

AI FOR GENDER EQUALITY

- Addressing inequality through AI

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Artificial intelligence has undoubtedly attracted enormous interest in the last decade and the excitement around this technology does not seem to slow down despite the substantial problems it poses that are yet to be solved. According to some studies, as much as 85 percent of all AI projects will produce incorrect results due to bias in the algorithms, parts of these problems is about AI linked to gender inequality, as AI tends to both maintain and reproduce societal inequality¹.

As reports from UN show, gender inequality persists in every country and this fact is displayed in historical data. At the same time, studies show that equality increases the conditions for growth through increased innovation capacity and societal resilience. A societal development where AI is applied without dealing with gender inequality is not sustainable. A lot of research, time and money has been spent trying to find solutions on how to mitigate the negative impact on gender equality, stemming from AI applications, and several methods has been explored and proposed.

However, much of the ongoing struggle is related to gender bias as a secondary consequence of AI applications. Less investigated is the question of how AI can be a part in solving gender inequality challenges, that is when gender inequality is the primary focus area for AI applications, rather than a secondary consequence of AI applications in other areas.

By focusing on how AI could be used as a tool to solve gender inequality challenges, the negative effects of AI technology, linked to gender bias, can be solved in new ways, for example by highlighting the contextual framework that require deeper gender analysis of data.

From a gender equality perspective, it is also important that the development of new technology covers areas where women are largely active. Historically, tech-areas have had a very skewed gender distribution, and emerging technologies have often been tested and developed in male-dominated areas. To counteract this, other strategies, rather than those correcting the problems that occurs afterwards, are needed.

In relation to this, Vinnova, Sweden's Innovation Agency, has initiated a project to investigate more closely how AI can be applied within the framework of the Swedish gender equality goals. These goals also have international relevance as they link to UN's SDG goals. Within the project "AI promoting gender equality", we will explore the potential of applying AI to achieve these goals and speed up the processes towards a more equal and sustainable society.

As a starting point, Ramboll have been commissioned to carry out a mapping and analysis of how AI is applied today to solve gender inequality challenges linked to the Swedish gender equality goals and how AI could potentially be applied to gender inequality challenges. Furthermore, the international network #WAI - Women in AI, have been commissioned to perform a set of international workshops where women working in the area of AI will explore the benefits of AI as a tool to solve gender inequality challenges, together with gender experts and experts in AI, and how the outcome of ideas and prototypes can be put into practice. The project is ongoing throughout 2020 with two reports as interim targets and should manifest in a strategy for how Vinnova can continue efforts in this novel field of innovation.

SUMMARY

Gender equality is highly prioritized on the political agenda in Sweden. Improving gender equality has many positive impacts on individuals and society at large, not only in terms of creating equal opportunities for all but also in terms of increased economic growth, improved education and labor market. Persisting inequalities come at a significant cost for women and men, employers and society as a whole, results in lost potential and leaves a large amount of talent underutilized. Even though Sweden is considered one of the world's most gender equal countries, there are still several pressing issues remaining and a long way to go.

European Institute for Gender Equality estimates that improving gender equality would lead to an increase in EU (GDP) per capita by 6.1 to 9.6% in 2050.

Ramboll has been commissioned by Vinnova, Sweden's innovation agency, to study the potential of using artificial intelligence (AI) to contribute to achieving gender equality. In this study, Ramboll lays out how AI solutions can contribute to gender equality, more specifically Sweden's gender equality goals. We explore how AI is currently used, and what potential there is in applying such solutions to solve gender related issues and speed up the progress towards a gender equal society.

A lot of what is written and studied on the intersection of AI and gender equality today is focused on what problems that AI creates, e.g. in terms of how AI tends to reproduce and even exacerbate existing gender stereotypes, an issue that needs to be acknowledged and handled when developing AI tools. However, the focus of our study is on how AI can contribute in solving current and unsolved gender equality problems, rather than what issues it creates and enforces.

Our study concludes that there are several existing examples of AI solutions that aims to improve gender equality, and Sweden's gender equality goals. The identified solutions improve gender equality in health, hinder men's violence against women and improves recruitment processes. On the other hand, there is a lack of examples that relate to the unpaid housework, equal division of power and equality in education. There are several examples and a consensus among the interviewed experts that there is potential in using AI as a tool to solve gender related issues. AI capabilities have the capacity of structuring large amounts of unstructured data and analyzing large amount of structured data – image, video, text or speech - to compute predictions or classifications, e.g. to early detect signs of breast cancer, predict relapse of violence against women, to ensure that students receive equal access to education, detect norms and stereotypes in popular culture and how the actual speaking room is distributed among genders.

There are several enabling factors that need to be in place in order to realize the benefits of AI for gender equality. Some are general and adhere to data-driven innovation in general, and some are specific to AI for gender equality.

The key enabling factors that are specific to AI for gender equality are:

- Synergetic cooperation among problem owners, entrepreneurs, AI-engineers and gender studies experts; a competent and diverse development team; a structure for economic incentives and a norm critical perspective in the development process

The more generic enabling factors are:

- Access to relevant data and regulation enabling innovation

Today there is a lack of knowledge, incentives and contact areas between organizations and individuals with knowledge in AI, gender equality and problem owners of gender inequality challenges. Although Sweden has leading competence in gender analysis and continues to rank high in innovation indexes, the tech sector and gender analysts rarely combine knowledge in the development of new solutions, especially between the two domains AI and gender. In order to contribute to the development, we give Vinnova the following recommendations:



Formulate missions based on gender equality policy goals



Create platforms for knowledge exchange between problem owners, AI experts and gender analysis



Collaborate to make data available



Acknowledge the bias, but focus on communicating and realizing the potential

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1. INTRODUCTION

Ramboll has been tasked by Vinnova, Sweden's innovation agency, to study the potential of using artificial intelligence (AI) to contribute to achieve gender equality. In this study, Ramboll lays out how AI solutions can contribute to gender equality, more specifically Sweden's gender equality goals. We discuss what barriers and success factors there are in developing solutions that address inequality, and what need to be established to realize the potential in using AI to contribute to achieve a gender equal society. We also account for illustrative examples where AI can, but also already is, applied to highlight and solve gender equality problems.

1.1 Gender equality brings great societal benefits

Gender equality is highly prioritized on the political agenda in Sweden. Improving gender equality has many positive impacts on individuals and on society at large, not only in terms of creating equal opportunities for all but also in terms of increased economic growth, improved education and labor market. A study from the European Institute for Gender Equality (EIGE) on the economic benefits of gender equality shows the positive impacts of reducing gender inequalities in STEM (science, technology, engineering and mathematics) education, labor market activity and wages on a European level.¹ Persisting inequalities come at a significant cost for women and men, employers and society as a whole, results in lost potential and leaves a large amount of talent underutilized. Gender equality has strong, positive impacts on Gross Domestic Product (GDP) per capita which grow over time. EIGE estimates that improving gender equality would lead to an increase in EU (GDP) per capita by 6.1 to 9.6% in 2050.² Even though Sweden is considered one of the world's most gender equal countries, there are still several issues remaining and a long way to go. For instance, ensuring a more equal division of power and influence, combating men's violence against women and adjusting the division of unpaid labor are great issues that remain.

THE POTENTIAL IN UTILISING AI TO ENHANCE GENDER EQUALITY

To increase the speed of Swedish society's conversion towards a gender equal society there is a need to utilize innovative methods and technological capabilities at hand. The political aim of the Swedish government is to be the world leader in harnessing the opportunities offered by digital transformation, where one of the fundamentals of the undergoing digital transformation is Artificial Intelligence (AI). From education to financial services and healthcare, A.I. is seen as a revolutionary technology that can transform how we work and function in society today. The technology has proven to have potential in contributing to the accomplishment of a more sustainable society and reaching the Sustainable Development Goals (SDG)³. Gender equality is pointed out specifically as one goal (SDG number 5) and is a perspective that is essential to integrate in all work to reach the development goals. Sweden's digitalization agency DIGG states that increased use of AI can strengthen welfare and create economic values in public administration, equivalent to about 140 billion SEK annually.⁴ This transformation is already ongoing and public agencies such as Försäkringskassan are using AI as a decision-making tool for e.g. sickness payments and parental leave. In their work, they have detected that there are systematic differences in how women's and men's medical certificates are formulated. This needs to be addressed in order to develop a non-discriminatory tool that works for all.

A lot of what is written and studied on the intersection of AI and gender equality today is focused on what problems that AI creates, e.g. in terms of how AI tends to reproduce and

¹ EIGE, 2019, Economic Benefits of Gender Equality in the European Union.

² EIGE, 2019


³ Vinuesa, R., Azizpour, H., Leite, I. et al. The role of artificial intelligence in achieving the Sustainable Development Goals. *Nat Commun* 11, 233 (2020). <https://doi.org/10.1038/s41467-019-14108-y>, page 1

⁴ DIGG. 2020. Främja den offentliga förvaltningens förmåga att använda AI

even exacerbate existing gender stereotypes.⁵ We give a brief introduction of this in chapter 2.4. This is an issue that needs to be acknowledged and handled when developing AI tools. However, the focus of our study is on how AI can contribute in solving current and unsolved gender equality problems, rather than what issues it creates and enforces. We present one such example in the box below. We explore how AI is currently used, and what potential there is in applying such solutions, to solve gender related issues and speed up the progress towards a gender equal society.

Box 1. AI for gender equality in practice: Traffic Jam

40 billion SEK annually is how much EIGE and a national inquiry in Sweden has estimated the societal loss that follows from men's violence against women. There are AI solutions to combat men's violence against women.



Traffic Jam is an AI-powered solution that uses facial recognition to find victims of sex trafficking and help law enforcement to take down organized criminal networks. In 2019, Traffic Jam was used by law enforcement agencies to identify an estimated 3,800 victims of sex trafficking in the United States, Canada, and the United Kingdom.

Source: SOU 2015:55, *Nationell strategi mot mäns våld mot kvinnor och hedersrelaterat våld och förtryck*, page 106

1.2 Methodology

The starting point of the mapping and analysis has been Sweden's gender equality goals. The data collection was done with document studies, desktop research, semi-structured interviews and an expert workshop with participants with expertise within AI, innovation and gender studies. The interviewees and workshop participants are found in Appendix 1.

1.3 The outline of the report

In chapter 2 we give a background on Sweden's gender equality goals and AI. In chapter 3 we present current and potential AI applications for each of Sweden's six gender equality goals. In chapter 4 we discuss the conditions needed to realize the potential of AI to contribute to gender quality. In chapter 5 we summarize and give recommendations for how Vinnova can continue their work to promote further development within the area.

⁵ Ibid, page 3

2. SWEDEN'S GENDER EQUALITY GOALS AND ARTIFICIAL INTELLIGENCE

In the following chapter we present Sweden's gender equality goals, we define AI and how it is used for social good. We then present how AI and gender equality is mostly discussed today, bias in design and data.

2.1 Sweden's gender equality goals

The Swedish government has committed to build a society in which women and men, boys and girls can live their lives to the fullest potential. The objective of Swedish gender equality policy is for women and men to have the same opportunities, rights and responsibilities in all areas of life, as well as equal power to shape society and their own lives. With this starting point, the government is working towards six goals for gender quality (see Box 2). Sweden's six goals are all interconnected and need to be understood from a holistic perspective. To fulfill one goal completely, other goals need to be addressed as well. Also, working towards one goal inevitably affects other goals as well. The entire Swedish gender equality policy has an interdisciplinary focus and concerns all sectors of society. The distribution of power, both formal and informal, is in focus for the work concerning gender equality.⁶

Box 2. Sweden's gender equality goals

1. Gender equal division of power and influence. Women and men must have the same rights and opportunities to be active citizens and to shape the conditions for decision-making.
2. Economic gender equality. Women and men, girls and boys must have the same opportunities and conditions regarding paid work which gives economic independence throughout life.
3. Gender equal education. Women and men, boys and girls must have the same opportunities and conditions regarding education, study options and personal development.
4. Gender equal distribution of unpaid housework and provision of care. Women and men must have the same responsibility for housework and have the opportunity to give and receive care on equal terms.
5. Gender equal health. Women and men boys and girls must have the same conditions for a good health on equal terms.
6. Men's violence against women must stop. Women and men, girls and boys, must have the same right to and opportunity for physical integrity¹.

GENDER EQUALITY IS MORE THAN EQUAL GENDER DISTRIBUTION

Gender equality is not only about achieving equal gender distribution in various settings, such as in the board of directors of a corporation or in political contexts. Gender equality also refers to attitudes, norms, values and ideals that affect the lives of women and men, boys and girls, in many areas of society. Gender equal representation and access to formal power does not directly implicate that real influence is gender equal. Gender equal representation is an important tool towards gender equality, but informal barriers, norms and structures that hinders women and girls from real power and influence also needs to be addressed. The work to improve gender equality can be carried out with two synergetic approaches; one using measurable factors to create a clear picture of different situations and conditions, and one that problematizes and examines what norms and values generate the reported figures.⁷

⁶ Jämställdhetsmyndigheten. 2018. *Rapport 2018:5*.

⁷ Jämställdhetsmyndigheten. *What is gender equality?* <https://www.jamstalldhetsmyndigheten.se/en/about-gender-equality/what-is-gender-equality>. [Retrieved 2020-05-04].

AI SOLUTIONS CAN ADDRESS SEVERAL GENDER EQUALITY CHALLENGES SIMULTANEOUSLY

Due to the interconnectedness of the gender equality goals, an AI solution would naturally address several equality challenges at the same time. A potential AI-solution that highlights the wage gender gap in different industries will show both economic differences between the genders as well as differences in power and influence. In the same way, solutions approaching goal 4, equal distribution of unpaid housework could have effects on goal 1 and 2 as well. When working towards economic equality (goal 2), the distribution of power and influence (goal 1) will most probably become more equal as well. The gender equality work is ultimately a matter of redistributing power and resources in order to achieve the goals.⁸ In chapter 5, you can read more in detail about the gender equality goals and what potential there is for AI to help achieving them. In the following section we introduce AI and its capabilities.

2.2 Artificial intelligence is built on data

There is no single definition of the concept of artificial intelligence (AI) – even scientists working every day with AI describe it in different ways. An artificially intelligent system can be defined as *a system that has the capability of performing tasks in complex environments, without constant guidance by a user.*⁹ AI could also be defined as an intelligent machine or a system with the ability to improve performance by learning from experience in order to achieve specific tasks and goals.¹⁰ Regardless of the definition used, an important aspect of AI is that it is built on data – data is what allows an AI solution to operate, to learn and evolve. Depending on what AI is used for, this data can be images, video or sounds, everyday language text or speech, or any sensor data in tabular form. In the table below we give examples of existing AI capabilities and what they can be used for. Today, examples of applications of AI are numerous and come from a variety of different fields such as health care, finance, industry and education. AI solutions are used to understand language and communicate, to plan and solve problems and to recognize images and patterns.

⁸ Jämställdhetsmyndigheten. *Sweden's gender equality policy*. <https://www.jamstalldhetsmyndigheten.se/en/about-gender-equality/swedens-gender-equality-policy>. [Retrieved 2020-04-28].

⁹ Elements of AI, (2020) <https://www.elementsofai.com/>

¹⁰ Kaplan, A., & Haenlein, M., (2019 January). *Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence*. *Business Horizons*. 62 (1): 15–25. doi:10.1016/j.bushor.2018.08.004

Table 3. Examples of AI capabilities and their potential application¹¹

AI CAPABILITY	POTENTIAL APPLICATION	
Image analysis (Computer Vision)	Person identification	Identifying individuals in images and video. Commonly referred to as facial recognition.
	Object detection	Detecting objects in images and video. For instance, detecting faces in video surveillance footage.
	Image and video classification	Classifying objects, animals or individuals in images and video. Can be used for detecting explicit content online or violent situations in surveillance video.
	Similarity detection	Detecting similarities between different videos and images.
Speech and Audio	Emotion recognition	Measuring emotions of individuals in images and video. Could be used to measure engagement during a video meeting.
	Person identification	Verifying individuals' identities using speech analysis. Could be used to provide online verification of identity without codes or apps.
	Speech-to-text	Automated transcription of speech. Can be used to transcribe audio files of speech, enabling it to be more easily analyzed further.
	Sound detection	Identifying voices or sound from audio files.
Natural Language Processing	Emotion recognition	Analyzing emotions of individuals by examining the way they speak. Could also be used to measure engagement for instance.
	Person identification	Identifying the author by analyzing the writing style, handwriting or other text.
	Sentiment analysis	Analyzing the sentiment of the author by examining text. Potential uses include scanning posts on social media to discern public opinion.
Others	Language understanding	Any task relating to comprehension of text: from text classification to understanding poetry. Allows chatbots to understand ambiguous language and abstract concepts.
	Content generation	Generation of text, video and audio content. Used in chatbots to be able to produce answers based on previous conversations.
	Structured deep learning	Machine learning algorithms that use multiple layers to extract advanced features using structured data.
Others	Analytics	Any analytics technique not involving deep learning: journey mapping or network analysis
	Reinforcement learning	Type of machine learning that differs from other types of learning by not requiring supervision

Note: For all examples, integrity is an important aspect. Some examples would be harder to implement in a Swedish setting, than e.g. in the US or China

2.3 AI is used to solve societal challenges – AI for Good

AI as a tool to highlight, analyze or solve societal issues is an emerging field. The United Nations host *AI for Good* summits every year where the core idea is to connect AI Innovators with problem owners in order to solve global challenges.¹² Gender equality is pointed out specifically as one goal (SDG number 5), but the perspective is essential to integrate in all work to reach the development goals. During the 2019 summit, several projects and AI solutions were exhibited. Among them an AI solution to monitor and aid individuals recovering from drug addiction¹³ and a software that allows a smartphone to recognize currency to help the visually impaired¹⁴. Within the research literature, sustainability and crime are two areas in which AI solutions have been applied and analyzed. For example, AI solutions have been suggested and utilized to enable sustainable

¹¹ McKinsey Global Institute, 2018, "Notes from the AI frontier: Applying AI for Social Good", Discussion paper.

¹² AI for Good, (2020), <https://aiforgood.itu.int/>

¹³ Behavior, (2020), <https://www.behavior.com/>

¹⁴ AID, (2018), <http://ainepal.org/public-release-of-cash-recognition-for-visually-impaired/>

city planning and urban development.¹⁵ AI can also be used for predicting areas within a city that will be hotspots for crime¹⁶ and recognizing violent behavior on video.¹⁷

Figure 1. Examples of how AI can be used for social good



2.4 Discussions on AI and gender equality are focused on bias in AI solutions

As with the other examples connecting AI and sustainability, research on AI and gender equality is an emerging field. However, most of the literature explicitly discussing the relation between AI and gender equality focuses on bias and what gender equality challenges that AI creates and enforces. Bias in AI generally arises either from issues in the data or flaws in the design of the solution.¹⁸ Although we are not focusing on bias in this study, it is still worth mentioning since 1) most research focuses on bias 2) all solutions developed to solve gender equality problems need to relate to data bias and design bias and 3) a way to solve gender equality problems may be to address bias in data by introducing new "bias" that is in line with Sweden's political agenda.

BIAS IN THE DATA

All AI solutions need data. Data is per definition based on historical events. Data will thus often reflect the biases that existed or still exist towards certain groups. In some cases, the data is biased due to historical norms and gender discrimination. One example is the legacy surrounding occupational groups, stemming from a time where certain occupations were not accessible to women. An example from an AI based translation tool reveals how norms and societal patterns generates data, and how data shapes AI solutions. Translating the phrase "[Pronoun] *is a doctor*" from a language with gender neutral pronouns (such as Finnish) to English renders the result "*He is a doctor*". The same procedure but using the sentence is "[Pronoun] *is a nurse*" provides the translation "*She is a nurse*".¹⁹ This despite the same original pronoun being used in both cases. This result is not caused by a programmer making a choice. It is instead caused by the translation tool scanning through websites (or whichever data source is used), finding that the words "*she*" and "*nurse*" are more often found in combination than the words "*he*" and "*nurse*". The result being a translation reflecting the gender biases found in society.

In other instances, and as a result of existing inequality problems, data simply does not exist. In clinical trials, little attention has historically been paid to the possibility that a disease or a drug may impact women and men differently. The result being that most

¹⁵ Nosratabadi, S., Mosavi, A., Keivani, R., Ardabili, S., & Aram, F. (2019). State of the art survey of deep learning and machine learning models for smart cities and urban sustainability. In *International Conference on Global Research and Education* (pp. 228-238). Springer, Cham.

¹⁶ Bogomolov, A. et al. (2014) Bogomolov, A., Lepri, B., Staiano, J., Oliver, N., Pianesi, F., & Pentland, A. (2014, November). Once upon a crime: towards crime prediction from demographics and mobile data. In *Proceedings of the 16th international conference on multimodal interaction* (pp. 427-434).

¹⁷ Nova, D., Ferreira, A., & Cortez, P. (2018). A Machine Learning Approach to Detect Violent Behavior from Video. *International Conference on Intelligent Technologies for Interactive Entertainment* (pp. 85-94). Springer, Cham

¹⁸ Dignum, V. (2019). *Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way*. Springer International Publishing.

¹⁹ Prates, M. O., Avelar, P. H., & Lamb, L. C. (2019). Assessing gender bias in machine translation: a case study with Google Translate. *Neural Computing and Applications*, 1-19.

treatments are developed for men. As an example, it has only recently been discovered that estrogen levels can influence lung cancer development and mortality.²⁰ Another example is that there is no data in the US for tracking complications sustained in pregnancy and childbirth, hiding potential issues and hindering solutions from being developed.²¹

BIAS IN THE DESIGN

Besides bias in data, there may be bias in the design of products and solutions. One commonly cited example is that cars have been designed to be driven by men, increasing the likelihood that female drivers are injured in accidents.²² There are also examples of technical solutions, including AI solutions, where the design has gone wrong.

One of the more prominent examples of flawed AI design is a facial recognition software that was significantly worse at identifying women, especially women with darker skin, compared to identifying white men.²³ This was documented in a study, and within seven months, all companies responsible for the software had been able to significantly reduce the number of erroneous categorizations.²⁴ Several of the companies released statements implying that the errors were reliant upon data that was not diverse enough, essentially arguing that data, not design, was the issue. Since none the algorithms are open source however, it is not possible to rule out that the problems of the original model were due to design flaws and that the reduction in error rates was caused by changes in the algorithms or training methodology.²⁵

Another example comes from a study from JAMA Internal Medicine which showed that artificial intelligence built into smartphones from Apple, Samsung, Google and Microsoft could not respond to questions regarding people in crisis. The phones' personal assistants did not understand words such as "rape" or "my husband is hitting me". The algorithms were programmed to, instead of doing a basic web search, make jokes and mock the users.²⁶

These are just a few examples of where AI development has gone wrong due to gender bias in design and data. There are ways to diminish this²⁷, e.g. by ensuring that the team that develops the solutions is diverse, with multiple perspectives represented. The training data should be representative, and the development team need to reflect on whether something is missing from the dataset that may affect the result. It is also of importance to identify processes to test and monitor for possible bias during the development and use of the solution. The team needs to reflect on the AI solution's impact on the potential user group and whether there may be individuals or groups disproportionately affected by negative consequences. But there are several existing and potential use-cases where AI in fact can help in reducing gender inequality.

²⁰ The Guardian. (2015). *The medical research gender gap: how excluding women from clinical trials is hurting our health*. <https://www.theguardian.com/lifeandstyle/2015/apr/30/fda-clinical-trials-gender-gap-epa-nih-institute-of-medicine-cardiovascular-disease> [Retrieved 2020-05-14]

²¹ D'Ignazio, C., & Klein, L. F. (2020). *Data feminism*. MIT Press.

²² The Guardian, (2019), *The deadly truth about a world built for men – from stab vests to car crashes*. <https://www.theguardian.com/lifeandstyle/2019/feb/23/truth-world-built-for-men-car-crashes> [Retrieved 2020-05-14]

²³ Buolamwini, J., & Gebru, T. (2018). Gender shades: Intersectional accuracy disparities in commercial gender classification. In *Conference on fairness, accountability and transparency* (pp. 77-91).

²⁴ Raji, I. D., & Buolamwini, J. (2019) Raji, I. D., & Buolamwini, J. (2019). Actionable auditing: Investigating the impact of publicly naming biased performance results of commercial ai products. In *Proceedings of the 2019 AAAI/ACM Conference on AI, Ethics, and Society* (pp. 429-435).

²⁵ Raji, I. D., & Buolamwini, J. (2019)

²⁶ Miner, A. S. (2016) Miner, A. S. (2016) Smartphone-Based Conversational Agents and Responses to Questions about Mental Health, Interpersonal Violence and Physical Health. *JAMA Internal Medicine* 176, no 5 (2016) 619-25

²⁷ See e.g. European Commission (2020) *Ethics guidelines for trustworthy AI*

3. THE POTENTIAL TO ADDRESS GENDER INEQUALITY WITH AI

Our mapping of existing and potential AI solutions addressing gender inequalities shows that there are ways that AI can or is already used to address the issues pointed out in Sweden's six gender equality goals. However, there is still much to learn and it's an underinvested and underexplored area. There are several examples of AI solutions addressing women's health as well as domestic violence, while less examples exist of AI solutions within the field of unpaid housework and educational equality. Some solutions have a larger potential to create a direct impact, such as tools for health care diagnostic, recruitment and loan issuing, while other solutions such as analysis of speaker space do not have the same direct societal effect but will rather highlight norms and stereotypes that can be acted on.

In the following chapter, we will describe Sweden's gender equality goals more in detail, as well as how AI solutions can contribute in solving them. In the table below we list existing and potential AI-solutions that could contribute in achieving Sweden's gender equality goals.

Table 2. Existing and potential (*in italics*) AI solutions per gender equality goal

	Image	Audio and speech	Text	Other solutions
1 Equal distribution of power	<i>Video analysis of an audience to show level of engagement depending on the gender of the speaker.</i>	<i>Audio analysis from a meeting to show who spoke the most, who interrupted others, and who was interrupted.</i>	<i>Visualize and categorize reports of sexist behavior in the workplace.</i>	Well-designed AI-tools could be utilized in recruitment processes in order to reduce potential hiring bias.
2 Economic equality		Analyze differences in what questions that are asked from venture capitalist to male and female entrepreneurs, and how this impacts decisions on investments.	Analyze pitches to venture capitalist, along with the outcome, determining whether there are gender differences in the decisions made.	Find and visualize differences in pay at companies or positions. Automating loan and venture capital processes to avoid bias in selections.
3 Equal Education	Video analysis of classrooms, analyzing gender differences in non-verbal behavior via e.g. sentiment analysis.	Analyze audio recordings from a classroom to highlight potential gender patterns in who speaks, who receive questions from the teacher and how the questions are asked.	Using AI for grading to avoid potential bias (both text and tabular). Using online posts to identify early indicators for abuse and bullying	Automatic generation of practice questions based on previous performance for adapted learning. AI-tools could be used in university application processes to avoid bias.
4 Equal distribution of unpaid housework	<i>Analyzing the video surveillance footage from a supermarket to determine the age and gender of the shoppers in order to see if there are differences in who goes shopping.</i>	<i>Use text and/or speech analysis of public data in order to determine a population's attitudes towards equality in unpaid labor.</i>	<i>Use text and/or speech analysis of public data in order to determine a population's attitudes towards equality in unpaid labor.</i>	<i>Highlight gender differences in unpaid work using existing data or data from smart assistants developed to reduce the workload.</i>
5 Equal Health	Analyzing microscopy images to scan for breast cancer.	<i>Analyze audio recordings of doctor-patient interactions to see if there are gender differences in questions posed or answers in accommodations.</i>	Analyze public posts on social media to show attitudes towards health issues related to women.	Health applications using content generation to ask specific questions depending on previous conversations, reducing bias in treatments.
6 Ending men's violence against women	Video analyses of surveillance footage to identify violent or aggressive behavior towards women.	<i>Sentiment analysis of emergency calls from women, determining the level of threat they are facing.</i>	Identify social media posts containing harassment, sugar dating and other similar content.	Provide a tool for determining whether an individual in prison for a domestic violence abuse is likely to commit the same crime if released.

1 EQUAL DISTRIBUTION OF POWER

The first gender equality goal is to achieve equal distribution of power. The purpose of the goal is to ensure that men and women shall have the same opportunity to be involved citizens and impact decision-making. Women and men should have the same access to power and influence, through a gender equal representation in decision-making contexts. The goal concerns formal power and influence, e.g. gender equal representation in politics and corporate boards, as well as real power and influence, which means the actual power and influence men and women in these positions have. There is a lack of gender equal representation in decision-making processes, as well as an uneven distribution of power among genders in these processes.^{28,29} To analyze and affect actual power and influence in setting the agenda and impacting decision-making is harder. However, discussions with gender and AI experts suggest that AI has a great potential in closing the gender gap both regarding formal and real power and influence across all sectors in society.

USING AI TO IMPROVE GENDER EQUAL RECRUITMENT

One crucial part in ensuring gender equal representation and access to formal power and influence, is to analyze recruiting processes in all sectors of society. A well-developed AI tool could give organizations support when recruiting new staff to overcome gender unequal structures and norms. One example of such a tool is [Textio](#), designed to mitigate biases in hiring. It's an intelligent text editor that highlights hidden gender bias in existing applications. The solution highlights key phrases that are statistically likely to change the gender balance of an organization. It can give suggestions on how job descriptions can be changed to appeal to candidates from groups that aren't well-represented.³⁰ [Pymetrics](#) has built a talent matching platform that uses AI to remove bias across gender and ethnicity and do predictions of what candidate that is the best fit.³¹ Analyzing recruiting processes is important since recruiters decide who ends up in power positions.

USING AI TO ANALYZE AND ADDRESS INFLUENCE AND POWER

To ensure gender equal real influence and power, AI could be used to analyze the opportunity to speak in meeting rooms, conferences and political contexts, from a gender perspective. AI could map who speaks and when, interruptions and how other people in the room react on speeches given by a man or a woman. To enable large scale analysis, a group of researchers has made an open-source speaker gender detection framework for monitoring gender equality.³² In their study, the authors use the framework to describe the gender equality in French audiovisual mediums such as radio. The long-term goal of the research is to increase awareness, based on the assumption that a quantitative description of gender equality in media may increase awareness of the issues and result in societal changes. The results could be presented anonymously on a gender aggregated level to inform corporate leaders and decision-makers about the actual speaking room and how it is shared between the genders.

[Ceretai](#)³³ is a Vinnova-financed project that aims to develop an automated tool designed for detecting norms and stereotypes in popular culture by analyzing speaking time, appearance, emotion recognition and descriptions of characters. The purpose of the tool is to increase awareness of how women and minorities are portrayed in movies to enable audiences to make informed choices. Although these solutions may not directly affect gender equality, norms and invisible barriers are particularly important to address and make visible.

²⁸ Regeringen, (2017) <https://www.regeringen.se/artiklar/2017/01/mer-om-jamstalldhetspolitikens-mal/> [Retrieved 2020-05-02]

²⁹ Jämställdhetsmyndigheten. (2018). Rapport 2018:5.

³⁰ Textio. (2020) <https://textio.com/>

³¹ Pymetrics. (2020) <https://www.pymetrics.ai/>

³² Doukhan, D. et al. (2018). An Open-Source Speaker Gender Detection Framework for Monitoring Gender Equality

³³ Ceretai. (2020) <https://ceretai.com/>

2 ECONOMIC EQUALITY

The second goal regards economic equality. The purpose of the goal is to provide equal opportunities for paid labor and economic independence to men and women. The paid labor must not only give financial independence in working age, but also lead to financial security and independence during the retirement years. The goal includes more equal allocation of financial resources between women and men, return on capital and access to venture capital and investments.

USING AI FOR GENDER EQUAL FUNDING

Research shows that women are repeatedly reviewed differently when granted loans, funding and venture capital. In Sweden, about one-third of businesses are owned and run by women, but they are not granted a corresponding proportion of venture capital funding. In fact, less than 1 percent of Swedish venture capital went to companies with only female founders in 2018.³⁴ A study by Malmström et al of a government venture capital investment process showed that the language used by venture capitalists to describe male and female entrepreneurs was radically different.³⁵ The differences had real consequences for those seeking funding — and for society in general. Not only was the language describing the applicants different, but women applicants were also asked more preventive questions. How women and men are evaluated differ, but their ideas may be as profitable and good as their male competition.^{36,37} AI can potentially assist in creating a more gender equal process and remove bias in assessment processes. *Rikare II* is a Vinnova-financed project with the purpose to develop an AI prototype to ensure gender equal learning algorithms in financiers' decisions. The project explores how innovation in AI can reduce unconscious bias for gender equality in access to finance. Discussions with experts suggest that this is an application that can be used in other areas such as access to venture capital or funding.

A study published in the MIT Management review describes how several VC firms are taking on a data-driven assessment process in investment decisions. Social Capital is a capital investment firm that uses an online platform where funders submit transaction data for an automated funding decision. Among the startups that received funding, 42 % were owned by women and more than half were nonwhite. F4 Capital are developing a scoring index to create an objective measure of startup maturity, opportunity and risk to help in investment decisions. *Alice* is an AI platform that helps connect female and minority entrepreneurs to resources to help businesses scale up.³⁸

USING AI TO IMPROVE GENDER EQUAL RECRUITMENT AFFECTS THE GOAL OF GENDER EQUAL DISTRIBUTION OF POWER AS WELL

The suggestion of a well-developed AI tool that gives organizations support when recruiting new staff to overcome gender unequal structures and discrimination is highly relevant with regards to the goal of economic equality as well as equal distribution of power. The reasons why women are not as present in some positions can be attributed to several factors, lower levels of hiring and promotion, unfriendly workplace-culture, and the inability of companies to keep the women they do hire. Ultimately, the underlying cause of the lack of diversity and gender equality stems from flawed human decision-making, especially by managers and others who influence the hiring, promotion, and retention of

³⁴ Dagens industri, (2020) <https://digital.di.se/artikel/mannens-techbolag-far-99-procent-av-allt-riskkapital> [Retrieved 2020-05-04]

³⁵ Malmström, M (2017)

³⁶ Hernandez, M. Reveendhran, R., Elizabeth, W., Barnett, M. (2019) How Algorithms Can Diversify the Startup Pool, Vol. 61, No.1

³⁷ Malmstrom, M. (2018) Malmström, M., Voitkane, A., Johansson, J., Wincent, J., (2018) VC Stereotypes About Men and Women Aren't Supported by Performance Data. Harvard Business Review, March 15, 2018.

³⁸ Hernandez, M. Reveendhran, R., Elizabeth, W., Barnett, M. (2019)

women³⁹. AI can possibly be a guiding tool to analyze, address and visualize why we make specific decisions and remind us of potential gender bias in our decision making. There are several examples of where algorithms and AI is used to make a recruitment process more diverse and gender equal. In most cases, algorithms attempt to remove factors such as gender, national origin, age etc. from the initial evaluation process and thus remove some of the unconscious bias. [Unbias.io](#) removes faces and names from LinkedIn profiles, [Entelo](#) anonymizes interviewing by removing all indication of gender and race. [Talvista](#) is an AI solution that hides characteristics and personal identifiers of the applicants and writes gender-neutral job descriptions⁴⁰.

USING AI TO ACHIEVE GENDER EQUAL SALARIES

Another area where AI solutions can contribute to economic equality is in transparent salary setting. [Gapsquare](#) is a software developed to analyze and clarify wage differences in pay levels at a company. The software uses machine learning to analyze large amounts of salary statistics from a company with the aim of producing quick and simple reports that clarify any gender differences.⁴¹ Gender pay gap is a Vinnova-financed project that develops an AI prototype for equal recruitment and salary setting. [ComplIQ](#) is a AI solution that aims to set a fair pay relative to comparable employees at the company.⁴² [PIHR](#) uses AI and machine learning, to make data-driven decisions for equal pay.⁴³

³⁹ Houser, K.A. (2019), Can AI Solve the Diversity Problem in the Tech Industry? Mitigating Noise and Bias in Employment Decision-Making, 22 STAN. TECH. L. REV. 290 (2019)

⁴⁰ Talvista, (2020) <https://www.talvista.com/>

⁴¹ Gapsquare, (2020) <https://www.gapsquare.com>

⁴² ComplIQ, (2020) <https://www.compensationiq.com/>

⁴³ PIHR, (2020) <https://pihr.com/>

GRACEHEALTH

Grace Health is a Vinnova-financed project that develops a chat bot aimed at women with the goal of assisting users to better understand their fertility, answer questions about contraception and other hygiene issues. It can also detect early symptoms needing medical attention. By analyzing the anonymized questions submitted, the chat bot improves its answers, thereby offering even better help to the users.



Equal health



Equal education

PERSPECTIVE

Perspective is an API that uses machine learning to score comments or posts in a conversation online. The score can then be used to categorize a comment as "toxic" to a discussion. The filtering of a discussion can be used to detect cyberbullying or harassment online.

GENDER PAY GAP

Gender pay gap is a Vinnova-financed project that develops an AI prototype for the implementation of a new algorithm for equal recruitment and salary setting. The overall purpose is to develop AI decision support that can remedy unreasonable wage differences for equal work. The solution is expected to assist in changing recruitment and wage setting so that women who previously held an unfavorable position can obtain better conditions for promotion.



Economic equality



Ending men's violence towards women

DETECTING VIOLENT BEHAVIOR FROM VIDEO

Researchers at the University of Minho have developed a machine learning algorithm, a Support Vector Machine approach, that can detect whether a human action caught on video is violent or not. The algorithm could be used to analyze large amounts of video surveillance footage and detecting violent behavior in general or towards women in particular.

AI LEARNING PLATFORM IN THE EQUESTRIAN SPORTS

The project is Vinnova-financed and develops a learning platform about AI in a female dominated industry, the equestrian industry. In line with Sweden's goal of gender equal education and the national goal of educating at least 1% of Sweden's population in AI, education needs to be adapted for several different target groups. The platform uses existing AI applications in the equestrian sports with the aim to educate and encourage women in the community to engage in AI.



Equal education

3 EQUAL EDUCATION

The third goal regards equal education and to ensure equal access to education for both men and women and to counteract unequal opportunities and conditions related to education. The goal covers the educational system, from pre-school to higher education. It also covers the non-formal educational sector such as associations.

Previous studies show that women and men, girls and boys go through the educational system with different conditions, terms and opportunities. This is shown in e.g. how teaching is organized and implemented, what expectations are put on girls and boys, access to support and space in the classroom.⁴⁴ Gender stereotypes are present in the educational system, e.g. in study choices where gender-related occupational roles are enforced; education programs within health care, teaching and social care is dominated by females, programs for technology and manufacturing are male-dominated. There are several examples of how AI is used as a tool for teachers and students to improve the education but few examples focus specifically on improving gender equality. However, there is potential in addressing challenges that relates to gender equality, e.g. cyber bullying and sexual harassments online. A survey conducted by Friends on vulnerability online from 2017 reports that 18 percent of girls and 6 percent of boys have been exposed to sexual harassment online.⁴⁵

AI IN THE EDUCATIONAL SYSTEM IS A GROWING FIELD, BUT FEW EXAMPLES OF AI FOR GENDER EQUAL EDUCATION EXIST

AI in education is a growing field. AI can also be utilized to increase access to a more equal quality driven education tailored to the student's conditions. AI enables learning based on the student's own requirements. The quality of the education can be raised by e.g. reducing the risk that students' needs are not noticed. It opens up to the possibility of differentiated and individualized learning based on an individual student's particular needs. The economic benefits of better education with AI are very high in society as a whole.⁴⁶ There are several AI-powered tools used in education. One example is [Cognii's Virtual Learning Assistant](#). It interacts with students via a real-time chat where the AI coaches the student in their learning and helps to revise answers in conversation form.⁴⁷ [Gradecam](#) is a solution based on handwriting recognition. The purpose of the tool is to quickly grade student papers and tests and the more it is used, the better it becomes at recognizing different writing styles. Other Swedish examples are [Digilär](#)⁴⁸, [Clio](#)⁴⁹ and [StudyBee](#). These solutions are not specifically targeting gender inequality, but rather an equal education for all.

AI TO IDENTIFY ABUSE AND CYBERBULLYING

There are several initiatives to create and train algorithms that can detect hate and abusive speech online to prevent cyberbullying. Girls are more exposed to cyberbullying, which could have consequences both on psychological health and the overall learning environment. Several studies have shown that AI can help in identifying bullying in school environments. Van Hee with co-authors investigate automatic detection of cyberbullying in social media text by modelling posts written by bullies, victims, and bystanders of online bullying. The enormous amount of information on social media requires intelligent systems to identify potential risks automatically, using classification algorithms. The authors will further develop the solution using deep learning techniques.⁵⁰ [Identity Guard](#) is a parental control app with natural language processing (NLP) and natural language classifiers (NLC),

⁴⁴ Jämställdhetsmyndigheten, (2018).

⁴⁵ Friends (2017) Friends nätrapport

⁴⁶ DIGG. (2020).

⁴⁷ Cognii, (2020) <https://www.cognii.com/>

⁴⁸ Digilär, (2020) <https://digilar.se/>

⁴⁹ Clio, (2020) <https://www.clio.me/se/>

⁵⁰ Van Hee, C., Jacobs, G., Emmery, C., Desmet, B., Lefever, E., Verhoeven, B., De Pauw, G., Daelemans, W., & Hoste, V. (2018). Automatic detection of cyberbullying in social media text. *PLoS one*, 13(10), e0203794.

able to understand and categorize what individuals are sending and receiving. The solution then monitors children's social media and flag potential cyberbullying or signs of self-harm.⁵¹ CREEP (Cyberbullying Effects Prevention) is an EU supported project that aims at identifying and preventing the possible negative impacts of cyberbullying on young people. The project uses AI for the early detection of cyberbullying through monitoring of social media.⁵²

AI TO IDENTIFY ENGAGEMENT IN THE CLASSROOM

A study from 2019 investigates how computer vision can support research and teacher training. The study examines visible indicators of students' engagement in learning. The study provided a proof of concept on how computer vision techniques examining head pose and facial expressions can be used to examine student engagement.⁵³ Another study examines a mood analysis using facial expression of a group of students in the classroom to measure the engagement and learning rate to improve teaching strategies.⁵⁴

AI SOLUTIONS TO PROMOTE A GENDER EQUAL RECRUITMENT PROCESS

Previously mentioned AI solutions to increase equality in assessment and recruitment processes, is relevant to apply in within the field of education as well. An AI tool that decodes gender bias from the description of job adverts could potentially be used for the description of educational programs and courses at high-school and in higher education. In higher education and academia, there are inequalities across genders regarding distribution of research grants, employment terms, carrier paths, merit system and sick leave.⁵⁵ More women than men enter and graduate from undergraduate and graduate levels of higher educations. However, more men than women continue in academia at postgraduate levels. At Swedish institutions for higher education, 74% of the professors are male and 26% are female.⁵⁶

⁵¹ IBM, (2018). <https://www.ibm.com/blogs/client-voices/ai-technology-protect-teens-cyberbullying/>

⁵² CREEP, (2020) <http://creep-project.eu/>

⁵³ Goldberg, P., Sümer, Ö., Stürmer, K. et al. Attentive or Not? Toward a Machine Learning Approach to Assessing Students' Visible Engagement in Classroom Instruction. *Educ Psychol Rev* (2019).

⁵⁴ Gupta, S.K., Ashwin, T.S. & Guddeti, R.M.R. (2019) Students' affective content analysis in smart classroom environment using deep learning techniques. *Multimed Tools Appl* 78, 25321–25348.

⁵⁵ Jämställdhetsmyndigheten, (2018)

⁵⁶ Statistics Sweden. 2018. *Women and men in Sweden – Facts and figures 2018*.

QUANTX

QuantX is a software platform built to facilitate diagnostics and care of patients with breast anomalies. The platform uses advanced analysis methods and machine learning to analyze x-rays. By comparing a patient's x-rays with many similar images and with current pathological research the anomalies can be mapped. This facilitates the physician's work to make a



Equal health



Equal education

GRADECAM

Gradecam is an AI solution based on handwriting recognition. The purpose of the tool is to quickly grade student papers and tests and the more it is used, the better it becomes at recognizing different writing styles. One benefit of using the tool is reducing the potential grading bias.

RIKARE II

Rikare II is a Vinnova-financed project with the purpose to develop an AI prototype to ensure gender equal learning algorithms in financiers' decisions. The aim of the project is to create a scalable prototype for the implementation of a new assessment algorithm for broader financing of an equal and competitive business sector. Using gender analysis and algorithms, the project explores how innovation in AI can reduce unconscious bias for gender equality in access to finance.



Economic equality



Ending men's violence towards women

SPOTLIGHT

Spotlight is an AI tool designed to facilitate the process of determining whether a child is or has been a victim of human trafficking, assisting in the police work of finding the child and identifying the traffickers. Using identifying information and matching it with – for instance – ads including trafficking victims, the tool is used by law enforcement to reduce the time required to find the victim.

4 EQUAL DISTRIBUTION OF UNPAID HOUSEWORK

The fourth goal regards the equal distribution of unpaid housework. The purpose of the goal is to provide equal care and terms of care for both men and women as well as ensuring an equal distribution of unpaid housework between men and women. Unpaid housework and care for children, the elderly and other relatives is to a large proportion carried out by women while men spend most of their time on paid work. Care allowance is paid out to parents with children or young people who due to sickness or disability are in need of special supervision and care. In 2017, 84 percent of the people who received care allowance were women and 16 percent were men in Sweden. Persons who abstain from work to care for a seriously ill close relative may receive benefits for care of a closely related person. Seriously ill means that there may be a significant threat to the ill person's life. In 2017, around 12 000 women and 5 000 men received benefits for case of a closely related person.⁵⁷

Women spend more time than men on unpaid work and less time on personal needs and leisure time than men. In average women spend around 12 hours per week on unpaid housework, while men spend around 7 hours on the same. Furthermore, women have a greater total workload than men have when both paid and unpaid work are weighed together.⁵⁸ An extensive workload in the form of both paid and unpaid work has also been shown to adversely affect women's health. This has consequences for women's and men's incomes, labor force participation, quality of life and health.

THERE IS A LACK OF EXAMPLES WHERE AI IS USED TO IMPACT THE DISTRIBUTION OF UNPAID HOUSEWORK

Our mapping concludes that there is a lack of examples where AI is used in to impact the distribution of unpaid housework. There are domestic robots such as connected household devices that potentially decreases the time spent on household work. An ongoing research project called [DomesticAI](#) at University of Oxford looks into the technologies' potential to free up time that is now locked into unpaid housework and care work. They also investigate how willing people are to introduce the technology into their private lives, and how social issues as gender inequality will potentially be affected.⁵⁹ But the question remains how it will impact the distribution of unpaid housework between men and women.

There are several public data sources available to estimate the unpaid housework, such as register on parental leave, hours spent on housework etc. Our discussion with experts within gender and AI on how AI can be used to solve these issues mostly regard detecting and visualizing gender inequalities in a home setting. To some extent, there could be a lack of awareness of the actual distribution of homework within families. Since the distribution of unpaid and paid work are connected, solutions that impact the economic equality has a direct impact on the distribution of the unpaid housework as well.

⁵⁷ Statistics Sweden. 2018. *Women and men in Sweden – Facts and figures 2018*.

⁵⁸ Statistics Sweden. 2018. *Women and men in Sweden – Facts and figures 2018*.

⁵⁹ DomesticAI, (2020) <https://www.sociology.ox.ac.uk/research/domesticai-ai-s-potential-to-transform-unpaid-domestic-work-in-the-uk-and-japan.html>

5 EQUAL HEALTH

The fifth goal regards equal health regardless of gender. The purpose of the goal is to ensure that women and men have equal access to healthcare as well as equal opportunity to live a healthy life. The goal includes physical, mental and sexual/reproductive health and encapsulates preventative public health measures aimed at individuals, such as social services, aid to individuals with disabilities and healthcare. The equality related challenges facing the field of healthcare are numerous and include that women are more likely than men to be on sick leave, that treatments for an illness that only affects one gender (most often women) are lacking in quality and that there are often gaps in the knowledge about how certain diseases that affects all genders, affect women in particular.⁶⁰

In general, men perceive their health to be good to a larger extent than women do, and women perceive their health to be poor to a larger extent than men do. However, the life expectancy at birth year 2017 was 84 years for women and 81 years for men. Men smoke and uses snuff daily to a larger extent than women and more men than women die from e.g. cardiovascular diseases and alcohol related diseases. More men than women also suffer from obesity. Concerning mental health, women perceive themselves to have more troubles with anxiety, worry or dread than men do. Men are on the other hand overrepresented in suicide statistics. In the age cohort 16-24 where the difference between the genders is the largest, 45% of women have troubles with anxiety, whilst around 25% of the men in the same age cohort experience similar troubles. In 2017, around 25 000 women and 6 000 men had ongoing sickness cases due to adjustment disorders and reactions to severe stress. Around 9 000 women and 4 000 men had ongoing sickness cases due to depressive episodes.⁶¹

AI IS BEING USED TO ENHANCE GENDER EQUAL HEALTH

The potential in using AI to enhance gender equal health is very large. The technique is already used in several ways to ensure that women and men have the same opportunity to live a healthy life. The technology is developed and used both to analyze large amount of data to better understand why and how diseases develop⁶², to diagnose and to provide health information. The application of AI technology to improve women's health can potentially have a great impact, both to help in triage and diagnosing, but also with future more developed AI solutions to help in treatment. Versions of image analysis is being used to assist doctors when diagnosing breast cancer. Researchers at Karolinska Institute are currently developing an AI system that can scan microscopy images to assist in finding and diagnosing breast cancer.⁶³ The solution is intended to assist doctors in providing patients with a more accurate diagnose. There are similar solutions currently being developed and tested in the US.⁶⁴ A research team from the National Institute of Health and Global Good have developed another image-based algorithm that can be used to identify cervical cancer.⁶⁵ The solution uses visual evaluation technology to scan images of a woman's cervix and can accurately identify changes that if left untreated, might develop into cancer.

AI is also used to facilitate the search for the cause of endometriosis. The cause of the disease remains unknown and many genes have been proposed and studied to explain its pathogenesis. To further the understanding of the results from previous research, a study

⁶⁰ Jämställdhetsmyndigheten. (2018).

⁶¹ Statistics Sweden. 2018. *Women and men in Sweden – Facts and figures 2018*.

⁶² Eichstaedt, J. C., Smith, R. J., Merchant, R. M., Ungar, L. H, Crutchley, P., Preotjiuc-Pietro, D., Asch, D. A. and Schwartz H. A., (2018), Facebook language predicts depression in medical records Proceedings of the National Academy of Sciences Oct 2018, 115 (44) 11203-11208

⁶³ Karolinska Institute, (2020), *AI ska optimera bröstcancerdiagnostiken*, <https://www.karolinska.se/om-oss/centrala-nyheter/2020/02/ai-ska-optimera-brostcancerdiagnostiken2/> [Retrieved 2020-06-04]

⁶⁴ QuantX, (2020), <https://www.qlarityimaging.com/>

⁶⁵ NIH, (2019), *AI approach outperformed human experts in identifying cervical precancer*, <https://www.nih.gov/news-events/news-releases/ai-approach-outperformed-human-experts-identifying-cervical-precancer> [Retrieved 2020-06-04]

used Natural language processing algorithms in order to rank endometriosis-related genes according to their score in an associated database.⁶⁶ The result was a suggestion on genes that appear to be promising candidates for further research.

AI TO PROMOTE REPRODUCTIVE HEALTH

There are several AI solutions regarding women's reproductive health that can monitor and assist reproductive cycles but also provide tailored responses to questions. [Grace Health](#) is a Vinnova-financed project that develops an AI powered chat bot aimed at women with the goal of assisting users to better understand their fertility, answer questions about contraception and other hygiene issues. By analyzing the anonymized questions submitted, the chatbot improves its answers, thereby offering even better help to the users. [Bonzun](#) is another Swedish developed app that acts as a virtual midwife, with the purpose of sharing relevant information about pregnancies. Women can track their pregnancy, look up their symptoms and check with an AI doctor bot what they mean. The app also explains test results and monitors progress, like the baby's movement, growth, and mother's blood pressure, over time.^{67,68} [NaturalCycles](#) is an application that provides women a non-hormonal solution for both preventing and planning pregnancies. Based on daily body temperature recordings, NaturalCycles' algorithm analyzes and monitors a woman's menstrual cycle and determines and predicts her fertile days.

AI in health apps can assist both men and women with their physical and mental health. [Babylon Health](#) is a digital health service that uses AI services to provide health information based on information that an individual enters. The health information provided is based on risk factors and statistics, rather than a personalized assessment.⁶⁹ There are not yet developed enough AI solutions to do full treatments of mental health issues, but several solutions exist to improve mental health. Two examples are (1) [Biobase](#), an AI-powered app that offers users to measure, track and manage stress⁷⁰ and (2) [Wysa](#), a conversational chatbot that makes use of AI and scripted answers that can provide therapy to users using a mobile app.⁷¹ A research study conducted at University of California uses an interactive voice-based AI in an app called [MyCoachConnect](#) to monitor the wellbeing of patients with serious mental illnesses.⁷²

AI CAN BE USED TO UNCOVER DISCRIMINATION IN THE HEALTH CARE SYSTEM

In addition to expanding upon these existing solutions, experts suggest that there are other areas within the scope of equal health in which AI solutions could be developed and used. For instance, AI solutions could be applied to analyze large amounts of healthcare data to discover if there are systemic differences and how these manifest and what the consequences are, perhaps showing whether there is a knowledge gap in gender specific care. AI could perhaps also be incorporated to analyze waiting time statistics and outcomes, specifically as it relates to gender, potentially allowing medical personnel to make improved determination whether a patient needs care immediately or can wait.

⁶⁶ Bouaziz, J., et al., (2018)

⁶⁷ Bonzun, (2020) <https://www.bonzun.com>

⁶⁸ Business insider. (2019) One of the most powerful female entrepreneurs in Sweden developed a virtual midwife to help fight the myths and misconceptions about pregnancy.

⁶⁹ Babylon Health, (2020) <https://www.babylonhealth.com/about>

⁷⁰ Biobeats, (2020) <https://biobeats.com/>

⁷¹ Wysa, (2020) <https://www.wysa.io/>

⁷² MyCoachConnect, (2020) <https://hss.semel.ucla.edu/portfolio/my-coach-connect/>

NOBIAS

NoBias is a Vinnova-financed project that develops a solution that helps companies and employees who lack the knowledge and resources to express themselves inclusively. The solution uses machine learning that eliminates prejudice and norms, by explaining what is non-inclusive and discriminatory. It also gives suggestions on how texts can be changed to become more inclusive, e.g. in as support to create inclusive recruitment advertisements.



Equal distribution of power



Equal distribution of power

CERETAI

Ceretai is a Vinnova-financed project that develops an automated tool designed for detecting discriminating norms and stereotypes in popular culture. The purpose of the tool is to increase awareness of how women and minorities are portrayed in culture and to enable audiences to make choices of movies based on their values. Ceretai also provides insights to the film making industry on discriminatory and stereotyped content in

ENTELO

Entelo is a recruitment platform designed both to automate several stages of the hiring process as well as to allow for anonymous applications. The automation process utilizes machine learning and predictive analysis to facilitate the hiring process at all different stages. This automation allows for the removal of potential biases interfering in the process and thus can both increase diversity as well as provide better employees



Economic equality



Equal distribution of power



Ending men's violence towards women

FORECASTING DOMESTIC VIOLENCE

Researchers at the University of Pennsylvania have developed an algorithm that can be used to predict whether a person charged with committing a domestic violence abuse is likely to repeat the offence if released prior to the court date. They show that by making prediction using background variables on an individual facing an arraignment decision, the level of repeat offences among released subjects could be lowered from 1 in 5 to 1 in 10.

6 MEN'S VIOLENCE AGAINST WOMEN MUST STOP

The sixth and final goal targets men's violence against women. The purpose of the goal is to ensure equal rights and opportunity to bodily integrity for men and women. The goal concerns physical, psychological and sexual violence against women as well as threats concerning violence against women. The goal also includes human trafficking, honor-related violence and prostitution. The bodily integrity of boys and men is included in the goal, but to highlight power structures concerning violence, the goal was formulated as written above. Men's violence against women is described as the utmost consequence of the unequal distribution of power between men and women.⁷³ According to a calculation done by the Swedish government, men's violence against women costs the Swedish society around 40 billion SEK every year.⁷⁴ The potential gain for society in combating and ceasing all violence against women is thus very large and there are many suggestions on how AI could be, and is being used to stop men's violence against women.

There are several studies and AI applications that are focused on reducing men's violence against women. The potential application is broad, and current solutions are used to identify repeated violence, trafficking and preventive work. There are several international examples of solutions, especially from the US, the UK and Canada.

AI TO ASSESS THE RISK FOR DOMESTIC ABUSE

An AI risk assessment tool to map and analyze behavior of men who are at risk of using violence against women could be a possible solution. *The Domestic Abuse, Stalking, Harassment and Honor Based Violence Risk Identification and Assessment and Management Model* (DASH) is a risk checklist with questions to be asked a victim of domestic abuse, developed to assist front line responder.⁷⁵ Depending on the context and answers, the results are used to determine whether the offence is likely to be repeated. While innovative, studies have shown that DASH is only marginally better than chance at predicting repeat offenders.⁷⁶ But efforts are being discussed that could improve the predictive power of the tool.⁷⁷ Another example is a paper on the utilization of machine learning in order to assist in arraignment decisions.⁷⁸ Using background data, the purpose of the solution is to assess the likelihood that an individual at an arraignment, facing a charge of domestic abuse, would repeat the offense before the court date if released. The results show that the algorithm can be used to better predict whether to release the offender or not. This could e.g. be helpful for the police and social services during investigations, to analyze what kind of support a family need and to recognize domestic violence and violent behavior.

AI TO IDENTIFY HUMAN TRAFFICKING

GPS data together with data from social media and picture analysis could also be used to create an AI tool to stop human trafficking. [Spotlight](#) is helping agencies in the US and Canada find child victims of human trafficking using a range of computer vision and NLP capabilities alongside analytics to identify thousands of victims of sex trafficking. It extracts information from images, e.g. phone numbers to find children from their last known number. The solution also detects and matches faces to images of missing and

⁷³ Jämställdhetsmyndigheten. (2018).

⁷⁴ SOU 2015:55, Nationell strategi mot mäns våld mot kvinnor och hedersrelaterat våld och förtryck, page 106

⁷⁵ Richards, L. (2009). Domestic abuse, stalking and harassment and honour based violence (DASH, 2009) risk identification and assessment and management model.

⁷⁶ Turner, E., Medina, J., & Brown, G. (2019). Dashing hopes? The predictive accuracy of domestic abuse risk assessment by police. *The British Journal of Criminology*, 59(5), 1013-1034.

⁷⁷ Terzis, P., Oswald, M., & Rinik, C. (2019). Shaping the State of Machine Learning Algorithms within Policing: Workshop Report.

⁷⁸ Berk, R. A., Sorenson, S. B., & Barnes, G. (2016). Forecasting domestic violence: A machine learning approach to help inform arraignment decisions. *Journal of Empirical Legal Studies*, 13(1), 94-115.

exploited children from open web data sources. The web-based tool has helped in identifying 14,874 child victims of human trafficking and 16,927 traffickers in the past four years. [Traffic Jam](#) uses facial recognition to help law enforcement find victims of sex trafficking and enable them to take down organized criminal networks. In 2019, Traffic Jam was used by law enforcement agencies to identify an estimated 3,800 victims of sex trafficking in the United States, Canada, and the United Kingdom.

AI TO HELP WOMEN IN EMERGENCY SITUATIONS

AI capabilities have the potential to prevent men's violence against women, but also to help women in emergency situations. [Nibye](#) is a Swedish-based organization that is developing a watch with an automatic man-down technology that can detect if a woman gets attacked and automatically send a notification to friends and family who can locate where the alarm was triggered, and if it was triggered manually or automatically.⁷⁹

Another potential AI solution to help women in emergency situations is smart surveillance solutions. In Sweden, there is a current pilot project where the police are improving their capabilities in face recognition to combat crime and identify suspects.⁸⁰ Facial recognition could thus be a potential AI capability in combating men's violence against women, although a lot of violence occur within a home setting.

AI TO DETECT SEXISM AND SEXUAL ABUSE

AI could also detect and map discriminating language and threats, during conferences and meetings, as well as on social media. AI solutions have also been used to categorize and map online recounts of sexism. Researchers at the Oxford Internet Institute conducted a study called *Topic Modeling for Everyday Sexism Project Entries* in which they developed a Topic Modeling algorithm that performed text analysis.⁸¹ The text analyzed was posts on the website [everdaysexism.com](#) which catalogs submitted stories about sexism in everyday life. The purpose of the study was to clarify patterns of sexual abuse and sexism in order to promote further analysis of how to counteract sexism and thus promote a more equal society.

THERE ARE OTHER AI SOLUTIONS TO HINDER MEN'S VIOLENCE AGAINST WOMEN THAT ARE YET TO BE REALIZED

Experts suggest that in order to develop AI solutions regarding men's violence against women, data from women's shelters and women's aid organizations could be collected. A paper from 2019 shows how a deep learning approach can be used to categorize posts in domestic violence crisis support groups on social media.⁸² Since the groups can be filled with awareness campaigns and prayers for victims, the categorization allows the user (law enforcement, health care workers or group administrators for instance) to quickly identify critical case where an intervention is necessary to prevent offences.

⁷⁹ Nibye (2020) <https://www.nibye.com/>

⁸⁰ SVT (2020) Polisen utökar kapacitet till ansiktsigenkänning med artificiell intelligens. <https://www.svt.se/nyheter/inrikes/polisen-utokar-kapacitet-till-ansiktsigenkanning-med-artificiell-intelligens>

⁸¹ Melville, S., Eccles, K., & Yasseri, T. (2019). Topic Modeling of Everyday Sexism Project Entries. *Frontiers in Digital Humanities*, 5, 28.

⁸² Subramani, S., Michalska, S., Wang, H., Du, J., Zhang, Y., & Shakeel, H. (2019). Deep learning for multi-class identification from domestic violence online posts. *IEEE Access*, 7, 46210-46224.



AI CAN ADDRESS GENDER EQUALITY

There are several examples and a consensus among the interviewed experts that there is great potential in using AI as a tool to solve gender related issues. AI capabilities have the capacity of structuring large amounts of unstructured data and analyzing large amount of structured data – image, video, text or speech - to compute predictions or classifications, e.g. to early detect signs of breast cancer, predict relapse of violence against women, to ensure that students receive equal access to education, detect norms and stereotypes in popular culture and how the actual speaking room is distributed among genders.

The identified solutions in our mapping link to Sweden's gender equality goals. The goals are in many ways interconnected and affecting each other, and thus also the solutions. Some solutions are already developed but not implemented in a wide scale. Several AI solutions improve gender equality in health, hinder men's violence against women and improves recruitment processes. We believe that this is where the most potential lies in the short term to realize benefits by applying and further developing existing solutions and building on experiences from other countries, e.g. around trafficking and monitoring systems or testing and evaluating recruitment tools. There is a lack of examples that relate to the unpaid housework, equal division of power and equality in education. We conclude that there is potential of using AI in all areas, but it is at a more immature stage and requires focused work going forward. Below we describe the potential in the different areas.

1

Equal division of power: Few AI solutions have a defined purpose of achieving a more equal division of power. However, many solutions impacting other goals are in fact contributing to changing power structures. There are several examples of how AI tools can be used in recruitment processes and to analyze representation in different forums. Our assessment is that **if implemented in a large scale and acted upon, there is a great potential for impact.**

2

Economic equality: Several AI solutions are being developed to improve economic equality, e.g. solutions that address an equal funding process. If implemented broadly and designed to overcome bias, there is a **potential to promote women's entrepreneurship.** There are developed AI solutions that can create a **more equal recruitment processes and salary setting.** Such solutions can both affect who gets formal access to power as well as access to better paid positions. An increased economic equality can improve conditions that align with other goals, e.g. equal health or unpaid housework.

3

Equal education: Several AI solutions aims to improve and create a more equal education, but few address gender equality in particular. But there are solutions that detect cyberbullying in social media text that can detect and prevent sexual harassments. We thus believe that there is potential in this area, especially in integrating AI technologies in education. But the examples are few, and **more research and development is needed.**

4

Equal distribution of unpaid housework: There are **no identified AI-solutions** that address the distribution of unpaid housework. We believe there is a challenge to address this in general, not just using AI. Public data on unpaid housework, such as register on parental leave, hours spent on housework etc. **can potentially be used to detect and visualize gender inequalities in a home setting.** Since the distribution of unpaid and paid work are connected, solutions that impact the economic equality can impact the distribution of the unpaid housework as well.

5

Equal health: The development in using AI in health care is increasingly gaining speed. AI can be used to better understand why certain diseases occur, such as the research on endometriosis. We conclude that **the potential to use AI to create a more equal diagnostics and treatment process is very large and the solutions are relatively developed.** But there is still a long way to go to being fully implemented, and aspects of integrity and secrecy needs to be handled on an ongoing basis.

6

Men's violence against women: There are **several AI solutions** that address men's violence against women. **AI tools are used by agencies in several countries** to detect trafficking and violent behavior. There are current ongoing studies to estimating the risk of domestic abuse. The solutions combating trafficking have proven to be efficient in the US and Canada. **The potential is thus very large.**

The potential does exist, but for this to be possible the right conditions must be created. This will be dealt with in the next chapter.

4. ENABLING AI TO SOLVE GENDER ISSUES

In the following section, we present key enabling factors needed to develop AI solutions for gender equality. These conclusions are based on discussions in interviews and workshop with experts. While there exist examples where AI is applied to help solve gender related issues, there is consensus among the interviewed subject-matter experts within AI and gender studies that there is much potential yet to be realized. We believe that for new solutions to be developed, there need to be a dialogue and collaboration between gender theorists, AI developers, entrepreneurs and problem owners. Our expert-workshop made it evident that gender theorists have a clear view of what issues need to be addressed. The AI experts on the other hand see the great potential in using AI to solve several societal issues. There are several enabling factors that need to be in place in order to realize the benefits of AI for gender equality. Some are general and adhere to data-driven innovation in general, and some are specific to AI for gender equality.

The key enabling factors that are specific to AI for gender equality are:

- Synergetic cooperation among problem owners, entrepreneurs, AI-engineers and gender studies experts
- A competent and diverse development team
- A structure for economic incentives
- Norm critical perspective in the development process

The more generic enabling factors are:

- Access to relevant data
- Regulation enabling innovation

4.1 Key enabling factors to realize the benefits of AI for gender equality

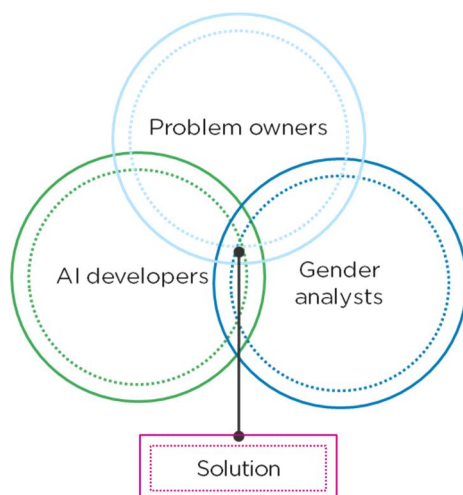
SYNERGETIC COOPERATION AMONG PROBLEM OWNERS, ENTREPRENEURS, AI-ENGINEERS AND GENDER STUDIES EXPERTS

Gender inequality issues are multidimensional, present in all parts of society and requires involvement of several different actors. These challenges are not only extensive, but also complex and systemic in nature. This means that it is often required that many different types of actors with the best understanding of how and why a specific problem occur in their context need to be involved to solve them. A solid identification of the problem, analysis of why it arises as well as a gender analysis is necessary in order to find proper use cases⁸³. For that, gender analysts need to cooperate with AI developers, together with problem owners, users and the ones affected by the issue at hand. The gender analyst provides knowledge and tools to conduct an analysis of why gender inequality problems occur and how they can be combated.

To realize the development of AI solutions that help reaching the goals of gender equality, a dialogue between gender theorists and AI developers needs to come into place to generate new ideas on how AI can be used to tackle gender inequality issues. A team with both technical know-how and knowledge in gender studies is more likely to develop high quality AI solutions approaching gender issues, than a team with a lack of knowledge in gender studies. Currently, the people studying gender theory are not the co-authors or co-creators of papers influencing the technical development and the two domains rarely meet, but the innovations arise in the conversations between them. There are several existing platforms and organizations working with using AI for social good: AI4All, the AI

⁸³ A use case is a description of the interaction between the user and a software system, defining what a solution is supposed to do. A use case is represented as a sequence of steps, beginning with a user's goal and ending when that goal is fulfilled.

for Good Foundation, DataKind, and Data Science for Social Good. None of these have a specific focus on gender equality.



There to, it is central to involve problem owners in the framing of a specific question or problem, and the development of AI solutions. Depending on what gender equality goal or domain that the solutions address, different problem owners should be involved, such as Skolverket regarding equal education, the regions regarding equal health or Försäkringskassan regarding equal division of unpaid housework. There is an issue of a growing distance between those who are designing and deploying AI solutions, and those who are affected by the solutions. The feedback from the ones using the solutions and facing the challenge, is crucial for the development of such systems. The workshop conducted with AI and gender experts adds that there is a great importance of including not only experts in AI and gender analysis, but also users and relevant organizations that owns the problem in the discussion of how systems could be adapted to work for their benefit.

A COMPETENT AND DIVERSE DEVELOPMENT TEAM

A diverse development team of AI solutions promotes innovative and inclusive capabilities. To build inclusion and diversity into AI design, teams need to keep gender roles and diversity in mind when developing different solutions interacting with different users. Different experiences and perspectives in the AI workforce are important, especially when developing AI for societal matters such as gender equality. But there is a high demand for AI skills globally as well as in Sweden. There is also a shortage of AI developers, and an even greater shortage of women in the AI field. The report "The Global Gender Gap Report 2020" by the World Economic Forum found that of the professionals in the AI area, only 26 percent are women. Of these, less than 20 percent are AI experts.⁸⁴ In line with Sweden's goal of gender equal education and the national goal of educating at least 1% of Sweden's population in AI, education needs to be adapted for several different target groups. There are initiatives that aims to increase women's interest and competence in AI. The Vinnova-financed project *AI learning platform in the equestrian sports* is developing a learning platform about AI in a female dominated industry, the equestrian industry. The platform uses existing AI applications in the equestrian sports with the aim to educate and encourage women in the community to engage in AI.⁸⁵

Our interviewed experts emphasize that a diverse workforce is not necessarily a workforce with equal distribution across gender, but also across age-groups, ethnicities and

⁸⁴ World Economic Forum (2020) The Global Gender Gap Report 2020

⁸⁵ Vinnova (2019) <https://www.vinnova.se/en/p/pilot-study-learning-platform-for-open-data-and-data-driven-innovation-in-the-horse-industry/>

knowledge areas (such as computer science, engineering, law, math, social science, gender studies and philosophy). Different organizations have pursued different strategies in reaching more diversified AI-design teams. Microsoft has created a framework for putting together inclusive design teams, to effectively consider the needs and sensitivities of different types of customers, including those with physical disabilities. The Diverse Voices project at the University of Washington has a similar goal of developing technology based on the input from multiple stakeholders to better represent the needs of underrepresented groups in the population.⁸⁶ Diversity in teams is especially important when developing AI solutions for gender equality issues, in order to ensure a good and truly helpful AI.

NORM CRITICAL PERSPECTIVE IN THE DEVELOPMENT PROCESS

AI for increased gender equality is about identifying and analysing an equality-related problem. This is done in the best way by creating a competent and diverse development team consisting of competences within AI and gender. However, although the team is diverse and competent, norms and preconceived notions could still impact the process. Therefore, it is not only necessary to incorporate gender analysis to the innovation process, but also a norm critical perspective. Products, services, and other solutions are today limiting many people since they are created from an increasingly narrow understanding of users' real needs. One reason is that there is often no knowledge of how norms and values affect new innovations and development work.

NOVA – tools and methods for norm-creative innovation

There are tools at hand to help incorporate a norm critical perspective into innovation processes. Vinnova has created a toolbox with concrete tools and hands-on methods for anyone who wants to create normative creative solutions. The material supports developers in both analyzing users' needs and translating knowledge into new thinking and value-creating solutions.

Source: Vinnova (2016) NOVA - Verktyg och metoder för normkreativ innovation

A STRUCTURE WITH ECONOMIC INCENTIVES TO DEVELOP THE SOLUTIONS

For solutions addressing gender equality to be developed and maintained, there must be enough incentives to make it happen. There are large economic benefits of gender equality, but the benefits could be realized somewhere else than where the investments are made. Thus, the willingness to pay is low. In some cases, the market or individual actors are unable to solve societal challenges on their own. Theoretically, there are three possible types of innovation failures: market failures, structural system failures and systemic switching failures.⁸⁷ Market failure occurs when actors underinvest in research and innovation (e.g. due to uncertain returns or that their own return is less than potential societal impact). Several of the interviewed experts' stress that there is a market failure that has not been rectified, which is the reason that AI solutions for gender equality is not being built. The question is also whether 1) there is a clear problem owner and 2) whether problem owners have the resources needed to develop such solutions or 3) whether they can pay for a solution developed elsewhere. To overcome that, public funding, venture capital and other external funding need to be made available.

AI solutions brings brand new business models that build on and use data. There are strong drivers for designing better services and systems, but the direct incentives are often lacking. Innovative organizations (business incubators, startups, innovative companies)

⁸⁶ Daugherty, P. R., Wilson, H. J. and Chowdhury, R., (2018) Using Artificial Intelligence to Promote Diversity. MIT Sloan Management Review. Winter2019, Vol. 60 Issue 2, p1-6. 6p.

⁸⁷ Weber, K.M./Rohracher, H. (2012): Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive 'failures' framework. Research Policy, 41, 1037-1047.

that can take ideas and turn them into sustainable AI solutions need to be engaged. In order to engage those actors, there is a need for incentives and conditions to do so. A potential sustainable business model for the solution is needed. The potential return on investment in building these solutions must be showcased.

4.2 Enabling factors relevant for all sustainable data-driven innovation

DATA IS KEY

Data is key to all AI applications. First, there need to exist data in the right format, with the right level of detail and the right content. In line with the increased digitalization in society there is more and more data available in digital form. But if the data quality is low and not gathered with the purpose of answering the defined questions, there could be a lot of data preparation work. Data produced in society is normally not standardized in such a way that it can be easily processed and combined with other data sources. Instead, extensive work is often required to make data useful. Second, the data availability is key. There is a lot of data that is being collected, but it is not always available for commercial or non-commercial purposes.

DATA REFLECTS EXISTING SOCIETAL ISSUES

AI must be understood as an integrated part of society with the benefits, drawbacks, challenges and structures that society holds. An order to understand the potentials and barriers in developing AI solutions, the context where the data is collected also needs to be understood. In chapter 2, bias in data was briefly discussed. Since data reflects society and the norms and structures that comes with it, potential underlying bias needs to be acknowledged. There could be both issues with what is in the data, regarding lack of representation and diversity, but also issues regarding what is missing in the data.

To counteract such biases, diverse development teams should consider potential issues in the training data or sample intelligently from them. With potential existing bias in mind, developing teams need to be very transparent and explicit about what assumptions the predictions are based on, and what choices have been made during the development. It should be easy to identify the choices and assumptions made by the developers that leads to a decision or prediction.

INVESTMENTS TO OVERCOME GENDER BIAS ARE BEING DONE

There are several initiatives to identify and handle bias in data. AI researchers from the initiative CIFAR have launched a large-scale natural dataset, StereoSet in English to measure stereotypical biases such as racism, sexism, and other forms of bias in AI language models.⁸⁸ Several large tech companies are making investments to develop solutions that handle gender bias. Google has recently launched improved algorithms for Google Translate that address gender bias by rewriting or post-editing initial translations. Facebook has also published a recent technical paper with a framework that decomposes gender bias in text to annotate data and identify gender bias classifiers.⁸⁹

AI Sustainability Center has, with funding from Vinnova, developed a commercial tool that detects vulnerabilities and avoids pitfalls when using AI and data-driven solutions. The tool is based on interdisciplinary knowledge with the aim to improve how companies work with data and AI and to reduce the risks of unwanted outcomes such as biased, incomplete and unsatisfying results. The risks that the tool can identify are:

⁸⁸ Nadeem, M., Bethke, A., & Reddy, S. (2020). StereoSet: Measuring stereotypical bias in pretrained language models. ArXiv, abs/2004.09456.

⁸⁹ Dinan, E., Fan, A., Ledell, W., Weston, J., Kiela, D., Williams, A. (2020). Facebook AI Research. <https://arxiv.org/pdf/2005.00614.pdf>

- Missuse/Overuse of data – AI can create violation of identity for users and citizens that they cannot understand or identify.
- Data bias – If the data used for the AI does not represent the reality or the preferred reality.
- Immature AI – Usage of low-quality data, non-validated data or unstructured data or AI methods/techniques that are not prepared for the task or developed incorrectly.
- Bias of the creator - Who is creating the AI and gathering the data, is there a potential agenda behind the work that can create bias?

REGULATIONS AND POLICIES

With the development of AI capabilities, the demand for personal data has increased. Access to personal data allows systems to do a range of personalized tasks, from tailoring content to individuals, to predicting outcomes with personal characteristics. At the same time, there are laws and policies surrounding data that protect people's rights to their own data to a certain extent. Regulations such as GDPR can impact the development of such tools. Different domains hold different regulations and standards that must be addressed. The health care sector is e.g. heavily regulated, and the application of new technologies and processes often takes a long time to reach acceptance. Important systemic challenges for the use of AI in this sector lie in regulatory barriers and uncertainties.⁹⁰ Thereto, in addition to the legal aspect, there are different policies and cultural conditions that affect the possibility of implementing different solutions. The majority of solutions and studies presented in the report originate in other countries where cultural conditions such as different views of integrity could be a potential barrier.

AI capabilities introduce questions around privacy and integrity, that must be understood and managed. Some information and data that can be used to develop AI tools to solve gender equality issues are very sensitive, e.g. regarding men's violence against women or minors.

⁹⁰ Vinnova (2018) Artificiell intelligens i svenskt näringsliv och samhälle – Analys av utveckling och potential. Rapport VR 2018:08

5. RECOMMENDATIONS ON HOW TO SUPPORT AI FOR GENDER EQUALITY

We have presented several examples of how AI solutions could have large social impact as a tool of many to combat gender inequality. In the following chapter, we present our recommendations to Vinnova on how to support a development where AI is applied to contribute to increased gender equality.

5.1 AI can promote gender equality

There are several examples and a consensus among the interviewed experts that there is potential in using AI as a tool to solve gender related issues. To achieve Sweden's gender equality goals, new approaches are needed, and AI has the potential to transform society and to generate new solutions and applications. Depending on what and how many organizations that adopt AI solutions to promote gender equality, the societal impact can be very large. Solutions that help improve women's health and reduce men's violence against women have a great potential to generate a large and direct impact on gender equality. There are several examples of AI solutions that address both recruitment as well as capital funding processes that could possibly have a large impact if developed the right way and used broadly. There are also AI solutions that may not have a direct impact on gender equality, but that can contribute in analyzing and visualizing norms and behaviors that enforces gender inequality.

However, today there is a lack of knowledge, incentives and contact areas between organizations and individuals with knowledge in AI, gender equality and problem owners of gender inequality challenges. There are several examples where AI is used to solve gender equality, but most of them are international. Although Sweden has leading competence in gender analysis and continues to rank high in innovation indexes, the tech sector and gender analysis rarely combine knowledge in the development of new solutions, especially between the two domains AI and gender. In order to contribute to the development, we give Vinnova the following recommendations on how to further promote AI to contribute to gender equality.

Formulate missions based on gender equality policy goals

Gender inequality issues are complex and require different approaches and efforts to be solved. There is an ongoing effort at Vinnova in transforming how the agency works, to become more mission oriented. Missions as an approach is based on cross-sectoral and cross-industry collaborations and requires a mix of top-down and bottom-up initiatives with a common direction.⁹¹ Missions are basically about formulating specific problems (missions) that relate to an overall challenge (e.g. gender inequality). The purpose of this is partly to set the framework for what needs to be solved and to promote innovation. In other words, missions mean a process where concrete and clearly defined problems (without an obvious solution) that demands different types of efforts, will be solved over a fixed period of time. A mission-oriented approach requires experimentation and thinking outside the box to come up with new solutions to address the mission objective that is set. The objective needs to be addressed by multiple actors with different perspective by promoting cross-discipline work, with a strong focus on the intersection between different research domains, collaborations across different industries; and new forms of partnerships between the public sector, the private sector and civil society organizations.⁹² We believe that discussions that take a starting point in Sweden's gender equality goals could be used to define missions connected to SDG goal 5 (and 10).

⁹¹ Vinnova (2020) <https://www.vinnova.se/m/missions/>

⁹² Mazzucato, M. (2018) Mission-Oriented Research & Innovation in the European Union. doi:10.2777/360325

Create platforms for knowledge exchange between problem owners, AI experts and gender analysis

To enable the development of AI solutions to solve gender inequality, a further dialogue between problem owners, AI experts and gender experts need to be facilitated. AI development requires large investments in collaboration between different actors. This interaction has no forum today. There is thus a need for a platform where different actors gather in co-creative processes to mobilize within the area, where AI and gender analysis is the core. We believe that Vinnova can facilitate such a platform and meeting place where domains meet and ideas within AI and gender equality are created and developed.

To get beyond generating new knowledge and closer to actual innovation, there should be funding connected to the platform. This to increase incentives for the business community to collaborate and co-create with problem owners. The platform can be organized around missions to ensure an action-driven platform focused on real impact. Funding is required for the development of new technology and new working methods. Innovators who are interested and have ideas could potentially apply to solve the gender equality challenges that have been defined together with problem owners.

Collaborate to make data available

All AI solutions require data. Making government owned datasets open and accessible can help stimulate innovations and development of new AI solutions. Agencies should actively collaborate to make data available under open licenses. To identify key datasets to make public, data sources need to be made visible for companies to generate interest and value business demand. Hackathons or data labs can generate visibility of what public datasets that are available and what potential benefits there are in developing the solutions.

A first step is to ensure that gender-segregated statistics are collected and accessible to companies. Datasets need to be made available in the appropriate format for AI solutions, e.g. by providing access through application programming interfaces (APIs), releasing metadata and descriptions of datasets.

New innovations require not only the use of existing data sources, but also the creation of new data sources in new forums, e.g. to study behavior in classrooms or meeting rooms. To enable this, problem owners must be involved and grant access to such forums. There are examples from both a Swedish⁹³ and an international⁹⁴ context to build further on. UN Global Pulse is a UN-initiative on big data and artificial intelligence for development, humanitarian action, and peace.

Acknowledge the bias, but focus on communicating – and realizing - the potential

A conclusion from the work with the report is that the knowledge on how AI can help gender equality is scarce and most research and discussions are around bias in AI solutions and what gender inequality problems that can arise. This report shows that there is a clear potential in AI doing the opposite, improving gender equality. However, we believe that this must be showcased by informing, communicating and making the potential societal gain visible. Bias in AI solutions is an issue that must be acknowledged and handled in the right way. But this is the case for all AI solutions. The potential lies within creating new solutions that are not only adapted to not being unequal but creates a society that is gender equal. It is therefore important to disseminate information about the research, development and innovation regarding AI for gender equality to the public sector, users and the general public.

⁹³ Rikare II

⁹⁴ Gupta, S.K., Ashwin, T.S. & Guddeti, R.M.R. (2019)

ADAPT COMMUNICATION TO DIFFERENT TARGET GROUPS

Reaching several target groups requires adapted communication. Several formats and channels could be relevant to reach out and communicate the results from this report and Vinnova's work on AI to promote gender equality. Therefore, the development of a communication plan is a relevant next step with headings as target groups, the desired change that the target groups make, channels, messages to each target group, communication activities, action plan, organization and follow-up. The next step could be formulated in two tracks 1) packaging and communicating examples that Vinnova is funding and showcase the potential impact, and 2) analyzing and communicating the socio-economic benefits. Different formats can be relevant for different target groups. The target groups could potentially be:

- stakeholders within the Swedish and EU government to put it on the political agenda,
- investors to increase interest and funding for AI solutions to promote gender equality,
- entrepreneurs to engage innovative companies to develop solutions
- AI experts to engage in collaborative platforms to define potential use-cases
- gender studies experts to engage in collaborative platforms to incorporate gender analysis in problem definitions
- universities to stimulate interest in further studies and encourage collaboration between research and tech

STUDY AND HIGHLIGHT THE SOCIO-ECONOMIC EFFECTS OF AI FOR GENDER EQUALITY

To know what investments and solutions will give the most effect, the potential economic benefits should be studied and highlighted. There are some studies on specific areas, such as men's violence against women, that highlights the large costs for society. But to show the potential in investing in AI solutions for e.g. venture capitalists, decision-makers, an economic analysis of the benefits should be conducted. The purpose of a socio-economic analysis is to reach an audience that normally doesn't engage in the area. This type of study is particularly important for communicating with policy-makers and investors. It can be of certain importance regarding innovations to promote gender equality since the benefits take relatively long time to achieve (changing structures takes time). The benefits are also societal and potentially realized among other organizations or people than those who made the investment, such as women and men whose lives are improved as a result of the solutions.

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