bailey (2007).

[294] Van Bussel (2017), (2020), and (2021).

[295] B.J. Bates (1993). 'The macro-social impact of communication systems. Access, bias, control,' K. Reardon (ed.), *Proceedings of the International Communication Association 43rd Annual Conference. Faces and Interfaces: Communicating Across Disciplines, May 27-31, Washington*, ICA. Without page numbering (p. 8.) Online source, retrieved 1 November 2024, from: http://www.academia.edu/220489/The_Macro-Social_Impact_of_Communication_Systems.

[296] Bates (1993) (p. 9.)

spective on decision making in organizations involves power dynamics and conflicts between actors. He highlights the role of information control in mobilizing power. [297] In both organizations and economic markets, access to information is a valuable resource for gaining power.

Business organizations attempt to gain an advantage by controlling personal information about customers and creating profiles to optimize their marketing and advertising, as discussed previously. In 1989, Oscar Gandy predicted that information could be used to control access to insurance and employment. 'Advanced electronic technologies dramatically increase the bureaucratic advantage in the workplace, marketplace, and government by enabling — and encouraging — increasingly automatic methods of surveillance of the individual.' And: 'Advances in digital communications technologies, … allows market research to apply the sophisticated techniques of social science to the surveillance of consumers in order to predict and control their behavior.' [298] This is exactly what big data analytics and artificial intelligence have been doing for the last decade. Power is most often associated with the control of information: having access allows for personal or departmental power. [299]

In knowledge management and learning research, information access is considered crucial as it enables the use of information to gain knowledge in learning processes. [300] According to Michael Goddard and col-

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[297] A.M. Pettigrew (1972). 'Information control as a power resource,' *Sociology*, Vol. 6, No. 2, pp. 187–204, p. 202.

[298] O.H. Gandy (1989). 'The surveillance society. Information technology and bureaucratic social control,' *Journal of Communication*, Vol. 39, No. 3, pp. 61–76. Quotations: p. 61 and 67. Also: O.H. Gandy (1993). *The Panoptic Sort. A Political Economy of Personal Information*, Westview Press, Boulder.

[299] Pettigrew (1972). Also: R.J. Skovira (2008). 'Analyzing power as information in organizations. Thinking about how to do it,' *Issues in Information Systems*, Vol. 9, No. 2, pp. 369–377.

[300] M. Goddard, D. Mowat, C. Corbett, C. Neudorf, P. Raina, and V. Sahai (2004). 'The impacts of knowledge management and information technology

leagues, information access requires meeting four requirements: discovery (when a user knows the information exists and how to find it), connectivity (when a user is able to obtain the information), language (when a provider and a user of the information agree on the meaning of used language), and permission (when a user is permitted to have access to the information). [301] In the view of Thomas Davenport and Laurence Prusak, knowledge is a dynamic and multifaceted construct comprising a combination of framed experience, values, contextual information, and expert insight. It provides frameworks for the evaluation and incorporation of new experiences and information, and originates and is applied in the minds of knowers. In organizational contexts, knowledge is frequently situated not only within documents or repositories, but also within the routines, processes, practices, and norms that constitute the organizational fabric. [302] Experience, values, and insights are intangible and exist only within the minds of individuals. They are employed to facilitate the acquisition, assessment, and integration of novel information into existing cognitive frameworks. [303] The transformation of tangible information (such as documents and repositories) and intangible phenomena into new knowledge represents a significant challenge for humans and machines alike. [304] Knowledge management is, in short, the

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advances on public health decision-making in 2010,' *Health Informatics Journal*, Vol. 10, No. 2, pp. 111–120.

[301] Goddard, et al (2004), p. 113.

[302] T.H. Davenport and L. Prusak (1998). *Working Knowledge. How Organizations Manage what they Know*, Harvard Business Press, Boston, p. 5.

[303] Davenport and Prusak (1998), p. 5, p. 24. See: M.J. Bates (2005). 'Information and knowledge. An evolutionary framework for information science,' *Information Research*, Vol. 10, No. 4, paper 239. Online source, retrieved 1 November 2024, from: http://InformationR.net/ir/10-4/paper239.html, especially for the definitions of knowledge.

[304] J. Sifakis (2022). *Understanding and Changing the World. From Information to Knowledge and Intelligence*, Springer Nature, Singapore, pp. 18–21. Sifakis integrates ma-

provision of a strategy, processes, and technology to enhance learning processes in organizations. [305] Organizational success is contingent upon the effective management of its 'knowledge assets,' which are defined as sources of knowledge that are relevant to the organization's strategy and operations. In their analysis, Ronald Freeze and Uday Kulkarni identify five categories of knowledge assets: expertise, lessons learned, documents, data, and policies and procedures. Expertise and lessons learned should be explicitly shared by senior employees with juniors during learning processes. Using documents and data as a source of knowledge requires information access. Using policies and procedures as a source of knowledge, requires to both learning the actual procedure and to have access to the codified one, due to the differences between the implicit reality and its explicit codification. There is frequently a substantial discrepancy between the manner in which a task is depicted in a process manual and its actual execution. [306] There is also a discrepancy between what individuals believe they do and what they actually do. [307] In all forms of knowledge, power is acquired, at least in part, by obtaining access to information and by withholding it from others. Knowledge is closely linked to organizational power. [308]

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chine learning and artificial intelligence in the definition of knowledge (pp. 65–87).

[305] A. Satyadas, U. Harigopal, and N.P. Cassaigne (2001). 'Knowledge management tutorial. An editorial overview,' *IEEE Transactions on Systems, Man and Cybernetics. Part C. Applications and Reviews*, Vol. 31, No. 4, pp. 429–437.

[306] R.D. Freeze and U. Kulkarni (2007). 'Knowledge management capability. Defining knowledge assets,' *Journal of Knowledge Management*, Vol. 11, No. 6, pp. 94–109.

[307] J. Seely Brown and P. Duguid (2000). 'Balancing act. How to capture knowledge without killing it,' *Harvard Business Review*, Vol. 78 No. 3, pp. 73–80, p. 75.

[308] W. Pan and Q. Zhang (2018). 'Withholding knowledge in teams. An interactionist perspective of personality, justice, and autonomy,' *Social Behavior and Personality. An International Journal*, Vol. 46, No. 12, 2009–2024.

Information management research covers a range of interdisciplinary subjects, from organizational science to information science and informatics. Most of these approaches assume access to and accessibility of information. In 2004, Goddard and colleagues concluded that progress had been made in realizing their four requirements for information access, but that a lot of work was still to be done. [309] This statement remains true in 2024, twenty years later.

Archival science research

Archival science is concerned with the management and organization of archives, as well as access to and accessibility of archival information. I will focus on the latter aspect.

Big data is not a new concept. Heritage institutions manage enormous amounts of historical information, including thousands of miles of parchment, vellum, and paper documents, and billions of pieces of information on microfilm. However, this represents only a fraction of the information that existed in the past. Unfortunately, much information has been lost, by fire, water, war, or other catastrophes, by willful destruction, by negligent behaviour, and by deterioration. Digitization efforts have transformed some historical information into digital substitutes. As mentioned before, our hybrid world generates vast amounts of digital-born information, some of which will be considered significant enough to be preserved indefinitely. This information is largely available to the public and must be easily accessible.

Access is crucial in archival science research as it enables the use of archival information, information that has been selected for permanent or long-term preservation due to its historical, cultural, or evidentiary value. Archival institutions are responsible for making this information accessible to promote a free society, the right to know, and freedom of

[309] Goddard, et al (2004), p. 113.

expression. These institutions are considered 'active agents of political accountability, social memory, and national identity.' [310] Identifying and accessing archival information is typically achieved through published guides, finding aids, indexes, lists, and catalogues. [311] Descriptions are crucial tools for gaining access to archives, and archival researchers have played a significant role in developing standards of description, such as EAD, ISAD(G), and Records in Contexts. These standards offer options for presenting and arranging archival information on the web to provide a way for researchers to find, present, and contextualize this information. [312] In a digitalized world, users need to be presented with

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[310] T. Cook (2002). 'A monumental blunder. The destruction of records on Nazi war criminals in Canada,' R.J. Cox and D.A. Wallace (eds.), *Archives and the Public Good*, Quorum Books, Westport, pp. 37–65. Quotation: p. 38. Also: M. Čtvrtník (2023). *Archives and Records. Privacy, Personality Rights, and Access*, Palgrave MacMillan, Cham, p. 2.

[311] P. Bobič (2019). 'Access to archives, access to knowledge,' *Atlanti. International Review for Modern Archival Theory and Practice*, Vol. 29, No. 2, pp. 30–37, p. 32.

[312] A. Menne-Haritz (2001). 'Access. The reformulation of an archival paradigm,' *Archival Science*, Vol. 1, pp. 57–82; R.C. Jimerson (2002). 'Archival description and finding aids,' *OCLC Systems & Services. International Digital Library Perspectives*, Vol. 18, No. 3, pp. 125–129; L. Freund and E.G. Toms (2015). 'Interacting with archival finding aids,' *Journal of the Association for Information Science and Technology*, Vol. 67, No. 4, pp. 994–1008; G. Wiedeman (2019). 'The historical hazards of finding aids,' *The American Archivist*, Vol. 82, No. 2, pp. 381–420. About EAD: D.V. Pitti and M. Rush (2017). 'Encoded Archival Description,' J.D. McDonald and M. Levine-Clark (eds.), *Encyclopedia of Library and Information Sciences*, CRC Press, Boca Raton, fourth edition, pp. 1423–1432. For ISAD (G): International Council of Archives (2011). *ISAD(G). General International Standard Archival Description*, Ottawa, second edition. For Records in Contexts: D. Llanes Padrón and J.A. Pastor Sánchez (2017). 'Records in Contexts. The road of archives to semantic interoperability,' *Program. Electronic Library and Information Systems*, Vol. 51, No. 4, pp. 387–405.

meaningful archival information, rendered on chosen technology, and possessing the quality to be reliable and trustworthy. [313] In addition to arrangement, description, indexing and finding aids, access research is focusing on embedding processes of digital preservation and information retrieval, enhanced by artificial intelligence.

There are several definitions of digital preservation. It can be defined as the 'policies, strategies and actions to ensure the accurate rendering of authenticated content over time, regardless of the challenges of media failure and technological change,' but also as 'the series of managed activities necessary to ensure continued access to digital materials for as long as necessary … beyond the limits of media failure or technological and organisational change.' [314] The definitions emphasize two distinct research directions within the field of preservation. The first is a goal-oriented approach, which considers aspects of digital preservation beyond the file level, such as workflow, capacity, and access to information. The second is an operational approach, which involves 'fetishising files' to enhance the accessibility of information. [315] This highlights the distinction between *access to* information and *accessibility of* information.

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[313] J. Evans, S. McKemmish, and B. Reed (2017). 'Archival arrangement and description,' J.D. McDonald and M. Levine-Clark (eds.), *Encyclopedia of Library and Information Sciences*, Vol. I, CRC Press, Boca Raton, fourth edition, pp. 115–126.

[314] ALCTS Preservation and Reformatting Section (2007). *Definitions of Digital Preservation*, Chicago, American Library Association. Online source, retrieved 1 November 2024, from: https://www.ala.org/alcts/resources/preserv/defdigpres0408. Archived at: https://archive.is/bUJqs; Digital Preservation Coalition (2015), *Digital Preservation Handbook*, second edition. Online source, retrieved 1 November 2024, from: https://www.dpconline.org/handbook/glossary. Archived at: https://archive.is/RK3Av.

[315] W. Kilbride (2016). 'Saving the bits. Digital Humanities Forever?,' S. Schreibman, R. Siemens, and J. Unsworth (eds.), *A New Companion to Digital Humanities*, Wiley Blackwell, Chichester, pp. 408–419, p. 415.

The Open Archival Information Systems (OAIS) reference model, which deals with the management of information in archival repositories, emphasizes the significance of submission and dissemination activities as crucial preservation concepts. [316] The model is essential in the development of audit processes for 'trustworthy digital repositories.' [317] A repository audit is a process that assesses the OAIS compliance and capability to address potential preservation hazards. In order to remain operational, it is necessary to possess both technical proficiency and sufficient resources. [318] Trevor Owens posits that while all models are wrong, some are more useful than others. He asserts that the utility of frameworks as tools is contingent upon their ability to facilitate the intended work. [319] Adding to these remarks, Devan Donaldson posits that

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[316] Consultative Committee for Space Data Systems (2012). *Reference Model for an Open Archival Information System (OAIS). Recommended Practice*, CCSDS 650.0-M-2, Magenta Book, NASA, Washington. Online source, retrieved 1 November 2024, from: https://public.ccsds.org/pubs/650x0m2.pdf. Archived at: https://web.archive.org/web/20230204213302/https://public.ccsds.org/pubs/650x0m2.pdf. See: *ISO 16363: 2012. Space data and information transfer systems — Audit and certification of trustworthy digital repositories*, ISO, Geneve.

[317] N. McGovern (2016). 'Current status of trustworthy systems,' P.C. Bantin (ed.), *Building Trustworthy Digital Repositories. Theory and Implementation*, Rowman and Littlefield, Lanham, pp. 325–335; and The Consultative Committee for Space Data Systems (2011). *Audit and Certification of Trustworthy Digital Repositories. Recommended Practice. CCSDS 652.0-M-1*, Magenta Book, CCSDS, NASA, Washington. Online source, retrieved November 1, 2024, from: https://public.ccsds.org/pubs/652x0m1.pdf. Archived at: https://web.archive.org/web/20231216082743/https://public.ccsds.org/pubs/652x0m1.pdf.

[318] J. Nadal (2017). 'Digital preservation,' J.D. McDonald and M. Levine-Clark (eds.), *Encyclopedia of Library and Information Sciences*, Vol. II, CRC Press, Boca Raton, fourth edition, pp. 1332–1337, p. 1333.

[319] T.J. Owens (2018). *The Theory and Craft of Digital Preservation*, John Hopkins University Press, Baltimore, p. 80.

the preservation of information is possible without adherence to best practices and standards. The efficacy of certified repositories in preserving information remains unproven. [320]

In 2017, Robert Spindler made clear that 'thirty years of work in acquiring and retaining electronic content has not resulted in complete solutions for electronic record preservation.' In those thirty years several challenges emerged. Seven key challenges can be identified: [1] physical degradation; [2] physical obsolescence; [3] incompatibility/non-interoperability of storage media; [4] software or encoding incompatibility or non-interoperability; [5] human error/vandalism; [6] backups and snapshots; and [7] insufficient metadata to reconstruct context. [321] Another outcome of 'thirty years of work' is the development of technical methods to ensure that archival information can be presented in meaningful ways, guaranteeing future access and accessibility. Four methods have become prevalent: [1] bit preservation; [2] emulation; [3] migration, and [4] forensics, conservation, and retrocomputing. These methods can be used to ensure the integrity and accessibility of information over time. Bit preservation involves maintaining integrity by using multiple copies, periodic copying to other storage media, and algorithms to compute fixity, like checksums. Emulation creates a virtual computing system that allows for executing code from an older, less powerful platform. Migra-

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[320] D.R. Donaldson (2020). 'Certification information on trustworthy digital repository websites. A content analysis,' *PLoS ONE* 15(12), article e0242525. Online source, retrieved November 1, 2024, from: https://doi.org/10.1371/journal. pone.0242525.

[321] R.P. Spindler (2017). 'Electronic records preservation,' J.D. McDonald and M. Levine-Clark (eds.), *Encyclopedia of Library and Information Sciences*, Vol. II, CRC Press, Boca Raton, fourth edition, pp. 1413–1418, pp. 1415–1416. On pp. 1413–1415, Spindler presents an overview of the history of digital preservation. Also: F. Boudrez, H. Dekeyser, and J. Dumortier (2005). *Digital Archiving. The New Challenge*, IRIS, Mont Saint Guibert, pp. 75–126.

tion involves converting information from one format or encoding to another. Forensics, conservation, and retrocomputing are disciplines that involve the maintenance or rebuilding of original system hardware and operating software in order to facilitate access and accessibility of information through the use of original software. [322] It is likely that only a combination of these methods will be successful in enabling access and improving accessibility of information, possibly until obsolescence itself is considered obsolete. [323]

The occurrence of human error or vandalism is identified as a major challenge. Nevertheless, the overreliance on technological solutions often overlooks the influence of organizational and human behaviour. It can be argued that the majority of instances of digital preservation issues originate from the actions of individuals or organizations, rather than technological failures. Accessibility can be extremely short-lived if not managed effectively. [324]

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[322] Nadal (2017), p. 1333. Bit preservation: D.S.H. Rosenthal (2010). 'Bit preservation. A solved problem?,' *International Journal of Digital Curation*, Vol. 5, No. 1, pp. 134–148. Emulation: J. Rothenberg (1999). *Avoiding Technological Quicksand. Finding a Viable Technical Foundation for Digital Preservation*, Council on Library and Information Resources, Washington, and L.T. Nguyen and A. Kay (2015). 'The cuneiform tablets of 2015,' *ACM International Symposium on New Ideas, New Paradigms, and Reflections on Programming and Software*, Association for Computing Machinery, New York, pp. 297–307. Retrocomputing: Y. Takhteyev and Q. DuPont (2013). 'Retrocomputing as preservation and remix,' *Library Hi Tech*, Vol. 31, No. 2, pp. 355–370. Forensics: L. Duranti and B. Endicott-Popovsky (2010). 'Digital Records Forensics. A new science and academic program for forensic readiness,' *Journal for Digital Forensics, Security and Law*, Vol. 5, pp. 45–62.

[323] Kilbride (2016), p. 416.

[324] In addition to the literature mentioned on pp. 18–23. M. Tibbets (2008). 'BBC Domesday Project,' *The Risks Digest. Forum on Risks to the Public in Computers and Related Systems*, Vol. 25, no. 44. Online source, retrieved 1 November 2024, from: http://catless.ncl.ac.uk/Risks/25.44.html%20#subj7. Archived at:

Another focus of archival research is the potential of artificial intelligence to enhance the understanding of the content of archival information. Artificial intelligence research is multidisciplinary, drawing on mathematics, logic, computer science, information theory, philosophy, cognitive science, and linguistics to develop new approaches. The aim of the field is the understanding of the nature of intelligence and the application of this knowledge to the construction of 'smart,' intelligent information (retrieval) systems. [325] Archival science has a strong affiliation with information retrieval research and employs intelligent information (retrieval) systems (e.g. augmented by artificial intelligence). By concentrating on the content, users are able to collect, study, and use

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https://archive.is/yNlm; M.D. Martin, C.L. Stanley, and G. Laughlin (1985). *Planetary Image Conversion Task. Final Report*, JPL Publication 85-50, California Institute of Technology, Pasadena. Online source, retrieved 1 November 2024, from: https://ntrs.nasa.gov/citations/19860009796. Archived at: https://archive.org/details/NASA_NTRS_Archive_19860009796/page/n9/mode/2up; United States General Accounting Office (1990). *Space Operations. NASA is not properly safeguarding valuable data from past missions*, GAO, Washington. Online source, retrieved 1 November 2024, from: https://www.gao.gov/assets/imtec-90-1.pdf. Archived at: https://web.archive.org/web/20170609155716/http://www.gao.gov/assets/150/148725.pdf; and D.S. Rosenthal, T.S. Robertson, T. Lipkis, V. Reich, and S. Morabito (2005). 'Requirements for digital preservation systems. A bottom-up approach,' *arXiv preprint*. Online source, retrieved November 1, 2023, from: https://arxiv.org/pdf/cs/0509018.pdf.

[325] J. Chen (2017). 'Artificial intelligence,' J.D. McDonald and M. Levine-Clark (eds.), *Encyclopedia of Library and Information Sciences*, Vol. II, CRC Press, Boca Raton, fourth edition, pp. 269–278. Also: G.F. Luger (2008). *Artificial Intelligence. Structures and Strategies for Complex Problem Solving*, Addison Wesley, New York, sixth edition. For a historical overview: B.G. Buchanan (2005). 'A (very) brief history of artificial intelligence,' *AI Magazine*, Vol. 26, No. 4, pp. 53–60. Also: Chen (2017), pp. 269–270, Luger (2009), pp. 3–34, and Aradau, and Blanke (2022), Chapter 1, pp. 21–41.

larger quantities of archival information than would otherwise be possible. [326]

The use of intelligent information (retrieval) systems begins with the automatic extraction of the content of archival information and its indexing. Natural language processing and text mining techniques rely on optical character recognition and use algorithms for semantic mapping, information extraction, and human language understanding. The aim is to uncover implicit, unknown, hidden, or obfuscated contextual information to enhance indexes of source texts and improve retrieval. [327] For example, tools such as Transkribus integrate image and text recognition to extract the content of archival information, enabling more effective searches. [328] Natural language processing, also known as 'distant reading' in the digital humanities, analyses information using text mining technologies. This involves vectorizing the text and transforming it into sets of numeric values that can be used to train topic models. These models allow users to identify themes and hidden patterns in large collections of text, which can be used to enhance semantic indexation and improve thesauri and ontologies. [329] All these techniques support search and re-

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[326] G. Colavizza, T. Blanke, C. Jeurgens, and J. Noordegraaf (2021). 'Archives and AI. An overview of current debates and future perspectives,' *ACM Journal on Computing and Cultural Heritage*, Vol. 15, No. 1, pp. 1–15.

[327] I.D. Dinov (2018). 'Qualitative learning methods. Text mining, natural language processing, and apriori association rules learning,' I.D. Dinov, *Data Science and Predictive Analytics. Biomedical and Health Applications using R*, The Springer Series in Applied Machine Learning, Springer Nature, Cham, Chapter 20, pp. 385–437.

[328] G. Muehlberger, L. Seaward, M. Terras, S. Ares Oliveira, V. Bosch, c.s. (2019). 'Transforming scholarship in the archives through handwritten text recognition. Transkribus as a case study,' *Journal of Documentation*, Vol. 75, No. 5, pp. 954–976.

[329] R. Sandhiya, A.M. Boopika, M. Akshatha, S.V. Swetha, N.M. Hariharan (2022). 'A review of topic modeling and its application,' M. Singh Manshahia,

trieval, including automatic classification, information visualization, template matching, automatic summarizing or describing, and sentiment analysis. [330]

V. Kharchenko, E. Munapo, J. Joshua Thomas, and P. Vasant (eds.), *Handbook of Intelligent Computing and Optimization for Sustainable Development*, Chapter 15, pp. 305–322; S. Hengchen, M. Coeckelbergs, S. van Hooland, R. Verborgh, and T. Steiner (2016). 'Exploring archives with probabilistic models. Topic modelling for the valorisation of digitised archives of the European Commission,' *2016 IEEE International Conference on Big Data (Big Data),* IEEE, Washington, pp. 3245–3249; M. Coeckelbergs and S. van Hooland (2020). 'Concepts in topics. Using word embeddings to leverage the outcomes of topic modeling for the exploration of digitized archival collections,' R. Mugnaini (ed.), *Proceedings of the First EAI International Conference Data and Information in Online Environments (DIONE 2020), Florianópolis, Brazil, March 19–20*, Springer Nature, Champ, pp. 41–52.

[330] Automatic classification: A. Chaudhary, S. Kolhe, and R. Kamal (2013). 'Machine learning classification techniques. A comparative study,' *International Journal on Advanced Computer Theory and Engineering*, Vol. 2, No. 4, pp. 21–25. Information visualization: U. Hinrichs, B. Alex, J. Clifford, A. Watson, A. Quigley, E. Klein, and C.M. Coates (2015). 'Trading consequences. A case study of combining text mining and visualization to facilitate document exploration,' *Digital Scholarship in the Humanities*, Vol. 30, supplement 1, pp. 50–75. Template matching: N.S. Hashemi, R.B. Aghdam, A.S.B. Ghiasi, and P. Fatemi (2016). 'Template matching advances and applications in image analysis,' *arXiv preprint*. Online source, retrieved 1 November 2024, from: https://arxiv.org/pdf/1610.07231.pdf. Automatic summaries: Á. Criado-Alonso, D. Aleja, M. Romance, R. Criado (2023). 'A new insight into linguistic pattern analysis based on multilayer hypergraphs for the automatic extraction of text summaries,' *Mathematical Methods in the Applied Sciences*. Online source, retrieved 1 November 2024, from: https://onlinelibrary.wiley.com/doi/full/10.1002/mma.9201. Automatic descriptions: M. Bell (2020). 'From tree to network. Reordering an archival catalogue,' *Records Management Journal*, Vol. 30, No. 3, pp. 379–394. Sentiment analysis: M. Birjali, M. Kasri, and A. Beni-Hssane (2021). 'A comprehensive survey

Intelligent information (retrieval) systems have the potential to be useful tools for accessing archives, whether they are born-digital or not. However, dealing with the complexity of languages, including ambiguity and sentiment, presents challenges. Jane Winters and Andrew Prescott highlight the importance of information hierarchy and context to avoid overlooking gaps within information. [331] Jo Guldi emphasizes the need to evaluate the tools used, reading, and engaging in critical reflection. A single tool or algorithm cannot provide definitive answers. [332] As Daniel Shore illustrates, using different algorithms can result in different perspectives of the past, 'transcending the past rather than seeking to describe it.' It is about 'liberating visions of possibility' rather than reconstructing the past. [333] Erik Larson explains that artificial intelligence primarily uses inductive reasoning to predict outcomes based on information. In contrast, human intelligence relies largely on intuition, which is a network of best guesses based on personal experience and knowledge of the world. It is not currently possible to program intuitive reasoning into artificial intelligence, and it may never be. Larson argues that while artificial intelligence will continue to improve at narrow, inductive tasks such as natural language processing, it will fail at intuitive reasoning. [334]

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on sentiment analysis. Approaches, challenges and trends,' *Knowledge-Based Systems*, Vol. 226, No. 107134. Online source, retrieved November 1, 2023, from: https://doi.org/10.1016/j.knosys.2021.107134.

[331] J. Winters and A. Prescott (2019). 'Negotiating the born-digital. A problem of search,' *Archives & Manuscripts*, Vol. 47, No. 3, pp. 391–403.

[332] J. Guldi (2018). 'Critical search. A procedure for guided reading in large-scale textual corpora,' *Journal of Cultural Analytics*, Vol. 3, No. 1. Online source, retrieved 1 November 2024, from: https://doi.org/10.22148/16.030.

[333] D. Shore (2018). *Cyberformalism. Histories of Linguistic Forms in the Digital Archive*, John Hopkins University Press, Baltimore. Quotations: p. 184.

[334] E.J. Larson (2021). *The Myth of Artificial Intelligence. Why Computers Can't Think the Way We Do*, The Belknap Press of Harvard University Press, Cambridge-London, pp. 157–190.

Most of the research mentioned previously is based on analysis of large corpora of born-digital or digitized archival information using *recent* optical character recognition software. Algorithmic analysis yields satisfactory results in that situation. However, information digitized ten to twenty years ago and indexed with optical character recognition software at that time is troublesome. Jørgen Burchardt's research of newspaper archives, for instance, revealed an average error rate of 18% in body text, with a significantly higher rate for text in advertisements. [335] The utilization of algorithmic spelling correction to combat the phenomenon of 'noise' can assist in the reduction of errors; however, it is not a definitive solution. A sample of one hundred documents (209,686 words) showed that 70% (145,718 words) were correct, 6% (12,946 words) required suggestions for acceptable replacements, and 24% (51,022 words) were impossible to correct. [336] These errors can be reduced through re-digitization, improved character recognition software, and new search algorithms, but this is a costly endeavour. Offline handwritten character recognition is particularly challenging due to paleographic variations in writing styles, which are essentially personal and subject to the slightest changes. [337] The accuracy of character recognition is heavily dependent

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[335] J. Burchardt (2023). 'Are searches in OCR-generated archives trustworthy? An analysis of digital newspaper archives,' *Jahrbuch für Wirtschaftsgeschichte/Economic History Yearbook*, Vol. 64, No. 1, pp. 31–54.

[336] A.J. Torget (2023). 'Mapping texts. Examining the effects of OCR noise on historical newspaper collections,' E. Bunout, M. Ehrmann, and F. Clavert (eds.), *Digitised Newspapers. A New Eldorado for Historians? Reflections on Tools, Methods and Epistemology*, De Gruyter, Oldenbourg, pp. 47–66.

[337] Offline: 'the process of translating offline handwritten word into a format that is understood by (a) machine.' Online: 'one writes on an electronic surface such as an electronic tablet with a special pen and words or characters are recognized at real time as soon as it is written.' S. Singh (2018). *A Framework for Offline Handwritten Devanagari Word Recognition. A research proposal*, p. 2. Online source. Archived at: https://perma.cc/HFB9-DKJN.

on the quality of input images. [338] Errors can occur due to blurring, uneven illumination, complex backgrounds, skewness, low resolution, multilingual content, scene complexity, perspective distortion, and variations in text layout or fonts. [339] According to Transkribus, an intelligent information (retrieval) platform for text recognition, transcription, and searching of historical documents, a character error rate of 20% to 30% is normal when applied to text not present in training datasets or scribble notes. With training, an error rate of 10% or lower can be considered very efficient for automated transcription. [340] Close reading will still be necessary due to errors, interpretation of results based on context, and possible bias of algorithmic models. [341]

Archival science research primarily concerns the access to and the accessibility of information. It is similar to information quality research in its focus on information, specifically in terms of its access and accessibility. Despite its relevance to all research domains discussed, archival research is often neglected. Digital preservation research has shown that the assumption that access implies accessibility is incorrect. When infor-

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[338] R. Sarkhel, N. Das, A. Das, M. Kundu, and M. Nasipuri (2017). 'A multi-scale deep quad tree based feature extraction method for the recognition of isolated handwritten characters of popular Indic scripts,' *Pattern Recognition*, Vol. 71, 78–93.

[339] Q. Ye and D. Doermann (2015). 'Text detection and recognition in imagery. A survey,' *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. 37, No. 7, 1480–1500, p. 1483; J. Liang, D. DeMenthon, and D. Doermann (2008). 'Geometric rectification of camera-captured document images,' *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. 30, No. 4, pp. 591–605.

[340] Transkribus Help Center (2023). 'Character error rate and learning curve.' Online source, retrieved 1 November 2024, from: https://help.transkribus.org/character-error-rate-and-learning-curve. Archived at: https://archive.li/Z9G5z.

[341] U. Fritsche and M. Spoerer (2023). 'Introduction: digital history,' *Jahrbuch für Wirtschaftsgeschichte / Economic History Yearbook*, Vol. 64, No. 1, pp. 1–7, p. 4.

mation management practices do not acknowledge the human element in maintaining the safety and accessibility of information, its survival becomes uncertain. Additionally, the use of intelligent information retrieval systems to support transcriptions of previously digitized information is problematic. Although the artificial intelligence used in these systems is a fast developing technology, it, at this moment, only *complements* existing tools, methods, and practices. For trustworthy results close reading is still necessary.

EVALUATION

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Positioning this diverse and complex body of research is challenging due to its varying philosophical and professional backgrounds and research traditions. The research is comprised of isolated fields that often do not communicate with each other. In 1999 and 2001, Maureen McCreadie, Ronald Rice, and Shan-Ju Chang analysed studies in library science, information science, information society, mass communication, organizational communication, and the economics of information to generate six general conceptualizations of access: knowledge, technology and media, communication, control, goods/commodities, and rights (participation). [342]

Based on my analysis, I recognize six approaches that, more or less, mirror these conceptualizations. The following six themes will be discussed: [1] social, economic, and political participation; [2] 'smart' and

[342] M. McCreadie and R.E. Rice (1999). 'Trends in analyzing access to information. Part I. Cross-disciplinary conceptualizations of access. Part II. Unique and integrating conceptualizations,' *Information Processing & Management*, Vol. 35, No. 1, pp. 45–76, pp. 77–99; and R.E. Rice, M. McCreadie, and S.L. Chang (2001). *Accessing and Browsing Information and Communication*, MIT Press, Cambridge (Ms.), Chapter 3, pp. 41–83.

evolving technology; [3] power and control; [4] sense-making; [5] knowledge representations; and [6] information survival. The 'participation' approach [1] is prevalent in research on access disparities (including digital divide research.) Information access and accessibility are considered essential for participation in social, economic, and political processes, both in society and in organizations. In order to be involved in decision-making processes and to exercise their rights, citizens and employees must be informed. Access to information (technology) is necessary and the information provided must be accessible. Without access and accessibility, political, social, and economic systems, including organizations, favour those in power, resulting in inequality and power disparities. Limited access and accessibility make it difficult to sustain social environments, and individuals attempting to access information may behave contrary to expectations in an effort to 'beat the system.'

'Smart and evolving technology' [2] is an approach followed in all discussed research areas. It is commonly believed that technology enhances access and accessibility, and access also means (cognitive) interpretability. While artificial intelligence and machine learning are seen as a solution to many problems, they are not a panacea in their current state. Archival science research acknowledges that technology can enhance access and accessibility, but also highlights that they can be negatively impacted by technology. This is due to the risk of technology becoming obsolete and the challenge of interpretability, which still requires 'close reading.' Information quality research distinguishes between availability (access to) and interpretability (accessibility of) when defining information quality characteristics, seemingly without assuming that the realization of one automatically leads to the other. Information retrieval research utilizes technology such as artificial intelligence and machine learning to access and enhance the accessibility of information. However, it does not discuss the concepts themselves. Research on access disparity and information seeking emphasizes the need for lifelong learn-

ing of new technological systems, to navigate, evaluate, create, and comprehend information effectively and critically. Despite the emergence of interest in the environmental implications of 'smart and evolving technology' (as descibed in the previous chapter), it has yet to emerge as a research topic within the disciplines considered here.

The concept of information access as a source of power to control participation and/or information [3] is prevalent in research on information disparity, information management, and information security. In organizational contexts, access control is crucial for safeguarding information against both external and internal threats, as well as for highlighting power dynamics within organizations and society as a whole.

The fourth approach involves access to sense-making [4], which involves moving through time and space to make sense of an individual's world, including the (cognitive) interpretability of information. However, this approach only applies when sense-making is relevant to the individual seeking and/or using information. It acknowledges that access and accessibility may differ, but generally endorses the assumption that 'access to' also means 'accessibility of.' This approach is prominent in information seeking and information management research.

The approach of 'knowledge representations' (5) emphasizes the artefacts or representations of existing knowledge, such as documents, records, nodes, datasets, or other data objects. These artefacts are viewed as building blocks for potential new knowledge. However, it is a common and incorrect assumption that when an artefact is available, the knowledge contained therein is accessible. Artefacts and knowledge do not have an unbreakable relationship. Their environment, creators, and users can affect these artefacts. According to researchers like John Athanassiades, Charles O'Reilly, and Benjamin Singer, access and accessibility to information can be affected by the deliberate manipulation of artefacts and the knowledge they contain. Ronald Rice and Stephen Cooper confirmed that the logistics, access, quality and context of artefacts

and knowledge can be manipulated by individuals for various reasons, including the desire for power. [343] This approach is strong in both information management and information retrieval research.

The approach of 'information survival' [6] is only discussed in research related to archival science. Access to and accessibility of information are viewed as continuously threatened by the vast amount of information that must be retained for future generations and by technological obsolescence. The latter has only recently been accepted due to evolving technology, where generations of hardware and software succeed each other, and older generations become unusable due to code and format incompatibility. Digital preservation research aims to find solutions for this problem, although a definitive solution has not yet been found. Archival practices and research have developed tools for gaining access to information, which are similar to those developed in information retrieval research. These tools consider the special position of archives as a reflection of organizational actions and transactions in the past and present.

[343] Van Bussel (2020), pp. 63–64. J.C. Athanassiades (1973). 'The distortion of upward communication in hierarchical organizations,' *The Academy of Management Journal*, Vol. 16, No. 2, pp. 207–226; C.A. O'Reilly (1978). 'The intentional distortion of information in organizational communication. A laboratory and field investigation,' *Human Relations*, Vol. 31, No. 2, pp. 173–193; B.D. Singer (1980). 'Crazy systems and Kafka circuits,' *Social Policy*, Vol. 11, No. 2, pp. 46–54; and R.E. Rice and S.D. Cooper (2010). *Organizations and Unusual Routines. A Systems Analysis of Dysfunctional Feedback Processes*, Cambridge University Press, Cambridge, Ch. 1, pp. 1–20.

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BOTTLENECKS AND REQUIREMENTS FOR INFORMATION ACCESS AND ACCESSIBILITY

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EIGHT BOTTLENECKS FOR ACCESS AND ACCESSIBILITY

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There are many obstacles to accessing information, in both senses of the term. Most of these were identified in the literature analysis presented earlier and are long-standing barriers that impede information access. Together, they constitute the 'digital divides.' Eight different (overlapping) bottlenecks are identified, which are a mixture of many experienced obstacles, including political, social, economic, legal, infrastructural, educational, personal and organizational. Tabel 3 presents an overview of the literature for this analysis.

A political bottleneck

Politics and access to information have a complex relationship, reflecting an ongoing struggle between transparency and confidentiality. The opening of information to the public is often at odds with the need for confidentiality for various reasons. It is important to consider the context when discussing access to information, as it may be interpreted differently in different circumstances. [344] Information may be accessible in some social and political contexts but confidential in others, resulting in access restrictions in all situations. Although there may be many laws concerning freedom of information, access possibilities for citizens depend on political and bureaucratic contexts. There are always constraints in place that make it difficult to exercise legal rights for access. Politicians and bureaucrats may claim to support freedom of information, but they change their stance when transparency is not in their best interest.

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[344] Elaborating on N. Couldry (2012). *Media, Society, World. Social Theory and Digital Media Practice*, Polity, Cambridge, introduction.

Literature used for bottleneck analysis
I. Aguolu (1997). 'Accessibility of information. A myth for developing countries ?, *New Library World*, Vol. 98, No. 1, pp. 25–29.
F. Bregha (1992). 'Institutional barriers to environmental information,' *Environmental Monitoring and Assessment*, Vol. 20, pp. 191–200.
C-C. Chen and P. Hernon (1982). *Information Seeking. Assessing and Anticipating User Needs*, Neal-Schuman Publishers, New York.
M.D. Ekstrand, A. Das, R. Burke, and F. Diaz (2021). 'Fairness and discrimination in information access systems,' *arXiv preprint arXiv:2105. 05779*. Online source, retrieved 1 November 2024, from: https://doi.org/10.48550/arXiv.2105.05779.
A.N. Gibson and J.D. Martin III (2019). 'Re-situating information poverty. Information marginalization and parents of individuals with disabilities,' *Journal of the Association for Information Science & Technology*, Vol. 70, No. 5, pp. 476–487.
A.M. Gingras (2012). 'Access to information. An asset for democracy or ammunition for political conflict, or both?,' *Canadian Public Administration*, Vol. 55, No. 2, pp. 221–246.
D. Hanson-Baldauf (2013). *Exploring the Everyday Life Information Needs, Practices, and Challenges of Emerging Adults with Intellectual Disabilitie*s, University of North Carolina, Chapel Hill.
R.M. Harris and P. Dewdney (1994). *Barriers to Information. How Formal Help Systems Fail Battered Women*, Greenwood Press, Westport-London.
H. Julien and D. Michels (2004). 'Intra-individual information behaviour in daily life,' *Information Processing and Management*, Vol. 40, No. 3, pp. 547–562.
A. Kralisch and T. Mandl (2006). 'Barriers to information access across languages on the internet. Network and language effects,' *Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS'06)*, IEEE, Washington, Vol. 3, pp. 54b (1–10).
M.S. Martin (1994). 'Economic barriers to information access,' *The Bottom Line*, Vol. 7, No. 1, pp. 3–4.
R.F. McCloud, C.A. Okechukwu, G. Sorensen, and K. Viswanath (2016). 'Beyond access. Barriers to internet health information seeking among the urban poor,' *Journal of the American Medical Informatics Association*, Vol. 23, No. 6, pp. 1053–1059
T. Mendel (2011). *Amending Access to Information Legislation. Legal and Political Issues*, World Bank, Washington.

Table 3. Overview of literature used for bottleneck analysis.

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Literature used for bottleneck analysis
S.M. Oltmann (2015). 'Data, censorship, and politics. Analyzing the restricted flow of information in federal scientific policy development,' *Journal of the Association for Information Science and Technology*, Vol. 66, No. 1, pp. 144–161
S.M. Oltmann, E.J.M. Knox, and C. Peterson (2021). 'The significance of access to information — and the challenges it faces in librarianship,' *Library Philosophy and Practice*. Online source, retrieved 1 November 2024, from: https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=9724&context=libphilprac.
M. Pasquier and J.P. Villeneuve (2007). 'Organizational barriers to transparency. A typology and analysis of organizational behaviour tending to prevent or restrict access to information,' *International Review of Administrative Sciences*, Vol. 73, No. 1, pp. 147–162.
M. Perkins (1996). 'Barriers to technical solutions. Institutional, policy and legal barriers to information access,' *Information Development*, Vol. 12, No. 3, pp. 149–154.
R.S. Rosenberg (2001). 'Controlling access to the Internet. The role of filtering,' *Ethics and Information Technology*, Vol. 3, pp. 35–54.
K.M. Thompson and W. Afzal (2011). 'A look at information access through physical, intellectual, and socio-cultural lenses,' *OMNES. The Journal of Multicultural Society*, Vol. 2, No. 2, pp. 22–42.
E.S. Warner, J. Murray, and V.E. Palmour (1973). *Information needs of urban residents,* Baltimore and Westat Inc. of Rockville.
M. Woodbury (2003). 'Information access,' A. Ralston, E.D. Reilly, and D. Hemmendinger (eds.), *Encyclopedia of Computer Science*, John, Chichester, pp. 848–850.
A.L.L. Zhao, A. Paley, R. Adler, H. Pack, S. Servantez, A. Einarsson, C. Barrie, M. Sterbentz, and K. Hammond (2021). 'Requirements for open political information. Transparency beyond open data,' *arXiv preprint arXiv:2112.03119*. Online source, retrieved 1 November 2024, from: https://doi.org/10.48550/arXiv.2112.03119.

Table 3. Overview of literature used for bottleneck analysis.

While citizens have the legal right to access information, the concentration of political power can result in the restriction of private use of information for many people. [345] Governments are often interested in

[345] M.L. Miller (2017). *A Political Ecology of Information. Media and the Dilemma of State Power in China*. A dissertation submitted to the Graduate Faculty in Political

implementing information control mechanisms for legal, bureaucratic, and/or security reasons, even if it means restricting the rights of citizens and potentially hindering their participation in society. These actions can have a significant impact on the objectivity and balance of information publicly available. In some cases, this can lead to censorship of the internet, as well as the dissemination of government and political propaganda and disinformation. [346] An example, to demonstrate how worrysome and even dangerous securitization of information could be. In step with rising tensions, China's leadership is working to restrict access to 'sensitive' online information from two angles: decreasing transparency of China's government and restrictions targeting foreign access. Authorities are reducing the amount of information they release to the public. The decline in transparency affects Chinese citizens and foreign observers equally. The government also implements regulatory and technical means to block access to potentially sensitive information from abroad. In the immediate future, foreign stakeholders will have to face global challenges with less information to guide them. [347]

Science in partial fulfillment of the requirements for the degree of Doctor of Philosophy, the City University of New York, New York, pp. 46–51. Online source, retrieved 1 November 2024, from: https://academicworks.cuny.edu/cgi/viewcontent.cgi?article=2956&context=gc_etds.

[346] S. Bradshaw, H. Bailey, and P.N. Howard (2021). *Industrialized Disinformation. 2020 Global Inventory of Organized Social Media Manipulation*. Oxford Internet Institute, Oxford. Online source, retrieved 1 November 2024, from: https://demtech.oii.ox.ac.uk/wp-content/uploads/sites/12/2021/01/CyberTroop-Report20-FINALv.3.pdf.

[347] V. Brussee and K. von Carnap (2024).*The Increasing Challenge of Obtaining Information from Xi's China*, Merics Report, Berlin, p. 3. Online source, retrieved 1 November 2024, from: https://merics.org/sites/default/files/2024-02/MERICS%20Report%20Online%20information%20on%20CHina.pdf. Archived at:

Michael Miller argues that a national information environment consists of two overlapping contexts: a social context, which reflects the economic and social constraints that shape information access and use, and a political context, which reflects the objectives and capacities of the state and shapes the autonomy of citizens and businesses that access information. [348] The social context refers, for example, to the power of business organizations to collect, control and use personal information about their customers for their activities, and whether they allow or prohibit customer access to this information. The political context determines the extent to which business organizations can exercise this power and the rights of citizens to access this information. Authoritarian forms of government have a strong political context with limited autonomy for organizations and citizens. When political and business elites overlap and share interests, as is common in all forms of government, it can have serious consequences for citizens' rights to access information. Such an alliance could provide economic benefits by controlling information access, which may lead to a reduction in government support for public information infrastructures and affect access opportunities. [349]

The rise of big data analysis, data mining, and smart technology has amplified this issue, strengthening the power of business and government organizations to collect, control, and use information, and restricting access to information that is deemed to conflict with the interests of the political and economic elite. The use of 'actionable intelligence' derived from algorithmic analysis of expanding data sets, regardless of the accuracy of the analysis, can enable the control of an individual's information access. Big data surveillance involves intervention based on pat-

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https://web.archive.org/web/20240215133718/https://merics.org/sites/default/files/2024-02/MERICS%20Report%20Online%20information%20on%20CHina.pdf.

[348] Miller (2017), pp. 48–49.

[349] See also: Ribot and Peluso (2003), pp. 76–78.

terns discernible only to those with access to the data and processing power. [350] The analysis of internet users' search behaviour can impact information access, often without the user's awareness. While restrictions are effective for most searchers, censorship may unintentionally prompt a small minority to take actions that result in information access. According to William Hobbs and Margaret Roberts' research on the use of prohibited social media in China, some citizens may adapt and create censorship circumventions. This may result in an increase in access to off-limits information among people motivated by the new censorship to seek out avenues for evasion. [351] However, most evasions are countered. The battle between transparency and confidentiality is a sign that censorship can be used as a political weapon. The political bottleneck is worrisome because it aggravates all other bottlenecks described here.

A social bottleneck

Within a social context, access to information is considered a resource for everyone. It is an opportunity to overcome social inequalities and divisions, empowering individuals, increasing social action and democratic involvement, and facilitating access to education and other public services. Access to information has the potential to reframe traditional power relationships through interactions of information sharing. Neil Selwyn argues that social and cultural attitudes suggest that access to information and information systems can improve the life chances of low-income groups. The social differences between information 'haves' and 'have-nots' are based on these attitudes. [352] As has been shown before,

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[350] M. Andrejevic and K. Gates (2014). 'Editorial. Big Data Surveillance. Introduction,' *Surveillance & Society*, Vol. 12, No. 2, pp. 185–196, p. 190.

[351] W.R. Hobbs and M.E. Roberts (2018). 'How sudden censorship can increase access to information,' *American Political Science Review*, Vol. 121, No. 3, pp. 1–16.

[352] N. Selwyn (2004). 'Reconsidering political and popular understandings of the digital divide,' *New Media & Society*, Vol. 6, No. 3, pp. 341–362.

research on information access disparity focuses on social inclusion and exclusion, information poverty, information marginalization, and other phenomena that cause or result from social inequalities. Access is patterned along social stratifications such as social status, income, gender, education level, age, geography, and ethnicity. Individuals' access to information can be influenced by a range of factors, including age, gender, and social background. It is important to consider how these factors may impact behaviour, attitudes, abilities, and financial means.

Differences between age, gender and ethnic groups exist for a variety of reasons, most of which are social. Those differences affect, for instance, the ways in which people of distinctive social backgrounds use information. Elfreda Chatman stated in her theory about 'small worlds' that these are 'social environments where individuals live and work, bonded together by shared interests, expectations, and information behaviour, and often economic status and geographic proximity.' [353] Chatman explained these social worlds with a theory of normative behaviour, which comprises four components: [1] social norms that dictate desirable behaviour; [2] a worldview that shapes values and determines what should be acknowledged or ignored; [3] social typification based on compliance to norms and worldview, and [4] information behaviour that involves sharing and understanding how and where information is accessed, exchanged, and avoided. This definition suggests that even a social stratum could be considered a small world.

In the 'hybrid amalgamation' we live in, the 'small world' theory can be applied to the virtual communities that have emerged with the rise of social networks and media platforms. These communities are, according

[353] According to: G. Burnett and P.T. Jaeger (2008). 'Small worlds, lifeworlds, and information. The ramifications of the information behaviour of social groups in public policy and the public sphere,' *Information Research*, Vol. 13, No. 2, paper 346. Online source, retrieved 1 November 2024, from: https://informationr.net/ir/13-2/paper346.html.

to Pierre Levy, 'guided by passions and projects, conflicts and friendships,' and can become distinct small worlds characterized by ideologies of groups or individuals. [354] In some communities, the avoidance of information that is not in line with the dominant ideology is a normative behaviour that can lead to the spread of misinformation. Such communities can become information bubbles, where individuals come across and access information that confirms the beliefs of the community.

Social differences can impact personal opportunities for learning, access to information systems, cultural involvement, and democratic participation. For example, a society that is male-oriented may limit women's educational opportunities and access to information. Additionally, group dynamics, social control, and economic factors can affect the ability of ethnic groups to overcome information disparities. Information access, as such, may have the possibility to overcome disparities, but, in the end, social barriers for information access are extremely difficult to solve (if ever.)

An economic bottleneck

Economic barriers can be influenced by political and social factors. Many economic barriers arise due to political actions or social disparities. In an economic context, the differences between private and public information are crucial in the debate about open and closed access.

Access to private information is often a component of commercial business models, either to recover the cost of obtaining the information or to protect it from misuse. In a traditional economy, these models worked relatively well. However, the dramatic rise in the use of the internet, social media platforms, webshops, and sharing platforms has presented challenges to these business models. A market system is assumed

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[354] P. Levy (1998). *Becoming virtual. Reality in a digital age*, New York, Plenum Trade, p. 29.

to rest on three pillars: [1] excludability: the degree to which a supplier, or a producer can prevent 'free' consumption of a good, their ability, thus, to force a consumer to pay for goods or services; [2] rivalry: the degree to which consumption by one consumer prevents simultaneous consumption by another one; and [3] transparency: the degree to which a consumer knows his or her desires and the products that can be bought to take advantage of competition. In a hybrid economy, these three assumptions are undermined, but not negated. However, in the traditional component of the economy, they still hold strong. [355]

A hybrid economy combines the traditional source of economic growth, which is the accumulation of physical capital, with a new source of growth — intellectual capital. This is achieved through the digitalized component of the economy, which utilizes big data, artificial intelligence, and deep learning. However, commercial efforts and intellectual property rights can create access tensions. [356] The traditional economy's scarcity of access is being replaced by an abundance of access, particularly for public information. Government and non-profit organizations, libraries, archives, and museums are digitizing and providing public access to their information. Despite being fragmented and difficult to locate, the internet has enabled access to this information to flourish. The internet presents a challenge to business models when it comes to private information. Digital goods can be easily reproduced without any loss of quality, leading to an increase in piracy. However, this also stimulates information access and knowledge sharing among consumers. Copyrighted digital products can be hacked and distributed using sharing

[355] J.B. DeLong and A.M. Froomkin (2000). 'Speculative microeconomics for tomorrow's economy,' B. Kahin and H. Varian (eds.), *Internet Publishing and Beyond. The Economics of Digital Information and Intellectual Property*, MIT Press, Cambridge, Chapter 1, pp. 6–44, p. 9–17.

[356] M.A. Peters, T. Besley, and P. Jandric (2018). 'Postdigital knowledge cultures and their politics,' *ECNU Review of Education*, Vol. 1, No. 2, 23–43, pp. 25, 29.

platforms, illegally making access easy and free. Producers try to protect their property by re-establishing excludability and rivalry through legal and technical measures. This includes implementing paywalls and limiting access to paying customers, as well as targeting popular online environments for accessing and sharing pirated materials. While paywalls can be effective, they do not completely prevent piracy. In March 2017, Sci-Hub contained almost all papers published in The Lancet, Science, Nature, and the Journal of the American Chemical Society, which were paywalled by their publishers. The platform seems to be successful in bypassing paywalls because it exists in a legal environment that does not shut it down, regardless of its legality. [357] The use of technology to prevent unauthorised distribution of digital products, such as through encryption or watermarks, is only a temporary solution as technology can also be used to remove these restrictions. This approach is expensive and unlikely to succeed in the long term.

Meanwhile, open access initiatives are challenging business models that rely on paid access or publishing. Producers may have changed their business models, but open access initiatives that offer publishing and access at low cost have caused increasing competetion. Nevertheless, most business organizations still continue to produce and make profits.

As previously explained, organizations collect, mine, and exploit data from internal and external sources, whether collected by themselves or purchased from other organizations. Business organizations use this information to personalize their advertising, contextualize user experience, and improve content. Digitization and big data analytics are opening up new opportunities to earn money but also leading to new challenges, such as privacy. Most of this information is not accessible to the public,

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[357] D.S. Himmelstein, A. Rodriguez Romero, J.G Levernier, T.A. Munro, S.R. McLaughlin, B.G. Tzovaras, and C.S Greene (2018). 'Research: Sci-Hub provides access to nearly all scholarly literature,' *eLife*, 7: e32822. Online source, retrieved 1 November 2024, from: https://doi.org/10.7554/eLife.32822.

although government organizations publish large datasets as open data. Business organizations keep this information private. When business and political elites overlap or share interests, government support for public information infrastructures may be reduced. This can limit and influence access to information that business organizations do not want to be accessible to the public. Economic interests can prove to be a minefield for information access.

A legal bottleneck

Legal principles can sometimes hinder the access and collection of information. Barriers to information collection can be direct or indirect, including self-imposed limits on the portability of information due to concerns about legal obligations related to collection activities. In many jurisdictions, barriers have been put in place to protect privacy and prevent discrimination. Legal barriers can also affect the ease of information access, particularly with regards to information ownership. [358] As information systems become more integrated into daily practice, legal problems become increasingly complex. In 1986, Richard Mason developed an information taxonomy from an ethical standpoint, identifying four key issues witch he denoted by the acronym PAPA: privacy, accuracy, property, and accessibility. These issues are also, in my opinion, among the most important legal issues of our time.

Privacy issues concern individuals' right to control their personal information, including who has access to it, how it is used, and how long it is kept. It is a legal requirement that information technology systems do not unduly invade a person's privacy by granting access to unauthorized individuals. *Accuracy* issues focus on the imperative of correctness and reliability of information within the legal system. This includes the

[358] D.L. Rubinfeld and M.S. Gal (2017). 'Access barriers to big data,' *Arizona Law Revues*, Vol. 59, No. 2, pp. 339–381, especially 359–362.

responsibility for maintaining accurate and reliable information, as well as accountability for errors in information technology and information processes. *Property* issues pertain to the ownership of information, the communication channels used, and the protection of intellectual property rights. It covers property rights in software, soft-lifting and the copying and sharing of digital art forms, films and music. *Accessibility* issues concern the legal principles of information access. Specifically, it explores what information a person or organization has the right to obtain, under what conditions and safeguards, and what specific information is (not) available to them. The legal imperative for system design is to ensure that people have access to the information needed to make informed decisions, participate in society, and exercise their rights. [359]

Laws and regulations have been established to both restrict and permit information access. Legal considerations are always a factor in information access and accessibility.

An infrastructural bottleneck

Information infrastructures refer to the various interrelated components that support the creation, use, transportation, storage, and disposal of information. [360] In 2010, Ole Hanseth defined information infrastruc-

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[359] R.O. Mason (1986). 'Four ethical issues of the information age,' *MIS Quarterly*, Vol. 10, No. 1, pp. 5–12. New isues have been proposed as additions to the framework based on big data developments, like behaviour, interpretation, and governance. See: J. Young, T.J. Smith, and S.H. Zheng (2020). 'Call me BIG PAPA. An extension of Mason's information ethics framework to big data,' *Journal of the Midwest Association for Information Systems*, Vol. 2020, No. 2, Article 3. Online source, retrieved 1 November 2024, from: https://aisel.aisnet.org/jmwais/vol2020/iss2/3.

[360] Z. Osinski (2019). 'Information infrastructure of contemporary humanities and the digital humanities development as a cause of creating new information barriers. A Polish case,' *Digital Scholarship in the Humanities*, Vol. 34, No. 2, pp. 386–400, p. 390. This definition is attributed to J.P. Pironti (2006). 'Key ele-

ture as 'a shared, evolving, heterogeneous installed base (which is also open and standardized.') [361] Existing infrastructures can have a positive or negative impact on how information is accessed.

An obstacle to accessing information may be the physical infrastructure. Individuals, particularly those with disabilities or special needs, may face difficulties when attempting to access information. It may need to be obtained from locations that are too far away, inaccessible, or require visual and manual skills to operate, especially when using information technology. Access depends on the design of the built environment, the organization of public transport, and the accessibility of buildings. For government offices, museums, libraries, or archives, it is important to provide features such as ramps for wheelchair users, widened doorways, wider parking spaces, handrails to assist disabled and elderly individuals with small steps, visual signs, clear passageways, and spoken instructions in lifts. [362] In cases where the buildings are inaccessible or geographically remote, access to information may be problematic.

Information technology infrastructures consist of three levels, each building on the one below it. The lowest level is the computing infrastructure, which includes hardware, software, databases, and telecommunications that provide functionality. The second level comprises services that enable the discovery and delivery of information, as well as

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ments of a threat and vulnerability management program,' *Information Systems Control Journal*, Vol. 3, pp. 52–56. I could not find this definition in this (and other) papers of Pironti related to information security and information risks although he mentions several of its elements.

[361] O. Hanseth (2010). 'From systems and tools to networks and infrastructures — from design to cultivation. Towards a design theory of information infrastructures,' J. Holmstrøm, M. Wiberg, and A. Lund (eds.), *Industrial Informatics Design, Use and Innovation*, IGI Global, Hershey, New York, Chapter 11, pp. 122–156. Quoation: p. 126.

[362] See European Standard: *DIN EN 17210. Accessibility and usability of the built environment – Functional requirements* (2021).

the processing of business transactions. The third level comprises products and structures, such as service delivery to consumers and supply chain organization. Each level presents its own challenges, as users must know how to use them to find, access, and utilize information. [363] Similar to buildings, information technology systems require features for potential users who are elderly, blind, deaf, or have mental and/or physical disabilities. When used by individuals with special needs, it should be possible to enhance colours, enlarge screens, have text read aloud by synthesised speech software, translate audio tracks into text as captions (and/or subtitles), and operate information systems through special keyboards or voice commands. Only through special human-computer interfaces can users with special needs access information on the internet, databases, document repositories, and networked organizational environments. As new or evolving information systems emerge, the number of potential special needs users grows.

McCreadie and Rice have shown that physical barriers such as geography, environment, technology, and space can restrict people's access to information, even for those without special needs. In human-computer interaction, information access should be inclusive of all people with different abilities, skills, needs, and preferences. [364] Note, however, that access to information technology does not necessarily mean access to information. Users of information infrastructures must be familiar with the core characteristics of the components, whether they are ana-

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[363] A. Dutta, (1997). 'The physical infrastructure for electronic commerce in developing nations. Historical trends and the impact of privatization,' *International Journal of Electronic Commerce*, Vol. 2, No. 1, pp. 61–83, pp. 61–62.

[364] McCreadie, and Rice (1999), pp. 61–63. For human-computer interaction: J. Grudin (2012). 'A moving target. The evolution of human-computer Interaction,' J.A. Jacko and A. Sears (eds.), *Human Computer Interaction Handbook. Fundamentals, Evolving Technologies, and Emerging Applications*, CRC Press, Boka Raton, third edition, introduction, pp. xxvii–lxi.

logue or digital, in the built environment or in computing systems. As shown before, a significant proportion of the global population lacks the necessary skills to utilize bibliographies, catalogues, and finding aids, as well as lacking transliteracy skills to access information in digital landscapes.

An educational bottleneck

Previously I discussed the dimensions of transliteracy knowledge, skills, and competences, needed for individuals to succeed in our hybrid, highly technological world, and for access to and accessibility of information. The conclusion drawn was that higher level skills are required to be functionally literate in a digitalized society. Findings from 2018 indicate that less than 10% of students were able to demonstrate the necessary skills, and in Western Europe, only 34% of the population had above basic literacy skills. These findings highlight that many people lack sufficient knowledge and skills to understand the information they access. Despite this evidence, the myth of the 'digital native' remains prevalent.

The neglect of transliteracy at all levels of the education system is the main reason for this concerning situation. This is mostly due to the assumption that young people, as 'digital natives,' possess the necessary literacy skills to find, use, and understand information. Therefore, schools often repeat what they assume students have already learned, without providing additional instruction. [365] Young people have not previously acquired knowledge, skills, and competences in information literacy. According to Danah Boyd (quoted on p. 53), this has resulted in a lack of support for young people. The education system prioritizes technology skills, such as software and hardware use, coding, and word

[365] H. Davies and R. Eynon (2018). 'Is digital upskilling the next generation our 'pipeline to prosperity'?,' *New Media & Society*, Vol. 20. No. 11, pp. 3961–3979.

processing, while neglecting transliteracy skills. According to Rebecca Enyon, the emphasis on young people's use of technology is often accompanied by an uncritical and deterministic view of technology as an exciting driver of the future. [366] The effective use of technology among young people is largely determined by their socio-economic circumstances and social stratification, despite their ability to use it. Neglecting transliteracy creates a significant bottleneck in access to and accessibility of information. According to William Badke, literacy is overlooked in the education system. It is misunderstood and academic administrators have not prioritized it on their institutions' agendas. There is a false belief that literacy is only acquired through experience and a mistaken assumption that technological ability is the same as being 'information literate.' Additionally, faculty culture tends to place less significance on literacy than on other educational pursuits, and faculty members often have a limited perception of which abilities are necessary to be transliterate. And, last but not least, accrediting bodies have not yet advanced literacy to a viable position in the education system. [367] Therefore, students may not learn what they need to, resulting in only average (or low) levels of transliteracy, with all the consequences that this entails. [368]

A personal bottleneck

Bottlenecks in accessing information are often exacerbated by personal barriers. Overcoming individual problems can be particularly challenging. Barriers can vary greatly in nature, complexity, intensity and duration. Barriers to accessing information may arise from special needs, a

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[366] Enyon (2020), pp. 131–143.

[367] W. Badke (2016). 'Why information literacy is invisible,' J. Hagen-McIntosh (ed.), *Information and Data Literacy. The Role of the Library*, Apple Academic Press, Oakville, pp. 137–153.

[368] A. Cree, A. Kay, and J. Steward (2023). *The Economic and Social Cost of Illiteracy. A Snapshot of Illiteracy in a Global Context*, World Literacy Foundation, London.

variety of factors such as illiteracy, lack of confidence, poor understanding, geographical isolation, income, language, stress, cognition, race, gender, age, and other socially and culturally determined factors such as bias and avoidance of information due to group ideologies or social stratification. There are reasons why individuals who are otherwise healthy may not avail themselves of opportunities to access information. Some of these reasons are socially or organizationally constructed, while others are based on personal dilemmas. Most individuals may be functionally literate for their work and daily lives, but they may lack the transliterate skills necessary to fully comprehend and engage in (political) debates in society. Cognitive and physical impairments, such as dyslexia, autism, reduced memory capacity, Down syndrome, visual impairments, hearing impairments, and motor impairments, exacerbate these problems.

There are two approaches to providing access for individuals with special needs. The first approach focuses on impairments and aims to ease the condition through medical, therapeutic, or technological interventions. This approach is useful for designing adaptive and assistive technologies and aims *to provide equal access to information* for everyone, regardless of outcome. The second approach goes beyond removing or reducing barriers to designing and supporting meaningful use, with a focus on *equitable design*: providing whatever support is necessary for equally successful outcomes. [369] Technology is important in both approaches. Adaptive or assistive technology refers to software and hardware that has been modified to be used by people with special needs, such as eye–tracking devices, speech recognition, touch screens, joysticks, trackballs,

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[369] A.N. Gibson and D. Hanson-Baldauf (2017). 'More than accessibility. Social and critical frameworks for exploring marginalization of people with autism spectrum disorders,' *Proceedings of the ASIS&T SIG-USE Symposium Call for Participation. Framing Inclusion and Exclusion in Information Behavior Research and Practice, October 28, New York*, 9 pp. Online source, retrieved 1 November 2024, from: https://cdr.lib.unc.edu/downloads/mw22v762n?locale=en.

visual cursors, and large keyboards. Accessing technology, although problematic, is not the main challenge. The main challenge is finding, understanding, and using digital information to one's advantage. However, this is largely dependent on personal motivation, skills, and capabilities. The 'digital divide' has the greatest impact on people at this personal level.

An organizational bottleneck

An often-overlooked obstacle to accessing information is of an organizational nature. In our society, every aspect involves some form of information technology. This technology provides new opportunities for accessing information, such as compatibility with multiple languages and media, assistive devices, adaptive and perceptual interfaces, and software for translation, intuitive search, intelligent data mining, and information retrieval. However, the functionalities of information technology are complex. Processing digital information requires hardware and software, which are constantly changing and may become unavailable in the future. Information can become obsolete and inaccessible without preservation efforts. The rendering of digital information is threatened by rapid changes in the ways it is recorded, stored, and processed. To combat the threat of technological obsolescence, human intervention and management are necessary. If left unmanaged, technological obsolescence will occur.

In 2020, I stated that organizational leaders acknowledge the importance of information as a crucial business asset, yet their actions in organizational life do not always align with this belief. Leaders do not apply the same level of discipline and rigour that is applied to other business assets, such as financial assets, to information. Information management is focused almost exclusively on structured information. This neglect resulted in [1] fragmented storage of information in a variety of information systems, unconnected with their metadata; [2] fragmented metadata,

separated from the information that caused their genesis, leading to a loss of contextuality; and [3] a declining quality of information, because its provenance, integrity, and preservation is in peril. [370]

The neglect of clear and concise information management often leads to 'information chaos,' which compromises the ability to access information and to achieve business objectives. This is unfortunately a common issue in many organizations. The cumulative impact of this neglect is astounding, resulting in increased operational costs of at least 10% of revenue, customer dissatisfaction, less effective decision-making, problematic implementation of new technology, a damaged organizational image, and reduced ability to define and execute new business strategies. Furthermore, it damages employee morale and creates a lack of trust within organizations. [371] The attitudes and behaviours of leaders, managers, and employees are crucial factors in the development and perpetuation of this situation.

In 2017, Tadhg Nagle, Thomas, and David Sammon argued that 3% of organizational information meets basic quality standards. Furthermore, they found that 47% of all new information contains at least one critical, work-impacting error. [372] Although some of this evidence pertains to information-as-knowledge, the majority of it pertains to information-as-thing. Research indicates that organizational dysfunctions can be directly associated with information behaviour, failures in the information value chain, and problematic access to and accessibility of information. Hiding and hoarding information are common in organizations due to selfishness, a lack of responsibility, interest, discipline, incentive, and competence. Information behaviour does not reflect the values es-

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[370] Van Bussel (2020), pp. 59–61.

[371] Van Bussel (2020), p. 161, note 153 and 155.

[372] T. Nagle, T.C. Redman, and D. Sammon (2017). 'Only 3% of companies' data meets basic quality standards', *Harvard Business Review*, Vol. 95, No. 5, pp. 2–5.

poused by organizational leaders regarding the importance of information. This results in undefined quality of information access.

Evaluation

Eight bottlenecks that obstruct information access and accessibility can be identified. These bottlenecks share similarities with the main approaches I identified in information access research, albeit from a different perspective. This is, of course, not surprising. The first research approach, which focuses on social, economic, and political participation, is reflected in the political, social, economic, and legal bottlenecks. Political, social, economic, and legal factors are determining forces for access to information and therefore participation in society and the organizations operating within it. 'Smart' and evolving technology is mainly present in the infrastructural, legal, and organizational bottlenecks. In our hybrid society, technological infrastructures are crucial for accessing information. Evolving technology also leads to problems with the accessibility of information itself, which is why the research approach of 'information survival' is also related. The third approach, power and control, is evident in the political, social, economic, infrastructural, legal, and organizational bottlenecks. This approach plays a significant role in almost all of the mentioned bottlenecks. Limiting access to information is one of the primary weapons that an elite has in this power struggle. The fourth approach, sense-making, is particularly relevant to personal and educational bottlenecks, as well as to the 'knowledge representations' research approach. It emphasizes individuals' capability to transform information into knowledge, which requires transliteracy and information that is (cognitively) interpretable. Information survival is primarily linked to the research approach of 'smart and evolving technology,' as well as organizational bottlenecks. However, there is also a connection with educational bottlenecks, as awareness of the limited sustainability of digital or digitized information is not part of educational programs.

Although all research approaches mentioned before are associated with bottlenecks, the research literature places the least emphasis on personal, educational, and organizational bottlenecks. The *personal bottleneck* encompasses most obstacles to information access and accessibility. There is research literature on access to technology and information regarding deficits due to physical or psychological disabilities. This literature focuses on medical, psychological, and psychiatric perspectives. Research on access and disability is marginally explored in the digital divide and information seeking fields. A search on Google Scholar yielded 1% and less than 0,5% of literature on these topics, respectively, compared to the total amount of available literature. Reasons why healthy individuals may not access information are understudied. *Education* is only marginally mentioned in research literature as a bottleneck to information access. There is a emphasis on education, especially in the literature on the digital divide, information disparity, and information seeking, to provide students with skills, but it is almost never pointed out that educational institutions start from the false assumption that students have already been taught information skills. In this sense, the education system is one of the major bottlenecks in acquiring the knowledge, skills and competences to find, access, interprete, and use reliable information. Even in literature on information quality, information security, and information management, little attention is given to the *organizational bottlenecks* that impede access and accessibility of information. The focus is mainly on quality conditions, access control, and power dynamics. However, most bottlenecks arise from the behaviour of both managers and employees. Organizational leaders who fail to recognize information as a valuable business asset provide employees with ample opportunity to disregard established protocols. Information manipulation is a prevalent issue that has consequences for the quality, processing, and preservation of information in the long term. The lack of awareness about information vulnerability may contribute to this problem, but it is not the only

explanation. Information is often treated as a commodity that is available upon request, without any effort required. Employee conduct can significantly impact information access and accessibility and even make it impossible. The problem is exacerbated by the educational bottleneck.

FIVE REQUIREMENTS FOR ACCESS AND ACCESSIBILITY

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Searching for access requirements

In a hybrid age of expanding legal frameworks, (organizational) accountability, and changing notions of privacy, economy, literacy, and daily life, the importance of access to and accessibility of information is amplified. As illustrated in the preceding chapters, the transition into a hybrid society has resulted in the crucial position of access to and accessibility of information becoming a significant burden due to the complex context in which it occurs.

According to Kay Mathiesen, theories of access do not provide sufficient guidance on the constituents, facets, or requirements of information access. To identify practical shortcomings in access and improve it effectively, she performed a 'standard threat analysis' of the conditions of access. [373] Mathiesen conducted her analysis by closely reading literature on information access and identified five facets of access: availability, findability, reachability, comprehensibility, and usability. *Availability* requires the generation, collection, storage, and archiving of information. However, this may not always occur due to various reasons, such as a lack of resources, incompetence, or misconduct. *Findability*, the ability to locate available information, requires information seeking competencies that a searching individual may not possess. *Reachability* refers to information that is findable but cannot be accessed due to restrictions

[373] Mathiesen (2014), p. 608.

such as a paywall. *Comprehensibility* refers to information that is clear, written in a known language, and easily understandable. The fifth and final facet is *usability*, which refers to the ability of individuals to effectively use the information at the time of retrieval. According to Mathiesen, these are the components of access — the conditions that must be met for information to be accessible to a person or group. [374]

Mathiesen is not the only one attempting to identify facets or requirements of information access. In 1991, Michael Buckland identified six aspects, four for information-as-thing and an extra two for information-as-knowledge. The first four are: *identification* (deciding where to look as well as identifying specific information), *availability* (being able to inspect the information), *user prices* (what a user must expend to use the information, in money and/or skills), and *provider costs* (what a provider must expend to provide the information, in money and/or services.) The last two are *cognitive access* (understanding the information offered) and *acceptability* (accepting the credibility of the information.) [375] In 2001, Leah Lievrouw proposed a process for 'informing' that ensures information has *availability* (it is present and circulating in the environment), *relevance* (it is interesting or useful), *accessibility* (it can be obtained), *capacity* (individuals have the personal capacity to use and understand the information), and *usability* (the information can be used). [376] Michael Goddard and colleagues define (in 2004) four requirements for information access: discovery, connectivity, language, and permission. *Discovery* refers to when a user knows the information exists and how to find it. *Connectivity* refers to when a user is able to obtain the information. *Language* refers to when a provider and a user of the information agree on the meaning of used language. *Permission* refers to when a user is permitted

[374] Mathiesen (2014), p. 606.

[375] Buckland (1991), pp. 79−80.

[376] Lievrouw (2001), pp. 13–16.

to have access to the information. [377] In 2011, Neil Doherty and Graham Doig recognized: *information existence*, the information is appropriately stored; *information awareness*, the information is known and well understood; *information sharing*, the information is readily made available to legitimite usters; and *information delivery,* the information can be transmitted to the required location. [378] Marie-Michèle Grenon et al. recognize five dimensions of information access: *availability* (how the provision of information responds to expressed needs), *accessibility* (the attainment of equal access to information for the various users), *acceptability* (how the values expressed by the information fit with those of the users, so that it is acceptable), *affordability* (the relationship between the cost of a service and the users' financial means), and *usability* (the ease with which people interact with information to fulfill their needs.) [379] Quality research recognizes several information quality characteristics that concern access and accessibility of information, namely: *accessible* (easy retrievable), *appropriate* (usable), *available* (physically available), *believable* (considered reliable), *contextual* (embedded in situational and environmental metadata), *interpretable* (cognitively interpretable), and *relevant* (being useful for the task at hand.)

Table 4 presents an overview of these 36 recognized facets, dimensions, or requirements. Meanwhile, Table 5 shows all requirements in a comparison, combining identical or similar requirements based on their definitions. This approach helps to distinguish unique requirements for access and accessibility, all combinations of similar (not quite the same but also not quite different) terms.

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[377] Goddard, et al (2004), p. 113.

[378] N.F. Doherty and G. Doig (2011). 'The role of enhanced information accessibility in realizing benefits from data warehousing investments,' *Journal of Organisational Transformation & Social Change*, Vol. 8, No. 2, pp. 163–182.

[379] Grenon et al. (2023), pp. 87–92

Facets of information access and accessibility *According to:*						
Mathiesen	*Buckland*	*Lievrouw*	*Godddard, et al*	*Doherty & Doig*	*Grenon, et al*	*Quality research*
Availability	Identification	Availability	Discovery	Existence	Availability	Accessible
Findability	Availability	Relevance	Connectivity	Awareness	Accessibility	Appropriate
Reachability	User prices	Acceptability	Language	Sharing	Acceptability	Available
Comprehensibility	Provider costs	Capacity	Permission	Delivery	Affordability	Believable
Usability	Cognitive access	Usability			Usability	Contextual
	Acceptability					Interpretable
						Relevant

Table 4. Overview of the facets of information access

Accoring to Table 5, *availability, findability,* and *comprehensibility* are recognized as requirements for access and accessibility. *Reachability* is defined as findable but not (yet) available information and is part of availability. *User prices*, *provider costs*, *affordability, permission*, and *delivery* are components of reachability and should therefore be considered as part of availability. *Usability* and *relevance* are quality characteristics of *information* but *not* requirements for *information access*. *Contextuality* is a prerequisite for relevance and use. Access should ensure contextuality to discern relevance and to facilitate use. Individuals can only discern relevance when they are aware of the situational and environmental context of the information they have found. Therefore, contextuality is a requirement that must be achieved through the access process.

Facets of information access and accessibility: comparison.							
Facets	*Mathiesen*	*Buckland*	*Lievrouw*	*Godddard c.s.*	*Doherty & Doig*	*Grenon, et al.*	*Quality research*
Availability	x	x	x	Connectivity	Existence Sharing	x	x
Findability	x	Identification	Accessibility	Discovery	Awareness	Accessibility	Accessible
Reachability	x	Availability	Availability	Permission	Existence Sharing	–	Available
Comprehensibility	x	Cognitive access	Capacity	Language	Awareness	–	Interpretable
Usability	x	–	x	–	–	x	Appropriate
Relevance	–	Acceptability	x	–	–	Acceptability	x Believable
User prices	–	x	–	–	–	Affordability	–
Provider costs	–	x	–	–	–	–	–
Permission	–	–	–	x	–	–	–
Delivery	–	–	–	–	x	–	–
Contextual	–	–	–	–	–	–	x

Table 5. Overview of the facets of information access: comparison
(x = mentioned; – not mentioned)

Five requirements for information access

A comparative analysis of the 36 requirements for information access and accessibility indicates that only four remain: findability, availability, comprehensibility, and contextuality. In my opinion the requirement of findability should be placed before that of availability. Information can

only be obtained and made available to the user once it has been successfully located. I also propose that 'interpretability' be preferred over 'comprehensibility,' in accordance with the views of Larry Smith and Cecil Nelson. [380] There seems to be a gap between availability and interpretability. Information is (always) presented in tangible or intangible 'representations' that can be located (findability) and acquired (availability.) These representations are the external manifestations of information that are directly *perceptible* by the human senses. Tangible representations refer to information that is embodied in a concrete, tangible form. Intangible representations are computationally mediated displays that are perceived in the world but are not physically embodied. [381] In order to facilitate interpretability, it is essential that users are able to perceive the information presented to them. Although not previously mentioned in the context of information access, *perceptibility* is one of the main principles of the Web Content Accessibility Guidelines. [382] It should be considered a requirement for information access and accessibility as well. Therefore, I have identified *five* requirements for information access and accessibility.

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[380] L.E. Smith and C.L. Nelson (1985). 'International intelligibility of English. Directions and resources,' *World Englishes*, Vol 4, No. 3, pp. 333–342; Y. Kachru and L.E. Smith (2008). *Cultures, Contexts, and World Englishes*, Routledge, London, pp. 60–66; C.L. Nelson (2011). *Intelligibility in World Englishes. Theory and Application*, Routledge, New York-Abingdon, pp. 32–38.

[381] B.A. Ullmer (2002). *Tangible Interfaces for Manipulating Aggregates of Digital Information*. Doctoral dissertation, Massachusetts Institute of Technology, School of Architecture and Planning, Program in Media Arts and Sciences, pp. 27–28. Online source, retrieved 1 November 2024, from: https://dspace.mit.edu/bitstream/handle/1721.1/29264/51909368-MIT.pdf?sequence=2&isAllowed=y.

[382] *Web Content Accessibility Guidelines (WCAG) 2.2*, W3C, 2023. Online source, retrieved 1 November 2024, from: https://www.w3.org/TR/WCAG22/#perceivable.

Information is accessible when [1] it is possible to locate or *find* information ('findability'); [2] it is possible to have (or make) information *available* ('availability'); [3] it is possible to *perceive* information, in other words: it is possible to hear, feel, smell, taste, or view it to facilitate understanding ('perceptibility'); [4] it is possible to identify what the information means and what it signifies in its situational and environmental context ('interpretability'); and [5] it is possible to reconstruct the contextual environment in which the information is (or has been) generated, used, controlled, and managed ('contextuality').

These five requirements together define information access and accessibility. Without even one of these requirements, access and accessibility do not exist. The five requirements allow information-as-thing to become information-as-knowledge.

Requirement 1: Findability

The term 'findability' refers to the ease with which information can be located. The concept is relevant in our hybrid world as it applies to digital, digitized, and analogue information. According to Peter Morville, findability is defined as the quality of being locatable or navigable, the degree to which a particular object is easy to discover or locate, and the degree to which a system or environment supports navigation and retrieval. Morville defines findability as 'a quality that can be measured at both the object and system levels.' [383] The term has been in use since at least 1943, when Urban Lavery used it in a paper about the 'findability of the law,' to mean 'ease of finding information.' [384]

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[383] P. Morville (2005). *Ambient findability. What we find changes who we become*, O'Reilly Media, Inc., Sebastopol, pp. 4–7. Quotation: p. 4.

[384] U.A. Lavery (1943). 'The 'findability' of the law,' *Journal of the American Judicature Society*, Vol. 27, pp. 25–28. On p. 25 Lavery states: 'somewhere in that vast storehouse of the law is the answer to his problem, but he cannot find it.'

Findability refers to an individual's ability to locate information that is created, published, stored, or preserved. It is not only a matter of finding *certain* information, but also of finding *relevant* information. Mathiesen accurately associated findability with the skills required to locate and/or search for information, provided it exists. [385] Finding and searching are different, although related. Finding something refers to locating something in a 'known space,' while searching for something refers to an 'unknown space' or an unexpected location. The ability to find information is an information management issue. However, if the information cannot be found within a known space, even if it is known to exist within that space, a search will be still necessary. [386]

Findability is a part of both social and organizational information architectures, the constellation of processes of organizing and structuring information in digital and physical spaces into logical classifications. The significance of information architecture is paramount in situations where users are impeded by complexity, unfamiliarity, and information overload. [387] The term 'information architecture' was coined by Richard Wurman in 1976 at the annual conference of the American Institute of Architects. Wurman argued that the world needed an 'architecture of information' rather than 'information about architecture.' [388] His book,

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[385] Mathiesen (2014), p. 608.

[386] Van Bussel (2017), p. 55. Based on: M. Baker (2013). 'Findability is a content problem, not a search problem,' *Every Page is Page One* (May 28). Blog. Online source, retrieved on 1 November 2024, from: https://everypageispageone.com/2013/05/28/findability-is-a-content-problem-not-a-search-problem/ Archived at https://archive.is/YWjEH.

[387] A. Resmini and L. Rosati (2007). 'From physical to digital environments (and back). Seven laws of findability,' *Translating Information Architecture. Proceedings of Europe's third Information Architecture summit (EuroIA), Barcelona*, ASIS&T, pp. 162–170.

[388] M. Wright Steenson (2017). *Architectural Intelligence. How Designers and Architects Created the Digital Landscape*, MIT Press, Cambridge-London, pp. 77–86.

Information Architects, popularized the concept and emphasized its importance in managing the overwhelming amount of information available. [389] Information architecture involves four distinct systems: organization, navigation, labelling, and search. The organization system defines the relationship between content groups. Navigation enables users to traverse the information structure. The labeling system is tied to the organization system, and users perceive labels as cues that guide their navigation. Search is a supplemental system that allows users to retrieve information using a label, a term, or a phrase. [390]

The aim of information architectures is to facilitate easy information retrieval in spaces where complexity, information overload, and unfamiliarity hinder findability. This architecture strives to achieve cognitive and informational continuity between different environments, eliminating the need for users to navigate between different, and often conflicting patterns of information structuring. [391] Finding information can be challenging due to the subjectivity involved in organizing and searching for it. Users may not be aware of idiosyncratic rules or exceptions, and may not be able to locate a specific item or search for a remembered unusual word or phrase. Thus, it is necessary to develop classification conventions that allow users the freedom of expression while maintaining constraints to ensure a high rate of findability. [392] When categorizing and

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[389] R.S. Wurman (1996). *Information Architects*, Watson-Guptill Publications, New York.

[390] P. Morville and L. Rosenfeld (2006). *Information Architecture for the World Wide Web. Designing Large-Scale Web Sites*, O'Reilly Media, Sebastopol, Chapter 5–8, pp. 53–192.

[391] Resmini and Rosati (2007), p. 163, p. 169.

[392] L.M. Berlin, R. Jeffries, V.L. O'Day, A. Paepcke, and C. Wharton (1993). 'Where did you put it? Issues in the design and use of a group memory,' B. Arnold, G. Van der Veer, and T. White (eds.), *Proceedings of the INTERACT'93 and CHI'93 Conference on Human Factors in Computing Systems IFIP TC13, 24-29 April 1993, Amsterdam*, New York, ACM, pp. 23–30, p. 25.

retrieving information from one's own collection, the passage of time can pose challenges due to differing perceptions of the same information between the past and present. To find information, one must coordinate spatially and temporally with their past selves, engaging in a sort of cognitive time travel. It is possible that a user may not search for information in the same way as they have in the past. Hindsight can alter perception and intentionality, making it difficult to find information. Additionally, the meaning of information can change over time. [393] To address this, a contextual view of information is necessary to reconstruct its meaning in different situational environments. [394] This is of course less important for this first requirement of access than for the fifth: contextuality.

If the information is on a website, locating it may be simple if the website has been designed with findability in mind, which is not always the case. A crucial aspect of website optimization is ensuring that the content is easily discoverable. [395] If something is not findable, it will not be utilized. Conversely, the more findable something is, the more likely it is to be used. [396] When information is not published on a website or is being preserved in an unknown repository, it will be more difficult to

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[393] D. Narayan and M. Olsson (2013). 'Sense-making across space and time. Implications for the organization and findability of information,' F. Bouthillier, B. Yu, and A. Grove (eds.), *Proceedings of the 76th ASIS&T Annual Meeting. Beyond the Cloud. Rethinking Information Boundaries,* Silver Springs, American Society for Information Science, Article 72, pp. 1–9.

[394] Van Bussel (2017), p. 54.

[395] Morville and Rosenfeld (2006), pp. 97–132.

[396] C. Wilkie and L. Azzopardi (2013). 'An initial investigation on the relationship between usage and findability,' P. Serdyukov, P. Braslavski, S.O. Kuznetsov, J. Kamps, S. Rüger, E. Agichtein, I. Segalovich, and E. Yilmaz, *Proceedings of the 35th European Conference on Information Retrieval, ECIR 2013, Moscow, Russia, March 24-27, 2013*. Lecture Notes in Computer Science, vol. 7814, Springer, Berlin-Heidelberg, pp. 808–811.

find it. In most information architectures, there will be (more or less detailed) overviews of repositories, libraries, and archives. These overviews contain general descriptions of information preserved in an individual repository, library, or archive. For each repository, finding-aids will be available for finding specific information. Most of those finding-aids can be consulted online. [397] However, finding-aids must also be continuously contextualized to reconstruct their meaning in different time-spaces. Failure to do so may make findability more difficult, if not impossible. If online consultation is not possible, it is necessary to visit the repository to obtain access to the finding-aid and the required information.

However, finding information has become more difficult due to the information overload that characterizes World 2.0, which makes finding relevant information in the dizzying amount of information much more difficult. Even if a user knows that the relevant information can be found in an extremely large data set, there is no guarantee that they will be able to make it available. This impresses the importance of extensive indexing of (archival) information.

Requirement 2: Availability

Although a potential user may know where to find specific information, it does not necessarily mean that the information can be retrieved at any given time. Mathiesen identified the facet of 'availability' and es-

[397] H. Tibbo and L. Meho (2001). 'Finding finding aids on the world wide web,' *The American Archivist*, Vol. 64, No. 1, pp. 61–77. Also: A. Velthe (2023). 'Assessing finding aid discoverability after description. Improvements using web analytics,' *Journal of Western Archives*, Vol. 14, No. 1, Article 9. Online source, retrieved on 1 November 2024, from: https://digitalcommons.usu.edu/cgi/viewcontent.cgi?params=/context/westernarchives/article/1158/&path_info=Velte___Assessing_Finding_Aid_Discoverability.pdf.

tablished a link between it and the decision of whether to collect, generate, or create information. If the information is not collected, generated, or created, it is not considered 'available.' However, the truth of this statement aside, it is important to note that availability as a requirement for information access pertains only to information that has been collected, generated, or created, and not to information that has not and for that reason is not available. Mathiesen's facet of 'reachability' refers to information that is findable but is not available when needed. Therefore, as previously stated, 'reachability' is synonymous with the requirement for availability. [398] The ability to access and review available information is always about information control, even for information that is or should be public. Information may be classified as confidential by the organization or the individuals who hold it. [399]

Several of the bottlenecks already mentioned are related to the availability of information. It may be difficult or impossible to obtain information because ownership is restricted, because it has been irretrievably destroyed, or because websites or databases containing the necessary information no longer exist. In addition, the information may be hosted in a repository behind a paywall. The information systems required to obtain the information may not be available. Even if they are available, the software may not be able to decipher the original data formats. Information may be part of an extremely large data set, which makes it difficult to locate and make available. Individual people may be disabled by a disability in interacting with information technology, by imperfect or limited sensory, physical or mental abilities, by situational impairments, or by digital illiteracy, so that they are unable or unwilling to ac-

[398] Mathiesen (2014), p. 608.

[399] Samonas and Coss (2014), pp. 35–37. Also: D. Khazanchi and A. Martin (2009). 'Information Availability,' J.D. Gupta and S. Sharma (eds.), *Handbook of Research on Information Security and Assurance*, IGI Global, Hershey, Chapter XIX, pp. 230–239.

cess and interact with information technology systems, making information unavailable. [400] Although a user knows where the information is located ('it is findable'), he or she cannot obtain it ('it is not available').

Especially over time and in changing circumstances, the availability of information is crucial for decision-making. As mentioned earlier, in countries with strict information control, emphasis is placed on information that benefits established parties, politicians and business interests. Even in countries with less stringent information control, restrictions on the availability of information have consequences. Citizens and (business) organizations are confronted with a lack of transparency that makes it difficult for them to participate in social, political and/or economic processes. In such an environment, the availability of information is used by social, political and economic elites as an instrument to protect their interests. There are many individuals and organizations that can benefit from the availability of this information, but government agencies are not always willing to disclose information and often seek to commercialize its use. Restrictions on the availability of this information prevent many individuals and organizations from adding value. The availability of information has always been a catalyst for innovation. [401]

Susan Feldman and Chris Sherman describe the consequences of a lack of availability in organizations: poor decisions, duplication of effort because existing information is not available in all departments, and loss of productivity because necessary information is not available when it is needed. [402] Maayan Nakash and Dan Bouhnik pointed out (based on a

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[400] H.K. Kim and S.H. Han (2017). 'Defining and classifying IT interaction disability,' *Behaviour & Information Technology*, Vol. 36, No. 4, pp. 422–434.

[401] E. Lakomaa and J. Kallberg (2013). 'Open data as a foundation for innovation. The enabling effect of free public sector information for entrepreneurs,' *IEEE Access*, Vol. 1, pp. 558–563.

[402] S. Feldman and C. Sherman (2003). *The high cost of not finding information. An IDC White Paper*, IDC Framingham, p. 3.

case study in Israel) that a third of their respondents spend between half and a full working day per week searching for information that is not available immediately. The COVID pandemic led to an increase in search times due to a deterioration in the quality of information management. [403] With these amounts of search time per week, the costs of unavailability are high, although it is difficult to determine them precisely as they depend on contextual factors.

The availability of information within organizations is also a matter of information security. This is very important in distributed computing environments. Organizations require availability to be guaranteed with the same level of security as confidentiality and integrity. Availability risks must be reduced and procedures must be in place to respond when availability is threatened. [404] The goal of information availability is the ability to make information and the associated resources available when needed, at the right time and in the right place to the individuals authorized to do so. This includes the technical suitability of the systems and the associated infrastructure, but also guidelines and procedures, a security policy, and a business continuity plan. [405] Access control is an important part of information security and has a direct impact on the availability of information, in extreme cases even to the detriment of the work to be done. [406] Information control restricts availability in such a

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[403] M. Nakash and D. Bouhnik (2024). 'How much time does the workforce spend searching for information in the 'new normal?,' *iConference 2024 Posters,* iSchools, University of Illinois Urbana-Champaign. Online source, retrieved 1 November 2024, from: https://www.ideals.illinois.edu/items/129980.

[404] D. Khazanchi and A.P. Martin (2009). 'Information availability,' J. Gupta, and S. Sharma (eds.), *Handbook of Research on Information Security and Assurance*, IGI Global, Hersey-London, pp. 230–239, p. 230.

[405] Khazanchi and Martin (2009), p. 232.

[406] A.J. Faxvaag, T.S. Johansen, V. Heimly, L. Melby, and A. Grimsmo (2011). 'Healthcare professionals' experiences with EHR-system access control me-

way that it entails some of the consequences mentioned by Feldman and Sherman. We have already mentioned Andrew Pettigrew's emphasis on the critical function of information control in mobilizing organizational power. The unavailability of information is a valuable resource for gaining organizational power, even if it means more inefficient and costly operations. The availability of information is crucial for access to and accessibility of information.

Requirement 3: Perceptibility

As mentioned, information is presented in tangible or intangible 'representations' that can be located (findability) and acquired (availability). These representations are the external manifestations of information that can be perceived by the human senses. [407] If information is findable and available, it should be possible to perceive it, to hear, feel, smell, taste, or see it. This gives the user the opportunity to interpret it cognitively. Perceptibility is a prerequisite for interpretation and grasping the meaning of the information.

There is a problem with perceptibility in connection with the problem of mass, the flood of information-as-things ('representations') that characterizes World 2.0. or Society 5.0. Individuals are confronted with more information-as-things than they can even perceive (and subsequently interpret). This is the result of the commodification of information, the process by which information simply becomes a product of consumption, to be acquired, traded, accumulated, and possessed. This is in contrast to the interpretation of information as a source of knowledge (information-as-knowledge). Since information-as-things increas-

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chanisms,' J. Aarts, S.K. Andersen, P. Hurlen, and A. Moen, *User Centred Networked Health Care*, IOS Press, Hershey-London, pp. 601–605, pp. 604–605.

[407] W. Jones (2011). 'No knowledge but through information,' D.J. Pauleen and G.E. Gorman (eds.), *Personal Knowledge Management. Individual, Organizational and Social Perspectives*, Gower Publishing, Farnham, pp. 143–166.

ingly become consumption goods or commodities, 'their value is decreasingly determined by the fulfillment of human or social needs and increasingly by exchange (as a commodity) on the market.' [408] The resulting overload makes it impossible to process the information provided or acquired. It is questionable whether the information sought is findable and available in this information flood, but it certainly is not perceptible.

It is obvious that physical impairments such as visual and hearing impairments as well as cognitive disabilities make access to information considerably difficult. Statistics show that more than one billion people worldwide struggle with disabilities. With an ageing population and increasing life expectancy, this number is expected to rise. [409] Visual and hearing impairments are challenging, but cognitive impairments pose a particularly complex problem for access to information, as they encompass a range of problems with different effects on the perceptibility of information. These include brain damage, memory disorders, dementia, learning disabilities, autism spectrum disorder, and the cognitive consequences of conditions such as stroke and trauma. [410] If potential users

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[408] S. Spier (2016). 'From culture industry to information society. How Horkheimer and Adorno's conception of the culture industry can help us examine information overload in the capitalist information society,' M. Kelly and J. Bielby (eds.), *Information Cultures in the Digital Age. A Festschrift in Honor of Rafael Capurro*, Springer, Wiesbaden, pp. 385–396, pp. 388–391. Quotation: p. 392.

[409] *Global Report on Health Equity for Persons with Disabilities*, Geneva, World Health Organization, 2022, p. 3. Online source, retrieved 1 November 2024, from: https://www.who.int/publications/i/item/9789240063600. Also: H.H. Magidimisha-Chipungu (2024). 'A global perspective on planning for disability', H.H. Magidimisha-Chipungu, *People Living with Disabilities in South African Cities. A Built Environment Perspective on Inclusion and Accessibility*. Sustainable Development Goals Series, Palgrave Macmillan, Cham, Chapter 1, pp. 9–28.

[410] P. Szabó, J. Ara, B. Halmosi, C. Sik-Lanyi, and T. Guzsvinecz (2023). 'Technologies designed to assist individuals with cognitive impairments,' *Sustainability*,

are disabled in a way that makes perception problematic (and they do not have an interaction disability), assistive and adaptive technologies should be used to enable them to perceive information in a personalized way. [411] These technologies include live captioning, sign language interpretation, transcription services, audio reading, visual or audio description/narration, magnifying devices, screen reading tools, speech output systems, non-verbal communication tools, reading pens, dyslexia software and fonts, etc. [412] If such technologies are not used, the perceptibility of information for people with special needs becomes difficult.

At both the perceptual and cognitive levels of human-computer interaction, software developers need to consider these issues when evaluating designs. Universal design refers to 'the creation of products and environments, as well as practices, programs, and services, that are accessible to and usable by all persons, including individuals with disabilities, without adaptation or specialized design.' [413] Universal design (design for all, integral accessibility, accessible design, inclusive design, barrier-free design, trans-generational design) is based on seven principles:

Vol. 15, No. 18, art. 13490. Online source, retrieved 1 November 2024, from: https://www.mdpi.com/2071-1050/15/18/13490#B3-sustainability-15-13490.

411 H. Hill (2013). 'Disability and accessibility in the library and information science literature. A content analysis,' *Library & Information Science Research*, Vol. 35, no. 2, pp. 137–142.

412 M. Sherman (2022). *Accessibility in Libraries. A landscape review*, American Library Association and Knology, Chicago. Online source, retrieved 1 November 2024, from: https://www.ala.org/tools/sites/ala.org.tools/files/content/230317-ppo-ltc-access-landscape-review-UPDATE.pdf.

413 W.N. Myhill, D.L. Cogburn, D. Samant, B.K. Addom, and P. Blanck (2008). 'Developing accessible cyberinfrastructure-enabled knowledge communities in the national disability community. Theory, practice, and policy,' *Assistive Technology*, Vol. 20, No. 3, pp. 157–174, p. 158.

equitable use, intuitive use, perceptible information ('communicates necessary information effectively regardless of ambient conditions or sensory abilities'), a tolerance for error, a low level of physical effort, and appropriate size and space for use. [414]

It is difficult to develop suitable solutions. [415] There is a lack of research that includes people with cognitive disabilities as key actors rather than subjects. There is a lack of studies on assistive and adaptive technology solutions and their effectiveness, usability and acceptability. While progress has been made for people with physical and sensory disabilities, people with cognitive disabilities did not get much attention. [416] Virtual and augmented reality, social robots, and artificial intelligence provide possible solutions as multisensory technologies that involve all the senses to create a more convincing reality. Although such devices provide only a limited sense of reality yet, it is expected that their sophistication increases rapidly. [417]

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[414] Myhill, et al, (2008), p. 163. About these methods: H. Persson, H. Åhman, A.A. Yngling, J. Gulliksen (2015). 'Universal design, inclusive design, accessible design, design for all: different concepts — one goal? On the concept of accessibility — historical, methodological and philosophical aspects,' *Universal Access in the Information Society*, Vol. 14, pp. 505–526.

[415] Dyslexia, motor, hearing, and visual impairments have received attention. See: G. Berget and A. MacFarlane (2020). 'What is known about the impact of impairments on information seeking and searching?,' *Journal of the Association for Information Science and Technology*, Vol. 71, No. 5, pp. 596–611.

[416] L.S. Guedes (2024). *Accessibility by Design. Designing Inclusive Technologies with and for People with Intellectual Disabilities*. Doctoral Dissertation submitted to the Faculty of Informatics of the Università della Svizzera Italiana, Lugano, p. 46. Online source, retrieved 1 November 2024, from: https://www.researchgate.net/publication/380124735_Accessibility_by_Design_Designing_Inclusive_Technologies_with_and_for_People_with_Intellectual_Disabilities.

[417] Guedes (2024), pp. 85–136, pp. 139–150, pp. 181–194.

If information is perceptible, it is *possible* to interprete it. It is only a possibility, because even if information is findable, available and perceptible, this does not mean that it is interpretable. The fact that information is perceptible does not guarantee that it is possible to grasp the meaning of the information and internalize it in understanding. [418]

Requirement 4: Interpretability

In 2017, I recognized this requirement as 'intelligibility.' [419] In the meantime, I have accepted Larry Smith and Cecil Nelson's interpretation that 'intelligibility' is used as an umbrella term for all aspects of understanding, but is in fact a three-tiered, interconnected system: intelligibility, comprehensibility, and interpretability. The first level is 'intelligibility,' the recognition of the information (the 'words and other sentence-level elements of utterances'); it is about recognizing the literal, superficial meaning of the information. The second level is 'comprehensibility'; it refers to the recognition of the contextual meaning of the information in a socio-cultural setting. The third level, 'interpretability' refers to the recognition of the intention or purpose of the information, the ability to understand the situational meaning, reasoning and intent behind the information at the moment it is received ('context of situation'). When information is interpretable, it can be cognitively processed and effectively utilized. [420] Intelligibility and comprehensibility are prerequisites for interpretability. It is possible for information to be intelligible but not comprehensible and (therefore) not interpretable. A user may be able to comprehend the information without really understanding the intention or purpose of the information, i.e. the interpretability of the

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[418] M. Hori and T. Kato (2008). 'Mobile web and accessibility,' S. Harper and Y. Yesilada (eds.), *Web Accessibility. A Foundation for Research*, London, Springer, Part IV, pp. 301–313, pp. 303–304.

[419] Van Bussel (2017), p. 56.

[420] Smith, and Nelson (1985), pp. 333–342; Nelson (2011), pp. 32–38.

information. Interpretability is the most complex level in this three-tiered system and is needed for the cognitive processing of the information by an individual. It is a requirement for the information to be accessible, for the information to be understandable, and contextually usable.

Understanding is only possible if the literacy capabilities of the users, discussed previously, make this possible. As stated before, only 34% of the Western European population possesses more than basic literacy skills, which significantly constrains their ability to access complex information. There has been a general decline in mathematics, reading and science scores since 2018, which has the potential to exacerbate the problems of information access in the long term. [421]

According to the Karlsruhe concept of comprehensibility, understanding depends on six dimensions: [1] 'concision,' the mimimum of information needed for communication; [2] 'correctness,' generate texts without mistakes; [3] 'motivation,' the motivation aroused by the text itself; [4] 'structure,' the content structure which refers to the objects, processes, events, etc. dealt with in the text; [5] 'simplicity,' the 'linguistic simplicity' of the text (lexis and syntax); and [6] 'perceptibility,' those features which determine the ease with which texts can be perceived and thus be made interpretable as well as the features which support the reader's recognition of content structures nonverbally. [422] The last dimension mentioned is covered by my requirement of perceptibility.

Models such as the Karlsruhe Concept are of interest when generating information, as they permit the optimization of new information, thereby facilitating a much greater degree of intelligibility, comprehens-

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[421] Schleicher (2022), p. 8.

[422] S. Göpferich (2009). 'Comprehensibility assessment using the Karlsruhe Comprehensibility Concept,' *The Journal of Specialised Translation*, No. 11, pp. 31–52. Online source, retrieved on 1 November 2024, from: https://jostrans.soap2.ch/issue11/art_goepferich.php.

ibility, and interpretability. If an information user is unable to gather one or more of the dimensions of the model, the information that is perceived may not be interpretable, in whole or in part. However, much information is generated by machines based on artificial intelligence and machine learning. The information in question is generated by algorithms, and its decisions must be interpretable by humans who possess knowledge of mathematics, coding and ethics. [423] A significant proportion of available information is based on professional knowledge that cannot be summarized in easily comprehensible formats. A vast amount of information is generated in the past, has been retained and preserved in libraries and archives, and requires users to possess knowledge of contexts and languages that are no longer in use. It can be argued that a large proportion of the information available today requires a level of literacy that is far beyond the scope of the basic skills possessed by 66% of the Western European population. The interpretability of information is in jeopardy. The long-term issues within the education system will present a challenge in rectifying this problem. [424]

Some examples of the types of expertise required include the ability to interpret the (artificial) intelligence model used and to explain its outputs based on inputs. Additionally, it is necessary for those interpreting the model to understand the explanations of the model for its decisions, recommendations, and predictions, enabling the discovery of racial bias,

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[423] K. Morrison, D. Shin, K. Holstein, and A. Perer (2023). 'Evaluating the impact of human explanation strategies on human-AI visual decision-making,' *Proceedings of the ACM on Human-Computer Interaction*, ACM, New York, Vol. 7 (Computer Supported Cooperative Work), pp. 1–37. Online source, retrieved on 1 November 2024, from: https://dl.acm.org/doi/10.1145/3579481.

[424] Schleicher (2022), p. 8. Also: W. Gaudelli (2020). 'The trouble of western education,' *On Education. Journal for Research and Debate*, Vol. 3, No. 7. Online source, retrieved November 1, 2024, from: https://doi.org/10.17899/on_ed.2020.7.8.

such as the imposition of stricter jail sentences on black defendants, the demonstration of racial discrimination against non-white mortgage applicants, and the revocation of tax allowances by tax authorities based on place of residence. Furthermore, it allows for the evaluation of the ethical implications of the models used by driverless cars to make decisions, given that their functionality directly impacts human lives. [425] Michael Chui, James Manyika, and Mehdi Miremadi observed that biases tend to persist due to the necessity of an understanding of data science techniques, coupled with knowledge of prevailing social forces, including data collection. [426]

Another example is the interpretation of information preserved from a long time ago. In the 1980s, I undertook research into the administrative history of the Cistercian abbey of Altenkamp (Germany) from the 12th to the 14th century as part of my research master's degree in medieval history. My education in medieval history and archival studies enables me to read and interpret the information presented in the available charters. However, I am only able to gather part of the socio-cultural context surrounding them because not much is known about that. My familiarity with medieval Latin, palaeography, chronology, and diplomatics enabled me to undertake such an endeavour. For those lacking the requisite literacy, information about Altenkamp is accessible, available, and perceptible, but not interpretable. The charters of this medieval abbey provide a complex example of the challenges associated with accessing information and the literacy abilities required to do so.

In 2013, even in very literate countries large minorities of the population could only read simple texts in their own language: 11% of the

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[425] Examples mentioned in: A. Marshan (2021). 'Artificial intelligence. Explainability, ethical issues and bias,' *Annals of Robotics and Automation*, Vol. 5, No. 1, pp. 34–37.

[426] M. Chui, J. Manyika, M. Miremadi (2018). 'What AI can and can't do (yet) for your business,' *McKinsey Quarterly*, No. 1 (January), pp. 97–108.

adults in Finland, 12% in the Netherlands and Norway, 13% in Australia and Sweden, 14% in Belgium, 15% in Austria, 16% in the United Kingdom, 17% in Germany, 21% in France, and 28% in the United States. These statistics do not really differ in more recent reports. [427] These minorities may be less educated individuals, untrained readers, or people with dyslexia, aphasia, cognitive disabilities, learning disabilities, or neuropsychiatric disabilities. For these individuals, the interpretation of text beyond the level of simple language is unfeasible. Consequently, a significant proportion of the population will experience difficulties in accessing information. It is evident that access to information technology will not be a solution to this problem.

Requirement 5: Contextuality

Information may be findable, available, perceptible, and interpretable, but if its contextuality is compromised, it may be challenging to reconstruct the context in which the information was generated, used, and managed. This makes it difficult to understand the information's intended meaning. Information has a meaning within the environmental context in which it is generated and used.

Context has been the subject of study in a number of scientific disciplines, including (but not limited to) philosophy, contextual psychology, artificial intelligence, information retrieval, mathematics, and organizational science. The concept has been attributed a multitude of definitions, interpretations, and frameworks, which can be divided into four distinct classifications: utilize context in order [1] to define and operate robotic activities in the near future, like oracles; [2] to create a situational environment for a user when utilizing information, [3] to adapt software

[427] OECD (2013). *OECD Skills Outlook 2013. First Results from the Survey of Adult Skills*, OECD, Paris; OECD (2015). *OECD Skills Outlook 2015. Youth, Skills and Employability*, OECD, Paris; and OECD (2017). *OECD Skills Outlook 2017. Skills and Global Value Chains*, OECD, Paris.

applications to the personal context of a user, and [4] the sense-making of social situations (and its information). [428] This fourth classification is the subject of the requirement of contextuality. There is a consensus regarding several characteristics. Context [1] is a complex social reality that can be captured as a simplified metadata construct, which represents the social reality, but is not reality itself; [2] encapsulates objects and situations to allow for sense-making; [3] requires accurate documentation and definition; and [4] is a phenomenon that is located in the past and is essential for the tracking and reconstruction of business processes, policies, decisions, products, actions, and transactions. [429]

The object of the concept is not information itself, but the environmental and situational circumstances that give information meaning. Context is an 'outside' phenomenon, 'even if it conditions meaning and, in time, its interpretation.' [430] Contextualization encompasses the environmental and situational influences that shape the meaning of information in metadata. It captures metadata about the environment the organization directly experiences and that modifies its responses. [431] This includes the organizational, personal, and social environments of the information (and its aggregation, an organizational or personal archive). It concerns the organizational structure, the business process hierarchy, and the legal, regulatory, and social-cultural environment in which infor-

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[428] G.J. van Bussel (2016). 'An Accountability Challenge. Capturing records and their context in Enterprise Information Systems,' P. Silva, A. Guerreiro and R. Quaresma (eds.), *Proceedings of the 10th European Conference of Information Systems Management. ECISM 2016, Evora, Portugal, 8–9 September 2016*, Reading, ACPI, pp. 204–211.

[429] Van Bussel (2016), p. 207.

[430] L. Duranti (1997). 'The archival bond,' *Archives & Museum Informatics*, Vol. 11, No. 3–4, pp. 213–218. Quotation: p. 217.

[431] J. Pfeffer, and G.R. Salancik (1978). *The External Control of Organizations. A Resource Dependence Perspective*, Harper & Row, New York, pp. 72–74.

mation is generated. Nevertheless, the representation of these influences in metadata is an extremely complex endeavour. This is because it is relational, defined dynamically at a given time and space, and arises from an activity (or situation.) It is 'actively produced, maintained, and enacted in the course of the activity at hand.' [432]

One might define context as a system's state and behaviour over time. The state of a system comprises all information (data, representations, and metadata) required to explain the current system's condition, including all relevant historical information necessary to understand that current condition. Every change in the state of a system over time represents the system's behaviour. In order to, for instance, demonstrate compliance, it is necessary to provide information about the *state of the system* at a specific moment in time and the changes that have occurred in that system's state (*the system's behaviour*) over a specific time frame. This might include audit trails, versions of business rules, process schedules, software systems security and maintenance logs, metadata schedules, etc. This evidence is required to allow for a reconstruction of the policies, decisions, products, actions, and transactions of the organization. In essence, context enables the reconstruction of social situations through the use of available information and metadata. [433]

It is not possible to capture context within metadata in any other way than by means of a simplified representation. This simplified representation is employed for the interpretation and understanding of information, and is continually augmented when the information is reused in novel and disparate contexts. This results in an ever-increasing quantity of metadata, which is employed to ascertain the context(s) in which the information has been situated throughout its lifespan, from its initial generation until its ultimate disposal or permanent preservation. Meta-

[432] P. Dourish (2004). 'What we talk about when we talk about context,' *Personal and Ubiquitous Computing*, Vol. 8, pp. 19–30. Quotation: p. 22.

[433] Van Bussel (2016), p. 207.

data serve to create a *mirror* of the organizational context within a specific timeframe. This mirror contains a simplified representation of all the captured contextual information about the organizational environment, the organization, and the business process the action or transaction was part of. The mirror is inseparably connected with the information generated within that action or transaction. The metadata serve to reflect the intricate social dynamics that give rise to information. Ultimately, this enables a (very) simplified reconstruction of the past. [434]

In the absence of a context, the intended and deeper meaning of the information at the time of its creation and subsequent use is irrecoverable. Consequently, the information loses its capacity to serve as a reference, evidence of actions and transactions, or source of knowledge for the creator or recipient. Information is communicated to recipients in a specific context for the purpose of informing decisions and production processes. In each context, information serves to comprise, notify, stimulate, reduce uncertainty, reveal alternatives, influence individuals, and stimulate them into action. [435]

Contextual information is essential for understanding social situations within business processes. This information is used to reconstruct situations for reference, decision-making, accountability and compliance, and to gain insight into the activities and interactions of individuals and organizations in their external environment. [436]

In the absence of contextual information, access to information is constrained. While the information itself may be of interest, it is challenging to ascertain its original role, function, importance, and meaning.

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[434] Van Bussel (2016), pp. 207–208.

[435] L.D. Introna (1993). 'Information. A hermeneutic perspective,' E.A. Whitley (ed.), *Proceedings of the First European Conference on Information Systems, ECIS 1993, Henley-on-Thames, March 29-30*, ECIS, pp. 171–179.

[436] J.R. Taylor and E.J. Van Every (2000). *The Emergent Organization. Communication as Its Site and Surface*, Mahwah (NJ), Lawrence Erlbaum Associates, p. 40.

Consequently, information loses its capacity to serve as a reference, evidence of actions and transactions, or a source of organizational knowledge. The requirement of contextuality allows users to interpret the meaning of information as it was intended by the organization or person that generated it. Nevertheless, researchers may endeavor to identify additional contexts that are subconsciously embedded within the information, as exemplified by Emmanuel Le Roy Ladurie in his analysis of Montaillou, Catarina Bruschi in her study of the Waldensian heretics in the Languedoc, and Arlette Farge, about the 'forgotten lives' in eighteenth century Paris. [437]

An evaluation and a checklist

Paul Jaeger posits that 'without access to information, there can be no exchange, use, collection, or management of information.' He asserts that access is 'central' 'to virtually every aspect of society.' [438] This assertion is indeed true. However, the majority of bottlenecks are societal in nature and are limiting the exchange, use, collection, and management of information due to a multitude of factors. These factors are of a political, social, economic, legal, infrastructural, educational, personal, and organizational nature. They all impede access to and accessibility of information.

The issues in question lack a straightforward solution. In order to address them, it is necessary to implement a series of changes at the soci-

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[437] E. Le Roy Ladurie (1975). *Montaillou, village occitan de 1294 à 1324*, Gallimard, Paris; C. Bruschi (2009). *The Wandering Heretics of Languedoc*, Cambridge University Press, Cambridge; and A. Farge (2023). *Vies oubliées. Au cœur du XVIIIe siècle*, Editions La Découverte, Paris.

[438] P.T. Jaeger (2007). 'Information policy, information access, and democratic participation. The national and international implications of the Bush administration's information politics,' *Government Information Quarterly*, Vol. 24, No. 4, pp. 840–859. Quotations: p. 843, p. 840.

etal, educational, personal, and organizational levels. Realizing those will be a challenge. The five requirements for information access and accessibility are not meant to solve those issues. These bottlenecks are too large and too deeply embedded in societal structures to be solved with a framework of requirements. They have resulted in the drawbacks of the hybrid world, as described on pp. 71–73. My conclusion was that the benefits of the hybrid world primarily related to convenience and commercial capabilities, while the drawbacks concerned societal issus, exacerbated by the digitalization of society. While there is a clear need for access to information, there are numerous reasons why its complete implementation may not be feasible.

The requirements framework is defined from the point of view of information users and is intended to define what needs to be realized to enable people to acquire, access, and use that information. For this to happen, all the requirements must be met, all the technologies must be available to enable rapid access to the information (or its aggregates), including all the contextual metadata to enable reconstruction of the past. If information is not findable, available, or perceptible, nothing can be done. In this situation, the last two requirements of information access do not have a role to play.

For information access and accessibility to exist, the findability, availability, perceptibility, interpretability, and contextuality of information *must* be realised regardless of source, format, disability, location, language, or technology. If an individual is able to obtain the information they need at a given time (findability, availability, and perceptibility) and has the opportunity and ability to interprete that information in context (interpretability and contextuality), then they have access to information. When information control precludes users from accessing available information, all requirements should be facilitated for the information they are allowed to access. That information needs to be findable, available, perceptible, interpretable, and contextual. It is evident that the necessity

for information access will present significant challenges for a multitude of organizations, including those with a heritage focus.

An audit checklist has been compiled for (heritage) organizational use, based on audit checklists used in information (systems) management. This checklist delineates the criteria that have to be fulfilled in order to achieve each requirement. While not exhaustive, it identifies the essential points. Checklists may be employed for the recall of information, the standardization and regulation of processes, the provision of an evaluation framework, and the utilization as a diagnostic tool. [439]

The following checklist of information access requirements may be employed for any of the aforementioned purposes, although it is primarily intended as an evaluation framework. It may be utilized by (heritage) organizations to assess the information access and accessibility frameworks available in their business processes. The application of the checklist may assist these organizations in addressing the challenge of information access and accessibility.

The checklist is structured in accordance with the five identified requirements. A total of 47 criteria have been identified, with 34 relating to the combined aspects of findability and availability. The perceptibility requirement is comprised of 5 criteria, the interpretability requirement comprises 3, and the contextuality requirement comprises 5. It seems reasonable to posit that no organization will be able to satisfy all these criteria. A substantial amount of work will be necessary. Most work will be on automatically identifying, indexing, structuring, and contextualizing all information available within the organization. It is recommended that the focus be on achieving the findability and availability criteria. The fulfilment of the criteria for these requirements will facilitate the subsequent realization of the other requirement criteria.

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[439] B.M. Hales and P.J. Pronovost (2006). 'The checklist — a tool for error management and performance improvement,' *Journal of Critical Care*, Vol. 21, No. 3, pp. 231–235.

Checklist *Requirements of Information Access.*	
Findability	
1.	Are all information systems and physical locations used for processing and storing information and data objects (and their aggregates) (whether digital or not) known and identified?
2.	Are all information and data objects (and their aggregates) (whether digital or not) known and identified?
3.	Are all information and data objects (and their aggregates) (whether digital or not) assigned a persistent identifier?
4.	Are all persistent identifiers unique within the organization?
5.	Are all identifiers unique within the archive to which their objects (and their aggregates) (will) belong?
6.	Are all information and data objects (and their aggregates) (whether digital or not) described with structured metadata?
7.	Is all this structured metadata based on a metadataschedule based (as a minimum) on ISO 23081 (latest edition)?
8.	Is all this structured metadata persistent when the information and data objects they belong to are frozen after being processed in business processes?
9.	Is all this structured metadata assigned a unique identifier, persistently related to the unique persistent identifier of the information and data object that is described by the metadata?
10.	Is all this structured metadata, when possible and applicable, automatically ingested based on the business and information management processes that generated them?
11.	Are all information and data objects (and their aggregates), including their metadata assigned an audit trail that documents their business process and information management history, from genesis until disposition?
12.	Are all information and data objects (and their aggregates, including their metadata associated with a detailed provenance and data lineage?

Table 6. Checklist: Findability criteria

Checklist *Requirements of Information Access.*	
Findability	
13.	Are all information and data objects (and their aggregates), including their metadata, related to a transparant (archival) structure, that facilitates navigating in both digital and physical environments?
14.	Are all information and data objects (and their aggregates), including their metadata, indexed by a search system with optical/intelligent character recognition?
15.	Are online thesauri seamlessy integrated into the search system index allowing searchers freedom of expression?
16.	Are all information and data objects (and their aggregates), including their metadata, when applicable, findable online, on the organization's website, intranet, or public repositories, based, if necessary, on access control requirements?
17.	Is it possible to use the search system index (including the integrations with online thesauri) to find the information and data objects (or their aggregates), including their metadata, on the organization's website, intranet, or public repository?
18.	Are the website, intranet, or public repository used for the findability of information and data objects (and their aggregates), designed using the most current version of the Web Content Accessibility Guidelines (WCAG) (or one of its predecessors)?
19.	Are, when applicable, finding-aids available on website, intranet, or public repository fot locating physical information and data objects (and their aggregates)?
20.	Are physical information and data objects (and their aggragates), when receiving a request for access, digitized and published on the organization's website, intranet, or public repository?
21.	Does the website, intranet, or public repository contain a user guide that explains how users may access the physical information and data objects they have requested for review?

Table 6. Checklist: Findability criteria

Checklist *Requirements of Information Access.*	
Availability	
22.	Are all findable information and data objects (and their aggregates), whether digital or physical, and all metadata associated with these objects (indexed within the search system) (immediately) available for retrieval and review?
23.	Are, when necessary, all physical information and data objects (and their aggragates) (even when digital surrogates are available) available for retrieval and review?
24.	Are all availability exclusions based on information control, ownership restrictions, legal disposal, or not otherwise publicly available information and data objects identified, excluded from search system indexes and the reasons for unavailability of these objects and metadata explained?
25.	Are all digital information and data objects synchronized to mirror sites ensuring their ongoing availability in the event of a primary site malfunction?
26.	Are all publicly available digital information and data objects mirrored to an external repository, outside of the organization's information security framework, synchronized daily and accessible to the public by way of a full-text search engine, at least on its metadata?
27.	Are all digital information and data objects (and their aggregates) and all metadata associated with these objects, retained in their original file or data formats as well as in formats that adhere to open standards?
28.	Are all digital information and data objects (and their aggregates) and all metadata associated with these objects continuously checked on retrievability and readability in an automated process?
29.	Are, when retrievability and/or readability are in jeopardy, preservation tools available to reconstruct retrievability and/or readability of digital information and data objects (and their aggregates), using migration, replication, emulation, or other preservation technologies?
30.	Are conservation and preservation tools available to maintain and reconstruct damage to physical information and data objects (and their aggregates) to allow for continuous retrieval and review?

Table 7. Checklist: Availability criteria

Checklist *Requirements of Information Access.*	
Availability	
31.	Are the necessary tools in place to enable the indexation of (extremely) large data sets in a manner that allows for a seamless integration into the search system index, facilitating the availablity of specified information in the data-set?
32.	Are the websites used to make (heritage) information available for users compliant to the Web Content Accessibility Guidelines (WCAG), most current version (at this moment version 2.1)?
33.	Are assistive technologies and applications in use for users with disabilities to allow for (partial) availability to information, based on available standards and guidelines, like the 2015 EU Standard (EU 301 549), the 2017 US rules which revised Section 508, and the 2008 Web Content Accessibility Guidelines 2.1.?
34.	Are the buildings used by (heritage) organizations and the manner in which they are integrated into the surrounding environment in accordance with the standards set forth in *ISO 21542: 2021. Building construction – Accessibility and usability of the built environment* to ensure that the information retained by those organizations is available, including for users with disabilities?

Table 7. Checklist: Availability criteria

Checklist *Requirements of Information Access.*	
Perceptibility	
35.	Are there, to fight overload, systems in place to capture all (relevant) information and data objects (and their aggregates) that enter the organization, whether digital or physical, including the metadata associated with those objects, so that they can be automatically indexed in the search system's index, with no information and data objects left out, forgotten, or without metadata?
36.	Are the organization's hardware and software platforms developed according to universal design principles, allowing for equitable, flexible and intuitive use, with low error tolerance and low physical effort, and with an appropriate size and space for use?

Table 8. Checklist: Perceptibility criteria

Checklist *Requirements of Information Access.*	
Perceptibility	
37.	Are adaptive technologies in use, personalizing computer software for people with special needs or disabilities?
38.	Are (as a minimum) the following software and tools available to allow for people (with special needs or disabilities) to perceive information and data objects (and their aggregates): - Live captioning? - Sign language interpretation? - Transcription? - Audio reading? - Visual and audio description or narration? - Magnifying? - Screen reading? - Speech output? - Non-verbal communication? - Reading pens? - Dyslexia software and fonts? - Braille translators and printers?
39.	Are multisensoring technologies in use, like virtual reality, augmented reality, social robots, or artificial intelligence solutions?

Table 8. Checklist: Perceptibility criteria

Checklist *Requirements of Information Access.*	
Interpretability	
40.	Are (as a minimum) the following software and tools available to enable people (with special needs or disabilities) to interpret information and data objects (and their aggregates)? - Correctness evaluation? - Summarizing information and data objects (verbal/non-verbal)? - Descriptions of information and data objects (verbal/non-verbal)?

Table 9. Checklist: Interpretability criteria

Checklist *Requirements of Information Access.*	
Interpretability	
	- (Palaeographic) Transcriptions of information and data objects (verbal/non-verbal)? - Translations from languages other than their own or from old versions of languages (verbal/non-verbal)? - Lexicons and thesauri (verbal/non-verbal)? - Content categorization tools?
41.	Are the following questions (at least) answered when interpreting information and data objects (and their aggregates) generated by artificial intelligence and machine learning? - Is it possible and/or allowed to evaluate the coding of the algorithm? - Is it possible and/or allowed to evaluate the intelligence models used? - Is it possible to explain how and why the intelligence model generates decisions, predictions, and recommendations? - Is it possible to explain how and why information was generated based on the coding of the algorithm and the intelligence model used? - Is it possible to evaluate the ethical implications of the intelligence models used to generate information? - If these questions cannot be answered, are there valid reasons to allow this information to be captured and indexed?
42.	Is there a training programme to help people acquire the transliteracy skills they need but lack?

Table 9. Checklist: Interpretability criteria

Checklist *Requirements of Information Access.*	
Contextuality	
43.	Is there a metadata schedule in place that documents the actual state of the organization as well as its behaviour (the changes made over time to the actual state of the organization)?

Table 10. Checklist: Contextuality criteria

Checklist *Requirements of Information Access.*	
Contextuality	
44.	Is metadata captured about the environmental context of the information and data objects (and/or their aggregates), with as a minimum: - The organizational structure, and its versions? - The communication structure, and its versions? - The information policy framework, and its versions? - The business process hierarchy, and its versions? - The legal framework, and the changes therein? - The regulatory framework, and the changes therein? - The information control framework, and the changes therein? - Descriptions of the external socio-cultural environment? - Descriptions of the organizational culture?
45.	Is metadata captured about the situational context of the information and data objects (and/or their aggregates), with as a minimum: - The business process schedule, and its versions? - The employee functions and roles, and its versions; - The metadata schedule used within the process, and its versions? - The information control framework for the business process, and its versions? - The case hierarchy, and its versions? - The case structure, and its versions? - The actions and transactions within the case structure, and their versions? - The business rules for processing actions and transactions, and their versions? - The possible results for cases, actions, and transactions; - The information and data objects (and/or their aggregates) that are part of cases, transactions, and actions? - The appropriate retention schedule for the business process? - The information management process used for managing information and data objects (and/or their aggregates)? - Audit trails for all actions and transactions?
46.	Does this metadata make it possible to reconstruct the original role, function, meaning and significance of the information and data objects (and/or their aggregates) in the situation of which they were a part?
47.	Are physical files contextualized in a way that allows for a reconstruction of their original role, function, meaning, and significance?

Table 10. Checklist: Contextuality criteria

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THE FUTURE OF INFORMATION ACCESS

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Perspectives of Artificial Intelligence

The advent of artificial intelligence (AI) has a profound impact on information access. GPT-4 has generated a considerable degree of hype. This chatbox is based on a large language model, which is a machine learning model that is capable of comprehending and generating human language text. The AI hype is a significant concern, as it encourages businesses to hasten the development and adoption of AI technologies (leading to 'bad' and/or biased code), driven by fear of being left behind. A hype always leads to a lack of nuance in the debates about ethical and effective AI-use, as well as fostering bad legal practice and worker anxiety. [440] As the hype reaches its zenith, these issues are becoming increasingly tangible.

It is impossible to think about a future for information access without considering AI. There is profound ambivalence about AI. The deployment of AI technologies is surrounded by complexity and ethical considerations. This ambivalence is not only common in academic discussions but also in public opinion. On one hand, there is the utopian vision of AI as a benevolent, omniscient assistant, exemplified by Vox 114 in the 2002 movie rendition of H.G. Wells's *The Time Machine*. On the other hand, there is a dystopian vision, illustrated in 2003 by Nick Bostrom's 'paperclip armageddon,' warning of the dangers of goal misalignment and the the lack of ethical and moral safeguards in AI systems, which may lead to unpredictability. Bostrom considers the likelihood of his thought experiment to be low, but he highlights the potential dangers of developing superintelligent machines without the knowledge to ensure their safety and prevent adverse effects on humanity. [441]

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[440] K. LaGrandeur (2024). 'The consequences of AI hype,' *AI Ethics*, Vol. 4, pages 653–656. Online source, retrieved 1 November 2024, from: https://doi.org/10.1007/s43681-023-00352-y.

[441] N. Bostrom (2003). 'Ethical issues in advanced artificial intelligence,' I. Smit, W. Wallach, and G.E. Lasker (eds.), *Cognitive, Emotive and Ethical Aspects of Decision*

The optimistic vision of AI portrays it as a means of facilitating convenient and straightforward access to information, enhancing knowledge, providing decision support, and democratizing access to information. AI is conceived as an extension of human cognitive capabilities, with the potential to assist in solving complex problems, improving education, and driving innovation. Large language models, such as the catalyst of this hype GPT-4, exemplify this potential by demonstrating how AI processes generate answers that are similar to those produced by humans, thereby making information more accessible and understandable. Research suggests that AI can enhance information access by automating data analysis, summarizing complex documents, and even predicting future trends based on vast datasets. [442]

The pessimistic perspective emphasizes the potential risks associated with the absence of an alignment between the values of AI and those of humanity. Even an objective that is not inherently problematic can result in adverse outcomes if the AI in question lacks an understanding of its potential impact. It is imperative that AI design is aligned with human ethics and societal norms. However, alignment hinges on the assumption of a *universal interpretation* of ethics and norms, which may prove to be a more complex proposition than initially anticipated. [443] Further-

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Making in Humans and in Artificial Intelligence, International Institute of Advanced Studies in Systems Research and Cybernetics, Windsor (Ontario), Vol. 2, pp. 12–17. Also in: N. Bostrom (2014). *Superintelligence. Paths, Dangers, Strategies*, Oxford University Press, Oxford, pp. 123–124.

[442] See note 330.

[443] M.T. Png (2022). 'At the tensions of south and north. Critical roles of global south stakeholders in AI governance,' *FAcct '22. Proceedings of the 2022 ACM Conference on Fairness, Accountability, and Transparency, Seoul, June 21–24*, pp. 1434–1445; V. Prabhakaran, M. Mitchell, T. Gebru, and I. Gabriel (2022). 'A human rights-based approach to responsible AI,' *arXiv preprint*. Online source, retrieved 1 November 2024, from: https://arxiv.org/abs/2210.02667.

more, it is essential to guarantee that AI systems remain under human control and do not act in ways that could cause harm to humanity.

Both scenarios are, to some extent, accurate. The current iteration of AI models, in their nascent state, displays characteristics that align with both of these perspectives. Although they facilitate access to information, they are lacking in ethical standards and are not aligned with societal norms. While they are able to summarize complex documents, they are unable to understand the implications of their actions. Despite their capacity for analysing vast amounts of information, they lack the contextual knowledge required to interpret their findings. The information presented may be cognitively interpretable, but there is no guarantee that the source of the information is known or that the quality or trustworthiness of the information is assured. They are capable of generating audiovisual information of a high quality, but are prone to scraping copyrighted information, failing to respect privacy, and neglecting to provide attributions when appropriate.

Three types of AI

AI is pervasive in our lives, whether we realize it or not. 'It may not always be obvious, but we are living in the age of intelligent machines.' AI 'permeates our lives in numerous subtle and not-so-subtle ways, performing tasks that, until quite recently, could only be performed by a human with specialized knowledge, expensive training, or a government-issued license.' [444]

The AI that people encounter on a daily basis, whether they are aware of it or not, represents the first type of AI to be identified: artificial narrow intelligence (ANI). The function of ANIs is to perform specific

[444] M.U. Scherer (2016). 'Regulating artificial intelligence systems. Risks, challenges, competencies, and strategies,' *Harvard Journal of Law & Technology*, Vol. 29, No. 2, pp. 354–400. Quotation: p. 354. Online source, retrieved 1 November 2024, from: http://dx.doi.org/10.2139/ssrn.2609777.

actions or commands. They are designed to excel in a single cognitive capability and are unable to independently learn skills that extend beyond the parameters of their original design. Examples of narrow AI include image recognition software, autonomous vehicles, virtual assistants such as Siri and Google Assistant, and large language models like GPT4, Gemini, or Claude. These models are highly proficient at generating text that closely resembles human language but do not possess a genuine understanding of the meaning of that language. ANIs are unable to demonstrate genuine intelligence beyond the scope of their designated function. They are unable to engage in independent thought or to grasp abstract concepts. Although ANI systems are capable of performing tasks in an efficient manner within the context for which they have been designed, they lack cognitive flexibility. However, they are the most successful applications of AI in daily life. They predict and diagnose disease at a faster rate than medical professionals, [445] they design drugs, [446] they reduce the time and costs of information processes by breaking down information silo's, [447] they assist in surgeries, language learning, and ergonomics, [448] and much more. The majority of these ANIs are

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[445] N. Ghaffar Nia, E. Kaplanoglu, and A. Nasab (2023). 'Evaluation of artificial intelligence techniques in disease diagnosis and prediction,' *Discover Artificial Intelligence*, Vol. 3, Article No. 5. Online source, retrieved on 1 November 2024, from: https://doi.org/10.1007/s44163-023-00049-5.

[446] M. Mock, S. Edavettal, C. Langmead, and A. Russell (2023). 'AI can help to speed up drug discovery — but only if we give it the right data,' *Nature*, Vol. 621, pp. 467–470.

[447] H. Chakraborty (2023). 'Revolutionizing the legal landscape. How AI is transforming the legal industry,' *International Journal of Law Management and Humanities*, Vol. 6, No. 2, pp. 3161–3167.

[448] A. Moglia, K. Georgiou, E. Georgiou, R.M. Satava, and A. Cuschieri (2021). 'A systematic review on artificial intelligence in robot-assisted surgery,' *International Journal of Surgery*, Vol. 95, 106151. Online source, retrieved on 1 November 2024, from:

able to function as effectively as they do as a result of the context in which they are deployed, as well as their access to information that is known, accessible, of good quality, and trustworthy.

Two further (hypothetical) types of AI can be distinguished: Artificial General Intelligence (AGI) and Artificial Superintelligence (ASI). AGI refers to the capacity to engage in cognitive processes such as thinking, learning, and problem-solving across diverse domains, without being constrained by contextual factors. It can adapt and respond flexibly to novel situations. [449] One can envisage a self-driving car, which would pick up a passenger from the airport, navigate unfamiliar roads, adapt its conversation in real time, answer questions about local culture based on the passenger's interests, suggest a restaurant based on preferences and current popularity, and recommend things based on earlier visits. [450] Although it is possible to perform all of these tasks in isolation within dis-

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https://www.sciencedirect.com/science/article/pii/S1743919121002867; S. Kouri, E. Köpman, A. Ahtinen, and V. Ramirez Millan (2020). 'Customized robot-assisted language learning to support immigrants at work. Findings and insights from a qualitative user experience study,' M. Obaid, O. Mubin, and Y. Nagai, *Proceedings of the 8th International Conference on Human-Agent Interaction*, virtual event, November 10–13, ACM, pp. 212–220; A. Shafti, A. Ataka, B.U. Lazpita, A. Shiva, H.A. Wurdemann, and K. Althoefer (2019). Real-time robot-assisted ergonomics,' *Proceedings of the 2019 International Conference on Robotics and Automation (ICRA), May 20–24, 2019, Montreal*, IEEE, pp. 1975–1981. Online source, retrieved 1 November 2024, from: https://arxiv.org/pdf/1805.06270.

[449] B. Xu (2024). 'What is meant by AGI? On the definition of Artificial General Intelligence,' *arXiv preprint*. Online source, retrieved on 1 November 2024, from: https://arxiv.org/pdf/2404.10731.

[450] 'Getting ready for artificial general intelligence with examples,' *IBM's Website. Think*, 18 April 2024. Online source, retrieved on 1 November 2024, from: https://www.ibm.com/think/topics/artificial-general-intelligence-examples. Archived at: https://archive.ph/B51Tb. More examples of AGI are menstioned on this page.

parate software environments and utilizing ANIs, the AGI for the simultaneous execution of these operations has yet to be developed. The development of AGI remains an aspirational goal due to the complexities inherent in replicating human reasoning, learning, and adaptability.

ASI is 'software-based artificial intelligence (AI) system with an intellectual scope beyond human intelligence, with cognitive functions and highly developed thinking skills more advanced than any human.' [451] This intelligence is the subject of Bostrom's 'paperclip Armageddon.' ASI is a highly speculative concept that currently resembles science fiction, given that we still lack the requisite knowledge to develop AGI.

It is essential to implement a degree of control in order to guarantee equity, fairness, and accountability, and to ensure that both AGI and ASI do not contravene our collective human values, such as safety, privacy, equality, benevolence, and universalism. [452] Chirag Shah proposes three 'ethos,' or perhaps better 'laws': [1] *conformity*, AI must understand and adhere to collective values and norms; [2] *consultation*, AI must consult with humans to resolve or codify values and value tensions; and [3] *collaboration*, AI must only take control with stakeholder permission (relinquishing control back on command). [453] The issue of conformity may

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[451] 'What is artificial superintelligence?,' *IBM's Website. Think*, 18 December, 2023. Online source, retrieved on 1 November 2024, from: https://www.ibm.com/topics/artificial-superintelligence. Archived at: https://archive.ph/QUIHX.

[452] I. Şuşnea, E. Pecheanu, A.Cocu, and S.M. Şuşnea (2024). 'Superintelligence revisited in times of ChatGPT,' *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, Vol. 15, No. 2, pp. 344–361. The authors argue that there is a shift 'from a theoretical possibility to a pressing concern' and suggest 'several directions of action to avoid the risk of losing control over superintelligent AI.' (p. 358).

[453] C. Shah (2023). 'AI and the future of information access,' *Information Matters*, Vol. 3, No. 10. Online source, retrieved on 1 November 2024, from:

present a challenge because of possible divergences in interpretation of these collective values.

The virtual assistents, image recognition software, large language models: they all have a profound effect on information access and its contexts. Chatbots as natural language interfaces are impacting how the interaction with retrieval and search systems is realized. Because ANIs based on language models are being embedded in the work processes of users, information access becomes context-driven, as Microsoft Copilot demonstrates. [454] If the information the language models are using is trustworthy, the answers of those models will be much more accurate.

Concerns

I have addressed the environmental concerns of the use of AI in Chapter 2 here before. Those are not the only concerns, however. Language models reproduce, and even amplify, stereotypes and biases, present in training data. [455] In August 2024, NewsGuard stated in its *AI Misinformation Monitor*, that the ten leading chatbots (including Microsoft Copilot, Meta AI, Google Gemini, and Perplexity) collectively repeated

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https://informationmatters.org/2023/10/ai-and-the-future-of-information-access/. Archived at: https://archive.ph/TM2qK.

[454] T. Warren (2024). 'Microsoft's new copilot pro brings AI-powered office features to the rest of us,' *The Verge*. Online source, retrieved on 1 November 2024, from: https://www.theverge.com/2024/1/15/24038711/microsoft-copilot-pro-office-ai-apps. Archived at: https://archive.ph/q3jHp.

[455] A. Caliskan, J.J. Bryson, and A. Narayanan (2017). 'Semantics derived automatically from language corpora contain human-like biases,' *Science*, Vol. No. 6334, pp.183–186, and: S.L. Blodgett, S. Barocas, H. Daumé III, and H. Wallach (2020). 'Language (technology) is power. A critical survey of 'bias' in nlp,' D. Jurafsky, J. Chai, N. Schluter, and J. Tetreault (eds.), *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics July 5–10, San Francisco,* ACL, Stroudsburg, pp. 5454–5476. Online source, retrieved on 1 November 2024, from: https://aclanthology.org/2020.acl-main.485.pdf.

misinformation 18% of the time, offered a non-response 31% of the time, and a debunk 51% of the time. [456] As reported by The New York Times, NewsGuard has also identified over a thousand websites that are disseminating a considerable number of AI-generated news articles that are characterized by a high degree of inaccuracy. This phenomenon creates a feedback loop when AI-generated information is employed by other AI models as a training set, resulting in a deterioration in the informational quality of the generated content. Moreover, a study conducted by The New York Times demonstrated that following twenty generations of training new AI systems on the output of their predecessors, the digits become blurred and begin to erode, thereby reducing the technical quality of the information over time. [457] However, this issue is not so much the informational quality of the information collected, but rather the necessity of ensuring its long-term preservation. It is widely acknowledged that, in the absence of meticulous bit preservation, the phenomenon of 'bit rot' will inevitably occur over time. AI training sets are not excluded from digital preservation problems. [458] The assumption

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[456] M. Sadeghi (2024). 'NewsGuard Monthly AI Misinformation Monitor of Leading AI Chatbots. Audit of the 10 leading generative AI tools and their propensity to repeat false narratives on topics in the news,' *NewsGuard*. Online source, retrieved on 1 November 2024, from: https://www.newsguardtech.com/wp-content/uploads/2024/08/August2024AIMisinformationMonitor.pdf.

[457] A. Bhathia (2024). 'When AI's output is a threat to AI itself. As AI-generated data becomes harder to detect, it's increasingly likely to be ingested by future AI, leading to worse results,' *The New York Times*, 25 August 2024. Online source, retrieved on 1 November 2024, from: https://www.nytimes.com/interactive/2024/08/26/upshot/ai-synthetic-data.html. Archived (partly) at: https://archive.ph/j5Qr6.

[458] See: Chapter 1, pp. 18–23. Also: M. Kosciejew (2015). 'Digital vellum and other cures for bit rot,' *Information Management Journal*, Vol. 49, No. 3, pp. 20–26. Online source, retrieved on 1 November 2024, from:

of the accessibility of information when access has been realized is strong, even in AI research.

A fundamental problem is a threat for both information access and social participation. A review of the most frequently cited AI papers revealed that the values espoused and operationalized serve to concentrate power with dominant platforms. All these papers were the result of a collaboration between prominent software companies and leading academic institutions. [459] It wil be necessary to avoid that technology-driven power is only in favour of dominant platforms, thus reducing the space for competition, critique, resistance, or counter-images of a future. Access to information should not be in the hands of leading software companies and academic institutions alone.

Large language models have the ability to estimate the preferences of the searcher for a given query. [460] This is an issue when considering the context of the power asymmetries that exist between business organizations, who have influence over the values that these models emphasize, and the users of these models. This is further compounded by the lack of mechanisms for civil society to participate in and challenge the model choices made, which risks further concentration of power. An example. Aleksandra Urman and Mykola Makhortykh have asserted that Google

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https://magazine.arma.org/wp-content/uploads/simple-file-list/2015_03_IM_digital_vellum_cures_for_bit_rotKosciejew.pdf; and V.G. Cerf (2011). 'Avoiding 'bit rot.' Long-term preservation of digital information [point of view],' *Proceedings of the IEEE*, Vol. 99, No. 6, 915–916.

[459] A. Birhane, P. Kalluri, D. Card, W. Agnew, R. Dotan, and M. Bao (2022). 'The values encoded in machine learning research,' *2022 ACM Conference on Fairness, Accountability, and Transparency (FAccT 2022), June 21–24, 2022, Seoul*, ACM, New York, 173–184. Online source, retrieved on 1 November 2024, from: https://doi.org/10.1145/3531146.3533083.

[460] B. Mitra (2024). 'Search and society. Reimagining information access for radical futures,' *arXiv preprint*. Online source, retrieved on 1 November 2024, from: https://arxiv.org/abs/2403.17901.

Bard did not respond to Russian prompts for items critical to the Russian authorities. This emphasizes the potential for Western large language models to facilitate the censorship and dissemination of disinformation by authoritarian regimes, and the ways in which they may impede access to information related to politics. [461] Information access is not as assured with such models as it seems. Social participation problems are not easily solved because of the power dynamics that create them.

Three developments for enhancing access

Three developments have the potential to enhance access to publicly available information using large language models, even if the collection of information sources for their training datasets may involve the illegal scraping of copyrighted or otherwise protected information. Integrating the current chatbox-based large language models, for instance, with developments within information retrieval research could improve the informational quality of AI models. Information retrieval systems are applied in search engines and systems for answering questions and/or recommendations and have for many years been a reliable means of information access. The combination of language models and generative information retrieval in retrieval augmented generation (RAG) allows for the memorization of trustworthy information and for the direct generation of information users seek, based on context. [462] RAG serves to an-

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[461] A. Urman and M. Makhortykh (2023?). 'The silence of the LLMs. Cross-lingual analysis of political bias and false information prevalence in ChatGPT, Google Bard, and Bing Chat.' Online source, retrieved on 1 November 2024, from:https://files.osf.io/v1/resources/q9v8f/providers/osfstorage/64fb0eabd9f2c93d17d04a1e?trk=public_post_comment-text&action=download&direct&version=2.

[462] X. Li, J. Jin, Y. Zhou, Y. Zhang, P. Zhang, Y. Zhu, and Z. Dou (2024). 'From matching to generation. A survey on generative information retrieval.' *arXiv preprint*. Online source, retrieved on 1 November 2024, from:

chor the language model in external knowledge sources, thereby reinforcing the model's internal representation of information. It guarantees that the model has access to the most current and reliable information, and that users have access to the model's sources. This enables users to verify the model's claims for accuracy and to place their trust in it. [463] It would reinforce information retrieval systems that are already assisted by AI tools with more easy searching and seeking channels for users.

The second development is the design of AI avatars, which are virtual characters that are capable of simulating human-like interactions and providing personalized guidance. According to Christine Liao, they are representations of (personal) identity within virtual worlds. [464] The advent of Second Life, a virtual world which enjoyed considerable popularity for several years, saw the emergence of avatars as a popular form of online identity. The utility of avatars is not limited to a single context; rather, they can be employed in a multitude of scenarios, including but not limited to games, virtual realities, and other environments that emulate game-like experiences. [465] The utilization of AI has facilitated the

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https://arxiv.org/pdf/2404.14851.

[463] P. Zhao, H. Zhang, Q. Yu, Z. Wang, Y. Geng, F. Fu, L. Yang, W. Zhang, J. Jiang, B. Cui (2024). 'Retrieval-augmented generation for AI-generated content. A survey,' *arXiv preprint*. Online source, retrieved on 1 November 2024, from: https://arxiv.org/pdf/2402.19473.

[464] C.L.Y Liao (2011). *Avatar Re/assembling as Art-making, Knowledge-making, and Self-making*. Dissertation, The Pennsylvania State University. The Graduate School College of Arts and Architecture, State College, p. iii. Online source, retrieved on 1 November 2024, from: https://etda.libraries.psu.edu/files/final_submissions/1035.

[465] G. Ünal Tüfekçioğlu (2024). *The Impact of Using Artificial Intelligence Generated Text-to-Speech Avatars on Learning in Video-based Trainings*. Master thesis, Middle East Technical University, Ankara. Online source, retrieved on 1 November 2024, from: https://open.metu.edu.tr/bitstream/handle/11511/109769/Gulden%20Unal%20Tufekcioglu%20Thesis.pdf.

interaction of avatars with users through text and speech via natural language processing. This enables them to comprehend questions, provide logical responses and assist in information access. In certain instances, they are even able to comprehend expressions and gestures. [466] They are capable of providing a personalized service by learning user information during interactions and of enhancing information access over time. They exert influence, have a presence in interactions, and affect (and are affected by) human and non-human actors. [467] The advancement of AI has led to its implementation in a multitude of contexts, including marketing, customer service, personalized tutoring, patient engagement and support, mental health support and advice, patient monitoring, student progress, customer guidance in business processes, collaborative software development, art and entertainment, and numerous other real-life situations, improving information access. [468] Given the acceptability of AI avatars by human users in human-computer interaction, it seems reasonable to suggest that avatars may represent a promising avenue for facilitating more universal information access. [469] When combined with RAG, the possibilities would be very interesting.

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[466] B.S. Kim and S. Seo (2022). 'Intelligent digital human agent service with deep learning based-face recognition,' *IEEE Access*, Vol. 10, p. 72794–72805.

[467] C. Liao (2024). 'My avatar's avatars. A visual exploration and response to AI-generated avatars,' *Visual Culture & Gender*, Vol. 19, pp. 11–23. Online source, retrieved on 1 November 2024, from: https://vcg.emitto.net/index.php/vcg/article/download/144/148.

[468] 'Avatars in Action. Real-world Applications Beyond Gaming,' *YouTube: Avataryug Podcast,* April 29, 2024. Online source, retrieved on 1 November 2024, from:https://www.youtube.com/watch?app=desktop&v=_I0Gcz4mtqQ&ab_channel=Avataryug.

[469] Y. Liu, K.L. Siau (2023). 'Human-AI interaction and AI avatars,' H. Degen, S. Ntoa, A. Moallem (eds.), *HCI International 2023. Late Breaking Papers. HCII 2023.* Lecture Notes in Computer Science, Vol 14059, Springer, Cham. Online source, retrieved on 1 November 2024, from:

A third area of development is the design of content credential systems, which aim to add watermarks, digital signatures and/or manifests to information in order to authenticate its provenance. Generative media tools have led to scraping practices that gather and process information in a way that makes it almost impossible to validate its quality and authenticity. The creation of AI-generated images and videos, or so-called 'synthetic content,' and other forms of AI-generated misinformation has significant and detrimental effects on society. These effects include the dissemination of falsehoods, the manipulation of original information into something transformed of its intended meaning, and the potential to modify both individual memories into something false, and a person's attitudes toward the target of the malignous misinformation. [470] This has led to calls for the development of tools capable of detecting this information. Nevertheless, the efficacy of such detection tools is likely to be limited to a period of weeks. [471] Other research posits that the objective should be to verify the veracity of information, rather than identifying misinformation. In order to achieve this, software has been developed which is capable of automatically watermarking and identifying images

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https://www.researchgate.net/publication/375910768_Human-AI_Interaction_and_AI_Avatars. Also: M. Yasuoka, T. Miyata, N. Nakatani, Y. Taoka, and N. Hamaguchi (2023). 'How remote-controlled avatars are accepted in hybrid workplace,' N.A. Streitz and S. Konomi (eds.), *Distributed, Ambient and Pervasive Interactions: HCII 2023*, Springer, Cham, pp. 295–307.

[470] J.T. Hancock and J.N. Bailenson (2021). 'The social impact of deepfakes,' *Cyberpsychology, Behavior, and Social Networking*, Vol. 24, No. 3, pp. 149–152. Online source, retrieved on 1 November 2024, from: https://doi.org/10.1089/cyber.2021.29208.jth.

[471] J. Vincent (2019). 'Deepfake detection algorithms will never be enough,' *The Verge*, June 17. Online source, retrieved on 1 November 2024, from: https://www.theverge.com/2019/6/27/18715235/deepfake-detection-ai-algorithms-accuracy-will-they-ever-work. Archived at: https://archive.ph/QQx21.

and videos captured on cameras, or of digitally signing other information. An additional solution is the utilization of blockchain technology to authenticate information originating from reliable sources, e.g. as the concept of the 'information bank.' [472] The objective of these cryptographic techniques is to verify the identity of the publisher, the technical integrity of the information, and the data lineage and/or provenance of the information. A part of this research is being conducted by the Coalition for Content Provenance and Authenticity (C2PA), an organization that is developing technical methods for the documentation of the provenance and history of digital media files, including both real and fake examples. [473] In 2021, the C2PA group published the initial version of a set of guidelines for the attachment of cryptographically secure metadata to image and video files. Any modification to the file is reflected in the metadata, thereby breaching the cryptographic seal and rendering any

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[472] Watermarks: H. Rhayma, R. Ejbali, and H. Hamam (2024). 'Auto-authentication watermarking scheme based on CNN and perceptual hash function in the wavelet domain,' *Multimedia Tools and Applications*, Vol. 83, pp. 60079–60101. Online source, retrieved on 1 November 2024, from: https://doi.org/10.1007/s11042-023-17924-z. Digital signatures: B. Jacobs (2024). 'The authenticity crisis,' *Computer Law & Security Review*, Vol. 53, 105962. Online source, retrieved on 1 November 2024, from: https://www.sciencedirect.com/science/article/pii/S0267364924000293. Information bank: B. Barrowes (2022). 'The Information Bank. Information authenticity with simultaneous accountability and anonymity in the digital era,' K. Arai (ed.) *Advances in Information and Communication. Proceedings of the 2022 Future of Information and Communication Conference (FICC)*, Volume 2, Lecture Notes in Networks and Systems, volume 439, Springer, Cham, pp. 1001–1014.

[473] E. Strickland (2023). 'Content credentials will fight deepfakes in the 2024 elections. Media organizations combat disinformation with digital manifests,' *IEEE Spectrum*, 27 December. Online source, retrieved on 1 November 2024, from: https://spectrum.ieee.org/deepfakes-election. Archived at: https://web.archive.org/web/20240923092127/https://spectrum.ieee.org/deepfakes-election.

tampering evident. In the event that the individual undertaking the alteration utilises a tool that is compatible with content credentialing, the pertinent information regarding the modifications is incorporated into the manifest that is associated with the image. [474] These techniques are of significant importance with regard to information access, as they provide the means to ascertain the provenance and historical background of digital information. Such a verification process enables internet users to make informed decisions regarding the veracity and accuracy of the information in question. A combination of these techniques with RAG would facilitate the seeking and retrieval of accurate and authentic information.

A possible future for information access and accessibility

The future is inherently uncertain. Nevertheless, based on the current state of information technology and the aforementioned developments, it is possible to project what the year 2050 might bring. The timeframe is sufficiently distant to allow for discrepancies between my expectations and subsequent reality, which is, in fact, highly probable. [475] Although the technological capabilities would, in theory, permit an earlier timeframe than 2050 for achieving these expectations, the organizational requirements are likely to prevent its realization before the aforementioned year. This perspective is primarily concerned with government organizations. Although the concept is applicable to business or-

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[474] *C2PA Specifications*. Online source, retrieved on 1 November 2024, from: https://c2pa.org/specifications/specifications/2.1/specs/_attachments/C2PA_Specification.pdf. Archived at: https://web.archive.org/web/20240926170204/https://c2pa.org/specifications/specifications/2.1/specs/_attachments/C2PA_Specification.pdf.

[475] This projection of a possible future has been published previously (with small differences) in Dutch: G.J. van Bussel (2023). 'Archivering in 2050. Een blik op de toekomst,' *Archievenblad*, Vol. 127, no. 3, 2023, pp. 6-9.

ganizations, its specific interpretation differs. Nevertheless, the fundamental premise remains unchanged.

In 2050:

[1] Irrespective of their geographical location, employees log in to their employer's dashboard portal with their mobile work units, which are fully encrypted. Once authentication has been completed via both facial and iris recognition, the individual is presented with a personalized dashboard. This dashboard is compiled based on the authorizations that have been granted to the individual, thereby allowing access to all information that employees are authorized to read and process.

[2] This personal dashboard provides an overview of work in progress, predominantly comprising decisions for which the organization has defined human input. The staff member's work comprises the review of Al's daily case processing reports, the identification of discrepancies, consultation with affected citizens and businesses, the evaluation of selected information concerning approved strategies, and the communication of any changes to the Al avatar for further processing. Additionally, the staff member provides information to managers and directors on politically sensitive matters. The Al avatar is always available to provide assistance, guidance, and information. The avatar is furnished with sophisticated speech technology.

[3] Business processes are conducted entirely automatically in accordance with Al-powered 'business rules' that have been designed to handle specific and complex processes. The involvement of multiple organizations in business processes and communication between (inter-organizational) applications are facilitated through the utilization of secure connections. The Al system employs knowledge bases, wherein all specifications, requirements, and contextual metadata are defined per process and process step and assigned automatically during process handling. In the event of non-compliance with the prescribed workflows,

each instance is allocated to three human reviewers, who are potentially situated across organizational boundaries. Each reviewer makes an independent determination. In conjunction with Al systems from other organizations, the Al system determines the potential consequences of the responses and the rationale provided for them. It then decides on the most appropriate course of action, discusses this with the reviewers and, if permitted, incorporates the deviation into the existing definitions automatically. The machine learning system ensures that the algorithms of the local Al and the applications used are continuously improved to enhance their capacity to handle complex processes. The Al system permits the incorporation of business rules and the rationale behind this incorporation into the central knowledge base (one each for the associations of federal, regional, and local governments) in order to adapt the standard models (where necessary). Policy and consultation processes are assigned automated workflows. The Al avatar is able, in discussion with employees, to modify the procedure to be followed and to add (internal and external) participants, as well as to provide them with the requisite authorizations for tasks to accomplish and/or information to access.

[4] The central knowledge bases contain all standardized data models of process definitions, metadata, business rules, retention schedules, archival models for long-term access, and so forth. These are used in the local knowledge bases as guidelines for an organization's specific data models. The central knowledge bases are employed by local AIs to guarantee the relevancy of the catalogue models, to assess the legitimacy of local adaptations to process definitions, and to ascertain whether decisions on deviations are permissible in their consequences.

[5] Each organization has an infrastructure that is secured with quantum technology, based on a Hybrid Storage Area Network (HSAN). All provisions have been made for the secure storage and communication of information. HSAN is both on-premises and in the cloud, with the IT branch of the central associations providing the necessary facilitation.

In accordance with the central guidelines, Al is responsible for determining the location and type of information stored. This requires the participation of numerous commercial entities, which serve as [a] suppliers of the HSAN and [b] data centres where hosting is conducted. The data centres operate on a combination of renewable energy sources, with hydrogen representing the primary source, while solar, wind and water also contribute to the overall energy mix. All storage is redundant and equipped with two synchronisations and three mirrors, thereby ensuring uninterrupted access to information in case of emergencies. Additionally, the HSAN incorporates a 'Digital Vault' for the long-term storage of information that is deemed essential for preservation. In light of the climate crisis, the five data centres utilized for synchronization and mirroring are situated in regions that are not vulnerable to sea level rise.

[6] The personal dashboard provides each employee with access to all the information they require to perform their duties. This includes metadata regarding the context of the information and potential relationships with other available information. The Al avatar can provide or suggest further information in consultation with the employee, taking into account their permissions. Where appropriate, the avatar may also provide answers.

[7] The management of information is automated, with processes aligned to the stages of the information value chain. Context is provided to information at each stage of its lifecycle, from initial intake through to preservation or disposal. All information has cryptographically attached provenance and data lineage information as well as digital signatures to protect its integrity and authenticity. Only information pertinent to the matter in hand is recorded, accessible only to those employees authorized to view this information. The implementation of archiving processes has been completely realized. The deadline for disposal is contingent upon the outcome of a business process. Where feasible, file formats are converted to sustainable formats (defined in format libraries as

Pronom). The disposal and transfer processes are automated, with the archivist acting as the sole arbiter of exceptions, based on input from the Al avatar regarding potential hotspots. The automated transfer to the Digital Vault is provided with the requisite formats and context for publication, ensuring the optimal presentation of the material in question. The archivist is duly authorized to perform the requisite management functions. A biannual external audit is conducted with regard to the management of information. The audit is conducted in accordance with the knowledge base of the Central Inspectorate for Information Management of the Ministry of Information and Information Infrastructure, as prescribed by the Information Act of 2042. Older archives have been digitized. Archives created prior to 1850 are retained in original form and stored in central archive repositories in accordance with the principles of good management practice. Access to this material is permitted for researchers by prior appointment. The entirety of this material is accessible in digital formats via the Digital Vault.

[8] The Digital Vault functions as the repository for all information to be preserved, accompanied by all requisite contextual metadata. This Vault is accessible to all employees within the organization. The HSAN provides the optimal level of security for the Digital Vault. A publicly accessible mirror of the Vault is provided. The mirror is searchable and furnished with an Al avatar, which welcomes visitors and assists them in locating the desired information. The mirror can be accessed from the organization's website, as well as from generic and public heritage sites. The information is presented in its 'original' form, with emulations provided where necessary, accompanied by transcriptions and translations into modern language. Optical character recognition indexes of all archives, including context, are available via search engines, thereby enabling users to access information from multiple Digital Vaults simultaneously.

6

CONCLUDING REMARKS

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As a phenomenon, information access and accessibility is full of contradictions, presuppositions and demands. It is a plaything of social forces that have both positive and negative effects on the ability of ordinary citizens or customers to access information. The advantages contribute to making it easier for people to participate in society and for companies to market information as an economic good. The disadvantages exacerbate socio-economic problems in society and concentrate power in the hands of those who control access to information. The confluence of political and economic elites means that access to critical information can (and often will) be restricted. Ever-changing technology makes it difficult for more and more people to access information because they lack the necessary literary skills. All in all, access to information is a problematic and intractable phenomenon, and as such a complex conundrum. For how can we ensure that everyone has the opportunity to access the information available (both as-thing and as-knowledge)? Information access and accessibility represent a conundrum, characterized by a lack of clarity and consensus. It is a complex problem that defies straightforward solutions and may appear intractable.

It is evident that access to and accessibility of information is a multifaceted and problematic phenomenon, comprising a number of interrelated approaches. My analysis of literature from seven (more or less isolated) research fields in Chapter 3 revealed the existence of six distinct approaches to the study of information access and accessibility. These are: [1] social, economic, and political participation; [2] 'smart' and evolving technology; [3] power and control; [4] sense-making; [5] knowledge representations; and [6] information survival. These approaches mirror, more or less, the conceptualizations recognized by Maureen McCreadie, Ronald Rice and Shan-Ju Chang in 1999 and 2001.

Of the research fields I evaluated (information access disparity, information seeking, information retrieval, information quality, information security, information management, and archiving), none considers

all of these approaches. The multitude of approaches, however, demonstrates the inherent impossibility of completely studying and describing information access. Nevertheless, despite the popularity of and the funding incentives associated with multidisciplinary research, such research of information access and accessibility remains underdeveloped in the aforementioned disciplines.

All research fields must address the myriad challenges posed by the hybrid world with respect to the access to and the accessibility of information (as-thing and as-knowledge). The seven most significant (closely related) challenges in the context of our hybrid world can be broadly categorized as follows:

[1] The *digitalization of society*, representing the process of socio-economic change that has been triggered by the introduction of digital technologies. The process of digitalization has led to the emergence of 'code' as a regulator of 'cyberspace,' defining how it is experienced, how privacy is protected, how speech is censored, how access to information is organized, permitted or prohibited, and how users are monitored. This process of regulation allows private actors to embed their values into technological structures, thereby constraining user actions, limiting anonymity, freedom of speech, information access, and individual control. This has the potential to endanger democracy. In Chapter 2 the digitalization of society is extensively addressed.

[2] The *'problem of mass,'* the disruptive change in the dissemination of information that has resulted in an overload of information, created by an increase in the number of content producers, as discussed in Chapter 1. The exponential growth of the information mass is an irrefutable phenomenon, although it is a challenge to quantify this growth. It is affecting the access to and the accessibility of information (as-thing and as-knowledge). The phenomenon of the 'problem of mass' gives rise to a situation in which information management processes are overwhelmed by a substantial influx of both structured and unstructured information,

thereby rendering access to relevant information challenging. I drew attention to this 'problem of mass' in Chapters 1 and 2.

[3] The *phenomenon of 'digital divides,'* characterizing significant inequalities in access to information and information technologies. These inequalities are a consequence of socio-economic disparities that restrict access to information, education, employment, and essential services. Furthermore, these divides manifest as 'literacy divides,' whereby individuals demonstrate considerable variability in their transliteracy abilities. These encompass the capacity to explore, identify, evaluate, extract, comprehend, interprete, and contextualize information through the utilization of diverse media styles. The 'digital divides' encompass both the availability of information and the capacity to utilize it effectively. The prevailing deficiencies in the quality of education are such that a significant proportion of the population lacks the requisite high-level competencies to evaluate the information with which they are confronted, which has a detrimental effect on their ability to gain knowledge. I have previously addressed this topic in Chapter 2.

[4] *Paradox 3.0*, which refers to the situation where, even if access to information is possible, it may still be inaccessible, due to a degraded file format, a format that lacks the software to make it accessible, a victim of 'bit rot,' written in code, or an incomprehensible language. Access to information does not necessarily imply that information is interpretable. The assumption that the realization of access implies accessibility is erroneous. The third paradox of access is that even if resources and skills are available and access is possible (i.e., findable and available), there is no guarantee that the information itself is accessible (i.e., perceptible, interpretable, and contextual). This assumption has resulted in the problematic retrieval of 'older' information. Furthermore, it is evident that this assumption is deeply embedded within the disciplines that I have evaluated in relation to information access and accessibility. The exceptions are information quality research, recognizing 'interpretability' as a

quality characteristic for information, and archival research, with its emphasis on digital preservation and the approach of 'information survival.' The third paradox was addressed directly in Chapter 1, while all other chapters addressed it indirectly.

[5] *The imbalances between convenience and social responsibility* are a significant issue. The advantages of the hybrid world in relation to information access and accessibility primarily concern *convenience and commercial capabilities*, while the disadvantages primarily concern *societal issues*, exacerbated by the digitalization of society. The disadvantages cause significant social disruption, creating divisions between different groups, and leaving the most vulnerable members of society behind. The disadvantages are exacerbated by the bottlenecks of digitalization that all concern information access. These bottlenecks (political, social, economic, legal, infrastructural, educational, personal, and organizational) can be associated with the research approaches identified in Chapter 3 and all disadvantages of digitalization. Although digitalization has made access to information more convenient and has opened up many libraries for consultation, the disadvantages and bottlenecks are far-reaching. This is not an easily solvable problem, as it would interfere heavily with private business practices. Nevertheless, the adverse effects on society are a cause for concern and require attention. One potential solution could be to limit the extent to which these private interests are able to exercise control over information access. In Chapter 2 and 4 these inbalances are addressed.

[6] As discussed in Chapter 5, *the advent of artificial intelligence* has had a profound impact on the manner in which information is accessed. It is capable of connecting to a multitude of sources and returning information that is both more profound and more perceptive. It generates responses in a variety of formats, including text, image, and video. Furthermore, it facilitates the expeditious retrieval of information and the discovery of new knowledge. It has the potential to enhance accuracy by

providing tailored results and recommendations. Additionally, it has the potential to complete search tasks with more specific goals. This represents a shift from the traditional act of clicking to a more natural mode of communication, namely language. Users are able to pose queries ('prompts') and receive direct, conversational answers. However, there are also potential negative implications of artificial intelligence. These include the risk of compromising privacy, information integrity, copyright, job security, and trustworthiness. This is due to factors such as inaccuracy and hallucinations, bias, propaganda, and misinformation. Such developments could erode public trust in information. When combined with proven information retrieval technology and data collection from trusted sources, such as those of scientific publishers, libraries, archives, and newspapers, artificial intelligence has the potential to evolve into a highly transparent and reliable tool for information access. Nevertheless, this does not guarantee the accessibility of the utilized resources. As discussed in Chapter 2, the environmental challenge posed by artificial intelligence systems is significant. However, several potential solutions are being explored and are in the process of being implemented. The impact of these solutions will become evident in the coming years.

[7] *The realization of the requirements of information access and accessibility* will not solve the societal challenges of information access and accessibility. However, it is vital that all information retained, stored, and preserved for whatever reason, even if it is affected by the information access bottlenecks outlined in Chapter 4, meets the requirements, whether it is held by a public or a private entity. In the same chapter, we identified five key requirements for information access and accessibility, based on a review of 36 criteria from scientific literature. These are: availability, findability, perceptability, interpretability, and contextuality. Information is accessible when it can be located, made available, perceived by users (even those with special needs), interpreted, and contextualized, thus having

the possibility to reconstruct the context of its generation, use, control, and management. These five requirements together define information access and accessibility. Without even one of these requirements, access and accessibility do not exist. The five requirements allow information-as-thing to become information-as-knowledge. The provided checklist enables organizations to evaluate their information environment in line with these requirements, optimizing information system implementation to enhance access, accessibility, and quality of information.

In today's fast-paced economic and technological environment, the realization of the requirements for information access is crucial in order to remain relevant and competitive. Open communication, collaboration, and the free exchange of ideas are essential for enhanced productivity and innovation. While they do not solve the complex conundrum of information access and accessibility, their implementation will be an important step towards enabling trusted information and optimizing information access and accessibility.

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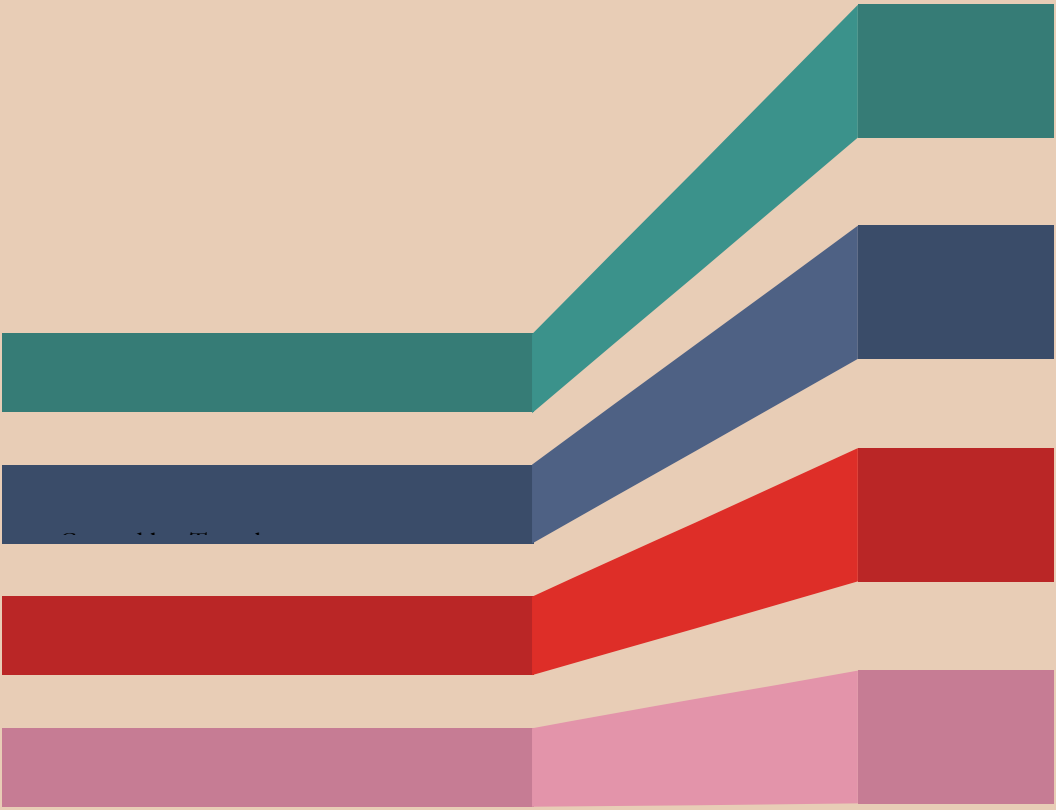

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