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Integrating futures imaginaries, expectations and anticipatory practices: practitioners of artificial intelligence between now and future

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ABSTRACT

Artificial intelligence (AI) is a world-changing technology due to its abilities to learn independently, process big data, and automate human work. Imagining the socio-technical future is necessary, but challenging, in the era of AI that rapidly developing technology has made turbulent. In this study, we addressed the need to understand the ways AI practitioners actualise their AI-related futures imaginaries at the grassroots level and in the present. Our empirical case study concerned Finland and Singapore, focussing on their AI strategies based on interviews with 26 AI practitioners. We created a new conceptual perspective by integrating three concepts: futures imaginaries, expectations, and anticipatory practices. We showed that imagining socio-technical futures is an ongoing process in which AI practitioners repeatedly co-constitute the future in 'the now'. These practitioners interpret futures imaginaries as expectations and address AI-related challenges via anticipatory practices. Whereas some AI practitioners 'ride the wave' of the AI hype, others are proactive and critically active in developing and educating people on AI. AI practitioners hold significant anticipatory agency that is actualised in the anticipatory zone.

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1. Introduction

Artificial intelligence (AI) is a world-changing technology due to its ability to learn independently, process big data, and automate work. Attempts to imagine socio-technical futures in the era of AI range from dystopic warnings of intelligence that surpasses that of humans (Bostrom 2017; Hawking et al. 2014) to co-creation between humans and machines, which would allow people to focus on performing creative tasks and creating meaningful lives (Jarrahi 2018). Imagining socio-technical futures in the era of AI is difficult because AI is a disruptive technology that may lead to uncertain development paths (Majumdar, Banerji, and Chakrabarti 2018). Moreover, AI development is prone to hype cycles: a peak of exaggerated expectations followed by the disappointment of 'AI winters' stemming from decreasing funding and slow technological progress, and finally, a revival of expectations (Dedehayir and Steinert 2016; Floridi 2020). Today, we are experiencing another round of AI hype.

An increasing number of nations have created AI strategies to imagine socio-technical futures in such turbulence, prevent unwanted development paths, and ensure competitive global positions.

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Proliferating research on AI strategies has led to identifying the need to understand the ways AI practitioners actualise these strategies at the grassroots level (Fatima, Desouza, and Dawson 2020). Practitioners include entrepreneurs and researchers who apply and develop AI. Such a need also exists at the core of futures studies that aim to research, imagine, and conceptualise AI-related futures and the socio-ethical opportunities and risks (e.g. Aicardi et al. 2018; Turchin 2018; Díaz-Domínguez 2020). So far, AI-related research in futures studies has focussed on the various levels of organisational strategies and state policies (e.g. AI 2030 Study Panel 2016; Makridakis 2017; Farrow 2020), as well as the fields that apply AI technology (Capatina et al. 2020; Liu et al. 2020). Moreover, a perspective that combines far-future imaginaries with AI practitioners' activities in 'the now' is needed to understand actualising futures.

In this explorative article, we follow Sovacool and Hess's (2019) suggestion of creating and exploring an integrative conceptual and empirical perspective as the next step for understanding the actualisation of AI-related futures. Our perspective integrates grassroots and strategic levels, as well as the time dimensions of the far future and 'the now', placing AI practitioners' activities at the centre of the research. We integrate three concepts in two areas of the academic literature: futures studies and socio-technical research (Sovacool and Hess 2019). These concepts are futures imaginaries (AI strategies) that structure the strategic levels of AI-related futures (e.g. Patomäki and Steger 2010), their interpretation and mutation into practitioners' expectations (e.g. Borup et al. 2006), and anticipatory practices executed in reaction to expectations in 'the now' (e.g. Anderson 2010). We answer the following research questions: (i) What are the key AI-related expectations that AI practitioners construct from futures imaginaries? (ii) How do AI practitioners work in relation to the expectations and imaginaries?

This empirical case study was conducted in Finland and Singapore, which are geographically and culturally different countries but hold interesting similarities to study AI practitioners. These countries are technologically advanced, are ranked repeatedly among the top 10 on the digital competitiveness index (e.g. WDCR 2020), and are populated with highly educated citizens. Therefore, Finland and Singapore present good opportunities for applying and developing AI. For such strategic development, both countries also need to imagine the future through the AI strategies and actualise such a future in AI practitioners' work. Finland was among the first countries worldwide to launch a national AI strategy in 2017, and Singapore followed two years later with a stronger knowledge of AI-related development and AI strategies globally. The empirical material in this study consists of the AI strategies representing futures imaginaries in both nations (National Artificial Intelligence Strategy 2019; Finland's Age of Artificial Intelligence 2017), interviews with 26 AI practitioners at companies and universities, and observations of 20 AI-related events in both countries.

Our results show that imagining socio-technical futures is an ongoing process, in which AI practitioners repeatedly co-constitute and actualise the future in the 'now'. AI practitioners interpret futures imaginaries as expectations and face AI-related challenges via anticipatory practices. Our integrative theoretical and empirical perspectives demonstrate that AI practitioners operate in the zone of anticipatory agency among far-future imaginaries, socio-technical expectations, and anticipatory practices.

2. Conceptual perspective

2.1 Futures studies' prospections on AI: two periods

In futures studies, researchers have discussed AI in two distinctive periods: around the 1980s and from the 2010s onwards. These periods share a few similarities. First, expectations of AI concern technical development and societal effects, but researchers discuss the future in general rather than individual AI practitioners' expectations and practices. Second, both general and narrow visions of AI frame the discussion: The former refers to the aim of developing general human-like intelligence,

and the latter refers to AI that only operates in specified tasks and environments (Boden 1984; AI 2030 Study Panel 2016).

The 1980s expectations of societal outcomes concern the use of general AI in expert systems where human knowledge could be transferred and applied in medical diagnosis, legal advice, financial planning, and education (Boden 1984, 63; Gurstein 1985, 664). The development of AI was expected to change the interaction patterns, lifestyles, and division of labour (Boden 1984, 64). However, expectations for expert systems encountered difficulties because researchers could not properly explain their reasoning, assess their problem-solving methods, or combine and transfer knowledge between domains (Boden 1984, 65). Even today, AI remains narrow. This level of development was visible in the technical expectations presented in the 1980s that focussed on restricted AI technologies, such as machine vision, human–machine interfaces, robotics, machine translation, language processing, and voice-to-text solutions (e.g. Boden 1984; Gurstein 1985).

In the 2010s, futures studies on the topic of AI underwent a renaissance (e.g. Makridakis 2017; Turchin 2018; Yampolskiy 2019; Farrow 2019; Díaz-Domínguez 2020). The expectations currently vary between moderate (narrow AI) and threat-oriented (general AI) perspectives (e.g. Hengstler, Enkel, and Duelli 2016). As a threat, AI could become a superintelligence that threatens human civilisation and alters society completely. Expectations of the technical development of AI still roughly resemble those of the 1980s with such keywords as 'learning processes', 'language and voice recognition', and 'machine vision' (AI 2030 Study Panel 2016). Even though AI's threat to certain professions is still debated, expectations regarding some of AI's societal effects have changed since the 1980s. For example, humans and AI are seen as co-operators, and AI is believed to assume an increasing role in societal governance. In these contexts, building trust as well as ethical and moral codes for AI is a key issue (Montes, and Goertzel 2019; Hengstler, Enkel, and Duelli 2016).

2.2 From general to grassroots: futures imaginaries, expectations, and anticipatory practices

We created our conceptual perspective under the umbrella that Sovacool and Hess (2019) established in their analysis of 14 theories. The two most powerful theories for explaining socio-technical change are the multilevel perspective (MLP) and social practice theories. The MLP recognises socio-technical transitions as transition pathways linking three layers: niche, regime, and landscape (e.g. Geels and Schot 2007). However, MLP scrutinises historical changes, and other conceptualizations are required to explain 'future change mechanisms' (Sovacool & Hess 2017, 711). Social practice theories primarily rely on theories of human agency and practice to explain how change is implemented (Sovacool & Hess 2017, 711–713), which we apply in our conceptual perspective. Practice entwines materials, meanings, competences, and performances in 'the now'. However, when we concentrate on practices, we risk excluding structural elements and a future time dimension from the analysis.

According to Sovacool and Hess (2019), two further theories focus on a future dimension to explain socio-technical change. The first is called 'sociotechnical imaginaries', which AI strategies represent. These imaginaries are 'collectively imagined forms of social life […] reflected in the design and fulfilment of nation-specific scientific and/or technological projects' (Jasanoff and Kim 2009, 120). However, temporal dynamics between the past, the present, and the future are tricky to trace using the concept of imaginaries only (Sovacool and Hess 2019, 719–720). Second, the sociology of expectations (SoE) explains that expectations about future technology lead to the creation of narratives (and hype) that channel the development of technology through, for example, shared beliefs and investments. However, although the SoE explains the formation of hype, it does not explore how to avoid the costs of hype (Van Lente et al. 2013; Sovacool and Hess 2019).

To take the critique (i.e. 'howevers') into account, we apply the strength of the MLP and create an integrative conceptual perspective from grassroots to the general strategic level(Geels and Schot 2007; Sovacool and Hess 2019). We choose three concepts that integrate time dimensions from far futures to 'the now'. First, to address the strategic level and far-future dimension, we apply

futures imaginaries: large-scale socio-technical visions that direct varied expectations and practices in a specific direction. Futures imaginaries map technological discourses into a 'semiotic order' (Jessop and Oosterlynck 2008) that frames our expectations (Patomäki and Steger 2010, 1057), creates a 'semiotic moment' for social practices (Jessop and Oosterlynck 2008, 1157–1158), and brings AI practitioners 'into an as-if world in which given reality is surpassed and a different one considered' (Beckert 2013a, 328). Such construction and the use of futures imaginaries could be called 'futures semiosis' (Ahlqvist and Rhisiart 2015, 102). In our empirical example, the national AI strategies represent futures imaginaries. In both Finland and Singapore, policymakers led the creation of the strategies, but the process also included consultation with experts in (practitioners of) AI, and discussions with various actors. Thus, the practitioners were aware of the key discussions around the AI strategies and could contribute to the creation of the futures imaginaries.

Second, expectations exist in human cognition and they are interpreted by reflecting the imaginaries (future) in today's realities (now). Expectations are (sequences of) events that individuals deem likely to occur in the future. Thus, expectations merge the far future and 'the now'. Expectations enable or restrict outcomes, and have a 'structuring effect' for the development of technologies and practices (Alvial-Palavicino 2015, 140, 146). Beckert (2013a; 2013b) argues that capitalism is a system of fictional expectations concerning creativity, credit, commodification, and competition that can be analysed through strategies, for example (Beckert 2013b, 226–230).

Third, *anticipatory practices* are actualised in human activity as responses to expectations in 'the now' (e.g. Anderson 2007, 2010; Alvial-Palavicino 2015). Anderson (2007, 158) describes 'anticipatory knowledge practices' as activities that are realised as futures exercises (e.g. Delphi) and that are used to construct innovation policies. Through such practices, anticipatory agency emerges (i.e. the strategic ability to construct future-oriented goals and implement them into actions; Ahlqvist et al. 2012, 824). These practices are entangled with affects, such as fear, hope, and anxiety (Anderson 2007, 158–160). When conceptualised further, the anticipatory practices form three categories: calculating practices, which are realised via an instrument or method; imagining practices, which are realised via knowledge creation; and place-based performative practices, which are performed with bodies (Anderson 2010, 783–787). Multiple anticipatory practices catalyse wider engagement with the future and futures knowledge, as well as construct an anticipatory culture (Ahlqvist et al. 2012, 822–824). Future-oriented planning and development processes include four types of futures knowledge that are relevant for anticipatory practices and cultures (Dufva and Ahlqvist 2015, 253–254). Codified knowledge can be expressed and transferred in written or visual form; articulated knowledge is expressed in a specific process context (e.g. in a workshop or meeting); embodied knowledge refers to the skills, competence, and expertise of the participants in a process; and off-radar knowledge refers to the insights created in a process,such as scenarios, trends, and weak signals.

3. Materials and methods

We conducted this empirical study in 2019. University of Turku's Ethics Committee approved the research plan (statement 2/2019). The study consisted of interviews with 26 AI practitioners from Finland ($n = 14$) and Singapore ($n = 12$; Table 1), as well as participant observations at 20 AI-related events associated with the interviewees' key networks in Turku and Singapore. We documented our observations in 64 pages of field notes. The interviewees were contacted by an email informing them of the study and interview content and providing a privacy notice. The interviewees consented to participate in the interviews (or they could decide not to participate), and they were given the opportunity to read and comment on the manuscript. In Finland, we identified the interviewees at a self-organised meetup group, Turku.AI, which brought together AI practitioners from industries, universities, and city administration to meet, share their knowledge, learn, and create opportunities for collaboration. Turku.AI has grown rapidly since its beginning in 2017 and had more than 650 members in 2020 (MeetUp 2020). We focussed our observations on Turku.AI meetups. Turku is an interesting city in Finland with regard to AI because it is currently undergoing

Table 1. The 26 interviewees and their organisations (n).

Country	Organization	Practitioner's relation to AI	Identifiers
Finland (14)	Company (12)	Coder (6), Founder (5), Manager[a] (1)	• C1 to C6 • F1 to F5 • M1
	University (2)	Researcher/coder (2)	• R/C1 and R/C2
Singapore (12)	Company (6)	Coder (1), Founder (2), Manager[a] (3)	• C7 • F6 and F7 • M2 to M4
	University (6)	Researcher/coder (3), Researcher[b] (3)	• R/C5 to R/C7 • R3, R4, and R6

[a]Leaders of AI projects, most of whom cannot code.
[b]Researchers or leaders in AI projects, most of whom cannot code.

a positive structural change due to a strong boost in industrial and economic development. As a result, various industrial companies located in Turku have focussed on the development of AI. In 2019, the University of Turku launched AI Academy, which organises courses for business practitioners to learn how to apply AI in their companies. In addition, in 2020, the new Faculty of Technology was created at the University of Turku to meet the local job market's requirements for engineers with extensive AI-related skills.

We observed the participants in Singapore in May and June 2019 at 10 AI events that the key AI actors in and among the public sector, universities, and companies had organised. The most important of these actors are SGInnovate, AI Singapore, local universities, and Innovfest Unbound. AI was the focus of Innovfest Unbound, which is Asia's largest innovation festival. The number of AI-related groups in Singapore was much larger than that in Turku, which is why we selected interviewees from all of the key groups. We identified the interviewees at these events. They played active roles in the events – for instance, by presenting how they apply AI.

Eighteen of the interviewees work at companies that apply AI, and eight interviewees work at universities but on projects aimed at developing AI for practical applications (Table 1). Four of these applications were in health care, three in creative fields, and one in job creation measures. Twenty interviewees had education in the 'exact sciences', such as information and communication technology, engineering, statistics, mathematics, natural sciences, and medicine. They understood AI from a technical perspective, and most could develop AI through coding as well. Six interviewees (F2, F3, F4, and F7 as well as M3 and M4) had education in business or the social sciences. As practitioners of AI, they focussed their roles on leading or participating in AI projects.

We conducted the interviews face-to-face. They lasted for about one hour, and the discussions progressed along the themes of this article, experiences working with AI, and the future and AI. We applied the semi-structured interview method, where the conversation follows a predesigned set of themes and their key questions, but gives the interviewee a possibility to discuss the answers freely (Longhurst 2003). The interview themes and questions were designed based on observations and discussions the author had in the Turku.AI meetings prior to the interviews. We recorded the interviews and later transcribed them verbatim. In addition, we conducted a directed qualitative content analysis of the interview transcripts (Assarroudi et al. 2018). We began by identifying the core content in response to the conceptual perspective (futures imaginaries, expectations, and anticipatory practices), and we wrote the core content as summaries to answer the research questions. Afterward, we discussed and refined the questions based on our discussions. Then, we visualised the core content in Figure 1. We deepened and focussed on the analysis via a conceptual perspective in three rounds of visualisations, summaries, and discussions. In addition, we applied Word (original transcripts and summaries), Excel (identifying the key content), and PowerPoint (visualising) software.

4. Results

4.1 Futures imaginaries in Finland and Singapore's AI strategies

We use the notion of a futures imaginary as an umbrella concept for the expectations and practices. Relevant state-scale futures imaginaries in AI are depicted as various strategies that are widely realised in OECD (2021) countries. Therefore, AI strategies represent state-scale AI futures imaginaries, and the discursive setting of AI in Finland (Finland's Age of Artificial Intelligence 2017) and Singapore (National Artificial Intelligence Strategy 2019) in the form of codified futures knowledge (Dufva and Ahlqvist 2015).

In Finland's strategy, the aim was to become the global leader in the application of AI technology in the private and public sectors (Finland's Age of Artificial Intelligence 2017). Singapore's strategy followed the country's wider aim of becoming a 'smart nation' (National Artificial Intelligence Strategy 2019). Both identify AI as disruptive and pervasive technology that is 're-ordering social and economic structures' (National 2019, 5), although, 'We do not yet know … all the things that [AI] will have an influence on' (Finland's Age of Artificial Intelligence 2017, 11). Strategic actions are needed to 'survive and thrive' (National Artificial Intelligence Strategy 2019, 5) and 'get along' (Finland's Age of Artificial Intelligence 2017, 11) with such disruptive change. AI is considered the new electricity in both strategies, signalling the idea of a fundamental transformation that affects society's core (emphasis added by authors):

> **Like the advent of electricity**, the potential impact of AI on society, economy, and Government cannot be understated. Any nation able to master this technology will be able to create tremendous social and economic value for its citizens. **Societies that cannot adapt will fall behind**. (National Artificial Intelligence Strategy 2019, 12)

> AI is like a turbocharger … or … Popeye's spinach … From the perspective of the citizen and user it is **like the new electricity**, so usual that one does not recognize its activity, but so irreplaceable that without it, in future, **one cannot get along**. (Finland's Age of Artificial Intelligence 2017, 11)

The key difference between the Finnish and Singaporean futures imaginaries consists of directing the domains of business and research, where AI is considered most applicable. In Finland, AI technology is considered an 'active part of every Finn's daily life' and applied 'in all areas of society – from health care to the manufacturing industry' (Finland's Age of Artificial Intelligence 2017, 14). Finns refer to groups of citizens and companies – that include also AI practitioners – to construct the imaginary. Therefore, the message for AI practitioners is not directed via domains of economy but rather through key terms such as 'ethical', 'safe', 'democratic', and 'world's best services' (Finland's Age of Artificial Intelligence 2017, 14). The Singaporean vision is more accurate, but it was also created two years later with a better understanding of the development of AI technologies and their effects, in addition to understanding many other countries' AI strategies. The Singaporean strategy focuses on 'key sectors of high value and relevance' (National Artificial Intelligence Strategy 2019, 16). Although the entire workforce is mentioned, 'engineers and entrepreneurs' are specifically mentioned as the key innovators needed to fulfil the Singaporean imaginary.

4.2 Key expectations for AI

Both the Finland- and Singapore-based practitioners described the ways politicians, civil servants, and business and event managers communicated futures imaginaries via speeches and media at various events. Discussions at observed events represented articulated futures knowledge, where futures imaginaries were open to questions and further argumentation (Dufva and Ahlqvist 2015). The AI practitioners participated in and interpreted such discussions by positioning themselves in the future of proposed imaginaries in light of their AI expertise and 'the now'. They brought the future imaginary closer to their realities and 'the now' into expectations. AI practitioners critically recognised three key expectations that were similar in Finland and Singapore.

The first expectation (i.e. AI is the new electricity and will be applied everywhere) was discussed by nearly all interviewees. The narrative that encourages everyone to learn AI is strong. Education for

'anyone' is available to all in both countries, along with support for those applying AI in. However, interviewees based in Finland described the expectation from a critical perspective more often than the interviewees in Singapore did. In Finland, the expectation that AI would be the 'new electricity', also referred to as 'hype' (FIN: R/C2, F5, and C4), seemed to be based on various misunderstandings about AI, such as calling it a 'pseudo-science thing' (C3, FIN) and '50% magic' (C5, FIN), and the media spread this 'hype'. Although a few Singapore-based interviewees raised a similar critique (SIN: C7 and M4), they more commonly concentrated on one's role in developing AI. Singapore was considered an optimal country for developing AI, with the 'best universities, good resources for funding, and ability to make quick decisions' (M2, SIN).

The second expectation is that AI will rapidly be developed until it becomes as intelligent as a person is. Among the interviewees, developers of AI (coders) were less certain about the technology as 'truth' compared to the appliers of AI (managers and founders), which is common and is recognised as a 'certainty trough' (McKenzie 1998; Brown and Michael 2003). However, they had a strong belief in reaching a general AI that is as intelligent as a human is, with all but one interviewee expressing this (R6, SIN). Determining the time required to reach general AI was difficult, and the proposed times ranged from 15 to 300 years – 'from a current hardware perspective, that's just not feasible … and the costs don't make sense' (M4, SIN). Moreover, the actual meaning of a human-like intelligence varied. Some thought it possible to code 'all the strange things of the human mind' into the general AI: 'Just collect the basis of experiences that humans have … . I believe … one cannot tell the difference [between AI and a human]' (C2, FIN). Several interviewees believed that the difference between humans and machines will not be resolved because humans are 'too complex' (R3, SIN) and 'full of mistakes' (C5, FIN). Therefore, achieving general AI was considered possible through simultaneous changes in people, technology, and definitions of intelligence.

The third expectation (i.e. AI will lead to a new allocation of work between people and machines) derives from the second expectation. Repetitive, routine work will be automated, and humans can focus on being creative and on planning and leading processes (FIN: R/C1 and R/C2, F4 and F5, M1; SIN: M2, R3, R4, and R6, M4, and R/C6). Although most interviewees considered this a desirable outcome, they also recognised downsides. For example, interviewees questioned what happens when people lose the sense of meaning they often obtain from their work (FIN: F3, F2, C4, and R/C1; SIN: M3 and M4). Some saw increasing unemployment leading to dissatisfaction, rebellion, drug use, the growth of extremism, and mental health issues (M3, SIN; C4, FIN). New divides between people were foreseen, such as the digital divide between older people lacking digital skills and younger people who are able to learn about AI (FIN: C1 and C3, F4, and M1), or the divide between the 'first type [of person] will do what the machine tells them to do, and the other type will tell the machine what to do' (R/C5, SIN).

Even though AI helps people to become more productive and effective (SIN: R/C5, R/C7, C7, and R3; FIN: C6, R/C1, and F1), the amount of time required is not changing. Stress and the demand for creativity go hand-in-hand:

> Workers will become more stressed because … half the day, we are thinking of new ideas that uses a lot of brainpower. The other half [is] just doing repetitive tasks … . But if AI were to be taking over repetitive tasks … ideas don't just come … . It's not a forced process. (R6, SIN)

Interviewees considered regulating the development of AI important to managing such unwanted expectations. They considered it a responsibility that global companies, nations, and practitioners shared. Finland-based interviewees stated that the EU was important. However, some thought that the development of AI has already escaped regulation because 'governments have been slow to understand what's going on' (R/C6).

4.3 Anticipatory practices

The expectations and future meet 'the now' via the work of AI practitioners. Their time-consuming and challenging work is aimed at applying and developing AI. Their work-related practices are

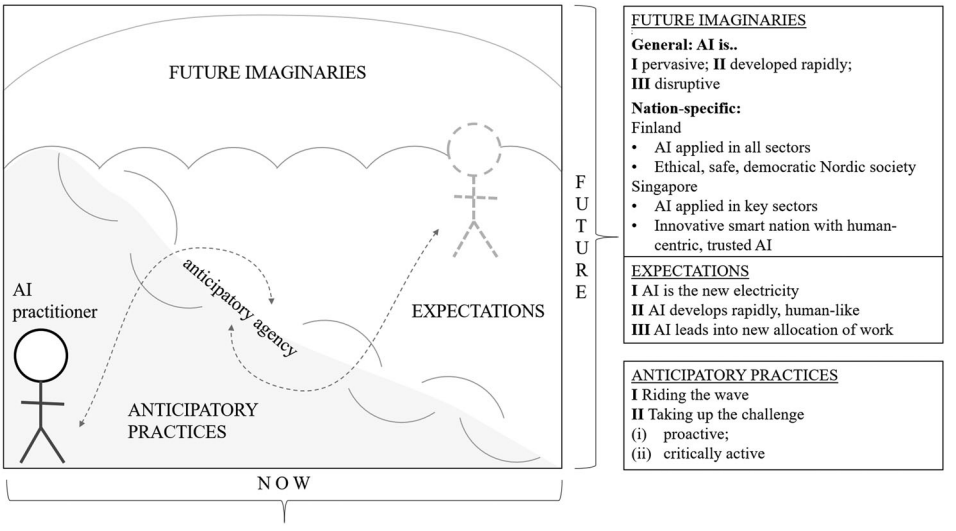

Figure 1. Futures imaginaries (strategic level) are interpreted by AI practitioners into key expectations (grassroots level). Anticipatory practices (now) are formed in relation to expectations (future). Anticipatory agency forms in this zone.

anticipatory because they concern the future in relation to expectations. Such practices represent embodied futures knowledge (Dufva and Ahlqvist 2015). The intersection of the future and 'the now' forms a zone for anticipatory agency (i.e. practitioners' strategic ability to create expectations by participating in and interpreting the imaginary as well as enacting anticipatory practices; Ahlqvist et al. 2012). We identified three main anticipatory practices (Figure 1).

The first is called 'riding the wave'. Meeting the AI hype and the expectation that AI will become as important as electricity will require resources (e.g. funding) to develop AI and customers' growing demand to apply AI. The AI practitioners have taken advantage of the hype: AI is technically complex and difficult to define. AI has become a word that is 'just thrown around' (C1, FIN) by the public, customers, and funders without consideration what AI is. Many practitioners branded their companies and projects with the prefix 'AI'. For instance, C6 (Finland), stated, 'It is only AI in the PowerPoint … . In practice … [it is] machine learning.', and C1 (Finland), ''Our PowerPoints include the word ''AI'' because, cynically said, it is supposed to be AI'.

The second category of anticipatory practices (i.e. taking up the challenge by being proactive and critically active, Figure 1) answers the practical challenges of developing AI. These challenges relate to technology, processes, people (Table 2), and the structure of technological development (Alvial-Palavicino 2015). They demonstrate that in 'the now,' the common expectation that AI will be the new electricity is not reality. Following Anderson (2007), AI can be considered an instrument or method, which means that developing AI represents a calculated anticipatory practice. However, our results demonstrate that calculative, imaginative, and performative (bodily) practices are connected.

Technical challenges have arisen in relation the availability, amount, and quality of data. Working with data has been described as requiring calculation, imagination, and a bodily practice (Anderson 2007): 'Wrestling with the data … looking at the data, clearing it' takes '80, 90 percent of [my] time' (C6, FIN). AI requires extensive high-quality data to train it, and such data are not everywhere but have to be actively 'hunted' (C4, FIN), accessed, and created, which does not fulfil the expectation that AI is the new electricity.

> [Customers think they] have some data … but then we get an Excel with 200 lines – that is not big data … Then it may also be that it [data] is like in [another country] in some drawer in a USB and no one has keys there … like literally someone has to go and fetch it … and often, it is difficult to find a person who really knows what it [the data] contains. (C4, FIN)

Table 2. Number of times interviewees mentioned AI-related challenges in their organisations during the interviews.

Challenge	All	Finland	Singapore
Technical-related	19	8	6
Data	13	3	5
Reliability of the product	2	2	0
Other	4	3	1
Process-related	13	8	5
From idea to a viable business product	7	3	4
Using AI in company's processes	3	3	0
Time required to create a viable product/train AI	3	2	1
Human-related	12	7	6
AI experts (finding, keeping, costs, collaboration)	7	4	3
Customers' AI awareness	4	2	2
Getting people to trust AI	1	0	1

Human-related challenges concern the difficulties with finding highly educated coders to develop AI. The coders are expensive, demanded in the job market, and hence difficult to find and keep. Process-related challenges occur when AI technology and people are brought together. Developing AI technology from an idea into a viable business product takes time and requires combining various technical experts (coders) and substance experts (company's domain, business, etc.). To avoid 'useless, senseless, or harmful' machine-learning processes, sound human learning processes are required at the team level: It is 'not what happens inside the machine but what happens around the learning of the machine' (F3, FIN). An AI product 'needs quite a lot of technological infrastructure to be alive somewhere as a service' (C6, FIN), and 'Once you scale it up, things start breaking' (M4, SIN).

Anticipatory practices to 'take up the challenges' are further divided into two sub-practices (Figure 1: i–ii). Proactive anticipatory practices (i in Figure 1) are aimed at developing AI and 'riding the wave', whereas critical anticipatory practice (ii in Figure 1) is aimed at not only developing technology but also at educating customers and audiences about AI and the misunderstandings surrounding the AI hype. Thus, critical practice risks 'riding the wave' in the future.

The companies had various proactive strategies. One strategy was systematic growth. To start, organisations offered services that allowed access to AI data and training. Only afterwards did they begin to apply AI in their core activities. Another strategy was to work in countries in which data regulation is less strict. One strategy was to shift the company's efforts from research (and collection of data) to business (and training AI with the data). Another strategy was to shift the original idea of the use of AI or to create a new and surprising use via collected data. For instance, one company had unexpected results of human behaviour outside of its original scope but could use the new results to offer their customers expanded services.

Many companies' customers easily adopted the expectation of 'AI as the new electricity' and were convinced that they needed AI: 'Everyone feels like you sprinkle AI on a problem and it gets solved, but the reality is a lot more difficult' (M4, SIN). Sometimes the practitioners took on the role of the customers' critical educators and patiently explained why other technology might be better.

> There are simple algorithms and rules that would solve the problem, but they [customers] just want to do it with AI … how can we educate the customer groups so they would understand AI is just one way … and in some cases, you do not need it?. (M3, SIN)

5. Discussion and conclusions

In this explorative article, we address the need to understand how AI practitioners actualise strategic AI-related futures at the grassroots level and constitute them in 'the now' in the technologically advanced countries of Finland and Singapore (Fatima, Desouza, and Dawson 2020). This need is at the core of futures studies, but the empirical research on AI-related futures has so far concentrated on nations, organisations, and fields (e.g. Makridakis 2017; Capatina et al. 2020; Farrow 2020; Liu et al.

2020), whereas the perspective of AI practitioners has not been studied sufficiently (Majumdar, Banerji, and Chakrabarti 2018). We create and explore an integrative perspective that has proven to be efficient in explaining socio-technical change (Sovacool and Hess 2019). Our perspective integrates grassroots and strategic levels, as well as the temporal dimensions of the far future and the present, and it places AI practitioners' activities at the centre of research. We apply three concepts from socio-technical research, as well as the intersection of socio-technical research and futures studies: futures imaginaries that structure the strategic levels of AI-related futures (e.g. Patomäki and Steger 2010), their interpretation and mutation into practitioners' expectations (e.g. Borup et al. 2006), and anticipatory practices executed in reaction to the expectations in the now (e.g. Anderson 2010).

When it comes to our research questions ([i] What are the key AI-related expectations that AI practitioners construct from futures imaginaries? [ii] How do AI practitioners work in relation to the expectations and imaginaries?), the practitioners in Finland and Singapore hold similar expectations of AI: AI will be applied widely as well as develop quickly and in a human-like way, and it will transform the allocation of work. To tackle the challenges of developing AI, we describe the anticipatory practices of 'riding the wave' of the AI hype, being proactive and critically active in developing AI, and educating people about AI. We demonstrate that AI practitioners transform state-led futures imaginaries into expectations and create anticipatory practices and agency for purposeful work in the uncertain and disruptive era of AI. In turn, the anticipatory agency of AI practitioners constructs futures imaginaries, which create a co-constitutive relationship among futures imaginaries, expectations, and anticipatory practices.

The article contributes to research on socio-technical change and futures studies. Our conceptual perspective, which integrates futures imaginaries, expectations, and anticipatory practices, adds to related theories. First, the MLP considers socio-technical change to have been actualised among the levels of a detailed niche, regime, and general landscape (e.g. Geels and Schot 2007), but struggles to grasp the future dimension (Sovacool and Hess 2019, 711), which our perspective adds.

Second, despite the interest in high-end technologies, empirical research on AI expectations has been insufficient (except for Hecht 2018; Kerr, Barry, and Kelleher 2020; Meurisch et al. 2020). Whereas the SoE explains the formation of technology hype, it cannot explain how to avoid related costs (Van Lente et al. 2013; Sovacool and Hess 2019). We intentionally conducted our empirical study during the peak of a hype cycle of AI development, which makes the finding of the conflicting anticipatory practices of AI practitioners a very interesting addition to the SoE. Although the practitioners ride the wave of the AI hype, which boosts the general futures imaginaries of AI, they also take on the challenge critically: The practitioners educate people about AI and develop better solutions to their problems that do not involve AI. With such practices, they challenge the futures imaginaries of AI partly based on the misunderstandings of AI, which deconstructs and avoids the costs of the AI hype.

Third, social practice theories explain socio-technical change through human agency and practice. The temporal dimension of practice is 'the now', which is relevant for actualising futures but also poses the risk of excluding structural elements and the future temporal dimension from the analysis (Sovacool and Hess 2019, 711–713). We contribute to the temporal dimension of practice by analysing practices within the structuring frame that futures imaginaries establish. We do this by applying the concept of anticipatory practices; that is, human activity as responses to the expectations in 'the now' (e.g. Anderson 2007, 2010; Alvial-Palavicino 2015).

Fourth, the study suggests that AI-related futures are being imagined in various temporal dimensions ranging from the far future to the present. We show that AI-related futures that are co-constructed as 'the now' (actual solutions) affect the perceptions of the future (solutions becoming possible), and vice versa. Thus, our conceptual perspective seems to be relevant in tracing the temporal dynamics between different time dimensions (past, present, and future), which has been challenging for current theories of socio-technical transformation (Sovacool and Hess 2019, 719–720). The finding of anticipatory agency actualising in the 'anticipatory zone' is specifically interesting (Ahlqvist et al. 2012, 824). In this zone, the far future, the expected future, and the present come

together and create an oscillating system that constantly moves back and forth between the positions of the present and the future (Figure 1). AI practitioners make sense of imaginaries and expectations, and they turn these into practices. The first movement begins with the present; that is, when practitioners experience AI in the present and the way this experience then channels their future perceptions. The second movement begins with the future expectations, which are outcomes of practical work with AI and of external impulses, such as industry expectations or even broader socio-economic AI imaginaries. The future expectations influence the way practitioners perceive AI in the present. Thus, grassroots practices and wider future imaginaries enable and structure grassroots expectations to a certain extent. The AI-related futures are envisioned at organisational and industrial levels, as well as in the spatial scales of regions and states. Such oscillating movement is a process of futures semiosis at the general and grassroots levels in the era of AI (Ahlqvist and Rhisiart 2015).

5.1 Limitations and recommendations for future studies

Three key limitations of and related recommendations for future studies are as follow. First, this research was conducted only in Finland and Singapore. The countries are technologically advanced and are populated with significant numbers of highly educated citizens, but they are geographically and culturally different. This study does not provide a comparative or broad overview of national AI strategies, and it does not describe the methods AI practitioners could use to actualise AI-related future imaginaries widely among different nations. However, this article is a first step towards building a theoretical framework that is suitable for such a comprehensive and comparative empirical study, which we recommend for future studies. With a comparative analysis, one could investigate national specificities, strengths, and weaknesses related to developing AI, as well as imagine and actualise futures. Second, our analysis was based on a selective sample of individuals and used semi-structured interviews, which means the sample could be sensitive or biased towards certain kinds of professional profiles (e.g. knowledge of AI technology) or worldview. As a further research topic, we recommend complementing the empirical sample of this paper with, for instance, a Delphi analysis involving a larger panel of experts (see Rowe and Wright 2011). Delphi analysis could indicate and quantify AI experts' consensus regarding futures imaginaries. Third, our theoretical perspective was based on concepts published mainly in journals of futures studies and socio-technical research. This theoretical background and our empirical strategy cannot explain, for example, imagining futures based on long-term trends in AI development. Such trend data and 'horizon scanning' can – and should – be applied to understand further the creation of AI-related futures imaginaries (e.g. Nemorin et al. 2022). As the final recommendation, research should integrate collective far-future imaginaries with individual anticipatory practices. Our results emphasised that the adoption and practices of using emerging technologies differ regarding the socio-cultural and geographical context, as well as between organisations. Even if the Delphi method, trend analysis, and horizon scan could provide a wider pool of experts and a longer timeline of analyses, they are not suited to understanding the ways imaginaries and expectations are actualised into anticipatory practices. However, such a perspective importantly develops futures studies that are often focused more on the average or median of the global or industry-related scales and trends.

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