TECHNOLOGICAL ENHANCEMENTS OF THE HUMAN BODY. A CONCEPTUAL FRAMEWORK

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1. Introduction

The evolution of the human being has been the object of investigation of researchers in many scientific disciplines. At the beginning of the 21st century, technology plays an integral part in many areas of human life and is a major driver behind the progress of human civilization. Additionally, technological development is proceeding at an accelerating pace. In his historical analysis of technology development, Kurzweil[1] found that technological change has been developing in an exponential rather than linear fashion: "we won't experience 100 years of progress in the 21st century -- it will be more like 20,000 years of progress (at today's rate)".[2] As the time until mass adop-

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[1] R. Kurzweil, *The Age of Spiritual Machines. When Computers Exceed Human Intelligence*, Penguin Books Ltd, London 1999; R. Kurzweil, *The Singularity is Near: When Humans Transcend Biology*, Penguin Books Ltd, London 2005.

[2] R. Kurzweil, *The Law of Accelerating Returns*, 2001, available: http://kurzweilai.net/meme/frame.html?m=1

tion decreases, technology's role in human civilization increases dramatically. Thus, technological advancements drive the continuous increase of life expectancy. Statistics on life expectancy at birth (for both sexes combined) in the US show a steady increase from 62.9 years in 1940, to 70.8 years in 1970, and 77.8 years in 2005. Importantly, technology also enters the human body and represents an increasing proportion thereof.

The profound dimension of technology is a central element in the attainment of a 'finalized' perfection of man.[3] It refers to the process of actualization of the human vocation, a process of directed and gradual transformation, in which the human being is continuously inventing and re-inventing himself and the circumstances of his life: "(E)l hombre es un ser temporal, es un espiritu en el tiempo, un espiritu que se va realizando, o mejor, que va sacando a luz sus potencialidades, se va actualizando".[4] At the beginning of the 21st century, technology becomes ubiquitous in everyday life. It not only affects life of the human being, but increasingly impacts the human being itself and its relationship with fellow human beings. Various lines of research in different fields (including medicine, engineering, and philosophy) adopt a broadening view of the human being. They go beyond the biological nature of the human being and include his technological enhancements. This gave rise to concepts such as cybernetic beings (or cyborgs), post-humans, trans-humans and homo cyber-sapiens. Despite their diverging research interests, philosophical perspectives and theoretical foundations, there appears to be a core common understanding across various scientific disciplines and lines of research: technology has an increasing impact, which goes beyond changing everyday life of human beings. In fact, technological development might give rise to some alteration of the very essence of the human being.

However, there is no common understanding regarding the implications of technological enhancements of the human being. Literature proposes a variety of theories of technological enhancement of the human being which are often based on diverging ontological assumptions. Thus, they do not allow for generalized conclusions across various theories. This paper proposes a conceptual framework that allows for a generalized approach to ethical issues related to the technological enhancement of the human being. The framework is based on foundations provided by Aristotelian ontology, systems theory and its derivatives including cybernetics, theories of complexity and self-organization.

[3] J.M. Galván, *On Technoethics*, «IEEE-RAS Magazine», 2003 (10/4), p. 58.

[4] L. Polo, *La diferencia entre el hombre y el animal: intervención de Leonardo Polo en las II Jornadas del Aula Ciencias y Letras*, 1992, p. 3; available: http://www.leonardopolo.net/revista/mp4.htm#1-Diferencia.

2. Research questions and approach

The importance of technological enhancements of the human being is widely established and gives rise to burgeoning research of many aspects of the homo cyber-sapiens, i.e. the technologically enhanced human being. In this context, life extension is an often mentioned goal. Some (such as trans-humanists) even strive to overcome mortality and achieve physical immortality. This gives rise to the need for analysing the ethical implications of technological enhancements of the human being.

The present paper aims at addressing the following research question:

What is a conceptual framework for studying ethical implications of technological enhancements of the human being?

This research question gives rise to the following secondary research questions to be addressed in this paper:

How can the human being be conceptualized?

How can technological enhancements be conceptualized?

In section 3, I establish the theoretical foundations of the proposed conceptual framework. In section 4, I draw a conceptual framework of the human being, its sub-systems and its higher-rank systems. In section 5, the conceptual framework is used to draw conclusions as to the ethical implications of life-prolonging technological enhancements of the human being.

3. Theoretical foundations of the conceptual framework

In this section, I discuss the theoretical foundations adopted for the conceptualization of the homo cyber-sapiens. The objective is to identify fundamental principles guiding us in our conceptualization of the homo cyber-sapiens in section 4.

Weber[5] describes rationalization as a progressive mastery of reality based on increasingly precise and abstract concepts. Such abstract concepts of rationalization assist the human beings with bounded rationality to assess complex phenomena, as mere observation and understanding might be too limited. Hereby, reality (e.g. complex systems) is represented based on these concepts of rationalization (e.g. modularity). The phenomenon of rationalization gives rise to an increasingly precise representation of reality leading to a more advanced understanding thereof. Hereby, a higher degree of rationalization is associated with a more precise representation and a more advanced understanding of reality. In my attempt to conceptualize the homo cyber-sapiens

[5] M. Weber, *The Theory of Social and Economic Organization*, Oxford University Press, New York 1947; M. Weber, *Economy and Society*, G. Roth, C. Wittich (eds.), Badminister, New York 1968; M. Weber, *Wirtschaft und Gesellschaft*, Mohr, Tübingen 1980.

– viewed as a complex system – I resort to insights stemming from theoretical foundations provided by theories of rationalization, including systems theory, emergentism, cybernetics, theories of complexity and of self-organization.[6] Hereby, I agree with the scientific view that "complexity science is little more than an amalgam of methods, models and metaphors from a variety of disciplines rather than an integrated science".[7]

3. 1. *Systems theory*

Whitehead, a proponent of process philosophy, can also be viewed as a precursor of systems theory. As Miller[8] mentions, Whitehead's thoughts in ‚Science and the Modern World' are particularly close to the basic ideas of both, process philosophy and systems theory. Whitehead describes science as the ‚study of organism'. Each organism has a particular structure, which Whitehead refers to as the ‚organic character'. From an ontological perspective, it is an organic process „that repeats in microcosm what the universe is in macrocosm".[9] Thus, there is a structure of organisms within organisms, each repeating at its own level similar processes. This is in line with the view adopted by systems theory, that complex systems have „parts-within-parts" structures. Specifically, they are „composed of subsystems that in turn have their own subsystems, and so on".[10] This hierarchical structure is composed of sub-systems, each being decomposed into further sub-systems. The sub-systems are re-integrated to form a higher-rank system with irreducible emergent properties, i.e. properties at the system level that cannot be reduced to the subsystems. The homo cyber-sapiens can thus be viewed as a complex system composed of sub-systems.

3. 1. 1. Modularity

Systems theory views complex phenomena as complex systems. These are artefacts (i.e. man-made as opposed to natural) moulded according to spe-

[6] Among others: M.M. Waldrop, *Complexity: The Emerging Science at the Edge of Order and Chaos*, Viking, London 1992; P. Cilliers, *Complexity and Postmodernism: Understanding Complex Systems*, Routledge, London 1998; F. Heylighen, *Towards a Global Brain, Integrating Individuals into the World-Wide Electronic Network*, published in German as: *Auf dem Weg zum "Global Brain": Der Mensch im weltweiten elektronischen Netz*, in U. Brandes and C. Neumann (eds.), *Der Sinn der Sinne*, Steidl, Göttingen 1997, pp. 155-170.

[7] F. Heylighen, P. Cilliers, C. Gershenson, *Complexity and Philosophy*, in J. Bodd, R. Geyer (eds.), *Complexity, Science and Society*, Radcliffe Publishing, Oxford 2007, p. 2.

[8] J.G. Miller, *Living Systems*, McGrawHill, New York 1978.

[9] Whitehead in *‚Process and Reality'* as quoted in T. Frandberg, *Living Systems and its Philosophy considered at the Level of the* Earth, «Systems Research and Behavioral Science», 22/5 (2005), p. 374.

[10] H.A. Simon, *The Sciences of the Artificial*, MIT Press, Cambridge MA 1996, p. 184.

cific goals and environments in which they live. Even though Simon does not propose a formal definition of complex systems, his notion of complexity used in the context of complex social systems is structural and more specifically hierarchical in nature. To make complex phenomena understandable, systems theory resorts to the basic concept of rationalization referred to as ‚modularity'. Modularity allows for some degree of theoretical mastery of complex phenomena. Hereby, complex systems are decomposed into simpler sub-systems that are easier to manage. This gives rise to ‚parts-within-parts structures' that can be represented by hierarchical architectures composed of various levels of sub-systems, i.e. components, or modules. As "hierarchies have the properties of near decomposability"[11], interactions within sub-systems are strong and interactions among sub-systems are weak. Structuring systems based on the concept of modularity is therefore about "separating the high-frequency dynamics of hierarchy – involving the internal structure of the components – from the low-frequency dynamics – involving interaction among components"[12]. Realistically complex systems (such as organisms, societies, ecologies) are characterized by a multi-level structure. A classic explanation for this hierarchical "architecture" of complex systems was given by Simon[13]. In this view, elements are connected and combined by natural interactions (or, equivalently, by the trials of a problem-solver). These assemblies form 'wholes', that function again as building blocks for assemblies of higher order (also referred to as higher-rank systems). This process can repeat itself at ever higher levels thus forming a set of hierarchically structured complexes.[14]

3. 1. 2. Emergentism

Emergentism is considered as the philosophical level of the new sciences of complexity. Opposing reductionism, it argues that the new and the whole are more than the old and the parts (of a system). A system is considered to be more than the sum of its parts. Thus, Checkland defines an emergent quality "as a whole entity which derives from its component activities and their structure, but cannot be reduced to them".[15] Baldwin and Clark[16] refer to modularity as the building of a complex system from smaller sub-systems that can

[11] *Ibidem*, p. 204. [12] *Ibidem*.

[13] H.A. Simon, *The Architecture of Complexity*, Blackwell, Malden/USA 2003.

[14] F. Heylighen, P. Cilliers, C. Gershenson, *Complexity and Philosophy*, in J. Bogg and R. Geyer (eds.) *Complexity, Science and Society*, Radcliffe Publishing, Oxford 2007.

[15] Ch. Fuchs, *Structuration Theory and Self-Organization*, available: http://www.self-organization.org/results/papers/pdf/hsicpaper13.pdf.

[16] C. Baldwin and K.B. Clark, *Design Rules: The Power of Modularity*, MIT Press, Cambridge MA 2000.

be designed independently, yet function together as a whole. This suggests that specialized sub-systems are coupled to give rise to emergent properties, i.e. properties at the level of the system that cannot be reduced to its sub-systems. Its sub-systems are coupled pending on the objectives associated with the system. The coupling of the sub-systems allows for emerging properties at the level of the system.

3. 1. 3. Generalized pattern of evolution of complex systems

I resort to the theory of natural selection for an explanation of the evolutionary dynamics of complex systems subject to rationalization. It is based on the Darwinian concepts of variation, replication and selection first introduced in Darwin's ‚Origin of Species'. These concepts gave rise to research on evolving systems in a variety of research fields. The application of the theory of natural selection in the context of evolution of complex systems is in line with the theoretical foundations of systems theory I use for the concept of the homo cybersapiens. More specifically, Simon's[17] argument for a hierarchical architecture of complex systems is based on a variation-and-selection view of evolution. The application of the theory of natural selection is also in line with the established view that "Darwinian principles provide a general explanatory framework into which particular explanations have to be placed"[18] and that the theory of natural selection "can be simply generalized to any kind of systemic evolution".[19] This is evidenced in theoretical and empirical research in the context of dynamic evolution in a variety of scientific disciplines, most prominently biology.

Theory of natural selection maintains that a system evolves based on a "generalized variation-and-selection dynamics".[20] From the perspective of systems theory, a system undergoes variation in an environment exerting a "selective pressure" on the system. In this view, "only those configurations of the system will maintain (or grow) which are ‚fit' or adapted to the environment".[21] In the face of environmental variance, the evolving system can be viewed as a problem-solving entity. It strives to adapt to the environment by generating possible solutions by trial (i.e. variation), which subsequently undergo selection by the environment. Internal variation thus gives rise to negative or positive feedback based on the selection by the environment. Both, the generalized pattern of variation-and-selection and the characteristic of systemic feedback, apply to complex systems.

[17] H.A. Simon, *The Architecture of Complexity*, cit.

[18] G.M. Hodgson and T. Knudsen, *The Firm as an Interactor: Firms as Vehicles for Habits and Routines*, «Journal of Evolutionary Economics», 14 (2004), p. 285.

[19] F. Heylighen, *Self-Organization, Emergence and the Architecture of Complexity*, in Proceedings of the 1st European Conference on System Science, AFCET, Paris 1989, p. 25.

[20] *Ibidem*, p. 24.

[21] *Ibidem*.

Unlike conventional problem-solving, a dynamic view suggests that there is no final solution. A system is never optimally adapted to its environment: the system's evolutionary process is driven by continuous external variance that calls for continuous adaptation of the system. Natural selection, as exemplified by the models of Simon and self-organization theorists, suggests that a rational approach proceeds in intermediate steps, i.e. relatively easy-to-find problem states or configurations, which are no final solution, but closer to the goal than initial configurations. In Simon's[22] terminology, one might refer to them as satisficing solutions. This search for intermediate solutions is essentially what happens during natural selection, as applied by the models of Simon and prominent theories of self-organization.

In line with the theoretical foundations of systems theory adopted for the proposed conceptualization of the homo cyber-sapiens, complex systems (such as the homo cyber-sapiens) are viewed as hierarchical multi-level structures of sub-systems. Hereby, the coupling of sub-systems gives rise to higher-rank systems with emergent properties, i.e. properties that are irreducible to the sub-systems. The higher-rank systems and the sub-systems, each follow the generalized evolutionary pattern of variation-and-selection. It can be concluded that a complex system follows a pattern of evolution based on internal and external variation as well as internal and external selection. Internal variation may be defined as a process in which inner parts of a system (i.e. its sub-systems) are changed. External variation refers to changes of the relation between the system and its environment. Internal selection leads to intrinsic stability as the internal structure of a system must be stable for the system to survive. This is associated with the phenomenon of self-organization. External selection gives rise to adaptation at the level of the system. In a multi-level complex system, the same applies also to the sub-systems. In a relatively closed system internal variation and selection refers to the parts of a sub-system, and external variation and selection to a sub-system's environment within the system. Thus, complex systems follow an evolutionary pattern that is in general parallel or distributed.

In relatively open complex systems, such as the homo cyber-sapiens, each sub-system is not only part of the system, but also interacts with its environment to give rise to other higher-rank systems. There is thus not just one system and its environment, but a multitude of sub-systems in continuous interaction with their environment. Hereby, each higher-rank system follows an evolutionary path based on internal/external variation-and-selection. Thus, sub-systems evolve partly autonomously from their primary higher-rank system (e.g. the homo cyber-sapiens) and their fellow sub-systems and partly in interaction with them. This 'network' structure of evolutionary processes

[22] H.A. Simon, *The Sciences of the Artificial*, cit.

implies that there is no absolute distinction between internal and external, i.e. between a system and its environment. What is conventionally viewed as external to a system (e.g. the homo cyber-sapiens) can also be viewed as internal to other systems. "Any external selection can be reduced to internal selection by considering a larger, more global system. Adaptation is then reduced to the existence of a stable relation between one sub-system (the original system) and another sub-system (the original environment)".[23] This more holistic view of a complex system and its sub-systems, reduces external variation and selection to internal variation and selection. This opens a broader potential for self-organization.

3. 1. 4. Self-organization

The theory of self-organization has led to a change of scientific paradigms – from the Newtonian paradigm to the approaches of complexity. There is a shift from predictability to non-predictability, from order and stability to instability, chaos and dynamics.[24] This gives rise to an evolution that is not only unpredictable, but truly creative, producing emergent organization and innovative solutions to global and local problems. When we focus on the complex system itself, we can call the process self-organization, i.e. the system spontaneously arranges its components and their interactions into a sustainable, global structure that tries to maximize overall fitness, without need for an external or internal designer or controller.[25] When we focus on the relation between the system and the environment, we may call it adaptation[26]: whatever the pressures imposed by the environment, the system will adjust its structure in order to cope with them.

3. 1. 5. Cybernetics

Cybernetics is closely associated with systems theory. It is based on goal-directed, apparently intelligent action.[27] "The principle is simple: certain types of circular coupling between systems can give rise to a negative feedback loop, which

[23] F. Heylighen, *Self-Organization, Emergence and the Architecture of Complexity*, cit., p. 26.

[24] Ch. Fuchs, *The Self-Organization of Matter*, «Nature, Society, and Thought», 16/3 (2003).

[25] S.A. Kaufmann, *At Home in the Universe: The Search for Laws of Self-Organization and Complexity*, Oxford UP, Oxford 1995.

[26] J.H. Holland, *Hidden Order: How adaptation builds complexity*, Addison-Wesley, Amsterdam 1996.

[27] W.R. Ashby, *An Introduction to Cybernetics*, Methuen, London 1964; F. Heylighen, C. Joslyn, *Cybernetcis and Second Order Cybernetics*, in R.A. Meyers (ed), *Encyclopedia of Physical Science and Technology*, vol. 4, Academic Press, New York 2001, pp. 155-170.

suppresses deviations from an equilibrium state".[28] Thus, a preferred state of affairs can be maintained or reached. This has at least two important implications for our research: (1) The Cartesian distinction between "res cogitans" and "res extensa" is undone. Both are merely two types of relations. (2) All knowledge is intrinsically subjective. "(I)t is merely an imperfect tool used by an intelligent agent to help it achieve its personal goals".[29] Based on a comparison of inputs and outputs certain information about the environment is induced.

3. 2. *Principles for conceptualizing the homo cyber-sapiens*

Being a complex system, the homo cyber-sapiens is composed of modular sub-systems. In this view, the homo cyber-sapiens may be represented by a modular hierarchical structure, i.e. a multi-level structure composed of sub-systems of higher- and lower-rank. Hereby, sub-systems of lower rank are coupled to form systems of higher rank. The coupling of sub-systems gives rise to emergent properties of the higher-rank system, i.e. properties of the system that are irreducible to its sub-systems.

Further, a change in any sub-system (induced by e.g. technological enhancements) may affect any higher-rank system, in which it participates. Additionally, the adopted view of the homo cyber-sapiens as an open complex system suggests that the sub-systems forming the homo cyber-sapiens participate in various higher-rank systems. These higher-rank systems may be situated within or beyond the boundaries of the homo cyber-sapiens.

4. Proposed conceptual framework

In this section, I draw a conceptual framework for studying the implications of the technological enhancements of the human being. The systemic view adopted suggests that – besides being composed of various sub-systems – the homo cyber-sapiens participates as a whole in higher-rank systems such as the human interpersonal system. Further, its sub-systems participate individually and independently in higher-rank systems beyond the boundaries of the homo cyber-sapiens, i.e. the corporeal system and the spiritual system. In the following, I further elaborate on the system "homo cyber-sapiens" (chapter 4.1) and various higher-rank systems (chapter 4.2).

4. 1. *System 'homo cyber-sapiens'*

The approach adopted to establish the concept of homo cyber-sapiens is of phenomenological nature. It is based on observation of the system homo cyber-sapiens, its sub-systems and its higher-rank systems.

[28] F. Heylighen, *Self-Organization, Emergence and the Architecture of Complexity*, cit., p. 8.
[29] *Ibidem*, p. 8.

4. 1. 1. Human being

The human being is a multi-level system composed of the two sub-systems 'body' and 'mind'. Each sub-system has its specific properties that can be analysed independently from the system and the fellow sub-system. In combination, the sub-systems (i.e. body and mind) form the system (i.e. human being). This gives rise to emergent properties at the level of the system homo cybersapiens that are not reducible to the properties of its sub-systems.

Conclusion

Technological enhancements of the human body can be associated with a variation of the sub-system body that has implications at the level of the human being.

4. 1. 1. a. *Irreducible nature of the human being*

The nature of the human being is not dual, but unitary encompassing body and mind: "L'unione nell'uomo tra anima e corpo è una composizione, ma non comporta dualismo: l'uomo non è un'anima che abita in un corpo. Anima e corpo, benché diversi, costituiscono un'unità sostanziale, un'unica essenza; più esattamente, l'anima informa il corpo dandogli l'essere e la vita".[30] The unity of body and mind in the human being gives rise to a nature that is personal, free, and responsible. These emergent characteristics are qualitatively different from the characteristics of corporeality.

This suggests that the nature of the human being is irreducible to the nature of its mere material dimension. This argument is supported by teachings and theories in various fields. The nature of the human being is qualitatively different from the nature of material things, i.e. the human being does not represent a perfected corporeality, but he is of a quality different from the quality of corporeality: "l'uomo non è semplicemente il più perfetto tra gli esseri materiali, ma sta a un livello qualitativamente diverso: è una persona. La sua particolare somiglianza con il Creatore risiede sopratutto nel suo spirito, cioè nel fatto di possedere un'anima spirituale e immortale, capace di conoscenza intellettuale e di volontà libera, che gli permette il dialogo amoroso con Dio; ma il suo essere personale include anche il corpo, non soltanto l'anima, cioè l'uomo intero, i due coprincipi, corpo e anima, che costituiscono la sua natura".[31]

Conclusion

The nature of the human being is associated with characteristics that are irreducible to either the sub-system body or the sub-system mind.

[30] F. Ocáriz, L.F.M. Seco, J.A. Riestra, *Il mistero di Cristo: Manuale di Cristologia*, eunsa, Pamplona 1991, p. 35.

[31] *Ibidem*, p. 36.

4. 1. 1. b. *Irreducible dignity of the human being*
The dignity of the human being refers to his entire being uniting body and mind. Thus, body and mind united participate in the dignity of the human being. Specifically, "(t)he human body shares in the dignity of 'the image of God': it is a human body precisely because it is animated by a spiritual soul, and it is the whole human person that is intended to become, in the body of Christ, a temple of the Spirit (…)"[32]. The reverse argument is that the dignity of the human being is irreducible to his either corporeal or spiritual dimensions. Among others, this argument is supported by GS.[33] "L'uomo, però, non sbaglia a riconoscersi superiore alle cose corporali e a considerarsi più che soltanto una particella della natura (...), riconoscendo di avere un'anima spirituale e immortale, non si lascia illudere da fallaci finzioni che fluiscono unicamente dalle condizioni fisiche e sociali, ma invece va a toccare in profondo la verità stessa delle cose".[34]

Conclusion
Human dignity is associated with characteristics that are irreducible to the characteristics of its corporeality and spirituality.

4. 2. *Higher-rank systems*

4. 2. 1. Interpersonal system – Human interpersonal dialogue

The human being engages in an interpersonal dialogue with fellow human beings. He participates in a higher-rank system I refer to as 'the human interpersonal system'. This higher-rank system has emergent properties that are irreducible to the homo cyber-sapiens.

Conclusion
Technological enhancements of the human being have implications at the level of the higher-rank system, i.e. the human interpersonal system.

4. 2. 2. Corporeality and spirituality

Further, the foundations of the framework suggest that multi-level systems are composed of sub-systems that individually and independently participate in various higher-rank systems within and beyond the boundaries of the multi-level system under investigation. Thus, the body is subject to the dynamics of

[32] *Catechism of the Catholic Church*, 364, available: http://www.vatican.ca/archive/ccc_css/archive/catechism/ccc_toc.htm.
[33] *Gaudium et Spes*, 14.
[34] *Ibidem*.

its higher-rank corporeal system, which is governed by principles and laws established in a variety of disciplines (such as physics, biology and medicine). Similarly, various authors and streams of research maintain that anima participates in a higher-rank system which I refer to as spiritual system.

In the context of this research project technological enhancements however, impact the body sub-system of the human being, which has implications at the level of the human being and the human interpersonal system. There are, however, no direct implications on the sub-system mind and its higher rank system spirituality.

Combining these findings, I theorize that the sub-systems constituting the homo cyber-sapiens, i.e. 'body' and 'mind' participate each individually in higher-rank systems I refer to as 'corporeality' and 'spirituality' respectively.

Conclusion

Technological enhancements of the human being are subject to implications of dynamics within the corporeal system.

The corporeal dimension actually allows for the emergence of a dialogue among human beings: "Il mondo materiale crea le condizioni per l'impegno delle persone umane l'una nei confronti dell'altra".[35]

Conclusion

His dialogical nature refers to both dimensions of the human being, his corporeality and spirituality. Thus, the body participates in the dialogical nature of the human being with regard to the dialogue with fellow human beings.

5. Discussion of life-prolonging technological enhancements

5. 1. *Technological enhancements*

We established that technological enhancements of the human body have implications at various levels. In the following, I discuss these implications and draw conclusions as to the coherence of technological enhancements with the nature of the human being. Specifically, I discuss technological enhancements as driven by dynamics in the system corporeality (chapter 5.1), and their implications at the level of the human being (chapter 5.2), and at the level of the human interpersonal system (chapter 5.3).

[35] Commissione Teologica Internazionale, comunione e servizio*: La persona creata a immagine di Dio*, 26, available: http//www.vatican.va/roman_curia/congregations/cfaith/cti_documents/rc_con_cfaith_doc_20040723_communion-stewardship_it.html

5. 1. 1. Level of corporeal system

There are different ways in which the human body is increasingly enhanced with technology. For instance, codification of the human genome and its translation into bioinformatics data; incorporation of cybernetic and other mechanical devices (such as heart pacemakers and cochlear implants) into the body; or the adaptation and reconstitution of physical and biochemical functioning via various techniques of genetic science and pharmacological treatments.[36] My review of various methods and approaches of technological enhancements of the human body produced the finding that these ground on diverging assumptions as to the purpose of enhancing the human body by technological means. I differentiate among two possible purposes – specifically, technological enhancements aiming at life extension (chapter 5.1.1.), and technological enhancements aiming at overcoming physical mortality (chapter 5.1.2).

5. 1. 2. Technological enhancements aiming at life extension

There are various forms of technological enhancements of the human body that ground on the underlying purpose of extending or enhancing the life of the human being. This group includes prosthetic devices (e.g. limb replacement or sensory devices such as hearing aids), neural prosthesis (e.g. implanted brain chips), implants (e.g. pacemakers), genetic manipulation, hormone treatments and telomere-based methods for age retardation.

There are three main functions that life-extension technologies can fulfil. Specifically, they may pursue the objective of conserving, repairing or improving the human body.

5. 1. 3. Technological enhancements aiming at overcoming mortality

Another type of technological enhancements does not aim at enhancing or extending the life of a human being. They ultimately ground on the objective to overcome mortality of the human being. *Mind uploading* implies that human consciousness is transferred onto a computer. *Cryonics* is a method to freeze a body shortly after death in the hope that future technologies will be able to revive the body and prolong its life indefinitely. *Self-improving artificial intelligence* is considered by some as having the potential to overcome physical mortality. This line of research focuses on cognitive advantages that artificial intelligence has for the human being. Further, some authors maintain that *nanotechnology* has the potential to repair the body's damaged organs and de-

[36] E. Graham, *Bioethics and Posthumanism: Natural Law, Communicative Action and the Problem of Self-Design*, «Ecotheology», 9/2 (2004), p. 178 f.

generated cells. Nano robots would replace human neurons and add new features to brain functions. In this context, BCIs (i.e. brain-computer interfaces) are of particular importance: "(t)he use of emerging technologies such as brain-computer interfaces is to enhance and possibly alter the human sensory and physical capabilities and find ways for a better synthesis between the human mind and various emerging technologies. (…) This raises the question of potential functional immortality by memory transfer".[37]

Considering the techniques of technological enhancements aiming at overcoming mortality that are mentioned above, there are many doubts as to whether they really lead to overcoming mortality. In the case of *mind uploading*, it is questionable, whether a computer with the scanned brain data of a human being is really a human being. Only the data in the brain continue to exist on a computer. *Cryonics* is not offering immortality of the human being either, as it is – in the best of cases – a postponement of death in the hope that a technique be found that offers immortality. *Self-improving artificial intelligence* and *nanotechnology* are but hopes for a potential of immortality. Thus, it can be said that the techniques of technological enhancements aiming at overcoming mortality of the human being are overstated. It is also too early to imagine what consequences overcoming immortality could have for the body of a human being.

5. 1. 4. Fear of technological enhancements

In his article "Aging: I don't want to be a cyborg!" Ihde examines different cyborg solutions to bodily problems due to aging. He notes that there is a "parallelism of resistance to contingent existence and to becoming a cyborg".[38]

The concept of cyborg, or cybernetic being, was first used in the 1960s by M. Clynes and N. Kline for human systems with chemical enhancements applied in outer space. However, as it is used today, it goes back to Donna Haraway's hybrid being "which can include human, animal and machinic or technological parts".[39] Cyborgs viewed from the humanist perspective adopted in this paper are technologically enhanced human beings.

Ihde (2008) conceptualized the relation between the human being and the technological enhancements as "embodiment relations". These have two sides: on the one hand, they reflect the desire for "total embodiment, for the technology to truly "become me". (…) The other side is the desire to have the power, the transformation that the technology makes available".[40] Thus, the human being desires the transformation that results from technology without

[37] F. Josserand, *Beyond Therapy and Enhancement: The Alteration of Human Nature*, «NanoEthics», 2 (2008), pp. 15-23.

[38] D. Ihde, *Aging: I don't want to be a cyborg!*, «Phenom Dogn Sci», 7 (2008), p. 397.

[39] *Ibidem*, p. 397.

[40] *Ibidem*.

wanting to recognize an external source of transformation. Ideally, he would want technology to become like he is. He would want a transplanted heart in his body to be his heart, a prosthesis to be an integral part of his body.

This embodiment relation reflects a relevant aspect for this paper. Namely, how does the human being perceive technological enhancements? Are they mere means to facilitate his life? Sources that, under certain circumstances, can become part of his body? Or are they entirely distinct from him? Can they even be dangerous to him in the sense that they can take over control of his body – as many futurists imagine?

5. 2. *Level of the human being*

It appears that technological enhancements of the original biological body are fully integrated in the human body and thus form an integral part of the human being. As integral part of the body, technological enhancements participate in the human being and specifically his dignity, his human vocation and the actualization thereof.

In the following, I discuss the two fundamental types of technological enhancements in the context of the homo cyber-sapiens, i.e. continuous enhancements (chapter 5.2.1), and disruptive enhancements (chapter 5.2.2).

5. 2. 1. Continuous technological enhancements

Continuous technological enhancements remain within the boundaries of the human biological world. They are coherent with human nature. In our conceptualization of the technologically enhanced human being, the essential emergent properties of the human being are enhanced with this first type of enhancement (i.e. the essential emergent properties are not altered or replaced by new emergent properties, that would change the characteristics of the human being in a disruptive, fundamental way). Technological enhancements aiming at prolonging life (vs. overcoming mortality) belong to the group of continuous technological enhancements. They enhance the essential emergent properties of the human being and do not give rise to fundamentally new essential emergent properties at the level of the human being.

5. 2. 2. Disruptive technological enhancements

Disruptive technological enhancements go beyond inherent limitations of human nature. They transcend the essential emergent properties of the homo cyber-sapiens (chapter 4.3). The homo cyber-sapiens thus is fundamentally altered, it acquires fundamentally new essential emergent properties, e.g. immortality.

Technological enhancements aiming at overcoming mortality belong to the disruptive type of technological enhancements. They give rise to fundamen-

tally new emergent properties at the higher-level system integrating the subsystems mind and body. Disruptive technological enhancements transcend the fundamental emergent property of the human being of finitude: the higher-level system, at which mind and body are integrated would no more be limited in time, i.e. it would be immortal. Thus, the integration of mind and body would give rise to a higher-rank system of a nature different from the nature of the human being.

5. 2. 3. Boredom

Williams (1993) initiated a debate about the intolerable boredom of immortal life. In his essay "The Makropulos case: Reflections on the tedium of immortality" he describes the "story of Elina Makropulos, who, having lived for 300 years at the biological age of 42, refrains from drinking any more of the elixir that would give her a further 300 years of life because she has grown weary of all that life can offer her"[41]. There have been different interpretations of absence of boredom: absolute unthinkability of boredom,[42] admittance of instances of boredom and distinction between a broader and narrower sense of boredom[43]. Immortality in all these different interpretations of boredom is a very long time which is, however, limited. It is up to the individual to set recurrent goals so that a very long timeframe doesn't lose its power of orientation for the human being.

5. 3. *Level of human interpersonal system*

5. 3. 1. Social consequences

As Kass mentions, several critics of retardation of aging view extreme life extension as a "classic instance of the Tragedy of the Commons, in which genuine and sought-for gains to individuals are nullified or worse, owing to the social consequences of granting them to everyone".[44] The main reasons are related to size and age of the population and ensuing work opportunities, retirement plans, hiring and promotion, cultural attitudes and beliefs, relations between generations and cultural attitudes and beliefs. Anissimov counters that the problems mentioned are real, they are to be affronted, not avoided. "A society with the technological capacity to overcome aging is also extremely

[41] M. Burley, *Immortality and boredom: A response to Wisnewski*, «International Journal of Philosophy of Religion», online edition, 2008, p. 1.

[42] B. Williams, *The Makropulos Case: Reflections on the Tedium of Immortality*. In: J.M. Fisher (ed), *The Metaphysics of Death*, Stanford University Press, Stanford 1993, pp. 73 - 92.

[43] J.J. Wisnewski, *Is the Immortal Life worth living?*, «International Journal of Philosophy of Religion», 58 (2005), pp. 27-36.

[44] L.R. Kass, *L'Chain and Its Limits: Why Not Immortality?*, «First Things», 113 (2001), p. 19.

likely to possess other useful technologies that will soften or eliminate the negative social impact of widespread life extension usage".[45]

It is true that innovation (be it of technological kind or otherwise) has often been underestimated by mainstream society. Thus, for example, conventional understanding of economic growth in the 19th century was deterministic. In "An Essay on the Principle of Population" Malthus discusses his 'theory of economic growth'. He states that "population, when unchecked, (increases) in a geometrical ratio, and subsistence for man in an arithmetical ratio"[46]. Such an evolution inevitably results in poverty, as population grows much faster than production. This inevitability theory was the standard explanation of poverty offered in the 19th century. Marx and Engels opposed Malthus' growth theory and maintained that it underestimates innovations in production technology. They were among the early scientists to write about the unprecedented growth of capitalism and underlined the importance of innovation to boost production growth. "The bourgeoisie (i.e. capitalism), during its rule of scarce one hundred years, has created more massive and more colossal productive forces than have all preceding generations together".[47] The challenge is thus not to underestimate innovation as a solution to issues a society is facing. I tend to agree with Anissimov's argument that issues are here to be solved, not avoided, if the result is an increase in well-being for the human being and society as a whole.

5. 3. 1. a. *Distributive justice*

Kass[48] argues that technological enhancements for life extension will not be accessible to everyone and thus the gap between rich and poor will be widened. Even though this might be correct for some initial period of time, technology tends to rapidly become a mass product and thus become widely accessible. This pattern of technology adoption applies also to technological enhancements for life extension that are customarily used today (e.g. heart pacemakers).

5. 3. 1. b. *Generations and families*

PCB[49] ask the following question: "families and generational institutions would surely reshape themselves to suit the new demographic form of so-

[45] M. Anissimov, *Objections to Immortality: Answering Leon Kass*, 2003; available: http://www.acceleratingfuture.com/michael/works/answeringkass.htm, p. 1.

[46] T. Malthus, *An Essay on the Principle of Population*, London. Available: http://www.ac.wwu.edu/edu/stephan/malthus/malthus.0.html

[47] F. Engels and K. Marx, *The Communist Manifesto*. Available: http://www.gutenberg.org/etext/61.

[48] Kass, o.c.

[48] The President's Council on Bioethics, *Beyond Therapy: Biotechnology and the Pursuit of Happiness. A Report of the President's Council on Bioethics*. Available: http://www.bioethics.gov/reports/beyondtherapy/index.html

ciety, but would that new shape be good for the young, the old, the familial ties that bind them, the society as a whole, or the cause of well-lived human lives?" This question is very relevant to this paper. However, at this stage, conclusions as to its implications at the societal level remain highly speculative. Change does not necessarily mean change to the worse. It is up to us human beings to make the changes of our society be for our best. Legislators, religious and political leaders are called upon to contribute to future changes being in the interest of society.

Abstract: *Literature proposes a variety of theories of technological enhancement of the human being. These are often based on diverging ontological assumptions and thus do not allow to draw generalized conclusions across various theories. This paper proposes a conceptual framework that allows for a generalized approach to ethical issues related to the technological enhancement of the human being. The framework is based on foundations provided mainly by systems theory. Central concepts such as modularity, emergentism, and cybernetics paired with the notions of body and mind are paramount. The article maintains that the human being can be seen as a hierarchical complex system composed of two sub-systems, i.e. body and mind. Each of these sub-systems can be viewed as a complex system that can be further subdivided into sub-systems of lower rank. Each system and sub-system participates as a whole and in its sub-parts in higher-rank systems within and beyond the system observed. There is thus a network of interconnected complex systems where the human being is but one – even though relatively special – integrated part. The proposed systemic view of the human being implies that there are – at system level – emergent properties by definition irreducible to its sub-systems. At the level of the human being, we distinguish between essential emergent properties determining what the human being is in its essence and secondary emergent properties subject to change in the course of the evolution of the human being. The article concludes that the human being viewed as a complex system has essential emergent properties which can be enhanced, but not significantly altered. Hereby, enhancement is associated with a linear evolution of a human being, whereas alteration is associated with a disruptive change of the human being that gives rise to a new species. Technological enhancements can be associated with the sub-system body. I distinguish between two types of technological enhancements: (1) continuous technological enhancements, and (2) disruptive technological enhancements. The first type of enhancements maintains the essential emergent properties of the human being. They might be enhanced, but not altered. This view suggests that there is a linear evolution of the homo sapiens sapiens towards the homo cyber-sapiens, the main driver being continuous technological enhancements of the human being. By contrast, the disruptive technological enhancements alter the essential emergent properties of the human being. The result is a being that is not within a linear evolution of the homo sapiens sapiens, as the very essence of the human being has been modified. The article illustrates the argument based on the fundamental emergent property of mortality. It is concluded that technological enhancements aiming at prolonging life, thus maintaining mortality as an emergent property, are compatible with human nature and thus with the essence of the human being. However, technological enhancements aiming at overcoming mortality are not coherent with human nature. A non-mortal being would be situated beyond the boundaries of the human being.*

Keywords: *anthropology, cybernetics, emergentism, technological enhancements.*