Preventing intellectual (near-) monopoly in digital education by developing free space for education technology development

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Executive summary

In this thesis I investigate possibilities for expanding freedom of choice in the development and use of digital education technologies. This thesis may be of interest to university policy-makers, students, professors, software-developers, or anyone interested in expanding freedom of choice in the development and use of digital education technologies.

This research aims to investigate possibilities for the creation of a free space in the cultural sphere for digital education technology to protect from intervention by intellectual (near-) monopolies. Intellectual monopolies are companies that build their wealth by excessive monopolising access to knowledge and converting it into intellectual rents, a type of intangible assets.

The thesis are examined against the background of an overarching perspective on society as consisting of three spheres. Legal-political sphere is to develop laws and regulations; Economic sphere is about production, distribution (trading) and consumption of goods; Cultural sphere is to generate idea and knowledge. In each sphere, there also are three aspects belonging to legal-politics, economics, and culture.

The thesis consists of two parts and adopts a macro-to-micro research framework. In the first part, the research focuses on the macro-sociological level first and then zooms in to business level (education technology) by analysing existing literature. This part investigates how intellectual monopolies emerge, first in general and then more specifically in digital education technology, and how they reduce freedom of education. More specifically, the thesis identifies economic, legal-political and cultural factors that promote intellectual monopoly in the digital industry, and explains how intellectual (near-)monopoly in digital education (e.g. in online-learning platforms, LMSs or video-conferencing software) arises as a consequence of particular relationships between the economic, legal-political and cultural sphere, where governments and international organisations give laws and regulation (e.g. IP law, education laws and regulation, the standardisation of education) that support the concentration of R&D in a few giant digital high-tech companies and the growth of (near-)monopoly positions in the digital education technology market, enabling high-tech giants to extract what in this study is called ‘learning-related rent’ (tangible and intangible assets formed by controlling learning tools and learning content), and reducing freedom of education (the core component of the cultural sphere).

In the second part, the thesis zoom in further to the university level and examines the possibilities decision-makers at universities have to expand freedom of choice in digital education technology for professors and students through a case study of a Dutch university. An interview is conducted as the main method of the case study to collect data. From the interview results, legal-political, economic and cultural hurdles in establishing free space in choosing education technology in the cultural sphere have been identified.

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Chapter 1 Introduction

1.1 Background

Intellectual monopoly is caused by the appropriation of knowledge by commercial companies, the introduction of intellectual property rights (IPRs) and people's ignorance of the importance of independent knowledge generation, starting from the end of the last century when large corporations increasingly privatised knowledge.[1] Public and private intellectual monopolies have caused many serious problems in social life, such as limiting individual intellectual freedom and exacerbating social inequalities. Behind these developments is a growing entanglement of the three spheres of social life (legal-political sphere, economic sphere and cultural sphere), with the economic sphere gradually exceeding its boundaries, and colonising and controlling the political and cultural sphere to further its own interests. Recently, the taxonomy of intellectual monopolies has been extended. Except for the legal IP rent which based on IPRs to make profits, other three categorises of intellectual rents: legal IP rents, vertical natural monopoly rents, intangibles-differential rents, and data-driven dynamic innovation rents.[2]

Most intellectual monopolies has been studied in digital era are the big tech corporations, such as Apple, Alphabet (Google), Microsoft, Amazon and Meta (Facebook). They are deeply influencing every aspect of our lives, and have large market share in their dominant markets. For instance, Facebook held a 75.83% of the social media market share,[3] and Google had a 83.84% market share of search engine in worldwide desktop market in July 2022[4].

Such as Learning Management Systems (LMSs), online learning platforms (including MOOCs and K-12 online learning platforms) and Video Conferencing software, education technology (digital learning) is a new kind of software or tool that developed in the last decade. Digital learning offers people a digital environment or digital materials to learn, which erase the obstacle of distance. Because Covid-19 has dramatically changed almost every aspect of our social life, including education, the demand and adoption of digital learning have been increasing explosively since 2020. Large tech companies do take part in this field, and some of their digital education products holds a lot of market share, lake Google Classroom and Microsoft Teams. In the meanwhile, there are plenty of smaller firm becoming (near-) monopolistic players. Take Zoom as the most obvious example, the Zoom app had been downloaded over 50 million times on the Google App Store in the first two

1 Ugo Pagano. "The Crisis of Intellectual Monopoly Capitalism." *Cambridge Journal of Economics* 38, no. 6 (2014): 1409-29.

2 Cédric Durand and Wiliiam Milberg, ‘Intellectual Monopoly in Global Value Chains’, *Review of International Political Economy* 27, no. 2 (2020): 404–29.

3 Statcounter, ‘Social Media Stats Worldwide’, accessed 10 August 2022, https://gs.statcounter.com/social-media-stats.

4 StatCounter, ‘Worldwide Desktop Market Share of Leading Search Engines from January 2010 to July 2022’, Statista, 16 July 2022, https://www-statista-com.tudelft.idm.oclc.org/statistics/216573/worldwide-market-share-of-search-engines/.

weeks of the global pandemic.[5] In June 2021, Zoom held a 50% of the market share of video conferencing tools.[6]

With the rapid development of educational technology, more and more scholars notice the potential risks and concerns behind its advantages. They care about the harm to academic freedom, privacy and security, and the power.[7]

However, there is barely literature analysing the education technology from the perspective of intellectual monopolies. Therefore, this thesis aims to build a bridge between intellectual monopolies and education technology and study the impact of intellectual monopolies in education technology on education in the cultural sphere, the sphere of generation of knowledge and ideas.

1.2 Research objective and research question

The main research objective of this master thesis is to investigate possibilities for the creation of a free space in the cultural sphere that is generally available and protected from commercial exploitation by intellectual monopolies and political interference at a Dutch university. More specifically, my research has the following objectives to be attained and questions to be answered.

1.2.1 Research objective

To investigate possibilities for the creation of a free space for digital education technology development in education, I will (a) analyse how intellectual (near-) monopolies arise from changes in relationships between three spheres of social life (legal-political, economic, and cultural), and in particular from a declining autonomy of the cultural sphere; (b) investigate (theoretically) how intellectual (near) monopolies could interfere with the education by the (near-) monopolistic digital learning tools; (c) study the decision-making process for adopting digital education technology at a Dutch university; (d) identify the economic, cultural, and legal-political barriers that need to be overcome to create a free space for digital education technology generation at a Dutch university.

1.2.2 Research question

The thesis aims to solve one research question and four sub-research questions:

5 Bader Hussain, ‘Zoom’s Boom Is Not Over Yet’, Seeking Alpha, 31 March 2020, https://seekingalpha.com/article/4335350-zooms-boom-is-not-over-yet.

6 TrustRadius, ‘84 Current Video Conferencing Statistics for the 2021 Market’, 1 July 2021, https://www.trustradius.com/vendor-blog/web-conferencing-statistics-trends.

7 Juliane Jarke and Andreas Breiter, ‘Editorial: The Datafication of Education’, *Learning, Media and Technology* 44, no. 1 (2 January 2019): 1–6, https://doi.org/10.1080/17439884.2019.1573833; Felicitas Macgilchrist, ‘Cruel Optimism in Edtech: When the Digital Data Practices of Educational Technology Providers Inadvertently Hinder Educational Equity’, *Learning, Media and Technology* 44, no. 1 (2019): 77–86; Tobias Fiebig et al., ‘Heads in the Clouds: Measuring the Implications of Universities Migrating to Public Clouds’, *ArXiv Preprint ArXiv:2104.09462*, 2021.

Research question

How do intellectual monopolies influence freedom of (digital) education, and which (economic, legal-political, and cultural) hurdles would need to be taken to widen freedom of choice in digital education technology?

Sub-research questions

1. How does the intellectual (near-) monopoly of (digital) giant corporations arise?
2. Who are the intellectual (near-) monopolies in digital education technology?
3. Does intellectual (near-) monopoly in digital education technology interfere with freedom of education in the cultural sphere? If so, how?
4. Which legal-political, economic and cultural hurdles would need to be conquered in establishing a free space for digital education technology development at TU Delft?

1.3 Research framework

A research framework is developed to answer the research question and sub-questions. The framework indicates that this study is a process from macro to micro. Macro-sociological level is used to review the existing literature on the intellectual monopoly and its impacts on the threefold social organism. Then, digital education has been chose in the business level to find the intellectual (near-) monopolies in digital learning and study its intervention on education in the cultural spheres. Lastly, in the university level, a case study on adoption of education technology is conducted. Interview will be used in the case study.

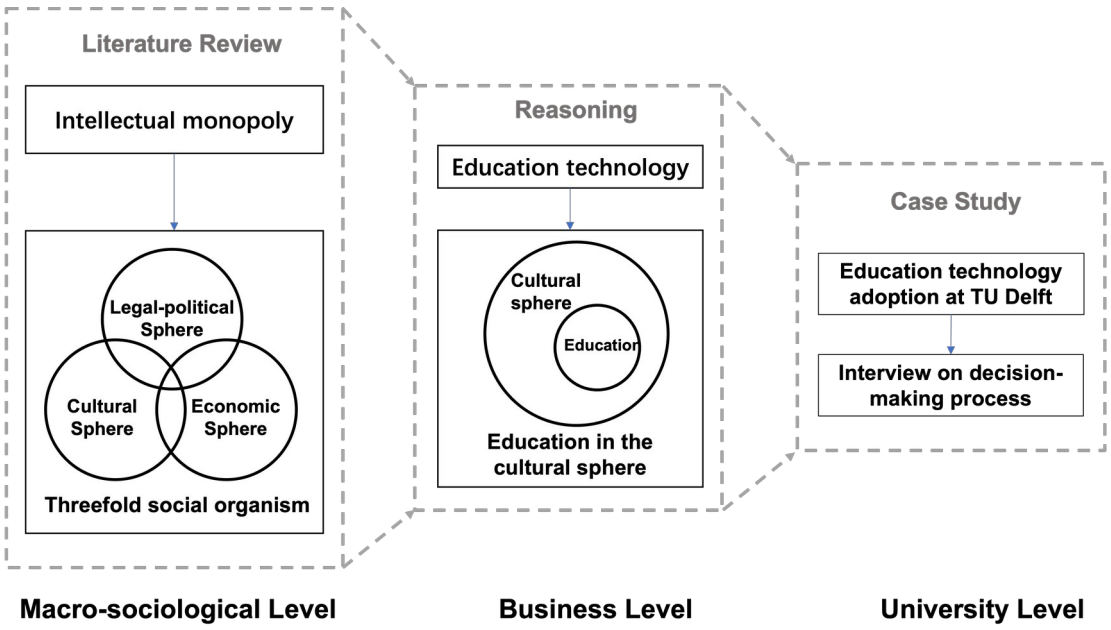

Figure 1.1: Research framework.

1.4 Research methods

Three research methods will be used in this master thesis, including analysis of existing literature, case study and interview.

1.4.1 Literature analysis

Literature research is a method for forming an argument or telling a story by combining the findings of previous studies in a logical and systematic way, and can help form an argument or tell a story by providing answers logically and systematically.[8] It is an excellent way to lay a solid foundation for many research questions.[9] Moreover, for many research questions, a thoughtful review and analysis of the literature is probably the best methodology to detect problems or gaps in current thinking, and a solid foundation for advancing knowledge and theories.[10] Careful analysis of the literature may lead to the discovery of a lacuna in existing knowledge, and a search for novel answers with a view to remedying existing problems.

The thesis first reviews existing theories, studies and research to find out how intellectual monopoly arises, and how intellectual monopoly impact three spheres (legal-political sphere, economic sphere and cultural sphere) in social life. Then, based on the results of previous literature review and other resources, this thesis analyses the intellectual (near-) monopolies in large digital learning tool providers, finds out who are the intellectual (near-) monopolies in education technology and their intervention to education in the cultural sphere.

1.4.2 Case study

A qualitative case study offers researchers the opportunity to explore or describe a phenomenon using a variety of data sources. This method is valuable to sciences research for developing theory, evaluating projects and developing interventions because of its flexibility and rigour. A hallmark of case study research is the use of multiple data sources to increase the credibility of the data.[11] Potential data sources include documentation, archival records, interviews, physical artifacts, direct observation, participant observation and more. However, qualitative case studies also have the problem of insufficient impartiality of the data since each person has his or her own unconscious biases. Although the case study approach aims to limit the impact of this bias by collecting fact-based data, the collector can define what is 'factual', which means that the real-time data being collected may be based on the results the researcher wants to see.[12] Therefore, personal biases of the researcher imply that the results may not be reliable.

8 R. F. Baumeister and M. R. Leary, 'Writing Narrative Literature Reviews', *Review of General Psychology* 1, no. 3 (1997): 311–20, https://doi.org/10.1037/1089-2680.1.3.311.

9 Jane Webster and Richard T Watson, 'Analyzing the Past to Prepare for the Future: Writing a Literature Review', *MIS Quarterly*, 2002, 13–23.

10 Webster and Watson.

11 Robert K Yin, *Case Study Research: Design and Methods*, vol. 5 (sage, 2009).

12 King Hafiz, 'Case Study Ecmple', *The Qualitative Report* 13, no. 4 (2008): 544–59.

In the thesis, a case study on the decision-making processes regarding the (future) adoption of online education tools at TU Delft. Interview is the main research method of this case study.

1.4.3 Interview

In the sphere of scientific research, interviews have long been recognized as an effective technique. Interviews are frequently regarded as a crucial component in study design since interviews can provide descriptions of people and events in surroundings.[13] Interviews have advantages like high return rate, complete answers, involvement, controlled answering order, and relative flexibility; While the disadvantages are time-consuming, small-scale study, cannot ensure anonymity, the potential for subconscious bias, and potential inconsistencies.[14] Semi-structured interviews will be used in this thesis as it allows the interviewer the chance to delve further into and elaborate on the respondent's response than structured interviews.[15]

This thesis uses a snowball sampling to select the interviewees. The process of snowball sampling is, when choosing informants, the researchers gather contact information by other informants' recommendations. Informants introduce the researcher to other informants, who in turn introduce the researcher to even more informants, and so on.[16] It served as a tool in this study to help the researcher find new participants when existing communication channels had dried up and enrich sampling clusters.

1.5 Thesis relevance

This section will go through the social relevance, scientific relevance and relevance to MoT of this thesis.

1.5.1 Scientific relevance

For one thing, some economists have analysed intellectual monopoly from the invention aspect, but for the education side, there is hardly existing literature to analyse the intellectual monopoly. This thesis try to define a new kind of intellectual monopoly based on learning-related rent. According to Chapter 4, if a monopoly can control the learning content or the learning tool, it could be a learning-related intellectual monopoly.

For another, this thesis fills another academic gap of practice research by choosing education technology to study the intellectual (near-) monopoly in a more realistic scenario. This thesis finds out the intellectual (near-) monopolies who provide education software, and uses a case

13 Victoria Elliott, ‘The Research Interview: Reflective Practice and Reflexivity in Research Processes’, 2018.
14 James Dean Brown, ‘19 Research Methods for Applied Linguistics: Scope, Characteristics, and Standards’, *The Handbook of Applied Linguistics*, 2008, 476.
15 Christiane Schmidt, ‘The Analysis of Semi-Structured Interviews’, *A Companion to Qualitative Research* 253, no. 258 (2004): 7619–7374.
16 Charlie Parker, Sam Scott, and Alistair Geddes, ‘Snowball Sampling’, *SAGE Research Methods Foundations*, 2019.

study to conduct how a Dutch university adopt education software and whether the intellectual (near-) monopolies has impact on the adoption process.

1.5.2 Societal relevance

The societal value of this thesis is to evoke a rethinking of social operation mode via investigating the inference from the intellectual (near-) monopoly in digital learning in the economic sphere to education, a core component of the cultural sphere. When the economic sphere colonises and controls the political and cultural sphere to further its own interests (through inter-national initiatives, government partnerships, and lobbying efforts), the cultural sphere loses its power and freedom to generate new knowledge. Knowledge generation (including invention and education), the most important role of the cultural sphere, should be an independent and accessible process.

More specifically, in the case study, the education technology adoption process of TU Delft has figured out and there are some influence from intellectual (near-) monopolies, such as Microsoft. One of the solutions to avoid such monopolies in digital learning is to develop a self-hosted open-source software. Although the reality is much more complicated than theoretical reasoning, this thesis can give guidelines for countering intellectual (near) monopolies in digital education technology and increasing the space for generating new knowledge in this field by improving decision procedures at the university level.

1.5.3 Relevance to Management of Technology (MoT)

The MoT programme is a combination of business, management and technology. Monopoly is referred to as an economic concept in some courses (e.g. Economic Foundation). In the thesis, intellectual monopoly, as a type of monopoly, will be carefully studied and analysed in terms of how it is formed, what its impact on social life is and how they can be resolved. Education technology is the digital learning tools which grow rapidly after the covid-19. This thesis also go deep in this kind of software and try to build the connection between education technology and intellectual monopolies.

In the profile page of MoT programme, it mentions the programme addresses challenging questions most companies face such as: (1) What technologies do we need and when? (2) Do we procure the technology we need with our own research capabilities, in collaboration with outside parties, or by acquiring it or licensing it from others? (3) How can we use the abundant technological opportunities to affect our mission, objectives and strategies?[17] Although this thesis is not aimed at solving a company's problem, it will provide a solution for Dutch universities who are in the process of digitalisation, and answers significant questions such as what cloud technologies should be chosen and implemented and whether universities should develop their own self-hosted open-source tools or choose commercial

17 "MSc Management of Technology." TUDelft, accessed April 18, 2022. https://www.tudelft.nl/onderwijs/opleidingen/masters/mot/msc-management-of-technology

proprietary closed software. Therefore, the issues that this thesis hopes to address are very relevant to MoT.

1.6 Thesis overview

Chapter 1: Research objectives and questions, research framework, research methods, research relevance and thesis overview have been described in Chapter 1.

Chapter 2: This thesis begins with defining some core concepts. In the first part of Chapter 2, the difference and relationship between knowledge, information and data have been presented. Two types of knowledge-related activities are distinguished: the development of new knowledge (research and the general progress of knowledge), and learning knowledge (education). The second half of this chapter goes into cultural freedom by putting forward the threefold social organism (legal-political, economic and cultural spheres) as well as using Mill and Belin's ideas to express the freedom of the cultural sphere. Additionally, education autonomy has been defined. It consists of professional autonomy (academic freedom) and organisational autonomy.

Chapter 3: This chapter introduces two kinds of intellectual rents (legal intellectual rent and data-driven network-externalities-based rent) and how these two rents and the global corporate innovation system can lead to intellectual monopolies. Then, two examples of digital intellectual monopolies are analysed. In addition, two existing models about the current situation of three spheres are reviewed. At the end of Chapter 3, the author summarises both positive and negative impacts on knowledge generation by intellectual monopolies.

Chapter 4: This chapter dives deep into digital education technology. In the start, the current situation of digital learning technology has been introduced. Then, the legal-rent-, data-driven network-externality-, and global-corporate-innovation-system-based intellectual (near-) monopolies and the learning-related intellectual (near-) monopolies in digital education have been identified. In addtion, this chapter links between intellectual (near-) monopolies in the digital education in the economic sphere and the legal-political sphere. Global Education Reform Movement (GERM) is introduced as one of the ways that the economic and legal-political spheres cooperate to attain both interests in education. this chapter ends with analysing the interference of the education freedom in the cultural sphere by intellectual (near-) monopolies in digital learning and use the models introduced in the previous chapters to depict the relationships between three spheres in education technology.

Chapter 5: A case study about the decision-making processes regarding the (future) adoption of online education tools at TU Delft is conducted. In the first half of Chapter 5, self-hosted open-source software (OSS) has been introduced as one of the potential alternatives to antitrust intellectual monopoly. In the rest of the chapter, the interview is conducted and the results are analysed. In the discussion of the interview results, some hurdles have been given

from the perspectives of legal-political, economic and cultural aspects in the education of the cultural sphere.

Chapter 6: The conclusion chapter will answer research question by answering all sub-questions, list the limitation of the thesis and provide recommendations for further research.

Chapter 2 Academic freedom in knowledge generation

This chapter defines the meanings of some concepts that will be used in this thesis to prevent ambiguity. Firstly, in everyday life we often use the term 'knowledge'. Sometimes we regard quantities of data as knowledge, sometimes we think skills are knowledge, and sometimes we refer to inventions as knowledge. Therefore, at the beginning of a thesis discussing 'knowledge generation', it is necessary to clarify what knowledge and knowledge generation's concepts this thesis follow (see Section 2.1). this chapter then goes on to explore definitions of liberty in society (see Section 2.2) and education (see Section 2.3), including what constitutes the cultural sphere, what constitutes academic freedom and what constitutes educational autonomy.

2.1 Knowledge generation

2.1.1 Knowledge, information and data

Data

According to Collins English Dictionary, a datum (plural: data) is *a.* a single piece of information, *b.* a fact (known or assumed). Data are understood to be discrete, atomistic, tiny packets with no inherent structure or necessary relationship between them.[18] Facts and figures that convey a certain message but are not arranged in any manner and give no meaning in terms of patterns, context, etc. In the digital era, 'Big Data' is an essential notion, referring to data that are very huge in volume, highly complex in diversity, and very quick in change.[19] It is worth noting that 'Big Data' do not become ordered or meaningful just because there is more of it. 'Big Data' are so big that they require researchers to invent new technologies to capture, analyse, store and use them.

Information

Data must be contextualized, classified, computed, and compacted before they can be considered as information.[20] Information is data with relevance and purpose.[21] Thus, information presents a more polymorphic phenomenon and a polysemantic concept. It can be associated with several explanations, depending on the level of abstraction adopted and the

18 Jonathan Hey, 'The Data, Information, Knowledge, Wisdom Chain: The Metaphorical Link', *Intergovernmental Oceanographic Commission* 26 (2004): 1–18.

19 David Lazer and Jason Radford, 'Data Ex Machina: Introduction to Big Data', *Annual Review of Sociology* 43 (2017): 19–39; Burt L Monroe, 'The Five Vs of Big Data Political Science Introduction to the Virtual Issue on Big Data in Political Science Political Analysis', *Political Analysis* 21, no. V5 (2013): 1–9.

20 Thomas H Davenport and Laurence Prusak, *Working Knowledge: How Organizations Manage What They Know* (Harvard Business Press, 1998).

21 Rajeev K Bali, Nilmini Wickramasinghe, and Brian Lehaney, *Knowledge Management Primer* (Routledge, 2009).

cluster of requirements and desiderata orientating a theory.[22] It might represent a trend in the environment or a sales pattern over a specific time period. Essentially, information may be discovered in responses to queries beginning with terms like "who, what, where, when, and how many". [23]

Knowledge

Knowledge is derived from the act of knowing. Knowing something means being aware of something, which requires effort. Each person's knowledge is a result of his experience, and it includes the standards by which he assesses fresh inputs from his environment.[24] Knowledge is a fluid mixture of framed experience, values, contextual information, expert insight, and grounded intuition that serves as an environment and framework for assessing and assimilating new experiences and information.[25] It is created and implemented in the minds of those who know. As a result, knowledge necessitates a relationship between "a conscious subject and some piece of reality, which is often thought to be mediated by a true proposition, and the majority of epistemological attention has been spent to the subject side of that relationship"[26].

The relationships between data, information and knowledge

For many years, the presentation of the links between data, information, and knowledge in a hierarchical order has been part of the definition of information science. The origin may be difficult to trace. In a *particular view* on the relationship between data, information, and knowledge, the three have a pyramidal connection, called the Data-Information-Knowledge pyramid (DIK model).[27] The model is shown in Figure 2.1. The lowest layer is data, the middle layer is information, and the top layer is knowledge. For one thing, data sit at the bottom of the pyramid, implying that it is the basic data we get or the basis of information. In this pyramid, information can be described as data that have meaning. The basic material, data, is transformed into information by shaping and arranging them in a meaningful manner. For another, from information to knowledge, it was described as the accumulation and assimilation of many pieces of information, creating links between the information, and internalising or personalising that knowledge by bringing it from the outside into people's mind.[28] In the knowledge pyramid viewpoint, the aggregation of disparate pieces of information and the filtering out of useless portions further reinforce the pyramidal structure from bottom to top, from large to tiny.

22 Luciano Floridi, 'Open Problems in the Philosophy of Information', *Metaphilosophy* 35, no. 4 (2004): 554–82.
23 Russell L Ackoff, 'From Data to Wisdom', *Journal of Applied Systems Analysis* 16, no. 1 (1989): 3–9.
24 Davenport and Prusak, *Working Knowledge: How Organizations Manage What They Know*.
25 Paul R Gamble and John Blackwell, 'Knowledge Management: A State of the Art Guide', 2001.
26 John Greco and Ernest Sosa, 'What Is Knowledge?', in *The Blackwell Guide to Epistemology*, 1999.
27 Marcia J Bates, 'Information and Knowledge: An Evolutionary Framework for Information Science.', *Information Research: An International Electronic Journal* 10, no. 4 (2005): n4; Chipo Mutongi, 'Revisiting Data, Information, Knowledge and Wisdom (DIKW) Model and Introducing the Green Leaf Model', *IOSR Journal of Business and Management (IOSR-JBM)* 18, no. 7 (2016): 66–71.
28 Hey, 'The Data, Information, Knowledge, Wisdom Chain: The Metaphorical Link'.

On top of knowledge, some authors added wisdom to the DIK pyramid, forming a four-layer DIKW pyramid.[29] Wisdom appears to be superior than knowledge, however both may be equally significant. Wisdom is the kind or category of things that is distinct from data, information and knowledge. As an alternative to the preceding sentence − what about: However, till date, the concept of wisdom has been insufficiently researched. Therefore in the past two decades, some researchers omit wisdom from the DIKW pyramid (leaving the DIK pyramid).[30]

By way of definition, in this research the author see technology such as software, hardware, Artificial Intelligence and Machine Learning themselves as information, distinguished from knowledge because of their lack of connection to the human consciousness.

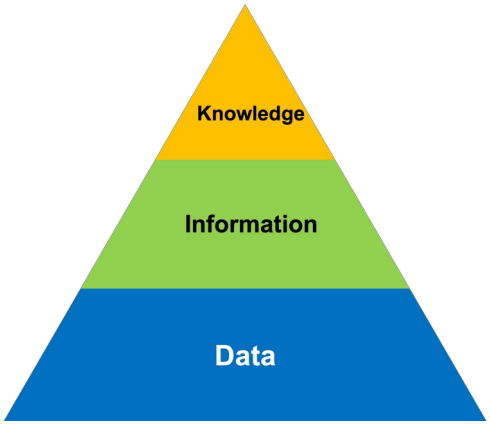

Figure 2.1: Data-Information-Knowledge pyramid (DIK model).[31]

2.1.2 Two types of knowledge generation

Knowledge generation is a complex and instantaneous human process that happens in the minds of people. Knowledge generation can be divided into two types. One is to create brand-new knowledge in society (invention).[32] The other is to learn and absorb existing knowledge from education and other learning channels by individuals.[33] Both are significant

29 Jennifer Rowley, 'The Wisdom Hierarchy: Representations of the DIKW Hierarchy', *Journal of Information Science* 33, no. 2 (2007): 163–80; Sasa Baskarada and Andy Koronios, 'Data, Information, Knowledge, Wisdom (DIKW): A Semiotic Theoretical and Empirical Exploration of the Hierarchy and Its Quality Dimension', *Australasian Journal of Information Systems* 18, no. 1 (2013).

30 Chaim Zins, 'Conceptual Approaches for Defining Data, Information, and Knowledge', *Journal of the American Society for Information Science and Technology* 58, no. 4 (15 February 2007): 479–93, https://doi.org/10.1002/asi.20508; Rowley, 'The Wisdom Hierarchy: Representations of the DIKW Hierarchy'.

31 Rowley, 'The Wisdom Hierarchy: Representations of the DIKW Hierarchy'.

32 Manfred M. Fischer, 'Innovation, Knowledge Creation and Systems of Innovation', *The Annals of Regional Science* 35, no. 2 (1 May 2001): 199–216, https://doi.org/10.1007/s001680000034; Silvio Popadiuk and Chun Wei Choo, 'Innovation and Knowledge Creation: How Are These Concepts Related?', *International Journal of Information Management* 26, no. 4 (1 August 2006): 302–12, https://doi.org/10.1016/j.ijinfomgt.2006.03.011.

33 Paul F. Conway, Rosaleen Murphy, and Vanessa Rutherford, '"Learningplace" Practices and Pre-Service Teacher Education in Ireland: Knowledge Generation, Partnerships and Pedagogy', in *Workplace Learning in Teacher Education*, ed. Olwen McNamara, Jean Murray, and Marion Jones (Dordrecht: Springer

for society since creating new knowledge is able to broaden the limitation of knowledge and education and other learning channels can increase the quantities of future knowledge creators.

2.2 Cultural freedom

2.2.1 Three spheres in social life

The idea that there exist three main spheres in social life − economic, political, and cultural − can be found with many well-known macro-sociologists (such as Alfred Weber, Max Weber, Karl Mannheim, Jürgen Habermas[34]) and was explained in more detail by Rudolf Steiner in 1919.[35] In this literature, social life is interpreted as comprising a legal-political sphere, an economic sphere and a cultural sphere. The legal-political sphere refers to the sphere where we develop laws and regulations to organise social life. The economic sphere is the sphere of production, distribution (trading) and consumption of goods. The cultural sphere is the sphere of generation of knowledge and ideas, including education, art, religions and research in schools, universities, research institutions and so on. In an independent cultural sphere, there would be freedom of thought and expression, including academic freedom, that is, knowledge would be generated freely, without interference by the legal-political and economic sphere.

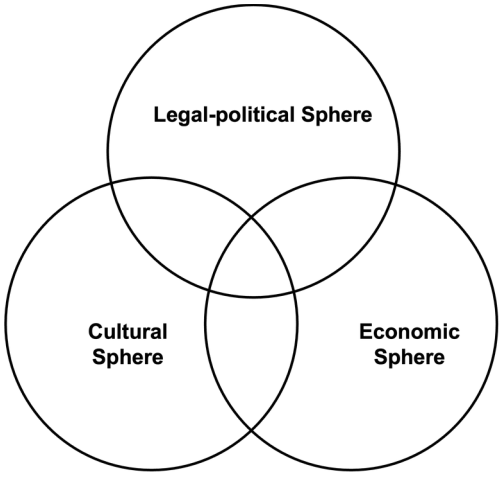

Figure 2.2: Three spheres in social life.[36]

Figure 2.2 is a frequently used picture to graphically represent the tripartite social organism: three interactive circles representing each of society's three primary spheres. Despite its simplicity, this diagram provides a great beginning point for a more in-depth understanding

Netherlands, 2014), 221–41, https://doi.org/10.1007/978-94-007-7826-9_13.

34 See, for example, Naastepad (2019, p. 369−370).

35 See the book reviews of 'Threefold Commonwealth' by J. E. Le Rossignol (1924) in The American Economic Review and John Maurice Clark (1923) in the Journal of Political Economy.

36 Gary Lamb, 'The Threefold Nature of Social Life', Biodynamics, East Troy, 2008, 41.

of the threefold organism of social life. However, the diagram should not be misunderstood. For example, each sphere shown in Figure 2.2 itself has elements belonging to politics and law, economics, and culture. For instance, a university which as a whole belongs to the cultural sphere, itself needs to be funded, which is the economic aspect of this cultural institution. It will also have internal rules and regulations (the legal-political aspect of a university), and the research and education that are going on in the university are cultural aspects of the university. The three domains must be viewed as three critical components of social existence, each having its own intrinsic roles and authorities. At the same time, the model's overlapping sections show that these spheres must assist each other. Steiner argued that the three spheres would correct each other and function together in a healthy way only if they were given sufficient independence; An increase in the autonomy of the three spheres would not eliminate their mutual influence, but would result in that influence functioning in a healthier and more legitimate way, since an increase in independence would prevent any one of the three spheres from dominating the others.[37]

2.2.2 The freedom in the cultural sphere

In this thesis, the word ‘freedom’ is used as synonymous with 'liberty'. Following the idea of Threefold society, in the cultural sphere, the main concern of the knowledge generation is to develop the unique abilities that each individual brings from the spiritual world, as well as to carry the intentions and tasks of each generation.[38] A healthy cultural sphere does not only promote individual self-development, it also promotes concern and care for other people and the world. In this way, people go beyond the desire for personal development to include the needs of others. As a result, our personal capacities become socialised.

How one carries out one's personal development, care and education should be the free decision of each adult, or the concern of a parent or guardian on behalf of a child until they mature. Freedom and self-determination are therefore essential for cultural issues such as education, art and medicine. The cultural sphere needs to be free from undue economic and political influence for the spiritual power of revitalisation to enter social life through the individual.

Similar ideas can be found in the philosophical discourses of John Stuart Mill and Isaiah Berlin on freedom (liberty).

In “On liberty”, Mill stated:

> *The only freedom which deserves the name, is that of pursuing our own good in our own way, so long as we do not attempt to deprive others of theirs, or impede their efforts to obtain it. Each is the proper guardian of his own health, whether bodily, or*

37 Rudolf Steiner, *Threefold the social order* (Canterbury: New Economy, 1996).
38 Lamb, ‘The Threefold Nature of Social Life’.

mental and spiritual. Mankind are greater gainers by suffering each other to live as seems good to themselves, than by compelling each to live as seems good to the rest.[39]

Mill believed that the freedom of opinion and expression should be unconstrained. he argued that in addition to government in society there was social tyranny with an invisible power and it was not easily perceived by the masses. Social tyranny worked by imposing strict customs and preventing individuals from accepting any gift or idea that was contrary to the laws of society. Mill said:

> "*In this age, the mere example of non-conformity, the mere refusal to bend the knee to custom, is itself a service. Precisely because the tyranny of opinion is such as to make eccentricity a reproach, it is desirable, in order to break through that tyranny, that people should be eccentric. Eccentricity has always abounded when and where strength of character has abounded; and the amount of eccentricity in a society has generally been proportional to the amount of genius, mental vigor, and moral courage which it contained. That so few now dare to be eccentric, marks the chief danger of the time.*" [40]

At that time, this social tyranny was an aspect of facts due to the general lack of freedom in society, and people had the choice of either adhering to social customs and avoiding the consequences of going against the norm, or breaking them and being rejected by society. When people do not create new ideas for fear of social tyranny of the majority, then society stagnates and the spiritual superiority of human beings disappeared. Therefore, Mill believed society could only make progress when other opinions are not be excluded. Freedom of expression and freedom of thoughts would be beneficial to the healthy development of society. Firstly, the suppression of different ideas may be suppressing the truth of social development; secondly, when society has many ideas existing simultaneously, the true idea would be more valuable by comparison.

Berlin used a different perspective to explain liberty in society. He divided freedom into negative liberty and positive liberty.[41] Negative liberty is that a person can act without being hindered by others to some extent. In other words, the person is free to do or be what he or she wants to do or be in the domain he or she is allowed. Thus, in negative liberty no one is completely free, and negative freedom is a freedom that must contains limitations because if everyone had unlimited freedom, no one would be free.

On the contrary, positive liberty arises from the individual's willingness to become his/her own master, which is the possession of the power and resources to act in the context of the structural limits of the larger society that effect a person's capacity to act. When one is able to become one's own master, the higher rational self can become the master of the lower freedom of irrational impulses. However, in society it is possible and reasonable to coerce

39 John Stuart Mill and Thomas De Quincey, 'On Liberty', 1885: 26.
40 Mill and De Quincey, 131.
41 Isaiah Berlin, 'Two Concepts of Liberty', in *The Liberty Reader* (Routledge, 2017), 33–57.

people for some aims. For example, it is compulsory to wear a seatbelt when driving. At this point, one is not one's own master, and we cannot decide all our choices. Once this coercion in society exceeds the normal threshold (which is difficult to control), people are easily controlled and oppressed.

Berlin believed that the idealised true freedom could not happen in real life. Since positive freedom may turn society into oppressive and coercive, negative freedom is preferable for social life. The measure of negative freedom seems more real and humane than the goal of those who seek the ideal of positive self-control of classes, peoples or humankind within the great disciplined, authoritarian structures. Specifically, it is also more real because it at least acknowledges the fact that there are many goals of humans, not all of which are comparable or in competition with each other. It is more humane because it does not deprive people away from unpredictable diversity.

Berlin's discussion of positive and negative freedom may be better understood when placed in the context of the concept of threefold society. According to Steiner, each of the three spheres have their own main value or logic, and the value of freedom belongs to the cultural sphere. Findeli elaborated Steiner's thinking of guiding logics of each sphere:

> "In the economic sphere, says Steiner, the relationships between individuals are based on needs and mediated by goods, so that there is a strong mutual interdependence; its guiding logics is solidarity or *fraternity*, not in the moral but in the strict economic sense. The political sphere, that of public rights, is the world of essentially human relationships, in the sense that we consider the other not as a provider of some good or service, but as an equal; its guiding logics is therefore *equality*. In the cultural sphere, the relationships are based on the mutual recognition of one's own and idiosyncratic capacities, competences and potentialities, which can only be cultivated and developed in a non-oppressive intellectual, artistic or religious environment; its ruling logics is *liberty*."[42]

Based on Findeli's description, Figure 2.3 is drawn. In a threefold society, each sphere would respect and support the other two and not use them to serve its own interest. A free cultural sphere would generate new knowledge and inspire the other two spheres. The legal-political sphere would protect liberty in the cultural sphere (for example by incorporating freedom of education in the constitution). The economic sphere would be focussing on meeting the material needs of people (rather than being based on the pursuit of self-interest) and voluntarily fund the cultural sphere and pay tax to support the legal-political sphere. There would be a triangle-like relationship between three independent spheres, which would allow for freedom and thereby diversity in the cultural sphere.

42 Alain Findeli, 'Sustainable Design: A Critique of the Current Tripolar Model', The Design Journal 11, no. 3 (December 2008): 313–14, https://doi.org/10.2752/175630608X365208.

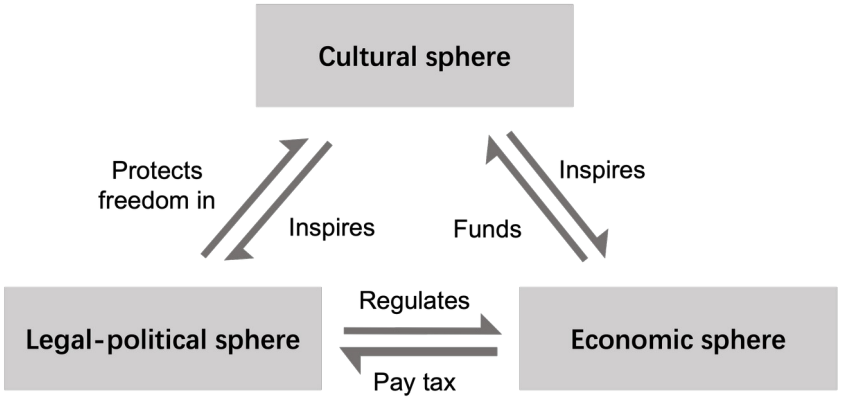

Figure 2.3 Virtuous triangle model (Elaborated from Findeli's explanation[43])

Coming back to Berlin's thoughts, and viewing them in this light, negative freedom is needed in the cultural sphere, not for the other two spheres because they have different values (fraternity and equality as mentioned by Findeli). Berlin's positive freedom could be seen as the misplacement of freedom, or the location of freedom in the wrong sphere (the legal-political sphere).

2.3 Academic freedom and education autonomy

Academic freedom

Although the idea of academic freedom appears straightforward, the discussion over academic freedom has been marked by a lack of clarity and consistency over what academic freedom truly entails.[44] The concept of academic freedom can be traced back to the time of Socrates. His sacrifice illustrated how unpopular speech against custom was an impermissible thing at the time. Since the Medieval Era, academic freedom has meant the freedom of the professor to teach without external restriction in his or her field of competence, as well as the freedom of the student to study. From the 19th century onwards, the idea of academic freedom evolved with the development of modern higher education.

In the United States, for example, the concept of academic freedom is at the heart of American higher education.[45] There is no concept of equivalence in business. The American Association of University Professors (AAUP) states that professors are not employees in the usual sense and they have a special relationship with the university and its administration.[46] By allowing professors to decide issues of academic quality, universities ensure that their

43 Findeli.

44 Gerlese S A˚kerlind and Carole Kayrooz, 'Understanding Academic Freedom: The Views of Social Scientists', *Higher Education Research & Development* 22, no. 3 (November 2003): 327–44, https://doi.org/10.1080/0729436032000145176.

45 Frank B McCluskey and Melanie L Winter, 'Academic Freedom in the Digital Age', *On the Horizon*, 2014.

46 Donna R. Euben, 'Academic Freedom Of Individual Professors And Higher Education Institutions: The Current Legal Landscape' (American Association of University Professors, May 2022), https://www.aaup.org/issues/academic-freedom/professors-and-institutions.

research and teaching will be determined by experts, not by the political views of administrators or boards of trustees.

To date, the extent of academic freedom is not quite the same across countries due to differences in laws and regulations. A quite comprehensive definition of academic freedom is given by the AFAF (Academics For Academic Freedom) of the United Kingdom. The AFAF "believe the following two principles to be the foundation of academic freedom:

- that academics, both inside and outside the classroom, have unrestricted liberty to question and test received wisdom and to put forward controversial and unpopular opinions, whether or not these are deemed offensive, and
- that academic institutions have no right to curb the exercise of this freedom by members of their staff, or to use it as grounds for disciplinary action or dismissal."[47]

In addition to what the AFAF has stated, obviously, freedom of education applies also to students if students are interpreted as also academics. The academic freedom of students could also be considered as belonging to academic freedom, meaning that students should not be limited to any type of knowledge and should be free to learn what they want to learn.

Education autonomy

The term education autonomy has also been influenced by educational reforms over the last few decades, leading to a blurring of definitions. Bourdieu's field concept, developed in 1988, theorised higher education as a field with a high degree of autonomy in that it generates its own organisational culture comprised of values and behavioural imperatives that are relatively independent of forces emerging from the economic and political fields.[48] For Bourdieu, higher education, because of its specificity in society, needs to be separated from the economic and legal-political spheres.

However, in the knowledge economy, the link between the higher education institutions and the policy objectives of economic growth has become stronger. As the education system becomes larger, so these external and governmental pressures on the higher education institutions are likely to increase.[49] Universities are gradually becoming 'market-like' competition model. At the same time, the positioning of the university as an organisation became commonplace, rather than a collection of individual academics. Enders et al. summaries this change as 'regulatory autonomy', arguing that universities are now both strategic actors and recipients of government control.[50] This conception captures university

47 AFAF, 'AFAF Statement of Academic Freedom', accessed 31 July 2022, https://www.afaf.org.uk/afaf-statement/.

48 Pierre Bourdieu, *Homo Academicus* (Stanford University Press, 1988).

49 Ewan Ferlie, Christine Musselin, and Gianluca Andresani, 'The Steering of Higher Education Systems: A Public Management Perspective', *Higher Education* 56, no. 3 (2008): 325–48.

50 Jürgen Enders, Harry de Boer, and Elke Weyer, 'Regulatory Autonomy and Performance: The Reform of Higher Education Re-Visited', *Higher Education* 65, no. 1 (January 2013): 5–23, https://doi.org/10.1007/s10734-012-9578-4.

autonomy as a tool of the new system of governmental control. The aim of regulatory autonomy is to align universities more closely with government objectives and to improve their respective performance. From the perspective of threefold social organism, 'regulatory autonomy' is an example of the legal-political sphere controlling the cultural sphere.

It is therefore necessary to define what is meant by education autonomy through the taxonomy. Following the working of Enders et al., education autonomy includes professional autonomy and organisational autonomy.[51] Professional autonomy is equivalent to the academic freedom defined above. Organisational autonomy consists of the level of the universities' decision-making competencies and the exemption of constraints on the actual use of such competencies. Specifically, organisational autonomy consists of managerial autonomy (the autonomy to manage the financial, human and property capitals), policy autonomy (legal status of the organization (e.g. public or private) and its implications for the autonomy situation), and governance autonomy (the autonomy to decide on internal structures and working processes).[52]

Considering the education freedom with the three spheres in the social life, the legal political sphere should protect equality before the law, but it should not be concerned with imposing ideas on people. In education(a core component of the cultural sphere), it should not dictate or try to influence what teachers teach, what researchers research, or more generally what citizens should think. When people realise that freedom is a value that belongs to the cultural life, and that is essential in the field of personal development and personal knowledge generation, they may choose representatives in parliament who will safeguard freedom of education through appropriate law-giving, for example constitutional law that protects freedom of thought and freedom of education (the classical human rights). Thus, in education, building a free space to keep education freedom is a valuable method to protect the freedom of expression and thoughts of teachers and students and build no restriction to personal knowledge generation for students.

51 Enders, de Boer, and Weyer.
52 Enders, de Boer, and Weyer.

Chapter 3 The rise of intellectual (near-) monopoly and impact on knowledge generation in social life

In this chapter, existing literature on the rise of intellectual monopoly will be reviewed and analysed in order to explain how intellectual monopolies emerge. This is done in three steps, moving from more micro- to more macro-level or system-wide explanations. First, the rise of intellectual monopoly is divided into two phases. From the 1980s to the 2000s, intellectual monopoly was formed mainly due to companies privatising knowledge through legal-intellectual rents such as patents, trademarks and copyrights. Giant corporations used Intellectual Property Rights (IPRs) to restrict the growth of other companies or to increase profits by 'rentiering' on IPRs (see Section 3.1) In the last two decades, as information technology has developed at a rapid pace and data have become increasingly crucial to the development of companies, intellectual monopoly has not only resulted from the privatisation of knowledge through legal intellectual rents, but has gradually transformed into a data-driven monopoly (see Section 3.2). Secondly, a third cause of intellectual monopoly besides intellectual rents is discussed − the global corporate innovation system (in Section 3.3). Intellectual monopolies outsource the innovation process to multiple stakeholders (such as smaller companies, universities and research institutions) via the global corporate innovation system to predate knowledge and enhance their monopolistic dominance. To better understand the three causes of the growth of intellectual monopolies (legal-based rent, data-based rent, and the global corporate innovation system), two empirical examples of digital intellectual monopolies are analysed in Section 3.4.

Then, thirdly, further 'zooming out' from micro to macro, two existing models about the current situation of relationships between the three spheres are reviewed in order to explain the emergence of intellectual monopoly at the wider level of society as a whole (see Section 3.5). Looked at from this (macro-sociological) perspective, intellectual monopolies emerge as a consequence of the interplay between developments in the economic, legal-political, and cultural spheres. It can then be seen, for example, that the development of endogenous growth theory in academia coincided with policies supporting patenting and IPRs and the growth of intellectual monopoly-based high-tech businesses in the economy. Thus, developments in one sphere are understood as related to (preceding or simultaneous) developments in the two other spheres.

Finally, the possible impact of intellectual monopoly on social life (due to excessive privatisation of knowledge) are investigated from the perspective of three spheres (in Section 3.6). In this chapter, knowledge generation mainly refers to creating brand new knowledge via invention rather than generating personal knowledge via learning.

3.1 The rise of legal-rent-based intellectual monopoly

3.1.1 The change of economic growth theory and economy base

From neoclassical economic growth theory to endogenous growth theory

The generation of knowledge in society has changed especially in the 1980s, partly under the influence of changes in economic theory. Prior to the 1980s, neoclassical economic growth theory, the dominant economic theory of that time, proposed that short-term economic equilibrium is the outcome of variable levels of labour and capital, both of which are important in the production process. The theory claimed that technological change (or the growth of knowledge in general) influenced the overall functioning of an economy and regarded technological change as an exogenous factor i.e. a factor that developed independently, outside the economy. Based on a growth model based on the Cobb-Douglas production function, with labour and physical capital inputs as independent variables, it was found that long-term economic growth ceased when factor returns began to decline.[53]

However, beginning in 1986, Romer proposed a new theory named "endogenous growth theory", which suggested that declining growth rates could be prevented by adding another factor to the model: knowledge.[54] The new theory differed from the neoclassical growth model, which treated technological improvement as exogenous, by including knowledge generation as a primary endogenous driver of economic growth.. It assumed that when knowledge generation is commercialised (that is, when the accumulation of knowledge is driven by profits or expected rates of return on R&D), this will lead to higher innovation and economic growth. In addition to capital and labour (factors already had been considered as internal in neoclassic theory), there were two other factors included in Romer's model, which were human capital and the level of technology. The endogenous growth theory expresses the causes of economic growth as follows: firstly, the acquisition of new 'knowledge' (including concepts such as innovation, technological progress, human capital accumulation, etc.); secondly, the stimulation of the application of new knowledge to production (market conditions, property rights, political stability and macroeconomic stability); and thirdly, the provision of resources for the application of new knowledge (human beings, capital, imports, etc.).[55] Thus, in economic theory, knowledge is no longer independent (i.e. exogenous to the economy) since knowledge growth is now tied to profit maximisation.

53 Robert M Solow, 'A Contribution to the Theory of Economic Growth', *The Quarterly Journal of Economics* 70, no. 1 (1956): 65–94.

54 Paul M Romer, 'Increasing Returns and Long-Run Growth', *Journal of Political Economy* 94, no. 5 (1986): 1002–37.

55 Romer; Paul M Romer, 'Endogenous Technological Change', *Journal of Political Economy* 98, no. 5, Part 2 (1990): S71–102; Paul M Romer, 'Two Strategies for Economic Development: Using Ideas and Producing Ideas', *The World Bank Economic Review* 6, no. suppl_1 (1992): 63–91; Paul M Romer, 'The Origins of Endogenous Growth', *Journal of Economic Perspectives* 8, no. 1 (1994): 3–22.

From a labour-intensive economy to a knowledge-based economy

In the 1960s, the term 'knowledge economy' was first proposed by Peter Drucker.[56] He pointed out the difference between manual workers and knowledge workers: knowledge workers worked with their heads rather than their hands and they generate ideas, knowledge and information. The knowledge economy was only heavily studied after Romer's endogenous growth theory. The knowledge economy, according to Powell and Snellman, is "production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence. A crucial feature of a knowledge economy is a greater dependence on intellectual abilities rather than physical inputs or natural resources."[57] A knowledge-based economy is one in which knowledge is generated, communicated, and used to foster economic growth and global competitiveness.[58] In the knowledge economy, intangible assets like knowledge and information have replaced tangible assets as the new key capabilities, encouraging innovation, initiative, entrepreneurship, and dynamism.[59]

3.1.2 Privatisations and commodification of knowledge by IPRs

With Romer's ideas, one of the key manifestations of a knowledge-based economy is the privatisation of knowledge for profit. This section will analyse how companies privatised knowledge in the 1990s and how IPRs helped to develop intellectual monopoly.

According to Organisation for Economic Co-operation and Development (OECD), the term 'intangible assets' refers to assets including computerized information (such as software and databases), inventive property(such as scientific and nonscientific R&D, copyrights, designs, trademarks), and economic competencies(such as brand equity, firm-specific human capital, networks joining people and institutions, organisational know-how that increases enterprise efficiency, and aspects of advertising and marketing) that might deliver future benefits without having a physical form.[60] Intellectual property rights are rights regarding intangible property created by human beings, including copyrights, patents, trademarks, and so on. Although the modern patent system could date back to the objective assessment of inventions in 1474[61], the regulation of intangible assets such as knowledge was not well established until the 1990s. The "Trade Related Aspects of Intellectual Property Rights" (TRIPS) Agreement,

56 Peter Drucker, *The Age of Discontinuity: Guidelines to Our Changing Society* (Routledge, 2017); Peter F Drucker, *The Effective Executive* (Routledge, 2018).

57 Walter W. Powell and Kaisa Snellman, 'The Knowledge Economy', *Annual Review of Sociology* 30, no. 1 (1 August 2004): 199–220, https://doi.org/10.1146/annurev.soc.29.010202.100037.

58 Shahrazad Hadad, 'Knowledge Economy: Characteristics and Dimensions', *Management Dynamics in the Knowledge Economy* 5, no. 2 (2017): 203–25.

59 Iwona Skrodzka, 'Knowledge-Based Economy in the European Union–Cross-Country Analysis', *Statistics in Transition. New Series* 17, no. 2 (2016): 281–94; Carl Shapiro and Hal R. Varian, *Information Rules: A Strategic Guide to the Network Economy* (Boston, Mass: Harvard Business School Press, 1999).

60 OECD, 'New Sources of Growth: Intangible Assets' (OECD publishing, 2011), https://www.oecd.org/sti/inno/46349020.pdf.

61 Daniele Archibugi and Andrea Filippetti, 'Knowledge as Global Public Good', The Handbook of Global Science, Technology, and Innovation, 2015, 489.

which was negotiated from 1984 to 1994 and signed in 1994, represents the most significant effort to harmonise intellectual property (IP) enforcement and protection globally. It establishes international guidelines for the protection of patents, copyrights, trademarks, and designs. It also includes a dispute resolution framework and intergovernmental enforcement measures. The European Union directive 96/9/EC of the European Parliament and of the Council on the legal protection of databases comes into force on March 11, 19961. It harmonizes database handling under copyright law as well as database creators' own rights for those who do not qualify for copyright. In addition, trademark law expanded in the 1990s, going beyond protecting consumers from confusion to create stronger and property-like rights for the goodwill in question.[62] Trademark law also created key assets for the information economy, anchoring the process of branding and advertising.

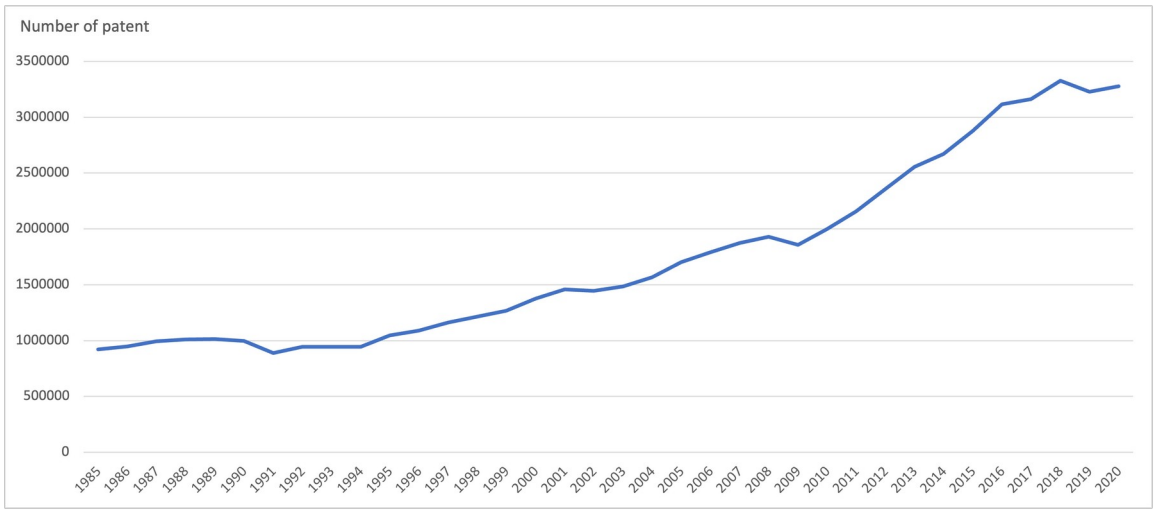

Figure 3.1: Statistics on worldwide patent application activity (Data source: World Intellectual Property Organization (WIPO)[63])

Since the 1994 TRIPS and 1996 EU Database Directive, the booming of intellectual property suggested the acceleration in the production of knowledge. Take patent as an example, Figure 3.1 shows the statistics on worldwide patent application activity. Before the mid of 1990s, the number of patent applications per year remained almost constant. After 1996, the number of global patent applications increased rapidly and tripled over the next 20 years. Trademark and copyright are both experiencing the same explosive growth trend as well. IPRs are intended to incentivize private agents to invest in knowledge development, to make knowledge temporarily exclusive, to create a market for them, and to disclose their knowledge. As a result, IPRs became the principal means of ensuring private innovators' access to the fruits of their knowledge. In other words, IPRs is the service providing to the economic sphere by the legal-political sphere.

62 Julie E. Cohen, in *Between Truth and Power: The Legal Constructions of Informational Capitalism* (New York, NY: Oxford University Press, 2019), 20–21.

63 World Intellectual Property Organization (WIPO), 'WIPO Patent Report: Statistics on Worldwide Patent Activity.', n.d., https://data.worldbank.org/indicator/IP.PAT.RESD.

Although the goal of the law is to protect the value of IP holders, stimulate innovation and accelerate the generation of knowledge, IPRs allow ownership of new knowledge to flow to the private sector. When intangibles are turned into assets, their owners gain the intellectual rents from private knowledge appropriation or control of intangibles. Firms assetalise knowledge through IPRs to gain legal intellectual rents.[64] It is well known that innovation (that is, the generation of new knowledge) is created on the basis of a large amount of known knowledge. When a large company in an industry consistently turns new knowledge into its own wealth, then it will occupy a very large number of legal intellectual rents in that industry and prevent its competitors from innovating. Meanwhile, smaller companies in the same industry cannot survive because they do not have enough legal intellectual rents, or they do not have enough capital to buy the existing knowledge. New companies are also unable to enter the industry because they lack the necessary pool of legal intellectual rents. Thus, by using legal intellectual rents to further generate new knowledge, increase the size and profitability of the company and build barriers to the industry, leading companies become the few players in the industry and eventually reach an intellectual (near-) monopoly situation.

After a large company has become an intellectual monopoly, the same knowledge can be used countless times, and its value increases as complementary knowledge grows. For example, skills are essential for the use of existing knowledge. Monopolistic ownership of intellectual property fosters investment in skills required to expand existing knowledge. As a result, the acquired talents make it much easier to learn and produce more private information. Large organizations are more likely to benefit from a virtuous circle between their skills and intellectual property.[65] With the monopoly of legal intellectual rents, the efficiency of large firms becomes higher as they have more knowledge. Knowledge rents are therefore the most important thing in maintaining a large intellectual monopoly.

According to Raconteur, the value of intangible assets has been increasing at a higher rate than the value of tangible assets (see Figure 3.2). In the S&P 500 worldwide, intangible assets were less than one-half of tangible assets before the privatisation trend began. On the contrary, intangible assets were already twice the value of tangible assets in 1995. With the value of intangible assets increasing at an even faster rate, knowledge had become the most important factor driving economic development. The increasing commoditisation of knowledge has contributed to the remarkable growth of the financial sector over the last three decades.[66] Stiglitz claimed that "If monopoly power of firms increases, it will show up as an increase in the income of capital, and the present discounted value of that will show up as an increase in wealth (since claims on the rents associated with that market power can be bought and sold.)".[67] While the strengthening of intellectual property rights facilitates

64 Durand and Milberg, 'Intellectual Monopoly in Global Value Chains'; Ugo Pagano, 'The Crisis of Intellectual Monopoly Capitalism', *Cambridge Journal of Economics* 38, no. 6 (2014): 1409–29.

65 Pagano, 'The Crisis of Intellectual Monopoly Capitalism'.

66 Thomas Philippon, 'Has the US Finance Industry Become Less Efficient? On the Theory and Measurement of Financial Intermediation', *American Economic Review* 105, no. 4 (2015): 1408–38.

67 Joseph Stiglitz, 'New Theoretical Perspectives on the Distribution of Income and Wealth among Individuals: Part IV: Land and Credit' (Cambridge, MA: National Bureau of Economic Research, May

financialisation, the financialisation of the economy induces companies to commoditise their intellectual capital even more.[68] Thus, the financialisation of the economy and the privatisation of knowledge go hand in hand and together lead to an abrupt change both in the nature of the business firm and in the generation and possession of knowledge.

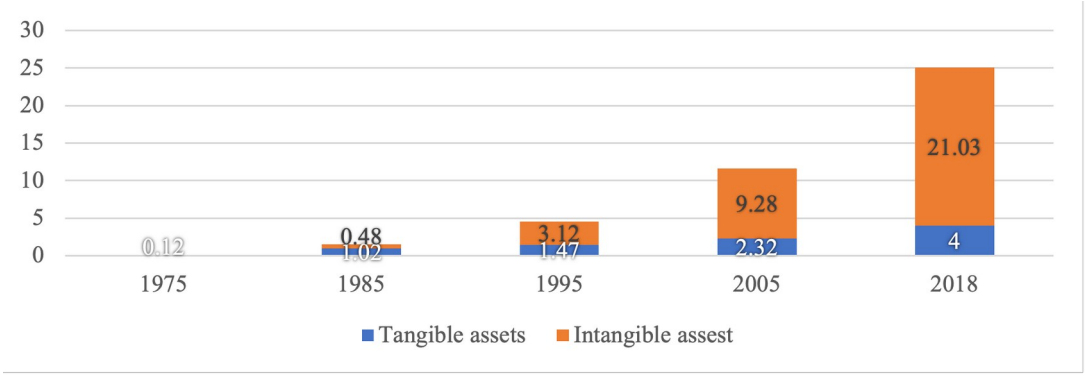

Figure 3.2: Value of the tangible and intangible assets of the five biggest companies on the S&P 500 worldwide from 1975 to 2018 (in trillion U.S. dollars).[69]

In addition, the privatisation of knowledge through IPRs has contributed to the internationalisation of large companies.[70] Empirical studies show that large US companies are more likely to establish advanced knowledge-based activities abroad if a strong and effective IPR regime is in place.[71] TRIPS has contributed to expanding the competitive environment for large companies by strengthening IPR regimes around the world. Large companies see the opportunity to move knowledge-based action relationships abroad by leveraging human resources, technological capabilities and more reliable IP regimes. Once they have multiple R&D centres in different locations around the world and large companies have developed an intellectual monopoly in multiple markets, they will have a global industry voice. With no concept of global government, it may be conceivably difficult to regulate. It also suggests that the intellectual monopoly could be seen as an international monopoly that transcends national boundaries.

2015), https://doi.org/10.3386/w21192.

68 Ugo Pagano, 'Knowledge as a Global Common and the Crisis of the Learning Economy', in *Toward a Just Society* (Columbia University Press, 2018), 353–76.

69 Raconteur, 'Value of the Tangible and Intangible Assets of the Five Biggest Companies on the S&P 500 Worldwide from 1975 to 2018 (in Trillion U.S. Dollars) [Graph].' (Statista, 25 February 2022), https://www-statista-com.tudelft.idm.oclc.org/statistics/1113984/intangible-tangible-assets-sandp500-largest-companies/.

70 Daniele Archibugi and Andrea Filippetti, 'The Globalisation of Intellectual Property Rights: Four Learned Lessons and Four Theses: The Globalisation of IPRs', *Global Policy* 1, no. 2 (May 2010): 137–49, https://doi.org/10.1111/j.1758-5899.2010.00019.x.

71 Lee Branstetter, Raymond Fisman, and C. Fritz Foley, 'Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from U.S. Firm-Level Data' (Cambridge, MA: National Bureau of Economic Research, August 2005), https://doi.org/10.3386/w11516.

3.2 The rise of Data-driven network-externality-based intellectual monopoly

3.2.1 Four types of intellectual rents

As stated in the previous section, intellectual monopoly is defined by Pagano, a key researcher on intellectual monopoly, as a type of legal monopoly acquired by huge firms relying on legal intellectual rents (through IPRs) to privatize information.[72] Admittedly, the importance of intellectual property rights in obtaining monopolistic power is obvious in the pharmaceutical and entertainment industries. However, the world has entered the digital economy in the previous two decades. A paradigm change in company development has occurred, with companies in various sectors transitioning from a purely physical economy to an economy relying on tangible assets as well as various sorts of intangible assets.

Table 3.1: A taxonomy of rents related to intangible assets[73]

Type	Description	Example
Legal IP rent	Rationing via exclusive rights on product production, process uses, cultural and scientific items, and marketing investment	Patents on pharmaceuticals, software copyright on features and coding, trademark protection (Nike, Louis Vuitton)
Vertical natural monopoly rent	Returns on intangibles underlying the integration Network complementarities within GVC Sunk costs resulting from asset specificities	Apple supply chain management Valeo, Bosch supply chain management of auto parts
Intangibles-differential rent	Uneven returns to scale on intangibles versus tangibles allow intangibles intensive segments of the chain to capture a large share of the gains	Apple and Nike fabless manufacturing versus assembling factories Nespresso versus coffee producers
Data-driven innovation rent	Central control of data generated along GVCs via asymmetric information systems Data access fuels innovation	Siemens sensors on machinery, Goodyear tires sensors Wal-Mart retailink software Amazon shopping histories

In the digital era, IPRs are of course also important. Giant tech companies, for example, are indeed acquiring more and more patents: HUAWEI has the most number of international patent applications with 6952 patent in 2021; It was followed by Qualcomm, Samsung

72 Ugo Pagano and Maria Alessandra Rossi, 'Incomplete Contracts, Intellectual Property and Institutional Complementarities', *European Journal of Law and Economics* 18, no. 1 (2004): 55–76; Ugo Pagano and Maria Alessandra Rossi, 'The Crash of the Knowledge Economy', *Cambridge Journal of Economics* 33, no. 4 (2009): 665–83; Pagano, 'The Crisis of Intellectual Monopoly Capitalism'; Pagano, 'Knowledge as a Global Common and the Crisis of the Learning Economy'.

73 Durand and Milberg, 'Intellectual Monopoly in Global Value Chains'.

Electronics, LG Electronics, and Mitsubishi Electric, which of all surpass 2500 international patent filings.[74] But not all intellectual monopolies rely exclusively on patents, trademarks and copyright. In addition to legal rents, there are other intangible intellectual rents that can lead to intellectual monopoly in the new age.

Table 3.1 outlines a taxonomy of rents from intangible assets proposed by Durand and Milberg: legal monopoly rents, vertical natural monopoly rents, intangibles-differential rents, and data-driven dynamic innovation rents.[75] There are three forms of rentals that are distinct from legal IP rent. To begin, vertical natural monopoly rent refers to the monopolistic power to control the entire chain, both upstream and downstream. Second, intangibles-differential rent refers to the higher returns on intangible assets when compared to tangible assets. Third, data-driven innovation rent refers to rents that can be obtained from data centralisation-derived innovation.

Since vertical natural monopoly rent and intangibles-differential rent are of low relevance to this thesis, they will not be developed here. The next part of this section will focus on data-driven intellectual monopoly.

3.2.2 Data-driven network-externality-based intellectual monopoly

Data are a core resource in the digital age. The increased usage of 'Big Data' is altering how knowledge is generated.[76] For example, according to Cockburn et al., deep learning and neural networks in machine learning, have prompted substantial improvements in knowledge generating processes, boosting their efficiency and profoundly modifying their organization and structure.[77]

However, as argued in Chapter 2.1, data are just known or assumed facts (clearly, whether data represent true facts depends on the quality of measurement). Since current IPRs do not cover protection of data, databases can only be legally protected in very narrow circumstances. Comino et al. also state that patents are not the most important mechanism for intellectual monopoly in the ICT industry.[78] Algorithms and machine learning, for example, are difficult to patent and copyright[79]. Algorithms are prohibited as subject matter, and machine-learning approaches are arguably detecting patterns in nature that cannot be properly attributed. Such technology is also difficult to protect through copyright. They may be

74 WIPO statistics database, 'Patents and Utility Models: PCT Top 10 Applicants', n.d., https://www.wipo.int/edocs/infogdocs/en/ipfactsandfigures/.

75 Durand and Milberg, 'Intellectual Monopoly in Global Value Chains'.

76 Marion Fourcade and Kieran Healy, 'Seeing like a Market', *Socio-Economic Review* 15, no. 1 (2016): 9–29, https://doi.org/10.1093/ser/mww033.

77 Iain M Cockburn, Rebecca Henderson, and Scott Stern, 'The Impact of Artificial Intelligence on Innovation', *The Economics of Artificial Intelligence: An Agenda*, 2019, 115–52.

78 Stefano Comino, Fabio M. Manenti, and Nikolaus Thumm, 'THE ROLE OF PATENTS IN INFORMATION AND COMMUNICATION TECHNOLOGIES: A SURVEY OF THE LITERATURE: PATENTS IN INFORMATION AND COMMUNICATION TECHNOLOGIES', *Journal of Economic Surveys* 33, no. 2 (April 2019): 404–30, https://doi.org/10.1111/joes.12277.

79 Amy Kapczynski, 'The Law of Informational Capitalism', *Yale LJ* 129 (2019): 1501.

protected by trade secret law, although trade secrets are a privilege that resembles tort or contract law rather than proprietary property. The absence of property in data, on the other hand, is formally true but practically incorrect.[80]

To develop digital knowledge, 'Big Data' are processed using machine-learning algorithms, deep learning, and neural networks. As a result, privatising 'Big Data' means privatising a source of potentially infinite knowledge generation. According to Birch et al., data leasing is defined as the new pursuit of innovative strategies that aim to capture or extract value by owning and controlling data as an asset.[81] As a result, the new type of information generated by major tech businesses from existing cutting-edge technology and 'Big Data' goes hand in hand with the rise of intellectual monopolies.

Digital large companies rely heavily on network externalities to attain the data-driven intellectual monopolies. Network externalities are the phenomenon where the value obtained in a product or service depends on the number of users of a compatible product or service.[82] For example, more users using the same digital platform increases convenience and content richness, and brings more value to existing users. The network effect has almost inevitably weakened competition in the digital market.

Once the large corporations have acquired this position, they can then reap the rents of the data monopoly that can be built on their network-externality-based digital-platform monopoly. When giant companies have access to large amounts of data, they can analyse 'Big Data' through a number of techniques. On the one hand, the findings of analysis and study can improve the level of current knowledge; on the other hand, 'Big Data' can assist huge corporations in developing new knowledge (including, but not limited to, new platforms, software, and hardware) through ICT. In a data-driven knowledge economy, this illustrates the intertwining of tangible and intangible capital in the data value chain.[83] Microsoft, for example, prioritized mobile and cloud services based on 'Big Data' and AI as sources of ongoing innovation.[84] Another example is Google, which exploits huge data streams from the network externalities of monopoly-level internet search market to increase the quality of its AI algorithms, allowing its search engine to maintain market dominance and produce targeted advertising[85]. And, like the legal intellectual monopoly, the same data can be reused in different processes of knowledge generation to drive continuous innovation in the organisation.

80 Cohen, 44-45.

81 Kean Birch, Margaret Chiappetta, and Anna Artyushina, ‘The Problem of Innovation in Technoscientific Capitalism: Data Rentiership and the Policy Implications of Turning Personal Digital Data into a Private Asset’, *Policy Studies* 41, no. 5 (2020): 468–87.

82 European Commission et al., Competition Policy for the Digital Era (Publications Office, 2019), 2, https://doi.org/10.2763/407537.

83 Cecilia Rikap and Bengt-Åke Lundvall, ‘Big Tech, Knowledge Predation and the Implications for Development’, *Innovation and Development*, 2020, 1–28.

84 Herminia Ibarra and Aneeta Rattan, ‘Microsoft: Instilling a Growth Mindset’, *London Business School Review* 29, no. 3 (2018): 50–53.

85 Ulrich Dolata, ‘Apple, Amazon, Google, Facebook, Microsoft: Market Concentration-Competition-Innovation Strategies’ (SOI Discussion Paper, 2017).

In the digital era, platforms are an integral part of user-facing products. Platforms are intermediaries organised through network logic, providing "potential counterparties" with access to each other and presenting users with clear and easy-to-read technology to those seeking to market goods and services to them.[86] Platform capitalism is a data-centric business model in which social media connect advertisers with users, taxi-hailing platforms connect drivers with passengers, and take-out platforms connect restaurants with people who want to order take-out, etc.[87] As data become a key resource that drives these businesses via data-driven innovation rent, platforms are created as a system for gathering, monitoring, and utilising data, functioning as infrastructure and an intermediary between different organizations. As a result, 'Big Data' platforms have become a source of unfettered political and economic influence, fostering data-driven network-externality-based intellectual monopoly.

Another distinction between data-driven innovation rent and legal intellectual rent is that they are created by different people. IPRs are created by researchers or employees, whereas data are created in social life by measuring aspects of organizational or individual behaviour. As a result, data have an additional layer of significance due to the relationship between the data and the data providers. In the old days, for a firm, figuring out who was the users and what they want were costly (both in terms of human and time costs) and difficult. But in the age of data, this kind of information is an adjunct to 'Big Data' so that companies with a lot of data can easily analyse and study the needs of their audience. As they accumulate it over and over again, their products will be more likely to be chosen by their users. In a word, if you have data-driven innovation rent for making transactions (whether monetised or not), then you have enormous power to collect data, personalise it, experiment with users and implement new contract models.[88]

3.3 Global-corporate-innovation-system-based intellectual (near-) monopoly

Apart from the essential feature of the intellectual monopoly mentioned above, which is privatization of intellectual rents, the other important feature is the appropriation of knowledge through a global corporate innovation system.

In order to expand the control over knowledge, large companies like to collaborate with other companies or other organisations. Rikap and Lundvall summarise this kind of corporation as global corporate innovation system, and use innovation circuits and global innovation networks to explain.[89] Innovation circuits are the interdependence of all the individuals and institutions involved in the creation of an invention, ranging from basic research discovery (if

86 Shoshana Zuboff, The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power, First edition (New York: PublicAffairs, 2019): 69,

87 Nick Srnicek, 'The Challenges of Platform Capitalism: Understanding the Logic of a New Business Model', *Juncture* 23, no. 4 (2017): 254–57.

88 Zuboff, The Age of Surveillance Capitalism, 42-44.

89 Rikap and Lundvall, 'Big Tech, Knowledge Predation and the Implications for Development'.

it is a science-based innovation) to the necessary industrial adjustments to implement the innovation. In contrast, global innovation networks focuses on how invention is sliced and diced into modular building blocks of specialized activities for geographically dispersed R&D teams.

Intellectual monopoly organises multiple innovation circuits and networks simultaneously, forming the global corporate innovation system, a concept proposed by Grandstrand.[90] Global innovation networks and innovation circuits complement each other. The creative process occurs in multiple organizations and institutions in both concepts, and one leading corporation, the intellectual monopoly, controls all networks or circuits. In innovation circuits, each innovation is seen as a distinct knowledge generation process organised by the dominating corporation. Global innovation networks demonstrate more the relationship between other institutions in the networks and the intellectual monopoly that other knowledge-creating stakeholders are under control of intellectual monopoly.

In other words, intellectual monopolies modularize the innovation process. Intellectual monopolies rely on both internal R&D and outsourcing to other organizations and institutions in each innovation circuit. The pharmaceutical sector is perhaps the most prominent example. Hospitals, universities, local R&D laboratories, and governmental agencies participate in the global corporate innovation system of the world's top pharmaceutical company.[91] However, all of the participants play a subordinated role in the system (including subordinated universities for research and innovating companies), which turns out that the intellectual rents generated by these engaged actors do not accrue to them.[92]

As a result, these intellectual monopolies develop new business, as well as decrease commitments of capital and risk of innovation, while predating knowledge from other organizations and enhancing their (near-) intellectual monopolistic dominance.

3.4 Examples of intellectual (near-) monopolies in the digital era

In addition to the essential features of the intellectual monopoly mentioned above, which are privatization of intellectual rents, the appropriation of knowledge through a global corporate innovation system and network externalities, the monopoly market for intangible assets also are characterized by (1) economies of scale arising from high fixed costs and low or zero variable costs, and (2) complementarities.[93]

90 Ove Granstrand, ‘Corporate Innovation Systems: A Comparative Study of Multi-Technology Corporations in Japan, Sweden and the USA’, *Chalmers University, Gothenburg*, 2000.

91 Cecilia Rikap, ‘Asymmetric Power of the Core: Technological Cooperation and Technological Competition in the Transnational Innovation Networks of Big Pharma’, *Review of International Political Economy* 26, no. 5 (2019): 987–1021.

92 Rikap.

93 Jonathan Haskel and Stian Westlake, ‘Capitalism without Capital’, in *Capitalism without Capital* (Princeton University Press, 2017).

Regarding the first, in the digital era, economies of scale are developed to the extreme because the marginal cost of digital products is almost zero. While the fixed cost of a digital service may be high, the cost of production is not proportional to the number of customers served. The more customers there are, the lower the unit cost. Regarding the second, Complementarity refers to two or more products that support each other. For example, users can use OneDrive to store Microsoft office files in the cloud. All strong economies of scale, network externalities and complementarity are able to create extreme entry barriers for potential competitors. In addition, Monopolies also consolidate their monopoly by acquiring other Small and medium-sized enterprises.

If a company or an organisation has acquired an intellectual monopoly in the digital era, it is likely to be based on at least one of the above-mentioned factors giving rise to a monopoly, and to have a large market power. Through the monopoly that is acquired, it will be able to reap a large amount of intangible rents (such as IPR- or data-driven rents).

Alphabet (Google) and Microsoft are two of the most representative examples of legal-rent-based and/or data-driven as well as global-corporate-innovation-system-based intellectual (near-) monopolies all over the world. They were the leading companies in the ICT revolution at the end of the last century. Both companies have a market capitalisation of over 1.4 trillion dollars in August 2022.

Microsoft: a legal-rent-, data-driven network-externality-, and global-corporate-innovation-system-based intellectual (near-) monopoly

The most successful product of Microsoft, Windows desktop operating system, has held near 80% of the market share till now.[94] Before it became a tech giant, Microsoft relied on IPRs to expand its intellectual (near-) monopoly on knowledge. Historically, Microsoft's intellectual monopoly was founded on legal rents based on the permission to patent or claim copyrights for software.[95] In the case of patent, as shown in Figure 3.3, the number of Microsoft patents increased rapidly from 1999 to 2005. This suggests that for Microsoft, patents were a very good means of monetising innovation and privatising knowledge during that time.

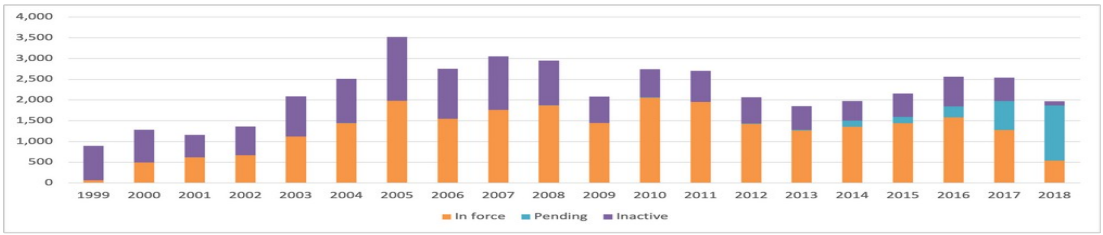

Figure 3.3: Number of Microsoft patent families worldwide from 1999 to 2018, by legal status (Data source: Statista)[96]

94 'Desktop Operating System Market Share Worldwide', Statcounter GlobalStats, accessed 21 August 2022, https://gs.statcounter.com/os-market-share/desktop/worldwide.

95 Charles Arthur, *Digital Wars: Apple, Google, Microsoft and the Battle for the Internet* (Kogan Page Publishers, 2014).

From 2014 onwards, Microsoft transformed from legal-rent-based intellectual (near-) monopoly to data-driven network-externality-based intellectual (near-) monopoly.[97] Microsoft shifted its business focus from Windows to mobile and cloud businesses with 'Big Data' and artificial intelligence(AI) as a source of continuous innovation. The further increase in the number of patents after 2014 on Figure 3.3 can be explained by the increase in the number of patents related to AI and 'Big Data'. Today, Microsoft has the second largest number of AI patents (after IMB) and is also the second largest public cloud provider in the world (after Amazon).

Microsoft's intellectual monopoly also bases on the global corporate innovation system, which will be discussed together with Alphabet in the end of this section.

Alphabet (Google): a data-driven network-externality- and global-corporate-innovation-system-based intellectual (near-) monopoly

Google's search engine product is more than familiar to most people, accounting for over 90% of the global search engine market.[98] Unlike Microsoft, Google is not an intellectual monopoly driven by IPRs. Google is a multi-technology and multi-product intellectual monopoly based on monopolising 'Big Data' and turning it into an intangible asset. Over 90% of internet search data provides Google with a massive data stream that further enhances the quality of its artificial intelligence algorithms and helps maintain its search engine dominance.[99] Google creates intellectual rents through data, which generates targeted advertising and profits. google's multiple product portfolio not only increases complementarity and extends its monopoly, but also provides other sources of 'Big Data' to Google for further innovation, such as from YouTube, Google Maps, Google Pay and Gmail. Furthermore, Google is a typical illustration of a vicious loop. Innovations, or knowledge generation, typically entail the creation of new sources of information or data from current data, so increasing its data-driven intellectual monopoly even more.

Like in the case of Microsoft, Alphabet's monopoly is also based on its involvement in a global corporate innovation system (see the next section).

Alphabet (Google) and Microsoft's global corporate innovation system

Google and Microsoft gain intangible assets through internal and external knowledge predatory. Their global corporate innovation system combines in-house innovation with the

96 LexisNexis PatentSight, 'Number of Microsoft Patent Families Worldwide by Filing Year from 1999 to 2019, by Legal Status.', Statista, 1 October 2020, https://www-statista-com.tudelft.idm.oclc.org/statistics/1034052/number-of-microsoft-patents-by-filing-year-and-status-worldwide/.

97 Rikap and Lundvall, 'Big Tech, Knowledge Predation and the Implications for Development', 10.

98 StatCounter, 'Worldwide Desktop Market Share of Leading Search Engines from January 2010 to July 2022', Statista, 16 July 2022, Accessed 21 Augus, 2022, https://www-statista-com.tudelft.idm.oclc.org/statistics/216573/worldwide-market-share-of-search-engines/.

99 Dolata, 'Apple, Amazon, Google, Facebook, Microsoft: Market Concentration-Competition-Innovation Strategies'.

outsourcing of modules or stages through global innovation networks, as well as the acquisition of potential start-ups. For example, Google's core business of search engines relied heavily on internal inventions, yet various other business sectors (particularly data-driven solutions) have relied heavily on outside created innovations.[100] These firms share exploitative rent-seeking and subordination activities with the corporations and research institutions that engage in their corporate innovation system. They collaborate extensively in science research, both with other firms, university and research institutions. However, they usually do not share patent. Predation is a spoliation of the production of new knowledge in which a business asserts its dominance by organising the operations of other companies.

Rikap and Lundvall summarise co-authorship versus co-patenting as evidence of knowledge predation[101]. Table 3.2 shows the quantity and ratio of co-authorship and co-patenting of Google and Microsoft. Table 3.3 shows the institutional affiliations of top co-authors of Microsoft and Google.

Table 3.2: Co-authorship versus co-patenting as evidence of knowledge predation.[102]

Company	Publications (until 2019 included)	Co-authored papers	% Co-authorship	Applied & granted patents (until 2017 included)	% of co-owned patents
Microsoft	17405	13622	0.78	76109	0
Google	6447	5305	0.82	25538	0

Table 3.3: Institutional affiliations of top co-authors of Microsoft and Google from 2014 to 2019. [103]

Microsoft	Google
University of California	University of California
University of Washington	Stanford University
University of Science & Technology of China	Microsoft
MIT	MIT
Tsinghua University	Harvard
University of London	Carnegie Mellon University
Carnegie Mellon University	University of Texas

100 Cecilia Rikap, Capitalism, Power and Innovation: Intellectual Monopoly Capitalism Uncovered (Routledge, 2021), 48.
101 Rikap and Lundvall, 'Big Tech, Knowledge Predation and the Implications for Development', 13-14.
102 Rikap and Lundvall.
103 Rikap and Lundvall.

Google	Illinois University of Washington
Stanford University	IBM
ETH Zurich	New York University

From 2014-2019, Microsoft researchers published 17,405 pieces of work, of which 13,622 were co-authored with others, representing 78.2%. However, with more than 76,000 patents until 2017, Microsoft only co-owns 150 with other companies and 11 with universities. The same trend occurred at Google, which published 6,447 publications till 2019, of which 5,305 were co-authored paper (82.3%). However, until 2017, Google had only shared 3 patents with a Stanford university, the rest of co-owned patents are shared with other companies. While this thesis cannot prove a direct relationship between publications, patents, and monopoly, the large number of co-authored papers suggests that cooperation with universities and research institutions may also be an important factor contributing to the high-tech giants' (near-)monopoly.

This is the proof that intellectual monopolies emerge also as a consequence of frequent and close collaboration with universities and research institutes (which are paid with tax-payers' money, not the high-tech giants' money). The predatory aspect is that private companies ‘exploit’ public knowledge (the global public invention and innovation system) for their own private purposes. In a word, intellectual monopolies arise also because the legal-political systems allow high-tech businesses to privatise public knowledge. In the next section, this thesis will zoom out to study how intellectual monopolies interact with the public sectors and how they interfere with the universities and research institutions from the relationships between the three spheres in the social life.

3.5 Explaining intellectual monopoly from the perspective of the three spheres

From this section, how the emergence of intellectual monopolies will be explained from the perspective of changing relationships between the three spheres of social life. The following scholars tried to use models to explain the current relationship between legal-political, economic, and cultural spheres in the knowledge economy.

Triple helix model

In 1995, Etzkowitz and Leydesdorff suggested that a spiral model captured the multiple reciprocal linkages at different stages of knowledge capitalisation.[104] Thus, as shown in Figure 3.4, the involvement of universities, industry and government in this process led to a triple helix model of innovation.

104 Henry Etzkowitz and Loet Leydesdorff, ‘The Triple Helix--University-Industry-Government Relations: A Laboratory for Knowledge Based Economic Development’, *EASST Review* 14, no. 1 (1995): 14–19.

> "Three sub-dynamics are reproduced as functions of a knowledge-based economy: (1) wealth generation in the economy, (2) novelty generation by organized science and technology, and (3) governance of the interactions among these two subdynamics by policy-making in the public sphere and management in the private sphere. The economic system, the academic system and the political system can be considered as relatively autonomous subsystems of society which operate with different mechanisms."[105]

The Triple Helix model's analytical function is to unravel the complex dynamics of a knowledge-based economy into its constituent sub-dynamics. A Triple Helix of university-industry-government linkages can be used to model a configuration with three possible degrees of freedom—markets, governance, and knowledge generation.[106] Governance can be thought of as the variable that instantiates and organizes systems in the model's spatial dimension; industry is the primary carrier of economic production and exchange; and universities play a key role in the organization of the knowledge-creation function.

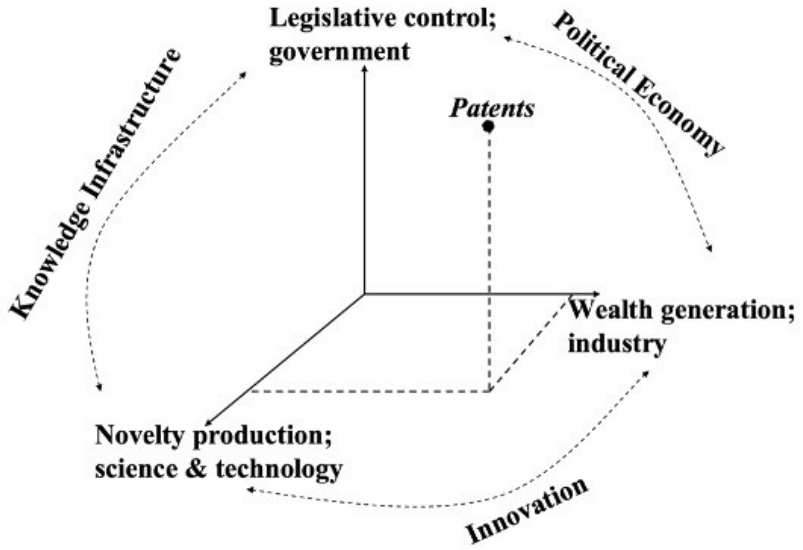

Figure 3.4: Patents as events in the three-dimensional space of Triple Helix model.[107]

In 2010, Leydesdorff claimed that relationships in real life between these three spheres were asymmetrical.[108] One of the branches (the university) was institutionally less powerful than the other two. The other two spheres (government and industry) increasingly and indirectly co-opt the university in a variety of ways (even a direct influence of military industrial complex). However, he then argued that the university had specific strengths: firstly, it

105 Loet Leydesdorff, 'The Knowledge-Based Economy and the Triple Helix Model', Annual Review of Information Science and Technology 44, no. 1 (2010): 368, https://doi.org/10.1002/aris.2010.1440440116.

106 Henry Etzkowitz and Loet Leydesdorff, 'The Dynamics of Innovation: From National Systems and "Mode 2" to a Triple Helix of University–Industry–Government Relations', *Research Policy* 29, no. 2 (2000): 109–23.

107 Leydesdorff, 368.

108 Leydesdorff, 399.

prominently provided the other two systems with a constant influx of new discursive knowledge (such as dissertations and patents) and new knowledge carriers (students).[109] From this perspective, the university could be seen as a major carrier of knowledge-based invention systems. Knowledge-based fluxes continuously upset and reformed the dynamic equilibria sought by the two other strands of the political economy. Thus, according to Leydesdorff, because the dynamics of reconstruction are reinforced, the destabilizing dynamics of innovation can be perpetuated when they are knowledge-based.

In the Triple Helix model, the dynamics between the three spheres has been depicted, but the autonomy and freedom of the university (in the cultural sphere) has not been paid attention to. According to Etzkowitz and Leydesdorff, "in such a complex dynamics (in the knowledge economy), the independent (steering) variables at one moment of time may become dependent at a next moment".[110] The dynamics triple helix would help the school to automatically correct the asymmetries created by the other two sub-mechanisms. For example, a patent can be regarded as an event in which the coordination mechanisms (knowledge infrastructure, innovation and political economy) interact with each other rather than equilibrations of mechanisms just between two sub-dynamics like market mechanism between supply and demand, political economy between government and industry (see Figure 3.4).

Although Etzkowitz and Leydesdorff recognised the importance of the three different sub-dynamics (spheres) working together in a knowledge economy, they did not point out that three spheres need to be run independently to protest knowledge predation. They thought the involvement of all three spheres would take into account the needs of all three, then achieve a feasible result, as well as avoid the problems caused when there are only two spheres.

'Vicious loop' model

Lankau developed his triangle ('Dreieck') model of connections between the three spheres to depict the domination of the cultural sphere by the two others (economic and legal-political spheres). As shown in Figure 3.5, he described a closed loop where the economic and the legal-political spheres cooperate in dominating the cultural sphere in order to further their own goals.

For example, from the point of view of this model, IPRs look like a service provided to the economic sphere by the legal-political sphere. The legal-political sphere ('political parties' in Figure 3.5) helps businesses in the economic sphere (at the top of Figure 3.5) to privatise the generation of knowledge (which now increasingly takes place in foundations or institutions dominated by businesses, or in research projects commissioned by them) and to create intangible assets based on this. This research can be used to directly support the business's intellectual monopoly, or also for lobbying and influencing policy makers to take measures that further benefit the businesses. The three spheres are no longer autonomous but part of a

109 Leydesdorff, 399.
110 Leydesdorff.

kind of feedback-loop, where economic and political power are used to support intellectual monopoly which is used to further increase the power of economic and political institutions. In various ways, the generation of knowledge is privatised and politicised, rather than being conducted in a free cultural sphere (a sphere of independent research and education) for the benefit of all.

In this sense, Lankau's triangle may be called a 'vicious loop': the economic sphere increases control over the generation of new knowledge and the legal-political sphere gives laws and rules that make this possible. What happens in the cultural sphere is no longer independent of commercial and political interests.

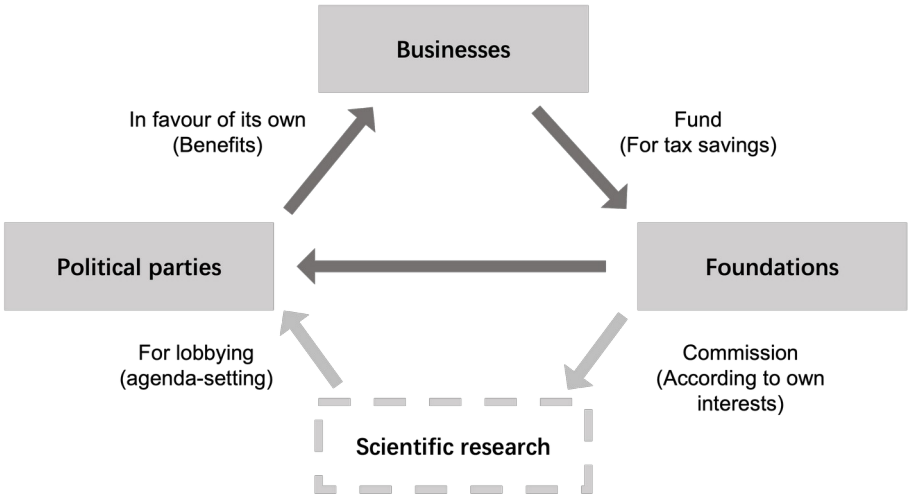

Figure 3.5: 'Vicious loop' model (translated from German).[111]

Lankau used his model to point to the need for an independent cultural sphere. In many works of literature, there seems to be a lack of awareness of the need for an independent cultural sphere. Only two spheres (the economy and the legal-political sphere) are generally recognised in society. The legal-political sphere is expected to protect the public interest and individual well-being, and to manage and control the economic sphere through legislation. However, as things happen in real life, if economic behaviour is based on the pursuit of self-interest, then the economic sphere tends to exceed its boundaries and colonise the political and cultural sphere to further its own interests.

The Triple helix model and the 'Vicious loop triangle' model help to further clarify the emergence of intellectual monopolies from a macro-sociological perspective. Through their law-giving powers, the legal-political sphere (which today includes international organisations such as the OECD, the UN, the WHO and their international treaties and standards as well as national governments) support the emergence of the intellectual (near-) monopolies (for example by granting IPRs; the role of standardisation is further discussed in

111 Lankau, Kein Mensch Lernt Digital: Über Den Sinnvollen Einsatz Neuer Medien Im Unterricht, 11.

the next chapter). As a result, knowledge generation loses its (academic) independence. Rather than receiving full support and protection from the other two spheres for goals set within the cultural sphere itself, the cultural sphere is used to serve the interests of the two other spheres.

3.6 Impacts on knowledge generation (invention) by the intellectual (near-) monopolists

Continuous invention (or new knowledge generation) and innovation are important cornerstones for maintaining the development of society, and according to a relatively large part of the economic literature, knowledge generation is stimulated by the privatisation and commercialisation of knowledge generation. On the other hand, the privatisation and commercialisation of knowledge generation is also the way in which large companies build and maintain a monopoly on knowledge, which may have undesirable effects in the sphere of research and education.

3.6.1 The benefits of privatising knowledge

The following reasons are often mentioned to justify the privatisation and commercialisation of knowledge: [112]

- It can attract more private investment into basic research and compensate for entry restrictions in applied research;
- New revenues from royalties will increase the total revenues in both private companies and public institutions;
- Inventors would be motivated to do more research because of the incentive system created by IPRs;
- Although the use of knowledge is non-competitive, there is already precedent in the world for paying for used of commons (e.g. forests, fishing, and grazing land). The international community, therefore, has the same right to charge for the sharing of knowledge;
- There is a free-rider problem in the current global economic structure: the public knowledge generated in one country may be used by other countries without compensation. Each country needs to protect its public knowledge ownership through IPRs. However, the excessive privatisation of knowledge in the real world has led to a near intellectual monopoly by giant corporations.

112 Guido Cozzi and Silvia Galli, 'Privatization of Knowledge: Did the US Get It Right?', 2011; Pagano and Rossi, 'Incomplete Contracts, Intellectual Property and Institutional Complementarities'; Joseph E Stiglitz, 'Knowledge as a Global Public Good', *Global Public Goods: International Cooperation in the 21st Century* 308 (1999): 308–25.

3.6.2 The negative impact of intellectual monopoly on social life

Every single thing has different consequences in different amounts. After discussing knowledge generation from the perspective of profit-maximising business, one might consider its impact on the three spheres of social life. In the literature on privatised knowledge mentioned in the previous section, basically all the benefits occur in the businesses that commercially exploit this knowledge. It is clear that the existing literature has ignored the impact on the legal-political and cultural spheres in justifying the privatisation of knowledge, as well as on the economy as a whole, and thus they may have underestimated the problem of intellectual monopoly that may result when knowledge is (over-)privatised. All in all, it is worthwhile to review the effects, including possible negative effects of intellectual monopoly on the various spheres of society as a result of (excessive) appropriation of knowledge as well. In this section, potential negative effects of intellectual monopoly on society are elaborated from the perspective of three spheres.

The legal-political sphere

- **Intellectual monopoly makes regulation more difficult.** Firstly, most intellectual monopolies today are international corporations, but there is no international legislation in place to regulate these multinational enterprises. Rules of competition/antitrust, labour, markets, data protection and intellectual property are becoming increasingly difficult to develop and legislate.[113] In particular, many intellectual monopolies rely on platforms to provide free services to users, which makes regulation even more difficult. Second, the intellectual monopolies lobbies a lot to interfere the regulation making of the legal-political sphere. According to the European Union's official transparency register, Alphabet (Google), Facebook, Amazon, Apple, Bytedance (TikTok), Snap, and Microsoft revealed over €25 million in lobbying spending in 2020.[114] For another example, Big Tech specifically targets politicians. Former politicians frequently move on to lucrative positions in Big Tech.
- **Intellectual monopoly may help government to control the cultural spheres because almost every one is using the same software.** Since intellectual monopolies have the most essential characteristic of monopolies, which is a large market share share, legal-political spheres can take advantage of this to cooperate with the intellectual monopolies and bring control over the cultural sphere through the products of the intellectual monopolies. In return, Intellectual monopolies can gain some profits from the legal-political sphere. For instance, Fiebig et al pointed to the digital standardisation which was taking place at Dutch universities, how this is

113 Martin Kenney and John Zysman, 'The Rise of the Platform Economy', *Issues in Science and Technology* 32, no. 3 (2016): 61.

114 'Transparency Register', European Union, accessed 25 April 2022, https://ec.europa.eu/transparencyregister/public/homePage.do?redir=false&locale=en.

related to the administrative centralisation of Dutch universities and how large cloud firms with quantities of users were supporting to finish the process.[115]

The economic sphere

- **Intellectual monopoly increases corporate disparities.** Since the same knowledge can be used indefinitely and its value increases with complementary knowledge, large firms with large portfolios of intellectual property could rely on the accumulation of past exclusive knowledge to generate more new knowledge. In contrast, smaller firms are unable to create new knowledge due to a lack of inputs. Therefore, once knowledge becomes part of a firm's private capital, large corporations may enjoy the fruits of a knowledge monopoly, and the knowledge-intensive economy becomes a very hostile environment for small and new firms.[116] Moreover, while substitutes (similar or equivalent assets) can perhaps be found for tangible assets, it is often impossible for a small company which requires a certain knowledge (intangible asset) to be able to innovate, to find a similar intangible asset if the intangible asset it needs has been privatised. In the end, small firms and start-ups would enter a vicious circle: the basic knowledge required to develop new knowledge are not available because of a lack of access to privatised knowledge.[117]
- **Intellectual monopoly rises income inequality.** Income inequality has increased worldwide. In the United States, for example, the median wage of American workers has been stagnant for the past four decades.[118] Goldin and Katz link technological change over recent decades to widespread wage stagnation and winner-takes-all dynamics. Because more technology requires higher levels of knowledge, these dynamics provide extraordinary rewards for individuals at the top who are highly educated.[119] When the upper echelons monopolize more knowledge, unequal knowledge accessibility can further create disparities in knowledge stocks. The end result is that those with knowledge may become increasingly knowledgeable, and those with low levels of education will remain at less educated levels. As a result, income inequality will widen further.
- **Intellectual monopoly can lead to stagnant economic growth.** Firstly, intellectual monopoly raises the revenues of IP-intensive firms and reduce investment opportunities for other (new) businesses, as IPRs preclude others' investments.[120] Secondly, market dominance means that there is limited competitive pressure on leading firms and therefore dominant firms are less eager to invest in new

115 Fiebig et al., 'Heads in the Clouds: Measuring the Implications of Universities Migrating to Public Clouds'.
116 Pagano, 'The Crisis of Intellectual Monopoly Capitalism'.
117 Pagano, 'Knowledge as a Global Common and the Crisis of the Learning Economy'.
118 Lawrence R Mishel, The State of Working America (Ithaca: ILR Press, 2012): 5.
119 Claudia Dale Goldin and Lawrence F. Katz, The Race between Education and Technology, 1. paperback ed (Cambridge, Mass.: Belknap, 2009): 2-3.
120 Pagano and Rossi, 'The Crash of the Knowledge Economy'.

knowledge.[121] Finally, the financialisation of non-financial firms may have led to a disconnect between profits and investment, especially in the US where high profits of large firms were distributed more to shareholders in the form of share buybacks and dividends than being invested to generate new knowledge.[122] In a word, these mechanisms have led to low reinvestment returns and increased fiscal spending, resulting in lower economic growth rates and increased income and wealth inequality.

The cultural sphere

- **Intellectual monopoly shrinks the liberty of knowledge generation in society.** Since the early 1980s, when basic research became patentable and commercialized, the cultural sphere (the sphere of research, education, and technology development) was opened up to the market. After 1980, since legal barriers to private commercial capital entering academia and research institutes were removed, it is easier for (profit-maximising) corporations to provide private funding to academia.[123] Although the introduction of stronger property rights was expected to stimulate invention and innovation, it may have caused a depression of innovative investments (after an initial boom).[124] IPRs restrict the freedom of knowledge development, and transform a world based primarily on open science and open markets into closed science and closed markets. Scientists and research institutions could join the innovation network run by a monopolistic corporation or could themselves operate like commercial businesses. According to Suarez-Villa, today's cultural sphere is more likely to be lured by the economic sphere, and the independent generation of knowledge declines.[125]

- **Intellectual monopoly can control the direction of invention and result in significant dynamic welfare losses for society.** For society, the negative effects of intellectual monopoly on the cultural sphere may be much greater than the incentive effect provided by them. Excessive privatisation of knowledge has forced universities and other public institutions to prosper only by betraying their mission to advance open science.[126] In many cases, they become 'patent trolls'.[127] At the same time, the cost of public research may increase when knowledge is privatised because privatisation may waste research resources by blocking access to knowledge. Unexpected discoveries in scientific research may become less frequent and the expansion of the knowledge base may slow down as most researchers without access to knowledge will not be able to work on the shoulders of previous scholars.

121 Durand and Milberg, 'Intellectual Monopoly in Global Value Chains'.
122 Cédric Durand and Maxime Gueuder, 'The Profit–Investment Nexus in an Era of Financialisation, Globalisation and Monopolisation: A Profit-Centred Perspective', *Review of Political Economy* 30, no. 2 (2018): 126–53.
123 Cozzi and Galli, 'Privatization of Knowledge: Did the US Get It Right?'
124 Pagano, 'The Crisis of Intellectual Monopoly Capitalism', 1423-25.
125 Luis Suarez-Villa, *Globalization and Technocapitalism: The Political Economy of Corporate Power and Technological Domination* (Routledge, 2016).
126 Pagano, 'Knowledge as a Global Common and the Crisis of the Learning Economy'.
127 Mark A Lemley, 'Are Universities Patent Trolls', *Fordham Intell. Prop. Media & Ent. LJ* 18 (2007): 611.

- **Intellectual monopoly might influence the sphere of 'public and private deliberation'.** From the perspective of a free and open cultural sphere, dominant digital companies monitor the entire process from information acquisition, information storage, and information dissemination channels.[128] This monopolisation of information may have consequences for freedom in the cultural sphere and through this, also for the democratic process. Information and knowledge are the basis for democratic decision-making. Through the data they possess on users' opinions etc., date-driven intellectual monopolies may manipulate the democratic process. For example, during the 2020 U.S. elections, both Trump and Biden's campaigns placed politically motivated ads on Facebook to black voters in Kenosha, Wisconsin.[129] Thus, intellectual monopolies may 'nudge' people's thinking in certain directions.

This chapter introduces the intellectual monopoly by analysing the existing literature from the macro-sociological level. Three kinds of rise of intellectual monopolies has been identified, which are legal-rent-, data-driven network-externality-, and global-corporate-innovation-system-based intellectual (near-) monopoly. The next chapter will zoom in to business level to study the intellectual monopoly in a more specific field, which is the education technology.

128 Hans Gersbach, 'Democratizing Tech Giants! A Roadmap', *Economics of Governance* 21, no. 4 (1 December 2020): 351–61, https://doi.org/10.1007/s10101-020-00244-5.

129 Nick Corasaniti, 'Political Campaigns Can Still Target You on Facebook' (The New York Times, 2021), https://www.nytimes.com/2021/11/11/us/politics/facebook-political-ads.html.

Chapter 4 The intellectual (near-) monopolies in digital education technology

According to the research framework, this chapter will zoom in the angle from the macro-sociological level to business level, which is the digital education. this chapter begins by introducing the digitalisation of education (see Section 4.1). Digital education refers to education supported by the educational technology (software or tools). These kinds of software has grown rapidly since last decade and the development has exploded since Covid-19. Then, two categories of intellectual (near-) monopolies will be determined (see Section 4.2). First, following the definition in Chapter 3, legal-rent- or/and data-driven network-externalities-based intellectual (near-) monopolies in digital education will be identified. Apart from that, I will define a new type of intellectual rent, the learning-related rent and explain which kinds of corporations are learning-related intellectual (near-) monopolies in digital education.

The focus of Chapter 4 is the impact of intellectual (near-) monopolies on education in the digital age. Since education-related corporations or organisations do not reach true monopoly, which means only one large corporation in one field, I will use '(near-) monopoly' to ensure consistency of terminology with the previous Chapter. In this thesis, near-monopoly markets include oligopolistic markets and markets that are on the verge of reaching a monopoly. Oligopolistic markets are markets dominated by a small number of suppliers. In Section 4.3, the links between intellectual (near-) monopolies in the economic sphere and the legal-political sphere will be analysed. Then, the impacts of intellectual (near-) monopolies in digital education technology on freedom of education (with the cooperation of the (para-)legal-political sphere) will be worked out (see Section 4.4). Finally, this chapter will zoom out again to use the models introduced in the previous chapters to review the research results in Chapter 4 from the macro-sociological level (see Section 4.5).

4.1 Education technology in the digital era

Information and communications technology (ICT) is any product that stores, retrieves, manipulates, transmits, or receives information digitally. ICT has changed the way people live over the past decades. The expanding telecommunication sector has brought people from different locations in different time zones closer together. People can communicate with people all over the world through various social media as well as chat software, sharing their insights and opinions with people all over the world. In addition to increasing the means of communication, these new technologies have led to a dramatic change in the way everyone generates knowledge through learning. The covid-19 pandemic that began in 2020 has accelerated the growth of digital learning.

Bersin defined digital learning (also known as D-learning) as follows:

> "Digital learning means bringing learning together in a format that fits today's digital world of work. All great learning organizations should deliver learning solutions through simulations, collaboration, meeting other people and learning from experts. So, digital learning is not all digital, but it should take advantage of digital tools in an integrated way."[130]

D-learning is viewed as an educational instrument capable of changing the way education is given, and it is spreading and gaining acceptance in the digital world on a daily basis.[131] There are three main areas of application for digital learning. Firstly, online asynchronous learning management systems (LMSs) (such as Google classroom, Canvas or Brightspace) aim to increase digital interaction and collaboration between and among lecturers and learners. Universities today often use an online platform to facilitate the organisation of courses/assignments/exams. These platforms provide teachers the possibility to upload relevant materials (rather than mentioning and/or handing them out in class), and to digitally assign homework and communicate grades; students are able to download materials, upload assignments, and ask questions online. LMSs are used by all age group of schools, including K-12 schools (from kindergarten to high school), higher-education institutions, school districts, etc. Secondly, online course platforms can be divided to Massive Open Online Courses (MOOCs) (such as edx or Coursera) which offer an alternative learning tools for those with higher education and beyond, and K-12 online course platform (such as Byju'). Online course platforms offer the possibility of distance learning for those who do not have access to schools, and the opportunity for students from developing countries to the coursed provided by universities in developed countries. Regardless of the time zone or location, students always are able to access courses through computers and the internet. Thirdly, in-school education was converted to online or hybrid teaching at the occasion of the sudden epidemic in 2020. A large number of synchronous online video conferencing platforms (like Zoom or Microsoft Teams) have been used since then, changing the learning and teaching ways that billions of students and millions of educators around the world.

Digital learning Market size surpassed USD 315 billion in 2021, increasing over 200 billion compared from 2019.[132] While the Digital learning market grows very fast over the past decade, market concentration is becoming consolidated and has gradually emerged as a near-monopoly. For LMSs, Figure 4.1a shows the global LMS market share in 2014, with no more than 10% market share for each LMS in the market, and almost half for a combination of

130 Josh Bersin, 'How Do You Define Digital Learning?', 11 June 2017, https://www.clomedia.com/2017/06/11/define-digital-learning/.

131 Lou Chitkushev, Irena Vodenska, and Tanya Zlateva, 'Digital Learning Impact Factors: Student Satisfaction and Performance in Online Courses', *International Journal of Information and Education Technology* 4, no. 4 (2014): 356–59, https://doi.org/10.7763/IJIET.2014.V4.429.

132 Global Market Insights, 'E-Learning Market Size By Technology, By Provider, By Application, COVID-19 Impact Analysis, Regional Outlook, Growth Potential, Competitive Market Share & Forecast, 2022 – 2028', April 2022.

companies with particularly small market shares (see 'Others' in Figure 4.1a).. This shows that the LMS market at that time was full of competition, with no leading companies and every firm having the potential to grow. However, the global LMS market share in 2021 (shown in Figure 4.1b) almost consists of a few companies with large market shares, with Google Classroom accounting for 39% as the top firm. The top 4 companies account for 83% of the market share. MOOCs have long been a near-monopoly, with Coursera and edx holding a steady share of more than half of the market since 2012. Video conferencing is the type of online education that has changed the most in the last couple of years, because the epidemic has increased its demand. According to statistics, the global demand for top video conferencing apps has increased by over 250% from March 2020 to mid-2021.[133] Zoom has a 50% market share of video conferencing in June 2021 and Microsoft Teams and Webex Meeting follow behind with 23% and 11% of market share.[134]

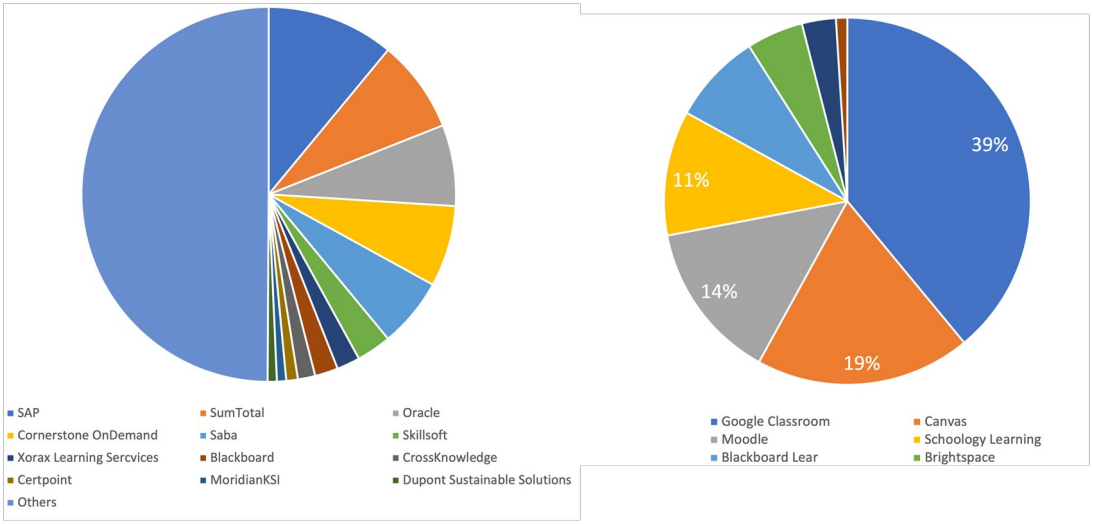

Figure 4.1.a: Global LMSs market share in 2014 (Data source: Bersin by Deloitte)[135]

4.1.b: Global LMSs market share in 2021 (Data source: TrustRadius)[136]

4.2 Who are the intellectual (near-) monopolists in digital education technology?

4.2.1 Legal-rent-based or/and data-driven intellectual (near-) monopolies in digital education

As introduced in Chapter 3.4, Alphabet and Microsoft are two representatives of the intellectual monopolies in the digital era. In the education technology, there are also two

133 Stephanie Chan, 'Usage of Mobile Video Conferencing Apps Including Zoom Grew 150% in the First Half of 2021', July 2021, https://sensortower.com/blog/video-conferencing-apps-mau-growth.
134 TrustRadius, '84 Current Video Conferencing Statistics for the 2021 Market'.
135 Lambda Solutions, 'The Learning Management System Market Today', 8 September 2014, https://www.lambdasolutions.net/blog/learning-management-system-market-today.
136 TrustRadius, '49 LMS Statistics and Trends for a Post-COVID World', 8 June 2021, https://www.trustradius.com/vendor-blog/lms-statistics-trends.

software developed by them and attaining high market share, which are Microsoft Teams and Google Classroom. Although neither Alphabet (Google) nor Microsoft primarily offers education-related products, their (near-)monopolistic market share on digital learning solutions is the result of their legal-rent-based or/and data-driven intellectual (near-) monopoly.

Microsoft Teams was announced in November 2016. Microsoft Teams grew significantly due to the impact of the Covid-19 policies. Lead communications for Microsoft, Frank Shaw, announced there were more than 270 million daily users in January 2022 (only 8 million in 2019 before the pandemic). Microsoft Teams offers workspace chat and video conferencing, file storage and application integration. Hundreds of integrations can be integrated with Teams through Microsoft's integration marketplace, Microsoft AppSource. For example, with the support of Microsoft's cloud services, users can call on files from Microsoft Office to share and edit documents, slides and forms with others at the same time. For education-specific features, Microsoft Teams allows teachers to distribute, provide feedback and grade student work submitted through Teams using the 'Assignments' tab available to Office 365 for Education subscribers.

Google Classroom is a free blended learning platform (a LMS) released in 2014, developed for educational institutions to simplify the process of sharing documents between students and teachers. Today, with Google Drive cloud storage service, Google classroom is integrated with other google education applications such as Google Docs Editor suite (Google Docs, Google Sheets, Google Slides), Gmail, Google Meeting and Google Calendar.

It is thus clear that Microsoft Teams and Google Classroom have become (near-)ies in digital learning not only from a single product, but also due to the complementary nature resulting from the integration of a large number of their own solutions, where other (near-) monopolies in digital learning are unable to achieve.

4.2.2 Learning-related intellectual (near-) monopoly in digital education

According to the Cambridge dictionary, the word 'intellectual' refers to the ability to think and understand things, especially complicated ideas. In Chapter 2.1, two types of knowledge generation (including invention and learning) have been identified. Learning is the process through which a person acquires knowledge (using and developing his or her intellectual abilities). Invention is the creation of new knowledge (by using the intellect). Both are important to our social life. The activities of the intellectual (near-) monopolies with rich quantities of IPRs, global innovation networks and 'Big Data' mentioned in the last section are related to invention. However, they also influence the activity of learning. In this section, I will put forward a type of intellectual rent linked to learning, named learning-related rent.

Learning-related intellectual rent

Learning-related rent is a rent in which large companies or organisations make excessive profits by controlling access to learning for the masses. This access includes access to the learning content and access to the tools used for learning.

For learning content, as giant intellectual companies monopolise the content of learning, learning resources no longer are various, affecting the diversity of knowledge generation of students and the development of the ability to think through growth.

In the case of learning tools, the monopoly position of the tool provider (more or less) forces the majority of students to use the software during their time as students. These students may think that this tool is the best and the only one available in the market. As a result, they may not consider other products and continue to use it for the rest of their lives, regardless of the problems it might bring. For example, Microsoft Office has lured users into using their product by partnering with schools, selling Windows desktops with giving away an educational version of the software, as well as indulging in piracy used at schools. In addition, intellectual monopolies can set high switch costs so that it becomes hard for users to use the other digital learning products.

Learning-related rents help monopolists to maintain their monopoly position. Once the private intellectual company has secured a large share of the market for a long time, it can control the content of the teaching or learning tools so that people would use the company's products for a long time, turning intangibles into assets and gaining learning-related intellectual rent. Therefore, learning-related rent can be understood as an additional factor contributing to intellectual monopoly.

In addition, there may be other benefits to the company. By controlling the learning content, the intellectual (near-) monopolies may promote a specific way of thinking which may negatively affect the diversity of knowledge and the development of student.[137]

Categories of learning-related intellectual (near-) monopolies in digital education

As a special intellectual rent that exists only in the education, learning-related rent is used by a large number of companies with a large market share. This section will go through the categories of learning-related intellectual (near-) monopolies in digital education.

The results are shown in the Table 4.1. Only K-12 online learning tools are easy to control the learning content to gain the learning-related rent to be intellectual (near-) monopolies. Since K-12 online learning tools provides courses by themselves, so there are possibilities that they offer knowledge in limited directions and ignore other kinds of knowledge. Students around the world study the same content, resulting in a loss of diversity for knowledge content.

137 Lankau, *Kein Mensch Lernt Digital: Über Den Sinnvollen Einsatz Neuer Medien Im Unterricht*.

LMSs and MOOCs both rely on controlling the learning channels. As for LMSs, there might be a high switch costs to transfer to other platforms, and it results in the vendor lock-in. Therefore, some users have to continue using their products. As for MOOCs, since only big providers can provides certification after finishing the courses that accredited by some universities, the students who wants this kind of certifications have to choose the large platforms run by intellectual monopolies.

For Video Conferencing tools, although there is no clear learning-related rent they can rely on to maintain the monopolistic power and make profits because there are so many alternatives not only developed for education, they might bring potential educational freedom harm, which will be discussed in the Chapter 4.4.3.

Table 4.1: Intellectual monopolies in digital learning with the learning-related rent.

Categories of learning-related rent	LMSs	MOOCs	K-12 online learning tool	Video conferencing
Learning content			✔	
Learning channel	✔	✔		
No learning-related rent				✔

4.3 Links between intellectual (near-) monopolies in the economic sphere and the legal-political sphere

Digital technology continues to penetrate the education sector over the past decade and reaches a spurt in the epidemic. As the nature of the world's economy, politics, culture and society developments, digital technology will continue being an important part to shape our future. Education is a significant part of the cultural sphere, as it breeds the way the next generation perceives and thinks. In Chapter 2, the importance of the independence of the three spheres was discussed, but in fact, we are moving further and further away from the ideal of autonomous yet mutually supporting spheres, with the economic sphere encroaching on the cultural sphere (often via the legal-political sphere). In education, a series of reforms are taking place which collectively have been called the Global Education Reform Movement (GERM), which is based on close linkages between the legal-political sphere and the economic sphere.

Since the 1980s, a new education management style has emerged and gradually become adopted by many education systems around the world as the organisational basis of global educational reforms. The GERM includes a collection of market-oriented policies that often involve school choice and competition, high-stakes testing, curriculum shortening, and hiring teacher. In 2012, Sahlberg named these reforms, which are taking place worldwide, as the

Global Education Reform Movement.[138] According to Sahlberg, the reforms are part of a concerted effort, a kind of 'movement', although not a formal movement.

Verger, Parcerisa and Fontdevila identified three core policy principles of the GERM, including standardisation, decentralisation and accountability.[139] Firstly, the idea is that setting clear and high-performance standards for schools, teachers and students will inevitably improve the quality of the desired outcomes. However, unlike commodities for which it is easy to set standards for production, setting standards for education can easily lead to problems. For example, national standards may limit the content of education in an entire country and lose the diversity of the knowledge generation by reducing the number of subjects taught, or by diminishing the diversity within each subject. Standards may focus on certain core subjects such as literacy and mathematics, causing the education system to neglect other subjects that are also important to the development of society, such as the arts, physical education and social studies.[140] Secondly, education decentralisation refers to the transfer of competences and power from the central government to lower administrative levels, as well as the delegation of management and educational tasks to principals and schools.[141] However, because the criteria for the evaluation system exist, the actual autonomy following decentralisation is limited. Decentralisation has become a term to mislead everyone that schools are becoming more autonomous, and a practical principle to make schools more like businesses.[142] Third, accountability implies that educational actors be held accountable for their actions/results by some type of evaluation with repercussions.[143] School performance, particularly student progress, is therefore inextricably linked to systems of certifying, promoting, inspecting, and rewarding or penalizing schools and/or teachers. School and teachers' success and failure are frequently judged by standardised exams and external teacher evaluations that focus on specific components of education, such as student accomplishment in certain subjects, exit examination outcomes, or teachers' classroom behaviours.

In the end, Schools are forced to choose content and teaching methods that is supported or guided by these standards in order to receive higher scores, financial support or administrative convenience.

The global reforms in education are proposed and promoted by "global education policy networks"[144] that include international organisations such as the OECD, 'public-private

138 Pasi Sahlberg, 'How GERM Is Infecting Schools around the World', *The Washington Post* (blog), 29 June 2012, https://pasisahlberg.com/text-test/.

139 Antoni Verger, Lluís Parcerisa, and Clara Fontdevila, 'The Growth and Spread of Large-Scale Assessments and Test-Based Accountabilities: A Political Sociology of Global Education Reforms', Educational Review 71, no. 1 (2 January 2019): 8, https://doi.org/10.1080/00131911.2019.1522045.

140 Pasi Sahlberg, 'Global Educational Reform Movement Is Here!', 2 February 2012, https://pasisahlberg.com/global-educational-reform-movement-is-here/.

141 Verger, Parcerisa, and Fontdevila, 9.

142 Enders, de Boer, and Weyer, 'Regulatory Autonomy and Performance', 14.

143 Verger, Parcerisa, and Fontdevila, 9.

144 Antonio Olmedo, 'Something Old, Not Much New, and a Lot Borrowed: Philanthropy, Business, and the Changing Roles of Government in Global Education Policy Networks', *Oxford Review of Education* 43, no.

partnerships' such as the World Economic Forum (WEF), and philanthropic organisations. Collectively, these organisations make up a 'parapolitical sphere'[145], a sphere of "new players in the political sphere" that are "developing their own policy agendas" "to influence the political sphere".[146] For example, according to the website of the World Economic Forum (WEF), the WEF's mission is to "engage the foremost political, business, cultural and other leaders of society to shape global, regional and industry agendas".[147] What they do is to put different actors in legal-political and economic spheres on the same table and make some agreement.

The standardisation and monitoring that are part of the GERM are facilitated, by the digital education technology that is developed and produced in the economic sphere, which facilitates the implementation of standards (established by governments and international organisations). *Vice versa*, the digital education technology industry benefits from developments in the GERM that use this technology. For example, according to the WEF website, the current educational system is hopelessly outdated and change is required in academic institutions. In one of the WEF's report, it stated that "enabling this shift toward technology skills will require public-private collaboration to ensure that schools have both the infrastructure to enable digital learning and the job market insight into the technology skills that will be most relevant to employment in the future."[148] So the WEF as a parapolitical sphere is promoting cooperation between the legal-political and economic spheres, and developing policy proposals which advocate interference by the legal-political and economic spheres ('public-private collaboration') with the development of education in the cultural sphere. International organisations such as the WEF seem to have little eye for the importance of freedom of education in the independent cultural sphere.

Under the GERM, there are a lot of tests and assessments that play a role in the implementation of the above-mentioned three principles (standardisation, decentralisation and accountbility), such as national large-scale assessments (NLSAs)[149], the Program for International Student Assessment (PISA)[150] of the Organisation for Economic Co-operation and Development (OECD), and the Teaching Excellence Framework (TEF) in the UK[151]. In

1 (2017): 69–87.

145 Janet R Horne, A Social Laboratory for Modern France: The Musée Social and the Rise of the Welfare State (Duke University Press, 2002). Quoted in Antonio Olmedo, 'Philanthropic Governance: Charitable Companies, the Commercialization of Education and That Thing Called "Democracy"', orld Yearbook of Education, 2016, 58.

146 Antonio Olmedo, 'Philanthropic Governance: Charitable Companies, the Commercialization of Education and That Thing Called "Democracy"', *World Yearbook of Education*, 2016, 44–62.

147 The World Economic Forum, 'Mission of The World Economic Forum', accessed 5 September 2022, https://www.weforum.org/about/world-economic-forum/.

148 World Economic Forum, 'Schools of the Future: Defining New Models of Education for the Fourth Industrial Revolution', 2020, 9.

149 Verger, Parcerisa, and Fontdevila, 5-30.

150 Xavier Pons, 'Fifteen Years of Research on PISA Effects on Education Governance: A Critical Review', *European Journal of Education* 52, no. 2 (June 2017): 131–44, https://doi.org/10.1111/ejed.12213.

151 Matt O'Leary and Phil Wood, 'Reimagining Teaching Excellence: Why Collaboration, Rather than Competition, Holds the Key to Improving Teaching and Learning in Higher Education', *Educational*

the next section I will describe PISA as an example of the OECD's approach to promote global education reform, and investigate the impact it may have on the cultural sphere.

4.3.1 Example: Program of International Student Assessment (PISA) as a component of the GERM

PISA is the OECD's Programme for International Student Assessment.[152] Introduced in 2000, PISA is an international assessment that measures 15-year-old students' reading, mathematics, and science literacy every 3 years. In each cycle, the principal domain of study alternates between reading, mathematics, and science. PISA also incorporates general or cross-curricular abilities assessments, such as collaborative problem solving. PISA is designed to highlight functional abilities that students have learned as they approach the conclusion of compulsory schooling. In the 2018 round of PISA, 80 countries and economies participated.

As an intergovernmental organisation of member states, the OECD exercises its power and influence as the central cog in the global governance complex.[153] The OECD is widely regarded as the global authority on education because of its unique role in setting and comparing educational governance outcomes.[154] In an era of overproduction of data and evidence, the OECD has become a major provider and interpreter of evidence and boil their narratives down to simple and comparable numbers.[155] While the OECD cannot make laws and policies, it makes learning achievement a governmental asset by ranking countries to let them compete with each other. The OECD engages in a so-called 'idea game'[156], i.e. it plays a leading global role in gathering, analysing and interpreting and disseminating data, information, visions, and ideas to its member nations and, to a lesser extent, to a group of non-member countries.

From a historical perspective, the OECD saw a strong relationship between education and economic growth from very beginning. In the 1960s, A. H. Halsey, the OECD pioneer, was positive about the new collaboration between educators and economists: "The new alliance between education and economics held out the promise of a richer life for millions of people..... It was a noble challenge for the government and its economic and educational

Review 71, no. 1 (2 January 2019): 122–39, https://doi.org/10.1080/00131911.2019.1524203.

152 'PISA - OECD', OECD, accessed 2 August 2022, https://www.oecd.org/pisa/.

153 Matthias Schmelzer, 'The Crisis before the Crisis: The 'Problems of Modern Society'and the OECD, 1968–74', *European Review of History: Revue Europeenne d'histoire* 19, no. 6 (2012): 999–1020.

154 Kerstin Martens and Anja Jakobi, *Mechanisms of OECD Governance: International Incentives for National Policy-Making?* (Oxford University Press, 2010).

155 Christian Ydesen, 'Introduction: What Can We Learn About Global Education from Historical and Global Policy Studies of the OECD?', in *The OECD's Historical Rise in Education* (Springer, 2019), 1–14.

156 Martin Marcussen, 'Chapter 2: Multilateral Surveillance and the OECD: Playing the Idea Game', in The OECD and European Welfare States (Cheltenham, UK: Edward Elgar Publishing, 2004), 11, https://doi.org/10.4337/9781843769705.00008.

advisers to pursue this promise."[157] The introduction of teaching evaluation tests such as PISA can be seen in this light.[158]

According to Andreasen, the link between evaluations and practices is complicated, with the former frequently having a substantial impact on the latter.[159] Values and the power of individuals with access to influence assessment processes are always reflected in assessments.[160] In education, this can take the form of expressing a specific understanding of subject knowledge, as well as which knowledge is deemed relevant and in what ways and forms. Such understandings are mediated by assessments, but this sort of mediation also occurs implicitly—in many cases, in ways that we are unaware of.

The OECD believes that educating more people will provide society with more human capital, which will lead to better economic growth. Specifically, economic development requires more products; More products is related to the need of labour market; And the size of labour market determines the number of educated people. Thus, in order to have the required number of educated labour with required skills, it is clear that there is a need for control and accountability. In short, the OECD is an international organisation concerned with economic growth, and acts as a promotor of a process that aligns the cultural sphere with what it believes to be necessary for the economic sphere.

4.4 How do intellectual (near-) monopolies in the digital education (potentially) interfere with the freedom of education in the cultural sphere?

This section aims to analyse possible negative effects or problems that intellectual (near-) monopoly in the digital education may have or has had on freedom of education in the cultural sphere according to the literature.

4.4.1 Enriched data collection of quality assessments, or reduced diversity in education?

A core element of the GERM is assessment systems which heavily rely on numerical data, since the numbers is the most easy-to-read, straightforward and comparable information. The quality of the assessments depends strongly on the quantity and quality of the data relating to students, teachers and schools. Until now, most of these assessment systems collect data actively, which rely on assessment participants involved rather than passive data collections.

157 Kjell Rubenson, 'Framing the Adult Learning and Education Policy Discourse: The Role of the Organization for Economic Co-Operation and Development', in *Global Perspectives on Adult Education and Learning Policy* (Springer, 2015), 179–93.

158 Karen Egedal Andreasen, 'The Impact of PISA Studies on Education Policy in a Democratic Perspective: The Implementation of National Tests in Denmark', in The OECD's Historical Rise in Education (Springer, 2019), 138–40.

159 Andreasen.

160 Gert JJ Biesta, *Learning Democracy in School and Society: Education, Lifelong Learning, and the Politics of Citizenship* (Springer Science & Business Media, 2011).

For example, in PISA 2018, all in-school study data have been collected by survey and questionnaire.[161]

According to some authors, intellectual (near-) monopolies in digital education can improve the data collection process of education quality assessment systems such as PISA. Firstly, the intellectual (near-) monopolies all have a very large number of users, which allows them to provide very large amounts of data to those who do the quality assessments. Secondly, the data from digital learning software offers assessment providers access to schools that were previously unavailable for fieldwork. Thirdly, intellectual monopolists use methods of passive data collection which are said to be more responsive to the realities of teaching and learning. Active data collection (where the one being observed is 'active' in the sense of actively giving responses, and being aware of being observed) could not guarantee were the truthfulness of respondents' answers. On the other hand, passive data collection is able to avoid any subjective feelings and moreover, it is a reflection of the current teaching and learning situation (because the intellectual (near-)monopolists can provide data directly at the time of using the software). Fourthly, provision of data by the intellectual (near-) monopolists can reduce the time and money costs of data collection by those doing the quality assessments. Lastly, because the 'Big Data' are very detailed, it is possible to combine data in multiple methods and at different levels of aggregation to derive expanded new survey directions.[162]

Thus, the intellectual (near-) monopolies help the GERM through data provision as part of a large movement to standardise output measurement and accountability in education. On the other hand, the assessments done based on these data are also criticised. For example, without a proper contextual perspective to view passively collected data, the data themselves can become meaningless.[163] Moreover, quality assessments and the importance attached to them may compress the managerial autonomy of schools and may help to tie teaching more one-sidedly to the development of 'human capital' for economic growth, as the OECD aims for.

4.4.2 Data security and user privacy

The issues of corporate concentration and Internet privacy are intricately intertwined. Intellectual (near-) monopolies are usually a very fast growing international company. There are two reasons why it is difficult for such companies to be fully regulated by law. On the one hand, these companies exceed national geographical limits, the country where they are registered may be different from the country where the users are located. There are currently no internationally applicable laws to regulate them (it might be extremely hard in the future

161 OECD, 'Data - PISA', accessed 6 August 2022, https://www.oecd.org/pisa/data/.

162 Malcolm R Parks, 'Big Data in Communication Research: Its Contents and Discontents', *Journal of Communication* 64, no. 2 (2014): 355–60.

163 Kyle M. L. Jones and Chase McCoy, 'Reconsidering Data in Learning Analytics: Opportunities for Critical Research Using a Documentation Studies Framework', *Learning, Media and Technology* 44, no. 1 (2 January 2019): 52–63, https://doi.org/10.1080/17439884.2018.1556216.

as well), so it is difficult to protect data and privacy. On the other hand, legislation is a long process, but becoming intellectual (near-) monopolies can be very rapid. For example, the General Data Protection Regulation (EU) (GDPR), a recent EU law on data protection and privacy, took four years from proposal to adoption and another two years to implementation. In contrast, it took less than a year for Zoom to become an intellectual (near-) monopoly with a 50% market share in video conferencing. Thus, for knowledge monopolies in the digital age, the non-global nature and lag of regulation leaves the door open for jeopardising data security and user privacy.

People who are optimistic about the use of technology in education ignore how public education should be safely intertwined with technology.[164] For example, the average age of of those whose data are being collected (students, pupils) is low. Ideally, the younger generation spends most of their lives in a protected space. However, when these intellectual (near-) monopolists use the data they collect for example for advertising, it can be difficult for young people to resist the temptation. Also, when personal data are leaked, then the consequences are hard to imagine. For example, children's picture could be taken and then circulated on social media if the education platform has been hacked. Therefore, the protection of the data of young people is even more necessary.[165]

In addition to these, the software provided by the vendor of the intellectual (near-) monopoly is like a black box, although the company may contractually promise a lot to protect the security of data. However, the actual implementation, as it is almost impossible for the user to enter the internal environment of the monopoly to check whether the security standards promised to the users are met.[166] This is therefore another security risk worth noting.

4.4.3 Education autonomy

As stated in Chapter 2.3, education autonomy consists of academic freedom and organisational autonomy. Intellectual (near-) monopolies in digital education can limit both of them.

For the academic freedom, both teaching and learning freedom should be considered. Teaching freedom refers to the academics have no limitation to spread idea. The learning freedom means that students or pupils/pupils' parents have the right to choose the education they would like to take. Both academic freedom are able to enrich the education diversity and keep different idea existed in the world. However, intellectual (near-) monopolies might use their monopolistic power to reduce the freedom of the academics and students.

164 Macgilchrist, 'Cruel Optimism in Edtech: When the Digital Data Practices of Educational Technology Providers Inadvertently Hinder Educational Equity'.

165 Arjun Kumar et al., 'Secure Storage and Access of Data in Cloud Computing' (2012 International Conference on ICT Convergence (ICTC), IEEE, 2012), 336–39.

166 Deyan Chen and Hong Zhao, 'Data Security and Privacy Protection Issues in Cloud Computing', vol. 1 (2012 International Conference on Computer Science and Electronics Engineering, IEEE, 2012), 647–51.

‘Zooming in’ on digital education technology, academic freedom can be restricted by digital education technology monopolists by controlling the channels of education and/or the content of education. Regarding the first, Video Conferencing tools could be used to block meetings where academics say something the intellectual (near-) monopolist is not willing to spread. For example, in October 2020, Zoom shut down a New York University webinar about censorship by tech platforms, including Zoom, that was being held via Zoom.[167] Zoom said that it had blocked the webinar because the Jewish coalition group "End Jewish Hatred" had lobbied that Leila Khaled, who hijacked two planes in 1969 and 1970 but now is a Palestinian rights advocate, should not attend that webinar. In a statement by the NYU-AAUP, the censorship by Zoom was described as a "sick comedy", and it raised serious concerns about the capacity of a corporate, third-party vendor to decide what is acceptable academic speech and what is not.[168] Such actions interfere with academic freedom in the sense that after being blocked, the person being blocked might rethink what she/he can and cannot share when using the software again. For another, K-12 online course platforms can decide what the young generation learns. As a result, the students or the pupil's parents are unable to choose the education they find interesting. For example, Byju’s has becoming the biggest India online educational technology company after several acquisitions, valued at about $22 billion, 20 times bigger than the second. The learning content is provided by themselves. Then the content they make is the majority of the online learning materials for kindergarten and primary school students.

Organisational autonomy relates to the abilities of decision-making in school, as well as the exemption of restraints on the actual use of such competencies. Intellectual (near-) monopolies might negatively influence the schools’ decision-making capacities in the following ways. Firstly, like other monopolists they tend to use large sums of money to for lobbying and advertising. Compared to small companies, they have more power to influence the decisions of schools quietly.[169] Secondly, the marketing budgets of monopolistic companies tend to be very large, and any marketing and advertising by intellectual (near-) monopolists is likely to reach almost everyone.[170] It will be hard to escape their advertisements. Thus, the advertisement effect might make us simply choose the product with the familiar impression rather than fully consider the advantages of the product or service.

167 Alice Speri and Sam Biddle, ‘Zoom Censorship Of Palestine Seminars Sparks Fight Over Academic Freedom’, n.d., https://theintercept.com/2020/11/14/zoom-censorship-leila-khaled-palestine/.

168 The NYU-AAUP Executive Committee, ‘Statement from the NYU-AAUP on Zoom Censorship Today’, 23 October 2020, https://academeblog.org/2020/10/23/statement-from-the-nyu-aaup-on-zoom-censorship-today/.

169 Natasha Singer, ‘The Silicon Valley Billionaires Remaking America’s Schools’, The New York Times, 6 June 2017, https://www.nytimes.com/2017/06/06/technology/tech-billionaires-education-zuckerberg-facebook-hastings.html.

170 Mahmud Akhter Shareef et al., ‘Social Media Marketing: Comparative Effect of Advertisement Sources’, *Journal of Retailing and Consumer Services* 46 (2019): 58–69.

4.4.4 Education access inequity

Obviously, freedom of education has meaning only when there is equal access to education. However, education technology can increase unequal access. For the online course platforms, although MOOCs and K-12 online course platforms aim to bring the education to any one from any where, some of them are not free. Therefore, learners from wealthy families can take more courses; by contrast, poor families will find it hard to afford them, and the inequity of access to knowledge expands. For example, the biggest Indian online learning platform BYJU's concluded, after segmenting its clientele, that the underprivileged were not a viable option (i.e. not profitable as customers). As a result, they targeted richer customers and made the greatest offers to these people even with after-school assistance such as tutoring.[171] This is an obvious instance to illustrate how an intellectual (near-) monopolist may actively broaden the gap between different classes and widen inequalities in the availability of educational resources.

For the video conferencing software, inequity also exists. During the covid-period, The ease of access to remote learning increases the inequality of knowledge generation for students. According to National Center for Education Statistics (NCES), part of the U.S. Department of Education Net-Centric Enterprise Services, the 95% of students from 3-18 year-old in the U.S. who had Internet connection, and 5% students cannot access the Internet in 2019. [172] Also, 6% of the students who has an Internet can only use their smartphones to study. Small screen on the smartphones is not sufficient for learning that requires constant focus and dedication.

4.5 Discussion on intellectual (near-) monopolies from the perspective of mentioned models

In the previous sections in Chapter 4, intellectual (near-) monopolies have been figured out and its impact on the freedom of education has been analysed. Now, it is time to zoom out again and to exam whether these finds in the education technology could be summarised in terms of the models mentioned in previous chapters to exam. For reading convenience, I will insert these models again in this section.

Firstly, in the Triple Helix model, Etzkowitz and Leyesdorff might interpret the GERM as a dynamic balance between government, industry and science & technology since all three spheres are involved. if society is organised in the way like the Triple Helix model, general feelings of many people are that it will stimulate economic growth, people will grow weather, and living standard will increase. However, simply overlaying mechanisms between two different spheres will not solve the problem, at least in digital education technology. With the "dynamic corrections", freedom of eduction in the cultural sphere has not been considered.

171 'Is BYJU's Being A Monopoly in Online Education Sector?', Managers Without Borders – India, 19 September 2021, https://mwbibs.blogspot.com/2021/09/is-byjus-being-monopoly-in-online.html.

172 'National Center for Education Statistics', NCES, May 2021, https://www.tandfonline.com/doi/full/10.1080/00228958.2020.1813502.

Schools may still be the place where policy guidelines are completed and the autonomy to choose e-learning is restricted by the intellectual (near-) monopolies.

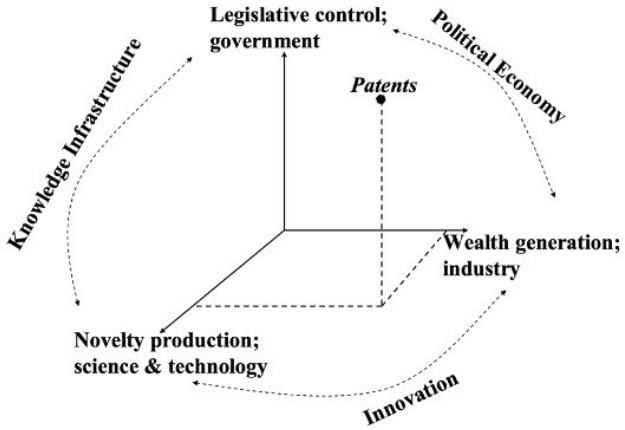

Figure 3.4: Patents as events in the three-dimensional space of Triple Helix model.[173]

Secondly, in 'vicious loop' model, Lankau in fact developed his triangle model to describe the education industry, and to explain how oligopolistic businesses use their economic position to lobby with politicians for rules that allow them to acquire a powerful position in the development of education materials, and to sell them (contents and tools) to schools and universities (see Figure 3.5). In the case of this research, the results of this chapter fit this model to some extent. Education technology is the tool that intellectual (near-) monopolies want to sell to schools and make all of them using it. And the business (intellectual (near-) monopolies in digital education) and political parties (governments and GERM evaluation providers) do collaborate and attain both of their interests. However, not all relationships in Figure 3.5 has been seen in the analysis of education technology, such as funding from business to foundation.

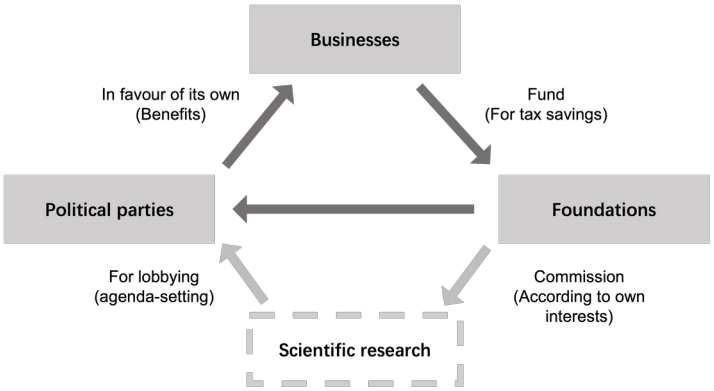

Figure 3.5: 'Vicious loop' model (translated from German).[174]

173 Leydesdorff, 368.
174 Lankau, Kein Mensch Lernt Digital: Über Den Sinnvollen Einsatz Neuer Medien Im Unterricht, 11.

The two models above show the impact of intellectual (near-) monopolies on education. Both models help to explain, from a macro-sociological level, that the selection and use of digital education software today does not take place in a free space, but relies on the influence of two other spheres. Thus, the way the 'education industry' is organised may negatively influence freedom of education, including the viewpoints mentioned in Chapter 4.4.

It may be worth our while to think about how we could get closer to the 'virtuous triangle' of Figure 2.3 as an ideal imagination. When the three spheres are independent of each other, schools in the cultural sphere can decide for themselves how to use and develop new educational technologies. In the next chapter, a case study on choosing education technology at one Dutch university will be conducted to mean to find ways to move from a model such as Figure 3.4 or 3.5 towards freedom of education (as depicted in Figure 2.3) − focusing, in this case, on one aspect of this freedom, namely freedom of choice in education technology.

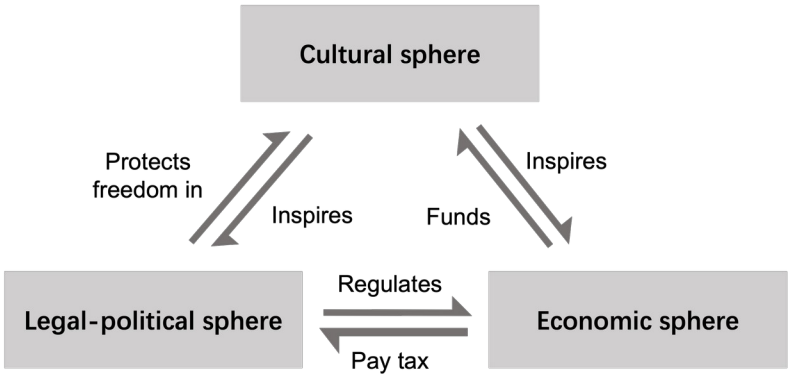

Figure 2.3 Virtuous triangle model (Elaborated from Findeli's explanation[175])

175 Findeli, 'Sustainable Design'.

Chapter 5 Case study: Decision-making processes regarding the (future) adoption of education technology at TU Delft

In the preceding chapters it has been analysed that digital intellectual near-monopolists tend to dominate digital learning tools and learning contents, in other word, to 'colonise' the cultural sphere by the economic sphere, while governments and international organisations try to dominate education tools and contents via laws and regulation (such as standardisation and accountability), which shows the 'colonisation' of the cultural sphere by the legal-political sphere. Often, the intellectual near-monopolists gain influence over the cultural sphere *via* the legal-political sphere, by lobbying for legal change and regulation that give them access to schools and universities. For example, producers of digital education technology may lobby for changes in regulation (e.g. the introduction of standards, assessments etc.) to the effect that schools and universities increasingly have to use their technology in order to meet the standards. In this case, businesses *indirectly* influence what is happening in cultural life (via the legal-political sphere). The effect is that at schools and universities, the space for professors and students to make their own decisions regarding the contents and methods/tools of education is reduced.

However, increasingly, near-monopolists are also *directly* operating as a legal-political entity by themselves. As the example of Zoom mentioned in Chapter 4.4.3, apart from its economic role (producer and seller of service), Zoom now also takes on a legal-political role. It is able to do so because of its near-monopolistic position, acquired by monopolising knowledge generation in the cultural sphere.

Thus, the economic and political sphere increasingly interfere with freedom in the cultural sphere. The freedom to think ones' own thoughts and to behave according to what one has reason to believe is good or desirable is shrinking.

To the extent that such loss of cultural freedom on the part of the users of digital education technology is considered undesirable, it is necessary to investigate how freedom of choice in digital education technology could be safeguarded. This can be done by disentangling the three spheres, which have become too much intertwined. Briefly, what is required is: (a) a free space for knowledge generation for the development of digital education technology (free from interference by economic and political interests), allowing also other software providers than the near-monopolist to innovate, and giving them an opportunity to (intellectually) compete with the intellectual near-monopolist; (b) decentralisation of decision-making regarding the use of digital education technology (in order to create space for individual choice), and (c) money to support the development and administration of a variety of digital education software at schools and universities.

In this chapter, the research is going to dive from business level (e.g. education technology) into university level to see whether one university is interfered and if so, how it might escape from the intervention by intellectual (near-) monopolies in education technology. In the case study, the research will try to find out what the hurdles (on the road to more freedom) are *by investigating decision processes* regarding the adoption of education software. This case study will investigate to what extent (a), (b) and (c) are taken into account in decision processes at a Dutch university regarding the adoption of digital education technology by conducting an interview. The aim is to identify any (legal, economic, cultural) barriers to the adoption of a variety of (Open Source) software as an alternative to or alongside education software offered by intellectual (near-)monopolists.

Before the interview, Chapter 5.1 is to introduce a possible alternative, which is (self-hosted) Open Source Software (OSS) to the intellectual (near-) monopolies in education technology. From Chapter 5.2 to 5.4, an interview about decision-making processes for the adoption of education software will be conducted at the TU Delft. In the end of this chapter, discussion of interview results are given. Potential hurdles for TU Delft to build a free space for digital education technology development will be figured out.

5.1 (Self-hosted) open-source software

(Self-hosted) open-source software is different from the closed-source software provided by the intellectual (near-) monopolies. It can be used as one of the alternatives to the commercial closed-source tools in the digital education. In this section, the development of (self-hosted) OSS will be introduced.

5.1.1 Open-source-software movement

Free software and free software movement

Free software is a type of software that can be freely used, copied, researched, modified and distributed without restriction. Free software fully respects the freedom of users.[176]

Free software grants users four kinds of freedom:

- Freedom to use the software regardless of the purpose.
- Freedom to study how the software works, and rewrite the software to meet the user's own needs.
- Freedom to redistribute the software.
- Freedom to improve and reuse the software, and to publish a modified version for public use.

176 Richard Stallman, *Free Software, Free Society: Selected Essays of Richard M. Stallman* (Lulu. com, 2002).

The notion of free software has had an increasingly widespread impact on society since its introduction. With the development of the information society, more and more people have been involved in developing, publishing, and using free software, and the free software movement arose in this background.

The free software movement is a social movement whose goal is to obtain and guarantee certain freedoms for software users, namely the freedom to run the software, research the software, modify the software, and share copies of the software. [177]

Free software is often misunderstood due to a lack of funding from corporations and difficulties in teaching new users the concept of free software. The free software movement didn't run well as expected. Some people in the free software community then tried to find new solutions. They decided to drop the ambiguous term "free software" in favor of "open-source software."[178] The definition of open-source software (OSS) then was introduced.

Open-source software(OSS) and OSS movement

Open-source software is a form of free software and shares similarities with free software. Unlike free software, OSS sometimes imposes some restrictions on users. First, some open-source licenses are very restrictive, and hence do not qualify as free licenses. Some open-source software, for example, is not free because the license prohibits making a modified version and using it privately. Second, the open-source requirements are primarily concerned with the licensing of open-source code. Because the source code is available freely, people frequently refer to an executable as ‘open-source’, but even if the executable is generated from free source code and has a nominally free license, sometimes users cannot run modified versions of it, hence the executable is not free.[179]

Open-source Software (OSS) is the kind of computer software released under a license in which the copyright holder grants the user the right to use, study, change, and distribute the software and its source code for any purpose.[180] OSS can be developed in a collaborative public manner, which means that any capable user can participate in development online, making the number of possible contributors uncertain.[181]

The open-source software movement is the movement to support the use of open-source licenses for some or all software. The open-source software movement is branched from the free software movement. But the two movements have fundamentally different opinions on free software. Members of the open-source community are willing to coexist with makers of

177 Margaret S Elliott and Walt Scacchi, ‘Mobilization of Software Developers: The Free Software Movement’, *Information Technology & People*, 2008.

178 Rishab A Ghosh et al., ‘Free/Libre and Open Source Software: Survey and Study’, 2002.

179 Richard Stallman, ‘Why Open Source Misses the Point of Free Software’, *GNU Operating System* (blog), accessed 20 August 2022, https://www.gnu.org/philosophy/open-source-misses-the-point.html.

180 James Edward Corbly, ‘The Free Software Alternative: Freeware, open-source Software, and Libraries’, Information Technology and Libraries 33, no. 3 (25 September 2014): 65, https://doi.org/10.6017/ital.v33i3.5105.

181 Sheen S Levine and Michael J Prietula, ‘Open Collaboration for Innovation: Principles and Performance’, *Organization Science* 25, no. 5 (2014): 1414–33.

proprietary software and consider the decision of whether the software is open-source as a matter of practicality.[182]

Programmers contribute to the open-source community by voluntarily writing and exchanging programming code for software development. The term "open-source" allows anyone to acquire and modify open-source code. These modifications will be distributed to developers in the open-source community who use the software. In this way, the identities of all individuals involved in code changes are disclosed, and code transitions are recorded over time. These goals promote the production of high-quality programs and collaboration with other like-minded individuals to improve technologies.

Compared to the free software movement, the open-source software movement compromised a certain principle, the freedom of users and developers. Unlike free software granting users four kinds of freedom, open-source software does not regard freedom as the most important value. In contrast, OSS is more interested in the functionality of the software.[183] Therefore, sometimes open-source developers provide more powerful software while restrict the freedom of users.

Open-source software has been recognized and supported by some large IT companies. Since its inception, the open-source software movement has become a hot topic and received support and attention from the technology community. The open-source software movement has developed rapidly.

5.1.2 Intellectual monopolies profit from OSS

Closed knowledge may not always be the best option for triggering greater economic profits. Intellectual monopolies has enter the world of OSS to profit from it. Rikap summarises some ways that intellectual monopolies profit from OSS: [184]

- By integrating the OSS Project, intellectual monopolists have access to code that they can use for their own private innovations.
- The OSS project also provides information about the types of recurring problems faced by small companies, risks that are valuable inputs for the tech giants to offer new services in their cloud services.
- Intellectual monopolies get feedback from potential users in advance, as open source developers are often employees of companies that will buy code or functionality that might be generated by an OSS project (e.g. through a cloud service).
- By placing internal innovation modules in the form of open source platforms, the intellectual monopoly profits from the developers' free work.

182 Elliott and Scacchi, ‘Mobilization of Software Developers: The Free Software Movement’.
183 Stallman, ‘Why Open Source Misses the Point of Free Software’.
184 Rikap, Capitalism, Power and Innovation: Intellectual Monopoly Capitalism Uncovered, 55.

5.1.3 Self-hosted OSS as a potential solution to antitrust intellectual monopoly

OSS run by intellectual monopolies may bring the vendor lock-in risk to people who use them.[185] High switching costs can make tenants captive to providers. Intellectual monopolies may use their increased bargaining power to the detriment of their tenants. To avoid this limitation, many open-source serverless platforms come out to allow developers to freely deploy and manage functions by self-hosting.

Self-hosting means installing, running, and maintaining hardware and managing the software applications locally, rather than renting this service from a provider. Self-hosted OSS runners (a tool that is used to run or execute tests and export results) can be added at different levels:[186]

- Repository level: A repository is a directory or storage space where your projects can live. Runners are dedicated to a given repository and cannot be used by other repositories.
- Organization level: You can run jobs in multiple repositories within an organisation.
- Enterprise level: Runners can run jobs for multiple repositories from multiple organizations in an enterprise.

With OSS hosted by intellectual monopolies, security remains a key sticking issue. Users tend to have far less control over the construction, operation, and auditing of the infrastructure than with self-hosting. Compared to self-hosted OSS, the vendors may not protect the tenants' infrastructure and rights properly. The software infrastructure selected by the provider, such as operating systems, cloud infrastructure services, and database services, may not meet the standards promised to tenants. They may be compromised by third parties or even intentionally designed to be subverted. As Cisco CEO John Chambers explained, "you won't know what's in the enterprise data centre".[187] The employees the provider chose to manage the infrastructure can also be a security threat, as they can pose an insider threat because they can compromise tenant security by exploiting their administrative privileges. As a result, tenants' resources may be accessible.[188]

In summary, when using self-hosted software, there may be fewer security problems and the risk of vendor lock-in is eliminated. At the same time, intellectual monopolies might be prevented from controlling and profiting from the users.

185 Junfeng Li et al., ‘Analyzing Open-Source Serverless Platforms: Characteristics and Performance’, *ArXiv Preprint ArXiv:2106.03601*, 2021.

186 Chaminda Chandrasekara and Pushpa Herath, ‘Using Self-Hosted Runners’, in *Hands-on GitHub Actions* (Springer, 2021), 63–80.

187 Robert McMillan, ‘Cloud Computing a “security Nightmare,” Says Cisco CEO’, IDG News Service, 22 April 2009, https://www.computerworld.com/article/2523825/cloud-computing-a--security-nightmare---says-cisco-ceo.html.

188 David Molnar and Stuart E Schechter, ‘Self Hosting vs. Cloud Hosting: Accounting for the Security Impact of Hosting in the Cloud.’, vol. 2010, 2010, 1–18.

5.2 Interview design

According to the *TU Delft Open Science Programme 2020-2024*, the university is going to bring research and education into the open era:

> "TU Delft wishes to take Open Science to the next level: a situation in which Open Science has become the default way of practising research and education, and the "information era" has become the "open era". This is reflected in the *TU Delft Strategic Framework 2018-2024*, with "openness" as one of its major principles. The *TU Delft Open Science Programme 2020-2024* tackles all areas of scholarly engagement where restrictions limit the flow of academic knowledge. It proposes new approaches to the process of research, education and innovation, with a strong focus on transparency, integrity and efficiency. "[189]

This statement above emphases the importance of "openness" in the digital era for both research and education. Unfortunately, there is no strategic plan or framework mentioned in the TU Delft Open Science Programme document for digital education technology. Because the adoption of self-hosted OSS may widen freedom of choice in digital education technology, and help to protect education autonomy and to provide a safe environment for TU Delft to step into further Open Science, interviews were conducted to figure out the current situation of adopting education technology at TU Delft and to study the possibility for TU Delft to widen freedom of choice in digital education technology (as an aspect of protecting freedom of education or freedom in the cultural sphere).

A (largely) open, semi-structured interview method was chosen to investigate decision-making processes regarding the adoption of educational software, with a focus on the choice between large commercial software provided by intellectual monopolies in digital education and self-hosted open-source software for education purposes at the TU Delft.

The intended interviewees for this interview were TU Delft staff who were related to the decision-making process for educational technology. Snowball-sampling was used to find the interviewees. The snowball started from the two supervisors of this thesis and each of them recommend an interviewee. And then at the end of each interview, the interviewees were asked to recommend more related people to be interviewed. However, due to time limitation, only three interviews were completed. In the interview results, Interviewees A, B and C are used to refer to the three interviewees.

5.3 Interview Results

189 I.M. Haslinger, 'TU Delft Strategic Plan Open Science 2020-2024: Research and Education in the Open Era' (Delft University of Technology, 2019), 2020–24, https://doi.org/10.4233/UUID:F2FAFF07-408F-4CEC-BD87-0919C9E4C26F.

5.3.1 Decision-making process of adopting education technology

Passive advice process for adopting educational software

When asked about what decision-making process exist at the TUDelft for adopting educational software, two interviewees answered that there exists an advice process for adopting educational software. Interviewee B said the advice process was the most process for considering and reviewing the educational software. This is an advice process under the charge of the *Advisory Committee Educational Tooling*. According to Interviewees B and C, the Advisory Committee Educational Tooling is a cooperation between the *Teaching and Learning Service* (TLS) section of the TU Delft *Education and Student Affairs* (ESA) department, and the Information Management (IM) section and Privacy and Security section within the ICT department. The website of the Teaching & Learning Services (TLS) section of TU Delft Education and Student Affairs (ESA) introduces that "Teaching & Learning Services (TLS) partners with faculties, lecturers and staff in offering services and expertise to continually improve education at TU Delft. Our team delivers technical support for educational tooling, provides trainings, workshops and consults on didactical matters, and the Teaching Academy shares best practices and organises educational events."[190] Interviewee C described that "Education Tooling is a new group since Corona, and this committee helps lecturers to evaluate the software. If we don't have agreements with companies (who provide the software) or don't have contracts with them, we usually cannot use the tooling because we don't have control over the data. And also we help lecturers to find alternatives."

Interviewees B and C stated the same steps of the advice process for adopting educational software. This process is shown in Figure 5.1.

- Step 1: The lecturers can send an e-mail with mentioning the educational tool they want to use and ask whether they can use it or not.
- Step 2: The Advisory Committee Educational Tooling will evaluate this software with mostly privacy and security issues, and also Figure out whether we are allowed to use this tool and whether we have a contract with the company behind the tool. (The factors will be discussed in Chapter 5.3.2.)
- Step 3: After evaluation, Educational Tooling advises whether the lecturers can use this tool or not. If not, they try to provide alternatives.
- Step 4: The lecturers who request the evaluation will receive the results.

190 Teaching & Learning Services, 'About Teaching & Learning Services', TU Delft, accessed 18 August 2022, https://teaching-support.tudelft.nl/TLS-support-tudelft-about/.

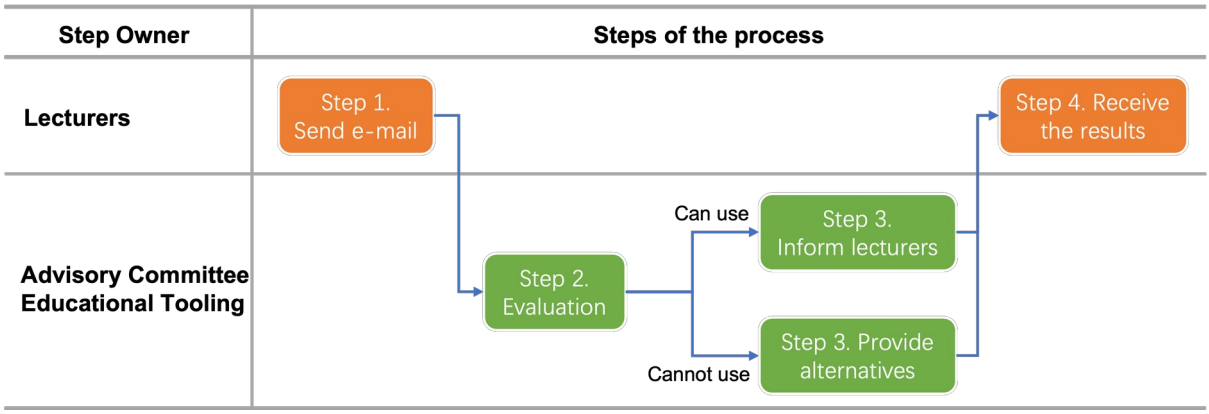

Figure 5.1: The process of passive advice process for adopting educational software at TU Delft.

The Advisory Committee Educational Tooling puts the results of the evaluation on their website as well.[191] On the website, green, yellow, red and grey colours behind each tool mean the results of the advice. Green refers to positive advice, yellow means preferable not used, but can be used under some conditions, read means negative advice, and grey is the tools that have not been determined.

It is important to note that this is only an advice process. This is not a decision-making process as the process ends at the step of providing advice. The results of the evaluation do not oblige lecturers to use or not to use the software. Although the Advisory Committee Educational Tooling informs the results lecturers who requested it and puts the result on their website, the lecturers can still use the tools that is not recommended by themselves.

When asked whether there are/will be more stakeholders participants in this process, Interviewee B said there were no executive board members involved in most situations. Interviewee B also stated that sometimes if the email in the first step has not been replied or responded, the lecturers also can contact IT managers in each faculty. There are four IT managers in TU Delft, and each one is responsible for two faculties.

As asked who is paying for the educational tools after advice process, Interview B shared that "sometimes ESA pays for the tool when the is tool is green. And sometimes the teachers themselves pay for the tool, and they use their own credit card, which may lead to a risk of shadowID."

A special adaptation of educational software when Covid-19 started – Zoom and Microsoft teams

Interviewee B recalled that "it was an exceptional situation when we adopted Microsoft Teams and Zoom, and the executive board of TU Delft made the decision to use these two tools as the only way to continue the learning and education." Since it was a very urgent use

191 Advisory Committee Educational Tooling, 'Educational Tooling: Overview of Tools Used in Education', TU Delft, accessed 19 August 2022, https://teaching-support.tudelft.nl/educational-tooling/.

case, there is no process that could be followed, and there was no time to go through the regular evaluation process. Then after Microsoft became clear with the GDPR used at TU Delft, the university tried to switch from Zoom to Microsoft Teams.

Interviewee B continued, “Recently, we decided to extend our contract with Zoom and not long after the extension of the contracts we got also the message that now Zoom is also compliance to the privacy terms that we want to use.” In the recent contract renewing, the advice process mentioned in last section has been made for Zoom. And now, Zoom becomes a back up to Microsoft Teams.

A pilot project for testing new educational software– a try-out process

In the interview with Interviewee C, he mentioned that a new try-out process was set up to do a pilot to test the suitability of the new educational software. This is the first decision-making process for adopting educational technology at TU Delft with clear steps.

“ TLS in ESA tried to set up a process for pilot projects to test new tools with other departments. When there are some functionalities or tools are missing, a small pilot can be launched. We're doing a pilot with H5P about an e-portfolio activity tool to allow for more interaction in the learning environment. There is no good process that we can use in the right way, so we use the pilot test out this process and see if this works, and then if it needs to be refined or improved.”

As shown in Figure 5.2, there are 8 steps in this try-out process for pilots.

- Step 1 is to start the pilot. In this step, which lecturers request the pilot, what educational tool will be tested and what kind of capacity there is from the university will be clear.
- Step 2 is called Intake. There will be a sort of project plan written in the intake. The project manager will take charge of this step. The project manager can be from various teams. In the H5P case, someone from TLS with project experience helps to do the pilot.
- Step 3 is Checks. A lot of checks need to be done in this step, including finance, security, privacy, ICT architecture, data archiving, and resources (support). In this step, so many departments will check the parts related to their duties. The project manager will lead this step with input from all the different departments.
- Step 4 is to make the decision. Several related departments will be involved, such as Advisory Committee Educational Tooling. At the latest, the project manager will be in the lead.
- Step 5: Organisational Setup. Make sure you make sure that all the contracts are being signed and that licenses are in place. The project manager takes responsibility and works with stakeholders.

- Step 6: Technical Setup, so make sure that the tool can be integrated into what TU Delft is using. The project manager is in the lead, and he or she always again works with stakeholders.
- Step 7 is named Perform, which means to implement and use this tool. The lecturers who request the pilot will really use the educational software.
- Step 8 is the Failure Weight, to review the success of this pilot. The project manager and the lecturers will accomplish this step together.

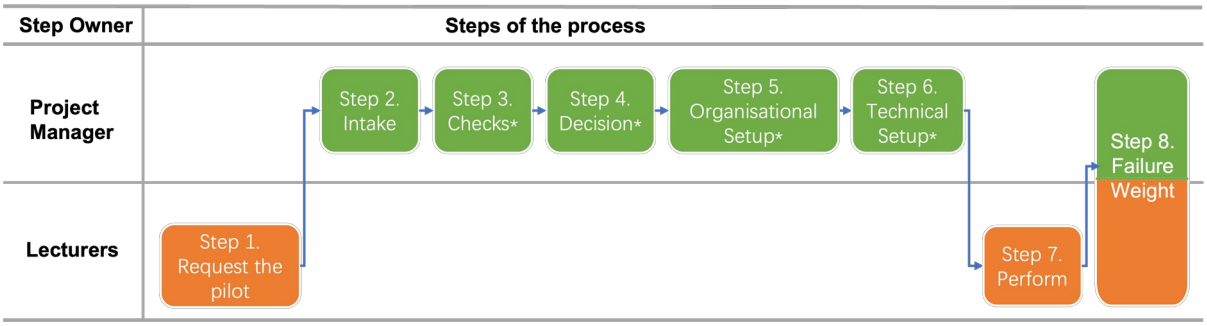

Figure 5.2: The try-out process of adopting a pilot of educational technology at TU Delft.

Though so many departments are involved in most steps, the project manager oversees the whole process. According to Interviewee C, this process also can be used for selecting all kinds of pilots, such as small commercial software, open-source software and more self-owned tools.

Strategic plan-making process

The strategic plan-making process is a process to set up the direction of ICT development for the next several years. According its website, TU Delft is in Strategic Framework 2018-2024 now. This Strategic Framework acts as a high-level compass for TU Delft, providing guidelines for the many decisions, both big and small, that are made at every level and sector of the University.[192]

Interviewee A shared a process to set up the strategic plan for ICT-related technology. Figure 5.3 shows that this process is between the ICT department, the Data protection & IT committee in the Works Council, and the Executive Board of TU Delft. According to the TU Delft website, "The Works Council is the central consultation body for TU Delft employees. The WC has the right to be informed, to appeal and to initiate, and – in specific areas – advisory authority or the right of approval. In principle, consultations are held on every

192 'Strategy Documents TU Delft', TU Delft, accessed 19 August 2022, https://www.tudelft.nl/en/about-tu-delft/strategy/strategy-documents-tu-delft.

important matter concerning TU Delft, or where they must be held in accordance with the Works Councils Act."[193]

- Step 1: The ICT department sets up the drafts of the strategic plan for software adoption at TU Delft (for the educational technology part, ICT would talk to ESA), and then submits it to the Executive Board. Also, there is informal channel through which the Data protection & IT committee and the ICT department can discuss the plans before they are submitted to the board and Works Council.
- Step 2: The Executive Board receives the plan.
- Step 3: The Works Council reviews this plan (using the right to agree and/or the right to advise).
- Step 4: The Executive Board reviews, discusses and decides on the strategic plan.
- Step 5: The ICT department starts to execute the plan.

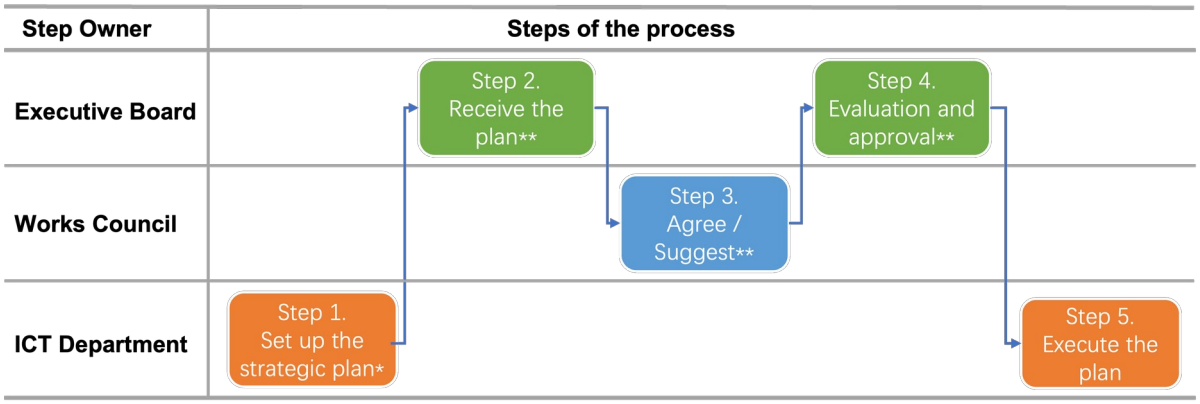

Figure 5.3: The strategic plan-making process.

However, Interviewee A said that in real life, since the Executive Board trusts the ICT department to be knowledgeable, the board usually adopted the ICT department's plans directly without the Works Council's involvement. The real life strategic plan-making process is shown in Figure 5.4. From this year, the Works Council expected to take part in this process to review the drafts and provide some suggestions to the Executive Board. The Works Council will be involved and will be allowed to contribute in practice.

193 'Consultation Bodies', TU Delft, accessed 18 August 2022, https://www.tudelft.nl/en/about-tu-delft/organisation/consultation-bodies.

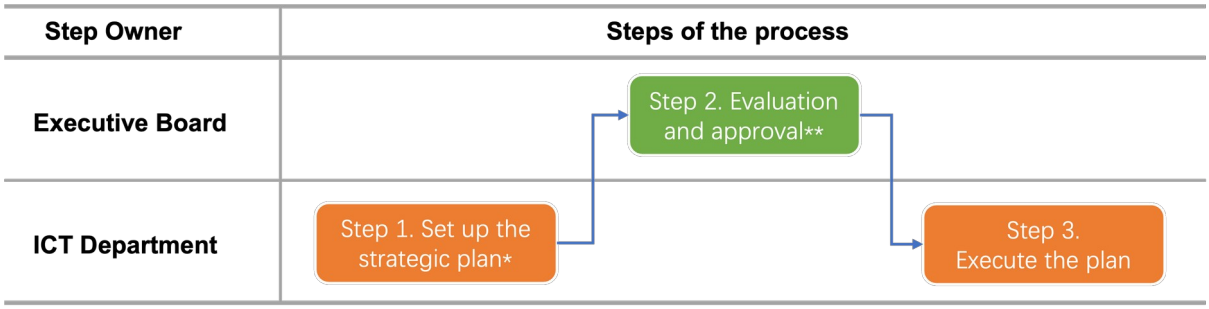

Figure 5.4: Strategic plan-making process (real life situation).

All in all, as all interviewees stated, there is no finalised active decision-making process for adopting educational software till now. But according to interviewee C, TU Delft has started to design some detailed processes (the pilot process) and tested them for future educational software adoption.

5.3.2 Factors concerned in the advice process of adopting education technology

Interviewees B and C shared the factors that are taken into consideration when education technology is evaluated. The factors they mentioned are as follows.

- Security and Privacy, including archiving process (data storage and data access), data uses and more.
- ICT Architecture.
- Functionality, including whether the functions fit all the requirements and whether there has been a double functionality already.
- Costs (price).
- Support capabilities from ICT and ESA.

Interviewee B also mentioned that the ICT department is drafting 10 cloud risk frameworks, as illustrated in Table 5.2 with its name and definition. The 10 risks are Shadow cloud, Lack of integral vision and strategy, Threat to academic freedom, vendor lock-in, limited transparency and assurance of cloud service providers and sub-processors, insufficient safeguards for privacy and (knowledge) security, Non-compliant use of cloud services, Negative sentiment and distrust toward cloud security and control, Lack of awareness on cloud usage by employees and students, and Organisational and operational dependency. “10 cloud risks are in the discussion process and have not been finalised. So, when these are finalised then we can use it also for the advice process for adopting educational software”, interviewee B said.

Table 5.2: 10 cloud risk frameworks (not finalised).

#	Risk Scenario Definition	Risk Scenario Summary
1	Shadow Cloud	Employees and students autonomously adopting cloud solutions without restrictions, resulting in the adoption of public cloud solutions that are not visible (i.e. shadow cloud).
2	Lack of Integral Vision and Strategy	A loss of control on cloud adoption caused by a lack of an integral vision and strategy resulting in ill-informed cloud adoption decisions that could potentially harm compliance, security, privacy and university values.
3	Threat to Academic Freedom	The CSP's decisions influence the TU Delft decision making due to the potential surveillance, platform restrictions, censorship, and/ or political interference, resulting in a threat to the autonomy and knowledge of the university (i.e. academic freedom).
4	Vendor Lock-In	Dependency on a single (or limited number of) CSP(s) caused by the technical heterogeneity and the competitive restrictions employed by CSPs to lock-in users towards their solutions resulting in limited data and application portability, ultimately creating a vendor lock-in.
5	Limited Transparency and Assurance of Cloud Service Providers and Sub-Processors	Adopting Cloud Service Providers that insufficiently address internal TU Delft requirements caused by limited transparency and assurance provided by CSPs and their sub-processors, resulting in the adoption and use of public cloud solutions regardless of being in control.
6	Insufficient Safeguards for Privacy and (Knowledge) Security	Loss or misuse of personal data or knowledge caused by insufficient safeguards for data protection, privacy and knowledge security when sharing data in the cloud.
7	Non-Compliant Use of Cloud Services	Violations with privacy and data protection legislation (e.g. GDPR) caused by the non-compliant use of cloud services resulting administrative fines and reputational damage.
8	Negative Sentiment and Distrust toward Cloud Security and Control	Cultural resistance toward cloud adoption within the TU Delft caused by the negative sentiment and distrust toward cloud security and control, results in barriers to cloud adoption.
9	Lack of Awareness on Cloud Usage by Employees and Students	Lack of awareness on cloud usage by employees and students may lead to sensitive data being shared via insecure means without data classification and cost considerations, therefore resulting in financial, security, privacy and compliancy risks.
10	Organizational and Operational Dependency	The increased role and responsibility of the CSP (and sub-contractors) in terms of incident management, change management, and security services caused by an increased organizational and operational dependency on the CSP, results in operational challenges and/or limited flexibility of the organization.

5.3.3 Commercial software or (Self-hosted) open-source software

Commercial software or open-source software

When they are asked what kinds of educational software would be considered at TU Delft, Interviewees B and C stated that they were treating all kinds of educational tools equally. Interview B said, “I think all alternatives should be considered, including open-source or commercial. They both have advantages. In the next of our plan, we will evaluate the OSS such as BigBlueButton (BBB).” According to Interviewee C, TU Delft is adopting both commercial closed-source software and open-source software now. For example, Microsoft Teams and Zoom are commercial tools, and the pilot, H5P, is an open-source tool.

Self-hosted open-source software

According to Interviewee C, TU Delft does not consider using the self-hosted OSS for educational technology at least now. Interview C said, “We want a partner rather than self-host the educational software. A partner can help us, for example implementing, making changes, making sure that everything is up to date or upgraded, as well as service is secure and data is stored securely”, and continued with “For self-hosted open-source tools, I don’t think we have the capacity and the knowledge to do this in the right way now. If you want it, that can be done, but then it needs to be a decision. And then we also need to invest in capable people.”

Interviewee C warned that “If you have a self-hosted open-source tool and you don't host it correctly, then there also are some risks.” On the website of Educational Tooling, there is a perfect summary of these risks as Interviewee C talked about:

> “You should be aware that there are some serious risks involved in using self-hosted software:
>
> First, there is no guarantee for uptime of the tool. With self-hosted software, it is usually one person that is hosting and supporting the tool. What will happen if this person gets sick, or leaves the TU Delft for another job? What will happen when a tool goes offline, and this person has no time to fix it?
>
> Secondly, installing a tool is not so difficult, but supporting the tool and servers is the tricky part. Is the tool installed in the best possible way? Who will update the tool, but also the servers? Who will monitor if the tool (or servers) has security issues? Who will make sure that the data is stored long enough (in some cases seven years) and in a safe and secure way?
>
> Finally, who is responsible if something goes wrong? What will happen when the tool is hacked and there is a data breach? Who needs to act and report to the authority? Who needs to pay the fines?
>
> To sum it all up: There are some serious privacy and security risks with using self-hosted tools. If you want to use self-hosted software, make sure to be aware of the risks it may cause you.” [194]

In fact, this is the only information provided on the website about self-hosted open-source educational software. For the content, Interviewee A did not think it was proper, because the Educational Tooling only mentioned the negative side of the self-hosted OSS and ignored the positive side of them.

In addition, Interviewee A had a viewpoint as a user of educational technology at TU Delft. He thought educational tools used at TU Delft were relying heavily on big commercial closed-source software rather than self-hosted open-source software. Here are several reasons why TU Delft made the decision to use Microsoft teams (the large commercial closed-source software) from the perspective of Interviewee A.

- The functionality and the interface are good. Microsoft has merged a lot of different functions in one interface and integrated plenty of software. The more time the users work on Microsoft’s products, more free they will feel since they can do almost everything related to teaching, chatting and storing files in one interface.

194 Advisory Committee Educational Tooling, ‘Educational Tooling: Questions Related to Privacy and Security’, TU Delft, accessed 20 August 2022, https://teaching-support.tudelft.nl/educational-tooling-questions/#22224.

- This is a safe choice and there is less risk to the decision-making person. Almost every university in the Netherlands is using Microsoft Teams, so if something is wrong on Microsoft products, the person(s) who decided to use Microsoft will not be blamed. Whereas when a group of people decide to use their own software in their own environment, not only that group of people have to support the software, but also whenever things go wrong (even if it's the smallest thing), it's that group of people's fault. What's more, people accept the MS and own products in different level. People always demand more from self-hosted software, believing that the self-hosted open-source software should be perfect when they are launched and should have no problems. In contrast, people think it is acceptable for Microsoft to gradually upgrade the functions, fix the bugs or even ignore change requests.
- The money cost for using Microsoft is relatively low for TU Delft compared to non-educational customers as well as compared to other commercial suppliers. With Microsoft, TU Delft has a complex license construction where products are bundled: When TU Delft needs product A, they receive A, B and C. When they later on want to use something like C, C is already available. When TU Delft uses C, this increases dependency and possibly results into expanding to D. So, in the tender system, combining so many functionalities, the solutions from Microsoft are apparently always relatively cheap and thus the university ends up with Microsoft.
- The ICT department at TU Delft views privacy as a combination with contracts and security when they make a plan or choice. Their data security evaluation process is not clear and very vague. On the one hand, Microsoft provides us 200-page legal contract with saying that they will handle our data according to the EU and Dutch privacy laws. However, in fact, it is very hard to enter their inner cloud environment to check whether they have done what they promised. On the other hand, when privacy is talked about, the ICT department is very fast to sub it to security, which actually should be two separate things. Privacy often refers to the user's capacity to control, access, and govern their personal information, whereas security refers to the system that prevents such data from falling into the hands of the wrong people due to a breach, leak, or cyber assault. Since it is true that privacy can be only protected when there is good security, ICT department starts to just focus on security. And Microsoft can do very well in data security since it builds walls everywhere in the world. Therefore, our ICT department thinks Microsoft fits in our privacy and security concerns.

Interviewee A also admitted that "Moving to (self-hosted) open source, we need knowledgeable technical people (IT developers & administrators), who may be hard to find", but he added that "it is feasible (to be independent from commercial closed-source software, like Microsoft Teams)." And he looked at the bright future if we can handle the data and the environment by ourselves: "we should develop it (to know the gap and hurdles to adopt the self-hosted open-source software) now, since it is important for the future."

5.3.4 Communication channels

One of the most important thing in the decision-making process is the involvement of different stakeholders. However, the feedback mechanism between the users and the ICT department / Advisory Committee Educational Tooling about educational tools is lacking. Interviewee A said there was barely a regular communication channel between lecturers and ICT department. For one thing, the reviews of educational technology by teachers has not been included in the regular evaluation. Interviewee A said that although there was a yearly questionnaire for students to rate the TU Delft (amongst others on ICT facilities), teachers were hardly ever consulted in choosing new ICT products for education. On the other hand, lots of the educational technology users don't know where to share their opinion and who to speak to. In the end, the users' sound is ignored, and the decision-maker will think they have made a great decision. For Interviewee A, he would like everyone to see the issues. However, if no one raises issues, there will be no issues on the table.

For the website that should be used to find the contact information, Interviewee B said that "I agree it's difficult to to find the right place to go to", but "I'm working on a programme at the moment, and one part in this program is to improve our find-ability, including improving the channels that the teachers and students can go to when they have a problem or question."

5.4 Discussion of the interview results

Through the interviews, three different processes were sorted out. The strategic plan is a macro-level guide to the adoption of software at TU Delft, while the other two processes (the advice process and the pilot process) are detailed workflows.

For the advice process, on the positive side, it is currently implemented by the multi-disciplinary Advice Committee Educational Tooling, so it is great that different aspects can be considered. For the passive side, the advice process is not a decision-making process and therefore it does not control the actual use of the teaching software. After receiving a recommendation, lecturers can still use the software even if the Educational Tooling has informed the software is not under our GDPR, which can be a big risk.

For the pilot try-out process, designing a clear pilot process, clarifying who is responsible for each step and considering more risks could be an effective method for TU Delft to support education autonomy.

The choice between education tools is complicated by the complicated license system which makes the price of Microsoft service (appear) cheap for TU Delft, and which possibly let the decision maker want to adopt Microsoft, since the tender system will tend to choose the cheapest software which meets all functional requirements.

5.4.1 Hurdles for TU Delft to build a free space for digital education technology development

Based on the interviews about current decision processes as well as on information found on TUDelft website, there seem to be a number of (legal-political, economic, and cultural) hurdles to take *if* freedom of choice regarding digital education technology is considered important.

Cultural hurdles

- Little awareness and knowledge about various kinds of educational technology (including commercial software, open-source software and self-hosted open-source software) among the users of this software (professors, students) which increases the likelihood of them choosing products provided by intellectual (near-) monopolies due to familiarity with them;
- Possibilities for adopting self-hosted OSS as the future direction of education software are limited also by available knowledge at the university) for developing, maintaining and updating self-hosted OSS. Perhaps surprisingly for a technical university, there appears to be no general enthusiasm for developing and expanding this knowledge.
- The current organisational culture appears to discourage rather than appreciate initiative and new ideas, and to instill fear for being blamed when something goes wrong while trying out something new. There appears to be no organisational culture of invention and innovation in the field of education software and no intellectual climate for competition with digital intellectual near-monopolists.
- Perhaps surprisingly for a university with an Open Science Programme, there appears to be no general enthusiasm for hosting and/or developing Open Source Software.

Economic hurdles

- The relative costs of alternative solutions are hard to assess (also due to the complicated licensing system with Microsoft).
- One option is to collaborate with a partner (a commercial company, or other universities / SURF) rather than to self-host OSS. However, so far there appears to exist little insight into the costs of developing and maintaining self-hosted OSS relative to other options.

Legal-political hurdles

- Procedures such as the pilot try-out process and the passive advice process could be effective methods to support education autonomy.

- Adequate regulation would be needed to manage data security and privacy as well as data storage in accordance with existing law and with desired levels of privacy and security.
- There seems to be a need for more clarity regarding responsibilities if something goes wrong (e.g. in case of hacking / a data breach: who needs to act and report, who pays the fines etc.);
- There seems to be a need for rethinking the current legal-political environment to prevent people from been blamed for not complying with the 'best practice' or 'standard' (set by the intellectual monopolist);
- A new strategic plan seems needed for future direction of adopting/developing education software and for clarifying and improving decision-making processes for adopting education technology.

Chapter 6 Conclusion

In this concluding chapter, the main research question and sub-questions will be answered in Section 6.1. Then, the limitations of this thesis research and recommendations for further research will be in Section 6.2.

6.1 Conclusion

Below I will answer the main research question by answering the sub-research questions one-by-one.

1. How does the intellectual (near-) monopoly of (digital) giant corporations arise?

This question needs to be answered in four parts. The perspectives from the macro-sociological level are used to visualise the relationships between the three spheres in the rise of intellectual monopoly.

The first two parts are about the development of new knowledge (research and the general progress of knowledge). Intellectual monopolies are companies that build their wealth by excessive monopolising access to information and converting it into intellectual rents, a type of intangible asset. Leading companies accumulate more and more intangible assets, and these exclusive intellect rents can also be reused to create unlimited new knowledge. They thus become legal-rent- or/and data-driven network-externality-based intellectual monopolies. Two main intellectual rents behind these intellectual monopolies are the legal IP rents and data-driven rents.

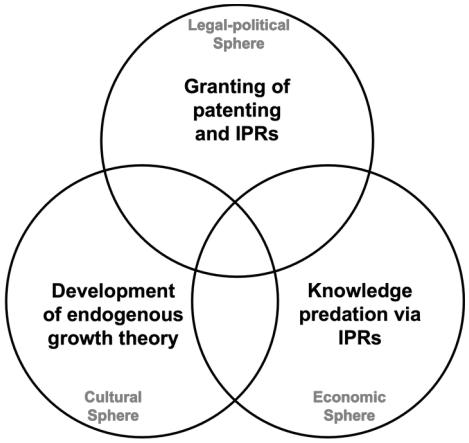

Figure 6.1: The rise of legal-rent-based intellectual monopolies.

For legal IP rent, it refers to the intangible assets from IPRs. The following three simultaneous developments in the three spheres related the rise of the legal-rent-related intellectual monopoly have been described in Chapter 3: (a) the growth of intellectual

monopolies in the economy coincides with (b) the development of endogenous growth theory in the cultural sphere (which legitimises the privatisation and commercialisation of knowledge, or the generation of knowledge in the economic sphere), and (c) the granting of patenting and Intellectual Property Rights in the legal-political sphere. In the context of this thesis it is not possible to say which caused which; however, the emergence of legal-rent-based intellectual monopolies are the coincidence of these three developments. Figure 6.1 visualises these development in the three spheres.

The data-driven rent is about the intangible assets resulting from 'Big Data' after Machine Learning. Regarding data-driven network-externality-based monopolies, which give these companies opportunities to reap data-driven rents, there is a sound that rather than too much regulation, there has been too little regulation. For example, there has been very little effort on the part of governments to protect the privacy of their citizens, and to protect data security. But also, one could say that the emergence of network-externality-based monopolies and the corresponding data-driven rents in the economy has been accompanied by a lack of initiative in the cultural sphere. In the case of educational technology, for example, many people are unaware of the importance of education freedom. Strictly limited awareness and initiatives mean that it is hard to see the intellectual monopoly as a problem in social life. Figure 6.2 depicted the rise of data-driven network-externality-based intellectual monopolies from the perspective of three spheres.

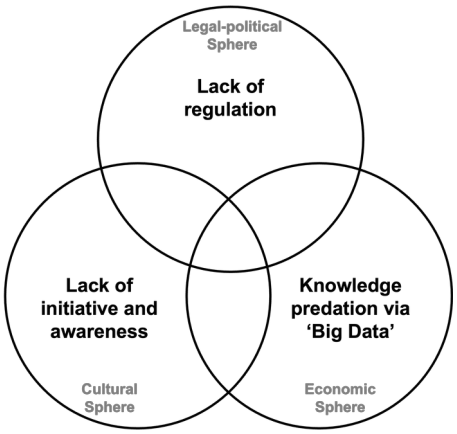

Figure 6.2: The rise of data-driven network-externality-based intellectual monopolies.

The third kind of the rise of intellectual monopolies is by using the global corporate innovation system to outsource other organisations to predate new knowledge while reducing risk. Regarding global-innovation-system-related monopoly, governments (the legal-political sphere) have allowed and stimulated the privatisation of public knowledge − for example by reducing their funding of universities and demanding that researchers fund their research by collaborating with commercial companies and seeking private, profit-maximising financiers for their research[195] − whereas instead they could have protected 'Open Science' and Free and

195 Such policies are again related to the idea that society will benefit from the privatisation and commercialisation of knowledge (endogenous growth theory).

Open-Source Software. Again, this is also a lack of initiative in the cultural sphere, like in schools and universities, or in civil society (the media etc.) more widely. The relationship between the three spheres in this category of the growth of intellectual monopolies is shown in Figure 6.3.

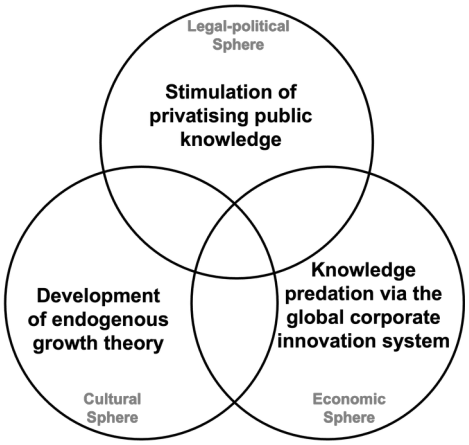

Figure 6.3: The rise of global-corporate-innovation-system-based intellectual monopolies.

The last part is about personal knowledge generation via learning (education). A new type of intellectual rent, the learning-related rent, has been defined in this research. Learning-related rent result from assets created by controlling learning contents or learning tools. In the view of three sphere, a coincidence of the GERM (in the legal-political sphere), the legitimisation of the privatisation and commercialisation of knowledge (by endogenous growth theory) and the growing acceptance of business influence in schools and universities in the cultural sphere, and the emergence of intellectual monopolies in the economy. All three developments together contribute to the loss of freedom of education in the cultural sphere. A Figure is given to picture their together contribution (see Figure 6.4).

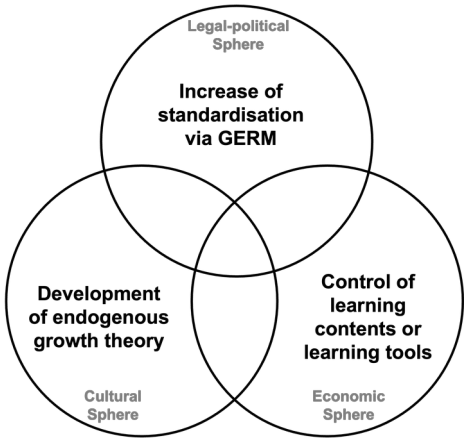

Figure 6.4: The rise of learning-related intellectual monopolies.

2. Who are the intellectual (near-) monopolies in digital education technology?

This research focuses on learning management systems (LMSs), online course platforms (Massive Open Online Courses (MOOCs) and K-12 online course platform), and Video Conferencing tools in the education technology. In education technology, there are a number of companies that have reached near-monopoly market share. When they rely on at least one of the three kinds of intellectual rents mentioned in the previous question to achieve or maintain a monopoly, then this thesis considers them to be intellectual (near-) monopolies.

Corresponding to the answer to the previous sub-research question, there should be two types of intellectual (near-) monopolies in digital education:

Legal-rent-based or/and data-driven network-externality-based or/and global-innovation-system-related intellectual (near-) monopolies in digital education are usually tech giants. Microsoft and Alphabet (Google) are this type(s) of intellectual (near-) monopolies in education technology. They offer Microsoft Teams and Google Classroom. Microsoft is a legal-rent-based and data-driven network-externality-based intellectual (near-) monopoly because it relied on IPRs to monetise innovation and privatise knowledge until 2014, and has transformed into a data-driven rent-based company since then. Google has always been a data-driven network-externality-based intellectual (near-) monopolies because from its earliest successful business, the search engine, it has used user data to form intellectual rents. Both are global-innovation-system-related intellectual (near-) monopolies as well.

As for learning-related intellectual (near-) monopoly, LMSs and MOOCs both rely on controlling the learning channels to get the learning-related rent to be intellectual (near-) monopolies. K-12 online learning tools are easy to control the learning content to gain the learning-related rent to be intellectual (near-) monopolies.

3. Does intellectual (near-) monopoly in digital education technology interfere with freedom of education in the cultural sphere? If so, how?

Yes, intellectual (near-) monopoly in digital education technology does interfere with the freedom of education in the cultural sphere. The coincidence of three developments has been described in Chapter 4: (1) the growth of the GERM, led by governments and international organisations, and the growing influence of governments and international organisations on education, (2) the growth of powerful near-monopolists in the ‘education industry’, in particular the digital education technology industry, and (3) loss of freedom / autonomy in the cultural sphere / education. Interestingly, the cultural sphere itself has also contributed to its own loss of freedom (by failing to generate an adequate response to the growing influence of businesses and governments in research and education). The developments between three sphere could also be shown in a diagram (see Figure 6.5).

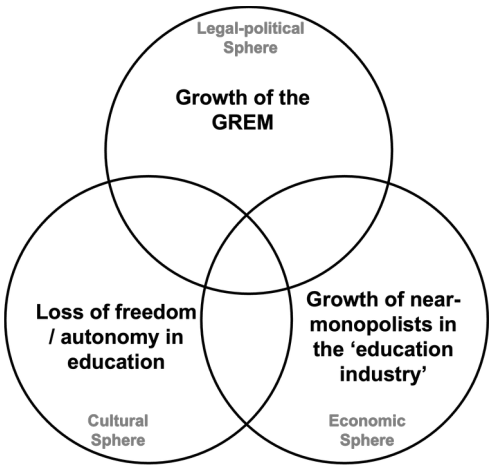

Figure 6.5: The developments between three sphere about interfering with freedom of education.

Specifically, there are four main interventions from intellectual (near-) monopoly in digital education to decrease the freedom of education in the cultural sphere.

- **Reduce diversity in education via providing data to GERM:** GERM is the Global Education Reform Movement which use standards, decentralisation and accountability as the policy principles. Many Governments follow their education evaluation project to use standards and less education autonomy to shrink the independency of education in the cultural sphere. Intellectual (near-) monopoly in digital education is able to provide more accurate data from using their tools to the education evaluation project providers to increase the credibility of GERM. When there are more and more evaluation data, the autonomy and diversity of schools will become less and less.
- **Threaten data security and user privacy:** Firstly, the non-global nature and lag of regulation leaves the door open for jeopardising data security and user privacy. Second, the ages of education technology users are so young that needs to be more careful with the data security and user privacy. Thirdly, it is hard to know the actual security level since the user is hard to check the internal environment of the software providers, the intellectual monopolies. When data security and user privacy cannot be guaranteed, then large companies can rely on this data and privacy to influence education-related decisions, thus interfere with the freedom of education in the cultural sphere.
- **Limit education autonomy:** education autonomy consists of professional autonomy (academic freedom) and organisational autonomy. Intellectual (near-) monopolies in digital education can limit both of them. For the professional autonomy, Video Conferencing tools might block the living meeting because the service provider does not want this meeting/event to be held. In addition, monopolistic K-12 online

education tools can control what most children learn since they are the only or one of the very few content provider online.

- **Expand education access inequity:** Education technology can increase unequal access. MOOCs and K-12 online course platforms are not always free to everyone, so poor families will find it hard to afford them, and the inequity of access to knowledge expands. For video conferencing software, since not all families have big-screen computer, access inequity exists as well.

4. Which legal-political, economic and cultural hurdles would need to be conquered in establishing a free space for digital education technology development at TU Delft?

In the case study, an interview on decision-making processes regarding the (future) adoption of education technology at TU Delft has been conduct to find ways to move from the intervention models such as figures above towards an ideal imagination of freedom of education with three mutually supportive and independent spheres. This case study focuses on one aspect of education freedom, called freedom of choice in education technology.

From the interview results, some hurdles have been given from the perspectives of legal-political, economic and cultural aspects in the education of the cultural sphere. There might be more barriers than I mentioned in this thesis, but the first step is to become conscious of their existence.

In the legal-political hurdles, complying regulation to manage data, a healthy responsibility model for educational technology decision-maker, the legal-political environment and a new strategic plan for future direction of adopting education software need to be conquered.

In the economic hurdles, costs for different kinds of educational technology should be figured out and the high cost issues of developing and maintaining self-hosted OSS needs to be solved if the future direction is to adopt such kind of technology.

In the cultural hurdles, raising the awareness of various types of educational software (including commercial and open-source software, finding partner and self-hosted tools), generating the knowledge for developing, maintaining and updating self-hosted OSS if if the future direction is to adopt such kind of technology, and developing an organisational cultural to encourage the different idea to keep the education diversity.

6.2 Limitation and recommendations

There are several limitations of this research:

- The data sample is small in the interview. Due to the time limitation, only three interviewees has been interviewed. The small number of interviews may lead to inaccurate and incomplete results due to individual subjective influences or other objective factors. For example, due to the limited length of a single interview, it was

not possible to mention every stakeholders of the pilot process. This issue could have been addressed if a larger number of interviews had been conducted.

- The interview design states that this interview will only be conducted with TU Delft workers related to the education technology adoption process, which means a single perspective is chosen to collect the data at the design stage. However, if detailed evidence of the impact of intellectual (near-) monopolies on education is required, interviewing all stakeholders related to education may yield fruitful results from multiple angles.
- Due to the author's academic background, this thesis mainly focuses on the social impacts and does not analyse it from a technological perspective. The thesis tells the impacts from the perspectives of market and potential risks, ignoring the impact of technology itself. For example, most online education platforms or LMSs require the support of cloud computing, so the choice of different types of clouds can also have an impact on the rise of intellectual monopolies.
- This thesis looks at the effects of intellectual monopolies mainly from the perspective of freedom of education. Any expected positive effects of intellectual (near-)monopolies on the three spheres of society are not mentioned in detail. This does not mean that the author thinks that there are no benefits (even for freedom of education), and any one-sidedness in this regard is due to the limited time and pages given for a Master thesis.

Regarding future research, the following directions are recommended:

- For the interview, the following directions could be considered for the next step of the study.
    - The same interview could be re-run after a period of time to see the results of the ongoing projects mentioned in this interview and whether the education software adoption strategy has changed.
    - A similar case study could be implemented at different universities in the Netherlands or in other countries for horizontal comparison.
    - Future interviews on research software could also be considered. Research software is as important as education technology in universities. They are both related to knowledge generation, the use of education software can influence personal knowledge generation (learning and education), while research software is related to generating brand new knowledge (invention).
- For the theoretical reasoning part, the thesis only focuses on the impact of intellectual (near-) monopolies in digital learning on the cultural sphere in Chapter 4. Future research could study the impacts on other spheres.

- Since TU Delft does not support the self-hosted OSS now and they aim to choose a partner to set up the online education, it might be an interesting follow-up research to study what the economic costs, the legal-political requirements, and the cultural benefits of the various options would be in such case.
- Besides choosing a commercial educational tool or OSS, another option might be to collaborate between universities and jointly set up a safe platform. It would be worthy to research on this kind of opportunity as well.

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Appendix

A. Interview questions

1. Which commercial education softwares have been take into consideration at the TUDelft?
2. Have you ever considered self-hosted Open-Source Software (OSS)?
3. Regarding decisions about the adoption of online education tools − which departments / sections are involved in the decision-making process?
4. Which factors / possible problems / issues have been considered during the decision-making process? (For example factors relating to costs, legal requirements, intellectual autonomy / academic freedom.)
    a) Where have these factors / possible problems / issues been put on the agenda?
    b) In your view, are there other factors that also need to be considered?
5. Could you describe in detail the steps of the decision-making process at TUDelft for adopting EdTech?
    a) What are the different steps in the process?
    b) Who is responsible for which steps in the decision-making process?
    c) Is there a step to seriously research the different options? If so, where has this research taken place?
    d) Who is responsible for the decision-making process as a whole?
6. In the literature, concerns have been raised regarding intellectual monopoly by high tech companies. Do you think this could also be a problem in the case of adoption of education technology − such as commercial software provided by major high tech companies, as compared to self-hosted open-source tools?