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Nordic lights? National AI policies for doing well by doing good

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ABSTRACT

Getting ahead on the global stage of AI technologies requires vast resources or novel approaches. The Nordic countries have tried to find a novel path, claiming that responsible and ethical AI is not only morally right but confers a competitive advantage. In this article, eight official AI policy documents from Denmark, Finland, Norway and Sweden are analysed according to the AI4People taxonomy, which proposes five ethical principles for AI: beneficence, non-maleficence, autonomy, justice and explicability. The principles are described in terms such as growth, innovation, efficiency gains, cybersecurity, malicious use or misuse of AI systems, data use, effects on labour markets, and regulatory environments. The authors also analyse how the strategies describe the link between ethical principles and a competitive advantage, and what measures are proposed to facilitate that link. Links such as a first-mover advantage and measures such as influencing international standards and regulations are identified. The article concludes by showing that while ethical principles are present, neither the ethical principles nor the links and measures are made explicit in the policy documents.

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1. Introduction

The past decade has seen great advances in the field of Artificial Intelligence (AI). In particular, the increased availability of both (i) suitable training data and (ii) computing power has enabled breakthroughs in machine learning, a subfield of AI, leading to substantial improvements in the state of the art in areas such as image recognition (He et al. 2016) and natural language processing (Hirschberg and Manning 2015). In the wake of this development, a vivid discussion about wider implications for, e.g. the economy, national security, the labour market and society at large has followed. Even though recent years have seen a bit more caution in the projections of what can actually be achieved by AI and how fast – see e.g. Hutson (2020) and Cross (2020) – it is clear that AI has already had and will continue to have a considerable impact.

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To benefit from and manage the development of AI, numerous national and international strategies have been developed. While these documents address many questions, our particular interest here is ethics: broadly speaking, how can we make sure that AI is used for good rather than for bad? The importance of this question is underscored by the discovery of various forms of *unintentional* bias in automated decision-making, disadvantaging, for example, poorer people and those from minorities (Nature 2016).

More precisely, this article sets out to investigate a strategic assumption made in the European AI strategies in general and the Nordic strategies in particular: that responsible and ethical AI is not only morally right but also confers a competitive advantage. Thus, the Nordic Council of Ministers for Digitalisation declared in May 2018 that: ‘Countries that are successful in utilising and realising the benefits of AI, while managing risks responsibly, will have advantages in international competition and in developing more efficient and relevant public sector activities’.

The same assumption is echoed, for example, in the Swedish *National Approach to Artificial Intelligence* (‘The countries that succeed in harnessing and realising the benefits of AI while managing the risks in a responsible manner will have a great competitive advantage internationally’, 5), in the Danish strategy for digital growth (‘the Government will support the establishment of data ethics as a competitive parameter for Danish trade and industry’, 46), in the Norwegian national strategy on Artificial Intelligence (‘In the global competition it could be an important competitive advantage to go ahead in developing human centric and responsible artificial intelligence’ 2) and in the Finnish final report of the artificial intelligence programme (‘Finland has potential for acting as a global pioneer in the area of human-centred, ethical data economy in the middle ground between the enterprise-driven U.S. model and the administration-driven Chinese model’, 52).

Such optimism, perhaps not about the power of individual countries but at least about the power of the EU as a whole to influence the rest of the world is shared by some academic observers. Notably, Damro (2012) argues that the EU may be best understood as an eponymous Market Power Europe, which exercises its power through market-related policies and regulatory measures. Similarly, Bradford (2020) argues in her book *The Brussels Effect: How the European Union Rules the World* that EU regulations are often adopted by the rest of the world by market forces alone, without any coercion. The basis for this ‘unique’ ability is that multinationals that wish to do business in the EU often find it more convenient to let EU rules govern their global operations than to manage a plethora of different rules for different jurisdictions. Of particular interest in the AI context, the book (chapter 5) explicitly studies the digital economy, citing data protection (GDPR) and the regulation of hate speech online as two examples where EU policy has shaped both the de facto and de jure policy around the world.

This leads us to our research questions:

- (1) How are the ethical principles for AI reflected in the Nordic national strategies for AI?
- (2) How is the link between (i) the ethical principles for AI and (ii) a competitive advantage described in the strategies?
- (3) What concrete measures are described (to facilitate the link)?

Nordic strategies may seem like a provisional concern, but the Nordic countries regularly score well in international rankings of digitisation etc. For example, in the 2020 edition of

the European Commission's Digital Economy and Society Index, Finland, Sweden and Denmark rank first, second and third, respectively, thus representing the very top of the EU. In 2017, Denmark became the first country in the world to appoint a Tech Ambassador, based in Silicon Valley. The Nordics being forerunners makes the results interesting to a wider audience, far beyond northern Europe.

The remainder of this article is structured as follows: the next section puts the contribution in context by discussing some related work on national AI strategies. Section 3 describes the method used, before Section 4 reports the answers to the RQs listed above. These are further discussed in Section 5, before Section 6 concludes the paper.

2. Related work

In tandem with the advances in AI, a prolific scholarly literature on what, following Dafoe (2018), can be broadly termed AI governance has emerged. Most research seems to share the starting point that strictly technological answers cannot be found to the challenges posed by AI, and instead advocate 'holistic, multi-disciplinary, and multi-stakeholder' approaches, as described by Rossi (2018). Some topics – not fully mutually exclusive – that have received much attention include AI as an existential threat to humanity (see e.g. Bostrom (2014), Bundy (2017) and Galanos (2019)), AI and the labour market (see e.g. Frey and Osborne (2017), Brynjolfsson, Mitchell, and Rock (2018) and Acemoglu and Restrepo (2018)), AI use in health care (see e.g. Reddy et al. (2020), Woods (2016) and Ho et al. (2019)), and the military applications of AI (see e.g. Maas (2019), Johnson (2019) and Lewis (2019)). This is not the place to give full accounts of these fields, but Calo (2018), for example, offers a comprehensive overview of AI policy dilemmas. In the following, we focus instead on the narrower research topic of national strategies for AI. While such strategies typically address topics such as those mentioned above, this still offers a useful delimitation of the literature review, since research on national strategies for AI is at least somewhat distinct from research on the topics themselves.

One strand of research looks at what can be broadly described as the mechanisms underpinning AI governance and strategies, national or international. For example, McGregor, Murray, and Ng (2019) propose international human rights law as an appropriate framework for algorithmic accountability, arguing that transparency and explainability are necessary but not sufficient to address the risk of human rights being violated by the adoption of AI technology. Thus, they call for a greater focus on states' obligations. Another source of inspiration for global AI governance, advocated by Gasser and Almeida (2017), is the structure that has evolved for internet governance. Developing this thought, they argue for AI governance consisting of three interacting layers: (i) a social and legal one, (ii) an ethical one, and (iii) one concerning technical foundations. Butcher and Beridze (2019) offer a recent overview of the state of AI governance, identifying (in addition to the internet governance example already mentioned above), space law, aviation safety and the Chemical Weapons Convention as possible sources of inspiration for the global governance of AI. Winfield et al. (2019) identify two governance considerations for what they call 'explicit ethical machines': (i) the choice of ethical rules and (ii) the transparency of the ethical decision-making process. To underpin appropriate governance of these considerations, they argue that transparency must extend beyond the machines to also encompass their design and operation. While this line of work addresses

governance mechanisms in a way that resembles our focus on ethical principles in national strategies, a key difference is that the existing literature is largely prescriptive, arguing that certain mechanisms are appropriate, whereas ours is more descriptive, outlining the actual contents of some existing strategies.

Another strand of research focuses, more concretely, on the national strategies of particular countries or groups of countries. For example, Dear (2019) argues convincingly that Russian strategic aspirations in AI are unlikely to come to fruition. Despite a number of positive factors, including a clear strategic purpose, a wide conceptual understanding of AI, excellent internet connectivity, and the legacy of a strong education system, these are outweighed by negatives: brain-drain, poor business climate, weak private sector, corruption, academic decline etc. Renda (2019) is concerned that Europe is struggling to keep up with the U.S. and China in the field of AI, but nevertheless argues that the EU could have a considerable impact on making AI more sustainable. The report makes 44 policy recommendations to achieve this end. Chatterjee (2020) studies aspects of India's AI strategy (before its formalisation into any single normative document) highlighting the need for a comprehensive Indian AI policy, not least from the perspective of the country's industry. Ding (2018) aims to 'decipher' China's AI strategy, arguing *inter alia* that China's approach to AI is less monolithic than commonly assumed, and that AI safety and ethics are emerging topics in China. Another finding, highly relevant for a comparison with Europe, is that China's protectionist approach to the data needed for successful AI development is a double-edged sword: while it does indeed favour Chinese AI companies by granting them exclusive access to the large domestic Chinese market, it also hinders the benefits of sharing data across borders. Berryhill et al. (2019), in an OECD report, study the use of AI in the public sector. In particular, their chapter 3 offers a discussion of government AI strategies (also mentioning the Declaration on Artificial Intelligence in the Nordic-Baltic Region introduced in the previous section) and identifies at least 50 countries that have developed, or are in the process of developing, a national AI strategy. Some common themes among the strategies studied include: AI as a catalyst for economic development; ethical, trustworthy and secure AI; education and training in AI; and AI as a tool for innovation in and transformation of the public sector. While this strand of work is quite similar to ours in its concern with national strategies, a main difference is our focus on the Nordic countries. To the best of our knowledge, there are no previous studies of Nordic AI strategies.

3. Method

First, the national strategies were identified and summarily read. Based on this first impression, the RQs were tentatively identified and formulated. With the RQs thus in place, a coding regime for more detailed reading had to be defined.

For this purpose, the AI4People taxonomy proposed by Floridi et al. (2018) was used: (i) beneficence, (ii) non-maleficence, (iii) autonomy, (iv) justice and (v) explicability. These five ethical principles are based on a synthesis of principles found in six previous influential sets of ethical principles for AI. As several of the taxonomy authors are also members of the High-Level Expert Group on Artificial Intelligence (AI HLEG) appointed by the European Commission, it is no surprise that this fivefold set of principles was also used in the first draft document of ethical guidelines from the AI HLEG, published in December 2018.

It should be noted, however, that in the final version of this document, released in April 2019, the set has been reduced to four, with beneficence removed. However, as beneficence plays a major role in the strategies analysed, it was decided to adhere to Floridi et al. (2018) anyway.

The national strategies were then read and coded according to the coding regime, rendering the answers to RQ1. The codes for RQ1 were also instrumental in finding the passages corresponding to RQs 2 and 3. More precisely, the authors first split the documents between themselves, reading half of them each, marking relevant words, sentences or paragraphs with different coloured markers for all five ethical principles. Then, the texts were passed on, so that each author reread the texts previously annotated by the other, making additional markings and annotations, or questioning the previous ones. Finally, impressions were compared, and notes and concepts were re-categorised until a consensus was reached before all markings and annotations were compiled and summarised. The result of this work is documented in the data supplement, where detailed references to the strategies are given. More accessible textual descriptions are given, along with summarising tables, in Section 4.

After the categorisation was done, we started the process of classification, the result of which is seen in the results portion of the text in Tables 1–5. Here we tried to summarise all the different statements we had categorised into comparable structures. For instance, the two marks categorised as *autonomy* for Sweden both fitted into the classification ‘control and ownership of data’, which in turn was a synthesis of several similar Categorisations across the different strategies.

The terms used in the strategies form the backbone of our classifications and categories used in the analysis. While their use in the strategies is sometimes broad and open to interpretation, we have deliberately refrained from introducing more precise definitions so as not to threaten validity.

Four additional remarks are worth making concerning the method. First, reading strategies was an iterative endeavour, as new documents were published during our research effort. Thus, in addition to the final documents listed in Section 4, a few others were thus read but then discarded as newer and more representative documents became available.

Second, it should be noted that statements that end up in *the same taxonomic category* – (i) beneficence, (ii) non-maleficence, (iii) autonomy, (iv) justice or (v) explicability – do not need to have *the same, or even consistent, substantive contents*. To make a somewhat stylised example, claims that (i) ‘governments should create a level playing field with few and simple laws, intervening only rarely’ and (ii) ‘companies should have access to government risk capital to remain internationally competitive’ are (at least somewhat) substantively contradictory, even though both reasonably belong in the justice category.

Third, it is also worth noting that something mentioned only once in the documents does not merit an inclusion in the results presented in the following section, which is apparent by looking through the notations in the supplement.

Fourth, there are other possible taxonomies that could have been used. An even more extensive taxonomy proposed by Fjeld et al. (2020) at the Berkman Klein Centre identified eight general principles and forty-two sub-principles across thirty-six AI principles documents. An analysis using this taxonomy would probably be very enlightening, but the application of the Floridi et al. taxonomy is more suited to the study for two reasons.

First, as already mentioned, it identifies beneficence as a component which turned out to have a significant presence in the texts analysed, and secondly, most of the analysis was already done before the Berkman Klein taxonomy was published. As Fjeld et al. show, this is a fast-moving research field, with 30 of the documents analysed having been published in 2018 and 2019.

4. The national strategies

The strategies identified were the following:

- Denmark: Both the *National Strategy for Artificial Intelligence* (DKAI 2019) and the *Report from the Expert Group on Data Ethics* (DKDE 2018) were analysed. The former is the official AI strategy, jointly written by the Ministry of Finance and the Ministry of Industry, Business and Financial Affairs. For the concerns of transparency, ethics and sustainability in AI, the latter report was an obvious complement.
- Finland: *Finland's Age of Artificial Intelligence* (FIAA 2017) and *Leading the way into the era of artificial intelligence* (FILW 2019) were used. The FIAA report was written in 2017 by a working group appointed by the Finnish Minister of Economic Affairs. The FILW report was the final report of the same programme presented in 2019.
- Norway: The *Nasjonal strategi for kunstig intelligens* (NOSK 2020) is the official Norwegian strategy on AI, written by the Ministry of Local Government and Modernisation. *The Artificial Intelligence* (NOKI 2018) report is made by the advisory body the Norwegian Board of Technology that is commissioned by the government, but has no mandate to dictate official policy.
- Sweden: Both the *National Approach to Artificial Intelligence* (SENA 2018) and the *Artificial Intelligence in Swedish Enterprise and Society* (SEAI 2018) report were read and analysed. While the former is quite short and avoids the word 'strategy' in its title, it is the Swedish AI strategy in all but name. By contrast, the latter report, developed by Sweden's innovation agency Vinnova on behalf of the government, is much longer and more comprehensive.

As for the previously analysed documents, the following changes were made: for Denmark the *Strategy for Denmark's Digital Growth*, a strategy presented by the Danish Ministry for Industry, Business and Financial Affairs in 2018, was replaced by the *National Strategy for Artificial Intelligence*, as the former dealt with digitalisation broadly and the latter specifically with AI. For Finland the *Work in the age of artificial intelligence* report published by the Ministry of Financial Affairs and Employment in 2018 was replaced by *Leading the way into the age of artificial intelligence*, as the former was a special report in the process of producing the latter strategy. In Norway, the government previously did not have an official stance but only reports from advisory groups. When the *Nasjonal strategi for kunstig intelligens* was published, we used it to replace the Digital 21 working group report *Digitale grep for norsk verdiskaping*.

Though Iceland is included in Nordic group, it was not included in the study for two reasons. First, at the time of the initial data collection the authors could not find a relevant strategy to study in Iceland. Second, since the authors do not speak Icelandic, only texts in English could be included (Finland has Swedish as an official language, and therefore the

authors expected to be able to read strategies from Finland). There are several other countries that have produced noteworthy AI strategies, as Kung (2020) shows in the CIFAR report 'Building an AI World: Report on National and Regional AI Strategies – Second Edition'. We have chosen to focus on the Nordic countries due to the Nordic Council's statement above, but would welcome similar analyses of other strategies and also comparative efforts.

4.1. How are the ethical principles for AI reflected in the Nordic national strategies for AI?

4.1.1. Beneficence

As seen in Table 1, there is considerable consensus in the way beneficence is reflected in the strategies. All four countries use similar descriptions of positive effects on the economy such as growth, innovation and efficiency gains, both in general and in the public sector in particular. Additionally, environmental sustainability and better healthcare outcomes are mentioned in the Danish and Swedish strategies, competitiveness in the Norwegian, and improved well-being for citizens in the Finnish. For more details, see the supplement.

4.1.2. Non-maleficence

As seen in Table 2, non-maleficence is somewhat less homogeneously described in the national strategies, even though there is consensus on the aspects of cybersecurity and malicious use or misuse of AI systems, as well as a near-consensus on privacy and the protection of personal data, which is mentioned by all but Denmark. Furthermore, risks related to weakened trust and to the pervasiveness and speed of AI adoption are mentioned in the Danish and Swedish strategies, and the need for an improved ability to detect AI-related threats are mentioned in the Finnish and Norwegian strategies. For more details, see the supplement.

Table 1. Beneficence.

Beneficence	Denmark	Finland	Norway	Sweden
Economic growth	x	x	x	x
Innovation	x	x	x	x
Improved and more efficient services	x	x	x	x
Competitiveness			x	
Better and less costly public services	X	x	x	x
Well-being		x		
Environmental sustainability	X			x
Better healthcare outcomes	X			x
Workplace safety				x

Table 2. Non-maleficence.

Non-maleficence	Denmark	Finland	Norway	Sweden
Cybersecurity	x	x	x	x
Weakened trust	x			x
Malicious use or misuse	x	x	x	x
Privacy and protection of data		x	x	x
Pervasiveness and speed of AI adoption	x			x
Detecting threats		x	x	

4.1.3. Autonomy

As seen in Table 3, there is a strong consensus between the Danish, Finnish and Norwegian strategies, which all mention control and ownership of data, knowledge of technology and its implications, people shaping the technology, prioritising human-centred AI, and informed choices and consent. Denmark and Finland both argue that AI capabilities may have to be limited, partly to protect human rights. With respect to autonomy, Sweden is an outlier describing it only in terms of control and ownership of data. Additionally, the Norwegian strategy also mentions the ability to trust systems can't be explained. For more details, see the supplement.

4.1.4. Justice

As seen in Table 4, justice is a multi-faceted concept. Only two aspects are expressed in all four national strategies: effects on the labour markets, and avoiding bias and discrimination. Furthermore, justice as standards and regulations, adhering to societal values and respecting human rights are expressed in all strategies but the Swedish. Additionally, the Danish and Finnish strategies alike describe justice in terms of making services available for everyone, offering incentives from governments or risk capital, adopting principles for data ethics, and competing internationally through principles. Finally, the Norwegian and Swedish strategies also describe justice in terms of the effects on markets and asymmetric market power, whereas Finland and Norway share descriptions of justice as lifelong learning, fair rules and competition. For more details, see the supplement.

4.1.5. Explicability

As seen in Table 5, there is considerable consensus in the way explicability is reflected. All four national strategies describe explicability in terms of responsibility for data

Table 3. Autonomy.

Autonomy	Denmark	Finland	Norway	Sweden
Control and ownership of data	x	x	x	x
AI and technology literacy	x	x	x	
Ability to trust systems that can't be explained.			x	
People shaping technology	x	x	x	
Prioritising human autonomy / human-centred AI	x	x	x	
Capability limitations on AI	x	x		
Informed choices and consent	x	x	x	

Table 4. Justice.

Justice	Denmark	Finland	Norway	Sweden
Effects on the labour market	x	x	x	x
Effects on markets			x	x
Lifelong learning		x	x	
Standards, rules and regulations	x	x	x	
Avoiding bias and discrimination	x	x	x	x
Making services available for everyone	x	x		
Risk capital or government incentives	x	x		
Principles for data ethics	x	x		
Asymmetry of power in market			x	x
Adhering to societal values	x	x	x	
Respecting human rights	x	x	x	
Competing through principles	x	x		
Fair rules and competition		x	x	

Table 5. Explicability.

Explicability	Denmark	Finland	Norway	Sweden
Responsibility and accountability	x	x	x	x
Open public data resources	x	x	x	x
Clear and easy regulatory environment	x	x	x	x
Transparency and traceability		x	x	x
Ability to audit AI and ethics	x	x	x	
Trust in AI	x	x	x	

processing, with public data resources being open and having a regulatory environment that is clear and easy to follow. Furthermore, the Danish, Finnish and Norwegian strategies mention the ability to audit AI systems for ethics and having trust in AI systems. The Finnish, Norwegian and Swedish strategies mention transparency and traceability of AI decisions. For more details, see the supplement.

4.2. How is the link between (i) the ethical principles for AI and (ii) competitive advantage described in the strategies?

In the previous section, we characterised how the ethical principles are reflected in the documents. As mentioned in the introduction, the general attitude in the Nordic strategies is that there is a competitive advantage to be found in having a more ethical approach to AI. In this section we investigate more closely how this link is described. In the subsequent section we then go on to describe by what measures the countries want to enable this link.

The most prevalent link was that of having a first-mover advantage (DKAI 7, 26, 58; DKDE, 20, 27; SENA 8; FIAA, 13, 57; FILW 95; NOSK; 2, 6, 36). Being the first in applying AI, and those implementations being ethical, may mean that the models applied in the Nordic countries will be applied elsewhere, simply due to availability. Almost all strategies mention a first-mover advantage in applying AI, and five of them also link this to some type of ethical principle. Denmark does this most explicitly in DKDE in a chapter called 'Denmark as a frontrunner for data ethics' (27), saying that 'The goal of this recommendation is to make sure that Denmark as a digital front runner sets its mark on the European and global development within data ethics'.

An associated link is that countries that do well in establishing the balance between realising the benefits of AI and managing the risks in a responsible manner might also have a competitive advantage in international competition (SENA, 4–5). Similarly, showing the country to be a good example of a strong digital economy while adhering to ethically sustainable practices might be beneficial (FILW, 120).

The Danish documents also include a proposal to make sure that companies must declare their ethical policies as a part of their report on annual results, which would showcase data ethical business models (DKDE, 18–22). This is in line with the strategy of actively striving towards *making* data ethics a competitive advantage (DKDE, 11)

Individuals having strong ownership of their own data might lead to the creation of new services and innovations (FIAA, 45; FILW, 60). In Finland this link is largely due to the platform MyData, while Danish documents mention that making sure that the rules regarding ownership of data are clear and intelligible reduces uncertainty and can

therefore improve innovation (DKAI, 34), and this is equally true for how the public sector uses citizen data (DKAI, 38).

Simply put, having clear and predictable legislation (DKAI, 30) as well as sector-specific rules create a trustworthy regulatory environment (FILW, 102) which in turn makes companies more certain of their actions.

Earning the trust of consumers is a key component of *competition* according to a quotation in DKDE (4), which is also reiterated in FILW (95). Looking forward, Finland describes its future position as one in which Finland is internationally competitive because its business environment promotes human-centric use of data as opposed to the business models of ‘global internet giants’ (FILW, 119).

Some strategies also mention negative links, where there might be decreased competitiveness from a lacking sense of urgency and absent investments (SEAI, 49), an inability to foresee the negative consequences of AI (SENA, p.4) or not being able to trust AI systems because of a lack of ethics and transparency (SEAI, 52).

Finally, Finland mentions the timing of its strategy itself as a competitive advantage. It has launched its programme early enough to be able to be a front runner, but not so early so that the AI potential is limited in scope (FILW, 119).

4.3. What concrete measures are described (to enable the link)?

As mentioned in the section above, this part of the text looks at the measures the documents describe that could help enable the link between ethical principles and a competitive advantage. While we initially assumed that if the documents display a link, there will also be a measure attached to the link, this proved not to be the case, and therefore there are measures listed below that do not necessarily aim at a specific link, but are measures towards ethical approaches in themselves.

Tied to the Danish reasoning around actively making ethical approaches a competitive advantage is the measure of influencing international standards and regulations (DKAI, 8, 19, 31; DKDE, 5; SENA, 10; NOSK, 8, 52). Additionally, international cooperation with countries leading AI development within and outside Europe might prove to be a way to establish the country as a player (FILW, 94, 103).

Establishing a market demand for ethical solutions, and giving different organisations a way of working with ethics may require countries or associations to develop guidelines and principles for the use of data and AI (FILW, 95; DKAI, 31), including example contracts (DKAI, 29). Starting a national ethics council for technology might be a way forward in doing this (FILW, 103).

The Danish documents also highlight the declaration of data ethics as a measure to enable the link (DKDE 18–20; DKAI, 31). Similarly, creating data ethics seals and marks on digital products to reduce complexity (DKDE 21–22; DKAI, 31) could increase customer demand for more ethical products. In the same vein, Finland proposes ethics certification (FILW, 96).

Another way of producing good examples would be testbeds where new operating models for novel cooperation are encouraged and can be examined from ethical viewpoints (FILW, 90, 103, 120). Pilots and testbeds can accelerate the introduction of new AI technology in an ethical, safe, secure and sustainable manner (SENA, 8; FILW, 63). Another possibility would be having a regulatory sandbox in order to improve the

regulatory environment and get innovations off the ground more quickly (NOSK, 25). Having produced these examples, showcasing ethical solutions at international tech events and using trade missions would be ways to improve international competitiveness (DKAI, 58).

Having access to high quality data is key for a well-functioning AI system. Countries could help by enabling a strengthened use of high-quality public data within companies (DKAI 21, 37–38) as well as good access to data abroad for business and research (DKAI, 39–40).

More directly, according to the Danish documents, governments could support innovation with a focus on data ethical business models (DKDE, 11, DKAI, 31), e.g. by competitions (DKDE, 29–30) and a National Centre for Public Sector Innovation (DKAI, 57). The Finnish documents instead call for governments to encourage ecosystems and for sectors to self-regulate and share good practices (FILW, 103).

Finally, using public procurements to support the development of ethical services could in turn boost the production of such products to the extent that they gain market shares on their own (DKDE, 31–32; NOSK, 55).

5. Discussion

As a reminder, this paper investigates the following research questions:

- (1) How are the ethical principles for AI reflected in the Nordic national strategies for AI?
- (2) How is the link between (i) the ethical principles for AI and (ii) competitive advantage described in the strategies?
- (3) What concrete measures are described (to enable the link)?

As for the first research question, the documents show a wide variety of ethical principles represented, but they are mostly implicit. ‘Ethics tend to be mentioned only in the introductions, in reference to their offering a competitive advantage. Consider the following sample from FILW: ‘Clarify the rules of how data is used from the perspectives of companies, society and users. Provide support for the use of data by means of legislations, agreements and self-regulation of industries’ (FILW, 53). The first sentence is categorised as explicability in the document and classified as ‘clear and easy regulatory environment’ in Table 5. The second sentence is categorised as justice in the document and classified as ‘standards, rules and regulations’ in Table 4. The first is interpreted as explicability due to it dealing with how well we can understand a regulatory environment, and the second is interpreted as justice due to it having more to do with shaping the environment in which data is used. The sentences are not written to reflect specific ethical principles but are simply things that the Finnish authority considers worthwhile efforts. It is also not clear that the categorisation necessarily needed to be ‘explicability’ and ‘justice’ and not the other way around, or indeed ‘autonomy’ when considering users. As such, the results for RQ1 are to be seen as a generalised view of the documents, and we acknowledge that there are instances in which others will interpret the documents differently.

For RQ2 we can see that, broadly speaking, while many of the strategies talk about a more ethical AI-approach being a possible competitive advantage for the Nordics, as well

as the EU in some instances, and all of the strategies put forward various ways in which the specific country might get a competitive advantage in or through AI technologies, there are very few instances in which the link between ethical principles and a competitive advantage are made explicitly. The instances we present above are what we can find when interpreting strategies through the framework we have established here.

Considering RQ3, the documents broadly describe the benefits of AI and ways of *realizing* those benefits (through testing, education, developing competences and having a good business environment). The documents also hint at ethically responsible AI being a *comparative* advantage in the Nordics, above other countries. But very few measures described in the documents aim at enabling the comparative advantage – they simply aim at realising the broader benefits.

The mechanisms to enable first-mover advantages and testing are only aimed at realising benefits (i.e. having testbeds and an attractive professional and educational environment for companies and people) and not at the enabling of the comparative advantage (i.e. having testbeds to make sure AI is ethical, and a professional and educational environment that promotes responsibility and social justice in AI development).

One effect of analysing the strategies based on the article by Floridi et al. rather than the later version of the principles published by the High-Level Expert Group was the inclusion of ‘beneficence’ as a principle. This proved to shed valuable light on parts of the texts that would not otherwise be apparent. Similarly, the taxonomy proposed by Fjeld et al. (2020) would have been interesting to apply to the strategies, but as it does not include beneficence, and this has proved to be an important tool for analysing the strategies, we did not do any further analysis using the Fjeld et al. taxonomy.

It is also the case that the strategies have a certain perspective that might not be representative of the countries as a whole. The strategies are written mainly by the equivalent of the ministry of business or economic affairs, or by groups constituted by business representatives or technology specialists. That means that beneficence is often described in terms of economic growth and progress, and justice is often described in terms of effects on the labour market or competition. And to reiterate, the terms used in the categorisation and classification are either lifted directly from the strategies, or a best effort compromise has been made to find a shorter term that relates two or more concepts.

5.1. Effectiveness of the strategies

Will the Nordic strategies be successful? This is a big question, going beyond the AI ethics question we have discussed here, and touching upon several fields such as economics, management and political science. Answering it requires delimitations, careful definitions, choice of appropriate methods and a subsequent investigation. Still, one reflection is worth making here: innovation policy is difficult. In 2018, *The Economist* provocatively asked: ‘can Europe support AI without wasting money or lapsing into protectionism?’ This concern is not unfounded. Kokko, Tingvall, and Videnord (2015) find, in a meta-analysis, that the growth-enhancing effect of R&D spending in the EU15 countries is smaller than the corresponding effect in the U.S. Gustafsson et al. (2016) study innovation subsidies in Sweden for the period 1997–2011 and find only a short-lived positive effect, which fades away over time. Deiacco and Gustavsson Tingvall (2015) report very mixed success for Swedish selective industrial policies – ranging from successful, to no effects at all,

to outright negative effects on companies' growth and competitiveness. Such findings offer a sobering contrast to the high expectations in the strategies of what can be accomplished through measures such as those catalogued answering RQ3.

5.2. Validity

The ethical framework (Floridi et al. 2018) was developed to guide the development of AI systems and applications in order to create a 'good AI society'. As such it is meant to be applied to concrete decisions about AI, whether by policymakers, incumbent firms, start-ups or individual coders. By contrast, the preceding section applies this framework as a taxonomy only: to categorise the texts of the national strategies. The application of the framework to a context other than that for which it was intended is a threat, albeit a small one, to the validity of the results.

Another threat to validity is that the principles of the ethical framework are not (fully) mutually exclusive. First, while this isn't a problem when designing a new application (does it adhere to both beneficence and justice? great!), it creates an interpretation problem when trying to categorise texts. One part of the problem is that beneficence and non-maleficence both include aspects of justice, autonomy and explicability as the former are broader categories than the latter. Another is that the difference between beneficence and non-maleficence is, often if not always, just a negation: if something increases well-being it is categorised as beneficence, and if it decreases or does not increase well-being it will be categorised as non-maleficence. Within the non-maleficence there are both negatives and positives (weakened trust vs privacy) that further complicate the matter.

Furthermore, one concept can of course belong to several different principles. Take 'knowledge' for instance. In the categorisation we've frequently noted knowledge as 'autonomy' when the perspective is knowledge an individual has or acquires in order to make informed decisions regarding data. However, it can also be categorised as 'justice' when the perspective is knowledge required to participate in the labour market or that should be taught in school. It could also be argued that knowledge could be categorised as 'explicability' when talking about knowledge (qualitative information) given to individuals about a service.

For some concepts it has been a matter of simply matching the concept to a principle, but for others, the context in which the argument is made matters more than the concept itself. The note 'opening public data to boost innovation' is explicability in method, but beneficence in consequence. In the specific case it is categorised as beneficence.

To mitigate some of the problems identified above, an academic philosopher specialising in ethics and engineering was asked to validate both the general interpretations of the five principles and two specific questions. The specific questions related to the problem of distinguishing different categories, as beneficence and non-maleficence are broad and justice and autonomy are somewhat narrower. The questions were: (1) Is it reasonable to place long term institutional developments (competition, working labour market, adequate laws, rules and standards) in the justice category? (2) Is it reasonable to place knowledge and education variously in autonomy (knowledge enabling the individual to make more informed decisions) and justice (knowledge that enables participation on the labour market). For both questions the philosopher agreed with our

categorisation and the broadly-made distinctions. In this way, we received confirmation that our interpretations were reasonable.

5.3. Reliability

Some reliability problems originate in the validity problems associated with interpretation. Dealing with this problem leads us to categorise similar concepts as different principles depending on the context in which the concept was introduced. 'Privacy and protection data' (non-maleficence), 'control and ownership of data' (autonomy) and 'responsibility and accountability' (explicability) contain data points that are very similar to each other, but we have categorised them differently according to the context in which the concept has been described.

Language is also a source of reliability problems. The texts analysed are written in English (the texts from Finland), Danish, Norwegian and Swedish respectively. This means that we have had to translate concepts in order to make them comparable, and while the Scandinavian languages are similar they also differ in how words are used and what may be implicit in certain words. The authors are fluent in Swedish and English and have decent comprehension of written Norwegian and Danish. But there may be things lost in translation nonetheless. This may be especially problematic when identifying sentiment in texts.

Another threat to reliability is the application of the coding regime and the resulting inter-coder agreement. As mentioned in Section 3, this was addressed by having both authors read all texts and discuss annotations and interpretations until consensus was reached. However, as an additional check, a colleague was approached to conduct a small test of the coding regime. When instructed to apply the coding regime to sample texts that had already been coded by the authors, a reasonable inter-coder agreement (before discussion) was reached. This suggests that the coding regime is sufficiently reliable.

6. Conclusions

With respect to RQ1, the ethical principles are well reflected in the documents, but mostly implicitly. Thus, for *beneficence*, there is considerable consensus on the positive effects on the economy such as growth, innovation and efficiency gains, both in general and in the public sector in particular. For *non-maleficence*, there is consensus on the aspects of cybersecurity and the malicious use or misuse of AI systems, as well as near-consensus on privacy and the protection of personal data. For *autonomy*, there is a strong consensus between the Danish, Finnish and Norwegian strategies, which all mention control and ownership of data, knowledge of technology and its implications, people shaping the technology, prioritising human-centred AI, and informed choices and consent. For *justice*, there is consensus on effects on the labour markets and avoiding bias and discrimination. Finally, there is considerable consensus on *explicability* as responsibility for data processing and as public data resources being open. Again, however, it should be emphasised that the ethical aspects are mostly implicit and made visible only by the analysis method employed. A more cursory reading would probably find explicitly ethical aspects in the passages on ethics as a competitive advantage (quoted in Section 1). It should be noted there is no universal definition of what constitutes ethical AI. Since no

universal definition exists, countries are mostly left to rely on their own classifications. It is therefore perhaps not surprising that the ethical principles are ‘well reflected [...] but mostly implicitly’ as stated above.

With respect to RQ2, the strategies address the competitive advantages of developing and applying AI technologies at length, but rarely explicitly link them to the ethical approach. However, on a closer reading, some such links can be found, first-mover advantage being the one most explicitly mentioned.

While there are many concrete measures proposed in the strategies, whether aimed at increasing adoption or development in AI or gaining a competitive advantage internationally, these are not motivated with reference to ethical principles or ethical competitive advantage.

To conclude, the Nordic countries claim that ethical AI is, or at least can be, a competitive advantage. This is a bold thesis, for which arguments can be found both for and against. It is also an attractive thesis, which one would like to be true. Alas, based on the detailed analysis reported in the previous sections, it is difficult to imagine that reading the Nordic AI strategies would convince anyone who was not already convinced of the truth of this thesis. The arguments made in the strategies are implicit and vague, leaving the question of whether ethical AI indeed offers a competitive advantage – and if so, under which conditions – for future work to resolve.

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References

- Acemoglu, Daron, and Pascual Restrepo. 2018. "Artificial Intelligence, Automation and Work". Technical report, National Bureau of Economic Research.
- Berryhill, Jamie, Kévin Kok Heang, Rob Clogher, and Keegan McBride. 2019. *Hello, World: Artificial Intelligence and its Use in the Public Sector*. OECD.
- Bostrom, Nick. 2014. *Superintelligence: Paths, Dangers, Strategies*. Oxford: Oxford University Press.
- Bradford, Anu. 2020. *The Brussels Effect: How the European Union Rules the World*. New York: Oxford University Press.
- Brynjolfsson, Erik, Tom Mitchell, and Daniel Rock. 2018. "What Can Machines Learn, and What Does it Mean for Occupations and the Economy?" *AEA Papers and Proceedings* 108: 43–47. <https://doi.org/10.1257/pandp.20181019>.
- Bundy, Alan. 2017. "Smart Machines are not a Threat to Humanity." *Communications of the ACM* 60 (2): 40–42. <https://doi.org/10.1145/2950042>.
- Butcher, James, and Irakli Beridze. 2019. "What is the State of Artificial Intelligence Governance Globally?" *The RUSI Journal* 164 (5–6): 88–96. <https://doi.org/10.1080/03071847.2019.1694260>.
- Calo, Ryan. 2018. "Artificial Intelligence Policy: A Primer and Roadmap." *University of Bologna Law Review* 3 (2): 180–218.
- Chatterjee, Sheshadri. 2020. "AI Strategy of India: Policy Framework, Adoption Challenges and Actions for Government." *Transforming Government: People, Process and Policy*. <https://doi.org/10.1108/TG-05-2019-0031>.
- Cross, Tim. 2020. "Artificial Intelligence and its Limits: Steeper than Expected". *The Economist*. Technology Quarterly, June 13.
- Dafoe, Allan. 2018. *AI Governance: A Research Agenda*. Oxford: Governance of AI Program, Future of Humanity Institute, University of Oxford.
- Damro, Chad. 2012. "Market Power Europe." *Journal of European Public Policy: EUSA 2011 Boston Conference Papers* 19 (5): 682–699. <https://doi.org/10.1080/13501763.2011.646779>.
- Dear, Keith. 2019. "Will Russia Rule the World Through AI?: Assessing Putin's Rhetoric Against Russia's Reality." *The RUSI Journal* 164 (5–6): 36–60. <https://doi.org/10.1080/03071847.2019.1694227>.
- Deiaco, Enrico, and Patrik Gustavsson Tingvall. 2015. *Do Selective Industrial Policies Cause Growth? Experiences from Sweden*. The Swedish Agency for Growth Policy Analysis. 2015/027. <https://www.tillvaxtanalys.se/publikationer/rapport/rapportserien/2015-11-18-do-selective-industrial-policies-cause-growth---experiences-from-sweden.html>.
- Ding, Jeffrey. 2018. *Deciphering China's AI Dream*. Oxford: Centre for the Governance of AI, Future of Humanity Institute, University of Oxford.
- DKAI. 2019. *National Strategy for Artificial Intelligence*. Danish Ministry of Finance and Ministry of Industry, Business and Financial Affairs. https://eng.em.dk/media/13081/305755-gb-version_4k.pdf.
- DKDE. 2018. *Data i menneskets tjeneste: Anbefalinger fra Ekspertgruppen om dataetik [Data in the Service of Humanity: Recommendations from the Expert Group on Data Ethics]*. Danish Ministry of Industry, Business and Financial Affairs. <https://em.dk/publikationer/2018/ekspertgruppen-om-dataetiks-rapport>.
- The Economist. 2018. "AI, EU, go: How Europe can Improve the Development of AI". 12–13. September 22nd.
- European Commission. 2020. "The Digital Economy and Society Index (DESI)". Accessed June 16, 2020. <https://ec.europa.eu/digital-single-market/en/desi>.
- FIAA. 2017. *Finland's Age of Artificial Intelligence: Turning Finland into a leading country in the application of artificial intelligence. Objective and recommendations for measures*. Finnish Ministry of Economic Affairs and Employment. <http://urn.fi/URN:ISBN:978-952-290-3>.
- FILW. 2019. "Leading the Way into the Era of Artificial Intelligence: Final Report of Finland's Artificial Intelligence Programme 2019." Finnish Ministry of Economic Affairs and Employment. <http://urn.fi/URN:ISBN:978-952-327-437-2>.
- Fjeld, Jessica, Nele Achten, Hannah Hilligoss, Adam Nagy, and Madhulika Srikumar. 2020. *Principled Artificial Intelligence: Mapping Consensus in Ethical and Rights-Based Approaches to Principles for AI*. Berkman Klein Center. <http://nrs.harvard.edu/urn-3:HUL.InstRepos:42160420>.

- Floridi, Luciano, Josh Cows, Monica Beltrametti, Raja Chatila, Patrice Chazerand, Virginia Dignum, Christoph Luetge, Robert Madelin, Ugo Pagallo, Francesca Rossi, et al. 2018. "AI4People – An Ethical Framework for a Good AI Society: Opportunities, Risks, Principles, and Recommendations." *Minds and Machines* 28 (4): 689–707. <https://doi.org/10.1007/s11023-018-9482-5>.
- Frey, Carl Benedikt, and Michael A Osborne. 2017. "The Future of Employment: How Susceptible are Jobs to Computerisation?" *Technological Forecasting and Social Change* 114: 254–280. <https://doi.org/10.1016/j.techfore.2016.08.019>.
- Galanos, Vassilis. 2019. "Exploring Expanding Expertise: Artificial Intelligence as an Existential Threat and the Role of Prestigious Commentators, 2014-2018." *Technology Analysis and Strategic Management* 31 (4): 421–432. <https://doi.org/10.1080/09537325.2018.1518521>.
- Gasser, Urs, and Virgilio A. F Almeida. 2017. "A Layered Model for AI Governance." *IEEE Internet Computing* 21 (6): 58–62.
- Gustafsson, Anders, Andreas Stephan, Alice Hallman, and Nils Karlsson. 2016. "The 'Sugar Rush' from Innovation Subsidies: a Robust Political Economy Perspective." *Empirica* 43 (4): 729–756. <https://doi.org/10.1007/s10663-016-9350-6>.
- He, Kaiming, Xiangyu Zhang, Shaoqing Ren, and Jian Sun. 2016. "Deep Residual Learning for Image Recognition". In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, pp. 770–778.
- AI HLEG (High-Level Expert Group on Artificial Intelligence). 2019. *Ethics Guidelines for Trustworthy Artificial Intelligence*. European Commission. https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=60419.
- Hirschberg, Julia, and Christopher D Manning. 2015. "Advances in Natural Language Processing." *Science* 349 (6245): 261–266. <https://doi.org/10.1126/science.aaa8685>.
- Ho, C. W. L., D. Soon, K. Caals, and J. Kapur. 2019. "Governance of automated image analysis and artificial intelligence analytics in healthcare". *Clinical Radiology*. <https://doi.org/10.1016/j.crad.2019.02.005>.
- Hutson, Matthew. 2020. "Eye-catching Advances in Some AI Fields are not Real". *Science*. <https://doi.org/10.1126/science.abd0313>.
- Johnson, James. 2019. "Artificial Intelligence and Future Warfare: Implications for International Security." *Defense and Security Analysis* 35 (2): 147–169. <https://doi.org/10.1080/14751798.2019.1600800>.
- Kokko, Ari, Patrik Gustavsson Tingvall, and Josefin Videnord. 2015. "The Growth Effects of R&D Spending in the EU: A Meta-Analysis." *Economics: The Open-Access, Open-Assessment E-Journal* 9 (2015–40): 1–26. <https://doi.org/10.5018/economics-ejournal.ja.2015-40>.
- Kung, Johnny. 2020. *Building an AI World: Report on National and Regional AI Strategies*. Toronto, ON: Canadian Institute for Advanced Research CIFAR. <https://www.cifar.ca/docs/default-source/ai-reports/building-an-ai-world-second-edition-f.pdf>.
- Lewis, Larry. 2019. "Resolving the Battle Over Artificial Intelligence in war." *The RUSI Journal* 164 (5-6): 62–71. <https://doi.org/10.1080/03071847.2019.1694228>.
- Maas, Matthijs M. 2019. "How Viable is International Arms Control for Military Artificial Intelligence? Three Lessons from Nuclear Weapons." *Contemporary Security Policy* 40 (3): 285–311. <https://doi.org/10.1080/13523260.2019.1576464>.
- McGregor, Lorna, Daragh Murray, and Vivian Ng. 2019. "International Human Rights law as a Framework for Algorithmic Accountability." *International and Comparative Law Quarterly* 68 (2): 309–343. <https://doi.org/10.1017/S0020589319000046>.
- Nature. 2016. *More Accountability for Big-Data Algorithms* 537 (7621): 449. <https://doi.org/10.1038/537449a>.
- NOKI. 2018. *Kunstig Intelligens – Muligheter, Utfordringer og en Plan for Norge [Artificial Intelligence – Possibilities, Challenges, and a Plan for Norway]*. Norwegian Board of Technology. <https://teknologiradet.no/wp-content/uploads/sites/105/2018/09/Rapport-Kunstig-intelligens-og-maski-nlaering-til-nett.pdf>.
- Nordic Council of Ministers for Digitalisation. 2018. "AI in the Nordic-Baltic Region". Accessed December 14, 2018. <https://www.norden.org/sv/node/5059>.

- NOSK. 2020. *The National Strategy for Artificial Intelligence*. Norwegian Ministry of Local Government and Modernisation. https://www.regjeringen.no/contentassets/1feb3bb2c4fd4b7d92c67ddd353b6ae8/en-gb/pdfs/ki-strategi_en.pdf.
- Reddy, Sandeep, Sonia Allan, Simon Coghlan, and Paul Cooper. 2020. "A Governance Model for the Application of AI in Health Care." *Journal of the American Medical Informatics Association* 27 (3): 491–497. <https://doi.org/10.1093/jamia/ocz192>.
- Renda, Andrea. 2019. "Artificial Intelligence: Ethics, Governance and Policy Challenges." Centre for European Policy Studies. CEPS Task Force Report. <https://ssrn.com/abstract=3420810>.
- Rossi, Francesca. 2018. "Building Trust in Artificial Intelligence." *Journal of International Affairs* 72 (1): 127–134. <https://doi.org/10.2307/26588348>.
- SEAI. 2018. *Artificiell intelligens i svenskt näringsliv och samhälle: Analys av utveckling och potential* [Artificial Intelligence in Swedish Enterprises and Society: Analysis of Development and Potential]. Vinnova. <https://www.vinnova.se/publikationer/artificiell-intelligens-i-svenskt-naringsliv-och-samhalle/>.
- SENA. 2018. *National approach to artificial intelligence*. Swedish Ministry of Enterprise and Innovation. <https://www.regeringen.se/4aa638/contentassets/a6488cceb6cf418e9ada18bae40bb71f/national-approach-to-artificial-intelligence.pdf>.
- Winfield, Alan F, Katina Michael, Jeremy Pitt, and Vanessa Evers. 2019. "Machine Ethics: The Design and Governance of Ethical AI and Autonomous Systems [Scanning the Issue]." *Proceedings of the IEEE* 107 (3): 509–517. <https://doi.org/10.1109/JPROC.2019.2900622>.
- Woods, Simon. 2016. "Big Data Governance: Solidarity and the Patient Voice." In *The Ethics of Biomedical Big Data*, 221–238. Springer.