

Chapter 22

The Internet of Beings: The Nightmares and Dreams of Digitalising Human Bodies

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Abstract

Internet of Beings is a voyage inside what the author predicts to be the third and final phase of the Internet revolution. The first phase ('Internet of Computers') linked all digital devices into a seamless information system; the second, 'Internet of Things', is integrating physical objects into such a network. The third is where living bodies ('beings') and learning machines will be connected among themselves through increasingly powerful, smaller devices. This chapter captures some of the main results of a vast interdisciplinary research and management consulting practice that the author has conducted in the last few years. The book will provide the big picture of a transformation: the underlying epistemological belief is that an understanding of such large technological, scientific, and economic change requires a frame that connects its different dimensions.

Keywords: *Artificial Intelligence, Internet, Healthcare, Pharmaceutical, Insurance*

Introduction – The Paradigm

The convergence between computer science and healthcare¹, data and drug discovery, may be the real next big thing. It may become the most important achievement of the Internet revolution. The 'internet of beings' can provide the theoretical framework to make sense of it. The paradigm is about a vision in which living bodies and computers become connected into a potentially seamless, global information system^{2,3}.

This vision is made more likely by the convergence of three powerful trends.

First, the huge investments made by tech companies have been in so-called 'artificial intelligence'. The objective of defeating some of the diseases we have accepted as part of our existence may give AI a problem to solve with the new technology and a possible return on such an investment. Second, the crisis of Western healthcare sectors is a political problem for most governments, together with the

¹Julia Amann et al., "Explainability for Artificial Intelligence in Healthcare: A Multidisciplinary Perspective," *BMC Medical Informatics and Decision Making* 20, no. 1 (November 30, 2020).

²Ernesto De la Paz et al., "A Self-Powered Ingestible Wireless Biosensing System for Real-Time in Situ Monitoring of Gastrointestinal Tract Metabolites," *Nature Communications* 13, no. 1 (December 1, 2022): 7405, <https://doi.org/10.1038/s41467-022-35074-y>.

³The Economist, "Wearable Technology Promises to Revolutionise Health Care," *The Economist*, May 5, 2022, <https://www.economist.com/leaders/2022/05/05/wearable-technology-promises-to-revolutionise-health-care>.

possibility for emerging countries to leapfrog the West. Third, the legacy of COVID-19, which introduced technologies in the delivery of health (and education) to nearly all families^{4,5}.

The work is exploring the opportunities of such an evolution^{6,7}; the industrial policies that may create national competitive advantages around the paradigm; the risks that may dwarf the ones we are currently trying to tame (body hacking may become a possibility); the regulations that national and global policymakers will design to limit those risks.

The Technological Implications

It is an evolution that has been anticipated by wearable sensors (like the ones that Apple and Garmin are perfecting) and implanted machines (like the cardiac bypasses) that have been around for years^{8,9}. Yet these devices are about to become capable of performing increasingly sophisticated functions that the book is exploring¹⁰.

This evolution will be accelerated by three simultaneous technological developments. The rise of large language models: this may lift the limits of machines' ability to make sense of data, which is dirty because it uses semantics that were not recognisable by computers. The introduction of communication systems (so-called 6G) is essential for remotely intervening in organisms under certain conditions. The development of chips and quantum computers¹¹ that will ultimately be able to provide the possibility to process much larger datasets.

The Impact on Industries: Five Industries at a Strategic Crossroad

The transformation in how we protect health will affect a wide variety of industries.

We will, more specifically, focus on three: insurance, pharma¹², and high tech.

⁴George Abi Younes et al., "COVID-19: Insights from Innovation Economists," *Science & Public Policy* 47, no. 5 (July 1, 2020), <https://doi.org/10.1093/scipol/scaa028>.

⁵Maria Costanza Cau and Giuseppe Cipolletta, "The Covid19 Pandemic: Winners and Losers - Vision | Think Tank; a 'Factory of Ideas,'" Thinktank.vision, February 25, 2021, <https://www.thinktank.vision/en/publications/the-covid19-pandemic-winners-and-losers?highlight=WyJjb3ZpZDE5Il0=>.

⁶Erica Coe et al., "Adding Years to Life and Life to Years," McKinsey & Company, <https://www.mckinsey.com/mhi/our-insights/adding-years-to-life-and-life-to-years>.

⁷"Closing in on Cancer," *The Economist*, September 16, 2017, <https://www.economist.com/leaders/2017/09/16/closing-in-on-cancer>.

⁸Andrea M. Matwyshyn, "The Internet of Bodies," *William & Mary Law Review* 61, no. 1 (October 2019), <https://scholarship.law.wm.edu/wmlr/vol61/iss1/3/>.

⁹"The Quantified Self," *The Economist*, 2022, <https://www.economist.com/technology-quarterly/2022-05-07>.

¹⁰"Wearable Tech to Become \$232 Billion Industry by 2030, Forecasts GlobalData," GlobalData, February 9, 2026, <https://www.globaldata.com/media/strategic-intelligence/wearable-tech-to-become-232-billion-industry-by-2030-forecasts-globaldata/>.

¹¹David P. DiVincenzo, "The Physical Implementation of Quantum Computation," *Fortschritte Der Physik - Progress of Physics* 48 (October 25, 2000): 771–83, [https://doi.org/10.1002/1521-3978\(200009\)48:9<11%3C771::AID-PROP771%3E3.0.CO;2-E](https://doi.org/10.1002/1521-3978(200009)48:9<11%3C771::AID-PROP771%3E3.0.CO;2-E).

¹²Marc Mitchell and Lena Kan, "Digital Technology and the Future of Health Systems," *Health Systems and Reform* 5, no. 2 (2019): 113–20, <https://doi.org/10.1080/23288604.2019.1583040>.

This will, indeed, be a transformation where it is not necessarily true that in the process the ‘first will win all’ (though in some industries this may happen) or that it would be better for companies to adopt disruption as soon as possible: innovation will carry not only the risk of failure but also of cannibalising existing competitive advantages, operations, customer bases, and branding. This is especially true for insurance that will be faced by a transformation that may change the nature itself of their industry (personalisation of the risk is somehow the opposite of managing risks by pooling them together); and pharma (enhancing drug discovery with much vaster databases may change the economics of research and the definition itself of intellectual property).

The ‘internet of beings’ will also be a huge opportunity/challenge for the Internet giants: companies like Alphabet have already made significant investments into healthcare and pharma as a possible diversification of a business model entirely based on revenues from digital marketing. So far, these efforts have not been successful (as the cases of Alphabet’s ventures, such as Calico and Verily Life Sciences, seem to demonstrate): Silicon Valley has so far had tough times when dealing with the production of socially relevant, highly regulated goods. And yet, as mentioned, the rise of artificial intelligence makes it more urgent for Internet companies to find new revenue streams to repay their huge investments into AI.

It would, however, be naïve to take for granted that economic change will proceed at the same pace as the evolution of technologies. The last few decades have shown clearly how resistance to change¹³ can delay or derail transformation. This is especially true (as we anticipated in chapter one) when it comes to healthcare, which has been traditionally reluctant to embrace digital innovation. The book will explore such resistance.

Social Implications: The Clash Between Two Opposite Visions

The idea of ‘digitalising human bodies’ will pose entire societies at a crossroads. More specifically, two opposite outcomes are theoretically possible as far as equality within countries and across them¹⁴.

Personalised insurance may, for instance, push all insurance companies to compete for the same, healthier individuals (leaving everybody else paying higher premiums); similarly, the personalisation of drugs (and the multiplication of drug products) may also have a devastating impact on cost and, thus, prices.

And yet it is also possible that the opposite scenario, where drugs will cost much less because they use personal information that belongs to patients and individuals, which will have to be rewarded for sharing data. Constant monitoring may also have the effect of allowing much better prevention, which would make healthcare more efficient and less costly.

¹³William J Baumol and David M De, *The Cost Disease: Why Computers Get Cheaper and Health Care Doesn’t* (New Haven, Conn.; London: Yale University Press, 2012), 3–32.

¹⁴N M Hjelm, “Benefits and Drawbacks of Telemedicine,” *Journal of Telemedicine and Telecare* 11, no. 2 (2005): 60–70, <https://doi.org/10.1258/1357633053499886>.

It is possible, indeed, both a dystopic scenario¹⁵ as the one envisaged by some Silicon Valley tycoons, where some superhumans could eventually live forever. And one where the use of technologies will serve the more mundane and concrete policy target of making health accessible to everybody. The direction we will undertake heavily relies on the capability of policymakers to foresee the transformation and steer it towards reasonable goals.

The Consequences on Geopolitics and Global Competitiveness

The digitalisation of health and drug discovery will elicit different responses: some countries, most likely the developed liberal democracies, will be delayed by the legacy of much more developed healthcare systems^{16,13} and pharmaceutical industries^{17,18}, while others may find the opportunity to find novel competitive advantages.

Asia has already shown how emerging from behind the curve can become a great strength. The majority of Indians did not have identity cards when the government decided to provide everyone with a biometrics-based identification system (the Aadhaar), which is considered one of the most sophisticated ID programs in the world and also one that may enable the fastest access to telemedicine services. China is also paradigmatic: it spends 12 times less than the USA (and four times less than the EU average), and yet it has almost reached America in terms of life expectancy and overcome Eastern EU countries by using data smartly¹⁹. The UAE is seeking to establish leadership in genomics by drafting regulations that make it easier to harness the benefits of personalised medicine while ensuring these benefits are fairly distributed across the population.

The West still has a formidable scientific lead²⁰ (and all 15 largest pharmaceutical companies are either American or European, plus one Japanese). European healthcare systems are still considered one of the cornerstones of the European welfare. And yet the idea of accessing data directly from human bodies can turn on its head both the process we have used for decades in medical research and the organisation of health care systems.

Experimentations will be the key. This may be an opportunity for international organisations, such as the WHO, to rethink their mission: they may well become producers of common knowledge that help countries avoid mistakes and deliver value to their citizens.

¹⁵Andréa Bellinger and David J Krieger, *Hacking Digital Ethics* (London; New York: Anthem Press, 2021).

¹⁶Mitchell and Kan, "Digital Technology and the Future of Health Systems," 113-120.

¹⁷Enrico Bonadio, Luke McDonagh, and Plamen Dinev, "Artificial Intelligence as Inventor: Exploring the Consequences for Patent Law," *Intellectual Property Quarterly* 1, March 22, 2021, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3798767.

¹⁸Christopher M. Holman, "The Critical Role of Patents in the Development, Commercialization and Utilization of Innovative Genetic Diagnostic Tests and Personalized Medicine," *Boston University Journal of Science and Technology Law* 21, no. 2 (2015), <https://doi.org/10.2139/ssrn.2731683>.

¹⁹Feng Yang, Huilin Shu, and Xiaoqian Zhang, "Understanding 'Internet plus Healthcare' in China: Policy Text Analysis," *Journal of Medical Internet Research* 23, no. 7 (July 26, 2021): e23779, <https://doi.org/10.2196/23779>.

²⁰"The Impact of Global Digital Companies on Consumers, Firms and Governments - Vision & Value," Vision & Value, December 20, 2022, <https://visionandvalue.com/portfolio/the-impact-of-global-digital-companies-on-consumers-firms-and-governments/>.

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References

- Abi Younes G, Ayoubi C, Ballester O, Cristelli G, de Rassenfosse G, Foray D, Gaulé P, Pellegrino G, van den Heuvel M, Webster E, et al. 2020. COVID-19: Insights from innovation economists. *Science & Public Policy*. 47(5). doi:<https://doi.org/10.1093/scipol/scaa028>. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7337780/>.
- Amann J, Blasimme A, Vayena E, Frey D, Madai VI. 2020. Explainability for artificial intelligence in healthcare: a multidisciplinary perspective. *BMC Medical Informatics and Decision Making*. 20(1).
- Baumol WJ, De DM. 2012. *The cost disease: why computers get cheaper and health care doesn't*. New Haven, Conn.; London: Yale University Press.
- Bellinger A, Krieger DJ. 2021. *Hacking Digital Ethics*. London; New York: Anthem Press.
- Bonadio E, McDonagh L, Dinev P. 2021 Mar 22. Artificial Intelligence as Inventor: Exploring the Consequences for Patent Law. *Intellectual Property Quarterly* 1. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3798767.
- Closing in on cancer. 2017 Sep 16. *The Economist*. <https://www.economist.com/leaders/2017/09/16/closing-in-on-cancer>.
- Coe E, Dewhurst M, Hartenstein L, Hextall A, Latkovic T. Adding years to life and life to years. McKinsey & Company. <https://www.mckinsey.com/mhi/our-insights/adding-years-to-life-and-life-to-years>.
- Costanza Cau M, Cipolletta G. 2021 Feb 25. The covid19 pandemic: winners and losers - Vision | think tank; a “factory of ideas.” Thinktankvision. [accessed 2026 May 1]. <https://www.thinktank.vision/en/publications/the-covid19-pandemic-winners-and-losers?highlight=WyJjb3ZpZDE5II0=>.
- De la Paz E, Maganti NH, Trifonov A, Jeerapan I, Mahato K, Yin L, Sonsa-ard T, Ma N, Jung W, Burns R, et al. 2022. A self-powered ingestible wireless biosensing system for real-time in situ monitoring of gastrointestinal tract metabolites. *Nature Communications*. 13(1):7405. doi:<https://doi.org/10.1038/s41467-022-35074-y>. <https://www.nature.com/articles/s41467-022-35074-y>.
- Hjelm NM. 2005. Benefits and Drawbacks of Telemedicine. *Journal of telemedicine and telecare*. 11(2):60–70. doi:<https://doi.org/10.1258/1357633053499886>.

- Holman CM. 2015. The Critical Role of Patents in the Development, Commercialization and Utilization of Innovative Genetic Diagnostic Tests and Personalized Medicine. *Boston University Journal of Science and Technology Law*. 21(2). doi:<https://doi.org/10.2139/ssrn.2731683>.
- M. Matwyshyn A. 2019. The Internet of Bodies . *William & Mary Law Review*. 61(1). <https://scholarship.law.wm.edu/wmlr/vol61/iss1/3/>.
- Mitchell M, Kan L. 2019. Digital Technology and the Future of Health Systems. *Health systems and reform*. 5(2):113–120. doi:<https://doi.org/10.1080/23288604.2019.1583040>. <https://www.ncbi.nlm.nih.gov/pubmed/30908111>.
- P. DiVincenzo D. 2000. The Physical Implementation of Quantum Computation. *Fortschritte der Physik - Progress of Physics*. 48:771–783. doi:[https://doi.org/10.1002/1521-3978\(200009\)48:9/11%3C771::AID-PROP771%3E3.0.CO;2-E](https://doi.org/10.1002/1521-3978(200009)48:9/11%3C771::AID-PROP771%3E3.0.CO;2-E). [https://onlinelibrary.wiley.com/doi/10.1002/1521-3978\(200009\)48:9/11%3C771::AID-PROP771%3E3.0.CO;2-E](https://onlinelibrary.wiley.com/doi/10.1002/1521-3978(200009)48:9/11%3C771::AID-PROP771%3E3.0.CO;2-E).
- The Economist. 2022 May 5. Wearable technology promises to revolutionise health care. *The Economist*. <https://www.economist.com/leaders/2022/05/05/wearable-technology-promises-to-revolutionise-health-care>.
- The Impact of Global Digital Companies on Consumers, Firms and Governments - Vision & Value. 2022 Dec 20. *Vision & Value*. <https://visionandvalue.com/portfolio/the-impact-of-global-digital-companies-on-consumers-firms-and-governments/>.
- The Quantified Self. 2022. *The Economist*. <https://www.economist.com/technology-quarterly/2022-05-07>.
- “Wearable Tech to Become \$232 Billion Industry by 2030, Forecasts GlobalData.” 2026. GlobalData. February 9, 2026. <https://www.globaldata.com/media/strategic-intelligence/wearable-tech-to-become-232-billion-industry-by-2030-forecasts-globaldata/>.
- Yang F, Shu H, Zhang X. 2021. Understanding “Internet Plus Healthcare” in China: Policy Text Analysis. *Journal of Medical Internet Research*. 23(7):e23779. doi:<https://doi.org/10.2196/23779>.