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Master Thesis

Transhumanist Techno Dystopia

The philosophy, intentions and risks of Transhumanism, Longtermism and Posthumanism for society from sociopolitical and economic perspective

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Abstract

The aim of this work was to examine the impact of the transhumanist agenda on science and technology policy and on socio-political and economic structures. The focus was on the question of how transhumanist technologies, in particular genetic modifications, neurotechnologies and artificial intelligence, could affect society and the economy, especially social inequalities and the economic distribution of power. To this end, a systematic literature review was conducted according to the PRISMA model. The results of the work show that the effects of the technologies are still unclear due to their early stages of development. However, initial indications suggest that transhumanist technologies have the potential to worsen existing social inequalities. Unequal access to genetic enhancements and technological augmentations could lead to an increasing division of society, with wealthy individuals and companies receiving preferential access to these technologies. This could deepen the gap between technologically enhanced and non-enhanced people. Furthermore, the "transhuman market" could contribute to the monopolization of technological innovations. Large technology companies, which already occupy a dominant position in the global economy, could further expand their power through exclusive access to transhumanist technologies. This carries the risk of economic concentration, which makes free access to these technologies more difficult and further increases social inequalities. However, the work has several limitations. Since many of the technologies considered are still speculative and robust empirical data is lacking, the results are largely based on theoretical assumptions and models. Furthermore, the analysis was focused primarily on Western, industrialized countries, which could limit the global relevance of the conclusions. Also, not all potentially relevant transhumanist technologies were comprehensively addressed, which limits the breadth of the analysis. The results show that comprehensive political regulation is needed to manage access to transhumanist technologies and to minimize ethical and social risks. Future research should focus on empirical studies, new regulatory mechanisms, and ethical frameworks to better understand and shape the long-term impact of these technologies.

Zusammenfassung

Ziel dieser Arbeit war es, die Auswirkungen der transhumanistischen Agenda auf die Wissenschafts- und Technologiepolitik sowie auf sozio-politische und wirtschaftliche Strukturen zu untersuchen. Im Mittelpunkt stand die Frage, wie sich transhumanistische Technologien, insbesondere genetische Veränderungen, Neurotechnologien und künstliche Intelligenz, auf Gesellschaft und Wirtschaft, insbesondere auf soziale Ungleichheiten und die wirtschaftliche Machtverteilung, auswirken könnten. Zu diesem Zweck wurde eine systematische Literaturanalyse nach dem PRISMA-Modell durchgeführt. Die Ergebnisse der Arbeit zeigen, dass die Auswirkungen der Technologien aufgrund ihres frühen Entwicklungsstadiums noch unklar sind. Erste Hinweise deuten jedoch darauf hin, dass transhumanistische Technologien das Potenzial haben, bestehende soziale Ungleichheiten zu verschärfen. Der ungleiche Zugang zu genetischen Verbesserungen und technologischen Erweiterungen könnte zu einer zunehmenden Spaltung der Gesellschaft führen, wobei wohlhabende Personen und Unternehmen bevorzugten Zugang zu diesen Technologien erhalten. Dadurch könnte sich die Kluft zwischen technologisch verbesserten und nicht verbesserten Menschen vertiefen. Außerdem könnte der „transhumane Markt“ zu einer Monopolisierung technologischer Innovationen beitragen. Große Technologieunternehmen, die bereits eine beherrschende Stellung in der Weltwirtschaft einnehmen, könnten ihre Macht durch den exklusiven Zugang zu transhumanen Technologien weiter ausbauen. Dies birgt die Gefahr einer wirtschaftlichen Konzentration, die den freien Zugang zu diesen Technologien erschwert und die sozialen Ungleichheiten weiter verstärkt. Die Arbeit hat jedoch mehrere Einschränkungen. Da viele der betrachteten Technologien noch spekulativ sind und es an robusten empirischen Daten fehlt, basieren die Ergebnisse weitgehend auf theoretischen Annahmen und Modellen. Außerdem konzentrierte sich die Analyse hauptsächlich auf westliche Industrieländer, was die globale Relevanz der Schlussfolgerungen einschränken könnte. Auch wurden nicht alle potenziell relevanten transhumanistischen Technologien umfassend behandelt, was die Breite der Analyse einschränkt. Die Ergebnisse zeigen, dass eine umfassende politische Regulierung notwendig ist, um den Zugang zu transhumanistischen Technologien zu steuern und ethische und soziale Risiken zu minimieren. Zukünftige Forschungen sollten sich auf empirische Studien,

neue Regulierungsmechanismen und ethische Rahmenwerke konzentrieren, um die langfristigen Auswirkungen dieser Technologien besser zu verstehen und zu gestalten.

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List of abbreviations

AC	Artificial creativity
AI	Artificial intelligence
BCI	Brain-computer-interface
CONTECS	Converging Technologies and their impact on Social Sciences and Humanities
CRMN	Center for Research on Microelectronics and Nanotechnology
CT	Convergence Technologies
DNA	Deoxyribonucleic acid
EU	European Union
GPT	Generative Pre-trained Transformer
HET	Human Enhancement Technologies
NBIC	Nanotechnology, Biotechnology, Information Technology, Cognitive sciences
NT	Neurotechnology
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RIMiNaS	Program for Research and Innovation on Micro and Nanotechnology for Sensors
RNA	Ribonucleic acid
rTMS	Repetitive transcranial magnetic stimulation
SKINDEV	Skin Microbial Devices
TMS	Transcranial magnetic stimulation
UNESCO	United Nations Educational, Scientific and Cultural Organization
WTA	World Transhumanist Association

1. Introduction

1.1 Background and problem definition

People have always been concerned with the question of how their natural limitations and weaknesses can be overcome. The desire to minimize or even completely eliminate physical, mental and intellectual deficits is at the forefront of this. While in the past the answers to this question were mostly sought in faith and religion, current efforts are based more on science and technology (cf. Lange, 2021, pp. 287). In recent decades, scientific and technological research has become homogenized. The interdisciplinary movement to improve humans through technology is called transhumanism (cf. Dreher, 2023, p. 6). Transhumanism pursues the idea of significantly increasing human potential through rational thought and technological innovation. The focus is on the use of modern technologies to extend lifespans, increase cognitive abilities and optimize physical and emotional functions. Examples of such technologies include genetic engineering, artificial intelligence (AI) and neurotechnology (NT), which can fundamentally change human nature. Proponents of this current see humans in their current form as incomplete and in need of improvement. They advocate the use of technological means for the continuous "further development" of humans and often push the question of the ethical and social implications of this progress to the background (cf. Lange, 2021, pp. 287). However, critics warn that the inconsiderate use of such technologies could lead to profound societal and moral challenges, particularly in terms of social justice.

The tension between social justice and transhumanist developments is growing in intensity. The Western hemisphere, above all the USA, is playing a pioneering role in the discipline of transhumanism, which is largely due to the highly developed tech companies in Silicon Valley, whose expertise and resources lie in the high-tech sector. One prominent example is the company Neuralink, founded by Elon Musk, which is researching brain implants. These are intended to enable people to control computer programs and improve their ability to learn languages or memorize information. In addition to operating technologies, Neuralink also aims to improve people's cognitive abilities (cf. FAZ, 2024). Another example is Microsoft, which is working intensively

on AI. The company's AI can currently mostly help users with online searches, but the longterm plan is to integrate AI into smart glasses that users can wear in their daily lives (cf. Microsoft, 2024). With this, human performance is enhanced by external technologies. A possible future development step is to combine the AI with Neuralink implants, which could connect the AI directly to the human brain.

One of the best-known examples of AI is ChatGPT, a text-based dialog system developed by OpenAI. ChatGPT is based on GPT technology (Generative Pre-trained Transformer) and was released in December 2022 with the free version GPT-3.5 (cf. Wolfhart, 2023, p. 11; Eichstädt & Spieker, 2024, pp. 400). The basis for this system is GPT-3, which was updated to the more recent version GPT-4 in June 2023. ChatGPT is designed to respond to natural language and answer questions in a conversational format (cf. Wolfhart, 2023, p. 11). ChatGPT's capabilities are diverse and include text generation in different styles, including articles, stories, poems and even technical programming support such as creating APIs in Python. In education, ChatGPT is increasingly used as a tool for support (cf. Eichstädt & Spieker, 2024, p. 404). A key advantage of this system is the storage of information from previous conversations to provide contextual references, as well as the ability for users to make follow-up corrections (cf. Wolfhart, 2023, p. 11). Chat-GPT can be understood as an intelligent tool to which people can give text-based commands to facilitate tasks or improve their own performance. Despite its versatility, ChatGPT also has limitations. It sometimes generates false or misleading information and can occasionally create biased content. In addition, ChatGPT's knowledge of events after September 2021 is limited, which limits its accuracy on more recent topics (cf. Wolfhart, 2023, pp. 11; Eichstädt & Spieker, 2024, pp. 404). AI and artificial creativity (AC) are still fallible at their current state. Nevertheless, it offers great potential for the future of AI in areas such as education and the work, where it is becoming increasingly important as a tool for text and programming creation (cf. Eichstädt & Spieker, 2024, pp. 400).

While AIs that help users with everyday tasks such as searching for information on the internet can be made accessible to a broad mass of people, the situation is different for advanced transhumanist developments. As they are developed and distributed by leading companies in the neoliberal and capitalist Western economy, critics assume that the transhumanism market will develop into a consumer market and thus further intensify social inequalities (cf. Huppenbauer, 2021, pp. 674; Warso & Gaskell, 2019, pp. 23, 25). Wealthy customers will be able to afford technological improvements, and less affluent customers will not. In this context, an EU research group criticized the developments of the neoliberal transhumanist agenda as early as 2008 and warned of negative effects on social justice (cf. Andler et al., 2008, pp. 2). In addition to this research group, other researchers also recognize significant points of criticism, which are essentially based on the orientation of the current transhumanist agenda (cf. Huppenbauer, 2021, p. 667). This is where the research approach of this paper arises.

1.2 Objectives, research question and procedure

The aim of the thesis is to examine the current transhumanist agenda and assess its social and economic impact. To this end, the motives and goals of the transhumanist movement are first presented. The current state of development is then analyzed to determine the actual progress and future direction of the technologies. On this basis, the possible consequences for society and the economy will be derived. The following research question forms the central theme of the work:

CR: What are the impacts of the transhumanist agenda for science and technology policy? What are the possible socio-political and economic implications?

The systematic literature review based on the PRISMA model is devoted to the ethical dilemma that the transhumanist movement could reinforce social inequalities. Section 2 begins with the theoretical foundations of the topic. The aim of this section is to comprehensively explain the main concepts of transhumanism, longtermism and posthumanism and thus their aims and motives. Section 3 deals with the current state of the art and developments in the field of transhumanism. To this end, international and EU-wide legal frameworks are explained, a detailed analysis of current fields of research is carried out and previous approaches to the integration of transhumanist

concepts are examined. In addition, transhumanist projects in the EU are presented and the criticism of transhumanism is examined from the perspective of humanism. This criticism forms the basis for the systematic literature analysis. The methodology of the literature analysis is explained in detail in section 4, followed by the presentation of the results of the analysis in section 5. Section 6 contains a discussion of these results, before a conclusion is drawn in section 7 and an outlook on the future development of the topic is given.

2. Theoretical background

This section of the paper is intended to show what goals and motives the transhumanist agenda is pursuing. It is important to distinguish between the three main currents, each of which is concerned with the improvement of humans through technology and science: transhumanism, longtermism and posthumanism. In the following, transhumanism, its concepts, premise and actors will be discussed first, after which the two currents of longtermism and posthumanism will be addressed.

2.1 Transhumanism

2.1.1 Definition and origin

Transhumanism is a philosophical and cultural movement that exists as a philosophy of life, an intellectual phenomenon and a field of research. The focus is on overcoming human limitations through the use of advanced technologies such as genetic engineering, nanomedicine, stem cell research, cryogenics and digital technologies to expand human potential (cf. Dreher, 2023, p. 6; Puzio, 2022, pp. 25). The movement aims to transform humans into a posthuman existence, with the desired capabilities far exceeding those of current humans. The aim is to significantly increase and expand the intellectual, physical and psychological abilities of humans (cf. Lange, 2021, pp. 288; Puzio, 2022, p. 27).

The prevailing belief is that humans are flawed and must be continuously improved and adapted to meet future challenges. Transhumanism is based on an optimistic belief in progress that accepts major risks that may arise in the further development of humans (cf. Lange, 2021, pp. 288). In contrast to posthumanism, which views humans as pluralistic beings and questions existing anthropocentric categories, transhumanism focuses on the technological advancement of humans with humans themselves at the center. In transhumanism, humans are seen as primary actors who bear the responsibility to shape and optimize both themselves and the environment according to their own ideas (cf. Braidotti, 2016; Puzio, 2022, p. 34). Within this movement, there is a variety of ideas and currents that focus on different aspects of human improvement and evolution. Adherents of transhumanism can be found in a number of

scientific and social fields, including art, which often provides inspiration for the external design of humans (cf. Dreher, 2023, p. 5; Lange, 2021, p. 288).

The origins of transhumanism can be traced back to ancient myths such as the Epic of Gilgamesh, which thematizes the quest for immortality (cf. Puzio, 2022, p. 50). The quest to overcome human limitations is deeply rooted in human thought and can be found in the philosophy of Renaissance humanism, which emphasized free will and the pursuit of self-improvement, as with Giovanni Pico della Mirandola in the 15th century. Scientific evolutionary theories by Charles Darwin and the idea of overcoming man by Friedrich Nietzsche created the theoretical foundations for transhumanism (cf. Puzio, 2022, p. 50; Lange, 2021, p. 290, pp. 328).

The first concrete transhumanist concepts were developed at the beginning of the 20th century by pioneering thinkers such as J. B. S. Haldane, who foresaw genetic improvements in humans (cf. Puzio, 2022, p. 28). The term "transhumanism" was coined in the 1950s by Julian Huxley, who considered it in the context of a new evolutionary stage of humans (cf. Lange, 2021, p. 291; Puzio, 2022, p. 26). In the 1980s and 1990s, transhumanism emerged as an independent movement, including through Extropy Magazine and the founding of the Extropy Institute. Other pioneering thinkers such as Robert Ettinger, known as the father of cryonics, and Fereidoun M. Esfandiary contributed to the further development of transhumanist concepts (cf. Dreher, 2023, p. 20, pp. 28, 31).

Due to technological progress and the new possibilities of realizing transhumanist visions, transhumanism has developed into a heterogeneous movement in the last decades of the 20th century, which is discussed and promoted in various scientific disciplines and technological fields. Rapid technological development and the influence of global capital structures, particularly in the field of digital technologies, have further advanced the discussion and implementation of transhumanist ideas. Nevertheless, transhumanism is not only understood as a visionary pursuit, but is also viewed critically, as social inequalities, ethical problems and unforeseeable risks could be associated with the radical change in human nature (cf. Lange, 2021, p. 287; Dreher, 2023, p. 13). In the following chapter, the core premises and philosophy of transhumanism are further elaborated.

2.1.2 Core premises and philosophy

Transhumanism is a multidimensional movement that encompasses both a philosophy of life and an interdisciplinary field of research. The focus of this movement is the endeavor to overcome human limitations and weaknesses through modern technologies. This includes the significant improvement of human intellectual, physical and psychological abilities. The philosophy of transhumanism emphasizes the importance of self-transformation and individual freedom, emphasizing the autonomy of the individual in the choice of technologies (cf. Dreher, 2023, pp. 5; Puzio, 2022, pp. 25). A positive attitude towards technological progress is considered necessary to continuously optimize human existence. Transhumanists advocate the use of technologies such as genome editing, nanomedicine, cryonics, cyborg technologies and mind uploads to overcome the biological limitations of the human body and enable a transformation towards a posthuman existence (cf. Lange, 2021, pp. 288).

In this view, humans are no longer seen as the end point of evolution, but as a being that controls its own further development through the targeted use of technical means (cf. Lange, 2021, p. 289; Dreher, 2023, pp. 6). This evolutionary development views the human body as inadequate, recognizing an interdependence between body and mind, both of which are seen as in need of improvement. Transhumanist philosophy thus challenges the traditional view of the human being as being in complete need of improvement and argues for a fundamental renewal of human nature and social structures (cf. Dreher, 2023, pp. 6). In this context, humans are seen as possessing the power to radically change and control both themselves and the environment. Beyond individual technological improvements, transhumanism strives for a transformation of society as a whole based on the principles of freedom, innovation and responsibility (cf. Dreher, 2023, pp. 12; Lange, 2021, p. 290).

Despite the optimistic view of technological progress, transhumanists recognize the potential dangers and risks, especially regarding possible misuse and the deepening of social inequality. Nevertheless, there is a conviction that these risks can be controlled through responsible, morally sound decisions that also take future generations into account (cf. Lange, 2021, pp. 294). In the following chapter, central actors and

concepts of transhumanism are explained. The chapter begins with the Humanity+ organization.

2.1.3 Actors and terms

Humanity+

Humanity+, originally known as the World Transhumanist Association (WTA), was founded in 1998 at the Transvision98 conference in Weesp, in the Netherlands. Initiated by Nick Bostrom and David Pearce, the organization aimed to coordinate European transhumanist groups and promote transhumanism as a movement. The original function was to create a network that supported the spread of transhumanist ideas in Europe (cf. Kürger, 221, p. 78).

The WTA's aspirations included the belief that human nature could and should be profoundly changed through the use of technology. This included defending the right to use technology to enhance mental and physical capabilities. In addition, the organization advocated the personal growth of humans beyond their current biological limits (cf. Kürger, 221, p. 78).

In 2008, the company was renamed Humanity+ to place greater emphasis on its impact on humanity as a whole. Natasha Vita-More took the helm from 2010 to 2018, followed by Ben Goertzel. Other influential figures shaping Humanity+ are Anders Sandberg, Aubrey de Grey, Martine Rothblatt and Eliezer Yudkowsky (cf. Kürger, 221, pp. 78).

Table 1 below lists the essences of the eight points of the transhumanist declaration of Humanity+:

No.	The Transhumanist Declaration
1.	Humanity will be profoundly shaped by future technologies, potentially overcoming aging, cognitive limits, suffering, and Earthly confinement.
2.	Human potential is largely unrealized, with possibilities for greatly improved conditions.
3.	Misuse of new technologies poses serious risks, threatening valuable aspects of humanity.
4.	Research is needed to understand and mitigate risks while promoting beneficial advancements.
5.	Reducing existential risks and improving health, foresight, and wisdom should be urgent priorities.
6.	Policies should balance risks and opportunities, respecting rights, dignity, and future generations.
7.	We advocate for the well-being of all sentient beings, including humans, animals, and future intelligences.
8.	Individuals should have wide personal choice in using technologies for self-enhancement and life improvement.

1 **Tab. 1.** Own presentation of the Transhumanist Declaration (cf. Humanity+, 2024b)

Among other things, Humanity+ clears up misunderstandings about transhumanism, such as the misconception that it only promotes elitist immortality. Instead, the movement strives for healthy longevity and access to technology for all. Technologies such as nanotechnology, biotechnology and AI should be used safely and ethically for the benefit of humanity (cf. Humanity+, 2024a).

In addition, the organization is concerned with life extension and the fight against aging. The transhumanist movement has developed over 30 years of knowledge focused on curing disease and slowing aging through modern science. Advances such as cochlear implants, regenerative medicine and smart prosthetics show how technology has already enhanced human capabilities. Humanity+ strives for a world in which technology expands human potential far beyond what was previously normal[1], while treating all life forms on Earth with respect (cf. Humanity+, 2024a).

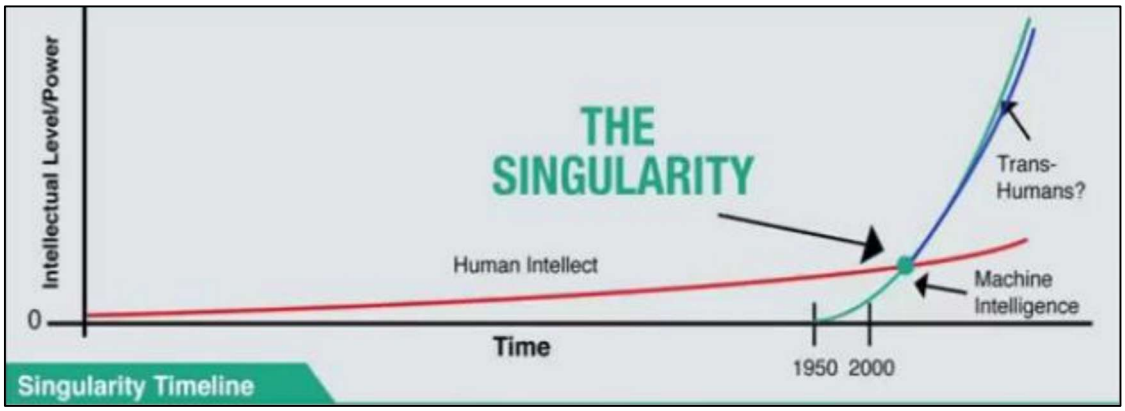
[1] Humanity+'s definition of "normal" human for their purposes consists of a generally healthy homo sapiens sapiens as evolved approximately 200,000 years ago with a maximum lifespan of 122-123 years. So likewise, as any enhancement would ascent a human beyond "normal", an ill person or someone with a physical affliction would differentiate from this supposed normality. As we are constantly accompanied by smartphones or other wearables, devices such as the mentioned cochlear implants or bionic eyes are being inserted into bodies and stem cell therapies and other enhancing interventions or ingestion products are being actively used, Humanity+ says the general perception of what is considered "normal" is lagging behind the actual use of modern technology one way or another anyway. (cf. Humanity+, 2024a)

Humanity+ also publishes the Journal of Evolution and Technology, an important platform for the discussion of technological and ethical issues in the context of transhumanism (cf. Kürger, 221, pp. 79). In the following, the technological singularity is presented as an essential concept of transhumanism.

Technological singularity

The Technological Singularity refers to a hypothetical event in which an Artificial General Intelligence acquires the ability to improve itself autonomously. This process could lead to ever more powerful machines being designed, resulting in an "intelligence explosion". As a result, an intelligence would emerge that far exceeds human understanding and control (cf. Silpa et al., 2020, p. 55). The Singularity thus describes a turning point at which superintelligence could improve itself or create more intelligent systems, resulting in an exponential increase in intelligence. This development could herald the end of human superiority, as machines would have significantly higher computing power than human brains (cf. Diéguez & García-Barranquero, 2024, p. 238).

The term "singularity" has its origins in physics, where it describes states in which the known laws of nature are no longer applicable, such as in black holes. In technology, it was used by Vernor Vinge and Ray Kurzweil to characterize the point at which machine intelligence surpasses human intelligence (cf. Diéguez & García-Barranquero, 2024, pp. 238). As early as 1958, the term was coined by Stanislaw Ulam in reference to John von Neumann, while Vernor Vinge popularized it by emphasizing the unpredictability of the future through superintelligence (cf. Silpa et al., 2020, p. 55). Figure 1 below shows the Singularity Timeline.



1 **Fig. 1.** Technological Singularity (Silpa et al., 2020, pp. 55)

Possible causes of the singularity include the development of AI, biological improvements to humans or brain-computer interfaces. Various predictions forecast when the Singularity will occur: Vernor Vinge expects this event to take place before 2030, while Ray Kurzweil predicts it will happen in 2045. It is generally assumed that a possible time span of five to 100 years is possible (cf. Silpa et al., 2020, p. 55).

Kurzweil argues that the exponential growth of computing power, as described by Moore's Law, will eventually surpass human capabilities. In the context of transhumanism, the Singularity is seen as a turning point at which technological and intellectual developments could radically expand human potential. After the Singularity, however, it would be difficult to predict the consequences and life in a post-singular world (cf. Silpa et al., 2020, p. 55). It also marks the culmination of the fusion of man and machine, after which there would no longer be a distinction between physical and virtual reality (cf. Diéguez & García-Barranquero, 2024, p. 238).

There are both risks and opportunities associated with the Singularity. On the one hand, it could lead to a cure for all diseases, scientific breakthroughs and the end of poverty. On the other hand, there is a risk that humanity could be destroyed or become embroiled in machine wars. One way to counteract these risks could be to integrate moral values into machines to prevent uncontrolled superintelligence (cf. Diéguez & García-Barranquero, 2024, pp. 239). The actor Ray Kurzweil is discussed below.

Ray Kurzweil

Ray Kurzweil, born on February 12, 1948, in Queens, New York, grew up in a secular Jewish family and showed a strong interest in science and technology from a young age. After graduating from MIT in 1970 with a degree in computer science and literature, Kurzweil became one of the leading futurologists and tech visionaries of our time (cf. Craine, 2024; Piper, 2024). Kurzweil is considered a pioneer in the fields of pattern recognition and AI. His most important inventions include early text-to-speech synthesizers, flatbed scanners and reading machines for the blind. He also founded several companies specializing in speech recognition, financial analysis, medical education and AI. His pioneering work in speech and pattern recognition significantly shaped technological development in these fields (cf. Piper, 2024; Craine, 2024). His entrepreneurial successes include the sale of his reading technology company to Xerox in 1980. Kurzweil also developed music synthesizers endorsed by artists such as Stevie Wonder, speech and image recognition software, and AI-based applications in finance and medicine (cf. Craine, 2024).

Kurzweil is particularly well known for his bold predictions about the technological future. In his book The Age of Intelligent Machines (1990), he predicted the rise of the internet. In The Age of Spiritual Machines (1999), he predicted that machines could one day achieve the performance of the human brain and feel emotions. According to Kurzweil, around 86% of his predictions have come true since the 1990s (cf. Craine, 2024; Piper, 2024). Kurzweil became particularly well known for his theory of the technological singularity, in which he assumes that AI will eventually surpass human intelligence. In his work The Singularity Is Near (2005), he describes the merging of humans and machines as inevitable and predicts that the singularity will occur by 2045. He believes that this technological singularity will lead to radical changes in human civilization (cf. Piper, 2024; Craine, 2024).

In the context of transhumanism, Kurzweil is a strong advocate of integrating technology and human biology to extend life and enhance human capabilities. He sees the fusion of biological and technological thinking as a key step towards improving human existence (cf. Craine, 2024, Piper, 2024). Kurzweil has received numerous awards for his innovations and influence, including the National Medal of Technology in 2000 and induction into the National Inventors Hall of Fame in 2002 (cf. Craine,

2024). He was also named one of the 100 most influential people in the world by TIME Magazine (cf. Piper, 2024). Alongside Ray Kurzweil, Max More is also a key player in transhumanism, who is introduced below.

Max More

Max More is an internationally recognized philosopher and was considered one of the central figures in the field of transhumanism. He is also co-founder of the Extropy Institute, the first organization explicitly dedicated to the transhumanist movement. More developed the philosophy of extropy, which recognizes the pursuit of human improvement and advancement through technology as essential (cf. CloserToTruth, 2020; Future Podcast, 2020). The Extropy Institute, co-founded in 1990, played a significant role in the development of transhumanism. More is known for his philosophical reflections on the cultural and ethical implications of new technologies and has made particularly valuable contributions in the area of the ethical implications of technological progress. He is considered a thought leader in the promotion of technology to expand human potential (cf. Future Podcast, 2020; CloserToTruth, 2020). An essential part of More's thinking is the Proactionary Principle he developed. This principle provides a framework for using advanced technologies responsibly by minimizing risks and maximizing potential benefits. More is considered one of the most influential figures in transhumanism and advocates the active advancement of humans through the use of technology (cf. Future Podcast, 2020).

Since 2011, Max More has been President and CEO of the Alcor Life Extension Foundation, the world's leading cryonics organization. In this role, he drives the global discussion on the potential of cryonics and life extension technologies that aim to extend human life and expand its potential through technological advances (cf. Future Podcast, 2020; CloserToTruth, 2020).

All these people and concepts are closely linked to the vision of a technologically enhanced human being. Transhumanism, the idea that technology can transform the human species, forms the basis. Ray Kurzweil and Max More are key thinkers who have laid the technological and philosophical foundations for this transformation. Humanity+ is an organization that promotes these ideas worldwide, while the technological singularity as a vision of the future marks the goal of these

developments. In the next subsection, other philosophical approaches related to transhumanism are presented.

2.2 Other philosophical approaches

In this subsection, the related philosophies of transhumanism, longtermism and posthumanism will be explained. The similarities and differences between the philosophies will be highlighted.

2.2.1 Longtermism

Longtermism is a philosophy that aims to consider the long-term future of humanity as the most important moral priority. It emphasizes the importance of today's decisions and actions for the lives of future generations and underlines the moral responsibility to have a positive impact on the long-term future of humanity (cf. MacAskill, 2022; Schaefer, 2022, pp. 1).

The central goals of long-termism are to safeguard the future by reducing the risk of human extinction and preserving civilization as well as shaping the future in a positive way. This includes the promotion of values and institutions that focus on the well-being of future generations. As well as the prioritization of resources and political measures that have long-term positive effects. Another goal is to avoid existential risks, such as pandemics or technological threats that could jeopardize the survival of humanity (cf. Schaefer, 2022, pp. 2; MacAskill, 2022).

Longtermism also emphasizes the importance of long-term survival strategies to ensure the survival of humanity over millennia. Given a potentially long future for humanity, possibly spanning millions of years, the development of strategies is seen as crucial to ensure the well-being of the species, including the consideration of space colonization to survive planetary catastrophes In a long-term perspective, humanity may have the potential to develop interstellar civilizations, which could ensure survival beyond planetary catastrophes (cf. MacAskill, 2022; Schaefer, 2022, pp. 1). Finally, it is emphasized that humanity is still at an early stage of its development and that today's decisions could influence the fate of billions of future lives (cf. Schaefer, 2022, pp. 3). Both transhumanism and long-termism see technological progress as playing a central role in shaping and advancing the future of humanity. Both movements are future-

oriented and aim to improve humanity and prepare it for long-term challenges (cf. Lange, 2021, pp. 288; Dreher, 2023, pp. 5; Schaefer, 2022, pp. 1). In addition, both philosophies recognize potential existential risks from technological developments that must be managed to protect humanity from catastrophe (cf. Puzio, 2022, pp. 27; Lange, 2021, pp. 294; MacAskill, 2022). Moral responsibility plays an essential role in both currents, as they emphasize that decisions must be made that positively influence both the present and future generations (cf. Lange, 2021, pp. 287, Schaefer, 2022, pp. 1).

The link between long-termism and transhumanism lies in the shared perspective of ensuring the long-term survival and well-being of humanity and using technological possibilities to overcome human limitations (cf. Schaefer, 2022, p. 1; Lange, 2021, p. 288; Puzio, 2022, p. 27). Both concepts address, among other things, the risks of potential superintelligence. While long-termism considers the long-term effects of such a development for humanity, transhumanism sees super AI as both an opportunity and a threat, as such intelligence could either ensure the continued existence of humanity or jeopardize it. One issue is the trade-off between the benefits and the control of AI (cf. Greaves & MacAskill, 2021, pp. 13; Öngören, 2024, pp. 51; Frederick & Reid, 2024, pp. 50).

Another field that links both systems of thought concerns the management of limited resources and living space in a potentially extended lifespan. Transhumanism aims to significantly extend the human lifespan through technological advances, but this could lead to problems in terms of resource scarcity and overpopulation (cf. Lange, 2021, pp. 288; Puzio, 2022, p. 27). Longtermism takes up similar questions and examines how humanity can manage existing resources appropriately with a growing population and longer lifespans. Space travel and the colonization of other planets offer a possible solution to address space problems on Earth in the long term (cf. Greaves & MacAskill, 2021, p. 13).

The digitalization of the human mind is seen by transhumanists as a step towards overcoming physical and mental limitations. Through this technology, human consciousness could exist independently of the biological body, which in turn would enable travel through space without the limitations of a physical body. This concept is

also relevant in Longtermism, as it represents a way to preserve the human mind over long periods of time and to cope with interstellar travel (cf. Hogue, 2016, pp. 37 ff.; Greaves & MacAskill, 2021, pp. 13; Sawarkar & Rane, 2023, pp. 18).

Furthermore, transhumanism focuses on the individual improvement and transformation of humans into a posthuman existence, while longtermism focuses on the long-term future of humanity as a whole (cf. Puzio, 2022, p. 27; Lange, 2021, pp. 288; MacAskill, 2022, Schaefer, 2022, p. 1). In terms of the time frame, transhumanism focuses more on short- to medium-term technological improvements in humans, while long-termism aims for a future that spans thousands to millions of years and focuses on avoiding existential risks (cf. Dreher, 2023, pp. 6; Lange, 2021, pp. 288; MacAskill, 2022; Schaefer, 2022, p. 3 ff). The goals of the two philosophies also differ. Transhumanism strives to overcome human limitations, achieve immortality and improve intellectual and physical capabilities, while Longtermism aims to ensure the survival of humanity through sustainable strategies, including space colonization. Finally, Transhumanism focuses on individual technological improvements and self-transformation to overcome biological limits, while Longtermism prioritizes overall societal measures to ensure the well-being of future generations (cf. Lange, 2021, p. 288 ff; MacAskill, 2022; Schaefer, 2022, pp. 1). The third key concept of this work, posthumanism, is presented below.

2.2.2 Posthumanism

Posthumanism represents a critical examination of anthropocentric humanism, which sees humans as the center of the world. It emphasizes the need to develop new perspectives on what it means to be human by recognizing the end of the human as the "measure of all things" and focusing on the interconnection of human and non-human forces and the dissolution of traditional hierarchies between species (cf. Braidotti, 2016; Scheerer, 2022, p. 226, 229). An important idea of posthumanism is "anti-anthropocentrism", which questions the dominance of humans over other life forms. Humans are no longer seen as autonomous, rational subjects, but rather as beings who are in a constant relationship with their environment and develop in this relational context (cf. Scheerer, 2022, p. 229). This philosophy questions the humanistic ideal and relies on a radical decentration of the human being by considering man, machine and nature to be of equal value (cf. Braidotti, 2016, Scheerer, 2022, p. 225).

A key difference to transhumanism is that posthumanism aims to deconstruct anthropocentric and hierarchical structures, while transhumanism focuses on the technological improvement and augmentation of humans to overcome evolutionary challenges (cf. Braidotti, 2016; Scheerer, 2022, pp. 225). Although both schools of thought are concerned with the transformation of humans and the influence of technology, posthumanism distances itself from the idea of the "improved human" and instead focuses on the integration of humans into a complex network of ecological and non-human factors (cf. Braidotti, 2016).

Philosophically, posthumanism strives for a monistic ontology that dissolves dualistic thought patterns such as human/animal and nature/culture and recognizes the interdependence of all forms of life. Socially, it calls for a redefinition of power structures and justice that includes not only humans but also non-human actors. Particularly with regard to global challenges such as climate change and technological progress, posthumanism emphasizes the link between technology, ecology and social justice issues (cf. Braidotti, 2016; Scheerer, 2022, pp. 230). An ethics of responsibilization aims to create new connections between human and non-human actors to enable a more inclusive and just future that recognizes the equivalence of human and non-human life (cf. Scheerer, 2022, pp. 229). In the following, an interim conclusion is drawn on the results of the second section.

2.3 Interim conclusion

The review of the sources makes it clear that the philosophies of transhumanism, longtermism and posthumanism pursue different goals and motives, but overlap in some aspects. Transhumanism strives to overcome human limitations through the use of advanced technologies such as genetic engineering, NT and AI. The focus is on significantly improving the intellectual, physical and psychological capabilities of humans. Transhumanists believe that humans are capable of controlling their own evolution through targeted technological interventions to achieve a post-human existence. Humans are seen as primary actors who actively shape and optimize both themselves and their environment (cf. Dreher, 2023, p. 6; Lange, 2021, pp. 288). Although the associated risks and ethical challenges, such as social inequalities, are recognized, they are seen as necessary consequences of progress (cf. Lange, 2021, p. 294).

In contrast, long-termism focuses on the long-term future of humanity and sees it as a moral obligation to minimize existential risks to ensure the survival and well-being of future generations. Technological innovations also play a central role in this philosophy. However, the focus is on developing sustainable strategies to ensure the survival of humanity for millennia to come, for example through the colonization of space. While transhumanism primarily emphasizes individual human improvement, long-termism focuses on collective solutions to ensure the long-term well-being of humanity (cf. MacAskill, 2022; Schaefer, 2022, pp. 1).

Posthumanism, on the other hand, questions the central role of humans and decentres anthropocentric structures. This philosophy aims to understand humans as part of a larger ecological and technological network in which both human and non-human actors act on an equal footing. In contrast to transhumanism, which focuses on the technological improvement of humans, posthumanism strives for a decentering of humans and advocates an equal coexistence of humans, nature and technology (cf. Braidotti, 2016; Scheerer, 2022, p. 226). On this basis, a reference to the current state of transhumanist developments can be established below.

3. State of affairs and practical reference

In this section, the status of the transhumanist agenda is presented to concretize the current direction of development. First, the legal framework for the industry and the relevant technologies is analyzed to show the extent to which existing regulations can influence the market. This is followed by a description of current technological developments in transhumanist research. Transhumanist projects within the EU are also discussed to illustrate which technologies companies are working on and what possible effects this could have on economic and social structures. Finally, critical voices that recognize risks in relation to economic and social developments are presented.

3.1 Legal framework

3.1.1 International legislation

There is currently no explicit international legislation that directly regulates human enhancement technologies (HET) (cf. Warso & Gaskell, 2019, p. 23). Although these technologies are becoming increasingly important, the international legal framework remains vague. However, basic human rights obligations exist that ensure the protection of physical and mental integrity, as set out in United Nations and European Union documents. These frameworks guarantee the right to health and privacy and thus create an indirect basis for dealing with HET (cf. Warso & Gaskell, 2019, p. 23, 25).

The United Nations has a fundamental obligation to respect human rights and ensure that individuals are protected from unethical medical practices. This is complemented by international treaties such as the Universal Declaration of Human Rights, the International Covenant on Civil and Political Rights and the Convention on Economic, Social and Cultural Rights. These treaties provide an ethical and legal framework for technologies that affect human life and dignity, including HRT (cf. Warso & Gaskell, 2019, pp. 23, 25).

UNESCO also plays an important role in setting ethical standards, particularly through the Declaration on Bioethics and Human Rights, which can be applied to technological developments such as HET. This declaration promotes the ethical use of technologies and thus creates international standards that are also taken into account in the context of transhumanism and HET (cf. Warso & Gaskell, 2019, p. 27).

The World Intellectual Property Organization regulates patents related to technologies, including HET, and ensures that intellectual property issues related to these innovations are clarified. In parallel, the International Narcotics Law restricts the use of performance-enhancing drugs to medical and scientific purposes, which also has implications for the regulation of HET (cf. Warso & Gaskell, 2019, pp. 23, 28, 29). European legislation does not differ significantly from international legislation.

3.1.2 European legislation

The European framework for HET is like international regulations, as there is no specific legislation for these technologies here either. Instead, relevant areas fall under existing laws. For example, various European directives and regulations govern certain aspects of HET without explicitly treating them as a separate area (cf. Warso & Gaskell, 2019, pp. 35).

The Medical Devices Regulation (93/42/EEC) covers medical devices but excludes those intended solely for aesthetic purposes. At the same time, pharmaceutical legislation (2001/83/EC) regulates medicines for therapeutic purposes, but excludes products intended to enhance human capabilities. The Product Liability Directive (85/374/EEC) ensures that defective products, including HET, are covered by liability law (cf. Warso & Gaskell, 2019, pp. 35).

Another important area of regulation is the General Data Protection Regulation, which regulates the protection of personal data, particularly in connection with HET that is networked or collects personal data. In conjunction with the European Convention on Human Rights, the General Data Protection Regulation forms a legal framework that ensures the protection of privacy and human dignity in connection with the use of HET (cf. Warso & Gaskell, 2019, pp. 22, 36).

While the European Medical Device Regulation regulates the therapeutic use of devices, the area of non-therapeutic enhancement devices remains largely unregulated. This has led to discussions about the creation of a new regulatory framework, as existing laws are considered insufficient to cover the specific requirements of HET (cf. Warso & Gaskell, 2019, pp. 39). Cultural and ethical principles also play a central role in European legislation. The protection of human dignity and the right to self-determination are key guiding principles to ensure that HET does not restrict individual freedom. The European Union faces the challenge of finding a balance between promoting innovation and ensuring the safety of new technologies such as HET (cf. Warso & Gaskell, 2019, pp. 21). The current research fields and priorities are explained below.

3.2 Current research fields and focal points

The aim of this subsection is to establish a practical link to transhumanism by presenting specific technologies. The current research fields and focal points of transhumanism will be presented, from which the current research and development steps of the transhumanism movement will emerge.

Transhumanism is not a uniformly coordinated movement, but rather consists of many smaller, private initiatives. At the same time, both large and small technology companies are driving forward projects and products that support transhumanist developments, often without explicitly committing to transhumanism. Companies such as Neuralink, OpenAI or companies in the field of biotechnology and robotics are contributing to the gradual realization of transhumanist goals with their innovations by developing technologies that could improve or even replace the human body and mind. Overall, social development is increasingly characterized by transhumanist concepts, be it through the use of AI, NT or other projects that are intended to support and optimize humans in many ways. To get closer to the core of the transhumanism movement, the NBIC concept, which forms the basis of American transhumanism research, will be introduced. NBIC stands for the convergence of four key areas of science and technology (cf. Coenen, 2008, pp. 6):

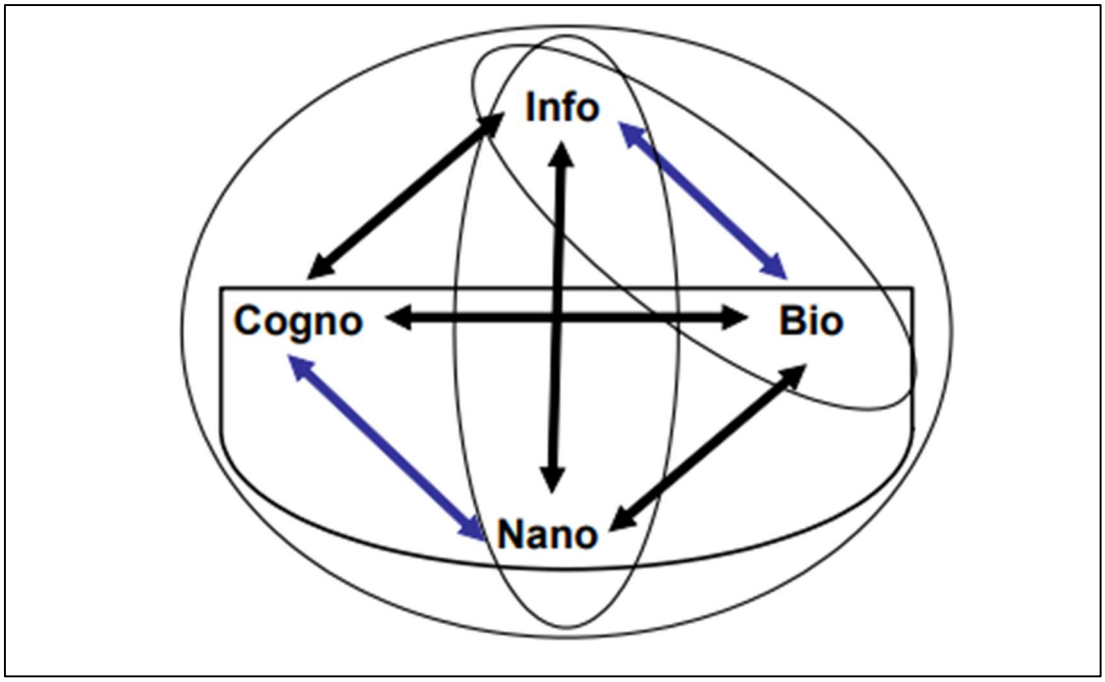
N = Nanotechnology

B = Biotechnology

I = Information technology

C = Cognitive sciences

This convergence was first introduced in the early 2000s by Mihail Roco and William Bainbridge at a conference in Washington, D.C. and aims to combine advances in these disciplines to significantly enhance human capabilities and create new technological opportunities (cf. Andler, 2008, p. 1). At the core of the NBIC concept is the conviction that progressive development in these four areas must be brought together to achieve the greatest possible scientific and technological progress in the field of transhumanism. Nanotechnology deals with the manipulation of matter at the atomic and molecular level, while biotechnology explores and modifies the genetic, biological and biomedical processes of life. Information technology encompasses the field of computer and communication systems, while cognitive science studies the human brain and its functioning, including the fields of neuroscience and AI (cf. Andler, 2008, p. 2). Figure 2 below illustrates the interplay between the four scientific fields.



2 **Fig. 2.** NBIC concept of transhumanism by Andler (2008 p. 2)

According to the NBIC concept, human enhancements can be achieved through genetic interventions, implants or machine interfaces such as brain-computer interfaces. Another goal of the NBIC concept is to promote synergies between these disciplines, which are seen as paving the way for a new stage of human evolution (cf. Coenen, 2008, p. 2). Roco and Bainbridge argue that these sciences have reached a tipping point where they need to combine to achieve maximum progress. An example of this synergy is the idea that at the nanotechnology level, atoms, genes, neurons and bits are becoming interchangeable, creating new avenues for research and development (cf. Andler, 2008, p. 3). The NBIC concept is often seen as technodeterministic, as it is strongly focused on the role of technology in human evolution. However, it also raises important ethical and social issues, such as the consequences for human identity, social justice and the control of these technologies by state or private institutions.

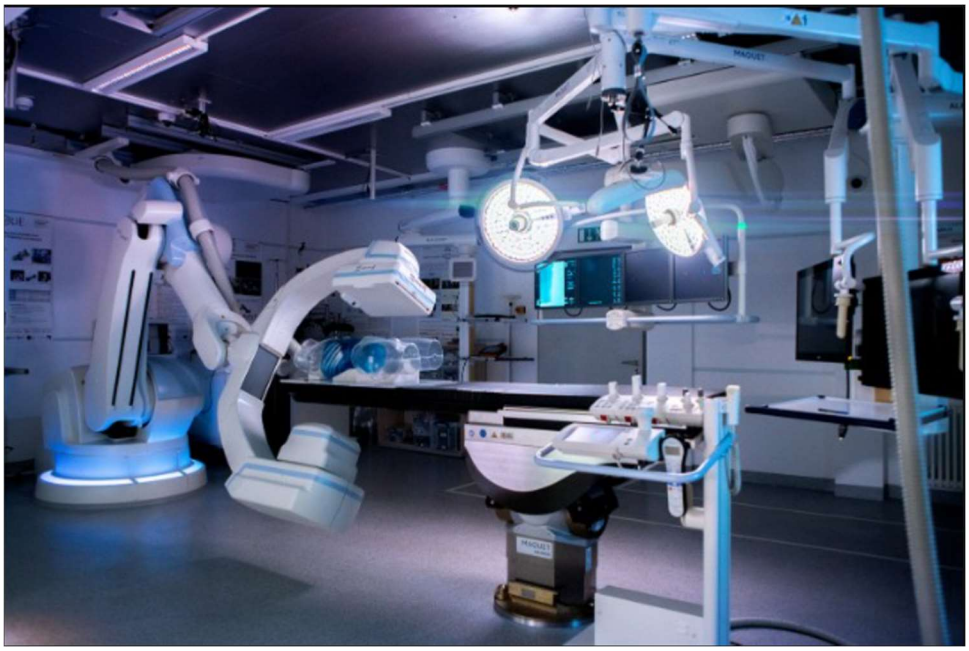
The EU's 2008 CONTECS report on the development status of converging technologies shows that there is still a large gap between the visions of CT and the actual applications. Furthermore, future applications of convergence are very difficult to predict. There could be a whole range of applications or scientific fields that benefit from convergence but have not yet been sufficiently explored or even discovered (cf. Andler, 2008, p. 22). Technology assessment is concerned with the technologies themselves and does not simply reflect on ethical issues without examining their relationship to reality. Long-term trends in these technologies need to be identified, but currently visible developments should not necessarily be regarded as definitive. Although most technological fields and applications are not yet sufficiently mature to be assessed in detail, it is important to consider possible ethical and social issues arising from the currently recognizable interests of the actors (cf. Andler, 2008, p. 23). The field of transhumanist technologies is broad. Some of the frequently discussed technologies are described below to make them more tangible. There are also other technologies in addition to those listed.

3.2.1 Artificial intelligence and robotics

AI and robotics play an important role in transhumanism as they have the potential to significantly enhance human performance. AI systems can perform cognitive tasks such as decision-making, problem-solving and learning that go beyond human

intelligence. And robotics not only enables the development of prostheses and exoskeletons that support people with physical limitations, but also the creation of autonomous systems that can perform tasks more efficiently and precisely. Transhumanism sees the merging of man and machine as a way of overcoming human limitations and achieving an expanded form of existence (cf. Dreher, 2023, p. 39; Lange, 2021, pp. 296).

One example of the field of cognitive AI assistants can be seen in the development of systems that support complex tasks such as medical diagnoses. AI-based chatbots and intelligent assistants are already being used in medical practice to analyze large amounts of data and make diagnoses faster and more accurately. These assistants can support radiologists, for example, by evaluating image data from MRI or CT scans and highlighting conspicuous areas. This shortens the diagnosis time and minimizes the risk of human error. This illustrates the potential of AI systems to reduce the workload of specialists and increase efficiency in healthcare (cf. Fraunhofer IPA, 2023). Figure 3 shows an experimental hybrid operating room from Fraunhofer IPA.



3 **Fig. 3**. Experimental hybrid OR at Fraunhofer IPA (cf. Fraunhofer IPA, 2023)

The use of distributed AI systems in operating theatres enables surgical data from various sources to be analyzed in real time and precise instructions to be given to medical staff. With the help of machine learning, the models are trained at different

locations without sensitive patient data having to leave the respective location. This not only enables continuous improvement of the AI models, but also protects patient privacy. One specific example is robot-assisted telesurgery, in which surgeons can perform operations over long distances. By using 5G and AI, delays in data transmission are minimized, which enables seamless execution of the procedures (cf. Fraunhofer IPA, 2023).

These examples show how AI can revolutionize the medical sector, which represents an intermediate step towards the fusion of man and machine in the sense of transhumanism. However, technologies that improve people's health and participation in life are also already being used and further developed in the field of robotics. Various exoskeletons are presented in Figure 4 below.

4 **Fig. 4.** Upper and Lower Limb Exoskeleton Robots (Cardona et al., 2020, p. 3, 6)

An example of current research in the field of exoskeletons can be seen in the development of the Ekso GT exoskeleton, which is used for the rehabilitation of people with motor impairments. The Ekso GT actively supports hip and knee movements and recognizes the user's intention to walk by shifting their weight. This technology is particularly useful for patients who have difficulty walking independently after a stroke or spinal cord injury. Studies show that the use of such exoskeletons improves mobility and speeds up rehabilitation by enabling patients to get up and walk again in the early stages of therapy. The Ekso GT has both CE and legal approval and is

considered one of the most advanced devices in the field of rehabilitation technology (cf. Cardona et al., 2020, pp. 4).

Another example of the possibilities of exoskeletons is their use in the rehabilitation of upper extremities. Devices such as the ArmeoPower support patients with shoulder, elbow or wrist injuries and are particularly useful in the treatment of stroke patients. These exoskeletons improve mobility and help to restore motor functions by targeting the affected muscle groups. The use of such technologies significantly improves patients' quality of life as they can regain their autonomy and strengthen their muscles (cf. Cardona et al., 2020, pp. 2).

The future prospects for exoskeletons are promising. The market is growing due to the increasing demand in rehabilitation technology and new developments aim to further improve the efficiency of motors, stabilization systems and sensor technology. This will help to optimize the recognition of movement intentions and make the rehabilitation process even more effective (cf. Cardona et al., 2020, pp. 7). These developments fit perfectly into the framework of transhumanism, which aims to radically improve human existence through technology. In this sense, exoskeletons could not only be limited to medical applications but could also be used in everyday life to support physically strenuous activities or even to enhance the physical abilities of healthy people.

In addition, another important field of research within AI is artificial creativity, i.e. the ability of machines to generate new and valuable ideas. Creativity is generally defined as the creation of something new, be it a concept, a design or a work of art. Margaret Boden (1998) distinguishes between three types of creativity: combinatorial, exploratory and transformative (cf. Rust & Huang, 2021, p. 143). Combinatorial creativity describes the ability to combine existing ideas in new ways. This form of creativity is currently the most widespread and is particularly well developed in AI. One example of this is machine-generated works of art, such as impressionist paintings or pieces of music, in which AI models combine different styles or concepts. AI achieves this type of creativity through machine learning by recombining known elements (cf. Rust & Huang, 2021, p. 143). Exploratory creativity goes one step further and develops new ideas within an existing framework or concept. New creative

possibilities are explored but remain within a defined system. Transformative creativity, on the other hand, refers to a form in which completely new concepts emerge and existing paradigms or rules are transcended (cf. Rust & Huang, 2021, p. 143).

In practice, AI has established itself as a valuable tool to support human creativity, particularly in areas such as design and product development. Here, the machine takes over cognitive and analytical tasks, while subjective decision-making is still carried out by humans. Despite these advances, machine creativity currently remains largely limited to the combinatorial level. However, future developments could lead to AI also achieving exploratory or transformative creativity if it succeeds in developing a form of "intuitive intelligence" that goes beyond pure data processing (cf. Rust & Huang, 2021, pp. 147).

Accordingly, AC is relevant in the context of transhumanism, as transhumanists aim to augment and enhance human nature through technology. In this context, AC could significantly increase the cognitive capacity of humans by allowing machines to take over creative processes and generate new ideas that go beyond the capabilities of the human mind. Such a symbiosis between humans and machines could lead to creative boundaries being dissolved, not only supporting human creativity, but expanding and transforming it. This could lead to the emergence of new technologies, arts and social developments that are relevant in a transhumanist context (cf. Rust & Huang, 2021, pp. 143, 147). Genetic technologies are discussed below.

3.2.2 Genetic engineering

Genetic engineering is a core area of transhumanism, as it acts directly on the human genome and thus changes the biological basis of human existence. Targeted genetic manipulation could eliminate diseases, slow down ageing or even improve physical and mental abilities. Transhumanism aims to control human evolution through interventions in human DNA and thus maximize physical and mental performance. The focus here is on the question of how humans can reach a new level of existence by controlling genetic processes (cf. Dreher, 2023, p. 39; Puzio, 2021, pp. 45, 147).

One example of genetic engineering is germline gene manipulation. This involves modifying the genes of human embryos to prevent genetic diseases and improve desired traits such as intelligence, immunity or certain physical characteristics. This technology offers the potential to fundamentally change the human genome and overcome the limits of biological predisposition. In the transhumanist perspective, this technology is seen as the key to expanding human capabilities and improving the quality of life. Transhumanists argue that the potential benefits, such as the prevention of disease or the enhancement of cognitive abilities, outweigh the ethical dilemma of "interfering with nature" (cf. Bostrom, 2003, pp. 499). Possible concerns about genetic manipulation relate to psychological and social effects. Critics warn that genetically modified children could be treated as "products", which could affect acceptance and unconditional love. In addition, social prejudices against people with disabilities could be reinforced, as genetic optimization could become the norm. Nevertheless, transhumanists emphasize that the potential benefits, such as healthier, smarter and happier people, outweigh the risks (cf. Bostrom, 2003, pp. 499).

Culturally, genetically enhanced individuals could drive new intellectual and technological advances by transcending previous human limitations. Transhumanists see a moral responsibility in delaying genetic enhancements, as preventable diseases continue to cause suffering. To address ethical concerns such as genetic determinism or cloning, advocates argue for educational initiatives to ensure that genetically engineered humans are afforded the same respect and dignity as others (cf. Bostrom, 2003, pp. 500). An important method in the context of genetic engineering is CRISPR/Cas9.

The CRISPR/Cas9 method enables targeted changes to the genome by cutting specific DNA sites and thus altering genetic information. Compared to previous methods, such as zinc finger nucleases and TALEN, CRISPR/Cas9 is characterized by its simplicity and precision. These gene scissors are not only easier to produce, but also more precise in recognizing the target sequences in the genome, making them a powerful tool in genetic research (cf. Cathomen, 2018, pp. 1). The target sequence of the DNA is recognized by an RNA fragment, the so-called guide RNA. This pairs directly with the target DNA and instructs the Cas9 enzyme to make the cut at the desired location. Another feature of CRISPR/Cas9 is its versatility: several sites in the genome can be

cut simultaneously, which is not so easily possible with other gene scissors. This ability makes CRISPR/Cas9 particularly useful for complex genetic interventions (cf. Cathomen, 2018, pp. 1). CRISPR/Cas9 is based on a natural defense mechanism of bacteria that serves as protection against viruses. If a virus attacks the cell again, the CRISPR/Cas9 system cuts the viral DNA and thus prevents the infection - a kind of immunological memory. Through further developments, the technology is now also being used to specifically switch genes on or off without cutting them by simply regulating the reading of genetic information (cf. Cathomen, 2018, pp. 3).

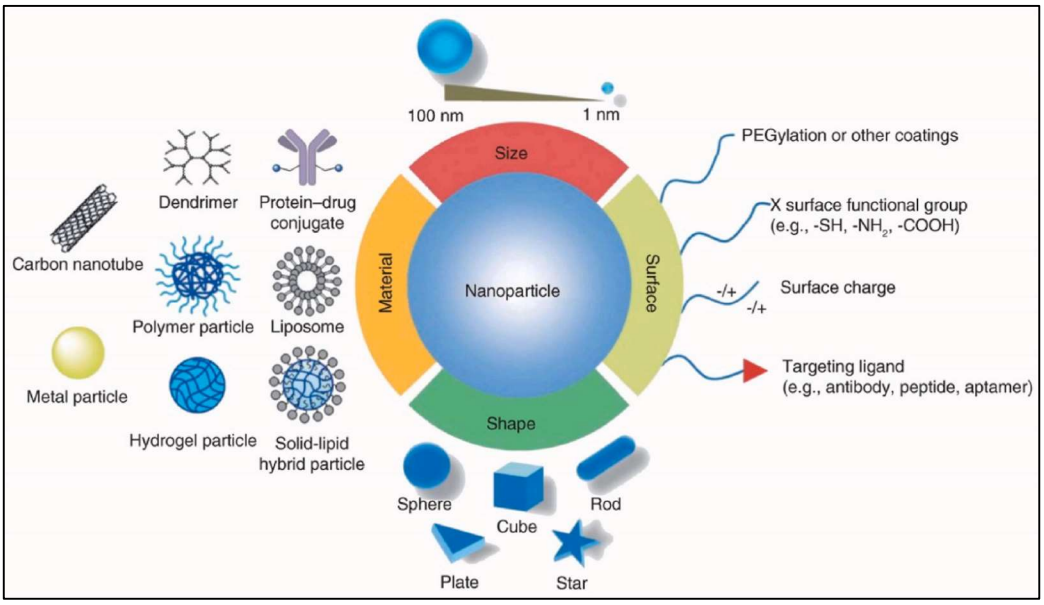
The applications of CRISPR/Cas9 are wide-ranging. In industry, it is used to change the metabolism of cells and produce useful molecules in large quantities. In basic research, CRISPR/Cas9 is used to gain new biological insights, for example by making chromosome ends visible. Since its discovery, the technology has quickly established itself in many areas, from biotechnology to medicine, and is enabling groundbreaking advances in science (cf. Cathomen, 2018, pp. 5). The following section focuses on the field of nanotechnology.

3.2.3 Nanotechnology

Nanotechnology deals with the manipulation of matter at the atomic and molecular level and is an important tool in transhumanism to improve the human body from the inside out. It offers potentially unlimited possibilities for repairing and improving cells and tissue, which can lead to a longer lifespan and optimization of bodily functions. For example, nanobots could be used in the human body to fight diseases, regenerate cells or neutralize toxic substances, supporting transhumanism's vision of immortality and physical perfection (cf. Puzio, 2021, p. 29, 147; Dreher, 2023, p. 5; Lange, 2020, p. 288, 302).

One example of the use of nanobots in medicine can be found in cancer therapy. These tiny machines, which are between 1 and 100 nanometers in size, work at cellular level and can perform precise tasks. In cancer therapy, nanobots enable targeted delivery of drugs directly to tumor cells without damaging healthy cells. This significantly reduces the side effects that occur with conventional treatment methods such as chemotherapy. Nanobots thus offer a more efficient and gentler method of cancer treatment (cf.

Chattha et al., 2023, pp. 1). Figure 5 below provides an overview of different types of nanoparticles used in cancer therapy and their possible functionalization.



5 **Fig. 5.** Overview of different types of nanoparticles (Chattha et al., 2023, p. 3).

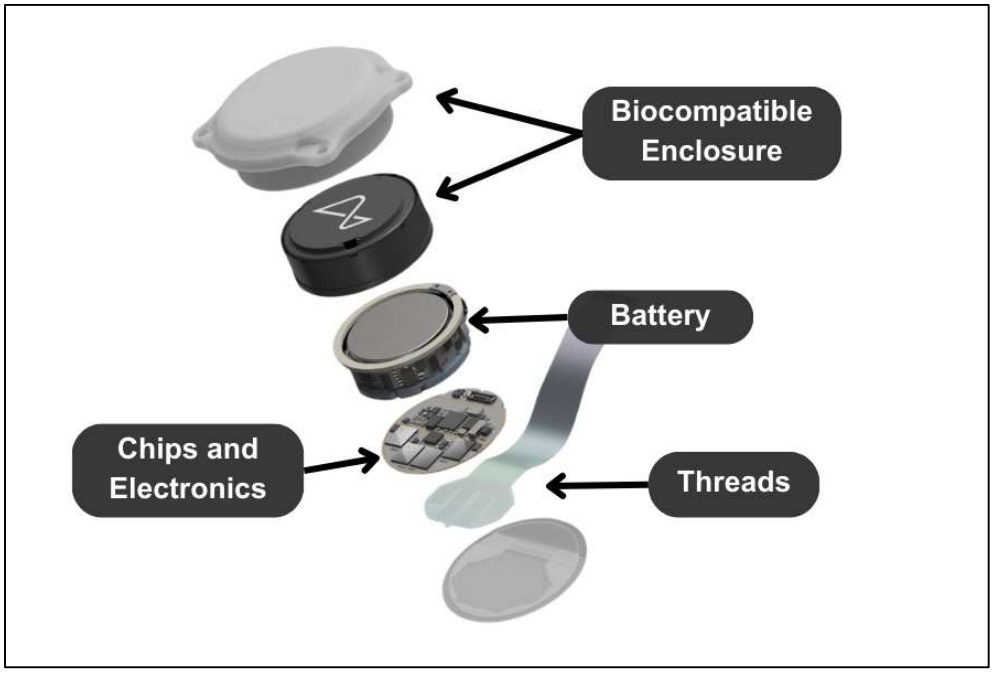
Nanobots can be divided into organic and inorganic categories. While organic nanobots are based on DNA, cells of viruses or bacteria, inorganic nanobots consist of proteins or diamond structures. An example of organic nanobots are DNA-based machines such as DNA walkers or hexagonally shaped DNA nanorobots. These can deliver targeted drugs or be used as biosensors for the early detection of cancer cells, enabling rapid diagnosis and targeted treatment (cf. Chattha et al., 2023, pp. 3).

The movement of nanobots in the body takes place via various drive mechanisms, such as magnetic, chemical or light-controlled drives. They navigate through the blood vessel system to specifically attack tumor cells. Nanobots offer several advantages over conventional methods, as their precision increases the efficiency of therapy while minimizing damage to healthy cells (cf. Chattha et al., 2023, pp. 3). In addition to targeted drug delivery, nanobots can also be used in heat therapy to destroy tumor cells or as bio-detectors. Despite these promising applications, however, there are challenges such as the high costs and technical complexity of development as well as difficulties in navigating through the viscous blood environment (cf. Chattha et al., 2023, pp. 3, 9). The area of NT is discussed below.

3.2.4 Neurotechnology

NT aims to connect the brain directly to machines and computers to enhance human cognitive abilities. It plays a crucial role in transhumanism, as it not only enables the enhancement of human thinking and memory, but also extends the concept of consciousness beyond the biological body. Through neuroimplants, people can download information directly into the brain or use their brain activity to control machines and devices, creating a symbiosis between humans and technology (cf. Delgado, 2024; Dreher, 2023, p. 7, pp. 10; Heuer, 2015, p. 84).

One example of brain-computer interfaces (BCIs) is the work of companies such as Neuralink, which are working to develop invasive BCIs. These systems use implantable electrodes that are inserted directly into the brain to enable more precise control of external devices such as prostheses or computers. This technology could enable people with neurological conditions or physical limitations to control devices through brain activity alone, significantly improving their quality of life. BCIs are already being used successfully in medicine to help people with disabilities, such as ALS patients, to communicate. Figure 6 below illustrates the Neuralink implant and its components (cf. GlobalLogic, n. d., pp. 3).



6 **Fig. 6.** Own presentation of Neuralink Implant (cf. Neuralink, 2024)

Despite the great potential, there are also challenges. There are ethical concerns, particularly with regard to data protection and possible manipulation of brain activity. In addition, BCIs are currently still expensive and difficult to access, which limits their application to a few specialized areas. Nevertheless, research shows promising approaches, particularly through the improvement of performance and the development of minimally invasive implants, which could enable a broader application of BCIs in the future (cf. GlobalLogic, n. d., pp. 15).

A further method in the field of neurotechnology is transcranial magnetic stimulation (TMS). TMS is a non-invasive method that stimulates the brain using electromagnetic impulses and is used in the diagnosis and treatment of neurological and mental illnesses. It specifically activates nerve cells without the need for surgical intervention. An example of the use of TMS to diagnose damage to the nervous system, for example in ALS, MS or after strokes. TMS can also detect subclinical damage at an early stage. Therapeutically, repetitive TMS (rTMS) is used for therapy-resistant depression and to promote motor recovery after strokes (cf. Jooß & Ziemann, 2023, pp. A 2147).

Advances such as theta burst stimulation enable shorter stimulation times with longer-lasting effects. In combination with electroencephalography, brain activity is measured directly and the use of AI to optimize treatment could lead to personalized therapies in the future (cf. Jooß & Ziemann, 2023, pp. A 2150). The field of cryonics is discussed below.

3.2.5 Cryonics

Cryonics is the technique of freezing people with the aim of reviving them in the future, when medical technology is advanced enough to cure diseases that are incurable today. In transhumanism, cryonics is seen as a way of overcoming death and extending life indefinitely. It is an attempt to maintain the body in a state of biological standstill until future technologies enable restoration and potential improvement of the physical state (cf. Dein, 2022, pp. 3164; Lange, 2021, p. 293; Dreher, 2023, pp. 28). The body is cooled down to -202°C and treated with special cryoprotectants to prevent the formation of ice crystals. This method should make it possible to keep patients in a frozen state until future technologies are developed that enable healing or resuscitation (cf. Dein, 2022, p. 3165).

One example of the current state of research is the successful cryopreservation of tissue samples and small organs, although complete resuscitation of a human body or brain has not yet been achieved. Proponents of cryonics argue that the structures in the brain that are responsible for personality and memory are preserved shortly after death. Future technologies, such as nanotechnology or cell repair, could be used to repair damaged tissue and revive patients (cf. Dein, 2022, pp. 3165).

Well-known organizations such as Alcor and the Cryonics Institute offer cryopreservation and rely on the vision that death is a process that can potentially be reversed. Critics point out that there is no scientific evidence yet to show that the brain can be fully restored after freezing, while advocates see cryonics as a long-term emergency medical treatment. (cf. Dein, 2022, pp. 3164). Figure 7 shows the cryotanks of the organizations Alcor and the Cryonics Institute.

7 **Fig. 7.** Own presentation of Cryotanks (cf. Alcor, n. d.; Cryonics Institute, n. d.)

Another relevant example in cryonics is the long-term preservation of donor organs. Since the beginning of transplantation medicine, there has been a great need for effective methods for the long-term storage of organs, but current methods such as static cold storage are only suitable for short-term preservation. One problem with these conventional methods is the formation of harmful ice crystals at temperatures below freezing, which destroy the structure of cells and make long-term storage difficult (cf. Shah, 2023, p. 1421).

Modern technologies such as vitrification, in which organs are transformed into an amorphous solid state through rapid cooling, have the potential to solve this problem. Vitrification leaves cell structures largely intact, as the formation of ice crystals is avoided. One challenge, however, was the uniform temperature distribution, especially for large organs (cf. Shah, 2023, p. 1421).

Another breakthrough was achieved in 2017 with the development of nano-warming. Using iron oxide nanoparticles and radio frequency coils, researchers were able to ensure even heating of organs. This method is not limited to organ size and solves the problem of uneven heating. Researchers at the University of Minnesota demonstrated 100-day cryopreservation of kidneys that were successfully transplanted into rats after rewarming - without the formation of ice crystals (cf. Shah, 2023, p. 1421).

Early attempts at cryopreservation often failed due to the toxicity of the cryoprotectants used. This problem was overcome by using a new cryoprotectant that significantly reduced the toxic effects. The possibilities of this technology are very promising. Long-term organ banks could significantly increase the availability of healthy donor organs worldwide, as storage would be possible regardless of geographical or time restrictions. In addition, transplant medicine could move from urgent surgery to more predictable operations, leading to better outcomes for patients. Such advances could revolutionize transplant medicine and significantly increase the number of available donor organs (cf. Shah, 2023, pp. 1421). The presentation of the various fields of transhumanism has provided an overview of the technologies currently available. In the following subsection, some transhumanism projects within the EU will be presented.

3.3 Transhumanism projects within the EU

3.3.1 CONTECS

The project "Converging Tecnologies and their impact on Social Sciences and Humanities" (CONTECS) investigated the role that social sciences and humanities can play in technological convergence, in particular regarding nano-, bio-, information- and cognitive sciences. The aim of the project was to explore the ethical and societal implications of these convergence technologies (CT) and to build a research agenda

for the EU's Seventh Framework Program. A central focus was on promoting interdisciplinarity between the sciences to create a knowledge-based society (cf. European Commission, 2023a; European Commission, 2012). The project analyzed the historical and institutional origins of technological convergence and examined the role of technology policy and funding institutions in setting research objectives. It discussed how "nano-convergence" is politically constructed and what influence this has on research and the use of these technologies. A key theme of the project was human enhancement, in particular the augmentation of human capabilities and intelligence through technology (cf. European Commission, 2023a; European Commission, 2012).

The project, coordinated by the Fraunhofer-Gesellschaft and involving leading European research institutions such as the Karlsruhe Research Center and the University of Oxford, contributed significantly to the development of a research agenda in the field of convergence technologies. With an EU contribution of €426,200, the project helped to put the ethical, societal and political challenges of these technologies at the center of European research and to create a basis for future integration into European society (cf. European Commission, 2023a; European Commission, 2012).

The project was particularly important for Europe as it focused on the European Commission's demand-driven approach, in which convergence technologies are intended to respond to societal needs. This contrasts with other approaches, such as in the USA, where CT is more strongly involved in military applications. Instead, Europe focuses on ethical and societal issues to promote the integration of these technologies into society in a responsible way (cf. European Commission, 2023a). The project mobilized European research capacities in the field of convergence technologies and identified social and ethical challenges associated with these developments. Central questions were raised about the technological expansion of the human being and the future of transhumanism (cf. European Commission, 2023a; European Commission, 2011). In the context of transhumanism, this project opens up new perspectives on how technological advances in nano-, bio-, information- and cognitive sciences can be used to augment humans and enhance their capabilities. Interdisciplinary cooperation and

consideration of ethical issues are crucial for the responsible development of these technologies (cf. European Commission, 2023a; European Commission, 2011).

3.3.2 Program for Research and Innovation on Micro and Nanotechnology for Sensors

The PRIMiNaS project (Program for Research and Innovation on Micro and Nanotechnology for Sensors) aims to strengthen the Center for Research on Microelectronics and Nanotechnology (CRMN) in Sousse, Tunisia, in the field of micro- and nanotechnology, particularly in the development of sensors. Through cooperation with leading European institutions, the technical and scientific capabilities of the center are to be expanded and Tunisia is to be further developed as a technology location (cf. European Commission, 2022). A central element of the project is the construction of the first clean room for micro- and nanofabrication in Tunisia, which will be equipped with an area of 120 m². Modern equipment for the physico-chemical characterization of nanomaterials, such as scanning electron microscopes and atomic force microscopes, as well as technologies for the production of micro- and nanosensors are also part of the project development. This represents significant progress for the research infrastructure in Tunisia (cf. European Commission, 2022).
However, the project faces a number of challenges, in particular the lack of technical and administrative expertise in the CRMN. PRIMiNaS therefore aims to strengthen the capacity of scientific and technical staff. To achieve this, the CRMN is working closely with three European research institutions: the Laboratory of Microelectronic Technologies in Grenoble, the Universidad Politécnica de Madrid and the Laboratory of Electrical Measurements and Sensor Technology at Chemnitz University of Technology (cf. European Commission, 2022).

PRIMiNaS expects a significant increase in the research excellence of the CRMN, closer networking with European research institutions and industry and the development of technology transfer strategies. Societal challenges of nanotechnology, such as education and safety, are also taken into account as part of responsible research (cf. European Commission, 2022). The project is fully funded by the European Union with a budget of € 952,750 and includes major international collaborations to develop Tunisia into a leading location in the field of micro- and nanotechnology. In the context of transhumanism, these developments could lead to the long-term improvement of

sensors and human-machine interfaces by using micro- and nanotechnologies to enhance human capabilities (cf. European Commission, 2022).

3.3.3 Skin Microbial Devices

The SKINDEV (Skin Microbial Devices) project aims to revolutionize the treatment and monitoring of skin diseases, especially atopic dermatitis, through the use of smart technologies and bioengineered microbes. The project will develop an intelligent skin device that uses genetically modified skin microbes to monitor and target inflammatory processes in the skin. This innovation represents an important step towards non-invasive systems that enable early detection and intervention of skin diseases directly at home (European Commission, 2023b; European Commission, 2024).

The project's technological innovations include the genetic modification of skin microbes such as Cutibacterium acnes, which act as sensors and can recognize inflammatory biomarkers. At the same time, sensors and actuators are used to monitor the condition of the skin in real time and take appropriate therapeutic measures. Tissue engineering will also be used to develop skin organoids that can be used for research into atopic dermatitis and for testing new treatment methods (cf. European Commission, 2024).

In the long term, the SKINDEV project aims to develop smart skin microbial devices based on the skin's natural microbiome. These devices could bring about revolutionary changes in the field of dermatology by providing personalized and effective solutions for patients that can be applied in the comfort of their own homes. The vision is to treat skin diseases in a preventive and targeted manner, ushering in a whole new era of preventive medicine (cf. European Commission, 2024).

Previous research results of the project have shown significant progress in the genetic modification of C. acnes and the investigation of the interactions between microbes and the host. In addition, 3D skin models and chemokine identifications have been developed to improve the diagnosis and treatment of atopic dermatitis. The bacterial interaction between the Smart Skin Microbial Devices and pathogenic bacteria such as

Staphylococcus aureus is also being investigated to test the efficacy of the microbial treatments (cf. European Commission, 2024).

The SKINDEV project, which is coordinated by leading European institutions such as the Universidad Pompeu Fabra in Spain, the Radboud Universitair Medisch Centrum in the Netherlands and Imperial College in the UK, could make a significant contribution to the transformation of dermatology and personalized medicine. With a budget of over 1.7 million euros, this project is fully funded by the EU (cf. European Commission, 2023b; European Commission, 2024).

In the context of transhumanism, SKINDEV could open the door to new ways of optimizing the human body through biotechnological approaches. In the future, the use of genetically modified microbes and smart skin devices could not only be used to treat diseases, but also to enhance human capabilities by enabling constant monitoring and adaptation of the physical state (cf. European Commission, 2024).

3.3.4 Micro/Nano Robotics for Single Cancer Cells

The "Micro/Nano Robotics for Single Cancer Cells" project aimed to revolutionize the research and treatment of cancer through the use of micro- and nanorobotics. The focus was on investigating individual cancer cells to gain a deeper understanding of the disease and develop new approaches for targeted therapy at cell level. As part of the project, a long-term research cooperation between European and Chinese institutions was established to promote research in the field of micro- and nanorobotics (cf. European Commission, 2024b).

Technological innovations play an important role in this project. For example, micro- and nanorobots were developed and used to precisely manipulate and measure individual cells. Atomic force microscope-based nanorobotics were used to characterize cancer cells in real time. Other technologies such as optical tweezers enabled contactless handling of cells, while magnetic nanoparticles helped to improve cell treatment rates (cf. European Commission, 2024c).

The research approaches of the project included the investigation of the nanomechanical and electrophysiological properties of individual cancer cells as well

as research into their reactions to mechanical and chemical stimuli. A significant advance was the development of mobile micro/nano-robots that deliver targeted drugs to cancer cells and thus enable precise treatment (cf. European Commission, 2024c). Important results of the project were the development of new techniques for the characterization of cells and soft materials, the in-situ monitoring of the mechanical properties of cancer cells and research into how drugs affect the mechanical properties of cancer cells. These findings offer great potential for future diagnosis and treatment methods (cf. European Commission, 2024c).

Participating institutions such as the University of Warwick, ETH Zurich and Aarhus Universitet worked together on these groundbreaking technologies. The success of the project not only led to progress in the field of nanotechnology and cancer therapy, but also opened up commercial prospects. The establishment of a spin-off company for the production of atomic force microscopes and biological applications demonstrates the commercial potential of this research (cf. European Commission, 2024b; European Commission, 2024c). The project, which was funded with a budget of € 1,755,000 and an EU contribution of € 1,215,000, contributes to pushing the boundaries of human health and quality of life in the context of transhumanism. The ability to treat diseases such as cancer at the single-cell level could pave the way to a future where people can extend their lives and improve their physical abilities through the use of nanotechnology (cf. European Commission, 2024c). The risks that critics see in the transhumanist agenda are discussed below.

3.4 Criticism of transhumanism

The main hemisphere and the USA in particular are pioneers in research into transhumanism. The market for transhumanism is largely determined by large digital companies such as Alphabet, Microsoft and Apple (cf. Forbes, 2023). In macroeconomic terms, the state in the USA is also heavily dependent on large tech companies and corporations such as Vanguard and Blackrock (cf. AssCompact, 2022; Kaufmann, 2019). This gives rise to the risk of monopoly capitalism, which can also have adverse consequences for society in the area of transhumanism and is strongly criticized by some specialist authors (study results).

The transhumanism movement in Western economic structures is closely linked to the principles of neoliberalism. Neoliberalism emphasizes individual responsibility, competition and market logic, which also characterize transhumanist ideals. The idea of technologically supported human optimization is not geared towards the well-being of humanity as a whole, but towards adaptation to economic and market-oriented goals (cf. Verständig, 2021, pp. 9). Monocapitalism and neoliberal transhumanism therefore stand in stark contrast to humanism, which is characterized by human dignity, equality and solidarity, among other things (cf. Huppenbauer, 2021, pp. 674; Warso & Gaskell, 2019, pp. 23, 25; Verständig, 2021, pp. 11; HVD, 2019).

The tendency towards self-optimization is deeply embedded in neoliberal society and is encouraged by external norms and incentives. The aim is to continuously improve one's own performance in line with social and market requirements. This is particularly evident in the transhumanist approach, in which technical enhancements are seen as a means of improving individual performance. Here, self-optimization is primarily geared towards the economic environment and market logic. This poses the danger of a consumer market that further promotes social inequalities (cf. Huppenbauer, 2021, pp. 674). Self-optimization in neoliberal transhumanism primarily follows the demands of the market. Individuals are encouraged to improve themselves through technological means - such as genetic interventions or cognitive enhancements - so that they can compete. This form of optimization is aimed less at long-term social or ethical progress, as sought by long-termism, and instead concentrates on the immediate increase in productivity and efficiency. The individual becomes an "entrepreneurial self" whose actions are guided by economic principles. Self-realization is closely linked to economic success and market logic shapes individual consciousness. This contradicts humanistic principles that place human development in a broader social and moral context (cf. Verständig, 2021, p. 10).

Furthermore, in neoliberal transhumanism, self-optimization is perceived as an individual project in which success or failure is attributed solely to the individual. Neoliberal logic requires each individual to continuously strive for improvement to remain competitive. This constant demand leads to an internalization of insecurities and an increased pressure to adapt and threatens economic and social equality of opportunity (cf. Huppenbauer, 2021, p. 667). In a neoliberal society, social and

economic inequalities are thus exacerbated, as individuals with more resources - financial or technological - are able to optimize themselves better and faster. This leads to a widening of the gap between different social classes and contradicts the humanist ideal of equality and justice (cf. Verständig, 2021, pp. 11).

In the neoliberal meritocracy, the boundaries between working life and private life are also blurred, as the individual is constantly striving to optimize themselves through innovation, creativity and self-empowerment. This leads to an incessant demand for self-optimization and increases the pressure on the individual to perform. Further points of criticism of neoliberal transhumanism include the reduction of the human being to an optimizable object that is only evaluated according to market criteria (cf. Huppenbauer, 2021, pp. 673). This focus on individual responsibility for success or failure reinforces social inequalities, as people with more resources have an advantage. The ethical implications of transhumanism, which views the human body and mind as objects that can be optimized, are also criticized from a humanist perspective, especially with regard to the disregard for humanity and solidarity. This could lead to an erosion of human dignity and an instrumentalization of the body, while ethical, social and cultural values are neglected. This perspective would dehumanize the individual and ignores the social responsibility that Western welfare states actually emphasize (cf. Verständig, 2021, p. 12). In the following section, the methodology of the literature review is explained.

4. Methodology

This section describes the methodology of the empirical survey. This includes the preparation of previous research results and the derivation of the specific research objective. In addition, the procedure for the literature research and analysis is explained and the selected research literature is described.

4.1 Processing the research results to date

The current state of the transhumanism movement presents a number of legal, technological and economic challenges. First of all, the legal framework at international and national level remains largely vague. There is no explicit international or national legislation that refers specifically to transhumanist technologies such as HET. Existing legal frameworks, such as international human rights obligations and regulations on health and privacy, offer only indirect protection mechanisms. Institutions such as the United Nations and UNESCO contribute to regulation through general ethical standards, while specific regulations are lacking (cf. Warso & Gaskell, 2019, pp. 23, 25). There is also no specific legislation for these technologies in Europe to date, with existing directives such as the General Data Protection Regulation only covering some relevant aspects (cf. Warso & Gaskell, 2019, pp. 35).

Most of the technological developments within transhumanism are still in the development phase. Many technologies, such as neuroimplants, genetic engineering or AI to expand human potential, are still immature and not fully developed. Some progress has been made, for example in the development of brain-computer interfaces (BCI) or genetic manipulation technologies such as CRISPR/Cas9, but these technologies are often still at the experimental stage. Implementation in the market is therefore not yet possible in most cases, and the long-term effects are difficult to predict (cf. Dreher, 2023, p. 6; Puzio, 2022, p. 27).

Another problem is the lack of uniformity in implementation strategies. There are no uniform legal regulations or guidelines governing technological developments and their integration into the market. This leads to a fragmentation of approaches and a lack of clarity regarding the future direction of transhumanist technologies. The

regulation and control of technologies, particularly with regard to ethical issues and social justice, remain insufficiently addressed (cf. Warso & Gaskell, 2019, pp. 29, 35). Despite these challenges, the European Union is funding numerous projects to support the transhumanist movement. One of the aims of these initiatives is to create social justice and fair economic structures in the emerging industry. The EU supports projects that aim to develop ethical standards and maximize the social and economic benefits of the technologies while minimizing risks (cf. European Commission, 2023a).

Critics warn in particular of the risks of a monopolization of the transhumanism market. They fear that the current neoliberal economic structures, particularly in Western countries, could lead to large technology companies dominating the market. This could degrade transhumanism to a pure consumer market and worsen social injustices. Wealthy people and companies would potentially have preferential access to transhumanist technologies, while poorer sections of the population could be excluded, further entrenching existing social inequalities (cf. Huppenbauer, 2021, pp. 674; Warso & Gaskell, 2019, pp. 23, 25).

In this context, the structured literature analysis aims to shed more light on the ethical aspects of transhumanism. Relevant research literature will be used to determine the effects of the transhumanist movement on the economy and society from an ethical perspective and the associated challenges. Following on from possible criticism, solutions to the predicted risks will also be outlined.

4.2 Search strategy and procedure

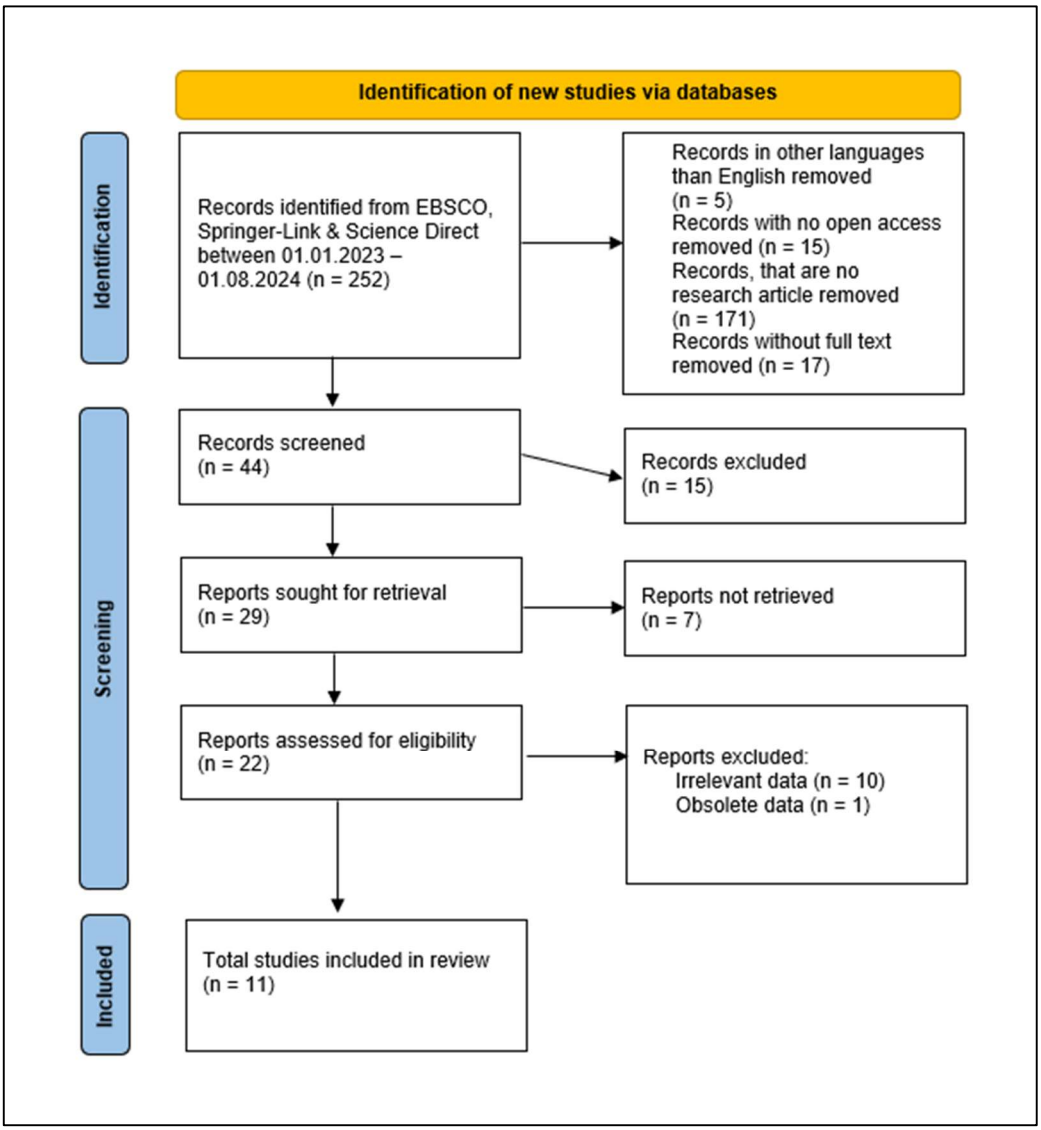
The literature search was carried out in the EBSCO, Science Direct and Springer Link databases. They were chosen because of their wide spectrum, size and peer reviewed content (EBSCO), focus on physical sciences and engineering (Science Direct) and economics and social sciences (Springer Link). At the beginning, search strings were created with the relevant terms, which were combined using the operators "OR" and "AND". These search strings contained terms related to "transhumanism" and "ethics". These included various terms from the field of transhumanism, such as "human enhancement", "longtermism" and "posthumanism", as well as ethics-related terms such as "policies", "morality", "moral responsibility", "bioethics" and "human values".

Special functions such as "" and "#" were used to take different spellings into account. The star symbol ("*") was used to cover different spellings. The hash sign ("#") was used to include different spellings of terms. The process of analyzing and selecting relevant literature was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. This methodology comprises four steps: Identification, screening, assessment of eligibility, and selection of relevant literature (cf. Moher et al., 2009, p. 1). The inclusion and exclusion criteria applied in the selection of research literature are explained below.

4.3 Inclusion and exclusion criteria

To ensure that the data analyzed is up-to-date and relevant, only sources published from 2023 onwards were taken into account. This restriction ensures that the studies reflect the latest developments and findings in the relevant field of research. In addition, only publications in English were included to ensure a broad international perspective. A further criterion for the selection of literature was the type of publication. Only scientific articles that either conducted primary data collection or in-depth literature analysis were considered. Papers such as master's theses, dissertations, conference presentations or other non-scientific publications were excluded. In addition, only papers that had undergone a peer review process were included in the analysis. Another key criterion for inclusion was relevance to the research topic. Only studies that dealt directly with the aspects of transhumanism, its ethical implications and its effects on the economy and society were included in the analysis.

As part of the systematic literature search, the PRISMA model was used to structure the selection process of the studies in a comprehensible manner. Figure 8 below illustrates the flow chart for the literature search according to the PRISMA model.



8 **Fig. 8.** Own presentation of PRISMA Flow Diagram.

The process began with the identification of 252 studies from the EBSCO, Science Direct and Springer Link databases that were published between 01.01.2023 and 01.08.2024. These studies were first screened to exclude non-relevant publications. These included studies in languages other than English (n = 5), papers without open access (n = 15), publications that were not research articles (n = 171) and studies without accessible full texts (n = 17). After this adjustment, 44 studies remained, which were subjected to further screening. In this phase, 15 studies were excluded as they did not sufficiently relate to the research topic. In the next step, the full texts of the remaining 29 studies were read. In seven cases, however, the full texts could not be retrieved, which is why these studies were also excluded from the analysis. The remaining 22 studies were then subjected to a detailed assessment of their suitability.

It was found that ten studies had to be excluded due to irrelevant data. A further study was removed from the analysis due to outdated data. At the end of the selection process, eleven studies remained and were included in the final systematic review.

4.4 Selected literature

Table 2 lists the 11 studies that were included in the analysis. The studies presented offer valuable insights into the ethical, philosophical and socio-cultural implications of transhumanist and posthumanist technologies. Each study pursues specific research objectives and uses appropriate methodological approaches to shed light on the topic in a differentiated way.

The study by Seyfried, Youssef & Schmidt (2023) aimed to investigate the motivations and views of neurohackers on NT. Qualitative interviews with 13 neurohackers from different fields were used to investigate topics such as technologies used, ethical considerations and future perspectives. The interviews were conducted between June and December 2020 and analyzed in a qualitative content analysis to inductively develop categories that led to larger thematic clusters. Hong's study (2024) examined the philosophical, ethical and socio-cultural implications of trans- and posthumanism on the consumer market and human identity. The study employed a qualitative analysis of transhumanist concepts in relation to AI, biotechnology and cybernetics and utilized philosophical currents such as Heidegger and Stiegler to understand the impact of these technologies on the consumer market. The focus was on the post-phenomenological perspective and network ontology. The study by Rueda, Pugh & Savulescu (2023) examined the moral and ethical implications of reprogenetic technologies, particularly with regard to genetic enhancements and their impact on justice and equality. The theoretical approach used historical and contemporary examples to shed light on possible changes in reproductive ethics. Potential future scenarios in relation to genetic interventions in reproduction were discussed.

The study by Caruana (2023) analyzed the psychological and cultural impact of digital technologies on the grieving process. Psychoanalytic and philosophical perspectives were used to examine technologies such as virtual resurrections through AI. The study used concepts such as the unconscious and grief to understand how digital technologies simulate and process the loss of loved ones. Edgell's study (2024) analyzed the social

and creative impact of AC. Using autoethnographic methods, it reflected on the concerns within the creative community about AC and how these impact creative identities. The theoretical framework was based on the concepts of "sociotechnical monsters" and questions of creative value. The study by Stahl et al. (2023) examined the ethical and human rights challenges associated with AI. The study used the Delphi method to determine a consensus among experts on ethical problems and their remedies in three rounds. The focus was on prioritizing ethical challenges and deriving recommendations for action. The study by Zou (2024) aimed to investigate the transhumanist perspective on genetic enhancements and develop the concept of "transhumanist evolution". The interdisciplinary study combined philosophical and evolutionary theories to analyze genetic enhancements in the context of advances in biotechnology, AI and neurobiology. The aim was to create a scientific basis for the integration of transhumanist technologies into the theory of evolution. The study by Akpan (2024) addressed the transhumanist philosophy and its goal of improving human nature. The hermeneutic examination of Max More's and Anders Sandberg's transhumanist concepts focused on the claim that technological enhancements could violate human dignity. The study addressed these arguments and defended transhumanism as a means of enhancing human nature and dignity.

The study by Basak & Saha (2023) dealt with the transition from human existence to posthuman states and the ethical implications of this change. A philosophical and ethical analysis was used to examine the impact of technological developments on human life. The focus was on transhumanist goals such as human enhancement and the moral questions raised by these developments. In the study by Liao (2024), the authors examined posthumanist and transhumanist themes in the "Rebuild of Evangelion" film series. A narrative analysis of the films was conducted to shed light on the contrast between transhumanism and posthumanism. The study analyzed how ethical and philosophical issues are portrayed through the characters and plot, drawing on existing literature on these topics. The study by Helbing & Lenca (2024) analyzed the ethical, societal and political challenges posed by the convergence of technologies such as AI, gene editing, nanotechnology, NT and robotics. The study conducted a systematic review of the scientific literature on these converging technologies and emphasized the need for international regulations to govern these technologies. The areas of application and risks of the technologies were analyzed to highlight their significance for the future.

Researchers & Year	Title	Focus of investigation
Seyfried, Youssef & Schmidt (2023)	Pioneering neurohackers: between egocentric human enhancement and altruistic sacrifice	Examine the motivations, goals and ethical implications of neurohackers and analyze how their human enhancement practices relate to established neurotechnological applications.
Hong (2024)	Transcendence up for sale: cracking the onto-existential codes for Übermensch	Examine the impact of transhumanism on human existence, particularly in terms of ethical and moral considerations and implications for consumer markets, by analyzing concepts such as posthumanism and technological transformations.
Rueda, Pugh & Savulescu (2023)	The morally disruptive future of reprogenetic enhancement technologies	Investigating the ethical and moral implications of reprogenetic technologies, particularly with regard to how these technologies might change future moral ideas about reproductive choices, justice and the moral status of human beings.
Caruana (2023)	Mourning revolutions in the virtual anastasis	Analyze the impact of virtual and digital mourning processes on individual and societal consciousness by drawing on psychoanalytic and philosophical concepts to explore the ethical, psychological and social implications of virtual "reanimation" technologies.
Edgell (2024)	A monstrous matter: The three faces of artificial creativity	To examine the complex challenges and concerns associated with artificial creativity, in particular by analyzing three key considerations: Trust, creative value and creative personal identity.
Stahl et al. (2023)	Exploring ethics and human rights in artificial intelligence - A Delphi study	Identification of the most pressing ethical and human rights challenges in connection with AI and prioritization of suitable measures to mitigate these challenges.
Zou (2024)	Genetic enhancement from the perspective of transhumanism: exploring a new paradigm of transhuman evolution	Examination of the concept of genetic enhancement from the perspective of transhumanism. The concept of transhuman evolution is proposed, which represents a new synthesis in evolutionary biology.
Akpan (2024)	Transhumanist technologies as enhancers of human nature and its dignity	Analyze the ethical and philosophical arguments made against transhumanist technologies, particularly in relation to the claim that they violate human nature and dignity.
Basak & Saha (2023)	Changing Patterns of Existence from Human to Posthuman: An Ethical Overview	Examination of the ethical aspects of the transformation of humans to the posthuman. It analyzes the transition from transhumanist technologies to posthuman concepts, focusing on the effects on human morals and values.
Liao (2024)	Visions of posthumanity: a posthumanist narrative study on *Rebuild of Evangelion*	Analysis of the posthumanist narratives in the "Rebuild of Evangelion" tetralogy. The contrast between transhumanist ideals, which focus on technological immortality and anthropocentric values, and posthumanist values, which aim at relational thinking and egalitarian ethics, is examined.
Helbing & Lenca (2024)	Why converging technologies need converging international regulation	Examination of the ethical, social and political challenges of technological convergence, in which previously separate technologies such as AI, genetic engineering, nanotechnology, neurotechnology and robotics are increasingly merging.

2 **Tab. 2.** Own presentation of included Studies

5. Results of the literature analysis

In this section of the paper, the results of the systematic literature review are presented, followed by a sober presentation of the results, which are then summarized and interpreted.

5.1 Presentation of results

The results are split into societal and social effects, criticism and alternatives and outlook and possible solutions.

5.1.1 Ethical and moral aspects

1. Societal and social effects

The societal and social impact of transhumanism is closely linked to the commercialization of technologies. However, these technologies pose ethical risks, particularly in terms of social inequality due to unequal access to these technologies. The market is increasingly developing into a "transhuman market" in which technological enhancements are traded as consumer goods (cf. Hong, 2024, pp. 152). The ability to select genetic traits could replace traditional genetic diversity, where children inherit their parents' genes by chance. This could lead to genetic disadvantages no longer being perceived as bad luck, but as injustice (cf. Rueda et al., 2023, pp. 589). In this context, society could develop new views on which technologies should be accessible to all, either through the free market or through government subsidies. In any case, there is a risk that the spread of genetic improvements will reduce genetic diversity and lead to an increased separation between genetically improved and unimproved people (cf. Rueda et al., 2023, pp. 589).

However, digital necromancy through AI and VR could hinder the grieving process by creating an idealized but false relationship with the deceased, disrupting the natural processing of loss. The creation of virtual copies of deceased loved ones indicates a need for control over the loss and interaction with the deceased. Furthermore, it warns of the risks of addiction to such technologies, which could be used as an escape from reality (cf. Caruana, 2023, pp. 140).

2 Ethical challenges in the application of technologies

Ethical challenges in the application of technologies lie in the increasing role of technology as a moral co-actor. In contrast to pure instrumentalization, technology in transhumanism influences human decisions and creates new moral dilemmas. This is particularly evident in genetic modifications or biotechnological enhancements, which can potentially create new social hierarchies and inequalities (cf. Hong, 2024, pp. 158, 164). The rapid pace of technological progress raises fundamental questions about data protection, consent and social inequalities (cf. Zou, 2024, pp. 5, 10). Critics argue that technological improvements could violate human nature and dignity, leading to alienation and dehumanization. In addition, some critics see genetic modification as a potential intervention that could have a negative impact on future generations (cf. Akpan, 2024, p. 1).

Another aspect of ethical reflection concerns posthumanist ethics, which, in contrast to traditional normative ethical theories, does not accept fixed moral rules and instead emphasizes flexibility and individual autonomy. This ethic propagates an egalitarian approach that respects all living beings (natural and artificial) (cf. Basak & Saha, 2023, pp. 157 f.; Liao, 2024, pp. 2). The lack of transparency in the use of AI as well as data breaches, bias and discrimination pose further ethical challenges. The loss of human decision-making through AI and the potential impact on the labor market are also the subject of ethical discussion (cf. Stahl et al., 2023, pp. 4).

Converging technologies also harbor the risk of dual use. They can be used for both civilian and military purposes, for example to monitor behavioral patterns or thoughts through NT. Technologies such as neuro-interfaces and digital pills create new forms of surveillance that could be misused for malicious purposes such as hacking or unauthorized data extraction. To counter such risks, there are calls for the introduction of new human rights such as "neurorights" to protect mental privacy and cognitive freedom (cf. Helbing & Ienca, 2024, pp. 1).

3. Changes in the understanding of identity and humanity

The changes in the understanding of identity and humanity in the context of transhumanism and posthumanism are profound. Transhumanists view self-improvement as an expression of human dignity and see technological progress as a natural part of human development. They argue that human nature is already subject to change (cf. Akpan, 2024, p. 1, pp. 4). A central aspect of this is the desire for immortality, which is manifested through technologies for virtual resurrection and is reinforced in capitalist societies through consumption and technological developments (cf. Caruana, 2023, pp. 140, 144).

Critics, on the other hand, fear that genetic improvements could bring about unpredictable social changes and lead to the erosion of human identity (cf. Zou, 2024, p. 1, 5). Reprogenetic technologies could give parents the opportunity not only to determine the timing of reproduction, but also to select the genetic characteristics of their children. This could expand reproductive autonomy, but also create new ethical challenges regarding the equal moral standing of all humans, especially if the gap between genetically enhanced and non-enhanced humans grows. There is also a risk that the spread of genetic enhancements will reduce genetic diversity and lead to increased social segregation (cf. Rueda et al., 2023, pp. 589).

In the area of creative identity, increasing dependence on AC carries the risk that people will be less creative themselves, which could lead to a loss of creative identity (cf. Edgell, 2024, pp. 1). In contrast, posthumanist approaches emphasize the importance of the body and relationships with other living beings for human existence. The attempt to overcome the body through technology is seen as problematic, as the body plays a central role in self-consciousness and human subjectivity (Studies 10). The criticism of transhumanism contained in the studies and the alternatives discussed are outlined below.

5.1.2 Criticism and alternatives

1. Technological feasibility and criticism of progress

The technological feasibility and criticism of progress associated with transhumanist technologies include safety concerns as well as ethical and moral challenges. The main

safety risks include possible infections following implantations, hacking of implants and battery risks arising from the integration of technology into the human body. These physical risks are important factors that need to be considered in the further development and implementation of such technologies (cf. Seyfried et al., 2023, pp. 1, 8). Furthermore, future moral uncertainty emphasizes that the moral implications of reprogenetic technologies are difficult to predict and require critical reflection on future technological and moral developments (cf. Rueda et al., 2023, pp. 589). In this context, it is pointed out that while many measures to regulate and ethically control such technologies are considered desirable, their feasibility is often considered low, indicating limited optimism regarding the realization of such measures (cf. Stahl et al., 2023, pp. 2).

A central point of criticism of transhumanism is the belief in technological progress, which critics regard as overly optimistic with regard to the feasibility and ethical consequences of technological developments. Many of the transhumanist ideas are based on speculative technologies whose actual feasibility is questionable. This raises the question of the extent to which technological progress can live up to the high expectations of transhumanists (cf. Zou, 2024, pp. 1).

2. Critique and alternatives to transhumanism and capitalist logic

The critique and alternatives to transhumanism and capitalist logic are particularly directed against the commercialization of human existence, which is strongly emphasized in transhumanism. Technologies designed to enhance human potential are marketed as consumer goods, leading to ethical risks such as social inequality through unequal access (cf. Hong, 2024, p. 152, 154, 161, 166). A similar phenomenon can be seen in the commodification of the grieving process through technologies used to re-create the deceased. These technologies are increasingly commercialized, which raises ethical questions regarding the commercialization of grief (cf. Caruana, 2023, p. 142). A key criticism is the lack of consensus on the prioritization or implementation of ethical measures, despite the clear identification of problems. Instead of specific legislative or technical measures, broad measures such as education and the sharing of best practices are often favored (cf. Stahl et al., 2023, pp. 2). Critics of transhumanism accuse the movement of relying on excessive optimism and speculative technologies

that could raise ethical concerns and lead to a loss of human identity, particularly through genetic enhancements (cf. Zou, 2024, pp. 5).

Bio-conservative critics argue that technological improvements violate human nature and could lead to dehumanization in the long term (studies 8, 9). This criticism is exemplified in the depiction of transhumanism as a quest for disembodied immortality, which is perceived as destructive and dehumanizing. According to critics, the attempt to overcome the human body through technology leads to isolation, alienation and environmental destruction (Liao, 2024, pp. 2). In addition, transhumanism is criticized for its interconnectedness with the capitalist system, which is based on exploitation and commercialization. This connection leads to people and technologies being seen as tools of the system, which raises ethical questions regarding social justice and responsibility (Liao, 2024, pp. 2).

5.1.3 Outlook and possible solutions

1. Future developments

The future of transhumanism and posthumanism is likely to be characterized by significant technological developments with far-reaching social and ethical implications. NT, such as neuroimplants, could become increasingly widespread in society and transform traditional notions of humanity and identity. The market plays a central role in the implementation and regulation of such technologies (cf. Seyfried, 2023, pp. 1; Hong, 2024, pp. 152). Similarly, the development of digital resurrection technologies by companies such as Microsoft and Amazon, which virtually resurrect deceased persons, will change the way death and grief are socially processed. These technologies could enable new forms of interaction with the deceased and require critical reflection on the ethical framework (cf. Caruana, 2023, pp. 140). AC will also become increasingly important as it can both augment and potentially displace creative processes. The question of how this technology is used and regulated will be crucial for the future of creativity (cf. Edgell, 2024, p. 1).

The societal and social implications of technological developments in the transhumanist context are complex. The integration of genetic modifications and neuroimplants could lead to a transformation of the markets, with ethical issues

regarding access to these technologies taking center stage to prevent social inequalities (cf. Hong, 2024, p. 152, 162). Furthermore, the management of grief will be redefined by digital technologies, such as digital resurrection. The boundaries between the real and virtual worlds could become increasingly blurred, bringing with it new challenges in dealing with death and grief (cf. Caruana, 2023, p. 140). In addition, the use of reprogenetic technologies will confront society with the decision of how and to what extent genetic enhancements are used, as these could have far-reaching effects on reproductive autonomy and genetic selection (cf. Rueda et al., 2023, pp. 589).

The ethical and moral challenges associated with transhumanism require a differentiated debate. In particular, the question of access to transhumanist technologies carries the risk of deepening social inequalities and must therefore be carefully addressed (cf. Hong, 2024, p. 152, 162). In the field of creative technologies such as AC, there is also the question of how this technology can be used to promote human creativity without repressing it (cf. Edgell, 2024, p. 1). Converging technologies, such as neuro-interfaces, also raise ethical questions regarding the protection of mental privacy, necessitating the introduction of new legal protections such as neurorights (cf. Helbing & Ienca, 2024, pp. 1, 7). Posthumanist evolution, which emphasizes genetic improvements and technological enhancements, also calls for a balanced approach that takes into account both technological potentials and ethical risks (cf. Zou, 2024, pp.1, 5).

The technological feasibility of many transhumanist ideas remains the subject of intense debate. While reprogenetic technologies and other speculative procedures await acceptance, it remains unclear to what extent these technologies are socially feasible and ethically justifiable (cf. Rueda et al., 2023, p. 591). Critics point to the limits of technological feasibility and exaggerated optimism regarding the possibilities of such technologies (cf. Hong, 2024, pp. 152, 158, 162). At the same time, progress is seen as an inevitable part of human development, with the shift towards a post-humanist existence seen as a long-term consequence of technological development (cf. Akpan, 2024, p. 1).

The question of the regulation and governance of technological innovations is at the center of debates on transhumanism. There is a broad consensus that international

cooperation is necessary to ensure that technological developments are ethically justifiable and comply with human rights. A flexible governance framework involving both national and international actors is seen as necessary to meet the complex challenges of converging technologies. Ethical principles such as the protection of neurorights and data protection should be guaranteed (cf. Helbing & Ienca, 2024, pp. 1, 7). In addition, systemic approaches to the regulation of specific AI technologies are necessary to effectively address ethical and societal challenges (cf. Stahl et al., 2023, pp. 1).

The future prospects of transhumanism are characterized by far-reaching developments. Transhumanist technologies such as genetic and cognitive enhancements are seen as inevitable advances that could bring about profound changes in human nature (cf. Akpan, 2024, pp. 1). At the same time, a balanced approach is called for that weighs the technological opportunities against the associated ethical risks (cf. Zou, 2024, pp. 1). In this context, the redefinition of human values and the merging of man and machine could have a profound impact on social norms and people's self-image (cf. Basak & Saha, 2023, pp. 153, 164).

2 Regulatory measures and governance

Regulatory measures and governance play a central role in the control and management of technologies in the transhuman context. Ethical reflection on access to and use of technologies is crucial to prevent social inequalities and abuse (cf. Hong, 2024, p. 152, 162, 166). It is therefore called for regulatory measures such as legal frameworks, international agreements and technical measures to test algorithms for bias and transparency to be developed to minimize ethical risks (cf. Stahl et al., 2023, pp. 2). A systemic approach is considered necessary to address the complexity of ethical issues related to AI technologies, as the current discourse is often too broad. A system-oriented approach could help to find more targeted solutions (cf. Stahl et al., 2023, pp. 1). The need for international regulation is emphasized, as current governance mechanisms are often technology- or domain-specific and are not sufficient to meet the challenges of converging technologies. International mechanisms that promote cooperation between actors are proposed as a solution (cf. Helbing & Ienca, 2024, pp. 3, 7).

Recommendations for regulation include the introduction of ten ethical principles, including data protection, neurorights, the protection of vulnerable groups and the creation of a new social contract for converging technologies (cf. Helbing & Ienca, 2024, p. 1, 7). These measures are intended to help address ethical and social challenges in technology development. They also include systematic testing of AI systems, guidelines for project management, stakeholder dialogs and tools for reviewing data sets (cf. Stahl et al., 2023, pp. 7). Central criteria for effective governance are the consideration of social impacts, transparency, the protection of human rights and the enforcement of measures (cf. Stahl et al., 2023, pp. 3). These principles are particularly important to ensure that technological developments are in line with ethical and social standards. The films that address collective action and restoring relationships emphasize the importance of collective efforts to create a more harmonious world (cf. Liao, 2024, pp. 2). In the field of NT, neurohackers express the desire for improvements in miniaturization, battery technology and medical applications of NT, which shows that regulatory measures must also be geared towards practical feasibility and technological development (cf. Seyfried, 2023, pp. 1, 9).

5.2 Interpretation

The actual development of transhumanist technologies remains unclear, which means that the long-term social and political impact is also difficult to predict. Technological progress in the field of genetic modification, NT and AI is advancing, but many of these technologies are still at an early stage of development. This means that their actual implementation and impact on social structures, the labor market and human identity are speculative. Studies suggest that technologies such as genetic enhancements or digital resurrection could potentially have a profound impact on societies, but the speed and scope of these changes remain uncertain. The ethical challenges associated with these developments are manifold. A central problem is the social inequality that could arise from unequal access to transhumanist technologies. For example, genetic modifications or neuro-enhancements could be primarily accessible to wealthy individuals, leading to a widening gap between genetically enhanced and non-enhanced people. This inequality could further entrench social hierarchies and give rise to new forms of discrimination. Furthermore, technologies such as digital resurrection raise moral questions as they could interfere with the

natural grieving process and offer people a distorted, virtual relationship with the deceased.

Another key aspect is the role of technology as a moral co-actor. While technologies have traditionally been seen as tools subject to human control, in the context of transhumanism they are developing an active role in decision-making processes. This is particularly evident in AI systems that influence human actions and could potentially replace human decision-making. These developments raise fundamental ethical questions, such as the protection of privacy, consent to the use of such technologies and the impact on future generations. Concerns about the loss of human dignity and possible dehumanization through technological enhancements are at the heart of the criticism. In view of these ethical dilemmas, solutions must be developed that both take into account the technological potential and ensure the protection of human values. One way to reduce social inequalities is to regulate access to transhumanist technologies by the state and, if necessary, to subsidize them. This could help to ensure that genetic improvements or other technological enhancements are not exclusively accessible to the privileged elite, but are open to all levels of society. The proposal to introduce new human rights such as "neurorights" aims to protect mental privacy and cognitive freedom. These rights could prevent technologies such as neurointerfaces or digital pills from being used for unethical purposes.

Comprehensive regulatory measures are needed at international level to prevent the misuse of transhumanist technologies. These measures should include the introduction of ethical principles such as data protection, the protection of vulnerable groups and the review of AI systems. A flexible governance approach involving national and international actors could mitigate ethical risks and evenly distribute responsibility for technological innovation. Promoting education and ethical awareness among the population could also help to ensure that transhumanist technologies are used in accordance with social and ethical norms.

6. Discussion of the results of the work

The results are discussed in this section of the paper. This includes answering the research question and a critical reflection on the research limitations. Based on this reflection, suggestions for further research are derived.

6.1 Answering the research questions

CR: What are the impacts of the transhumanist agenda for science and technology policy? What are the possible socio-political and economic implications?

The impact of the transhumanist agenda on science and technology policy and the associated socio-political and economic implications are currently difficult to assess. The reason for this lies in the unclear technological development and the speculative nature of many transhumanist technologies. This applies in particular to technologies such as genetic modification, NT and digital resurrection, which are still in the early stages of development. As a result, the potential impact on society and the economy can only be identified by circumstantial evidence. However, initial indications suggest that the spread of these technologies could exacerbate social inequality and economic concentration in the wake of neoliberal and capitalist structures.

A central problem in this context is the unequal access to transhumanist technologies. Studies show that access to genetic enhancements, neuro-enhancements and AI-supported applications could depend heavily on the financial means of individuals. This leads to the assumption that social inequalities will deepen, as wealthy people and companies could have an advantage in the use of such technologies. These technologies could lead to a new form of social division, where genetically and technologically enhanced people are privileged, while those who do not have access to these technologies are disadvantaged. This would further widen the existing social divide and exacerbate inequality between different social groups.

Furthermore, there are indications that genetic technologies that make it possible to eliminate certain genetic predispositions could jeopardize natural genetic diversity. If it becomes possible to specifically select genetic traits, this could lead to a devaluation of those people who are unable to use these technologies. The perception of genetic disadvantages would change - they could no longer be seen as "natural bad luck", but as a kind of social failure because there are no technical barriers that could prevent certain "undesirable" genetic traits. This could result in a stigmatization of those people who have genetic deficiencies or who consciously decide against the use of such technologies.

The monopolization of technological markets is an economic risk. Large technology companies already have a dominant position in the market for innovative technologies, and this could be further strengthened by transhumanism. The "transhuman market", in which technological enhancements are traded as consumer goods, offers companies such as Google, Amazon and Microsoft enormous economic power. This monopolization carries the risk that access to transhumanist technologies will be controlled by a few large players who can dictate both price and availability. As a result, free access to these technologies could be restricted, deepening economic inequality and leading to a greater concentration of economic power in a few companies.

In addition to these aspects, the research findings also raise questions about the role of technology policy. In a society where transhumanist technologies play an increasing role, policy makers need to introduce new regulatory mechanisms to minimize the social and ethical risks. A central point of the debate is whether and how the state should intervene to regulate access to these technologies and prevent social inequalities. In addition, new protections, such as the proposed "neurorights", need to be included in legislation to protect mental privacy and cognitive freedom. The present study has several limitations that could restrict the validity of the results. These are discussed below.

6.2 Limitations

As many technologies are still in the early stages of development or in the realm of speculation, the actual technological development remains unclear. This makes it difficult to accurately predict the social and economic impact, which may differ significantly from the scenarios discussed in this paper. In addition, the availability of empirical data on the real effects of transhumanist technologies is limited. Most of the studies used are based on theoretical models or speculative assumptions, which limits the generalizability of the conclusions. In particular, long-term studies or comprehensive empirical analyses that could provide reliable data are not yet available. This limitation makes it difficult to make a well-founded assessment of the long-term effects on society and the economy.

Another aspect is the regional limitation of the analysis. The focus of the work is primarily on western, industrialized countries where technological innovations are being driven forward. The work may not sufficiently consider the impact on less developed countries or regions with limited access to transhumanist technologies. This regional limitation may detract from the global relevance of the work. The paper also focuses on specific technologies such as genetic modification and NT. Other transhumanist technologies, which could also have significant societal and economic impacts, are not discussed in detail. This could lead to a limited perspective and not fully reflect the breadth of technological developments.

Finally, the complexity of the ethical issues raised by transhumanist technologies makes a comprehensive analysis difficult. The ethical perspectives are diverse and context-dependent, so that the work cannot fully cover all possible ethical debates. Rapid technological development could also bring new ethical challenges after the publication of the work, which could not be considered here. The limitations result in approaches for further research, which will be presented below.

6.3 Implications for further research

To answer the open questions of this thesis and to develop a deeper understanding of the impact of transhumanist technologies on society, the economy and science policy, further research approaches are required. These future research projects should build on the limitations identified in this thesis and close specific gaps to enable a more comprehensive and empirically sound analysis.

A central research approach is to conduct empirical studies that investigate the real social impact of transhumanist technologies. Long-term studies should be developed that analyze the use of technologies such as genetic modification, NT and AI in different social classes. Particularly relevant are studies that look at access to these technologies in different socio-economic groups and examine how these technologies might increase or decrease social inequalities. Surveys and qualitative interviews should also be conducted to understand the perception and acceptance of such technologies in different societal contexts.

Another research approach is the analysis of the economic impact of transhumanist technologies, particularly with regard to monopolization tendencies and market structures. In particular, the role of large technology companies and the influence of their power on the dissemination and regulation of transhumanist innovations should be examined. Research projects could analyze the "transhuman market" in more detail by investigating how technological enhancements are traded as consumer goods, which market strategies are used and what role patents and intellectual property play in this area. The possible effects on labor markets and income distribution should also be researched.

Given the ethical and social challenges posed by transhumanist technologies, there is an urgent need for research into new regulatory and governance models. Future studies should investigate how national and international regulatory mechanisms could be designed to control access to transhumanist technologies and prevent social inequalities. The introduction and implementation of "neurorights" as well as data protection and ethics guidelines in different countries could also be analyzed. In particular, the role of international organizations and bodies in the governance of such technologies should be examined to promote transnational ethical standards.

Further research approaches could focus on the ethical and philosophical implications of transhumanist technologies. Here, it would be important to conduct in-depth ethical analyses that address the issues of human identity, genetic modification and the long-term impact on future generations. The development of new ethical frameworks that do justice to the growing importance of AI and genetic interventions could also be investigated. A particular focus could be placed on post-humanist ethics, which challenges traditional moral theories and propagates new approaches for dealing with technologically modified living beings.

To understand the regional differences in the perception, implementation and regulation of transhumanist technologies, country-specific comparative studies should be carried out. Such studies could examine how different countries and cultures react to technological change and which political, ethical and social framework conditions play a role in this. The analyses could also clarify the extent to which different economic systems and political structures influence access to transhumanist technologies and how this affects social inequality.

As the long-term consequences of transhumanist technologies are largely unclear, scenario analyses and long-term forecasts should be developed. These could draw up various future scenarios based on current technological developments and social trends to model the possible positive and negative effects of transhumanist technologies on society and the economy. Worst-case scenarios should also be included, focusing on potential risks such as social divisions, surveillance or dehumanization through technology.

7. Conclusion

7.1 Conclusion

The conclusion of the work clearly shows that the transhumanist agenda could have far-reaching effects on science and technology policy as well as on social and economic structures. However, many of these effects remain uncertain due to the speculative nature and early stages of development of transhumanist technologies. The paper highlights that technologies such as genetic modification, NT and AI-enabled applications in particular are not yet fully developed or extensively researched, making precise predictions difficult. Nevertheless, there are initial indications that point to potential challenges. A central result of the work is the assumption that access to transhumanist technologies will be unequally distributed. This could lead to an exacerbation of social inequality, as wealthy individuals and companies could be given preferential access to these technologies. This social divide between genetically or technologically enhanced people and those without access to these enhancements could give rise to new forms of discrimination and marginalization. The spread of transhumanist technologies could also change the understanding of social and genetic disadvantages. Genetic deficits could no longer be seen as a natural condition, but as avoidable social problems, leading to a stigmatization of those who cannot or do not want to use these technologies.

The economic impact of transhumanism is another focus of the work. Large technology companies, which already occupy a dominant position in the global economy today, could further expand their power through the emerging "transhuman market". This monopolization of technological innovation carries the risk that access to transhumanist technologies will be heavily controlled by a few large players, which could influence both the price and availability of these technologies. This could further increase economic inequality and technological power would become increasingly concentrated in the hands of a few corporations. The work also makes it clear that there is an urgent need for action at a political level to control these developments. The introduction of new regulatory mechanisms and governance models is seen as essential to minimize the social and ethical risks of the transhumanist agenda. A central element of this regulation could be the introduction of "neurorights" that ensure the protection

of mental privacy and cognitive freedom. In addition, international cooperation and transnational ethical standards should be established to manage the potential dangers of the technologies.

Despite the findings, the work points to several limitations. As many of the technologies considered in the analysis are not yet fully developed, the actual technological development remains unclear, which makes it difficult to accurately predict the social and economic impact. In addition, the majority of the results are based on theoretical models and speculative assumptions, as reliable empirical data is still largely lacking. Further research is therefore necessary to gain long-term and empirically sound insights into the effects of these technologies. In conclusion, the transhumanist agenda could bring profound social and economic changes, especially in terms of social inequalities and economic monopolization. However, it is essential that future policies and regulatory mechanisms are developed to ensure that technological progress is in line with social and ethical norms. Only comprehensive and inclusive regulation can ensure that the benefits of transhumanist technologies are fairly distributed and the potential risks are minimized.

7.2 Outlook

Future developments in the field of transhumanism will be decisively shaped by the speed and direction of technological progress. Genetic modification, NT and AI are at the center of this and could have the potential to fundamentally change human capabilities. Access to these technologies will play a central role. If access continues to be concentrated among wealthy population groups, social inequalities are likely to deepen. A two-tier society could emerge in which genetically and technologically enhanced people have clear advantages over non-enhanced people. Economically, large technology companies are expected to further expand their dominant position by controlling the market for transhumanist technologies. These developments could lead to further monopolization, which could inhibit both technological progress and free access to innovation. Competition for patents and intellectual property in the field of biotechnology and AI will also be crucial, as it will significantly influence the availability of these technologies.

At a political level, the regulation of these technologies will be one of the biggest challenges. Governments and international bodies will need to ensure that ethical standards are upheld while encouraging innovation. Particularly important will be the introduction of new legal frameworks that address issues of data protection, mental privacy (neurorights) and social justice. International cooperation will be required to establish global ethical and social standards. In the long term, transhumanist technologies could bring about profound changes in the understanding of humanity, identity and social structure. If these developments are not carefully monitored and controlled, there is a risk that they will lead to social division and new forms of exploitation. How we deal with these technologies will play a decisive role in determining whether transhumanism contributes to a fairer society or exacerbates existing inequalities.

8. Literature

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9. Attachment

9.1 Exposé

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Date of submission	08.03.2023
Supervisor	Prof. (FH) Mag. Dr. Tassilo Pellegrini
Working Title	**Transhumanist Techno Dystopia – The philosophy, intentions and risks of Transhumanism, Longtermism and Posthumanism for society from sociopolitical and economic perspective**
Focus of the Master Thesis	**Problem of the Thesis:** Transhumanism is a movement that advocates for the use of technology to enhance human capabilities beyond their current biological limitations. Their desire of living forever or becoming superior beings through technological enhancements brings up several ethical considerations as to how far one should be allowed to experiment on a healthy human body to exceed biological limitations. (cf. McKie 2018) These ideas of mankind's future are not that far-fetched as several technologies are already in development and promise to change the way humans interact and do business with each other significantly. Not only will our bodies be augmented by technological prosthetics such as contact lenses but also computer chips that are implanted into our heads to enhance our mental capabilities (cf. Singh 2017) In a broader perspective, transhumanism is part of an overarching philosophical ideology called Longtermism that advocates for transhumanism use to cloud their worldview with a less negatively

	connotated term. In its core, this philosophy follows a utilitarian principle that is guided by the idea of putting future human potential above everything else. The longer humanity exists, the more of its potential it can unfold, the further it can expand its existence in the universe before the inevitable heat death. What presents itself as a worldview that benefits everybody harbors dangerous implications as it deems events that will eventually cause a lot of casualties such as the climate crisis as a mere ripple in the billions of years humanity is destined to exist. Advocates also declare human altercation and enhancement as a necessity to overcome bodily limitations and deem people of poorer countries as less detrimental to humanities future and prosperity as they contribute less to technological development. (cf. Torres 2021) As Torres also points out dangerous developments as supporters of Longtermism find their way into high-level US government positions that are then able to shape national policies and decide which innovation and research projects receive funding. Politicians who base their decisions on the idea of a future utopia could justify terrible actions for this “greater good”. With the thesis, the author will explore the philosophy of Longtermism and Transhumanism and what potentials and risks they bring for humanity. A discussion of the potential benefits and risks associated with the use of technology to enhance human capabilities, as well as an examination of the ethical considerations involved are integral to understand these movements. It would also be fitting to examine the potential impact on the workforce, including issues such as social inequality. The aim of the planned work is to examine the current transhumanist agenda and to assess its social and economic impact. To this end, the motives and goals of the transhumanist movement will first be presented. Subsequently, the current state of development will be analyzed to

	determine the actual progress and future direction of the technologies. On this basis, the possible consequences for society and the economy will be derived. The following research question forms the central guideline of the work: **Central Research Question:** What are the impacts of the transhumanist agenda for science and technology policy? What are the possible socio-political and economic implications?
Scientific and Practical Relevance	**Scientific Relevance** Transhumanism and Longtermism as movements and philosophies to enrich our bodies with technological prosthetics is not a negative philosophy per se but should be discussed deeply to prevent unethical and dangerous altercations to otherwise healthy bodies. Groups such as US inventor and entrepreneur Ray Kurzweil and his followers even dream of a future of merging with machines or overcoming physical existence as a whole, becoming "gods" in a way as they phrase it. SpaceX and Tesla founder Elon Musk also sees people upgrading themselves as a way of avoiding becoming redundant in the face of rapidly developing AI. (cf. McKie 2018) To not be taken aback by unpredictable scenarios, the author concludes that thinking ahead, being aware of and regulating those developments is a necessary step to ensure purely rational world interpretations are not used to develop non-objectifiable, philosophical ideologies that sacrifice everything for technological advancement and a hypothetical future potential.

	Practical Relevance As a future manager for digital businesses, learning of the developments of and keeping up to date with the technological systems that will define our world in the next years is essential. By researching the school of thought and the drive behind those developments, the use and implementation of AI powered and body altering technologies can be brought into perspective and are a necessary task to prevent techno dystopias and shine a light on ethical and moral risks they bring along. As the introduction of ChatGPT has shown, new technologies that bring undeniable benefits and possibilities to everybody will be used by a broad mass at a great pace and can turn several fields of our system upside down in very short time. (cf. Metz 2022) Driven further with the wrong intentions and ideology, however, they may further increase the inequalities of the world. **Relevance for Digital Media Management:** • Digital Media & Convergence Management • Digital Commerce : Serviceorientierung & Customer Experience • Content Portfolio Strategien & Lizenzmanagement • Innovation & Business Development • Medien- & Internetethik
Construction and structure	Master Thesis – Table of Contents – Declaration of Honor – Abstract/ Summary – Table of Contents – Table of Figures – List of Tables – List of Abbreviations 1 Introduction 1.1 Background and problem definition 1.2 Objective, research question and procedure

	2 Theoretical background 2.1 Transhumanism 2.2 Other philosophical approaches 2.3 Interim conclusion 3 State of affairs and practical reference 3.1 Legal framework 3.2 Current research fields and focal points 3.3 Transhumanism projects within the EU 3.4 Criticism of transhumanism 4 Methodology 4.1 Processing the research results to date 4.2 Search strategy and procedure 4.3 Inclusion and exclusion criteria 4.4 Selected literature 5 Result of the literature analysis 5.1 Presentation of Results 5.2 Interpretation 6 Discussion of the results of the work 6.1 Answering the research question 6.2 Limitation 6.3 Implications for further research 5 Conclusion Conclusion Outlook 6 Literature
Choice of Method	**Empirical method:**

	The research method chosen by the author to analyze the projects and guidelines is a systematic literature analysis according to the PRISMA principle (cf. Moher et al. 2009, p. 1) **Justification for the choice of Method** The choice of research method used is based on the specific objective of examining the ethical, social and economic impacts of the transhumanist movement. The choice of systematic literature research as the central method is well-founded, as it enables a comprehensive and structured analysis of the existing research literature. The use of PRISMA guidelines ensures a transparent and comprehensible process that allows relevant studies to be identified, evaluated and included in the analysis (cf. Moher et al. 2009, p. 1). The decision to consider only scientific articles that either collect primary data or conduct in-depth literature analyses guarantees that the sources analyzed are of high scientific quality. In addition, the strict inclusion criteria ensure that only current studies that are relevant to the research topic are used. This approach is particularly important because the transhumanist movement is a very dynamic field of research in which new technological and ethical developments must be continuously taken into account (cf. Warso & Gaskell 2019, p. 35; Dreher 2023, p. 6). In addition, the use of several scientific databases such as EBSCO, Science Direct and Springer Link offers a broad and international perspective, which is essential for the topic of the work, which deals with legal as well as ethical and economic issues at the global level. Carefully selecting search terms, combined with the use of operators such as “AND” and “OR”, ensures a precise focus on relevant studies that address transhumanist and ethical issues (cf. European Commission, 2023a). The decision to use a systematic literature review as the primary research

	method is therefore both methodologically sound and thematically appropriate. **Universe** The universe for this research is all research published on the EBSCO, Springer Link and Science Direct databases. At the time of the exposé, the total number of research papers on the three platforms was 231 (cf. EBSCO 2024; Science Direct 2024; Springer Link 2024). **Frame of Survey and Selection Criteria:** The scope of this work focuses on analyzing the ethical, social, and economic implications of the transhumanist movement. To ensure the relevance and timeliness of the studies examined, strict selection criteria were established. Only scientific publications published from 2023 onwards were considered to include the latest developments and research. Furthermore, only peer-reviewed articles that either collected primary data or conducted an in-depth literature analysis were included. Publications in languages other than English and works that were not freely accessible were excluded to ensure a consistent international perspective. Thematic relevance also played a crucial role: only studies that directly addressed transhumanist technologies and their ethical, social or economic implications were considered. This clearly defined scope and the precise selection criteria enabled a well-founded and focused analysis.
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Additional	

Approved by Course Management