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Effects of human enhancement technologies (HET) on society

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1. Introduction

Human enhancement technologies (HET) have already become a part of our daily lives. Almost every day, we are confronted with new developments in human research and innovation, which increasingly demand societal (re)orientation. What initially seemed like a linear increase in human knowledge has turned into an exponential curve, growing ever steeper, making us aware of the complexity of societal relationships through the multitude of elements, structures, processes and interactions.

This contribution, starting with the historical development of HET (Chapter 1.1), aims to outline the current state of research (Chapter 2). Chapter 3 is dedicated to the societal significance of HET, presenting three selected sociological theories as potential analytical tools, addressing the "social drivers", sketching the key developments since the Industrial Revolution, highlighting HE as an economic factor and exploring the societal benefits of these new technologies along with public expectations and attitudes.

The most extensive part of this discussion is dedicated to the societal challenges (Chapter 4). Alongside selected critical voices from science, reference is made to the possible influence of social groups, and the question is raised as to the extent to which the very concept of humanity itself could change. Chapter 4.4 deals with the potential effects of human enhancement on state security forces and emergency organisations today and in the near future, rounding out the discussion with any associated safety concerns.

Chapter 5 concludes the paper with a brief summary of the previous discussions and the derived conclusions. Embedded tables and graphics serve to broadly categorise specific subject areas and aid in orientation.

1.1 Historical development of human enhancement

The historical development of HET and their application in military contexts goes back a long way and reflects the efforts to enhance the performance of soldiers and achieve military objectives more effectively.

In ancient times and in the Middle Ages, various methods were already being used to improve the physical and mental abilities of warriors. These included techniques such as the use of stimulants like caffeine or plant extracts before battle, the use of armour and weapons to increase survivability and the application of tactics and strategies to improve combat effectiveness.

For instance, Hanson examines warfare in ancient Greece and describes how disciplinary measures and physical training contributed to the improvement of soldier performance.[1] DeVries analyses military technologies and tactics from the Middle Ages, including methods to enhance soldier performance through armour, weapons and siege techniques.[2] Keegan, in his work, covers the development of warfare from antiquity to modern times, touching on both psychological and physical aspects of troop leadership.[3]

Since antiquity, there have been examples of prosthetics and orthopaedic devices used to replace or support lost limbs.[4] In his autobiography, Götz von Berlichingen describes the loss of his right hand in the Battle of Landshut in 1504, as well as the use of his famous iron hand prosthesis.[5] These prostheses can still be found today in the Götzenburg in Jagsthausen and the German Historical Museum in Berlin.

Many of these technologies also found their way into civilian life. For example, the Roman road network was originally built to facilitate rapid troop movements and efficient army supply. Beyond this, these roads promoted

1 Hanson, Victor Davis: The Western Way of War: Infantry Battle in Classical Greece. Berkeley: University of California Press, 1989.

2 DeVries, Kelly: Medieval Military Technology. Ontario: Broadview Press, 2012.

3 Keegan, John: A History of Warfare. New York: Alfred A. Knopf, 1993.

4 Gerste, Ronald: Die Geschichte der Prothesen. https://www.nzz.ch/wissenschaft/cybathlon-die-geschichte-der-prothesen-ld.119480, accessed 10 September 2024.

5 Von Berlichingen, Götz: Lebensbeschreibung: Götz von Berlichingen's Ritterliche Thaten. Daun (D): Aurel Verlag, 2008.

trade, communication and governance throughout the Roman Empire. Aqueducts ensured the water supply for Roman garrisons and fortified cities, while also providing fresh water to urban populations, improving public health and hygiene and supporting the growth of cities. At the Battle of Agincourt in 1415, the English gained a decisive advantage through the use of longbows. The longbows, with their greater range, allowed them to fire a large number of arrows and their penetrating power could even pierce the armour of French knights.[6]

With the advent of science and technology in the early modern period, new possibilities for improving military performance were explored. This included the development of better weapons and armour, medical techniques for treating injuries and diseases and the introduction of training programmes to improve the physical fitness and combat skills of soldiers.

One milestone, significant even for the civilian sector, was the development of glasses, which likely appeared around the year 1285 in the region of Pisa or Florence. These early glasses, made from convex lenses, were primarily used to correct farsightedness. Initially, these valuable tools were used in scriptoria, where monks and scholars copied and studied manuscripts. In the 14th and 15th centuries, the use of glasses spread among educated and wealthy individuals, and the first workshops in Italy, Germany and the Netherlands began producing and selling glasses. In the 16th century, the utility of glasses expanded with the development of concave lenses to correct shortsightedness.[7]

During the Industrial Revolution and up until the 20th century, increasingly advanced technologies and methods were developed to improve military performance. This included the introduction of firearms, artillery and other modern weapon systems, the application of new camouflage techniques, the development of military medicine and first-aid techniques and the use of propaganda and psychology to boost soldiers' morale and commitment.

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6 Curry, Anne: Agincourt. A New History. Tempus Publishing Ltd. 2006. https://archive.org/details/agincourtnewhist0000curr/page/n5/mode/2up.

7 Wikipedia: Die Erfindung der Brille. https://de.wikipedia.org/wiki/Brille#Erfindung_der_Brille, accessed 10 September 2024.

In the course of World War II and the subsequent Cold War, the possibilities for human enhancement expanded significantly. Radar and microwave technology revolutionised warfare by improving reconnaissance and early warning systems. Penicillin, the first antibiotic produced in large quantities, significantly reduced mortality rates and increased the survival chances of the wounded. To achieve higher speeds and altitudes, jet engines were developed for military aircraft, which later laid the foundation for modern commercial airplanes.

Research on drugs and stimulants to increase soldiers' endurance and performance also advanced. Both the German Wehrmacht and the Allied forces used amphetamine-based stimulants to keep soldiers awake, increase endurance and improve cognitive performance. For instance, the Wehrmacht used the drug "Pervitin" (a form of methamphetamine) to keep soldiers alert and focused during combat.[8] During the Iraq War in the 2000s, some military units used Modafinil, a medication for treating narcolepsy and sleep disorders, known as an "attention enhancer" to mitigate the effects of sleep deprivation (allowing soldiers to stay on active duty for up to 40 hours) and improve cognitive performance.[9]

The development of implantable medical devices such as pacemakers, cochlear implants (hearing prostheses) and neurological stimulation devices has made it possible to enhance or support human body functions, and organ transplants today give people with life-threatening illnesses a second chance.

In recent years, significant technological leaps have been made in areas such as genetics, biotechnology, robotics, neurotechnology and AI. Advanced prosthetics and exoskeletons have been developed to improve physical abilities, drones and robots are used for remote surveillance and control, and pharmacological substances are employed to enhance cognitive abilities. However, the latter has not always been successful. Vrecko examined the limitations of those known as "cognitive enhancers" such as Ritalin and

8 Mdr.: Die Droge, mit der Hitlers Soldaten in den Krieg zogen. https://www.mdr.de/geschichte/ns-zeit/zweiter-weltkrieg/pervitin-soldaten-droge-crystal-hitler-deutsches-reich-100.html, accessed 20 September 2024.

9 Schleim, S./Walter, H.: Hochleistung durch weniger Schlaf. https://lehrerfortbildung-bw.de/u_gewi/ethik/bs/weiteres/fb1/5cog/2art/3schlaf/, accessed 10 September 2024.

Modafinil, which are also used in military contexts, and found that the effects of these substances are not universal and are often influenced by emotional and contextual factors.[10]

2. State of research

Presenting the state of research on the diverse challenges surrounding the topic of human enhancement places one in an interdisciplinary field that brings together scientists from areas such as medicine, biotechnology, neuroscience, ethics, law, sociology and philosophy. From a sociological perspective, the social implications of human enhancement and its effects on society take centre stage.

In this context, two related but distinct philosophical and cultural movements come into play, both of which deal with the future of humanity and the role of technology in this future: transhumanism[11] and posthumanism. While transhumanism aims to improve humanity through technology, posthumanism also deals with deconstructing and re-conceptualising what it means to be human, questioning the boundaries between human, animal, machine and environment.

In recent years, there have been numerous publications exploring how transhumanist ideas and technologies impact society and culture, including issues of justice, social inequality, privacy, security and access to enhancement technologies. Transhumanists often strive for a posthuman future, where human existence is so much improved by technology, that it can barely be compared to the current human condition. In this posthuman future, humans could possess a variety of new abilities and traits, allowing them to live longer, be more intelligent and experience the world in new ways. Central themes of posthumanist ideas and visions include "technological immortality", "enhanced intelligence", "physical enhancements" or the "transcendence of space and time".

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[10] Vrecko, Scott: Just How Cognitive Is "Cognitive Enhancement"? On the Significance of Emotions in University Students' Experiences with Study Drugs. AJOB Neuroscience 4(1), pp.4-12, 2013.

[11] See Grinschgl, Sandra: Cognitive enhancement – A critical reflection from psychology and neuroscience. In chapter MEDICINE in this publication; Tragbar, Lisa/Lagos, Rodrigo: Human enhancement for military purposes: Ethical considerations. In chapter ETHICS in this publication; Klerx, Joachim: The Future of Human Enhancement in the Military Domain. In chapter TECHNOLOGY in this publication.

One particularly interesting concept is Ray Kurzweil's "technological singularity". He predicts this event for the year 2045. The concept is based on the idea that advances in areas such as artificial intelligence, nanotechnology, biotechnology and robotics will lead to a point where technological development advances so quickly that human existence will be elevated to an entirely new level. According to Kurzweil, technological developments do not progress linearly but exponentially. From 2045 onward, he predicts that human knowledge and technical capabilities will increase explosively. A key element of the technological singularity is the development of artificial intelligence, which will be more intelligent than the human mind and thus able to improve itself. Through the digitisation of human consciousness, the connection of the brain with digital systems or other technologies, the technological singularity will allow humans to overcome death and continue their existence independently of the limitations of the biological body.[12]

Similarly, the philosopher Nick Bostrom speaks of a "superintelligence" and speculates on various ways it could be achieved. However, he also warns of the potential risks of superintelligence, including the risk of insufficient control. A superintelligence could threaten human intelligence, either through unfriendly behaviour, unintended side effects or misunderstandings in goal setting. Moreover, it could resist any attempts from the outside to shut it down. To counter such a development, Bostrom argues that it is necessary to instil goals in the superintelligence that are vital for human survival and well-being.[13]

The robotics and AI researcher Hans Moravec also discusses the possibility of transferring human brains into digital formats, thereby extending human existence beyond death.[14]

These ideas and visions mentioned above are not mere utopian fantasies of certain authors but outline actual stages of human research and development in some areas.

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12 Kurzweil, Ray: Menschheit 2.0: Die Singularität naht. 2nd ed. Berlin: Lola Books, 2014.

13 Bostrom, Nick: Superintelligence: Paths, Dangers, Strategies. Oxford: Oxford University Press, 2014.

14 Morawek, Hans: Mind Children: The Future of Robot and Human Intelligence. Cambridge, MA: Harvard University Press, 1988.

In 2016, Elon Musk founded the company Neuralink,[15] which aimed to create a direct connection between the human brain and computers. The ultimate goal of Neuralink is to expand brain capacity and treat neurological diseases. Neuralink developed a technology that allows tiny electrodes to be implanted in the brain to record and interpret neural signals. These electrodes may be capable of sending and receiving signals, theoretically making it possible to directly connect the brain to computers or other external devices. The potential applications of Neuralink are vast. They include the treatment of neurological diseases such as Parkinson's, epilepsy and depression; the restoration of sensory functions in people with disabilities; the enhancement of cognitive abilities; and the creation of brain-computer interfaces (BCIs) for interacting with digital devices and virtual environments. Despite remarkable progress,[16] however, there are significant challenges and setbacks in this area. While invasive BCIs, which are implanted into the brain, provide the most precise data, they pose significant risks such as infections, scarring and tissue rejection. Additionally, the brain is extremely complex, and understanding the specific patterns responsible for particular thoughts, movements or sensations is still limited.[17]

For the military, the exploration of BCIs offers numerous new possibilities.[18] Jecker and Ko point to research aimed at improving the interaction between soldiers and weapons or other devices through direct brain-computer interfaces.[19] BCIs could also be used in the rehabilitation and treatment of soldiers

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15 Neuralink. https://neuralink.com/, accessed 10 September 2024.

16 Der Standard: Schlaganfalltherapie mit Brain-Computer Interface Technologie - Jetzt neu in Wien. https://www.derstandard.at/story/2000133413828/schlaganfalltherapie-mit-brain-computer-interface-technologie-jetzt-neu-in-wien, accessed 16 February 2022.

17 Akhtar, Altaf et al.: Recent Advances in Implantable and Wearable BCI Systems: A Comprehensive Review. IEEE Transactions on Biomedical Engineering, 2021.

18 See Schulyok, Bernhard/Grangl, Lukas/Gruber, Markus: Human enhancement from a military perspective – WHAT, WHY and HOW? In chapter MILITARY in this publication; Harbich, Harald/Kunze, Michael:Human Enhancement – biological-neurological aspects from a military perspective. In chapter MEDICINE in this publication.

19 Jecker, Nancy S./Ko, Andrew: Brain-computer interfaces could allow soldiers to control weapons with their thoughts and turn off Their fear – but the ethics of neurotechnology lags behind the science. *The Conversation*, 2022. https://theconversation.com/brain-computer-interfaces-could-allow-soldiers-to-control-weapons-with-their-thoughts-and-turn-off-their-fear-but-the-ethics-of-neurotechnology-lags-behind-the-science-194017, accessed 10 September 2024.

who have suffered injuries affecting their central nervous system, such as controlling prosthetics or exoskeletons to assist soldiers with amputations or other neurological impairments.

Advances in neurotechnology made a significant leap forward with the demonstration of the first brain-to-brain interface (BBI).[20] [21] BBIs enable direct communication between two brains via a brain-computer interface (BCI), bypassing the peripheral nervous system. This discovery promises new possibilities for future battlefield technology. As battlefield technology continues to evolve, it is likely to place greater demands on future soldiers.

Many of these applications are still in the research and development phase and cannot currently be deployed on a large scale or in operational situations. In the United States, well-known institutions such as DARPA (Defense Advanced Research Projects Agency)[22] – which developed the ARPANET (the precursor to the internet), stealth technology and GPS – are investing considerable resources in developing BCIs, particularly for military applications like neurological rehabilitation, improved communication for soldiers and pilots and controlling drones and other devices. Through the "Continuous Assisted Performance" programme, DARPA attempted to enable soldiers to remain awake for up to seven days without losing their cognitive functions by using implants, metabolic manipulation and other techniques.[23]

In Europe, Germany's "BrainLinks-BrainTools project"[24] and Switzerland's "Wyss Center for Bio and Neuroengineering"[25] are leaders in BCI research. They are working on a variety of applications, ranging from neurological re-

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20 Rao, Rajesh PN: Towards Neural Co-Processors for the Brain: Combining Decoding and Encoding in Brain-Computer Interfaces. *Science Direct,* 2019, pp.142–151. https://www.rajeshpnrao.com/_files/ugd/f0c175_71f09a3aa6514874a427b92357f1e6f1.pdf, accessed 10 September 2024.

21 Linxing, Jiang/Stocco, Andrea/Losey, Darby M./Abernethy, Justin A./Prat, Chantel S./Rao, Rajesh P. N. 2019a: BrainNet: A Multi-Person Brain-to-Brain Interface for Direct Collaboration Between Brains. *Scientific Reports* 9 (1). https://doi.org/10.1038/s41598-019-41895-7.

22 DARPA. https://www.darpa.mil/, accessed 10 September 2024.

23 Netzeitung. http://www.netzeitung.de/wissenschaft/253228.html, accessed 15 July 2024.

24 BrainLinks BrainTools. https://www.brainlinks-braintools.uni-freiburg.de/de/, accessed 10 August 2024.

25 Wyss Center. https://wysscenter.ch/, accessed 10 August 2024.

habilitation to brain-computer interfaces for everyday tasks. In Japan, research institutions such as the "RIKEN Brain Science Institute" and companies like "Panasonic" and "Sony" have also made significant progress in developing BCIs. China has also invested heavily in neuroscience and BCI development in recent years.

Neuroenhancement) is now applied in various areas, including academic performance, professional productivity, athletic performance, creative abilities and even the treatment of neurological or psychiatric disorders.[26]

In the field of biotechnology and bioengineering, certain procedures and techniques have enabled the cultivation and modification of tissues and organs in laboratories, potentially contributing to the treatment of diseases and the enhancement of human functions.

The discovery and development of techniques for genetic manipulation, such as the CRISPR/Cas9 method (clustered regularly interspaced short palindromic repeats), which can precisely cut and alter DNA, have the potential to modify the human genome, treat diseases or adjust genetic traits.

Interesting progress has also been made in the area of camouflage, such as in the fashion industry. For instance, facial recognition technology, commonly used in smartphones, which initially categorises, measures and matches facial features, can be thwarted with clothing developed by the Italian startup "Cap_able." Cap_able uses what are known as adversarial images in its clothing to deceive facial recognition systems. The algorithm recognises individuals wearing Cap_able's clothing not as humans but as dogs, zebras or giraffes.[27]

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[26] Viertbauer, Klaus/Kögerler, Reinhart: Neuroenhancement: Die philosophische Debatte. Suhrkamp Verlag, 2019.; Harbich, Harald/Kunze, Michael: Human Enhancement – biological-neurological aspects from a military perspective. In chapter MEDICINE in this publication.

[27] Diese Kleidung schützt dich vor Gesichtserkennung. In: *20 Minuten*. https://www.20min.ch/story/diese-kleidung-schuetzt-dich-vor-gesichtserkennung-767520860973, accessed 19 August 2024; See also Ö1 Radiokolleg: Die Kunst der Camouflage (4). https://sound.orf.at/podcast/oe1/oe1-radiokolleg/die-kunst-der-camouflage-4, accessed 19 August 2024.

Another notable project is the STILE initiative –a European Defence Agency (EDA) project aimed at developing a European multifunctional smart textile for defence purposes. Experimental prototypes are currently being tested to determine the extent to which the textile can improve camouflage, environmental monitoring (temperature, humidity, radiation, etc.), the wearer's vital signs and protection from chemical, biological, radiological (CBR) threats.[28] At the Hagenberg campus of the University of Applied Sciences Upper Austria, researchers in the Embedded Systems Lab are also working on smart textiles. The researchers have developed and patented a new process that enables software to recognise hardware attached to textiles more quickly. This should significantly accelerate the production and activation of smart clothing.[29]

3. The significance of human enhancement to society

3.1 HET in light of sociological theories

3.1.1 The AGIL scheme as a static analytical tool

One initially useful theoretical structure that can help generate a broader understanding of the complex dynamics and requirements associated with the development and implementation of HET is Talcott Parsons' AGIL scheme. The AGIL scheme describes four fundamental functional requirements that every system must fulfil in order to survive and develop. These four functions are: Adaptation (A), Goal Attainment (G), Integration (I) and Latency (L).

Adaptation refers to the system's ability to respond to external environmental demands and mobilise resources to meet those demands. Goal Attainment refers to the system's ability to set and achieve specific objectives. Integration refers to the coordination and maintenance of cohesion between the various parts of a system. Latency refers to the maintenance of core values and cultural patterns that ensure the long-term stability of a system.

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28 European Defence Agency. https://eda.europa.eu/docs/default-source/eda-factsheets/deliverable_d1-18_factsheet-(final)-(stile)-(30-04-2020)-(v-5-0)#Fact%20sheet, accessed 19 August 2024.

29 Embedded Lab. https://www.csi.minesparis.psl.eu/en/people/honorary-members/michel-callon/, accessed 19 August 2024.

Within this overall system, specialised interconnected components, known as subsystems, operate with their own specific functions, tasks and processes that contribute to achieving the overarching goals. By applying this scheme to the development of HET, we can conduct a systematic analysis of societal responses and developments in this area.

- **Adaptation** refers to the ability to utilise technological developments and innovations to enhance human capabilities. This can include access to resources such as research funding, scientific data and technological infrastructures. Subsystems might include research and development institutions, universities and technology companies, which continuously develop new technologies and solutions to enhance human capabilities.
- **Goal Attainment** involves setting specific objectives and visions for improving human capabilities and consistently pursuing them. This includes both short-term goals (e.g. developing new medical devices) and long-term visions (e.g. improving quality of life or life expectancy). Subsystems such as regulatory bodies, ethics committees and political institutions play a key role in setting goals and guidelines for the development and application of HET.
- **Integration** stands for ensuring that various technologies and systems work together harmoniously and that there is a coordinated effort to optimise their implementation and use. This could also include establishing standards and protocols to ensure compatibility and collaboration. Standardisation organisations, professional associations and international bodies could act as subsystems that ensure the integration and coordination of various actors and technologies within the HET sector.
- **Latency** refers to the ethical, cultural and social values that need to be preserved and promoted to support the acceptance and sustainable development of these technologies. This also includes public education and awareness of the implications of HET. Educational institutions, media outlets, religious organisations and cultural institutions could act as subsystems that contribute to preserving and promoting societal values and norms necessary for the acceptance and integration of HET.

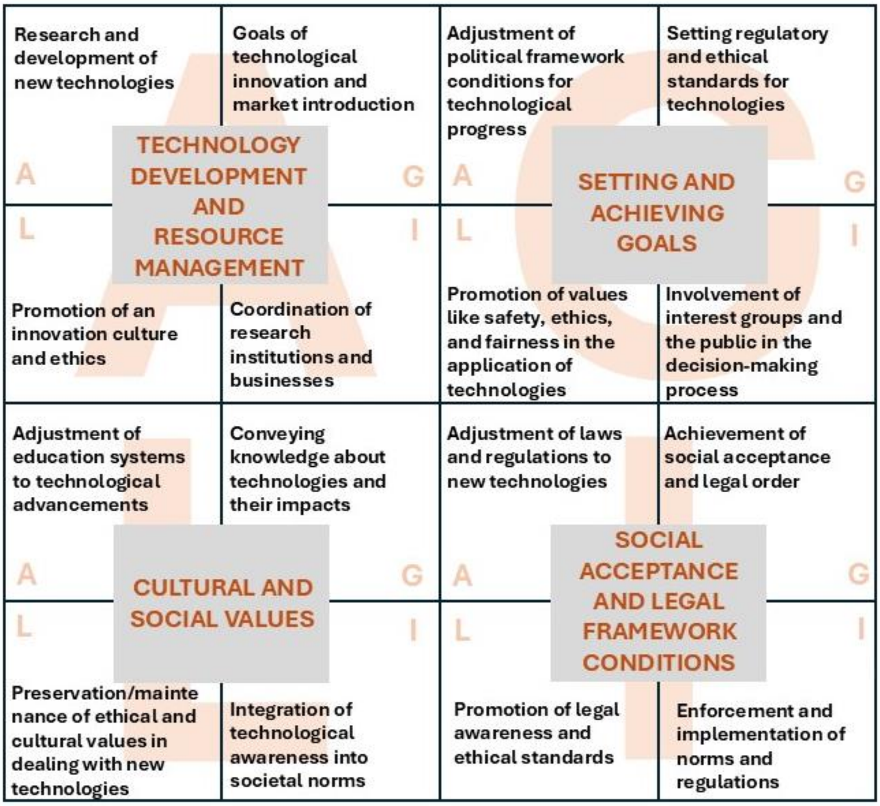

Figure 1: Application of the AGIL scheme to the development of human enhancement technologies. Source: Author's illustration.

This structure demonstrates how each subsystem (A, G, I, L) can be divided into the four functional imperatives, allowing for a comprehensive analysis of social systems.

However, the AGIL scheme, with its structured perspective, has some weaknesses. The development of HET is often characterised by rapid technological advances, diverse ethical considerations and global interdependencies, which cannot be fully captured in a static scheme like that of AGIL. The scheme might also imply that there are certain "correct" ways in which HET should be developed and integrated, potentially excluding alternative approaches or critical perspectives. Moreover, there is a tendency to adopt a Western-centric perspective, without sufficiently considering global differences in the development and acceptance of HET.

3.1.2 Actor-Network Theory (ANT)

To better address the critiques of applying the AGIL scheme to the development of HET, one might turn to a sociological theory that is more dynamic, conflict-oriented and less normative. One suitable alternative is the Actor-Network Theory (ANT) by Bruno Latour,[30] Michel Callon[31] and John Law.[32]ANT is a sociological approach that views social, technical and natural elements as equal actors within a network. It emphasises that both human and non-human actors (e.g. machines, objects, concepts) operate and interact within a network to shape socio-technical systems. ANT analyses how these actors form complex networks through their interactions and relationships, where power and agency[33] are not restricted solely to humans.

For the analysis of HET, this theory offers several advantages:

- It considers both human actors (e.g. scientists, politicians, users) and non-human actors (e.g. technologies, machines, documents) as equally important in the analysis. This helps to better understand the role of technologies and their interactions with human actors.
- It emphasises the significance of networks that arise from the interactions between actors. These networks are dynamic and constantly evolving, enabling a detailed examination of the development and dissemination of HET.
- It investigates how scientific facts and technological artefacts are constructed and stabilised through social processes. This helps analyse the complex and often conflict-laden processes of technology development and implementation.

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30 Latour, Bruno: Wir sind nie modern gewesen: Versuch einer symmetrischen Anthropologie. Frankfurt am Main: Suhrkamp, 2008.

31 Callon, Michel. n.d. https://www.csi.minesparis.psl.eu/en/people/honorary-members/michel-callon/.

32 Law, John/ Hassard, John: Actor Network Theory and After. The Sociological Review, Special Issue, 47(S1). eds. 1999.

33 “Agency” refers to the ability of an actor (“agent”) to perform actions and exert influence over events or other actors. In Actor-Network Theory (ANT), this concept is expanded to include not only humans but also non-human actors such as objects, technologies and concepts. These non-human actors also possess agency, as their characteristics and interactions within the network influence actions and can co-determine specific outcomes. ANT thus emphasises that agency is not exclusively human but is distributed across a network of diverse actors.

By analysing negotiations, power struggles and conflicts of interest between the various actors involved in the development and implementation of HET, the often contentious processes can be captured more realistically. ANT is not limited to a specific cultural or social context, allowing it to better account for global differences in the development and acceptance of HET. It also allows for a detailed and complex analysis of interactions between different actors and technologies without oversimplifying social processes.

<u>Application of ANT to HET</u>

1. **Identification of actors**: identify all relevant human and non-human actors in the field of HET, including scientists, engineers, politicians, users, technologies, research instruments, regulatory documents, etc.
2. **Network analysis**: examine the networks and connections between these actors. How do they interact with each other? What alliances and conflicts arise?
3. **Tracing controversies and stabilisation**: analyse how controversies and conflicts are resolved and how specific technological solutions and standards become established and stabilised.
4. **Examination of power relations**: consider power relations and conflicts of interest between different actors and how these influence the development and implementation of HET.

<u>Example application</u>

A research team develops a new brain-computer interface (BCI) technology. Using ANT, one could investigate how the interactions between developers, users, regulatory authorities, ethical committees and the BCI devices themselves shape the design, implementation and acceptance of this technology. Additionally, one could analyse the power struggles around the definition of standards, the negotiation of ethical guidelines and the influences of global markets.

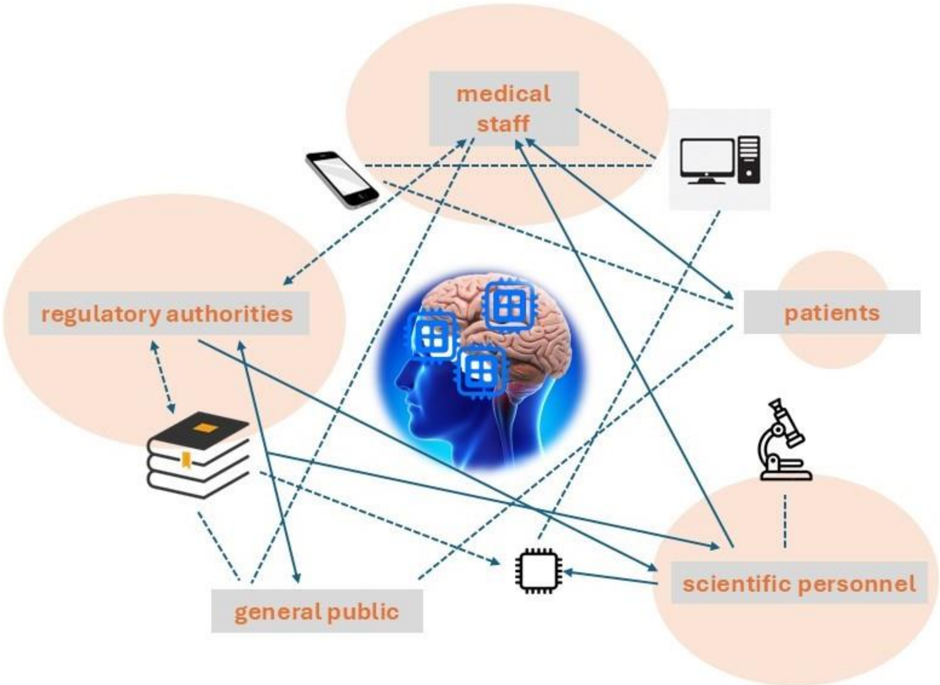

Figure 2: Example application of Actor-Network Theory to the development of HET. Source: Author's illustration.

Legend

Lines: interactions and relationships

- Solid line: direct cooperation
- Dotted line: indirect influence
- Arrow direction: direction of influence

Circles/Shading: areas of influence and agency

- Large circle: strong influence
- Small circle: weak influence

This structure allows for the visualisation of complex interactions and dependencies within the development and use of human enhancement technologies, as seen through the lens of Actor-Network Theory.

3.1.3 The systems theory of Niklas Luhmann

Niklas Luhmann's systems theory[34] offers an extremely useful framework for analysing and assessing the impact of human enhancement technologies (HET) on society. This theory helps to understand the complex interactions between such technologies and social systems. It views society as a network of differentiated, self-referential social systems, each operating according to its own logic and communication codes. These systems (e.g. politics, economy, science, law, health) serve specific functions (e.g. money, power, law, knowledge), interact with each other, but are largely autonomous and operate according to their own rules, meaning that they can only change internally. Social developments are therefore open-ended and not predetermined; they depend on the decisions and reactions of the systems. Communication is the driving force that determines how various social systems respond to human enhancement technologies and how these technologies are evaluated, regulated and disseminated within society.

[34] Luhmann, Niklas: Soziale Systeme. Grundriss einer allgemeinen Theorie. Frankfurt am Main: Suhrkamp, 1984.

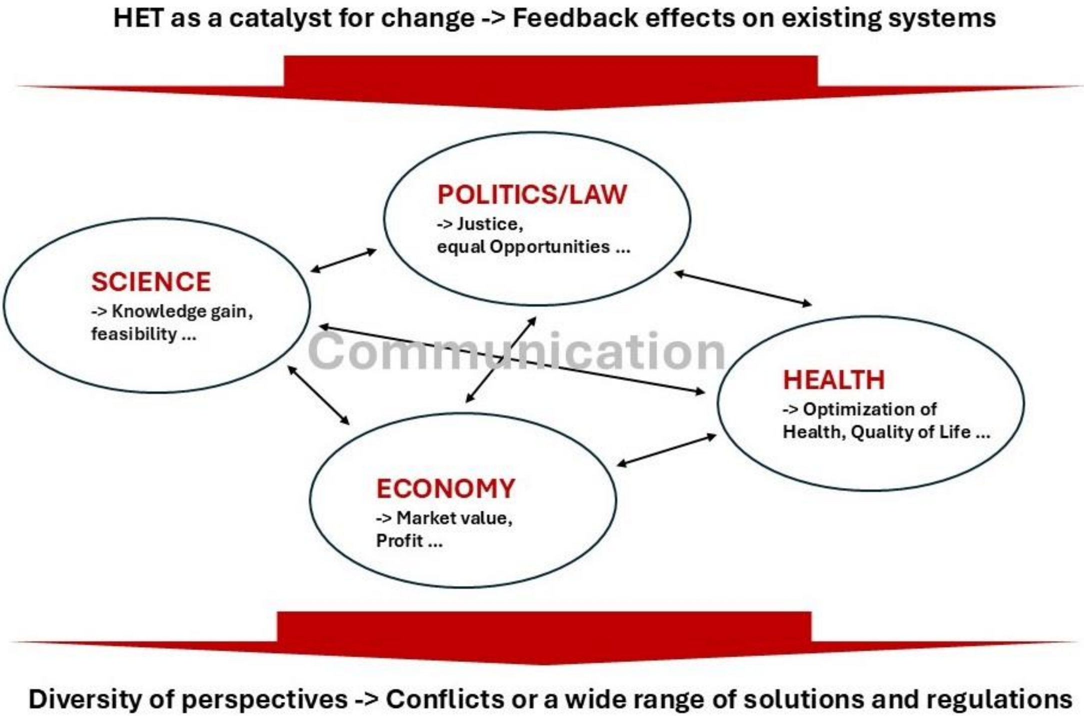

Figure 3: HET considering Luhmann's systems theory. Source: Author's illustration.

Human enhancement technologies can act as catalysts for changes in society, which in turn have feedback effects on existing systems. Since each social system processes the introduction of HET according to its own logic, we are dealing with a diversity of perspectives. This diversity of perspectives can lead to conflicts but also to a wide range of solutions and regulations.

3.2 Human enhancement in the context of social drivers

The term "social driver" refers to social, cultural, political and economic factors that influence the behaviour, attitudes and decisions of individuals and groups in a society. These "drivers" can drive a variety of social phenomena and trends and have a significant impact on the functioning and development of societies. In the context of technology and innovation, social drivers can help identify the demand for certain technologies, promote the adoption of new technologies and influence the direction of technological developments.

Typical examples of social drivers include cultural norms and values, societal trends and needs, political decisions and regulations, economic conditions and issues of social justice and ethics. Cultural norms and values shape the attitudes and behaviours of a society, although one must distinguish between norms and values. Drawing on the American philosopher John Dewey, who differentiated between "desired" and "desirable",[35] sociologist Hans Joas emphasises: "A value is not a factual wish but a notion of what is worth wishing for".[36] While norms regulate sociocultural, social, economic and political relationships between actors, expressing the rightness of social action, values determine what is considered good. Values, according to Joas, are "highly emotionally charged"[37] and do not always align with norms, which creates potential for conflict.

Societal trends and needs, such as demographic changes, social inequality or environmental issues, can increase the demand for certain technologies and solutions, thus steering the direction of technological developments. Closely associated with this are political decisions and regulations, which are reflected in laws, regulations and political programmes and thus initiate a process of steering development. The "economic framework" is a particularly significant social driver. Economic factors such as supply and demand, investments, labour market conditions and financial incentives have a direct impact on the development and dissemination of technologies. They can influence the success or failure of innovations and drive the development of new markets and industries.

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35 Kostrova, Elizaveta: The "Ought"-Dimension in Value Theory: The Concept of the Desirable in John Dewey's Definition of Value and Its Significance for the Social Sciences. In: Philosophy of Science: Between the Natural Sciences, the Social Sciences, and the Humanities, edited by Alexander Christian, David Hommen, Nina Retzlaff, and Gerhard Schurz. Springer International Publishing AG. 2018.

36 Joas, Hans: Wie entstehen Werte? Wertebildung und Wertevermittlung in pluralistischen Gesellschaften. tv-Impuls-Veranstaltung, 15 September 2006. https://mediendiskurs.online/data/hefte/pdf/Veranstaltungen/tv_impuls/2006_Ethik/Vortrag_Joas_authorisiert_061017.pdf.

37 Ibid.

3.3 Social and economic factors

Once new technologies have become established, they have various effects on society, depending on their degree of penetration. They play a central role in how we perceive and understand nature, culture and society. A glance at history may illustrate this.

The Industrial Revolution, which began in the 18th century, led to a rapid acceleration in developments in technology, productivity and science. As the Industrial Revolution increasingly affected and transformed various aspects of economic life, people's living conditions also changed. Industrial factories, mostly located in cities, initially saw a large influx of labour from rural areas, leading to a general depression of wage levels. The companies competing in the market were focused on profitability and profit generation; as a result, technological developments replaced jobs where possible, and the remaining necessary workforce was given subsistence wages for cost reasons. This preordained social misery led to protests, strikes, the formation of trade unions and only gradually, over time, to an improvement in people's living standards.

With increased mechanisation, mass production of goods and the widespread use of electricity, the early 20th century saw another upheaval, which sociologist Georges Friedman referred to as the second industrial revolution.[38]

In his book *The Coming of Post-Industrial Society*, Daniel Bell pointed out in the early 1970s that there was a shift from an industrial society to a knowledge- and service-based society, which was accompanied by a significant reduction in the number of industrial jobs.[39] At the same time, the service sector boomed, partly due to outsourcing activities that were not part of companies' core competencies and partly due to changing leisure habits as a result of shorter working hours. Leisure industries began to attract consumers with promises of pleasure, entertainment and relaxation.[40]

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38 Friedmann, Georges: La crise du progrés: Esquisse d'histoire des idées 1895-1935. Paris. 1936.

39 Bell, Daniel: The Coming of Post-industrial Society. 1973. https://katalog.ub.uni-heidelberg.de/titel/65729022.

40 Bell, Daniel: Die kulturellen Widersprüche des Kapitalismus. Frankfurt am Main: Campus. 1991.

By the late 1960s and early 1970s, society was increasingly reliant on information and communication technologies in more areas of life. Bell was also one of the first to use the term "information society".

Towards the end of the 20th century, a further shift occurred due to digital technology and computers, a shift Bell referred to as the "digital revolution" or the "third industrial revolution".[41] The term digital revolution refers to the transformation triggered by digital technology and computers, which (since the end of the 20th century) has impacted almost all areas of life in many countries, leading to a digitally connected lifestyle (digital lifestyle) – similar to how the Industrial Revolution 200 years earlier led to an industrial society.

Authors such as Klaus Schwab,[42] Nikolas Davis[43] or Luciano Floridi[44] already refer to a "fourth industrial revolution" and emphasise that HET, such as genetic modifications, brain-computer interfaces and biotechnological enhancements, are a crucial component of this revolution. These technologies are transforming not only the world of work but also human self-conception and the way individuals are integrated into society at unprecedented speed and on an unprecedented scale.

Our relationship with nature has also been transformed by technology, which has enabled new ways of exploring, utilising and manipulating the natural environment. Advances in science and technology have helped us better understand and utilise natural resources, yet they have also raised new ethical and environmental concerns.[45] Technologies also shape our individual and collective identities as well as our self-image.

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[41] Bell, Daniel: The Third Technological Revolution and Its Possible Socio-Economic Consequences. Salford: University of Salford. 1988.

[42] Schwab, Klaus: The Fourth Industrial Revolution. London: Penguin Books Ltd. 2016.

[43] Schwab, Klaus/Davis, Nicholas: Shaping the Fourth Industrial Revolution. Crown Publishing Group, Random House. 2018.

[44] Floridi, Luciano: The 4th Revolution: How the Infosphere is Reshaping Human Reality. Oxford: Oxford University Press. 2014.

[45] See also Stimmer, Gernot: European AI ethics – between categorical imperative and placebo rhetoric. In chapter SOCIETY in this publication.

3.4 Human enhancement as an economic factor

The economic impact of HET is evident both in direct growth opportunities for new markets and in enhancing the competitiveness and innovative capacity of existing industries. In particular, entirely new possibilities are emerging in key areas such as healthcare, the labour market and the innovation economy. In recent years, the global market for human enhancement has shown impressive growth. In 2022, it reached a market size of $97.9 billion. Forecasts are promising: by 2028, the market is expected to grow to $215.9 billion, representing an annual growth rate of 14.09%.[46] The global human enhancement market valuation includes products from the categories of exoskeletons, smart devices (technologies that improve cognitive functions), medical devices (equipment supporting health) and implants (implanted devices that enhance performance). According to the IMARC report of 2023, the world's leading companies in the human enhancement field include Vuzix Corporation (specialising in Augmented Reality (AR) glasses and smart glasses), Ekso Bionics Holdings Inc. (developers of exoskeletons and bionic prosthetics that enhance mobility), Google LLC (known for its research and development in artificial intelligence, robotics and wearables), B-Temia Inc. (focused on wearable robotics and exoskeletons) and Samsung Electronics Co. Ltd. (a technology giant active in areas including wearables and health technology).[47]

3.5 Human enhancement technologies and their potential societal benefits

Smart technologies that extend and enhance human abilities can encourage new behaviours in various ways and help workers become better versions of themselves. The relationship between technology and workers has evolved over time: in the past, technology was used to replace workers in repetitive, dangerous or isolated tasks. Back then, technology was used as a supplement to workers, providing additional skills and insights. Today, we see technologies that can help workers improve and become better versions of themselves.

[46] International Market Analysis Research and Consulting Group: Global Human Enhancement Market: Industry Trends, Share, Size, Growth, Opportunity and Forecast 2023-2028. IMARC Group. 2023.

[47] Ibid.

New possibilities for self-measurement and self-optimisation that can change our understanding of ourselves and our bodies are emerging. In simpler terms, people can now monitor, analyse and optimise their bodies and abilities in more detailed and precise ways. For example, with technologies such as fitness trackers, wearables and apps, people can closely monitor their physical activity, sleep, nutrition and other health parameters. They receive real-time data on their physical performance and health, allowing them to adjust their behaviour and optimise their health and performance. Although this seems positive, there are also potential downsides. Excessive use of self-optimisation technologies could lead to people increasingly defining themselves by their performance and outward appearance, rather than by their personality and inner values. Additionally, a certain dependency on technology is created, which could lead to a decline in natural abilities and a reduction in self-reliance.

Another example, beyond the technologies already integrated into everyday life, are brain-computer interfaces (BCIs), which could allow people to monitor and control their brain functions. With BCIs, people could, for example, enhance their concentration, control their thoughts or even treat neurological disorders. According to Don Ihde, such human enhancement technologies (HET) would expand our traditional understanding of the body by adding new components or functions that are not natural. For instance, implanted devices or prosthetics could be considered an integral part of the body, leading to a new definition of embodiment. It would also be possible to develop various identities and self-images shaped by the technologies individuals choose.[48] This could lead to a variety of identities, distinguished by different technological preferences, physical traits and abilities.

Moreover, the way people perceive themselves and their environment could change by enabling new sensory or cognitive capabilities.

The use of brain-computer interfaces (BCIs) could also influence social behaviour in society. One positive outcome could be that people who are unable to communicate verbally or physically due to injuries or neurological disorders might gain a voice through BCIs and communicate with others. Ad-

48 Ihde, Don: Postphenomenology and Technoscience: The Peking University Lectures. Albany: SUNY Press. 2009.

ditionally, BCIs could help break down barriers for people with disabilities and improve their participation in social life. Individuals with paralysis could move wheelchairs or even create artworks with the help of BCIs, giving them greater autonomy and independence.

Extending this thought further, individuals could also become conditioned in their thought patterns through the use of BCIs. Direct interaction between the brain and computers could lead to new forms of thinking and problem-solving, initially influenced by the functions and limitations of the technology. In the long run, however, people using BCIs might be able to communicate telepathically or solve complex problems together by synchronising their brain activity.

In general, HET could benefit not only individual users but also various groups and institutions by improving health, performance and quality of life, and by creating new opportunities for innovation and economic growth. Among the beneficiaries could be healthcare systems, which would gain more efficient medical treatments, shorter recovery times and potentially reduced long-term costs. Employers could also benefit from the increased productivity and performance of their employees. Workers who are healthier, more motivated and more focused could work more effectively and achieve better results. Additionally, enhancing workers' cognitive and physical abilities would transform how work is organised and carried out. New work forms with greater productivity and efficiency would emerge, although this could also raise questions surrounding job security, equal opportunities and labour rights.

Educational institutions would also be beneficiaries, with improved learning capabilities and concentration among students leading to better learning outcomes and more efficient teaching. Naturally, this would require appropriate guidelines for integration into the curriculum, ensuring that teachers and students have access to the necessary resources and training. Additionally, attention would need to be paid to the privacy and security of students.

3.6 Expectations and attitudes of society

Currently, in Austria and Europe, there are no specific social science surveys exclusively focused on the public's expectations and concerns regarding human enhancement technologies. Most studies addressing such technologies tend to deal more generally with digitisation, medical technologies and their societal impacts.

However, there are two interesting studies on the subject so far: a Pew survey[49]from the USA conducted in 2020 and a survey from the EU-funded SIENNA project[50]from 2019.

In the Pew survey, the majority supports the use of facial recognition technologies to identify individuals who may have committed a crime or to monitor crowds. On the other hand, driverless, autonomous passenger vehicles are mostly rejected, as are brain-embedded computer chips that would allow people to process information much faster and more accurately. Interestingly, when examining respondents' levels of religious commitment, there are significant differences. Individuals with a strong sense of religious affiliation are more likely to express concerns, particularly that certain physical and cognitive enhancements could be seen as interfering with nature. This is particularly true for gene editing for babies or brain-embedded computer chips.

The SIENNA study provides an initial insight into the perspectives of selected EU countries. In general, a positive attitude towards human enhancement technologies is observed. This is particularly true for technologies that enhance human intelligence or help improve people's moral values. However, when it comes to extending human life through technology to up to 120 years, the majority are opposed to it, with opposition being even more pronounced in EU countries.

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49 Rainie, Lee/Funk, Cary/Anderson, Monica/Tyson, Alec: AI and Human Enhancement: Americans' Openness is Tempered by a Range of Concerns. Pew Research Center. 2022.

50 Prudhomme, Marie: Public views of human enhancement technologies in 11 EU and non-EU countries. University of Twente. 2019.

4. Challenges

Public perception of human enhancement varies depending on culture, education level and other factors.[51] Petersen analyses the role of trust and scepticism in public perception of biotechnologies, including human enhancement, and highlights the political implications.[52]

While some people welcome the possibilities of human enhancement, concerns about the potential risks and side effects of these technologies also exist. Given the potential societal impacts of human enhancement, organisations and governments are considering creating ethical and legal frameworks for the development and use of these technologies. There is growing debate about issues such as privacy, equality and fair access to human enhancement technologies. The development of HET also raises complex ethical and moral questions. For example: should parents be allowed to enhance the genetic traits of their children? Is there a moral obligation to promote technologies that could improve physical or mental abilities?

The development of HET could also challenge our notions of what it means to be human. If people can enhance their physical or mental abilities, how will this affect our understanding of human identity?

Particularly concerning is the fact that, through the individual's habituation to technology and the associated perception of it as an integral part of daily life, a relatively heavy dependency is created – essentially, a kind of reliance on the hope for functional technology.

What applies to the individual can also be transferred to society as a whole. For example, the widespread use of BCIs could lead to changes in social norms as society adapts to new forms of human interaction and communication, leading to a general acceptance of new behaviours and social practices. However, if this technology is used by governments, corporations or other groups to monitor and control citizens' behaviour and thoughts, it would represent a restriction on individual freedom and privacy. In this con-

51 Nakazawa, Eisuke/Mori, Katsumi/Udagawa, Makoto/Akabayashi, Akira: A Cross-Sectional Study of Attitudes Toward Willingness to Use Enhancement Technologies: Implications for Technology Regulation and Ethics. BioTech (Basel) 11(3): 21. 2022.

52 Petersen, Alan: The Politics of Bioethics. New York: Routledge. 2011.

text, comparisons with the dystopian society described by George Orwell, controlled by "Big Brother",[53] or Michel Foucault's work, *Discipline and Punish: The Birth of the Prison,*[54] are almost inevitable.

In general, the use of human enhancement raises a number of ethical, legal and security-related questions.

Ethics provide a framework within which individuals can make moral decisions. They help in understanding what is right and wrong and offers guidelines for moral behaviour. Ethics allow us to critically reflect on, analyse and develop a deeper understanding of moral issues. For our purposes, the area of applied ethics, which deals with applying ethical principles to concrete situations or areas of human life, is particularly important.

Ethical and moral questions may arise, with particular regard to the use of violence and responsibility for decisions made by autonomous systems. These questions could lead to debates about the role of technology in warfare and the ethical limits of military use. The alteration of human nature also brings about numerous questions. In the use of neuroenhancement technologies, in particular, questions of autonomy, self-determination and integrity are at the centre of debate.

The SIENNA initiative (Stakeholder-informed ethics for new technologies with high socio-economic and human rights impact) examined the ethical, legal and social aspects of human enhancement and developed proposals for ethical frameworks, which were presented at the final conference in 2021.

Among other things, it was found that the societal values most at risk from human enhancement technologies (HETs) are autonomy, dignity, equality, fairness, health and safety, peace, privacy, respect for human life and solidarity. The most vulnerable communities are patients, people with disabilities, the elderly and children (e.g. due to their lack of choice and decision-making power when using HETs, combined with an incomplete understanding of the full implications). The SIENNA initiative suggests that the impacts of HET on these groups should be carefully monitored (and, if necessary, reg-

53 Orwell, George: Nineteen Eighty-Four. London: Secker & Warburg. 1949.

54 Foucault, Michel: Überwachen und Strafen: Die Geburt des Gefängnisses. Frankfurt am Main: Suhrkamp. 1977.

ulated). One of the identified impacts relates to the changing nature of what is considered "human" or what was previously recognised and acknowledged as "human". However, the study also emphasises the potential benefits for individuals and society, provided they are fairly distributed.

The authors also mention the possible costs of HET's impacts. Some of these costs may be direct (attributable to the technology itself) or indirect (not directly caused by the technology but associated with its broader effects on society). Finally, the study points to measures that can be taken to mitigate the negative impacts of HET. These include political and regulatory measures (responsibility: politicians, regulatory authorities, national ethics commissions), technological/industry-specific measures (responsibility: companies, industry associations, HET designers and innovators), societal measures (responsibility: academia, civil society, media) and individual measures (responsibility: individuals who use HET, consider using them or are affected by such HET).[55]

Although there are no specific international standards or treaties governing the use of HET, some instruments and norms may still be relevant. For example, the Geneva Conventions and their Additional Protocols[56] contain provisions for the protection of war victims, including the wounded, sick, prisoners and civilians. The use of human enhancement technologies in a military context would have to comply with these provisions to ensure that the rights and dignity of those affected are protected.

Two other conventions – the Biological Weapons Convention[57] and the Chemical Weapons Convention[58] – could also be relevant. While HET does not directly fall under these conventions, certain applications or technologies related to biological alterations or manipulations, or certain pharmacological

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55 Publications - SIENNA. 2024. 15 February 2024. https://www.sienna-project.eu/w/si/publications/.

56 Genfer Abkommen Und Kommentare. Internationales Komitee vom Roten Kreuz. 21 June 2024. https://www.icrc.org/de/recht-und-politik/genfer-abkommen-und-kommentare.

57 Biological Weapons. United Nations Office for Disarmament Affairs. https://disarmament.unoda.org/biological-weapons/, accessed 19 August 2024.

58 Organisation for the Prohibition of Chemical Weapons. n.d. OPCW. https://www.opcw.org/, accessed 19 August 2024.

substances or chemical compounds used to enhance physical or cognitive performance, could raise ethical and legal questions.

Moreover, the use of HET would have to be consistent with the Universal Declaration of Human Rights[59] and international humanitarian law.[60] The former establishes fundamental rights and freedoms that apply to all people, while the latter provides rules and principles to protect civilians and war victims in armed conflicts.

4.1 Critical voices from science

The human and social sciences, which deal with humans as research subjects and study the phenomena of social life, have a significant influence on future behaviour, attitudes and decisions regarding human enhancement.

For example, philosopher Jürgen Habermas has critically addressed the ethical and societal implications of HET. Habermas argues that the manipulation of human nature through biotechnologies and neuroscience could lead to a loss of human dignity by treating human nature as a manipulable object. The use of HET could thus compromise human dignity by reducing people to a set of traits that can be modified through technology. He also warns of the risk of social exclusion and the creation of a new class division between those who have access to HET and those who do not. This would exacerbate existing social inequalities and lead to a division between the "enhanced" and the "non-enhanced" members of society. Individual autonomy and self-determination could also be jeopardised by the manipulation of human nature, as increasing reliance on technology could impair our ability to make free

[59] Allgemeine Erklärung der Menschenrechte. 2019. Vereinte Nationen - Regionales Informationszentrum für Westeuropa. Vereinte Nationen. https://unric.org/de/allgemeine-erklaerung-menschenrechte/, accessed 13 December 2019.

[60] IHL Treaties - Treaties and States Parties. n.d. https://ihl-databases.icrc.org/en/ihl-treaties/treaties-and-states-parties.

decisions and exercise self-determination, making us dependent on external control mechanisms.[61] [62]

Nikolas Rose, in his work *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century*, examines the political and social consequences of biomedical research and practice, including the development and application of HET. Rose highlights the importance of state regulation and control in the development and application of HET. For him, these technologies are potentially powerful tools that can influence political and social structures. At the same time, like Habermas, he warns that such technologies could deepen the divide between those with access to them and those without, thus reinforcing social injustice. Regarding the impact on individual self-formation and self-optimisation, Rose also sees the danger of new forms of social pressure and coercion to conform to such norms.[63]

Similarly, Sherry Turkle, an American sociologist at the Massachusetts Institute of Technology (MIT), has studied the impact of technology on human relationships and social interactions. In her book *Alone Together: Why We Expect More from Technology and Less from Each Other*, Turkle shows how people are increasingly developing emotional bonds with robots and how these relationships could influence our understanding of intimacy and empathy. She examines how technologies such as Facebook, Twitter and text messaging affect our ability to maintain real connections with other people and how they change our perceptions of closeness, privacy and identity. She warns that we are increasingly expecting more from technology and less from each other, which could have negative effects on our mental well-being and social relationships.[64]

Francis Fukuyama goes even further, discussing the possibility that advances in genetic engineering could allow people to manipulate the genetic traits of

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61 Habermas, Jürgen: Die Zukunft der menschlichen Natur: Auf dem Weg zu einer liberalen Eugenik? Frankfurt am Main: Suhrkamp. 2001.

62 See also Stimmer, Gernot: European AI ethics – between categorical imperative and placebo rhetoric. In chapter SOCIETY in this publication.

63 Rose, Nikolas: The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century. Princeton, NJ: Princeton University Press. 2007.

64 Turkle, Sherry: Alone Together: Why We Expect More from Technology and Less from Each Other. New York: Basic Books. 2011.

their children to make them smarter, stronger or more attractive. He warns of the potential risks of these technologies, including the creation of a genetic elite and the emergence of new forms of discrimination. Like Habermas and Rose, Fukuyama points out that the introduction of HET could deepen social inequality, as wealthy individuals are more likely to afford expensive enhancement technologies. This could further widen the gap between those who can enhance themselves and those who cannot afford to do so. Fukuyama also warns that biotechnology has the potential to fundamentally alter human nature and identity by blurring the boundaries between human and machine, nature and technology, leading to a loss of humanity and alienation from our natural environment.[65]

In summary, the following concerns and critiques can be noted:

- The potential loss of human dignity due to the manipulation of human nature.
- The risk of reducing humans to certain traits that can be modified by technology.
- The risk of social exclusion and the creation of a new class divide.
- The exacerbation of existing social inequalities and injustices.
- The threat to individual autonomy and self-determination due to social pressure and coercion.
- The impairment of the ability to make free decisions and exercise self-determination.
- The influence of technology on political and social structures.
- The impact on intimacy and empathy, as well as on mental well-being and social relationships due to increasing reliance on technology.
- Potential existential threats due to inadequate control and misunderstandings in the use of technology.

[65] Fukuyama, Francis: Our Posthuman Future: Consequences of the Biotechnology Revolution. New York: Farrar, Straus and Giroux. 2002.

4.2 The influence of social groups

Social groups have always had a significant impact on society as a whole by shaping politics, culture, the economy, social norms and values, education, health and many other areas. They can exert political pressure and drive political change by engaging in lobbying, organising petitions or holding demonstrations. Social groups can also influence political parties and participate in shaping laws and policies. They impact culture, for example, by organising events, preserving cultural traditions or influencing the economy through consumer decisions, promoting economic activities or advocating for specific interests. By promoting and supporting particular behaviours and lifestyles, social groups also contribute to defining and spreading social norms and values.[66]

Social groups might oppose the use of HET for various reasons. Some groups, focusing on ethical principles and moral values, raise concerns about the potential impact of human enhancement on human identity, autonomy and justice. They argue that certain forms of enhancement technologies might endanger human dignity and integrity and should therefore be rejected. Today, there are already global civil rights groups that oppose the use of surveillance technologies by governments and corporations. These groups express concerns about privacy, individual freedoms and the abuse of power, and advocate for the protection of citizens' rights and limitation of state surveillance.

Religious organisations could also oppose HET. In the past, religious groups have spoken out against the genetic manipulation of plants and animals, as they believe it is morally wrong to interfere with the genetic code of living

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[66] Gemeinsames Positionspapier von 139 Verbänden und Organisationen. *Keine Deregulierung neuer Gentechnik-Verfahren.* 2023. https://www.greenpeace.de/publikationen/Positionspapier_Gentechnik.pdf, accessed 12 July 2024.; Amnesty International: Österreich: Einsatz von Gesichtserkennung verstößt gegen Menschenrecht. May 2021. https://www.amnesty.at/presse/oesterreich-einsatz-von-gesichtserkennung-verstoesst-gegen-menschenrechte/, accessed 12 July 2024.; Amnesty International. Satzung. https://cdn.amnesty.at/media/10929/amnesty-international-oesterreich-satzung-2023.pdf, accessed 12 July 2024; PETA (People for the Ethical Treatment of Animals). https://www.peta.de/ueberpeta/, accessed 12 July 2024; Disability Rights Advocates. https://dralegal.org/, accessed 12 July 2024.

beings. From their perspective, human enhancement represents an intrusion into the divine creation plan, an intrusion they consider sinful.

Socialist and communist groups may be concerned about the potential impact of human enhancement on existing social inequalities and injustices. They might argue that certain forms of human enhancement could reinforce existing social hierarchies.

Organisations advocating for the rights of people with disabilities may raise concerns about how human enhancement affects the perception and treatment of disabilities. For example, HET could exacerbate the stigmatisation of people with disabilities. Furthermore, these organisations have historically opposed eugenic practices aimed at controlling the genetic composition of the population and eliminating or discriminating against individuals with certain disabilities.

Environmental and sustainability groups might argue that some forms of enhancement technologies could pose a threat to natural ecosystems, particularly if these technologies require unsustainable levels of resources or if they lead to unintended environmental consequences.

And lastly, there are groups to consider that oppose animal testing and advocate for alternative methods of researching and testing medications: anti-globalisation activists who raise objections regarding global standards for "optimised" humans, arguing that these could suppress regional and cultural differences, thereby overwriting traditional views on health, performance and social roles with technologically driven norms and ideals. And – finally – conspiracy theorists and their followers, who warn of surveillance, mass "re-education" or manipulation, genetic "superhumans" and ruling elites, as well as depopulation and population control.

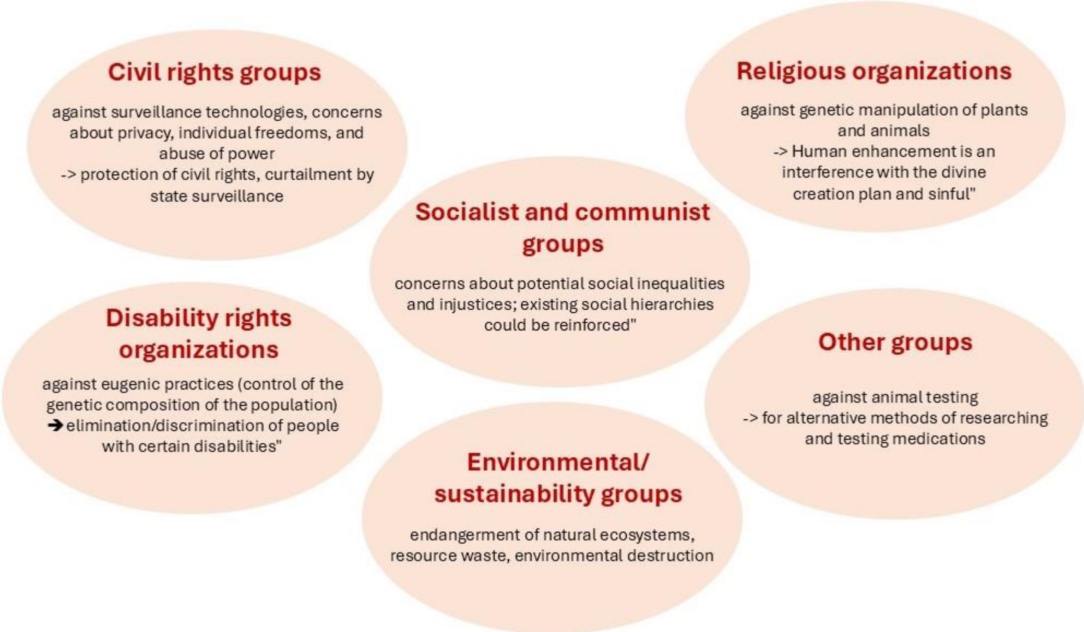

Figure 4: Influence of Social Groups. Source: Author's illustration.

4.3 Does human enhancement technology change the concept of humanity?

Overall, the development of human enhancement technologies (HET) has the potential to fundamentally change our concept of what it means to be human, by pushing the boundaries of what we consider possible and redefining our notions of human identity, human-technology relationships and ethical questions.

With technologies that enhance physical or mental abilities, people could achieve things previously thought impossible, leading to a shift in the boundaries of what it means to be human. Individuals using certain enhancement technologies may no longer consider themselves solely "natural" humans, but rather transhuman or posthuman beings. This raises complex ethical and moral questions. Is there a moral obligation to promote the development of technologies that can improve humans' physical or mental abilities?

The issue posed by the use of HET is evident in the simple question of where the boundary between a "normal" human and a cyborg lies. The term "cyborg" is short for "cybernetic organism" and was first coined by astronaut and scientist Manfred Clynes and neuroscientist Nathan S. Kline in the 1960s. The boundary between human and cyborg is a complex and evolving question, as it is influenced by a variety of factors and can vary depending on perspective and definition. Generally speaking, the transition from human to cyborg begins when technological components are integrated into the human body to support, enhance or replace biological functions. According to Chris Hables Gray,[67] a cyborg is an organism composed of technological extensions and biological organs. Based on this definition, someone wearing a pacemaker could be considered a cyborg. However, a single dental implant or medical prosthesis does not necessarily make someone a cyborg. It is the presence of multiple technological components that affects essential biological functions – the more comprehensive the integration of technology into the human body, the more likely one is to be considered a cyborg. Traditionally, the term "cyborg" is used for individuals with more extensive technological enhancements that go beyond medical prosthetics. This includes implants to improve the senses, artificial limbs with enhanced functions, brain-computer interfaces or other complex technological integrations. Through these technological enhancements, cyborgs can achieve abilities beyond what is possible for a normal human. This could include the ability to control electronic devices with the brain or gain superhuman strength through prosthetics. Thus, the transition to being a cyborg should be seen as gradual. If the respective changes significantly influence a person's identity or self-concept, this could be interpreted as a sign that they are moving towards a cyborg state. Furthermore, the perception and acceptance of technology in the human body vary depending on cultural context and individual attitudes. In some societies, technological enhancements are seen as normal and widely accepted, while in others they may be viewed as unusual or even frightening. Therefore, it can be said that the definition of what makes a cyborg may change over time, as advances in technology also evolve our understanding of humanity and identity.

[67] Gray, Chris Hables: The Cyborg Handbook. New York: Routledge. ed. 1995.

4.4 Impact of human enhancement on state security forces and rescue organisations

HET plays an increasingly important role in public safety. Currently, access to performance-enhancing technologies for security forces and rescue organisations is limited; with a few exceptions, traditional methods and equipment are mainly used. However, future possibilities of HET are diverse, ranging from enhancing performance and efficiency to raising ethical and legal concerns.

4.4.1 Use of HET today

Security forces increasingly use AI to analyse large data sets; AI systems help evaluate information from various sources and assist military leaders in planning operations.

While civilian companies already use exoskeletons to support their work in logistics and warehousing,[68] the US Army is still testing various exoskeleton systems.[69] A well-known project is Lockheed Martin's "ONYX" exoskeleton, which aims to reduce the physical strain on soldiers during heavy physical activities.[70] Russia, at the University of Science and Technology in Moscow, produces a next-generation combat suit with a "motorised exoskeleton" called Ratnik 3. The innovative Ratnik 3 combat suit includes a variety of armour and protective components from head to toe. A titanium frame for the lower body is intended to give soldiers more strength and endurance. Medical, reconnaissance, target identification and other information are displayed on screens in the helmet.[71] The Japanese company CYBERDYNE,

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68 About Us - Eksobionics. n.d. https://eksobionics.com/de/about-us, accessed 15 August 2024.

69 See Klerx, Joachim: The Future of Human Enhancement in the Military Domain. In chapter TECHNOLOGY in this publication. See Schulyok, Bernhard/Grangl, Lukas/ Gruber, Markus: Human Enhancement from a Military Perspective – WHAT, WHY and HOW? In chapter MILITARY in this publication.

70 Military Exoskeletons: The Next Phase - Global Defence Technology. Issue 98. April 2019. 2024. https://defence.nridigital.com/global_defence_technology_apr19/military_exoskeletons_the_next_phase, accessed 15 August 2024.

71 Ritsick, Colin: Ratnik 3 - Russian Combat Suit. Future Infantry Exoskeleton Combat System. Military Machine. 13 January 2020. https://militarymachine.com/ratnik-3/, access 15 August 2025.

founded in 2004 mainly for medical-therapeutic purposes, produces devices that process bioelectrical signals from the skin's surface, enabling natural movement with motor support and thus reducing strain.[72]

Special clothing with integrated heating and cooling systems keeps the body warm in cold conditions, while cooling garments can regulate body temperature in hot conditions. The intake of specially developed dietary supplements helps to increase the energy, endurance and mental alertness of soldiers and police officers.

By using drones, satellites and other surveillance systems, important data can now be gathered about threats, the extent of damage, the location of victims and the availability of resources, leading to faster information processing and decision-making. Drones and autonomous systems are increasingly being used in military operations, particularly for conducting reconnaissance missions, identifying targets and carrying out surveillance tasks. AI-powered drones can also make more autonomous decisions and conduct targeted attacks.

Real-time data transmission, GPS tracking and remote control of robots are helpful in coordinating emergency organisations, as well as for respiratory protection and protection from chemical substances.

4.4.2 Use of HET tomorrow

In the future, it will be possible to use sleep management improvement methods (technologies to optimise sleep) to ensure that soldiers, police officers and disaster relief workers get enough rest to remain effective in extreme situations. Wearable medical devices could monitor the health of their users and provide rapid medical assistance when needed. Additionally, brain-computer interface (BCI) technologies could improve cognitive abilities by monitoring and controlling brain activity. Sensors and implants can enhance the perception of security and disaster personnel by improving vision, hearing and communication.

72 Cyberdyne Etabliert Sich Als Marktführer Der Cybernics Technologie. n.d. Cyberdyne Care Robotics GmbH. https://www.cyberdyne.eu/, accessed 15 August 2024.

Gene-editing technologies such as CRISPR (clustered regularly interspaced short palindromic repeats) and Cas9 (CRISPR-associated protein 9) could be used to optimise the genetic makeup of soldiers and police officers, improving their performance and resilience.

Bionic implants that send electrical signals to muscles to enhance their contraction could increase muscle strength and performance.

Nanotechnology could be used to develop implantable devices that enhance soldiers' and police officers' physical abilities, for example, by accelerating the healing of injuries. These could be biodegradable implants coated with growth factors or other bioactive substances, which can be introduced into the body to speed up recovery. Electronic implants could also be used to block or reduce the sensation of pain. Nanotechnology-based implants that release growth factors or medications to promote healing could also be of interest in accelerating wound healing.

Furthermore, advances in robotics and AI will lead to an increase in the use of autonomous robots and drones in military and police operations, improving safety and reducing risks for personnel. The increased use of robotics in military logistics and support tasks will facilitate the transport of goods and materials, improving the efficiency of supply chains. Autonomous vehicles could be used to evacuate the injured and provide medical care.

4.4.3 Other challenges and concerns

The use of HET in security forces raises a number of ethical questions, particularly regarding justice, equality and privacy. Concerns exist about access to these technologies and the potential inequalities that could arise from the deployment of "enhanced" security forces. Over-reliance on HET could also lead to reduced flexibility and adaptability. If these technologies fail or are unavailable, their ability to respond effectively to emergency scenarios would be severely compromised.

In this context, the use of so-called "autonomous systems" must also be questioned.[73] Autonomous systems are those capable of making decisions and taking actions independently and without human intervention. These systems often use artificial intelligence (AI), machine learning and complex algorithms to process data, recognise patterns and act autonomously based on that information.

Vehicles	Self-driving cars, drones and autonomous ships
Industry	Robots working in industrial environments, performing tasks such as assembly, packaging and storage
Weapons systems	Military systems capable of identifying and attacking targets without direct human control
Aerospace	Aircraft, satellites and space probes that fly autonomously and perform manoeuvres
Surveillance	Systems for monitoring and securing areas, operating independently to detect and respond to suspicious activities

Table 1: Examples of the use of autonomous systems.

The use of autonomous systems comes with a number of potential risks. A lack of human control, malfunctions and misinterpretations can lead to unpredictable, inappropriate or even dangerous actions. Ethical considerations might be ignored or inadequately addressed. This also raises questions of responsibility and accountability. Potential security vulnerabilities could make these systems susceptible to cyberattacks and hacking, which could allow malicious actors to take control and use them for harmful purposes. In areas where human labour was previously used, autonomous systems could lead to job displacement or, in a worst-case scenario, job loss.

There is also an increased risk that BCIs (brain-computer interfaces) or other surveillance technologies could be used for espionage or surveillance pur-

73 See Phillips, Rita: Ethical discourses on autonomous weapon systems. Opportunities of Austria's conservative position on autonomous weapon systems in international settings. In chapter SOCIETY in this publication.

poses. This raises numerous new questions about possible countermeasures, including encryption, electronic interference capabilities and defence training.

Despite the rapid development of HET and its integration into everyday life, parts of the population will remain sceptical or even reject these technologies.[74] A lack of acceptance of HE could lead some people to feel uncomfortable or uneasy about being rescued by "enhanced" rescue workers. Furthermore, there could be concerns that the use of enhancement technologies might cause security forces to lose their humanity and become "superhuman" beings who are no longer understood or controlled by ordinary people. This could lead to concerns about a shift in security culture, or even a move towards a militarised or surveillance-driven society.

In general, it seems necessary to subject the types of technologies to be used as well as their practical application and the ethical and social frameworks surrounding them to careful review and ongoing evaluation, ensuring that the use of HET serves the well-being of society as a whole and respects fundamental human principles.

5. Conclusions

The previous considerations show how complex the impact of human enhancement is on society and its various sectors. With each step in development, a new set of challenges arises, with questions that often lag behind the technological advances.

Sociologist Wolfgang Sofsky argues that "we are returning to normal, historically dangerous times"[75] and suggests that we must learn to live with fear, as doing so will reduce the public's demand for state security and its responses. Although "learning to live with fear" is more relevant than ever, a return to "normal, historically dangerous times" seems unlikely from today's perspective. Is it not this very learning from and with fear that drives us to equip people with better traits and abilities to protect themselves against (even per-

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74 See Grinschgl, Sandra: Cognitive enhancement - A critical reflection from psychology and neuroscience. In chapter MEDICINE in this publication.

75 Sofsky, Wolfgang: Wir kehren zurück in normale historisch, gefährliche Zeiten. Süddeutsche Zeitung, 24 August 2006, No. 194, 11. 2006.

ceived) threats? Is it not this learning that propels HET forward with all its advantages and disadvantages? And do these "new" technologies not also offer hope for a better world?

On closer examination, one finds that many believed, during the golden age after World War II, that the focus was solely on welfare. This attitude has persisted until today. Services have increasingly been outsourced to the state, which guarantees not only security but also prosperity. The individual's sense of entitlement has steadily grown, while the modern administrative and tax state would be unthinkable without constant data collection and surveillance of its citizens. Sofsky remarks, "When did we internalise being watched to the point where we behave as if we are constantly being observed? Then the external gaze has become an internal habit".[76]

It is this habituation effect that makes us careless in our handling of personal data. But it is also the habituation effect that dulls our critical thinking and actions, robbing us of our natural responsibility to advocate for the safety of the community.

The use of enhancement technologies in the military and security sectors on a global scale also raises a number of questions regarding national security, including issues of control, responsibility and stability. The fact that Austria is a neutral state might exacerbate the problem, but a detailed analysis of this issue would exceed the scope of this discussion and is best left to more qualified experts.

The rapid development of human enhancement technologies presents society with fundamental ethical, social and political challenges. These technologies offer the potential to significantly improve human life, but they also carry the risk of exacerbating social inequalities and reinforcing existing power structures. From the perspective of classical sociological theorists such as Max Weber[77] and Émile Durkheim,[78] as well as contemporary ap-

[76] Ibid.

[77] Weber, Max: Soziologische Grundbegriffe. 6th ed. Tübingen: Mohr Siebeck. 1984.

[78] Durkheim, Emile: Über soziale Arbeitsteilung: Studie über die Organisation höherer Gesellschaften. Frankfurt am Main: Suhrkamp. 1992.

proaches by Anthony Giddens[79] and Ulrich Beck,[80] it becomes clear that a purely technological solution is insufficient to address the complex effects of these innovations. Instead, an integrative approach is required –one that critically reflects on technological developments, establishes ethical guidelines and promotes a broad societal dialogue.

Savulescu and Bostrom[81] insist that it is ultimately not very helpful to debate whether human enhancement is good or bad. In order to derive ethical judgements, it is necessary to pose more specific questions. The focus should be on clarifying which abilities are being enhanced in what ways, who has access, who makes the decisions, what the cost is and within which cultural and socio-political context all of this takes place.

The future of our society depends on whether we are able to shape HET in a way that benefits everyone, not just a select few. The path to a just and inclusive future lies in our shared responsibility and requires deep engagement with the social and cultural implications of these groundbreaking developments.

To successfully navigate this path, we must return to the principles of social justice, solidarity and responsibility. Society must develop mechanisms to ensure that access to human enhancement technologies is fairly and transparently regulated. It is crucial to consider not only economic and technological interests but also the moral and ethical dimensions that are inseparably linked to these technologies.

To successfully compete and remain competitive in the international race for human enhancement,[82] investments in research and development are essential. Collaboration and the exchange of knowledge and resources between governments, universities, research institutions and companies are necessary. Special attention should be given to start-ups specialising in human enhancement. All of this requires the development and implementation of clear legal

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79 Giddens, Anthony: The Consequences of Modernity. Stanford, CA: Stanford University Press. 1990.

80 Beck, Ulrich: Risikogesellschaft: Auf dem Weg in eine andere Moderne. Frankfurt am Main: Suhrkamp. 1986.

81 Savulescu, Julian/Bostrom, Nick: Human Enhancement. Oxford: Oxford University Press. (eds). 2009.

82 See Klerx, Joachim: The future of human enhancement in the military domain. In chapter TECHNOLOGY in this publication.

and ethical frameworks, including standards and guidelines for safety, accountability and transparency in the development and application of enhancement technologies. To ensure that Europe has the necessary expertise and capabilities, educational and training programmes on human enhancement must be promoted, with a particular emphasis on interdisciplinary collaboration between the fields of medicine, technology, ethics, social sciences and law. Naturally, this also requires the provision of funding opportunities, tax incentives and other support measures.

The most challenging task will likely be to involve society and public opinion in the development process of HET (human enhancement technologies) and to ensure access to these technologies for all social groups. It is crucial that political decisions related to enhancement technologies are made through democratic processes in which all segments of society can participate. Legal and ethical regulations can help ensure that "enhanced" individuals do not gain disproportionate advantages in certain areas. For instance, this could involve regulations that limit the use of enhancements in education and the workplace to avoid unfair competition. Such measures also help prevent the emergence of a two-tiered society and foster a sense of fairness. Additionally, to guarantee broad access, it is necessary for the state to finance public programmes or provide subsidies. These initiatives should also acknowledge the value of non-technological forms of human potential and well-being, such as creativity, emotional intelligence and social engagement.

Drawing on the sociological perspectives of classical thinkers who emphasise social cohesion and moral order, as well as the modern discourse on risk societies and reflexive modernity, we must collectively reflect on which forms of enhancement we seek and which societal values should be prioritised. The dialogue between science, politics, civil society and ethics is essential in creating a future where human enhancement technologies do not become another source of division and inequality but serve as a tool to promote the well-being of all people.

Ultimately, it becomes clear that the key to responsibly integrating human enhancement technologies into our society does not lie solely in technological feasibility but in our ability to find just, sustainable and humane solutions as a global community. Only in this way can we align technological possibilities with social values and create a future that is not only technologically advanced but also humanly liveable.

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