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Prohlašuji, že jsem tuto diplomovou práci vypracoval samostatně a uvedl v ní veškerou literaturu a ostatní zdroje, které jsem použil.

V Olomouci 24.4.2018   Podpis:……………………...

                                                                        David Pospíšil

ACKNOWLEDGEMENTS

EDITORIAL NOTE

Chinese expressions are referenced in pinyin transcription alongside with an original character. For each Chinese term I use simplified characters and brackets including pinyin transcription. Translations from Chinese and English are my own, unless stated otherwise in the text. The literature is referenced in pinyin transcription and in simplified characters in bibliography.

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INTRODUCTION

The aim of this thesis is to analyse the possible outlook of development of artificial intelligence in the field of global management. The thesis deals with the field of artificial intelligence and its closely related question about how the advent of technology disturbs building structures and decision processes in companies and society in whole. We will also analyse and compare leading power houses in the development of artificial intelligence like China, USA and European Union. Throughout this thesis I will argue that individuals, corporations and societies in general will find themselves on a fundamental crossroads in managing global data, privacy and liberty in the digital age. My hypothesis suggests, that we as a global society will undergo fundamental reorganization for the purpose of developing Artificial General Intelligence (AGI) as the second law of thermodynamics states that the entropy of the total system always tends to increase, i.e. the natural force always tends to make things more random. I will analyse how our society and current global management structures will change into either decentralized or totally centralized networks. This discourse will be mainly shown on the approach of main power engines behind the development of artificial intelligence, namely based on my models of the USA and China. This thesis posits that competition and cooperation of these two countries in AI will have dramatic implications for global economics and governance, therefore my research is aimed at companies and governmental approaches by these two specific countries. I will conclude that EU has its own place in this global drama and there is a niche that can be filled. This thesis has a very broad theoretical and multidisciplinary approach. To achieve my goal, we will first explore the underlying concept of complexity, stratification, multi-agent theory, and emergence to show how artificial intelligence is an inevitable consequence of entropic forces within a more effective, interlinked and complex society. The second chapter will explore the state of artificial intelligence in general, its definitions and the concepts within this scientific field of study. The third chapter will introduce decentralized networks, P2P networks and blockchains to support my argument that management structures will be disrupted, and we will explore the trend to gradually dissolve hierarchical management of global affairs to community-driven decision making.

To support my claims thoroughly I will give examples of case studies of companies dealing with artificial intelligence. My focus will be Chinese, state-owned and

private, hugely capitalized and centralized companies like Tencent, Alibaba, Baidu and SenseTime in comparison with tech hegemons in the USA like IBM, Google, Amazon, Facebook, Apple, Microsoft and others. The final comparison is however made to the decentralized model of AI proposed by the company SingularityNet, which is a schematic model of a new architectural approach towards AGI. The work has been fundamentally influenced by a variety of sources, but principally complexity theory, narrative and recent thinking about the nature of human decision theory.

1. COMPLEXITY, SELF-ORGANISATION AND STRATIFICATION

In this introductory chapter I would like to explain the theoretical basis for my thesis. Artificial Intelligence (AI) is believed to be redefining what it means to be human. It has become the hoped-for milestone of our technological improvement. However, what is called artificial intelligence today, is only built on the basis of certainty and accuracy and is limited by its formal axiom systems. Throughout this thesis I will point out how companies dealing with AI exaggerating the significance of the attainments of their own era and hence causing confusion in using the right terms and vocabulary related to AI. On the other hand, my thesis would not have a purpose, if there would not be any likelihood of achieving the emergence of human-like AGI. I will argue that there is a chance of achieving AGI following basic arguments of theory of complexity. Therefore, in this chapter, I will briefly explain complex systems, self-organization and hierarchical layering.

Complex systems are emerging across all areas of scientific research, so we can pursue a constant drive for a transdisciplinary approach. By defining these terms, I want to clarify the fundamental links between data, artificial intelligence and global management, while as well helping to frame limitations and the scope of my work and argument. This thesis involves several multidisciplinary approaches, where each topic brings only limited insight to the problem, however the conclusion should be well-structured as a clear evidence for my hypothesis devoted to the role of AI in a global management. For further understanding lets first define what complex systems are, how they are organized and why layering is essential to understand any complex system.

1.1 COMPLEXITY

The study of complexity is broadly based on an examination of the behaviour of a unit independent of its aggregate parts.[1] The complex systems theory is a scientific theory coming out of a tradition of chaos theory, control theory and cybernetics. Complex systems theory arises as a rejection of the traditional programme of reductionist science.

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[1] PRIGOGINE, Ilya. Order out of chaos: Man's new dialogue with nature. 1984. pp. 11-13

It rejects reductionism as being both unnecessary and intractable.[2] With the help of research by professor and famous cyberneticist Francis Heylighen from Vrije Universiteit, Brussel, I define main characteristics of complex systems as following: Complex systems such as the Internet, society, organism, environment, cannot be reduced to the characteristics of their individual parts. Complex systems are conditioned by internal processes, which can have statistical regularities, but we are not able to set the objective measurements in their quantitative and qualitative analysis. The main tools in describing complex systems can be considered as metaphors or modelling of initiation conditions using computer simulations.[3]

Complexity can be defined more closely within the specific disciplines. By enumerating complexity properties, it is universally acceptable to situate it on the edge between order and chaos. Complex systems are neither regular nor accurately predictable, they are not random, nor chaotic. They range from two dimensions, when they are predictable in certain aspects, surprising and unpredictable in others.[4] This balance between the chaos and the order is considered a necessity in the formation, adaptation and self-organization of most systems, e.g. the very existence of life itself. Hence it is enough for us to understand the complex inherent properties of complex systems, and that is self-organization from chaos to order and their inherent layers.[5]

One of the examples of applied complex theory can be traced to Shannon's work on Information theory which provides a mathematical foundation for the quantification, compression and transmission of information. Shannon showed that information itself is measured by unexpected bits – by its surprisal. Core set of concepts concerning entropy – a measure for information, or uncertainty is the duality of order and disorder, where order defines the expected bits, the redundancy and the signal, while disorder is measured by the degrees of freedom in the message.[6]

Waldrop (1992, in Rusnák, 2012) understands "the complex" as behaviour of a system, which is composed of a variety of interactions between independent agents. The richness

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[2] This proposal will be explained in the segment related to stratification and layers, and will be crucial to the understanding of the difference between hierarchy, hybrid structure and network.

[3] HEYLIGHEN, Francis. Complexity and Self-organization. *Encyclopedia of library and information sciences*, 2008, 3: 1215-1224. p.2

[4] As we will show later on, this is a fundamental aspect or characteristics of today's available AI software.

[5] WALDROP, M. *Complexity: The Emerging Science at the Edge of Order and Chaos*. New York City: Simon and Schuster, 1992.

[6] Shannon C.E . A mathematical theory of communication. *Bell system technical journal*. 1948 Jul;27(3):379-423.

of these interactions allows the system to be spontaneously *self-organized*. We can draw here a metaphor: as the trillion of chemically reactive lipids and nucleic acids, living cells or billions of interconnected neurons make up the brain, millions of interrelated individuals and their transactions create human society.[7] Moreover I will argue in this thesis that individuals and their interactions and transactions are basically a *by-product*[8] for the fundamental layer necessary for the emergence of AGI.

These agents[9], as well as the entire systems, have the ability to adapt to the ever-changing conditions of their environment, if they won't do so, they might swiftly go extinct. Finally, specific nonlinear dynamics brings inherent unpredictability or *strange behaviour* into these systems. Kaisler and Madey in the tutorial named Complex adaptive systems: Emergence and Self-organization, recognize some key features of complex systems that can be distinguished: [10]

- Openness to the environment
- Variety of elements and their interrelations
- Nonlinear dynamics
- Adaptive behaviour - adapting to learning
- Self-organization and emergence
- Evolution

In my final interpretation, these key features of complex systems are in fact necessary to successfully achieve AGI as a self-aware intelligence. This very general conclusion is in the core based on the fact that we need to focus less on solving human problems intelligently but focus more on understanding human intelligence, e.g - understand the fluid nature of mental categories. Douglas Hofstadter's (1979) and his Pulitzer prize–winning book *Gödel, Escher*, *Bach*: *An Eternal Golden Braid*, also known as GEB, argues that AI will never emerge due the fundamental lack of creative thoughts, the ability to use

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[7] RUSNÁK, J. Komplexita a ekonomická geografie. *Geografický časopis* [online]. c. 54. February 2012 [cit. 2018-3-11]. accessible at: http://www.sav.sk/journals/uploads/08210939Rusnak.pdf
[8] By using term „*by-product*", I indirectly suggest, that we are somehow metaphysically drawn by the historical attractor to turning everything we do into free-flowing data.
[9] In this work, when I speak of *agents* I consider it as an objective and commutable term, while *individuals* are the specific category of agents, generally in a human society.
[10] KAISLER, S.; MADEY, G. Complex adaptive systems: Emergence and self-organization. *Tutorial Presented at HICSS-42 Big Island*, 2009.

language and form concepts and to solve problems now solvable only by humans.[11] I believe that big data, high complex systems, decentralized networks, nonlinear dynamics and emergence will ensure the invention of AI. In the end, AI won't be built on the straight-forward, deterministic algorithmic models, but it will naturally evolve and adapt through approximation and data-procession. I understand that such statement is too general, so I will continue to try to better examine the theoretical and systematic model, behind my reasoning.

Nonlinear dynamics is the underlying concept as the uncertainty of intelligence is inevitably reflected in language, knowledge, thought processes, and results. Uncertainty is all around us, however rich one's knowledge and experience might be, it is impossible to predict what will happen within two days. As Li and Du (2017) rightly stated in their book *Artificial Intelligence with Uncertainty*: „*… an increasing number of scientists believe that the only certainty is actually uncertainty.*"[12] I argue that the concept of *singularity*[13] will occur, but not in a linear and deterministic way, but chaotic and non-linear. This thought is not new, nor revolutionary, but too many major thinkers in the field of AI like Kurzweil (2015)[14] or Bostrom (2017)[15] are rather neglecting what is rather obvious and do not discuss complex theory, self-organisation, emergence in details, which is mainly the domain of the renowned researcher in the field of AI – Ben Goertzel (2008). [16] I believe that this whole dilemma could be traced to a much deeper philosophical perspective of the problem between consciousness and determinism, and I will deal with this philosophical issue in the next chapter.

Douglas Hofstadter's (1979) believes that the complexity of human thoughts or consciousness is achievable by using analogies or it will rather emerge via the level-crossing feedback loop as he detailly described in his. I side with his view, that formalization of transition from data to concept, and from concept to knowledge will lead into the fully developed AGI. In my opinion, uncertainty, complexity, non-linearity, self-

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[11] HOFSTADTER, Douglas R. *Gödel, Escher, Bach: an eternal golden braid*. 20th-anniversary ed. London: Penguin Books, 2000. pp.658-699

[12] LI, D., DU, Y. *Artificial Intelligence with Uncertainty*, Second Edition. 2017. Boca Raton: CRC Press. p. 5

[13] The technological singularity (also, simply, the singularity) is the hypothesis that the invention of artificial superintelligence (ASI) will abruptly trigger runaway technological growth, resulting in unfathomable changes to human civilization.

[14] KURZWEIL, Ray. *The singularity is near: when humans transcend biology*. New York: Viking, 2005.

[15] BOSTROM, Nick. *Superinteligence: až budou stroje chytřejší než lidé*. Přeložil Jan PETŘÍČEK. Praha: Prostor, 2017. Obzor (Prostor).

[16] GOERTZEL, Ben. *Probabilistic logic networks: a comprehensive framework for uncertain inference*. New York: Springer, 2008.

organization and emergence is particularly prominent in this process and to achieve this final singularity, we will need public interaction in compliance with important statistical characteristics based on blockchain and decentralized networks and organizations, rather than hierarchical authority and monopolized data. This argument will be discussed later the chapter 5.

1.2 SELF-ORGANISATION AND EMERGENCE

In a self-organizing system, new order emerges from the old system. Similarly, to the definition of a complex system in general, this new order cannot be reduced to single elements, it is due to the importance of their interactions. The process of the appearance of order in a self-organizing system is termed *emergence*. This observation is based on the dialectical principles of the transition from quantity to quality.[17]

So, what determines which emergence is successful and which not? Based on evolutionary principles, we can say that in the universe, living and non-living complex systems develop through the method of trial and error and the phenomenon of emergence. [18] Over time, the advantageous position for adaptation to the external environment is fixed and gains the main preference within the systems. In ecology and economy, we use the term *niche* to detect a posteriori observation of successful adaptation in the system.

Ecological niche determines the fitness of a species living under a specific environmental condition and its ability to respond to the actual distribution of resources and competitors and how it in turn alters those same factors.[19] The market niche has a similar characteristic as the ecological one, while being defined in the context of market economy, instead of the natural environment. To find a successful niche, you need to aim at satisfying specific market needs, as well as the price range, production quality and the demographics that it intends to impact, otherwise you will be overrun by the competitor.[20]

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[17] ARSHINOV, Vladimir; FUCHS, Christian (ed.). *Causality, emergence, self-organisation*. Moscow: NIA-Priroda, 2003.pp.863-864. Accessible at: http://fuchs.uti.at/wp-content/uploads/selforganization.pdf
[18] STEWART, John. *Evolution's Arrow: The direction of evolution and the future of humanity*. Chapman Press, 2000. p. 246
[19] PETERSON, A. Townsend, et al. *Ecological niches and geographic distributions (MPB-49)*. Princeton University Press, 2011. p.18
[20] DALGIC, Tevfik. *Handbook of niche marketing: principles and practice*. Psychology Press, 2006. pp. 3-30

Why is self-organization so important in the development of AI? Because self-organization arises based on a predominantly local interaction that emerge synergistically in a global scale.[21] It spreads through waves, where the epicentre at one point affects the neighbours, and if the response of others to change is positive, it spreads until it reaches a complete coverage of the whole structure. As a metaphor, we could easily think of a strong political movement or revolution, which spreads through the society via individual/agents to reorganize itself, usually with implementing the vision to achieve more effective and equal system.[22] Self-organization can therefore simply be defined as a spontaneous emergence from the dense structures created by local interactions. Li and Du (2017) did an extensive research in the modelling of Internet data to something what they call cognitive field, where "*machine's cognition*" is modelled exactly on the local interactions with various maximus and minimums. They describe this method as following:

"The cognitive field method extends cognition of the objective world in physics to the cognition of the subjective world by human beings, using data fields to describe complex interactions and interactions between primitive, chaotic, and unstructured data objects, to realize the self-organized clustering and simplified induction of large-scale data sets. The topological potential method can extend the physical field method to the understanding and recognition of the complex natures of complex systems, such as their structure, function, and dynamic behavior, as a result opening up new thinking in the research of complex networks and complexity science. [23]*

Spontaneous means that the external or internal epicentre does not control the self-organizational process within the system. This argument will be used later in this thesis against the model of centralized AI developed by prominent Western and Asian companies.

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[21] I would like to put emphasis on this statment as it is crucial in my following argument towards artificial intelligence.

[22] I would like to explain further *the fuel* of this spread between individual agents. As it has been described in the previous chapter. For any dissemination or spread, we need the transaction of a value or information. Later in my thesis, from the economical and rewarding aspect, I consider tokenization within the blockchain and cryptohashes as a transacting value. While in society and culture, I consider *meme* as the main interacting value between agents. Meme is a unit of cultural transmission defined by Richard Dawkins in his book *The Selfish Gene* (1976).

[23] LI, D., DU, Y. *Artificial Intelligence with Uncertainty*, Second Edition. 2017. Boca Raton: CRC Press. p. 214

1.3 STRATIFICATION

For a better understanding of my thesis, I would also like to explain more closely the underlying concept of *stratification* [24], which is derived from the study of complexity and through which I apply any of my observations that is being made on any complex system as such. As Veverka has shown in his phenomenal book *Evoluce svým vlastním tvůrcem* (2013), we can find layering principle of nature in all most any field of study, ranging from geology to psychology with the same underlying behaviour based on the models of complexity.[25]

Stratigraphic principles, which imply stratification in the scientific research in fields like archaeology and geology for dating and chronological exploration, are further proceeding from another principle called *superposition*. Superposition ensures that higher the layer is, the younger its strata is and vice versa.[26] These differences are manifested by a degree of ordering. The bottom layers have a lower degree of entropy, but higher degree of order.[27] For even better understanding of the concepts, lets illustrate it at the most obvious example – an atmosphere. An atmosphere is a layer or a set of layers of gases surrounding a planet. These layers are known as troposphere, stratosphere, mesosphere, thermosphere, ionosphere and exosphere. All these layers have unique psychical characteristics and contain areas of discontinuous change similar to the Earth's lithosphere with the Mohorovičić and Gutenberg's discontinuity.[28]

To be even better articulated, another more accurately put model would be clouds themselves. Clouds are formed by drops of moisture and they have a visible form if they

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[24] I put *stratification* in quotation mark, because it is a term I decided to use as the most accurate one. By stratification I mean hierarchical layers, where every individual layer contains its own unique quality. There is no definite consensus concerning the terminology, and every branch of science uses their own vocabulary. In geology and archaeology it is *stratigraphy*, in meteorology it is *stratum*, in information theory it is *layers*. As it will be written from now on, in the utmost sense, we can talk of any term consenting to the proposition of layers derived from Latin word for layers – *stratum*.

[25] VEVERKA, M. *Evoluce svým vlastním tvůrcem: od velkého třesku ke globální civilizaci*. Praha: Prostor, 2013. Obzor (Prostor). pp. 22-44

[26] HAMBLIN, W.K. The *Earth's Dynamic Systems, A Textbook in Physical Geology*, by W. Kenneth Hamblin, BYU, Provo, UT, Illus. William L. Chesser, Dennis Tasa, (Burgess Publishing Company, Minneapolis, Minnesota), c 1978, pg. 115,

[27] For a better understanding of this phenomenon let's think about the production of cars in the biggest Czech car-manufacturer Skoda automobile. As the lower layers we could identify machines and workers in a production line. They are doing routine tasks to ensure order of production, while the top layers of management have to be more flexible, more chaotic and process more information to ensure that the whole organization can adapt in the environment. Another example could be simply brain itself. The body is effective, highly organized vehicle for a flexible and information processing brain.

[28] MELLOR, George L.; YAMADA, Tetsuji. A hierarchy of turbulence closure models for planetary boundary layers. *Journal of the Atmospheric Sciences*, 1974, 31.7: 1791-1806.

are viewed from far away, but they are shapeless when viewed closely. I will argue throughout this thesis that we can describe process as a meta-object, but it is hardly describable within the layer itself. When I use term Aritficial General Intelligence (AGI) in the next chapters, I won't go specifically into its algorithmic nature, neither the mathematical one, but I will put my own thought process to the higher strata of AGI-related observation and analyse how AGI could work and what the trend is about to be, when AGI is finally implemented. Metaphorically speaking, this thesis is more about a fair distribution of computers in the society and securing the individuals against disruptive forces of AGI modelled by the global management of governments and corporations. I will not argue which software program should be used and what are the best algorithms available in the market, but how artificial intelligence should be globally managed and approached to achieve a healthy development in the global data, corporations, governments and individuals., e.g. the higher strata of observation.

As previously mentioned, you can approach the *stratification* through biological, psychological, cultural, historical means, and it is mainly because of hierarchical nature of our world.[29] We see that everything together is the growth of complexity during the history of the universe: from elementary particles, atoms, molecules, living cells, multicellular organisms, plants, and animals to human beings, and societies. Every stratum has its unique insights even though they are inherently interlinked. As I mentioned in the introductory segment for this chapter, the complexity theory is necessary for non-reductionist understanding of the universe and chaos in general. There is a substantial relation between micro and macro world. To further understand this topic by means of mathematical modelling characteristics and philosophy of the evolution of complexity and its specific mathematical and computer models, I would highly recommend book *The evolution of complexity: the violet book of "Einstein meets Magritte"* by Heylighen, Bollen and Riegler (1999)[30] and again Li and Du's (2017) book *Artificial Intelligence with Uncertainty*.[31]

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[29] If we would like to illustrate the founding layer of any phenomenon in the world, we would always come back to The Big Bang. For example, if we would like to simply retrace back life itself, then we would have to climb from the lower complexity layers, randomly named quantum world, subatomic particles, atoms, elements, molecules, single-celled organism, precambrian era, pass to the more complex organisms, up to ourselves as a species.

[30] HEYLIGHEN, Francis., Johan. BOLLEN a Alexander. RIEGLER. *The evolution of complexity: the violet book of "Einstein meets Magritte"*. Boston, Mass.: Kluwer Academic Publishers, c1999.

[31] LI, D., DU, Y. *Artificial Intelligence with Uncertainty*, Second Edition. 2017. Boca Raton: CRC Press.

1.4 UNCERTAINITY

Nick Bostrom (2015), who is well-known in the field of AI as a speculative philosopher at the University of Oxford for his work on existential risk, the anthropic principle, human enhancement ethics, superintelligence risks and as a founder of the Oxford Martin Programme on the Impacts of Future Technology, and as a director of the Future of Humanity Institute at Oxford University, started to use the term "*Superintelligence*" due to the fact, that once AI is invented in a fully independent entity, it will rather exhibit non-human behaviour. In his famous book *AGI: Paths, Dangers, Strategies* he proposes various theories and simulations on how the AGI could behave when it is invented and how anthropic principle is false when we think of machine intelligence.[32]

As previously mentioned, even though his book more or less neglects specific models of complexity and uncertainty, the theory of complexity itself suggest that reductionism won't be applied as the AGI will emerge as a higher layer on the top of the human society. AGI will indeed exhibit behaviour much different from the one that is it anticipated either by AI optimists like Kurzweil or neither by AI sceptics like Hofstadter. By the nature of its emergence, we won't be able anticipate behaviour of truly emerged, self-organised and self-prioritized AI and our anthropocentric expectations about the AGI will be proven as misleading. I lean towards the Bostrom's (2015) description of this intelligence as a *superintelligence*, where human society will fail in every degree to anticipate AGI behaviour. Complexity, approximation, emergence and self-organization will ensure that we can't say anything about the presence and future of AGI and we will more likely analyse its behaviour a posteriori. As Elon Musk discussed this issue in interview with Joe Rogan, Musk simply stated: *"...it could be terrible and it could be great, it's not clear, but one thing is for sure, we will not control it."[33]*

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[32] BOSTROM, Nick. *Superinteligence: až budou stroje chytřejší než lidé*. Přeložil Jan PETŘÍČEK. Praha: Prostor, 2017. Obzor (Prostor). p.47

[33] MUSK, E. Joe Rogan Experience #1169 [Video file]. Streamed live on 6.9.2018. Retrieved from https://www.youtube.com/watch?v=ycPr5-27vSI&t=1798s.

1.5 CONCLUSION TO CHAPTER 1

Now, my final statement to this brief chapter is that there would be no reason for writing my thesis, if there is no underlying argument in favour of an actual emergence of AGI.[34] By briefly describing concepts of chaos theory, self-organization and emergence, which are interlinked by layers, either because of entropy[35], which we cannot fully cover in this thesis for the scope of the argument, or more empirically through the argument that layers are related to the *sedimentation of information*. I believe this basic observation lays down the theoretical proof of inevitability of AI to emerge as a higher strata of complexity in the world.

By combination of Veverka's book *Evoluce svým vlastním tvůrcem* (2013)[36] and Haken's *Information and self-organization: a macroscopic approach to complex systems* (Haken, 2006)[37] I would like to argue, that you can apply axioms to the fundamental characteristics of the layering principle and create a basic formal model. The axioms would be following:

- Every layer has its root layer.
- The lower layer is always present at the higher level.
- The more complex systems we have, the longer their history is.
- The oldest layers are in general more stable and less chaotic.
- The upper layers are younger, flexible and volatile than the older one.

I would like to argue even further that intelligent systems should be a highly complex system with dense local interactions, regardless of what their architecture and design is,

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[34] On this occasion, to be absolutely accurate, I am more refering to Artificial General Intelligence (AGI) as a completely independent thinker and transferable intelligence used on any given problem, similiarly to definition of *Superintelligence* proposed by Nick Bostrom.

[35] For a deep understanding of mathematical argument towards uncertainty and entropy I would highly recommend the book by Li, D., Du, Y. (2017) *Artificial Intelligence with Uncertainty*. Their book introduces entropy into the study of cognitive model, which is cloud modeled for quantitative and qualitative dual transformation and they further propose concept of super-entropy. They stand fo a similiar thought proces, where the information entropy is described as the average uncertainty of events occuring in the event set x. They are basically trying to prove mathematicaly that the higher the entropy, the greater is the degree of uncertainty, hence emergence of artificial intelligence.

[36] HAKEN, Hermann. *Information and self-organization: a macroscopic approach to complex systems*. 3rd enl. ed. Berlin: Springer, c2006. Springer series in synergetics. 31, p.

[37] VEVERKA, M. *Evoluce svým vlastním tvůrcem: od velkého třesku ke globální civilizaci*. Praha: Prostor, 2013. Obzor (Prostor).

since they must exhibit self-organisation in some degree, it will be virtually impossible to predict the global impact and invisible reasoning behind the emergence of AI from the local interactions. I believe that the consequences of this assumption are, that current monopolized approaches to AI will never lead to a full, human-level artificial intelligence, unless they are fully implemented into the society's global performance and interaction, e.g. the upper stratum of complexity cannot fully emerge, if the lower one is not cover thoroughly. I consequently suggest that this will be the biggest disruption caused by the emergence of AGI as you need almost every individual's performance within the human society to achieve AGI. This applied reasoning led me to suggest, that every individual should become a node or processing unit within the decentralized network, because architecture of Artificial Intelligence should be considered as a bona fide example of the emerging layer from previously achieved complexity, e.g. human society.

2 WHAT IS ARTIFICIAL INTELLIGENCE?

Admittedly, it is beyond my expertise and scope of this work to fully cover the historical or present scientific discussions in the field of AI, neither the technical issues of achieving AGI. With the advent of global conferences devoted to the AI, there are infinite debates of every aspect of so-called "*AI Revolution*", the term which is widely used by Yuval Noah Harari in his book *21 lessons for the 21th century.*[38] In my opinion, the AI revolution is determined not just by algorithms getting smarter and able to handle uncertainty and random thoughts, but it will be all about the human capability of understanding biochemical mechanisms within his own brain. With a better understanding of our conscious and unconscious phenomena, as well as feeling and thought, the better we can project replacement of our kind to the artificial mind. My views side with Thomas S. Kuhn (1962), who described in *The Structure of Scientific Revolutions* how during periods of change, introduction of an irrational element into the normal science can determine a completely new paradigm.[39] The connections between the previously unconnected will be needed as to define what exactly AI stands for. In the last hundred years, culture has seen a rapid evolution in science and I have always been intrigued by the ambiguity between positivist approach based on quantitative methodologies and empirical evidence in compare with qualitative discourse in social sciences. I believe that the synthesized dialectic and modelling between these two will be the last play to determine if actual creation of the AGI is possible.

The term *artificial* does not requires much controversies as it is simply referring to a thing caused or produced by a human. But for *intelligence,* we are confronted with the difficulty in measuring such concepts. In this chapter, I will try to map the discourse of defining terms like *intelligence* and *consciousness* and consequently we will investigate the basic categorization of AI development to illustrate the concept behind the idea of AI. Unquestionably, every term and categorization in this chapter could be researched much more broadly and, in more detail, therefore I will try to refer to relevant sources for the subject being discussed in this thesis and I will also draw attention to my possible generalization in the given passages.

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[38] HARARI, Y. N. *21 Lessons for the 21st Century*. Random House, 2018. p.33
[39] KUHN, Thomas S. *Struktura vědeckých revolucí*. Praha: Oikoymenh, 1997. Oikúmené.

Intelligence is a term that is difficult to define, and it can mean many different things to many different schools of thoughts. There is a different approach to defining intelligence across the cybernetic community as well as from the neurological and psychological perspective. In fact, it has divided the scientific community for decades and controversies still rage over its exact definition and form of measurement, because there is no mathematical approach or "hard science" behind the concept itself. Not only conceptualization of intelligence is problematic, there are also proven geographical distinction, therefore Western notions about intelligence are not shared by different cultures.[40]

The Western concepts are usually built on the emphasis of mental processing, while other cultures like Chinese are more focused on the depth of what participants have learned and how it was understood. Yang & Sternberg (1997) argued in their article Conceptions of intelligence in ancient Chinese philosophy published by *Journal of Theoretical and Philosophical Psychology,* that there are fundamental philosophical differences in perception of intelligence. For example, the Confucian perspective emphasizes the characteristic of benevolence and of doing what is right, similarly Taoism is more about humility, observation and relying on one's intuition. Logical reasoning was considered by the Taoists as part of the artificial world of man, together with social etiquette and moral standards.[41]

More concretely in Chinese classic text traditionally credited to the 6th-century B.C. sage Laozi *Tao Te Ching,* which is also known by its pinyin romanization Dao De Jing, is intelligence characterized as evil. This classic text further claims that as intelligent people spread around the world, the more evil acts take place, the more tools are made and the more disordered the state gets. Taoism stands that freedom from conventional standards of judgment, and full knowledge of oneself and exterior observation is the most valued characterics that people should strive for.[42]

In general, there were three major theories produced on intelligence in the 20th century. In 1904 Charles Spearman published article called General Intelligence, which is consider as a manifesto for differential psychology and in his article for *American*

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[40] STERNBERG, R. J., KAUFMAN, J. C. Human abilities. *Annual Review of Psychology*, 1998. pp. 49, 479−502.

[41] Yang, Shih-ying, and Robert J. Sternberg. "Conceptions of intelligence in ancient Chinese philosophy." *Journal of Theoretical and Philosophical Psychology* 17, no. 2 (1997): 101.

[42] LAOZI. *Tao te ťing: kniha o tao a cestě ke cnosti*. Olomouc: Fontána, 2008.

Journal of Psychology he's trying to "…*positively determining all psychical tendencies and in particular those which connect together the so-called 'mental tests' with psychical activities of greater generality and interest*" (Spearman, 1904, p. 205).[43] He further divided the intelligence in two fundamental categories – the first is *g* and stands for general intelligence shared by all of us and the second one is *s*, which stands for rather specific abilities.[44]

Ian J. Deary (2012) in his article 125 Years of Intelligence in *The American Journal of Psychology* believes, that Spearman's article provides a thorough literature review of attempts to correlate measures of intelligence with more basic psychological abilities.[45] J. B Carroll (1993) in his book *Human mental abilities: A survey of factor analytic studies* stated that Spearman research has its importance in the fact that it was the first paper in which a set of correlations made attempt to explain them in terms of a theory of individual differences in intelligence, however Carrol decisively stated in his book that the data provided by Spearman are weak and the measurements themselves have weaknesses and are not accurate.[46] Therefore, Spearman's argument for a general intelligence factor called "g" remains controversial to this day.[47]

Decades later, Harward psychologist Howard Gardner has started to question the general idea that intelligence is a single entity, that it results from a single factor, and that it can be measured simply via IQ tests. The conclusion of his work was summarized by the Theory of Multiple Intelligences, which set forth eight distinct types of intelligence: *musical-rhythmic, visual-spatial, verbal-linguistic, logical-mathematical, bodily-kinaesthetic, interpersonal, intrapersonal, and naturalistic*. Gardner (1983) claimed that there is no need to have a straight correlation between them. Person can have strong logical-mathematical intelligence without being gifted musically.[48] His theory of intelligence was strongly based on individualism, so that no two persons have same type of intelligence in the same exact configuration and it is as unique as our fingerprints.

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[43] SPEARMAN, C. General intelligence, objectively determined and measured. *American Journal of Psychology*. 1904, 15, 210–293.
[44] SPEARMAN, C. General intelligence, objectively determined and measured. *American Journal of Psychology*. 1904, 15, 210–293.
[45] DEARY, I. 125 Years of Intelligence in The American Journal of Psychology. *The American Journal of Psychology*, 2012. 125(2), 145-154. doi:10.5406/amerjpsyc.125.2.0145
[46] CARROLL, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies*. Cambridge University Press.
[47] DEARY, I. 125 Years of Intelligence in The American Journal of Psychology. *The American Journal of Psychology*. (2012). 125(2), 145-154. doi:10.5406/amerjpsyc.125.2.0145
[48] GILMAN, L. (2001). The theory of multiple intelligences. *Human Intelligence*.

Since Howard Gardner's original listing of the intelligences in *Frames of Mind* (1983) [49] he later added a ninth intelligence, which he called *existential intelligence* and is characterized as the ability and proclivity to ponder about the questions of life, death, and ultimate realities. Subsequent research and reflection by Howard Gardner and his researching team concluded that existential intelligence is a link between spiritual intelligence and naturalistic intelligence and should be added to the list of the original eight intelligences. [50]

The third influential theory was put forward by the former dean of Tufts and now professor at Cornell University and Yale University – Robert J. Stenberg. Sternberg has criticized IQ tests, saying they are "…*convenient partial operationalizations of the construct of intelligence, and nothing more. They do not provide the kind of measurement of intelligence that tape measures provide of height.*" [51] He argued that previous definitions of intelligence are too narrow, and he believed that there three fundamental subtypes of intelligence: analytic, creative, and practical. He was further advised readers that individual must make the best use of his or her analytical, creative and practical strengths, while at the same time compensating for weaknesses in any of these areas. He suggested that people should make an effort to choose environment that values their strengths to become better adapted and successful in their lifetime mission. Stenberg also contributed to encyclopaedia Britannica on the topic of human intelligence where he defined Human intelligence as "*A mental quality that consists of the abilities to learn from experience, adapt to new situations, understand and handle abstract concepts, and use knowledge to manipulate one's environment.*" [52] As AI pioneer professor at Harvard University Margaret Boden (2016) rightly pointed out in her book *AI, Its Nature and Future,* intelligence isn't a single dimension, but a richly structured space of diverse information processing capacities, which is rather hard to define. [53]

Consciousness is defined by Merriam-Websted dictionary as: "*the quality or state of being aware especially of something within oneself the quality or state of being aware*

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[49] GARDNER, H. *Frames of mind: the theory of multiple intelligences*. New York: Basic Books, c1983..

[50] GARDNER, H. *Intelligence Reframed. Multiple intelligences for the 21st century*, 1999. New York: Basic Books.

[51] STENBERG, The Theory of Successful Intelligence. *Interamerican Journal of Psychology* - 2005, Vol. 39, Num. 2 pp. 189-20

[52] STENBERG, J. Article Title: Human intelligence Website Name: Encyclopædia Britannica Publisher: Encyclopædia Britannica, inc. Date Published: April 26, 2017 URL: https://www.britannica.com/science/human-intelligence-psychology Access Date: November 20, 2018

[53] BODEN, Margaret A. *AI, Its Nature and Future*. Oxford: Oxford University Press, 2016. [8], pp. 1-15

especially of something within oneself". [54] The Cambridge Dictionary defines consciousness as "*the state of understanding and realizing something.*"[55] The Oxford Living Dictionary defines consciousness as "*The state of being aware of and responsive to one's surroundings.*", "*A person's awareness or perception of something.*" and "*The fact of awareness by the mind of itself and the world.*" [56] Arne Dietrich in his book *Introduction to consciousness* claims that there is no scientific method in existence to prove or disprove consciousness, therefore I cannot be defined.[57] Dietrich (2007) suggests that theory of complexity and chaos theory or perhaps quantum modelling could give some possible answers, however these methods are still unsupported by the hard empirical evidence.[58] Noë, Alva (2009) in his book *Out of our heads: Why you are not your brain, and other lessons from the biology of consciousness* argues that the mind is not in the brain or part of the brain and therefore cannot be understood except in terms of the interaction of a whole organism with the external environment, especially the social environment.[59] In contrast to Noë's ideas of "extended mind" I would put in place the book named *Consciousness: An Introduction* by Susan Blackmore and Daniel C. Dennett's book *Consciousness Explained*, where both argues in favour of the fact that human brain is complicated information-processing system and consciousness derives from the complexity of electrochemical interactions between billions of neurons.[60] They are both trying to neglect the idea, what Dennett calls "Cartesian theatre".[61] As shown in the previous paragraphs, we should at least make the difference between intelligence and consciousness.

Stenberg defined the term intelligence in encyclopaedia Britannica as the ability to learn from experience. In his understanding, the intelligence should also provide the capability of abstract concepts, adaptation and use of one's knowledge to manipulate

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[54] Consciousness. In: *Merriam-Webster.* 2018, [cit. 15.8.2018]. Accessible at: https://www.merriam-webster.com/dictionary/consciousness

[55] Consciousness. In: *Cambridge Dictionary* [online]. Cambridge, 2018, [cit. 15.8.2018]. Accessible at: https://dictionary.cambridge.org/dictionary/english/consciousness

[56] Consciousness. In: *Oxford Dictionaries* [online]. Oxford, 2018, [cit. 15.8.2018]. Accessible at: https://en.oxforddictionaries.com/definition/consciousness

[57] DIETRICH, A. *Introduction to consciousness*. Macmillan International Higher Education, (2007). p. 83

[58] Ref. 59

[59] NOE, A. *Out of our heads: Why you are not your brain, and other lessons from the biology of consciousness*. Macmillan, 2009.

[60] DENNETT, Daniel Clement. *Consciousness explained*. Ilustration by Paul WEINER. London: Penguin Books, 1993. Penguin science philosophy.

[61] Concept of Cartesian Theater remains that the ontological dualism of body-mind problem somehow "comes together" in a brain to create consciousness. Dennett argues that this concept is misleading and transfixed by illusion of researches who are trying to detach the mind from the physical.

one's environment. [62] Consciousness on the other hand is the fact of the awareness about "mind itself" and the world surrounding. In other words, being aware of something "within oneself". [63] Alan Turing used the term "oracle" as to refer to the source of intelligence outside the system itself. [64]

For the scope of this thesis I will not further analyse the various aspect of the consciousness, unconsciousness or the body-mind problem. No matter how interesting and worthwhile this topic is, realistically speaking, it is beyond my expertise and hypothesis of my argument to proceed deeper. But I assume we can clearly see that the term intelligence is not the same as consciousness and this distinction will provide valuable insight for the definition of AI.

Finally, how do we then define the AI? John McCarthy, who coined the term in 1955 and is often regarded as one of the godfathers of AI, defined AI as "*the science and engineering of making intelligent machines that have the ability to achieve goals like humans do*".[65] Marvin L. Minsky similarly defined AI in the book *Semantic information processing* as "*the science of making machines do things that would require intelligence if done by men.*"[66]

As we can see, in general, AI is the intelligence exhibited by machines or software, thus not exhibited organically and it is rather intelligence made by man for its own sake. Similarly, it is also the name of the academic field of study in computer science which studies how to create computers and computer software that are capable of intelligent behaviour. As it has been written in the previous paragraphs, there are different approaches to undertake and define intelligence and intelligent behaviour, but one way or another, AI is ongoing and pervasive theme in our society and it will surely outlive everybody, if it is not directly experienced by humans of 21th century. In popular culture

[62] STENBERG, J. Article Title: Human intelligence Website Name: Encyclopædia Britannica Publisher: Encyclopædia Britannica, inc. Date Published: April 26, 2017 URL: https://www.britannica.com/science/human-intelligence-psychology Access Date: November 20, 2018

[63] *"consciousness". Merriam-Webster. Retrieved June 4, 2018. Also see "consciousness". Oxford Dictionaries. Retrieved June 4, 2018.*

[64] COPELAND, B.J. and PROUDFOOT, D., 1999. Alan Turing's forgotten ideas in computer science. *Scientific American*, *280*(4), pp.98-103.

[65] MCCARTHY, John a Vladimir LIFSCHITZ. *Artificial intelligence and mathematical theory of computation: papers in honor of John McCarthy*. Boston: Academic Press, c1991.

[66] MINSKY, Marvin. *Semantic information processing*. Cambridge, Mass.: MIT Press, 1968.

there has been infinite narrative battles concerned if AI is a promise of a Utopian future or if it can be a harbinger of our own demise.[67]

Artificial intelligence exhibits some form of intelligence by way of introducing systems that learn new concepts and have the ability to reason and draw useful conclusions about the world.

Artificial intelligence systems can also understand a natural language or perceive and comprehend a visual scene and perform other types of feats that require human types of intelligence. [68]However, especially in recent years, AI is highly overestimated in what it can do, and I think that in fact, AI is not fully intelligent, neither is it consciousness.[69] I would like to argue here that the most AI projects are based on machine-learning and big data clusters that simply help to identify patterns within data sets and thus try to make predictions based on existing data. However, they are not flexible in their thoughts and self-reflection, therefore I perceive machine-learning as expert systems or intelligent systems, but not AI or AGI. I would like to emphasize here that the term **Artificial Intelligence (AI),** in my understanding, is intelligence in the sense of an artificial program based on non-biological structure, that can imitate human intelligence in every possible aspect straight-forwardly derived from the definition of intelligence made by Stenberg (2017, In: Britannica). However, in this thesis I will use the term Artificial Intelligence (AI) as it has been used in scientific literature and how it is prevalent in the cultural narrative and the news, e.g. when the term AI is used in this thesis, it denotes various activities and systems, such as activites in the research of AI, including expert systems, cloud computing, neural networks, natural language processing etc. as shown in the Figure 1. I believe this use of terminology will reduce the amount of confusion in the text, even though I do not regard the term Artificial Intelligence as it will be used as a satisfying term. Over and above that, if I refer to **Artificial General Intelligence (AGI)**, I am speculating on the hypothetical creation of a conscious mind, self-aware and meta-objective, self-referential about its own existence derived from the stated definition of consciousness and the description of Superintelligence made by Bostrom (2017) or more precisely by Ben Goertzel's in his book *Artificial General Intelligence*.[70]

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[67] Ex Machina [film]. Directed by Alex GARLAND, United Kingdom, 2014. Also see 2001: A Space Odyssey [film]. Directed by Stanley KUBRICK, United States, 1968. Also see The Matrix [film]. Directed by Lilly WACHOWSKI, Lana WACHOWSKI, 1999.
[68] BODEN, Margaret A. *AI, Its Nature and Future*. Oxford: Oxford University Press, 2016. [8], p.28
[69] HARRIS, Michael C. *Artificial intelligence*. New York: Marshall Cavendish Benchmark, c2011.
[70] Goertzel, Ben. *Artificial general intelligence*. Edited by Cassio Pennachin. Vol. 2. New York: Springer, 2007
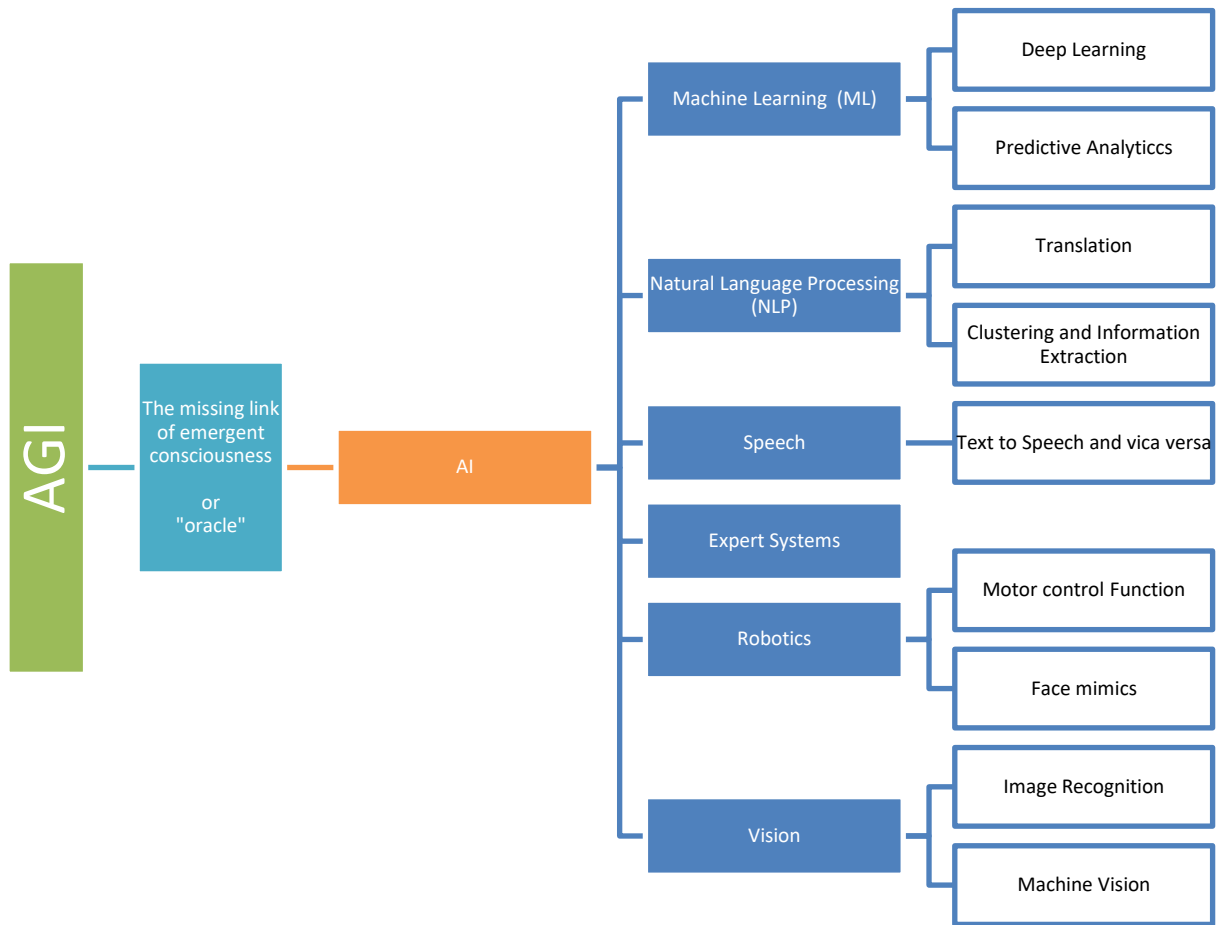
Figure 1. Artificial Intelligence scheme as understood in this diploma thesis.

Accordingly, AI uses many different techniques, addressing many different tasks. This may come as a problem since there are various AI systems, but they are not transferable and interchangeable. For example, there are AI's practical applications found in the self-driving car, within the game of chess or GO, in hospitals or at home, but they are very much limited by their specialized modelling and can't be easily move to a different task, that they were originally made for. This is the fundamental idea, that derived me to write this thesis and proof that multi-agent, decentralization and community-driven AI based on cryptography, e.g. anonymous token economy, will be the next step to establish AGI.

The expert systems and intelligent systems are based on deep learning, fuzzy sets, statistics, logic, machine-learning, data clusters and data analytics and are already in use

use by banks and financiers to predict movements on the stock market [71], for the modelling of the outbreak of epidemy[72] or they help governments to guide policy decisions in health and transport.[73] AI is recently applied also in the fields that were it was previously unimaginable like exhibitions of computer art [74], music composition [75] and writing.[76] AI is also applied in military drones, robots and weapons in general. [77]

Expect the Artificial General Intelligence, in the scientific literature focused on AI is also widely used another categorization originally made by Searle (1980), the author of the famous *Chinese room problem*[78] and I would like to use it here as it is sufficient for the understanding and the scope of this thesis: [79]

- **Strong AI**
- **Weak AI**

Strong AI should be defined as the frontrunner of genuine simulation of human reasoning, which should be used not only to build systems that think as a human, but also to explain how humans think in general. We have yet to see a real model of strong AI, since there hasn't been developed AI strong enough to fully match human-like cognition. Undoubtedly, if this will ever happen publicly, it will be world-changing event. In my

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[71] DUNIS, Christian L., et al. (ed.). *Artificial Intelligence in Financial Markets: Cutting Edge Applications for Risk Management, Portfolio Optimization and Economics*. Springer, 2016.

[72] LUXTON, David D. *Artificial intelligence in behavioral and mental health care*. Boston: Elsevier/Academic Press, 2016.

[73] FUCHS, S., SHEHADEH, R. The department of transportation of the future [online]. *mckinsey.com.* 2017 [cit. 2018-03-21]. accessesible at: https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/the-department-of-transportation-of-the-future

[74] BOEHRE, K. Google's algorithms created all the art for an exhibit in San Francisco [online]. *The Verge*. 2016 [cit. 2018-03-21]. accessesible at: https://www.theverge.com/google/2016/3/1/11140374/google-neural-networks-deepdream-art-exhibition-san-francisco

[75] DREDGE, Stuart. AI and music: will we be slaves to the algorithm? [online]. *Guardian*. August 2017 [cit. 2018-03-22]. accessesible at: https://www.theguardian.com/technology/2017/aug/06/artificial-intelligence-and-will-we-be-slaves-to-the-algorithm

[76] *The Economist* [online]. 2017. How soon will computers replace The Economist's writers? *The Economist.* [cit. 2018-03-22]. accessesible at: https://www.economist.com/news/science-and-technology/21732805-weve-got-few-years-left-least-how-soon-will-computers-replace-economists

[77] CUMMINGS, Missy. *Artificial intelligence and the future of warfare* [online]. Chatham House for the Royal Institute of International Affairs, 2017. accessesible at: https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2017-01-26-artificial-intelligence-future-warfare-cummings-final.pdf

[78] The famous *Chinese room* argument holds that a even intrigue software program cannot give a computer a understanding and consciousness, regardless of how intelligently or human-like the program may make the computer behave. The argument was first presented by philosopher John Searle in his paper Minds, Brains, and Programs. ref.44

[79] SEARLE, J."Minds, Brains, and Programs." *Behavioral and Brain Sciences* 3, 1980. pp. 417-424.

opinion, probably the closest model to Strong AI that has been recently achieved was made by Hanson robotics in a collaboration with Ben Goertzel - *OpenCog*.

OpenCog is most likely the software architecture that is the closest to our definition of strong AI or consequently AGI. *OpenCog* is a project that aims to be an open source artificial intelligence framework by the set of interacting components designed to give rise to artificial general intelligence as an emergent phenomenon of the whole complex system. Sophia, an icon of today's achievement in robotics and AI and famous social humanoid robot by Hanson Robotics, is running on OpenCog software design. [80]
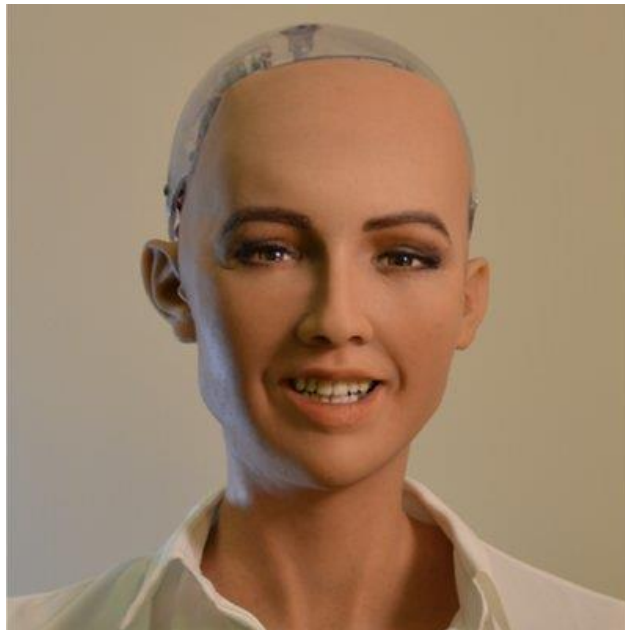
Figure 2. Sophia, the robot became the first robot to receive citizenship of any country. Source: https://twitter.com/realsophiarobot

Weak AI is simply thinking-like programs which can be added to existing computers to become more useful tools. Weak AI in general is rather the data analytics with unique algorithms using neural networks and expert systems. They are mainly rule-based, and the informational structure is represented by the set of IF-THEN rules. When IF is satisfied, THEN acts.[81] Weak AI should be able to pass the Turing test [82], but they are not consciousness and self-referential in the sense of the word unlike the strong AI. Most of the software used for analytics in private and governmental sector can be

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[80] HART, D., GOERTZEL, B. Opencog: A software framework for integrative artificial general intelligence. In *AGI.* 2008, February. pp. 468-472

[81] BODEN, Margaret A. *AI, Its Nature and Future*. Oxford: Oxford University Press, 2016. [8], pp. 29-33

[82] *The Turing test* was developed by Alan Turing in 1950 to test machine's capability to exhibit intelligent behavior indistinguishable from a human.

considered as weak AI, even though there is no deeper research that would support this claim and categorization.

As I have explained in the previous segment. Evolutionary development is seemingly an inexorable trend towards higher, more complex systems. Artificial intelligence (AI), in very basic terms, seeks to make computers do the sorts of things that minds can do in more a complex way. As I also noted before, complex systems, should involve the main characteristics as an openness to the environment, variety of elements and their interrelations, nonlinear dynamics, adaptive behaviour - adapting to learning and self-organization, which should subsequently lead to the emergence of a new layer. For the purpose of making example of what might be the main disruptive forces of AI in society and global management, we should examine the last two mentioned terms - adaptive behaviour and adaptive learning. I believe that the final metamorphosis of artificial intelligence should include these two basic processes to achieve a human-like intelligent:

- Learning [83]
- Reasoning [84]

Reasoning and learning are a difficult task, since they both must derive from highly efficient representations of the environment. To achieve this, they must approximate huge piles of data or with collaboration of using high-dimensional sensory inputs.[85]

Collecting of these data sets a machine learning derived from these set is something very accessible in the stage of the developed software, however to generalize experience to new situations is something remarkably hard to achieve. Humans and other animals seem to solve this problem through a harmonious combination of reinforcement learning and hierarchical sensory processing systems.[86] My actual views on AGI are exactly based on the ability of processing real data with high-dimensional sensory inputs.

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[83] Which should lead into the acquisition of information and rules for using the information.
[84] More precisely using the rules to reach approximate or definite conclusions, and self-correction.
[85] WENG, J. *Learning in Computer Vision and Beyond.* Department of Computer sciences, Michigan State University. Accessible at:
http://www.cse.msu.edu/~weng/research/VCIPchapter.pdfhttp://www.cse.msu.edu/~weng/research/VCIP chapter.pdf
[86] SERRE, Thomas; WOLF, Lior; POGGIO, Tomaso. Object recognition with features inspired by visual cortex. In: *Computer Vision and Pattern Recognition, 2005. CVPR 2005. IEEE Computer Society Conference on.* Ieee, 2005. p. 994-1000.

These inputs are providing complex randomness, which reflects on our ability to act spontaneously. Algorithmic reasoning on the other hand is limited by how fast they can move information from where it is now to where it has to go next and by how fast that information can be processed once it gets where it is needed. The ultimate limitation is speed of light or fractionally the speed of of electron motion. Human brain rarely operates in the absolute sensory deprivation and we are constantly open to the environment, therefore our thinking is subtly influenced by huge amount of redundant data, which is non-correlated with the task we may try to resolve. The developers of AI must closely follow neurological studies to undertake the linear and non-linear processes within the brain, moreover to understand how to algorithmically approach architecture and system design to simulate smart generalization.

The evidence provided by a wealth of neural data and brain scans revealing notable parallels between the phasic signals emitted by dopaminergic neurons and temporal difference reinforcement learning algorithms. [87] Although reinforcement learning agents have achieved successes in a variety of domains and holds a promise of achieving Artificial General Intelligence, there is still a problem of its application and use in the more complicated and complex architecture of software engineering.[88] Learning system can be proceed in two ways as:

- Unsupervised learning
- Supervised learning

To formulate the difference between unsupervised learning and supervised learning I would like to use the definition formulated by Zhao and Liu in article Spectral feature selection for supervised and unsupervised learning. In *Proceedings of the 24th international conference on Machine learning*: *"The chasm between supervised and unsupervised feature selection seems difficult to close as one works with class labels and the other does not. However, if we change the perspective and put less focus on class information, both supervised and unsupervised feature selection can be viewed as an effort to select features that are consistent with the target concept. In supervised learning the*

[87] SCHULTZ, Wolfram; DAYAN, Peter; MONTAGUE, P. Read. A neural substrate of prediction and reward. *Science*, 1997, 275.5306: 1593-1599.

[88] PAN, A. Deep Reinforcement Learning Doesn't Work Yet [online]. *alexirpan.com*. Feb 14, 2018. [cit. 2018-03-21]. Accessisable at: https://www.alexirpan.com/2018/02/14/rl-hard.html

target concept is related to class affiliation, while in unsupervised learning the target concept is usually related to the innate structures of the data. Essentially, in both cases, the target concept is related to dividing instances into well separable subsets according to different definitions of the separability.[89]

In more comprehensive way, the supervised learning is where you have input variables and an output variable, and you use an algorithm to learn the mapping function from the input to the output. Unsupervised is where you only have input variables, but no corresponding output variables, hence algorithm is encouraged to find the output data by itself. [90]

2.1 BASIC MODELS OF ARTIFICIAL INTELLIGENCE

In the previous segment we have seen that AI can be divided into the weak and strong AI. However, the hypothetical desired outcome of the AI research is creating a sustainable and self-aware general artificial intelligence, that is comparable very much similar to human or even exhibit more superior characteristics. This dream of AI has been proved extremely difficult and there are now many competing sets of practices that have achieved partial successes in a various field. Undoubtedly, AI research and development can be categorized much more widely than it is done in this thesis. For the further of this topic I would like to recommend book from Margaret A. Boden *Artificial intelligence and natural man*[91] or *Artificial intelligence: a modern approach* from Russel and Norwig.[92] For the limitations of this thesis I will generalize them into these basic categories:

- Neural Networks
- Deep Learning
- Expert Systems
- Cloud Models

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[89] ZHAO, Z., LIU, H. Spectral feature selection for supervised and unsupervised learning. In *Proceedings of the 24th international conference on Machine learning* (pp. 1151-1157). ACM. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.75.9437&rep=rep1&type=pdf

[90] https://machinelearningmastery.com/supervised-and-unsupervised-machine-learning-algorithms/

[91] BODEN, Margaret A. *Artificial intelligence and natural man*. 2nd ed., expanded. New York: Basic Books, c1987.

[92] RUSSELL, Stuart J a Peter NORVIG. *Artificial intelligence: a modern approach*. 3rd ed. Harlow: Pearson Education, c2014. ISBN 978-1-29202-420-2.

I decided to use this categorization as these principles in developing AI are the most prevalent. I excluded machine learning, because machine-learning programs, in a sense, are programs that can adjust themselves in response to the data they're exposed to, hence all these pointed methods of programming could be define as a machine learning software.

2.1.1 NEURAL NETWORKS

Artificial neural network (ANN) is one of the most popular computational models used in AI. Its pattern is conducted from the behaviour of the corresponding biological structures – neurones and its architectural models are brain-inspired systems which are intended to replicate the way that we humans learn. [93] Similarly, like the human nervous system is used to capture and treat parallel stimuli to provide adequate responses, an artificial neural network is a structure designed for distributed parallel data processing of provided information. Neural networks usually have an arbitrary number of inputs, but only one desired output. Their application spread from recognition and compressing of images and sounds, anticipation of the development of stock indexes, spam filtering, subsequent decision-making.[94] Luke Dorhmel, the author of the book *Thinking Machines: The Quest for Artificial Intelligence and Where It's Taking Us Next* regards in the article of magazine *Digital Trends* ANN as: "…*excellent tools for finding patterns which are far too complex or numerous for a human programmer to extract and teach the machine to recognize.*" [95] ANN is using the structure based on "Hidden Layer Neuron" or "Hidden Node Layer", which is a so-called neuron whose output is connected to the inputs of other neurons and is therefore not visible as a network output, hence it is referred as the term hidden layer.[96]

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[93] SCHMIDHUBER, Jürgen. Deep learning in neural networks: An overview. *Neural networks*, 2015, 61: 85-117. pp. 1-35

[94] SCHMIDHUBER, Jürgen. Deep learning in neural networks: An overview. *Neural networks*, 2015, 61: 85-117. pp. 1-35

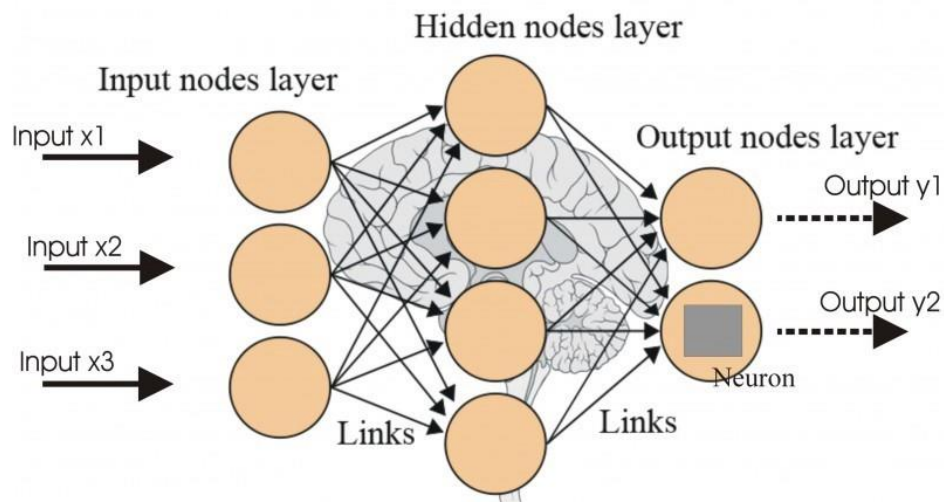[95] DOHRMEL, L. What is an artificial neural network? Here's everything you need to know [online]. *digitaltrends.com.* 13 September, 2018. Accessible at: https://www.digitaltrends.com/cool-tech/what-is-an-artificial-neural-network/

[96] http://standoutpublishing.com/g/hidden-layer.html

Another possible area of use for neural networks is the management of complex equipment in dynamically changing conditions. For example, they are used as a control system in a car autopilots that moves in a computer simulation and they are responsible to manipulate with steering wheel according to the curve of the motorway, which is a technology behind the outburst of self-driving cars.[97] Another very common example of using neural networks is signal analysis such as EKG, EEG.[98] The most recent ANN-related hype concerns subdivision of ANN - Deep learning.

2.1.2 DEEP LEARNING

Deep Learning has become one of the primary research areas of the subsequent usage of artificial neural networks. Deep learning's big technical development arrived in the mid-2000s, when leading researcher Geoffrey Hinton discovered a way how to efficiently train amounts of rich data on new layers in neural networks.[99] The majority of recent outbreak in applications of AI like translation, speech and sound recognition is made on the top of

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[97] SHEPANSKI, J. F.; MACY, S. A. Teaching artificial neural systems to drive: Manual training techniques for autonomous systems. In: *Neural Information Processing Systems*. 1988. p.120-180

[98] SORDO, Margarita. Introduction to neural networks in healthcare. *Open Clinical Document*, 2002. pp.30-60

[99] KAI-FU, L. *AI Superpowers: China." Silicon Valley, and the New World Order.* Houghton Mifflin Harcourt (2018).

the Deep learning architecture.[100] How this architecture works? Primarily you need lots of data and input information for processing, so to say that more complex problem and abstraction you want to solve, the more parameters need to be tuned and more parameters require more data. The system uses parameters, e.g. hyperparameters to value information by previously defined learning process. Even a little change in parameters can produce a large change in the performance of the modelling. Multi-core high performing GPUs are needed and their power consumption.[101]

		Machine Learning	Deep learning
Architecture		Automated algorithms and using the vast data sets to learn to predict future decisions and model functions	Computing based on interpretation and relationship between the input data. Deep Learning pass the relevant information through several stages of data processing
Management		The algorithms are managed by the analyst to examine different variables in the datasets	Algorithms are self-directed for relevant data analysis.
Data points		By standard it is about thousands of data points per operation	By average standard, it is about a few million data points used for the analysis
Output		The output Is usually simple classification, number, word or score	The output can be almost anything - picture, sound, text or score

Figure. 4 Difference between Machine Learning and Deep Learning. Made by author. Source of information: https://www.datacamp.com/community/tutorials/machine-deep-learning

Scientist within the Deep Learning field are using petabytes of data for the algorithm to acquire the ability of the software to provide relevant data. For example, speech recognition needs input of many dialects, sounds, various pronunciations of the same world, therefore the development of Deep Learning is tied to the big data management this requires data processing capabilities only found with big corporations and university campuses. Deep Learning architecture is modelled to maximize its performance on a huge corpus training data set, but it still cannot generalize or get adjusted to completely new situations for the system. [102]

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[100] LECUN, Y., BENGIO, Y., HINTON, G. Deep learning. *nature*, 2015. p. 436
[101] LECUN, Yann; BENGIO, Yoshua; HINTON, Geoffrey. Deep learning. *nature*, 2015, 521.7553: p. 5-45
[102] SCHMIDHUBER, Jürgen. Deep learning in neural networks: An overview. *Neural networks*, 2015, pp. 61: 85-117.

For this reason, Deep Learning as well as neural networks is threatened by the need of the capacity and it cannot benefit the right people at the right time, without being obstructed by the costs of computational processes and impossibility to access these tools for the immense costs. One way to do this is through a tech-enabled learning platform or interacting decentralized ecosystem as it will be demonstrated in the case study in chapter 5. During my research, I found professor Shoucheng Zhang 张首晟 [Shǒuchéng Zhāng], professor of physics at Stanford University, who believes that Deep Learning and AI patternization is something that will advance human civilization by miles, since humans are gradually lacking the capability of patterning high-complexity data structures to meaningful models. In his research on Stanford, Shoucheng was trying to recreate Mendeleev's periodic table using AI software based on Deep Learning - Atom2Vec. "*We wanted to know whether an AI can be smart enough to discover the periodic table on its own, and our team showed that it can,*" said Shoucheng Zhang. [103] Shoucheng Zhang is recently researching the possibility of updating Atom2vec to the next version, which should help with natural language processing and medical research designed to make the right immune response to attack antigens, that are specific to cancer cells. [104]

2.1.3 EXPERT SYSTEMS

Expert systems are used since the very beginning of the research in AI and they are also called knowledge-driven systems or recommender systems. They are rather simpler computer programs in compare with ANN and they are designed to provide expert advice, decisions or recommend solutions in a specific situation. They are using fuzzy sets, fuzzy logic and approximation, e.g. non-numeric and vague information to solve tasks that are hardly solvable by traditional algorithmic procedures. [105]

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[103] THAN, K. Stanford AI recreates chemistry's periodic table of elements [online]. *Standford News*. June 25, 2018. [cit. 2018-11-16]. https://news.stanford.edu/2018/06/25/ai-recreates-chemistrys-periodic-table-elements/
[104] THAN, K. Stanford AI recreates chemistry's periodic table of elements [online]. *Standford News*. June 25, 2018. [cit. 2018-11-16]. acessible at: https://news.stanford.edu/2018/06/25/ai-recreates-chemistrys-periodic-table-elements/
[105] POWER, Daniel J.; SHARDA, Ramesh; BURSTEIN, Frada. Decision support systems. John Wiley & Sons, Ltd, 2015. acessible at:
http://fumblog.um.ac.ir/gallery/412/Decision%20Support_%20An%20Examination%20of%20the%20DSS%20Discipline%20.pdf#page=44

2.1.4 CLOUD COMPUTING

Cloud computing is a recent approach derived from the cognitive science studies and information processing during human cognition and thinking. They research complex networks with the emphasis on the system structure and the analysis of system function based on that structure using probability theoretic, fuzzy set and rough set, which start from the uncertainty of an event. They are basically cognitive model for qualitative–quantitative transformation and cloud-based models on different ways of distributions Gaussian distribution, power law distribution, the symmetric cloud model, the half-cloud model, the combined cloud model, and so on. The pioneers of this field of study are Li and Du (2017) and their research is summarized in the book *Artificial Intelligence with Uncertainty,* which I can highly recommend.[106]

2.2 IS AI INTELLIGENT?

In this subchapter I would like to summarize what have been stated and answered about AI. Technology have not reached the features, that would possess transferable consciousness, that is to say, it can only focus on a one task but cannot multi-task in completely unrelated realm of the original configuration. Also, AI is lacking self-reflection and self-awareness and even though it can be programmed to do a various sort of creative activities like making music and process images, it can hardly re-evaluate its activity like humans do. Therefore, as previously mentioned, I suggest that none of these systems are truly intelligent per say. Cloud computing in theory has some strong points about AI generating independent thoughts as well as unsupervised learning can draw out unspecified outputs, but nothing has been yet empirically proven as actually independent action not derived from human pre-programming.

As Douglas Hofstadter persistently argues in interviews like the one conducted for the magazine *Quartz*, that programs like *Watson*, IBM's *Jeopardy*-playing supercomputer, or Siri, Apple's iPhone assistant, have in fact very little to do with intelligence. He further argues that Turing test is not enough to proof self-aware intelligence, because the answers could be just data-driven by interconnected layers of

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[106] LI, D., DU, Y. Artificial Intelligence with Uncertainty, Second Edition. 2017. Boca Raton: CRC Press.

algorithms. These feed data are rather trained to carry out specific tasks by relate and compare through huge data clusters without self-reflection and unprogrammed self-preference.[107] During my research I have found out, that even authorities in the field like professor Shoucheng Zhang don't consider Turing test as the ultimate test for AI. Shousheng Zhang stated in the news article from news.standford.com following: "*Humans are the product of evolution and our minds are cluttered with all sorts of irrationalities. For an AI to pass the Turing test, it would need to reproduce all of our human irrationalities,*" Zhang said. "*That's very difficult to do, and not a particularly good use of programmers' time.*"[108] Output from the neural network have fuelled media hype and attention, but there is still a missing link to call machines intelligent and up to the year 2018, AI is nothing more than a computer program smart enough to accomplish tasks that typically require human quality analysis. It has no genuine creativity, self-awareness, self-reflection, emotions or desires other than what we program into them and they are ultimately controlled by humans.

Most of the research referring to the revenues and mapping of Artificial Intelligence openly claims that they take a practical approach to the definition of AI and present an analysis based on self-identified businesses that claim to be using or building AI.[109]

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[107] SONNAD, N., GERSHGORN. Q&A: Douglas Hofstadter on why AI is far from intelligent [online]. *Quartz*. October 10, 2017 [cit. 2018-11-07]. accessible at: https://qz.com/1088714/qa-douglas-hofstadter-on-why-ai-is-far-from-intelligent/
[108] THAN, K. Stanford AI recreates chemistry's periodic table of elements [online]. *Standford News*. June 25, 2018. [cit. 2018-11-16]. acessible at: https://news.stanford.edu/2018/06/25/ai-recreates-chemistrys-periodic-table-elements/

3 GLOBAL MANAGEMENT

In this chapter, I will thoroughly examine the definition of global management and what is the difference between top-down organization, bottom-up managing and mutually shared network. One of the main objectives of my thesis is to research and analyse the disruption tendencies within the global management. In the previous chapter, I tried to underpin the possibility of systemic disruption, that is to say, I will use a system theory references from the first segment of this thesis to underlie the transformation and disruption, that I believe, will occur within my lifetime for the reason of developing self-consciousness AGI. I would like to argue here, that there will come a day, when blockchain technology will be used as a trust system within the organization to effectively run organizations, global economy and even governmental administration. I would like to show how a historical shift from top-down companies and management into more decentralized networks has become the necessity for managing a reliable data in a secure way. Also, I would like to clear up what is my understanding of global management and what are the dangerous that may come in, if we are not disrupted and self-organize by anonymous distributed databases and P2P systems.

3.1 FROM HIERARCHY TO NETWORK

The application of partial characteristics of chaos theory on organization, management and *society* [110] in general has become widespread.[111] It is being researched in the context of the free choice of an individual/agent in creating the social links that influence ultimately the whole form of society.[112] In a smaller scale it could be applied on any fragment of society, e.g. proposing a change within organization, company, state and others. I would like to argue that chaotic models with a certain historical subtext are the

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110 When I speak of society I usually refer to a non-specified group of individuals, eg. companies, state and communities.

111 Even though it is used in several fields, there are notable problems with the interdisciplinarity, transdiplanarity, postliciplinarity, multidisciplinarity, etc. in the application on chaotic models. For further information I would like to recommend book by Lukáš H. Zámečník (2012, p. 10-12) *Filozofické aspekty teorie chaosu*.

112 WASSERMAN, Stanley; FAUST, Katherine. Social network analysis: Methods and applications. Cambridge university press, 1994. Also see LIBEN-NOWELL, David; KLEINBERG, Jon. The link-prediction problem for social networks. journal of the Association for Information Science and Technology, 2007, 58.7: 1019-1031.

closest possibility as we can methodologically approach the seemingly unpredictable movements of society. Society as well as a complex system is modelled by *individuals* and *agents* who are interacting with each other continuously and react to events related to the external environment in which they exist.

The number of agents in the system is not important and is not firmly fixed, as agents can multiply as well as "die" and can be mostly replaced in time, if not immediately. Typically, agents are implicitly targeted and aim to maximize their own usefulness, suitability and ability.[113] These agents form three patterns of organization: hierarchies, networks or hybrid, which combines the previous two. The most valuable definition I could find was coined by the authority in the field Thomas L. Satty (2008) in his phenomenal article Relative Measurement and Its Generalization in Decision Making Why Pairwise Comparisons are Central in Mathematics for the Measurement of Intangible Factors the Analytic Hierarchy/Network Process, where he stated that:

„A hierarchy is comprised of a goal, levels of elements and connections between the elements. These connections are oriented only to elements in lower levels. A network has clusters of elements, with the elements in one cluster being connected to elements in another cluster (outer dependence) or the same cluster (inner dependence). A hierarchy is a special case of a network with connections going only in one direction. [114]

As we can see hierarchies and networks are very different forms of organizing, even though hierarchy is rather categorically a part of a network than other way around, in a hierarchical organization, agents are formed in a vertical manner and are centralized with top-down command and usually with control functions. As an example, hierarchies are easy to spot, they include a wide range of structures like clans, companies, states and any group of agents.

As it is well-documented by Yaneer Bar-Yam (1997) in his research paper Complexity Rising: From Human Beings to Human Civilization: A Complexity Profile, a hierarchy imposes many limitations on the degree of complexity of collective behaviours of the system, which can be understood by considering more carefully the processes of coordination. We know that the hierarchy is responsible for ensuring

113 HEYLIGHEN, Francis. Complexity and Self-organization. *Encyclopedia of library and information sciences*, 2008, 3: 1215-1224.
114 SAATY, Thomas L. Relative Measurement and its Generalization in Decision Making: Why Pairwise Comparisons are Central in Mathematics for the Measurement of Intangible Factors-The Analytic Hierarchy/Network Process. *RACSAM* (Review of the Royal Spanish Academy of Sciences, Series A, Mathematics) 102 (2): 251–318. *Int J Manag Decis Mak*, 2008.

coordination of various lower strata of the system. [115] Lower levels of the hierarchy are responsible for locally coordinating smaller parts of the system and higher levels of the hierarchy are responsible for coordinating the larger parts of the system.

This implies that the collective actions of the system in which the other parts of the system must be no more complex than the controller. So why is it important to

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[115] BAR-YAM, Yaneer. Complexity rising: From human beings to human civilization, a complexity profile [online]. 2008. [cit. 2018-03-13]. str. 34. accessed at: http://www.necsi.edu/projects/yaneer/Civilization.html

understand the limits of hierarchical structure? In human hierarchies, the collective behaviour must be simple enough to be represented by a single human being, however that is not the case. The bandwidth of communication through the controller is limited to the complexity of a single human being. Yaneer Bar-Yam (1997) similarly concluded following: [116]

"In summary, hierarchical control structures are symptomatic of collective behaviour that is no more complex than one individual. A group of individuals whose collective behaviour is controlled by a single individual cannot behave in a more complex way than the individual who is exercising the control. Comparing an individual human being with the hierarchy as an entirety, the hierarchy amplifies the scale of the behaviour of an individual but does not increase its complexity."

Is the human society in general more networked or hierarchical? What is the measurement to really answer this question? Firstly, it is difficult to detect the system's transition based on the principal mode of the pattern dynamics. My expertise is not broad enough to formulate any mathematical measurement to conclude possible constant in the historical development of our civilization. During my research I did not find any mathematical theorem or model, however I believe there could be one, at least similarly formulated to Moore's law, which stands for the observation that the number of transistors in a dense integrated circuit doubles about every two years.[117] Similarly, there could be a constant of measurement to see how complexity and network is gradually rising with the advent of civilization.[118]

Also, I would like to interlink here the concept of stratification and its impact on our observation. In the paragraph devoted to the term stratification I argued that every different stratum has its own unique characteristics and structure, which cannot be reduced back to its previous layers. There are metaphors to be drawn here. One of very old idea traced as far as to Aristotle himself and which is detailly explored by Stock (1993) in his profound book *Metaman: the merging of humans and machines into a global superorganism*, is that society, in several respects, like an organism is a living system

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[116] BAR-YAM, Yaneer. Complexity rising: From human beings to human civilization, a complexity profile [online]. 2008. [cit. 2018-03-13]. str. 34. accessed at: http://www.necsi.edu/projects/yaneer/Civilization.html

[117] Thackray, A., Brock, D., & Jones, R. (2015). Moore's Law: The Life of Gordon Moore. *Silicon Valley's Quiet Revolutionary*.

with its cells, metabolic circuits and systems. Metaphorically speaking, different organizations or institutions play the role of a various organs, each fulfilling its function in keeping the system alive. We could easily say that the army functions like an immune system protecting the organism from foreign elements, while the government functions like the brain, steering the wheel of policies and making decisions.[119] While state in its local departments are overall hierarchically structured, in a higher perspective is more collaborative and distributive, thus we can talk about hybrid structure.

To understand how societies can be modelled by systems theory it is instructive to look at some historical examples like the old kingdoms in Europe or at the remaining authoritarian regimes in some developing countries, where the organisation of society is primarily hierarchical, and the system can be almost easily modelled by the behaviour of the highest ruler. This example is practical implication of previously quoted Yaneer Bar-Yam (1997) research, so that system is not acting in ways more complex than the ruler itself. Even though agents in a lower stratum can behave independently and they can go for a beer to the near pub or bath instead of shaving, overall, the system remains simple. I would argue that almost comparatively, today's system is still highly hierarchical and is led by the decision of a few rather than many. However, the main paradigm has been slowly shifting with the invention of disruptive technologies. Taylor Owens (2015) in his book *The Crisis of the State in the Digital Age* explains in detail that the digital age provides a mechanism for change because "*Digital technology overwhelms challenges of coordination, communication, size, complexity, and velocity that previously limited hierarchical behaviour.*[120]

On a societal-scale decision-making, Western world have been facing the problem of deriving a decision that is in accord with the collective's intentions and values. Modern political institutions utilize hybrid networks manifested by representational structures for decision-making such that any individual in the society can, in potential, participate in the decision-making behaviour of the collective, even if only so indirectly through a proxy representative. Researcher Marko Antonio Rodriguez (2004) went further into the

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[119] I would like to recommend a research paper on this topic by The Global Superorganism: an evolutionary-cybernetic model of the emerging network society Heylighen for further reading on this topic. Acessed at: https://www.researchgate.net/publication/2458402_The_Global_Superorganism_an_evolutionary-cybernetic_model_of_the_emerging_network_society
[120] OWEN, Taylor. *Disruptive power: The crisis of the state in the digital age*. Oxford Studies in Digital Politics, 2015. p. 30.

mathematical simulation of traditional representation structures and I would like to directly quote him here:

"…as the size of the total population increases linearly relative to the number of decision-making representatives, there is an exponential increase in the likelihood that decision outcomes will not accurately reflect the preferences of the collective." [121]

My argument is partly built on his (and others) findings about the obsolescence of traditional structures and that future will be formed by open networks based on thrustless blockchain and network of nodes. [122][123] I personally lean towards accurate description of trend within society by directly quoting from an abstract of the academic study named Global Superorganism: an evolutionary-cybernetic model of the emerging network society published in *Social Evolution & History* by Francis Heylighen (2007):

„An analysis of the evolution of complex, networked systems point to the general trends of increasing efficiency, differentiation and integration. In society these trends are realized as increasing productivity, decreasing friction, increasing division of labour and outsourcing, and increasing cooperativity, transnational mergers and global institutions. This is accompanied by increasing functional autonomy of individuals and organizations and the decline of hierarchies. The increasing complexity of interactions and instability of certain processes caused by reduced friction necessitate a strengthening of society's capacity for information processing and control, i.e. its nervous system." [124]

In my opinion, Francis Heylighen accurately predicted where the obvious trend lays, e.g. in blockchain and P2P networks. In his article he later concluded following:

"…this is realized by the creation of an intelligent global computer network, capable of sensing, interpreting, learning, thinking, deciding and initiating actions: the global brain. Individuals are being integrated ever more tightly into this collective intelligence. Although this image may raise worries about a totalitarian system that restricts individual initiative, the superorganism model points in the opposite direction, towards increasing freedom and diversity. The model further suggests some specific

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[121] RODRIGUEZ, Marko Antonio; STEINBOCK, Daniel Joshua. Societal-scale decision making using social networks. In: *North American Association for Computational Social and Organizational Science Conference Proceedings*. 2004. p. 4-5

[122] STEINBOCK, D.; RODRIGUEZ, M. Self-Modeling Complex Systems: A Social Networks Application. In: *International Conference on Complex Systems*. 2004.

[123] FISCHER, Gerhard. A Group Has No Head-Conceptual Frameworks and Systems for Supporting Social Interaction. 1999.

[124] FRANCIS, Heylighen. The Global Superorganism: an evolutionary-cybernetic model of the emerging network society. *Social Evolution & History*, 2007, 6.1.

futurological predictions for the coming decades, such as the emergence of an automated distribution network, a computer immune system, and a global consensus about values and standards. "[125]

Heylighen's visions are, in my mind, accurate in their description. As I will try to show in the chapter. 4, the centralized models of AI are destined to fail. They can work to some extent, but the future lies in the global management based on collective intelligence and network. I will try to further argue, how the promise of Heylighen model could gradually crystalize and slowly emerge into the reality. I believe that the future development of policy-making, decision-making, community-driven, privacy-secured systems should be supported by the computer network infrastructure of nodes and cryptography within the ecosystem. But let's explain decentralized networks even further to show, what could be the disruptive tendencies behind the infrastructure for AI will in companies and societies.

3.2   DECENTRALIZED NETWORKS

As it has been shown earlier networks are self-organizing structures.[126] Whereas the traditional model relies on control and hierarchy, a networked, self-organized and decentralized model is based on adaptability and fluidity. It is prioritising the ability to change rapidly to survive and thrive. We could paraphrase it into the system theory as a highly collaborative open complex system. However, the dynamics, especially the non-linear ones, in these networks are still poorly understood. Networks are random and spontaneous and as such they are hard to monitor. The main difference is surely that network is not planned or directed by a single authority, hence they have a great capacity to innovate and spread.

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[125] FRANCIS, Heylighen. The Global Superorganism: an evolutionary-cybernetic model of the emerging network society. *Social Evolution & History*, 2007, 6.1.

[126] I use the term *network* as it is derived from the terminology used in chaos theory and cybernetics, however there is also a competing term *grid* applied by Ian Foster, professor in the department of computer science at the University of Chicago, who had a huge impact on an evolution of grid architecture within the computer science. Grid computing has emerged as an important new field, distinguished from conventional distributed computing by its focus on large-scale resource sharing, innovative applications, and, in some cases, high performance orientation. All of his thoughts can be found in his book *The Grid: Blueprint for a New Computing Infrastructure* written in 1998. As far as my own use of this term goes, I apply term *network* as a structure composed by individual agents and grid rather as the architectonical framework in computer sciences.

Mainly through the internet, the connection between independent individual is very easy to get. There is a fundamental growth of either specialized networks like scientific databases or community-driven networks like 4chan.org or reddit.com, which continue to empower different groups to self-organize themselves and let the users express spontaneous reactions with the surprising real impact on the whole society by means of producing memes, trolling, cyber-hacking and by spreading fabricated news.[127]

In addition, I would like to highlight here well-articulated observation by blogger Oday Kamal in his post named When Hierarchies and Networks Collide: The Emerging Frontier for Organizations on *medium.com*:[128]

„Established hierarchies around the world, democratic and undemocratic alike, are taking notice of the profound challenges posed by this fundamentally different way of organizing. The telephone and its network allowed ordinary citizens to communicate with one another. The internet drastically improved the availability of information and the advent of laptops and smartphones spurred the growth of social media channels. New networks will surely emerge and increase the probability of successful disruption."

Oday Kamal continues:

„…these networks pose challenges to established hierarchies in three different ways. First, they drastically increase the volume of information and speed with which others have access to it. Second, they empower the individual to publicize things more

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[127] For example the anonymous board 4chan.org was originally designed by the programmer with moniker Moot for discussing the latest anime, but its influence grew to such an extent, that there are many different subcultures, which even spured the Anonomyous movement of hackers and DDOS attacks on the major corporations.

[128] ODAY, K. When Hierarchies and Networks Collide [online]. *Medium.com*. Aug 26, 2018. [cit. 03-04-2018]. Acessed at://medium.com/the-ready/when-hierarchies-and-networks-collide-2b80358de3cb

broadly, beyond their social circle. Just think about how we would remember Beijing's Tiananmen Square protests of 1989 if everyone participating had the equivalent of Snapchat and Twitter. Third, they expose the inefficiencies of hierarchical forms of organizing and their inability to fulfil pledges because of outdated policies, unnecessary processes and bureaucratic procedures."

I side with Kamal's reasoning here. For further reading on this topic, I would recommend are at least to some extent reflecting the point I would like to make here. For the scope of this work I will not analyse here the concepts proposed by Marshall McLuhan in *Understanding media: the extensions of man*, but I would like to encourage reader of my thesis to understand how media and technology always affects society in unpredictive manner.[129] Interestic concepts to networked society are made in R. Dyal Chand's book *Collaborative Capitalism in American Cities: Reforming Urban Market Regulations* [130] and on the other hand - against this claim - I would recommend reading Tom Slee's *What's yours is mine: Against the Sharing Economy*.[131]

3.3 MANAGEMENT, GLOBALIZATON AND BIG DATA

When I use the term *global management* it is meant as to describe the growing potentiality for the international management to relay on the emerging disruptive technologies and become less dependent on the prevalent hierarchical model. Artificial management in global management in my understanding is the ability to execute global decisions and globally manage community of individuals, therefore I would like to argue that Ulrike Schuerkens (2015) in his book *Global management, local resistances: theoretical discussion and empirical case studies*[132] has been misusing two terms, which I find strictly different – global management and globalization of management.

I assume that when we talk about *globalization of management*, we refer to the term used similarly by Helen Deresky (2006) in her book *International management:*

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[129] MCLUHAN, Marshall. *Understanding media: the extensions of man*. 8. print. New York: New American Library, 1964. Signet Books.
[130] DYAL-CHAND, Rashmi. Collaborative Capitalism in American Cities: Reforming Urban Market Regulations. Cambridge University Press, 2018.
[131] SLEE, Tom. What's yours is mine: Against the Sharing Economy. Scribe Publications, 2017.
[132] SCHUERKENS, Ulrike. Global management, local resistances: theoretical discussion and empirical case studies. New York, NY: Routledge, Taylor & Francis Group, 2015

managing across borders and cultures.[133] Where she addresses management functions and behaviours necessary to develop global vision and management skills. She expressed the need for a truly global perspective in dealing with dynamic management issues in both foreign and diverse host environments. She argues that a global entanglement and digital revolution has been gradually changing the global manager's environment, the cultural context of global management and there is a need to reformulate and implement new strategy for international and global operations, and global human resources management.[134] This is how I understand the term *globalization of management,* while using the term *global management*, I personally refer to the companies or states which can use a large variety of sources including browsing history, geolocation, social media, purchase history and medical records to track the citizens of the world to purposely or unpurposely manage them for the desired outcome.

We can think of Facebook as an example of a company behaving purposely as well as unpurposely while having in mind stated definition of a global management. In a decade, Facebook as well as his Chinese competitor Tencent has transformed people's relationships, businesses and the way we absorb the information and news.

Siva Vaidhyanathan (2018) explored in detail how Facebook has helped overthrow regimes, disrupt elections and is widely used for propaganda on a geopolitical playground.[135] Facebook itself use the data of its clients to target directly the right customer for a specific product, based on a client's likes, follows, interests and digital tracking. While this might be a neutral, unpurpose, algorithmic behavior, recent media outbreak with Cambridge Analytica shows that the same data can be used to widely manipulate Facebook clients to change outcome of major elections.[136] Even though whistle-blowers like Edward Snowden have been warning about the misuse of personal data for almost a decade, there is still not an effective regulatory system put in control. As David Lyons (2015) asserts in *Framing Futures,* the surveillance connects directly with everyday practices of ordinary internet and cell phone. Lyons (2015) built his argument on older and even more detailed book *Electronic Eye: The Rise of Surveillance*

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[133] DERESKY, Helen. International management: managing across borders and cultures. 5th ed. Upper Saddle River, N.J.: Pearson Prentice Hall, c2006.
[135] VAIDHYANATHAN, S. *Antisocial Media: How Facebook Disconnects Us and Undermines Democracy*. Oxford University Press, 2018.
[136] GRASSEGGER, Hannes; KROGERUS, Mikael. The data that turned the world upside down. *Vice Magazine, January*, 2017, 30.

Society (1994) with the statement that *they* [137] know things about us, but we often don't know what *they* know, why *they* know, or with whom else *they* might share their knowledge.[138]

Since the massive adoption of the internet in the world, each week brings some new incendiary rhetoric in almost any major election cycle or some new global political disruption emerging from the overlapping religious, political, social, economic, technological, and environmental systems that govern our lives. Each disruption seems to make us surprised and even shocks us. No matter how much we, the consumers of the digital media, believe that we are the higher instance of the actual truth, we are rather living in a world run by algorithms and smart technology. These smart social analytics drive us to a highly emotional content and basically trigger our instinctual behaviours meant to accentuate and stoke our fears to hold our attention. It is all happening without a pragmatic oversight, which would drive people into the more consensus-based and productive discussion.

Therefore technology, especially big data is capable of much more then calculation of our mortgage, which stocks should we pick, or which movies should we watch.[139] The rapid technological change depends in large measure on honing internal and external technological, organizational, and managerial processes inside the companies and government by identifying a new opportunity in organizing effectively and efficiently to embrace them to keep competitors off balance, or at least raises rival's costs, and excludes new entrants. As we can see, we are talking about the same evolutionary behaviour for the agents to survive in a complex system when searching for the most successful niche for further expanding. Big data became a raw material of business and a vital economic input to create a new form of an economic value.[140]

In the recent development with giant tech-companies like Facebook, Amazon and Google[141], there are paradoxes and controversies associated with big data and are very much relevant to global governance. Siva Vaidhyanathan (2018) in her book *Antisocial Media: How Facebook Disconnects Us and Undermines Democracy* published by Oxford

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[137] By using the term *they,* author is pointing at the higher managment of big corporations, surveillence agencies and governmental bodies.
[138] LYON, David. *Surveillance after Snowden*. John Wiley & Sons, 2015. pp. 35-58
[139] HUNG, Patrick CK (ed.). *Big data applications and use cases*. Springer, 2016.
[140] MAYER-SCHÖNBERGER, Viktor a Kenneth CUKIER. *Big data: a revolution that will transform how we live, work, and think*. Boston: Houghton Mifflin Harcourt, c2013.
[141] In this thesis I will refer to Alphabet Inc., an American multinational conglomerate headquartered in Mountain View, California as Google.

University wrote introduction as following: "*If you wanted to build a machine that would distribute propaganda to millions of people, distract them from important issues, energize hatred and bigotry, erode social trust, undermine respectable journalism, foster doubts about science, and engage in massive surveillance all at once, you would make something a lot like Facebook.*"[142] The detailed understanding of people and their interests allows Facebook to sell extremely well targeted advertising to any business. Undoubtedly, Facebook can help businesses find potential customers based on detailed demographic and interest data or you can simply let them do their big data magic by finding other customers that are like the ones you already have. Big data involve an increasingly independent role for algorithms, technical artefacts, the Internet of things, and other objects, which can reduce the control of human actors. Secondly, big data involve new boundary transgressions as data are brought together from multiple sources while also creating new boundary conflicts as powerful actors seek to gain advantage by controlling big data and excluding competitors. These changes are not just about new data sources for global decision-makers, but instead signal more profound changes in the character of global governance.

The top-level management 顶层设计 [dǐngcéng shèjì] [143] is already implemented by the Chinese Communist Party according to the Third Plenary Session of the 18th CPC Central Committee and it is named 社会信用体系 [shèhuì xìnyòng tǐxì] - The Social Credit System (SCS). This system was marked as an important part of the socialist market economic system and social governance system. It is based on laws, regulations, standards and contracts and a network of credit members and credit infrastructure that covers society members. It is supported by credit information from various public and private services to establish solid culture of integrity. Virtue is an internal requirement of the system, and the reward and punishment mechanism should be based on trustworthiness and distrust. According to the documents by Peking University of Law named Outline of the State Council's Plan for The Construction of a Social Credit System[144] accelerating of the construction of the social credit system is an important basis for comprehensively implementing the scientific development concept and building a

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[142] VAIDHYANATHAN, S. *Antisocial Media: How Facebook Disconnects Us and Undermines Democracy*. Oxford University Press, 2018. pp. 1-3

[143] Author's own translation from the orginal tex:t 国务院关于印发社会信用体系建设规划纲要

[144] *guó wù yuàn*; guānyú yìnfā shèhuì xìnyòng tǐxì jiànshè guīhuà gāngyào [online]. *pkulaw.cn*. October, 2014 [viewed 2018-02-10]. accessible at: http://www.pkulaw.cn/fulltext_form.aspx?Gid=228619 07/20/content_5211996.htm

socialist harmonious society.[145] However, as it is reported in the document, the social SCS has some implementation problems. The main problems include: the credit system covering the whole society has not yet been formed and the mechanism of trustworthiness and disciplinary punishment is far from being perfect. Document concludes that the credit service market is underdeveloped, and the service system immature, since the individual behavior is not standardized.[146] SCS system is not only focused on individuals and their behaviour but it should eliminate incidents, such as commercial fraud, counterfeiting and selling, fraudulent taxation, false reporting, academic misconduct, etc., which is similar to any judiciary database in other countries.

I believe there might be another option in place as how society could be modelled in the future and that is P2P networks. The development of P2P networks ensures more random and self-organize behaviour than top-down control and I believe it will be more beneficial to all the participants.

4   DECENTRALIZATION AND P2P NETWORK

„*Technological artefacts are the result of careful design. The fate of technology however, lies in the hands of its users* "[147]

Peer-to-peer (P2P) computing or networking is a architecture that partitions tasks or workloads between peers. Peers are equally privileged, equipotent participants in the application. They are said to form a peer-to-peer network of *nodes*.[148] There has been a huge interest amongst start-ups and businesses and by one of the most leading tech figures - peer-to-peer technology could be the future of internet networking.[149]

P2P networking has generated interest worldwide among the both - Internet users and computer networking professionals as the latest outcome has been the using of

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[145] *guó wù yuàn*; guānyú yìnfā shèhuì xìnyòng tǐxì jiànshè guīhuà gāngyào [online]. *pkulaw.cn*. October, 2014 [viewed 2018-02-10]. accessible at: http://www.pkulaw.cn/fulltext_form.aspx?Gid=228619 07/20/content_5211996.htm

[146] *guó wù yuàn*; guānyú yìnfā shèhuì xìnyòng tǐxì jiànshè guīhuà gāngyào [online]. *pkulaw.cn*. October, 2014 [viewed 2018-02-10]. accessible at: http://www.pkulaw.cn/fulltext_form.aspx?Gid=228619 07/20/content_5211996.htm

[147] FRENKEN, Koen. *Innovation, evolution and complexity theory*. Northampton, MA: Edward Elgar Pub., c2006. ISBN 9781843761976.

[148] *Node* is potentionaly any electronic device involved in the P2P network.

[149] SCHOLLMEIER, Rüdiger. A definition of peer-to-peer networking for the classification of peer-to-peer architectures and applications. In: *Peer-to-Peer Computing, 2001. Proceedings. First International Conference on*. IEEE, 2001. p. 101-102.

cryptocurrencies and DApps.[150] P2P technologies promise to radically change the future of networking and the form of companies and any given organisation. Decentralized P2P protocols seek to remove the central authority, e.g. server that is found in the centralized networks, because the provide infrastructure for communities to share processing capacities, digital resources or a storage space to simply support interpersonal collaborative environments. It is possible to identify the two major factors that have fostered the recent explosive growth of such systems:

1. The low cost and high availability of huge computing and storage resources.
2. Increased network connectivity.

Apparently, these trends continue and attracting more venture capital every year, thus the P2P paradigm can be expected to grow and become even more popular.[151] While being one of the most of disruptive technologies, there is a huge controversy as well, especially regarding the popular file sharing. The outcome of this technology has been truly disruptive for many established industries and some would argue that the activities connected with P2P are even illegal. For example, we can think of the whole torrent culture in the early decade of 21th century like Napster, Pirate bay, BitTorrent, Isohunt and many others. Peers by sending its request to any peers can get connected to for desired file, the reacting peers can send the request to its peers, so when a peer notices it has the desired file it sends a reply through the network. At that point the searching peer can download or use the file directly from any peers.[152]

More simply put, P2P network is created when two or more computers are connected and share resources without going through a separate server computer, therefore being decentralized, without any top-down control. A P2P network can be a therefore a decentralized connection or can be a network on a much grander scale in which special protocols and applications set up direct relationships among users over the Internet, without additional regulation and control.[153] Compared to the client-server

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[150] WOOD, G. DApps: what Web 3.0 looks like . online]. *What is Web*, 2014 [cit. 2018-4-18]. accessible at: http://gavwood.com/dappsweb3.html
[151] RIPEANU, Matei. Peer-to-peer architecture case study: Gnutella network. In: *Peer-to-Peer Computing, 2001. Proceedings. First International Conference on*. IEEE, 2001. p. 10-12.
[152] GUMMADI, Krishna P., et al. Measurement, modeling, and analysis of a peer-to-peer file-sharing workload. *ACM SIGOPS Operating Systems Review*, 2003, 37.5: 314-329.
[153] ORAM, Andy. *Peer-to-Peer: Harnessing the power of disruptive technologies*. " O'Reilly Media, Inc.", 2001, p. 21-34

model, in the P2P network there are no clients or servers, but all peers play the roles of both client and server. In a client-server network, all connections within the networks travel through a central server. By having more peers participating in a client-server network, it usually would drag down the bandwidth and creates lag, whereas in a P2P network where peers provide bandwidth and allow to increase the speed.[154]

To integrate this notion to the argument of my thesis. P2P network architecture allows highly densed, faster, secured and decentralized complexity in compare to the hierarchical systems we had in 20th century. If we think of some music streaming platform like iTunes, their software architecture is solely based on the data files of music stored on their servers. If user wants to listen to the song, he will send a request and the music will be streamed. In P2P network user will send the request to the network and he can use dataflows from many other computers around the world, that already have the data to get it streamed. By bringing this example I would like to point out that peers are both suppliers and consumers of resources, in contrast to the traditional relationship between client-server model in which the consumption and supply of resources is divided.

As Kwok, Lang and Tam (2002) made the case in their article for *Electronic Markets* Peer-to-peer Technology Business and Service Models: Risks and Opportunities decentralized network search in the system by the preference and collaboration. Network is basically looking for diverse peers that can bring in unique resources and capabilities to a virtual community, therefore behaves like an open market, which empowers to engage in greater tasks beyond those that can be accomplished by individual peers, yet that are beneficial to all the peers. [155] Therefore, I believe this the trend, where society is heading, and P2P networks will be the necessity and founding stone to the AI age.

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[154] FOMENKO, Oleg, et al. *Distribution of digital content*. U.S. Patent No 8,639,630, 2014.
[155] KWOK, Sai Ho; LANG, Karl R.; TAM, Kar Yan. Peer-to-peer technology business and service models: risks and opportunities. *Electronic Markets*, 2002, 12.3: 175-183.
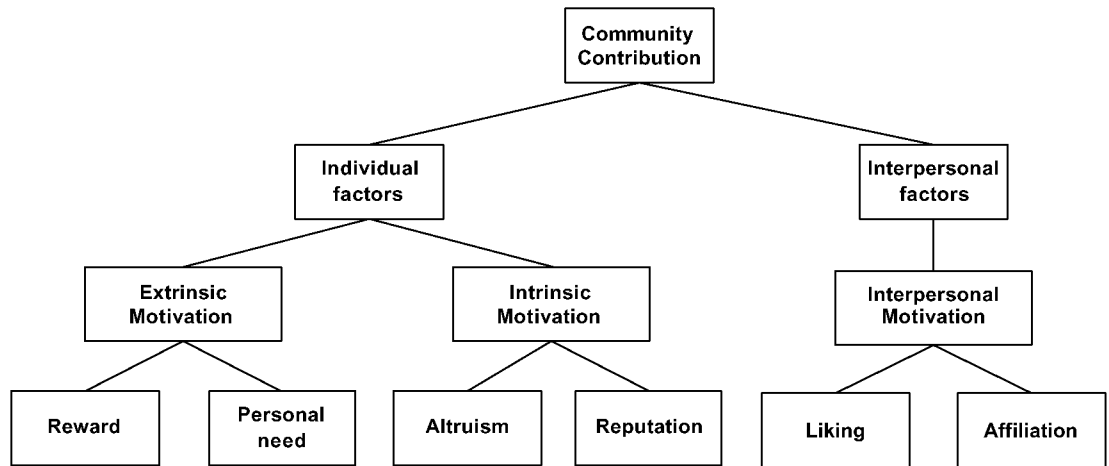
But why should we use P2P networks instead of central-server? Why would anybody even care? The unique approach of motivation based on rewards illustrated in fig.3 by Kwok, Lang and Tam (2002), shows how community motivates other members to contribute to the larger group.[156] To summarize the main features of a distributed system I would like to use the reference from the book Managing Big Data in Cloud Computing Environments from Ma Zongmin: [157]

- **Functional Separation**

- **Inherent distribution**[158]

- **Reliability**

  Nodes are functioning as a backup and data saver

- **Scalability**

  Resources can be scaled to increase performance or availability.

- **Economy**

  Shared economy and distributed value. Reduced cost of ownership.

- **Goals of Distributed Systems**

  There is a various system for all kinds of problems.

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[156] KWOK, Sai Ho; LANG, Karl R.; TAM, Kar Yan. Peer-to-peer technology business and service models: risks and opportunities. *Electronic Markets*, 2002, . 172-178

[157] SCHOLLMEIER, Rüdiger. A definition of peer-to-peer networking for the classification of peer-to-peer architectures and applications. In: *Peer-to-Peer Computing, 2001. Proceedings. First International Conference on*. IEEE, 2001. p. 101-102.

[158] Inherently distributed entities such as people, information, e.g. files and data in general. For example, different information is created and maintained by different people. This information could be generated, stored, analyzed and used by different systems or applications which may or may not be aware of the existence of the other entities in the system.

- **Transparency**

  Interactions between the agents is typically hidden, cryptographically secured or private

- **Fault Tolerance and Failure Management**

  Failure of one or more systems can not jeopardise the whole system

- **Concurrency**

  Shared access to resources

- **Openness and Extensibility**

For example, the usage of decentralized storage could attribute to the practical demands of storing high volumes of data in the company. As the name suggests, decentralized storage works by distributing the data across a network of nodes, in a similar way how P2P networks are working. I believe that by managing global markets and supply chain, the gradual usage for decentralized systems will be inevitable for their security and market advantage. To elaborate on this topic further I would recommend reading the article Blockchain Is Critical to the Future of Data Storage - Here's Why from Sherman Lee in magazine *Forbes*, which maps some interesting projects in this area. [159]

4.1 THE PARADIGM SHIFT IN ORGANIZATION AND MANAGEMENT

Since the invention of the Internet, there was a collective and prevalent dream of promised freedom to access and share any kind of information. In the beginning, internet was a highly unorganized platform with various kind of public domains related to various subjects, but it was rather hard to find the information we would like to request, that is why companies like Yahoo and Google gained the internet dominance as most of the searches and net traffic is now digested through this centralized search channels.

I believe that we are now living in a post-internet era, when the originally decentralized structures (like internet) has once again became highly monopolized and consolidated (or sedimented) by centralized and hierarchical bodies. In fact, the

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[159] LEE, S. Blockchain Is Critical To The Future Of Data Storage - Here's Why [online]. *forbes.com*. Jun 8, 2018 [cit. 2018-07-01]. accessible at:
https://www.forbes.com/sites/shermanlee/2018/06/08/blockchain-is-critical-to-the-future-of-data-storage-heres-why/#2d44b00d33e9

informational monopoly and the market value of technological giants like Facebook, Amazon, Tencent and others have reached an unprecedented scale in the history.[160] From the point of view of the market niche in a contemporary epoch of mankind, every technological revolution has its own winners. Under the Industrial Revolution, it was manufactories, producers of iron, cars, chemistry and machines etc., now, we can easily observe that we live at a time when the most valuable companies are inherently connected with the internet. These companies are highly innovative, and their public perception is prevalently positive due to the rapid development and technological positivism in a global society. Regulation of these companies are rather limited and effective control of their usage of data is basically non-existent.[161] They are allowed to collect immense data clusters to find the exact information and needs of their customers. These data sets are not poorly regulated, and they are sold to advertisers. Until now, the construction of the company, decision-making and the responsibilities were based on a hierarchical structure, e.g. the management, board of directors or the owner of the company by himself. These are the highest instances of a decision-making in almost any technological giant.

Prieto (2009) in *Decentralized In-Network Management for the Future Internet* claims that in-network management (INM) is a new paradigm for the management of the future and is based on the internet and principles of decentralization and self-organization.[162] The vision of the INM is embedding management capabilities in the network, so to build-up distributed in-bound network management architecture, which has inherent support for self-management features, integral automation and automaticity capabilities.[163]

I believe that by using INM model, companies could be rather spontaneous projects empowered by vision, meaning and passion. The network could use some meta-programming to gradually build cognition and intelligence. Management operations by the means of a highly distributed architecture are already taking place in a domain of

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[160] MADRIGAL, A.C. When the Tech Mythology Collapses [online]. *The Atlantic*. Nov 15, 2018 [cit. 2018-07-01]. Accessible at: https://www.theatlantic.com/technology/archive/2018/11/facebook-google-amazon-and-collapse-tech-mythology/575989/

[161] BOSKIN, M. It's high time to regulate the tech giants [online]. *The Guardian*. 26 Apr 2018 [cit. 2018-07-01]. Accessible at: https://www.theguardian.com/business/2018/apr/25/tech-giants-must-manage-policies-without-stifling-innovation

[162] PRIETO, A. G., DUDKOWSKI, L., MEIROSU, c. et kol.. "Decentralized in-network management for the future internet." In *Communications Workshops, 2009. ICC Workshops 2009. IEEE International Conference on*, pp. 1-5. IEEE, 2009.

[163] Ref. 158

booming ecosystem around the technology of *blockchain* and *smart contracts*. The main objective is the design of management functions that are in/or close to the network elements and services to be managed, so the management model is mostly collocated on the nodes; as target approach, they would be codesigned with the network elements and services. The paradigm shift is following: In-network management will cause to move from a managed object paradigm to one of management by objective. I will show later in this thesis some real projects and the application of this philosophy in practice.

A new change in the organization of society is gaining momentum and I believe it is motivated by *layering down* the new stratum of complexity with the lower entropy, hence a new stratum can emerge – Artificial Intelligence. I believe that the economy will gradually change into a community-driven society, where there will be distributed management and no middleman, but rather decentralized networks democratically driven by the community and ideally secured by cryptic messages and transactions based on public and private keys. As it has been shown in the following segments and will be pointed out later, this option is now available, and I would like to argue here, that this architecture might be inevitable to achieve AGI. Let me explain my claims by making an example on two ongoing and highly influential projects within the internet to illustrate, what is the fundamental change and how global workplace and management will be gradually switched from hierarchical to decentralized and community-driven. Briefly, I will introduce some other small, but highly discussed decentralized platforms.

Github is a internet platform that has been found to create a transparent development environment, which together with a pull request-based workflow, provides a mechanism for developing open-source program and reviewing and managing code changes within the public or commercial project.[164] Errini Kaliamvakou (2014) call these platform Decentralised Version Control Systems (DVCS).[165] GitHub brought a major change in a collaborative software development and makes an investigation of networking workplace valuable. To this day there is about 31 million active users and it enables teams to self-organize. Developers or programmers can independently get involved into developing various projects, allowing thus parallel work. DVCS have become a viable option for teams to structure their workflow and GitHub is currently the

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[164] KALLIAMVAKOU, Eirini, et al. Open source-style collaborative development practices in commercial projects using github. In: *Proceedings of the 37th International Conference on Software Engineering-Volume 1*. IEEE Press, 2015. p. 574-585.
[165] KALLIAMVAKOU, Eirini, et al. The code-centric collaboration perspective: Evidence from github. *Tech. Rep.*, 2014.

most widely used such service hosting over 10 million repositories for open source and proprietary software projects, given that GitHub's workflow and model does not intuitively fit the commercial development way of working for its transparency. In fact, there are still projects which includes reduced communication and openness due to the competition, but it is rather than rare than prevalent.[166] GitHub was recently bought by Microsoft Inc for 7.5 billion USD. This deal spurs great amount of criticism, since GitHub was always perceived as a neutral marketplace for developers and it may be that lots of developers will jump to GitHub competitors, which include GitLab and Bitbucket.[167]

Steemit is a social news site that allow members posting and curating content and uses micropayments backed by a tradeable currency base on their own blockchain-backed currency. This website is rather difficult to describe if we are not familiar about how cryptocurrencies work. By fundamentals the difference between Steemit and other user-content social-news website like Reddit, Facebook or 4chan is that people who create content are rewarded and people who upvote content are rewarded for helping to curate the best content available on the site. Steemit is viewed as a gateway coin that helps people, who don't know much about cryptocurrency, to get involved in the blockchain ecosystem and the use of cryptocurrencies. Commenters who add to the discussions are paid too. Mike Thelvawall (2017) thinks that if this model will succeed, this paradigm shift might change the way in which volunteer-based sites operate.[168] Steemit recently announced his first 1 million users.[169] The adaptation and rise of the blockchain-based platforms is quite appealing and allows more capital to flow in.

Indorse is a blockchain-based alternative to LinkedIn that promotes a skills economy with its own currency and is quite similar to Steemit, so its rewards users with its own currency in exchange for helping them build the platform. So, if you need experts to become a part of your team, especially for terminated time, you can find the using

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[166] DABBISH, Laura, et al. Social coding in GitHub: transparency and collaboration in an open software repository. In: *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*. ACM, 2012. p. 1277-1286.

[167] LUNDEN, I. Microsoft closes its $7.5B purchase of code-sharing platform GitHub [online]. *techcrunch.com*. 21 October, 2018 [cit. 2018-11-01]. accessible at: https://techcrunch.com/2018/10/26/microsoft-closes-its-7-5b-purchase-of-code-sharing-platform-github/?guccounter=1

[168] THELWALL, Mike. Can social news websites pay for content and curation? [online]. The SteemIt cryptocurrency model. *Journal of Information Science*. December 15, 2017. [cit. 2018-11-01]. accessible at: https://journals.sagepub.com/doi/abs/10.1177/0165551517748290

[169] DOLLENTAS, N. Steemit Announces over 1 Million Users [online]. *btcmanager.com*. May 23, 2018 [cit. 2018-05-11]. accessible at: https://btcmanager.com/steemit-announces-over-1-million-users/

Indorse and pay them by a website's currency, while there is no privacy issues and surveillance from central authority.

Peepeth is a DAPP based, decentralised microblogging service running on the Ethereum blockchain. It is modelled as a Twitter-like website, so users can tweet messages of up to 160 characters. However, in compare with Twitter, this app is completely decentralised and there is no central entity that controls what is being published, so once a message is posted, it can only be removed by the publisher. **Maidsafe** is a project that reflects the monopolized cloud services and data storage by companies like Apple through their service iCloud, Dropbox or OneDrive by Microsoft. Maidsafe is blockchain based storage solutions that store a data identifier (e.g. hash) in a blockchain but store the data through participated nodes.

In the beginning of this thesis, I claim that we, as a society, are in a crossroad. Because if we will finally achieve such a technological and knowledge-based progress in the development of AGI, it will be highly essential, how the technology is distributed. I believe that the final model of AGI must be decentralized without any management, but available for the global society fairly and accordingly to their needs. As I just showed, there is a movement within the development of Web 3.0, that aims to remove people from the management of our information to protect the world's data and individual privacy.[170] I argue that through this conceptual thinking, we could secure and make sure that AGI will not fall in hands of a few within the giant tech corporations or a state. Now, let me introduce more closely some of the terms that have been used and are essential for my hypothetical emergence of AGI - DAPPs and Blockchain.

4.2 BLOCKCHAIN AND DAPPS

The word blockchain is literally derived from the junction of two words *block* and *chain.* The word *chain* stands for a special type of distributed database that maintains an ever-expanding number of records that are protected against unauthorized interference from both, the external and peer-to-peer nodes themselves. *Block* is on the other hand mechanism that secures combination ofc cryptography, so to ensure anonymity of

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[170] I would like to encourage reader to read about the growing community behind the project Skycoin, which aims to replace the internet by the usage of the multi-board individual nodes. See at: https://www.skycoin.net/

operations and to prevent unauthorized transactions and a peer-to-peer network in a with a distributed time-stamping server. Blockchain is managed autonomously to exchange information between disparate parties, e.g. it is the most obvious example of decentralized, self-organizing network. The blockchain users are the administrator of the overall structure.[171]
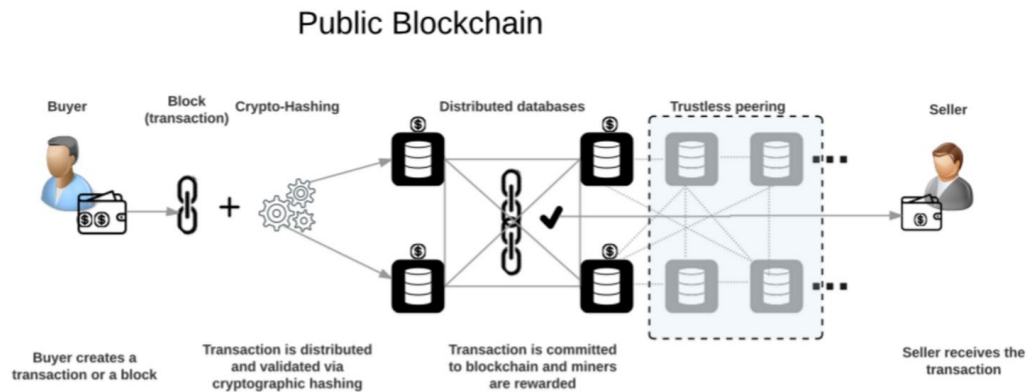
Public Blockchain

Once blockchain has been put on the network, there is no specific location of the data and there is no main centre of maintenance and control. Each new block made by proceeded transaction refers to the previous one, confirming all previous records and transactions. The more participated users doing transactions there are, the harder it is to the corrupt the overall system. Additional control and management of blockchain is not possible, since there is no way of implementing the third parties in to the system.[172]

Bitcoin is the most notorious representative of this technology. The idea of cryptocurrency was published on the cryptographic forum in 2009 by anonymous user with moniker Satoshi Nakamoto[173], since then there has been built a wide ecosystem of users an enthusiast developing solution and application for its usage. The attractiveness of Bitcoin is derived from the fact that no one can control it, thanks to the nature of blockchain technology and P2P architecture. There is not a single central point in its entire network. No one can seize an account, transactions cannot be tracked or changed, and no

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[171] NAKAMOTO, Satoshi. Bitcoin: A peer-to-peer electronic cash system [online]. *bitcoin.org*. 2008 [cit. 2018-04-10]. accessible at: https://bitcoin.org/bitcoin.pdf
[172] SWAN, Melanie. *Blockchain: Blueprint for a new economy*. " O'Reilly Media, Inc.", 2015. p.3
[173] Ref. 170

government can inflate it the currency. With the continuing rise of users, it threatens the existence of banks and financial sector in general.[174]

As a peer-to-peer network in a combination with a distributed time-stamping server, blockchain is managed autonomously to exchange information between disparate parties, e.g. it is the most obvious example of decentralized, self-organizing network. The blockchain users are the administrator and it is reflected one of another recent invention derived from this disruptive technology – Decentralized applications (DAPPS). As an example, we can use one of the most traded cryptocurrency called Ethereum, which is basically improved bitcoin-like ledger, that allows developers to build application on the top of its network. These applications are called DAPPS. Their emergence was encouraged by the programming community, who believes, that the large corporations and governments stretch and overstep their authority and misuse the data and privacy of their users. The main concept of using DAPPS is to address consensus, instead of the usage of centralised corporations such as Facebook, Google, Amazon, Tencent and many others. The goal is to achieve the reduction of corporate and governmental websites together with the software upon which they are built.[175]

The DAPP development is still in its infancy, but portal for blockchain enthusiasts pointed out the most noticeable common features in his guide to understanding of DAPP, which I will quote directly: [176]

- *Open Source. Ideally, it should be governed by autonomy and all changes must be decided by the consensus, or a majority, of its users. Its code base should be available for scrutiny.*

- *Decentralized. All records of the application's operation must be stored on a public and decentralized blockchain to avoid pitfalls of centralization.*

- *Incentivized. Validators of the blockchain should be incentivized by rewarding them accordingly with cryptographic tokens.*

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[174] Geek4geek. Do you know there are different types of Blockchain? [online]. 2018. *Steemit.com*. [cit. 2018-04-10]. accessible at: https://steemit.com/blockchain/@geek4geek/do-you-know-there-are-different-types-of-blockchain

[175] WOOD, G. DApps: what Web 3.0 looks like. *& 'What is Web*, 2014, p.3.

[176] Blockgeeks. What Are Dapps? The New Decentralized Future [online]. *blockgeeks.com*. 2018 [cit. 2018-04-11]. accessible at: https://blockgeeks.com/guides/dapps/

- ***Protocol.*** *The application community must agree on a cryptographic algorithm to show proof of value. For example, Bitcoin uses Proof of Work (PoW) and Ethereum is currently using PoW with plans for a hybrid PoW/Proof of Stake (PoS) in the future.*

4.3 CONCLUSION TO CHAPTER 4

In this chapter I tried to explain the beneficial outcomes of self-organized, decentralized networks in compare with the ongoing centralized and hierarchical structure of society, management and digital space. I believe that the possible future impact of this new digital model on a society as whole and companies alike will be proven in the years ahead of us, however prediction cannot confirm the applicability, therefore we should not withdraw any empirical conlusions from this chapter.

I have introduced these concepts mainly to support my claims about the foundation of AGI and the needed structural model to secure the emergence of fair and distributed AGI for the management of a global affairs. I claim that blockchain and DAPPS will provide the essential structural architecture, security and free, independent environment without central point of failure, while protecting the privacy of its users. This model, in my mind, will alternate and disrupt the contemporary tech industry to a different framework of digital space, which I believe, will be essential for the emrgence of AGI. To support even further my claims, I would like to show examples of what have been discussed on the case studies and my hypothetical model of two main discourses, the Western model and The Chinese model.

# 5   AI SUPERPOWERS: CHINA, USA, NEW WORLD ORDER – AND THE REBIRTH OF EU.

In this chapter I will try to formulate and examine, what I believe are the tendencies towards invention of Artificial General Intelligence (AGI). We will closely analyse available and relevant information for ongoing plans or already executed actions by governmental bodies and corporations. Later in this chapter, we will also look at the investment in centralized and decentralized AGI to test my hypothesis, that we are approaching a significant division in the development of AGI. I will also explore what is the ideological motivation behind companies in the West and Asia and test my hypothesis that none of the current systems proposed by major corporations and government will be proven correct and that the most probable solution lies on the edge of cyber-culture and AGI modelled by the consensus. Finally, I will test my hypothesis that EU could be the possible leader, even though it hasn't been the powerhouse of internet revolution, computer invention, mobile technology, neither it is taking the leading role in the development of AGI.

As a source I will mainly use official documents and news article produced by the Communist Party of China and the work of Kai-Fu Lee 李开复 [Kāifù Lǐ], who is a venture capitalist, technology executive, writer, and a major Artificial Intelligence expert. His book *AI Superpowers: China, Silicon Valley, and the New World Order*, was a major inspiration to my work and it is the most valuable insight into Chinese advancements in AI. He is a prolific author and has published eight books to date: *AI Superpowers: China, Silicon Valley, and the New World Order* has become a New Times, USA Today, and Wall Street Journal Bestseller. [177]

Kai-Fu Lee argues that China's advantage in AI development goes beyond the competitive edge provided by escaping the much tighter data privacy restrictions that exist in Europe and the U.S and is based on top-down encouragement by the media and state apparatus. Admittedly, the Chinese tech companies such as Taobao, Weibo, Xiahongshu, T-Mall, JD.com, Alibaba, Tencent, Meituan or DiDi are enabling the real-time chronicling of people's lives: what they like to eat, drink, buy, watch and these tech giants have basically every information they needed about highly digitalized Chinese

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[177] KAI-FU, L. *AI Superpowers: China." Silicon Valley, and the New World Order.* Houghton Mifflin Harcourt (2018).

population. On the other hand, Google and Facebook are limited to recording their users' online activities through their likes, searches, photos, videos, and posts, but they are restricted on the storage of information and real-time surveillance. Not only that Chinese online data tracks digital lives but they create a complex profile of Chinese individuals, their behaviour, habit, friends, emotion, psychology, emotion and ideology. Obviously, such richness and diversity of user data from one of the world's biggest populations provides abysmal resources to power services and effectiveness within the society. Nonchalant attitude towards data privacy continuously improve the machine learning algorithms powering their services, which in turn helps further enhance their service and control qualities.[178] Central Chinese government is unthreatened by election pressure; however, they are challenged by demographical pressure and the ultimate transition from once undeveloped nation to the global superpower. Of course, future can take unexpected turn, but one thing is guaranteed, China is taking the sturdiest approach and is indeed quietly winning the A.I. war. Silicon Valley or EU has no room for complacency.
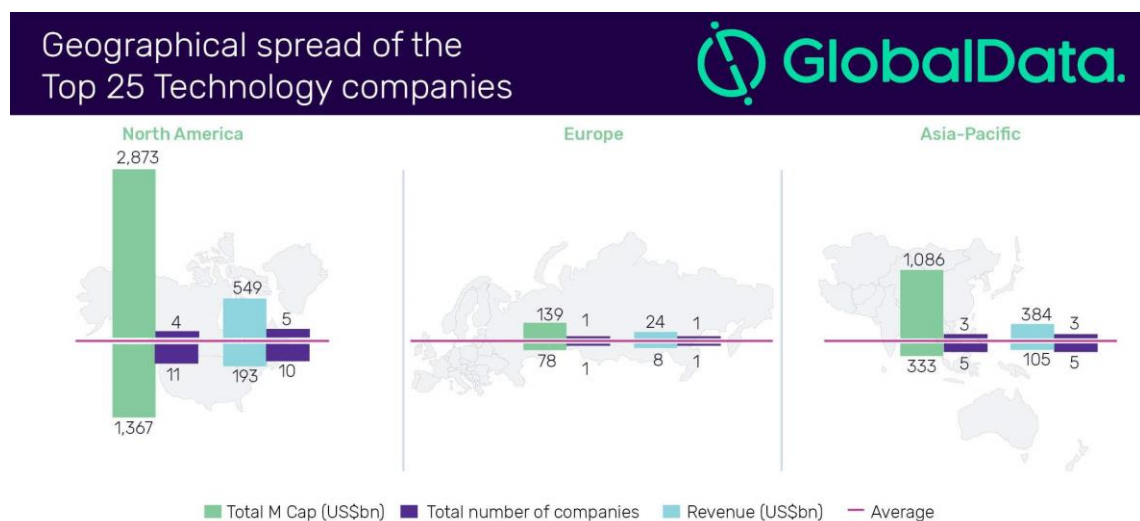
Figure 6 Geographic spread of the top 25 Technology companies. Source: https://www.globaldata.com/top-25-global-technology-companies-market-cap-end-2017/

Are there any precautionary measures taken by the USA and EU? Well, I do not think they are, but I believe there is another way, how could we march towards future with the individual dignity, liberty and freedom.

[178] KAI-FU, L. *AI Superpowers: China. Silicon Valley, and the New World Order.* Houghton Mifflin Harcourt (2018).

On one side of the argument I would put another influential Chinese thinker – Shoucheng Zhang 张首晟 [Shǒuchéng Zhāng], who made a tour through IT related conferences in the summer of 2018 with a thought-provoking lecture titled *"In Math We Trust"*.[179] I was struck how similarly he unpacked the fundamentals of crypto-AI alliance to my thesis, which I have been writing since October 2017. Dr. Shoucheng Zhang is professor of physics at Stanford University and condensed matter theorist known for his work on topological insulators, the quantum spin Hall effect, spintronics, the quantum Hall effect and high temperature superconductivity. His academic credit is endlessly hallmarked by awards and honourable titles. Dr. Zhang and Stephen Hawking were given the Physics Frontiers Prize in 2013. In the same year, he joined the Chinese Academy of Sciences as a foreign academician. Dr. Zhang received the Thomson Reuters Citation Laureate in 2014 and the Benjamin Franklin Medal in 2015 and has been considered by media outlets as a future Nobel-prize candidate for his research in the quantum Hall effect and superconductivity. In a talk on April 2018 at Stanford blockchain salon, Dr. Zhang uses example of magnets and bacteria, which can reach consensus without any centralized entity and he argues that the second law of thermodynamics states that the entropy of the total system always tends to increase, i.e. the natural force always tends to make things more random. He thinks fragmentation of web content leads to the centralized content platforms like Google and Facebook. Blockchain technology leads to a new wave of decentralization with self-organized P2P trust and consensus based on math and this will be fundamental for the emergence of AGI.[180] He suggests similarly to my thesis that data for AI is wrongly monopolized by centralized platforms without an incentive structure so AI as it stands now is broken.

Now, lets formulate the criteria for our case studies and why should we be concerned about China versus USA and not include into our model other Asian companies as the goal of this thesis suggested. The AI market is projected to continue experiencing significant growth through 2020, with venture capitalists and tech company's investment in the sector tripling according to Forrester Research. With this growth, it is projected the market value is will be up to $1.2 trillion annually by 2020 with Global GDP annual

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[179] ZHANG, S. *In math with trust* [video file]. Retrieved from *youtube.com*. USA, 2018 Accessible at: https://www.youtube.com/watch?v=oYh90ajAjcY
[180] ZHANG, S. *In math with trust* [video file]. Retrieved from *youtube.com*. USA, 2018 Accessible at: https://www.youtube.com/watch?v=oYh90ajAjcY

growth rate of 3.5%.181 According to Kliener Perkins Caufield Internet Trends Report for 2018, in the last five years, there has been a significant geographic monopolisation into the binary share of the most valued tech companies.[182] The top 20 tech companies by market valuation are now situated either in China or The USA, which is a significant difference between 2013, where Japan held two companies in the rank and Russia with South Korea were also included.
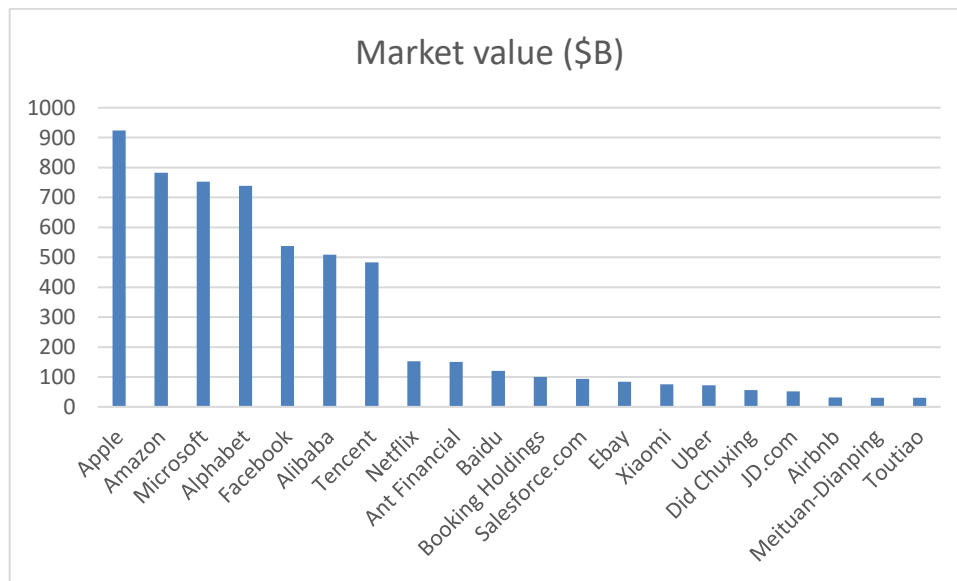
Figure 7 Market value of top 20 tech companies. Source of the data: Mary Meeker, KPCB, Internet Trends Report 2018

As Yip with McKern argue in the book *China's Next Strategic Advantage: From Imitation to Innovation*, today's foreign companies must regard China as the lead market, in which they must be present. To their advantage, China knows how to tackle the growth in the local knowledge and technology and is advancing rapidly. Since China's economy is significantly controlled by the Communist Party of China, politics are clearly are important and it is regarded as a barrier for foreign companies.[183] Yip with McKern argues further, that the main advantage might be hidden in Chinese users and consumers: "*In today's China, customers and users behave quite differently from those in the rest of the world. Fast to mature and fast to adopt new trends, and often e-savvy, they have a*

[181] McCORMIK et all. Predictions 2017: Artificial Intelligence Will Drive The Insights Revolution [online]. *forrester.com.* November 2, 2016 [cit. 2018-06-07]. accessible at: https://go.forrester.com/wp-content/uploads/Forrester_Predictions_2017_-Artificial_Intelligence_Will_Drive_The_Insights_Revolution.pdf

[182] Kleiner Perkings. *Internet Trends Report* [online]. Menlo Park, California. May 30, 2018 [cit. 2018-09-07]. accessible at: https://www.kleinerperkins.com/files/INTERNET_TRENDS_REPORT_2018.pdf

[183] Yip, G.S. and McKern, B., 2016. *China's Next Strategic Advantage: From Imitation to Innovation.* MIT Press.pp. 9-10

"forgive and forget" mentality, and their changing tastes often create micro-niches. China's young people don't fit the old stereotype of placid conformists. They are diverse in their social and political values, care about their peer group yet embrace personal expression, are materialistic yet idealistic, and may have contradictory nationalistic and international tastes. These Chinese tastes and behaviors matter, because they can be early signals of trends emerging in other markets, including Western ones."[184]

In July, Facebook won approval to open a subsidiary in China; a day later, its licence was revoked.[185] Also Google is working on censored versions of their products that comply with China's Great Firewall. According to the list *The Global and Mail* company has demonstrated the service to Chinese government officials. Backlash from Google's own employees forced the company's leadership to clarify that the project was exploratory.[186]

Now, which criteria do we apply to the companies that we want to make a comparison on? Our criteria are not strict in their measurement, but are necessary for explanatory purposes, why some companies will be excluded. Criteria are following:

- The user base and dynamic model of incoming data
- The availability of data
- Market valuation
- Investment into the AI and AI-talent workforce
- Proclaimed ambition to achieve AGI
- AI platform developer

The user base and dynamic model of incoming data stands for the ability to have a new data available through services provided to company's user base. For example, Baidu and Google are daily flooded by search requests. Apple possesses immense data from the iOS platform as well as Google with their Android platform. Tencent and Facebook have

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[184] Ref. 182. pp .224-225

[185] CHITNIS, S. Picking a winner in the tech war between US and China [online]. *livemint.com.* Aug 28 2018 [cit. 2018-11-07]. accessible at: https://www.livemint.com/Companies/qZ0myHUDN7r2NuPaDmHhBP/Forget-trade-the-US-China-technology-war-is-here-and-now.html

[186] YUAN, L., WAKABAYASHI. Google working on censored search engine for China: sources [online]. *The Globe and Mail*. Hong Kong, August 1, 2018 [cit. 2018-11-07]. accessible at: https://www.theglobeandmail.com/business/article-google-working-on-censored-search-engine-for-china-sources/

incoming data from their social platforms, etc. **The availability of data** is complementary to the previous criteria as IBM and Sensetime do not possess immense data from the daily user interaction, but their sources of the data comes from their business partners and various services. **Market valuation** means they are included in the top 12 tech companies by market valuation. **Investment into the AI and AI-talent workforce** stands for the effort to incorporate AI research teams into to the organizational level and declared investment in the AI hubs in general to possibly achieve AGI.

In the next subchapter dedicated to case studies I have excluded from the fig.7 Ant Financial as they are an affiliate company of the Chinese Alibaba Group and can be counted as such.[187] Even though Netflix is a major player in providing entertainment, I do not count it as AI platform developer. The only use cases of Netflix using any ML systems are for the quality of video streaming and recommendation algorithms.[188] Beyond the case study criteria I have also made three additional case studies dedicated to IBM, SenseTime and SingularityNet. IBM is a leading developer of AI-related software and, apart from the market price criteria, contains all the mentioned case study criteria. Chinese company SenseTime plays an important role in the policy of the Chinese government and is the result of the joint efforts of several Chinese companies, so I decided to include him in the list of case studies to illustrate the ties between Chinese government and private sector. SingularityNet is added to be denoted as an alternative to a centralized model of all previous case studies and should function as the link to the premise of the possible disruptive force of AI in the global management. These three are separated by the title of the subchapter. During the compilation of case studies I was mainly using secondary sources, because of the topicality of the issue.

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[187] RUSSEL, J. Alibaba's Ant Financial fintech affiliate raises $14 billion to continue its global expansion [online]. June, 2018 [cit. 2018-06-07]. accessible at: https://techcrunch.com/2018/06/07/ant-financial-raises-14-billion/

[188] WONG, J. I Netflix's new AI tweaks each scene individually to make video look good even on slow internet. February 28, 2017 [cit. 2018-06-07]. accessible at: https://qz.com/920857/netflix-nflx-uses-ai-in-its-new-codec-to-compress-video-scene-by-scene/

5.1 CHINESE MODEL

In July 2007 on an official site of the Chinese Communist Party *gov.cn* released a document regarding the strategic planning for Artificial Intelligence called 新一代人工智能发展规划 [xīn yī dài rén gōng zhì néng fā zhǎn guī huá][189], which can be translated as A Next Generation Artificial Intelligence Development Plan. This strategic plan was released rather unnoticed by the Western media, although I would argue that these strategic plans provided by the Chinese governmental bodies are necessary to foretaste an official viewpoint of Chinese Communist Party towards taking the global leading role in the the development of AGI.

The introductory to this strategic plan announces that the development of an Artificial Intelligence has entered a new phase. After more than 60 years of evolution, especially in the theoretical and technological innovation, such as mobile Internet, big data, supercomputing, sensor networks, and neural sciences, as well as the strong demand for economic and social development, Artificial Intelligence has finally accelerated its development and has demonstrated a great achievement through the architecture of deep learning and analytics.[190] China accounted for 48 percent of the world's total AI start-up funding in 2017, compared to 38 percent for the US.[191] China lagged years, if not decades, behind the United States in artificial intelligence and any other high-tech development, but over a decade so, China has caught AI fever, experiencing a surge of excitement about the field that dwarfs even what we see in the rest of the world.[192] Enthusiasm about AI has spilled over from the technology and business communities into government policymaking, and it has trickled all the way down to kindergarten classrooms in Beijing. This broad-based support for the field has both reflected and fed into China's growing strength in the field. Chinese AI companies and researchers have already made up

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[189] *guó wù yuàn*; xīn yī dài rén gōng zhì néng fā zhǎn guī huá fā bù jì huá chū lú [online]. 2017. Gov.cn. [cit. 2016-02-10]. accessible at: http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm

[190] *guó wù yuàn*; xīn yī dài rén gōng zhì néng fā zhǎn guī huá fā bù jì huá chū lú. 2017 [online]. Gov.cn. [viewed 2016-02-10]. accessible at: http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm

[191] VINCENT, J. China overtakes US in AI startup funding with a focus on facial recognition and chips [online]. *The Verge*. October 10, 2017 [cit. 2018-11-07]. accessible at: https://www.theverge.com/2018/2/22/17039696/china-us-ai-funding-startup-comparison

[192] KAI-FU, L. *AI Superpowers: China. Silicon Valley, and the New World Order.* Houghton Mifflin Harcourt (2018).

enormous ground on their American counterparts, experimenting with innovative algorithms and business models that promise to revolutionize China's economy.[193]

The plan is further divided into „分三步走" [fēn sān bù zǒu], which should frame the Chinese superiority in the field of AGI. These steps are following:[194]

- *"In the first step, by 2020, the overall technology and application of artificial intelligence should be synchronized with the world's advanced level. The artificial intelligence industry will become a new important economic growth point and the application of artificial intelligence technology will become a new way to improve people's livelihood and effectively support the entry into and implementation of innovative countries. The goal is to build a well-to-do society in an all-round way."*

- *"The second step is to achieve a breakthrough in the basic theory of artificial intelligence by 2025, and some of the technologies and applications invented by China should reach the world's leading level. Artificial intelligence should become the main driving force for China's industrial innovations, economic transformation, and smart social construction for the sake of positive social development."*

- "*In the third step*, by 2030, the artificial intelligence theory, technology and applications should reach the world's leading level and become the world's leading artificial intelligence innovation centre. The smart economy and smart society will achieve remarkable results, laying an important foundation for being the forerunner of innovative countries and the major economic power."

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[193] KAI-FU, L. *AI Superpowers: China. Silicon Valley, and the New World Order.* Houghton Mifflin Harcourt (2018).

[194] Author's own translation from the orginal text: „第一步，到 2020 年人工智能总体技术和应用与世界先进水平同步，人工智能产业成为新的重要经济增长点，人工智能技术应用成为改善民生的新途径，有力支撑进入创新型国家行列和实现全面建成小康社会的奋斗目标…第二步，到 2025 年人工智能基础理论实现重大突破，部分技术与应用达到世界领先水平，人工智能成为带动我国产业升级和经济转型的主要动力，智能社会建设取得积极进展…„第三步，到 2030 年人工智能理论、技术与应用总体达到世界领先水平，成为世界主要人工智能创新中心，智能经济、智能社会取得明显成效，为跻身创新型国家前列和经济强国奠定重要基础 "

By the year 2020, Chinese government wants to establish a lifelong learning and employment training systems that meets the needs of smart economy and smart society, therefore there should be a big governmental subsidiaries and investment to support institutions of higher learning and to carry out artificial intelligence skills training to meet the needs of high-skilled and high-quality jobs.[195]

The document also encourages the implementation of the National Education Program for Intellectuals, the establishment of artificial intelligence related courses in primary and secondary schools with an emphasizes on building and improving artificial intelligence popularization infrastructure.[196] I believe these are not just a flatulent claims, since we can already see a well-produced, state propaganda and documentaries like the document staring the well-known television celebrity and popular figure 杨澜 [yáng lán] Yang Lan in the special series on *youku.com* and other Chinese video-sharing portals called 人工智能真的来了 [réngōng zhìnéng zhēnde láiliǎo] - *Artificial Intelligence is really here* with almost 30 million views just on Youku, which is openly propagating the advantage of Artificial Intelligence and its benefits, while completely ignoring the potential misuse and dangers related to AI in general.[197]

On the other hand, in the *A Next Generation Artificial Intelligence Development Plan* is also stated that the Party Central Committee and the State Council should secure the foundation of regulatory mechanism to review the risks connected with the use of AI, and it is openly stated, that which will secure ethical and peaceful development strategies to accelerate the integration of artificial intelligence and the deep integration to the economy, society, and defence systems. Other chapters are mainly related to development of smart economy, smart society, national security, and building an ecosystem that supports the mutual integration of knowledge, technology, and industry groups, as well as talents, minorities, and cultures.[198] While the main goal should be to gradually become the world's scientific and technological power and the completion of the 两个一百年 [Liǎng gè yībǎi nián] goal for the Chinese nation's great rejuvenation of the Chinese

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[195] *guó wù yuàn*; xīn yī dài rén gōng zhì néng fā zhǎn guī huá fā bù jì huá chū lú. 2017 [online]. *Gov.cn*. [viewed 2016-02-10]. accessible at: http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm

[196] *guó wù yuàn*; xīn yī dài rén gōng zhì néng fā zhǎn guī huá fā bù jì huá chū lú. 2017 [online]. *Gov.cn*. [viewed 2016-02-10]. accessible at: http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm

[197] jì shí：rén gōng zhì néng zhēn dí lái liǎo. In: *Youku* [online]. 2016 [cit. 2018-04-12]. Accessible at: http://list.youku.com/show/id_zefbfbd59efbfbdefbfbd.html

[198] *guó wù yuàn*; xīn yī dài rén gōng zhì néng fā zhǎn guī huá fā bù jì huá chū lú. 2017 [online]. Gov.cn. [viewed 2018-04-11]. accessible at: http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm

dream advanced by General Secretary Xi Jinping following the 18th National Congress of the Communist Party of China held in 2012, it's actually very unique and systematic agenda, which successfully spur the investment in the field of AI.[199]

These tools will be mainly used for facial recognition, in public security systems, and it will help the desire by the central government to improve public safety through massive surveillance of citizens in general. *Tractica's* (2017) research indicates that the biometrics market will post a 10-year cumulative revenue of $69.8 billion at an annual growth rate of 22.9. The mainland China with regions surrounding it will be the largest market due to a combination of massive population, several strong or strongly growing economies, and a growing demand for biometric solutions to manage large initiatives, such as national ID programs. Total global revenue in the final year of the forecast period, 2025, will reach $15.1 billion.[200] Facial recognition is not theoretical anymore, but is massively applied mainly through the machine-learning and the most prominent Chinese start-up Sensetime.

5.1.1   CASE STUDY 1: TENCENT 腾讯

Tencent Holdings Limited 腾讯控股有限公司 [téngxùn kònggǔ yǒuxiàn gōngsī] is a Chinese multinational investment holding conglomerate whose subsidiaries specialize in various Internet, AI and information technology both in China and globally and is mainly known as the owner of the most used social platforms in China, namely Wechat and QQ.[201] Tencent Holdings Limited for the last two years was valued higher than Facebook with a market cap valued of nearly 600 billion. However recently, their shares were crushed to 200 billion USD on April 2018 due to the recent market reaction Tencent was for many years the Asia's most valuable company, but in 2018 was surpassed by the

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[199] MENG, J. How artificial intelligence will change the face of security in China. *South China Post* [online]. March, 2018. accessible at: http://www.scmp.com/tech/leaders-founders/article/2136528/how-artificial-intelligence-will-change-face-security-china

[200] Ref. 139

[201] DONG, Yang; XUE, Annie Ying. The Application of the Chinese Anti-Monopoly Law in the Internet Market: Qihoo 360 v. Tencent Case Study. *경쟁법연구*, 2013, 28.단일호. pp.323-346

biggest competitor - Alibaba Group.[202] Tencent major valuation comes from the fact that it has a massive user base of approximately 1 billion daily users.[203]

This huge user base plays another crucial role besides generating advertiser and service fee revenues. In 2017, Tencent started their own music streaming platform and digital reading company called China Literature, which follows Amazon model of offering the chance to pay for sample chapters of 10 million books before committing to buying the entire work. China Literature is not entitled to sell books, but is determined to develop their own movies, documentaries and other media and it is all run through the central platform of WeChat.[204]
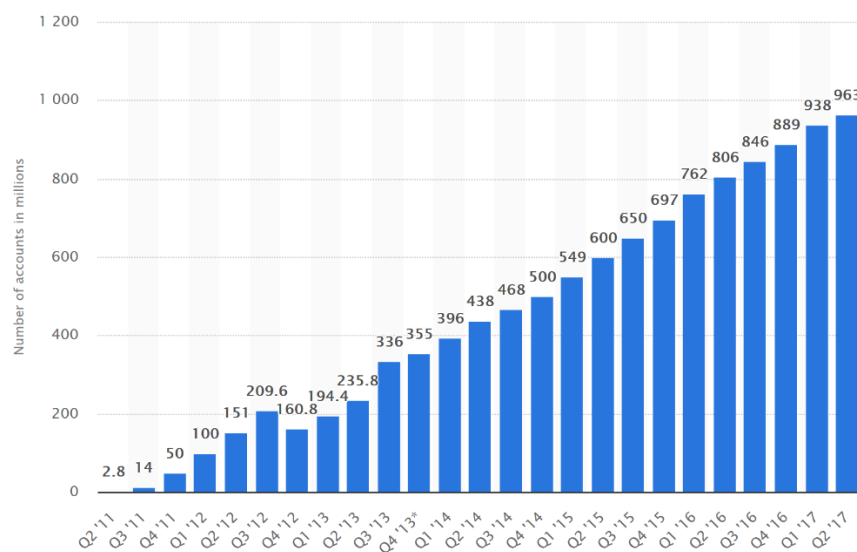
Figure 8 The growing user base of Tencent. Source: http://www.statista.com/number-of-active-wechat-users

Tencent is also functioning as a gateway for the cashless payments and already processing 40% of all mobile payments globally. WeChat users are using service called WeChat Pay integrated into the app WeChat itself. The value of these transactions is expected to $1.5 trillion every year and the number of people using WeChat Pay is growing rapidly by every day.[205] Chinese company with such a scale of services and influence cannot be operated independently, even though there is no hard evidence to

[202] SHANE, D. It's not just Facebook: China's biggest tech company is getting crushed [online]. CNN Money. March 28, 2018. [cit. 2018-04-11]. accessible at:
http://money.cnn.com/2018/03/28/investing/tencent-stock-plunge/index.html
[203] Statista [online]. 2018. Number of monthly active WeChat users from 2nd quarter 2010 to 2nd quarter 2017 in millions. Statista,com . 2018. [cit. 2018-04-11]. accessible at:
https://www.statista.com/statistics/255778/number-of-active-wechat-messenger-accounts/
[204] SHANE, D. It's not just Facebook: China's biggest tech company is getting crushed [online]. CNN Money. March 28, 2018. [cit. 2018-04-11]. accessible at:
http://money.cnn.com/2018/03/28/investing/tencent-stock-plunge/index.html
[205] FUNG, Ben. Cashless society: Is it the future?. In: *Speech at Suomen Pankki's "Going Cashless" conference, Helsinki*. 2015.

support strong claims about their infiltration with Chinese Communist Party officials, however it has been reported that Tencent has been complicit and in a close cooperation with the Chinese authorities on many occasions throughout their history of entrepreneurship.[206] Tencent is basically the vast data cluster that can provide the data about what users are buying, to where they are taking taxi, with whom they are friends and what they are discussing in real time.[207]

Tencent is a leading innovator in AI as well and consider itself as the one of the biggest investors in AI itself [208] and possesses perhaps the single richest data ecosystem of all the giants, which helps him to attract and empower top-flight AI researchers.[209] In 2017, Tencent opened an AI research institute in Seattle and immediately began poaching Microsoft researchers to staff it. Tencent is probably one of the best companies that has application scenarios for AI technologies, because of their diversified portfolio of activities that span across messaging, video, gaming, payments, music, healthcare, education, maps, and much more, so the combination of more powerful computing and larger sets of data enable Tencent to understand actual use cases of everyday consumers.[210]

5.1.2   CASE STUDY 2: ALIBABA 阿里巴巴

Alibaba's record-breaking 2014 debut on the New York Stock Exchange hit the news all around the world. Alibaba had claimed the title of the largest Initial Public Offering in history, and Jack Ma was immediately crowned as the richest man in China. Jack Ma had become a national hero, but a very relatable one. He is pictured as the self-made man and icon of "Chinese dream", which empowers the biggest Tencent's competitor Alibaba is

[206] ZHANG, Wenxian; ALON, Ilan (ed.). *Biographical dictionary of new Chinese entrepreneurs and business leaders*. Edward Elgar Publishing, 2009.

[207] MATTURDI, Bardi, et al. Big Data security and privacy: A review. *China Communications*, 2014, 11.14: 135-145.

[208] SOPER, Taylor. Chinese tech giant Tencent is poised to be a leader in AI, says head of new Seattle research lab [online]. *GeekWire*. 2018. [cit. 2018-03-13]. accessible at:

https://www.geekwire.com/2017/chinese-tech-giant-tencent-poised-leader-ai-says-head-new-seattle-research-lab/

[209] KAI-FU, L. *AI Superpowers: China." Silicon Valley, and the New World Order.* Houghton Mifflin Harcourt (2018).

[210] SOPER, Taylor. Chinese tech giant Tencent is poised to be a leader in AI, says head of new Seattle research lab [online]. *GeekWire*. 2018. [cit. 2018-03-13]. accessible at:

https://www.geekwire.com/2017/chinese-tech-giant-tencent-poised-leader-ai-says-head-new-seattle-research-lab/

already using AI and machine learning to optimize its supply chain, stockhouses and personalize recommendations on their online shop. Alibaba is basically built on the same model as the biggest USA's e-commerce platform Amazon and builds similar products like Tmall Genie, a home device similar to the Amazon Echo or Google Home.[211] Besides leveraging the AI technology to support their platforms, they are also starting to transfer AI services to empower more and more businesses in China, especially with their service Alibaba Cloud. Alibaba can leverage smart business intelligence through data analysis, which will then help better predict demand and optimise the entire supply chain system of the business. Machine-learning algorithms are already helping customers to predict their next possible purchase with data analyses empowered by machine-learning algorithms. Their vast data centres in Shenzhen are also planned to help China's healthcare industry, including the development of AI-based tumor diagnosis and data-driven production systems.[212] In contrast with Amazon though, Alibaba is also heavily investing in machine-learning hardware and quantum chips. According to Alibaba's chief technology officer Jeff Zhang, who gave interview to *MIT Technology Review* in September 2018. Alibaba believe that chip industry will give them an advantage upon their competitors. The market niche they are trying to fill is recent specialization in chips productions, where chips are becoming more specialized and customized for their business operations. Jeff Zhang thinks that this smaller customization is something that traditional chip companies can't do.[213] These investment efforts should see the launch of Alibaba's first in-house developed AI chip in the second half of 2019. Called AliNPU, the new AI chip had the potential to support technologies used in autonomous driving, smart cities, and smart logistics, said Alibaba at its annual flagship computing conference held in Hangzhou.[214] In July 2018 Chinese e-commerce giant Alibaba launched an artificial intelligence (AI) or again, rather machine-learning tool where e-commerce sites

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[211] HUDDLESTON, T. Alibaba Debuts a Smart Home Speaker Similar to Amazon's Echo [online]. July 5, 2017 2017 [cit. 2018-10-11]. accessible at: http://fortune.com/2017/07/05/alibaba-tmall-genie-voice-assistant/

[212] LONG, D. Alibaba is using AI to create tailor-made shopping experiences. *The Drum*. 20 June, 2017 [cit. 2018-09-11]. accessible at: https://www.thedrum.com/news/2017/06/20/alibaba-using-ai-create-tailor-made-shopping-experiences

[213] SUN, Y. Why Alibaba Is Investing in Ai Chip and Quantum Computing [online]. *MIT Technology Review*. September 25, 2018 [cit. 2018-04-11]. accessible at: https://www.technologyreview.com/s/612190/why-alibaba-is-investing-in-ai-chips-and-quantum-computing/

[214] YU, E. Alibaba To Launch Own AI Chip [online]. *ZDnet.com*. September 19, 2018. [cit. 2018-09-28]. accessible at: https://www.zdnet.com/article/alibaba-to-launch-own-ai-chip-next-year/

can insert a link on one of their product pages and produce smart copy button to see different advertising ideas.

Hence this tool can take care of a portion of their copywriting needs and creative effort and it may disrupt the way copywriters work. The future marketing model may be more about carefully picking out one line at a time from the best machine-generated options.[215]

More ambitious plans are held for 2019 as Alibaba introduced their move to open a global network of research labs, including in Silicon Valley and Seattle. They would like to success in the USA with machine-learning "City Brains", which is massive AI-driven network that optimize city services by drawing on data from video cameras, social media, public transit, and location-based apps. Working with the city government in its hometown of Hangzhou, Alibaba is using advanced object-recognition and predictive transit algorithms to constantly tweak the patterns for red lights and alert emergency services to traffic accidents. Alibaba already put the model in practice in some Chinese cities and so far, the trial has increased traffic speeds by 10 percent in some areas, and Alibaba expects to bring the service to other cities. In some places, Alibaba is arguably ahead of the competition.[216] Last December, it announced a collaboration with the Malaysian government to provide smart city services, including a video platform that can automatically detect accidents and help optimize traffic flow.[217]

5.1.3   CASE STUDY 3: BAIDU 百度

The Chinese search engine titan Baidu, sometimes referred as the Google of China, is one of the largest internet companies in the world with its user base estimated around 700 million daily users, which is, according to *chinainternetwatch.com,* about 76,5% percent

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[215] HANDLEY, L. Alibaba's new A.I. tool can produce thousands of ads a second but it says it won't replace humans [online]. *CNBC.com*. 4 July, 2018. [cit. 2018-09-11]. accessible at: https://www.cnbc.com/2018/07/04/alibabas-ai-makes-thousands-of-ads-a-second-but-wont-replace-humans.html

[216] BEALL, A. In China, Alibaba's data-hungry AI is controlling (and watching) [online]. *Wired.* 30 May, 2018 [cit. 2018-09-11]. accessible at: https://www.wired.co.uk/article/alibaba-city-brain-artificial-intelligence-china-kuala-lumpur

[217] KNIGHT, W. Inside the Chinese lab that plans to rewire the world with AI [online]. *MIT Technology Review*. March 7, 2018 [cit. 2018-11-11. accessible at: https://www.technologyreview.com/s/610219/inside-the-chinese-lab-that-plans-to-rewire-the-world-with-ai/

of all internet searches in China.[218] Baidu announced a range of "AI products" and services at its annual Baidu World conference in Beijing. In my opinion, the most interesting product they launched just recently is called EZDL. [219] It is online tool in beta version that makes easy for virtually anyone to build, design, and deploy machine-learning models without writing a single line of code. EZDL is a simple drag-and-drop platform that allows users to design and build custom machine learning models. Even if you don't have any programming background you can easily manage the input data and adjust the outcome. Their aim is to help those companies which are struggling to scale up their AI operations and don't have access to a ton of data. Currently EZDL offers the option of building two kinds of custom models:

- Image Models: This includes image classification.
- Sound Models: This includes speech recognition and sound classification.
- Object Models: This includes object classification and object detection models EZDL is aimed at small and medium-sized businesses, with the goal of breaking down the barrier to allow everyone to access AI in the most convenient and equitable way and it takes just four steps to build and deploy a model:
- Create a model
- Upload the image(s) and label the object(s)
- Train, validate, and test the model

Robin Li Yanhong, co-founder and CEO of Baidu has claimed that over the next few decades AI will have a bigger impact on society than the internet due to the technology's potential to change the way businesses and industries work. On stage at Bloomberg Global Business Forum in New York. He metaphorically related internet to appetizer before the main course, which is fully autonomous AI.[220] Similarly to Alibaba, Baidu announced a collaboration with Intel Corp. to develop specialized chips for deep learning

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[218] CIW Team. China search engine market share in April 2017 [online]. China Internet Watch. May 15, 2017 [cit. 2018-11-11]. accessible at: https://www.chinainternetwatch.com/20538/search-engine-market-share-apr-2017/

[219] WIGGERS, K. Baidu launches EZDL, an AI model training platform that requires no coding experience [online]. venturebeat.com. September 1, 2018 [cit. 2018-10-10]. accessible at: https://venturebeat.com/2018/09/01/baidu-launches-ezdl-an-ai-model-training-platform-that-requires-no-coding-experience/

[220] STANWAY-WILLIAMS, C. Baidu CEO: "AI will be bigger than the internet"[online]. theinnovationenterprise.com. 2018 [cit. 2018-06-11]. accessible at: https://channels.theinnovationenterprise.com/articles/baidu-ceo-ai-will-be-bigger-than-the-internet

framework based on Baidu's open-source PaddlePaddle platform. As the AI chip market is expected to grow up to 24 billion dollars of revenue in 2024.[221] Baidu also previously announced plans to tailor its open source deep learning framework to Volta GPUs from Nvidia and bring AI capabilities to the Chinese consumer market.[222]

On August 1st, at the 2018 Baidu World Congress, Robin Li Yanhong announced that he has cooperated with Zhongshan Ophthalmology to develop the Baidu AI fundus screening machine. This machine can help patients quickly screen a variety of fundus diseases including glaucoma, maculopathy, and diabetic fundus, and detect the risk of blindness as early as possible. At present, Baidu has cooperated with the team of Professor Liu Yuzhi, director of the Zhongshan Ophthalmic Center of Sun Yat-Sen University and director of the State Key Laboratory of Ophthalmology and put it in usage across China.[223] Baidu also announced a partnership with Ford. Cooperation of these two companies should lead to self-driving cars and should be run by machine-learning program Apollo, a hardware and software platform for self-driving cars, which Ford has been using for a while without Baidu. There numerous signals from Baidu, that they would like to compete in taxi services and are about to roll out autonomous taxis and buses in Changsha in 2019.

Another notable ongoing project is Baidu "Brain 3.0", which was led by Andrew Yan-Tak Ng, who is now building Artificial Intelligence Group and became an adjunct professor at Stanford University.[224] From 2011 to 2012, he worked at Google, where he started the Google Brain Deep Learning Project and in 2014, he joined Baidu as their chief scientist and carried out the Baidu Brain project, which includes Baidu's facial recognition, natural language understanding and video, object detection system and cloud analysis. Baidu Brain is representing the company's effort to create AGI with intelligence that can handle more tasks at once and contain all other Baidu projects in the field of

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[221] OTOKITI, E. AI chipset market to exceed \$59bn by 2024 [online]. *theinnovationenterprise.com.* 2018 [cit. 2018-06-11]. accessible at: https://channels.theinnovationenterprise.com/articles/ai-chipset-market-to-exceed-59bn-by-2024

[222] NVIDIA. Baidu Announce Partnership to Accelerate AI [online]. *nvidia.com.* July 5, 2017 [cit. 2018-09-11]. accessible at: https://nvidianews.nvidia.com/news/nvidia-baidu-announce-partnership-to-accelerate-ai

[223] XUEMIN. Bǎidù AI kāifā zhě dàhuì zuìxiǎo kāifā zhě liàn chéng jì érzi "wán" diànnǎo fùqīn dǎ yǎnhù [online]. *zsnews.*cn. 7 October, 2018 [cit. 2018-06-11]. accessible at: http://www.zsnews.cn/news/2018/07/10/3272497.shtml

[224] NG, A. AI, Machine Learning, Deep learning, Online Education [online]. *medium.com.* 12 March, 2017. [cit. 2018-04-11]. accessible at: https://medium.com/@andrewng/opening-a-new-chapter-of-my-work-in-ai-c6a4d1595d7b

machine-learning. Baidu Brain is for example diploid in natural conservation park in Northeastern China to collect and identify animals for their further protection researchers trained a vision system to identify wildlife automatically at a natural conservation in North-eastern China to collect data for animal protection.[225]

5.1.4   ADDITIONAL CASE STUDY 4: SENSETIME 商湯

SenseTime 商湯科技 [shāngtāng kējì] is a Chinese start up founded by a team of the School of Engineering of the Chinese University of Hong Kong and led by Professor Tang Xiao. It is now the world biggest company in terms of image processing, face recognition, self-driving, augmented reality, and deep neural networks. It has deep technical accumulation in algorithms, data, and computation acceleration. Its strategic partners include Alibaba, Qualcomm, Huawei, Xiaomi Technology, Honda Automobile and MIT and recently received governmental and Alibaba investment funding worth 620 million USD. This funding, led by retailing giants gives Sense Time a total valuation of more than 4.5 billion USD, making it the most valuable AI start up in the world.[226]

One of the company's technologies is to increase the resolution of images and videos through neural networks. Shangtang Technology Co., Ltd. has claimed to have commercialized technology that can automatically convert video etc., into text by-words for retrieval. In 2015, Shang Tang Technology joined the Chinese University in the ImageNet Video Recognition Competition and won the title of Global Champion in Dynamic Video Object Detection. SenseTime became profitable in 2017 and claims it has more than 400 clients and partners. It sells its AI-powered services to improve the camera apps of smartphone-makers like OPPO, Vivo and Huawei to offer "beautification" effects and AR filters on Chinese social media platforms like Weibo and

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[225] MARR, B. How Chinese Internet Giant Baidu Uses Artificial Intelligence and Machine Learning [online]. forbes.com. Jul 6, 2018, . [cit. 2018-09-21]. accessible at:
https://www.forbes.com/sites/bernardmarr/2018/07/06/how-chinese-internet-giant-baidu-uses-artificial-intelligence-and-machine-learning/#2472a0182d55
[226] GAO, Jìng Yuán. quán qiú zuì guì AI dú jiǎo shòu shāng tāng wán chéng 6 yì měi yuán C lún róng zī [online]. *Business Next Publishing Corp*. April 2018 [cit. 2018-04-12.
accessible at: https://www.bnext.com.tw/article/48740/ sensetime-china-ai-startup-surveillance

to provide identity verification for domestic finance and retail apps like Huanbei and Rong360[227]. Although co-founder Xu Li was heard that the company's technology "*will not affect privacy because only authorized persons can access it*." [228] In Hong Kong's series of sit-in street protests, often called the Umbrella Revolution at Central in 2014, the Hong Kong police used the technology of Shang Tang Technology to control the flow of people. The technology has successfully assisted the capture of hundreds of prisoners in mainland China as well.[229]

SenseTime is not limited to mainland China but have been successfully entering the USA market as well. Their computing capacities were aligned to MIT project to develop machine-learning algorithms to better approximate how people converse. One such project features MIT faculty from the Department of Linguistics and Philosophy, the Department of Brain and Cognitive Sciences, and MIT's Computer Science and Artificial Intelligence Laboratory.[230]

SenseTime has two core products, first one is SenseTotem, which is being used for surveillance purposes and SensePhoto, which uses facial recognition technology for messaging apps and mobile cameras. With these features they are empowering ongoing projects like smart glasses for Chinese police to identify police suspects.[231] These glasses or nothing a far from future. According to *The Wall Street Journal* (2018), these glasses have been deployed in Zhengzhou, the capital of central province Henan, where it has been used to monitor those traveling by plane and train.[232]

[227] SHU, Tíng, Wēng. pò 120 yìtái bì! shāngtāng kējì chuàng quánqiú AI dānlún róngzī zuìgāo jìlù [online]. *shù wèi shí dài*. 2017 [cit. 2018-04-05] accessible at: https://www.bnext.com.tw/article/45350/sensetime-computer-vision-fund-raise-

[228] *Bloomberg News*, (2018).This Chinese Facial Recognition Surveillance Company Is Now the World's Most Valuable AI Startup [online].. 2018. April 9, 2018 [cit. 2018-04-11] accessible at: https://www.bloomberg.com/news/articles/2018-04-09/sensetime-snags-alibaba-funding-at-a-record-3-billion-valuation

[229] ZHIYU, Zhèng. zhōngguó shuāliǎn rénliǎn biàn rènjì shùláizì xiānggǎng shāng tāng kējì CEO xúlì yī miǎo jiānshì jīwàn rén [online]. *míngbào zhōukān*. 2017 [cit. 2018-04-02] accessible at: https://bkb.mpweekly.com/cu0001/20170930-53823

[230] Resource Development. MIT and SenseTime announce effort to advance artificial intelligence research Alliance will be part of new MIT Intelligence Quest [online]. *MIT News.* February 28, 2018. [cit. 2018-05-11]. accessible at: http://news.mit.edu/2018/mit-sensetime-announce-effort-advance-artificial-intelligence-research-0228

[231] RUSSEL, J. Chinese police are using smart glasses to identify potential suspects [online]. Techcrunch. February [cit. 2018-05-11]. accessible at: https://techcrunch.com/2018/02/08/chinese-police-are-getting-smart-glasses/

[232] CHIN, J. Chinese Police Add Facial-Recognition Glasses to Surveillance Arsenal]. March 28, 2018 [cit. 2018-05-11]. accessible at: https://www.wsj.com/articles/chinese-police-go-robocop-with-facial-recognition-glasses-1518004353?mod=rss_Technology

5.2 THE USA MODEL

The U.S government has been maintaining more benevolent and market-oriented approach than Chinese Communist Party. However, in 2018, the White House decided to take more active role and held on May 10, 2018 the Artificial Intelligence for American Industry summit, to discuss the promise of AI and the policies they will need to realize to fulfil that promise for the American people and maintain U.S. leadership in the age of artificial intelligence.[233] The outcome was 15 pages long summary report. Where was stated key takeaways:

- Supporting the national AI R&D ecosystem.
- Developing the American workforce to take full advantage of the benefits of AI.
- Removing barriers to AI innovation in the United States.
- Enabling high-impact, sector-specific applications of AI

According to the report Trump administration made, the Federal Government's investment in research and development has grown by over 40% since 2015, in addition to substantial classified investments across the defence and intelligence communities and president Trump's 2019 Budget Request was the first in history to designate artificial intelligence and autonomous and unmanned systems as administration's priorities. In September 2017, president Trump signed a Presidential Memorandum, which should fund and prioritize high-quality science, technology, engineering, and math to avoid unemployment caused by expert systems. President Trump's National Security Strategy was the first in history to specifically call out the importance of AI for the future of the American military and committed broad investing in applications of AI, autonom systems and machine learning. The highlighted outcome of this Artificial Intelligence for American Industry summit was creation of committee in order to improve the coordination of Federal efforts related to AI and ensure continued U.S. leadership in AI. Committee should advise The White House and consider federal partnerships with

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[233] THE WHITE HOUSE. Summary Of The 2018 White House Summit On Artificial Intelligence For American Industry. *Office Of Science And Technology Policy*. 10 May, 2018 [cit. 2018-09-20]. accessible at: https://www.whitehouse.gov/wp-content/uploads/2018/05/Summary-Report-of-White-House-AI-Summit.pdf

industry and universities, it should establish and coordinate research a development of AI and identify opportunities to leverage American hegemony in AI.[234] Besides the pompous tone in today's administration report regarding AI. I found more useful report from 2016, which goes more deeply into structural changes and possible impact made by Artificial Intelligence. [235]

In this subchapter, I will mostly cover and compile the activities in the field of AI by Chinese counterparts in The U.S. I chose the leaders case studies based on investment and there public declaration of desire to achieve AGI. On the other hand, I will mention a contradictory tendency in the development and research, which is focused on the self-organisation and decentralization. These case studies where picked as the opposition towards the centralised AGI in hands of governments and corporations. Moreover, I would like to show that the architecture of these applications will accelerate the emergence of Artificial Intelligence because of its effectiveness, reliable economic model and distributed costs, that cannot be fully covered by a single entity and how can the EU profit from it.

5.2.1 CASE STUDY 5: GOOGLE

I will not deconstruct the vast activities of Google in the field of AI, because it is beyond the scope of this thesis. There are thousands of news articles and publications dedicated to Google research and there are thousands more projects, that are already under the construction. At Google's annual I/O in 2017 developer conference, CEO Sundar Pichai communicated just how important AI is to the company and announced, that all its future artificial intelligence initiatives will be housed at the Google.ai website. The website and company at large will focus on three areas: research, tools and "applied AI". However, I will try, for the purposes of this thesis, pick up the most significant areas of research for

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[234] THE WHITE HOUSE. *Summary Of The 2018 White House Summit On Artificial Intelligence For American Industry* [online]. Office Of Science And Technology Policy. Washington DC. 10 May, 2018 [cit. 2018-09-20]. accessible at: https://www.whitehouse.gov/wp-content/uploads/2018/05/Summary-Report-of-White-House-AI-Summit.pdf

[235] Executive Office of the President. *Preparing For The Future Of Artificial Intelligence National Science and Technology Council* [online]. Office Of Science And Technology Policy. Washington DC. 16 Decemember, 2016. [cit. 2018-09-19]. accessible at: https://obamawhitehouse.archives.gov/sites/whitehouse.gov/files/documents/Artificial-Intelligence-Automation-Economy.PDF

the future comparison. In my opinion, Google's AI research can be categorized into five types:

1. DeepMind
2. Google Cloud
3. Google Sustainable and Healthcare Tools
4. Google Brain

DeepMind is the world leader in machine-learning research and its application. It is solely based on deep learning network, which uses the raw pixel data or the raw sensory stream data of things Google researches want to classify or recognise. Although DeepMind is associated strongly with Google itself, it was in fact a London based start-up acquired by Google in 2014. DeepMind's founders Demis Hassabis, Shane Legg and Mustafa Suleyman created a neural network that learns how to play video games in a fashion similar to that of humans, that may be able to access an external memory like a conventional Turing machine, resulting in a computer that mimics the short-term memory of the human brain.[236] The company made headlines in 2016 after its AlphaGo program beat the human professional Go player for the first time in October 2015.[237] Google use DeepMind mostly in the image recognition and image search. It was used in 2012 to achieve very accurate recognition on around a million images with about 16 percent error rate, which was dramatically reduced to about 5.5 percent. [238] DeepMind is also used in speech recognition and language processing. In 2012 it delivered a 30 percent reduction in error rate against the existing old school system, which was, according to one is founder Mustafa Suleyman, the biggest single improvement in speech recognition in 20 years.[239]

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[236] MIT. Emerging Technology from the arXiv. Google's Secretive DeepMind Startup Unveils a "Neural Turing Machine" [online]. *MIT Technology Review*. October 29, 2014. [cit. 2018-10-24]. Accessible at: https://www.technologyreview.com/s/532156/googles-secretive-deepmind-startup-unveils-a-neural-turing-machine/

[237] REYNOLDS, Matt. DeepMind's AI beats world's best Go player in latest face-off [online]. NewScientist. May 23, 2017. [cit. 2018-11-13]. Accessible at: https://www.newscientist.com/article/2132086-deepminds-ai-beats-worlds-best-go-player-in-latest-face-off/

[238] SHEAD, Sam. Google DeepMind: *What is it, how does it work and should you be scared?* [online]. Techworld. March 15, 2016. [cit. 2018-11-13]. Accessible at: https://www.techworld.com/apps-wearables/google-deepmind-what-is-it-how-it-works-should-you-be-scared-3615354/

[239] Ref. 261

Google Gmail using Deep to spam detection, but it is widely used for hand writing recognition, image search, speech recognition, Street View detection and translation. [240] On 5th of October 2018, DeepMind announced pre-tax losses more than $368 million and company maintain its losses since its very establishing. According to magazine *Forbes*, this annual revenue show, how much is Google determined in his mission to acquire talent and bear the cost in order to win the AI battle.[241]

Google Cloud Platform (GCP) provides modern machine learning services, with pre-trained models and a service to generate your own tailored models. It is neural-net-based service that is already achieving increased accuracy compared to other deep learning systems.[242] The GCP is a collection of Google's computing resources made available to the public as a public cloud offering. The GCP resources consist of physical hardware infrastructure like computers, hard drives, solid state drives, and networking contained within Google's globally distributed data centres. GCP services are available in 18 zones in 6 regions: Oregon, Iowa, South Carolina, Belgium, Taiwan, and Tokyo and in 2016, Google announced plans to make 22 zones and 8 new regions available in 2017: Sydney, Sao Paulo, Frankfurt, Mumbai, Singapore, London, Finland, and Northern Virginia and this plan was successfully implemented.[243] In compare with DeepMind Google is using it as a cloud service platform to bring unmatched scale and speed to business applications in direct competition with Alibaba cloud.

Google Sustainable and Healthcare Tools is a category related to Google activities, which are using various machine-learning architectures to process health data or they are trying to understand processes in nature or at least make them more regulated and sustainable. According to the magazine *The Verge*, there is nobody more invested in Silicon Valley so heavily in healthcare-related companies than Google. Google established two major programs Google Fit and Google Health, which will try to use as many sensors as are available to estimate the health of its consumer. If you use android based smart watches, it will be possible to track your heart rate directly and automatically detect when you start exercising. As with all tech companies, Google is careful not to

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[240] Ref. 261

[241] SHEAD, Sam. DeepMind Losses Grew To $368 Million In 2017 [online]. Forbes. October 5, 2018. [cit. 2018-11-13]. Accessible at: https://www.forbes.com/sites/samshead/2018/10/05/deepmind-losses-grew-to-302-million-in-2017/#628832c1490e

[242] Google. Google Cloud [online]. *google.com.* 2018. [cit. 2018-09-08]. Accessible at: https://cloud.google.com/customers/global-fishing-watch/

[243] MEIER, Reto. What is Google's Cloud Platform? [online]. Medium. February 10, 2017. [cit. 2018-11-14]. Accessible at: https://medium.com/@retomeier/what-is-googles-cloud-platform-d92a9c9e5e89

cross the line into making actual health claims with Google Fit or Google Health. [244] Google claims on their webpage *ai.google.com* that AI is poised to transform medicine, delivering new, assistive technologies that will empower doctors to better serve their patients and will dramatically improve the availability and accuracy of medical services.[245]

Google's portfolio is very diverse ranging from genetics to orthopaedics. Google invested in 23andme, which the most well-known direct-to-consumer genetic testing company with one of the largest DNA databases in the world. Google attempts to become the leader of personalized health care and plan to use genetic information of its clients to map and store it for the purpose of direct individual diagnose as we as of high-overview analysis. In addition, Google has stakes in Oscar Health, the New York-based venture disrupting health insurance; Doctor on Demand, a telehealth company helping people talking to physicians from afar; Flatiron Health, a company building, and data platform dedicated to oncology or Impossible Foods developing plant-based meats and cheeses.[246] Besides healthcare, Google is also link up with scientists at Harvard to predict future locations of possible earthquake or to predict the advancing of an aftershock wave. Researchers are using trained neural networks to look for patterns in a database of more than 131,000 mainshock-aftershock events, before testing its predictions on a database of 30,000 similar pairs.[247] Another ambitious program made by Google is to use Google Cloud Platform to process millions of messages from more than 200,000 fishing vessels every day. This initiative is called Global Fishing Watch and it aims to develop sustainable fisheries. According to Google's webpage describing their goals to be achieved by Global Fishing Watch, they are willing to:[248]

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[244] BOHN, Dieter. Google Fit is getting redesigned with new health-tracking rings [online]. The Verge. August 21, 2018. [cit. 2018-11-14]. Accessible at: https://www.theverge.com/2018/8/21/17761768/google-fit-redesign-heart-points-aha-whowear-os-android

[245] Google. AI in Heathcare [online]. *google.com.* 2018. [cit. 2018-09-08]. Accessible at: https://ai.google/research/teams/brain/healthcare-biosciences

[246] THOMPSON, N. Health Care is Broken. Oscar Health Thinks Tech Can Fix It [online]. Wired. August 14, 2018. [cit. 2018-11-13]. Accessible at: https://www.wired.com/story/oscar-health-ceo-mario-schlosser-interview/

[247] REUELL, P. Examining aftershocks with AI [online]. The Harvard Gazette. September 6, 2018. [cit. 2018-11-13]. Accessible at: https://news.harvard.edu/gazette/story/2018/09/harvard-scientists-probe-aftershocks-with-ai/

[248] Google. Google Cloud [online]. *google.com.* 2018. [cit. 2018-09-08]. Accessible at: https://cloud.google.com/customers/global-fishing-watch/

- Enable unprecedented global visibility of fishery data with Google Cloud Platform
- Develop new understanding of human interactions with ocean ecosystems
- Identify boats that may be fishing illegally and provides supporting evidence for enforcement actions
- Provides new tools to governments, non-governmental organizations (NGOs), researchers, and private industry

Google Brain states its mission as "*to make machines intelligent and improve people's lives*".[249] The team is using deep learning research, a subfield of machine learning, focusing on building highly flexible models that learn their own features, end-to-end, and make efficient use of data and computation. The idea is to reconstruct and integrate all the branches of Google's AI research under one umbrella. Andrew Ng-Tak in 2011 founded Google Brain and was two years a director, before he came to Google's Chinese competitor Baidu to run the similar project called Baidu Brain. Google Brain is used for another Google project – Waymo, which is self-driving car developed together with car manufacturer Jaguar.[250] Google however invented one of the most interesting way of data collection for self-driving cars and that is reCAPTCHA.

According to the project website: "*reCAPTCHA is a free service that uses an advanced risk analysis engine to protect your app from spam and other abusive actions. If the service suspects that the user interacting with your app might be a bot instead of a human, it serves a CAPTCHA that a human must solve before your app can continue executing.*"[251]

Google is using reCAPTCHA to collect data to teach sensors of self-driving cars to recognize traffic lights, shops and streets.

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[249] Google. Google Brain [online]. *google.com.* 2018. [cit. 2018-09-08]. Accessible at: https://ai.google/research/teams/brain/our-mission/

[250] Waymo We're building the world'smost experienced driver [online]. *waymo.com.* 2018 [cit. 2018-09-08]. Accessible at: https://waymo.com/

[251] Google. Introducing reCAPTCHA v3 [online]. *google.com.* 2018. [cit. 2018-09-08]. Accessible at: https://www.google.com/recaptcha/intro/v3.html
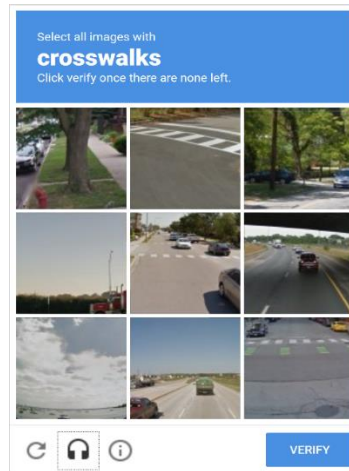
Figure 9 ReCAPTCHA as a tool to train AI.

5.2.2 CASE STUDY 6: FACEBOOK

Facebook is the Western counterpart of Tencent and possess immense data to analyse and use for machine training. Their AI team, which is called Facebook Artificial Intelligence Research (FAIR) understand, that they are mainly machine-learning research, but the final goal is AI. On their webpage they put following statement: "*We are committed to advancing the field of machine intelligence and are creating new technologies to give people better ways to communicate. In short, to solve AI.*"[252] Facebook has published over 588 machine-learning related academic articles since 2009 an on their website there is a list of ongoing research project, which counts total 20 results.[253] These projects are mainly focused on analysing data from their social platform, therefore the research area is language processing, image search and mood recognition from the status of their users. However, there many areas Facebook took a lead and it recently announced a commitment to double the size of their FAIR department.[254]

On 2th of October 2018 Google and Facebook announced a cooperation of an unspecified number of engineers to collaborate on Facebook's open source machine learning PyTorch framework, which will be tested on Google's custom computer chips

[252] Facebook. Advancing the field of machine intelligence [online]. *Facebook.com.* 2018. [cit. 2018-09-13]. Accessible at: https://research.fb.com/category/facebook-ai-research/
[253] Facebook. Advancing the field of machine intelligence [online]. *Facebook.com.* 2018. [cit. 2018-09-13]. Accessible at: https://research.fb.com/downloads/
[254] SHEAD, Sam. Facebook Plans to Double Size of AI Research Unit By 2020 [online]. Forbes. October 1, 2018. [cit. 2018-10-24]. Accessible at: https://www.forbes.com/sites/samshead/2018/10/01/facebook-plans-to-double-size-of-ai-research-unit-by-2020/#1f3e6a224c4f

for machine learning. [255] Traditionally, Facebook and Google were researching AI independently, therefore their cooperation is unprecedented, and both companies are expecting major breakthrough from this partnership.[256] There was notable buzz in the AI community, when Facebook temporarily suspended its program, where two bots within their AI platform started chatting to each other in a strange language only they understood.[257] However, professor Amit M. Joshi, researcher at the University of Central Florida in Orlando, claimed that the development was more of a human error rather than any kind of AI breakthrough. The problem happened since the AI bots had been programmed to learn negotiation techniques and were rewarded on how quickly they achieved the best solution for themselves. However, the programmers forgot to tell the bots to restrict their negotiations to human language, therefore the bots qualified spoken English as wasteful and started using their shorthanded language based on a few words and syllables. Hence professor Amit M. Joshi concluded in his article *Why Facebook's artificial intelligence break is scary for companies,* that it can't be counted as AI breakthrough, but it is scary for the reason of human intellectual lapses. [258]

5.2.3   CASE STUDY 7: AMAZON, APPLE, MICROSOFT

In this subchapter, I will briefly introduce AI research conducted by the biggest leading tech-companies in USA, however during my research I found out that these companies are more focused on AI-as-a-service, instead of appetite to swarm intelligence and data for the purpose of developing AGI.

Microsoft developed platform called Microsoft Azure and, on their website, they are claiming how it has been used and which partners are applying their solutions. For example, Agrimetrics help the right people get precise answers to modernise the whole

[255] VANIAN, Jonathan. Google and Facebook Are Teaming Up on Artificial Intelligence Tech [online]. Fortune. October 2, 2018. [cit. 2018-10-24]. Accessible at: http://fortune.com/2018/10/02/google-facebook-artificial-intelligence-chips/

[256] FALCON, William. What Will Google And Facebook's AI Partnership Accomplish? [online]. Forbes. October 3, 2018. [cit. 2018-10-24]. Accessible at: https://www.forbes.com/sites/williamfalcon/2018/10/03/what-will-google-and-facebooks-ai-partnership-accomplish/#71c7081e4c2f

[257] CLARK, Bryan. Facebook's AI accidentally created its own language [online]. Business Insider. June 20, 2017. [cit. 2018-11-10]. Accessible at: https://www.businessinsider.com/facebook-chat-bots-created-their-own-language-2017-6

[258] JOSHI, Amit M. Why Facebook's artificial intelligence break is scary for companies [online]. IMD. September, 2017. [cit. 2018-10-14]. Accessible at: https://www.imd.org/research-knowledge/articles/why-facebooks-artificial-intelligence-break-is-scary-for-companies/

agri-foods industry through the usage of chatbot Cami, which helps shoppers find products and offers advice through a conversational interface. Cami can also check stock levels, show photos of shelf labels, and reach out to the staff for help. Microsoft cloud-based smart factory solution is used by LG CNS conglomerate to get real-time data from factories or product and utilizes machine learning to predict possible breakdowns in production. Another use of Microsoft Azure is used by shipbuilding company Carnival Maritime to track and predict water use, monitors equipment health, and analyses asset data streams, these live operational data helps maintain everything needed to keep a cruise ship in working order.[259] In May, 2018 Microsoft announced their plan to build a new AI platform called Brainwave Project integrated with Azure Machine Learning, which should compete to Google Brain and Baidu Brain. But so far, the project Brainwave preview only includes the ability for customers to do ultra-fast image recognition, but it is far from live-processing AI platform involving combination of various machine-learning programs, cloud systems and sensors, which are developed by Google and Baidu. You can read more about this project at Microsofot's the AI blog.[260]

Apple's artificial intelligence strategy is completely different from their tech competitors. Apple AI research team continues to focus on running workloads locally on devices, rather than relying heavily on cloud-based resources, as Google, Amazon, and Facebook do. [261] Apple has provided some updates about its approach to artificial intelligence at the recent Worldwide Developer Conference in San Jose, where the company announced their product Core ML 2, which should be improved version of Apple's machine learning software development kit, designed for iOS. Core ML 2 framework should allow easy application of machine learning models. This will help developers to design and build intelligent apps with a minimum of code.[262] However, there is no public action taken from Apple to approach AGI.

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[259] Microsoft. AI news and events: Stay up to date with Microsoft AI. [online]. *Microsoft.com.* 2018. [cit. 2018-09-16]. Accessible at: brainwave/https://www.microsoft.com/en-us/ai?activetab=pivot1%3aprimaryr5

[260] Microsoft. Real-time AI: Microsoft announces preview of Project Brainwave [online]. *Microsoft.com.* une 13, 2018. [cit. 2018-10-24]. Accessible at: https://blogs.microsoft.com/ai/build-2018-project-brainwave/

[261] SANDLE, Tim. Why Apple's AI strategy stands apart from its rivals [online]. Digital Journal. June 15, 2018. [cit. 2018-11-10]. Accessible at: http://www.digitaljournal.com/tech-and-science/technology/why-apple-s-ai-strategy-stands-apart-from-its-rivals/article/524711

[262] NOVET, Jordan. Apple's A.I. strategy stands apart from the rest of big tech, for better or worse [online]. *CNBC.* June 13, 2018. [cit. 2018-10-24]. Accessible at: https://www.cnbc.com/2018/06/13/apples-ai-strategy-devices-not-cloud.html

Amazon recently announced Amazon Lex, Amazon Polly, and Amazon Rekognition tools to provide deep learning components for application and easy-to-use interface for businesses and developers. On their webpage Amazon AI research are these machine-learning tools categorized in this following order: [263]

- Amazon Lex
- Amazon Polly
- Amazon Rekognition
- Amazon Machine Learning

Amazon Lex is a conversational interface using voice and text and it is a platform used in Amazon Alexa, IoT device, that can handle complex speech recognition and natural language understanding in the cloud, so you can play music, control your smart home, get information, news, weather, etc. It can convert speech to text and is taught by Amazon to recognize the intent of human speech. Amazon Lex is therefore sold as a sophisticated conversational chatbot and conversational interface for various applications. [264]

Amazon Polly is a counter-device to Lexa, which enables the reverse service of converting text into lifelike speech. It supports multiple languages and includes a variety of lifelike voices, which help companies to customize their services in multiple locations and use the ideal voice for their customers. [265] Amazon developed this tool as a reading component for their e-book devices like Amazon Kindle, therefore common use cases for Polly include newsreaders, games, eLearning platforms, accessibility applications for visually impaired people, and the rapidly growing segment of Internet of Things (IoT).[266] Amazon Rekognition is image and video processing neural network to identify the objects, people, celebrities, facial expressions, activities, as well as any inappropriate content. It can compare faces for a wide variety of user verification, people counting, and public safety use cases. According to Amazon, Rekognition is always learning from new data,

[263] Amazon. Amazon AI: Building powerful artificial intelligence products [online]. *amazon.com*. 2018 [cit. 2018-04-11]. accessible at: https://www.amazon.jobs/en/teams/amazonai
[264] Amazon. What Is Lex [online]. *amazon.com*. 2018 [cit. 2018-04-11]. accessible at: https://aws.amazon.com/lex/
[265] Amazon. What Is Amazon Polly [online]. *amazon.com*. 2018 [cit. 2018-04-11]. accessible at: https://docs.aws.amazon.com/polly/latest/dg/what-is.html
[266] Ref. 289

and their team continually adding new labels and facial recognition features to the service.[267]

Amazon Machine Learning is a managed service for building machine-learning models to build robust and scalable smart applications for prediction and analysis. The process consists of three operations: data analysis, model training, and evaluation. The data analysis step computes and visualizes your data's distribution and suggests the predictive patterns within the transformed data. It aims to help companies to understand strengths and weaknesses and adjust its performance to meet business objectives.[268]

5.2.4 ADITTIONAL CASE STUDY 8: IBM

IBM helped pioneer information technology over the years, and it stands today at the forefront of a worldwide industry. It has unbelievable history, which goes over 100 years into the history. In 1888 Alexander Deymade the first dial recorder for company C-T-R, which was incorporated into IBM on June 16, 1911.[269] IBM research today has been exploring artificial intelligence and machine learning technologies and techniques for decades and as they stated on their webpage, they believe AI will transform the world in dramatic ways in the coming years, therefore they are focusing mainly on three specific fields of research:[270]

- towards human-level intelligence
- platform for business
- hardware and the physics of AI

IBM was Watson originated in 1997 when IBM's computer Deep Blue defeated Kasparov. In early 2014, IBM invested $1 billion to establish the "Watson Group", which used the machine-learning architecture for Deep Blue. Watson is therefore a computer that combines neural networks and sophisticated analytical software for optimal

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[267] Amazon. Rekognition [online]. *amazon.com*. 2018 [cit. 2018-04-11]. accessible at: https://aws.amazon.com/rekognition/

[268] Ref. 291

[269] IBM. Chronological History of IBM [online]. *IBM*. Jul 6, 2018 [cit. 2018-09-21]. accessible at: https://www-03.ibm.com/ibm/history/history/decade_1880.html

[270] IBM. IBM Research AI: Advancing AI for industry and society [online]. *Research IBM*. 2018 [cit. 2018-04-11]. accessible at: https://www.research.ibm.com/artificial-intelligence/

performance sometimes referred as a "question-answering" machine. The supercomputer is named for IBM's founder, Thomas J. Watson and processes at a rate of 80 teraflops (trillion floating-point operations per second), accesses 90 servers with a combined data store of over 200 million pages of information.[271] It is also put in practice in legal research to replicate and improve upon the abilities of a human legal research assistant. This expert system using Watson architecture and capacity is a virtual lawyer or attorney, which can search through digitalized databases of uploaded legal cases.[272] Watson established the Watson Health division in April 2015 and then acquired a large number of medical data companies, laying the groundwork for today's layoffs.[273] During 2010-2015 IBM was promoting the term "Cognitive Intelligence" or "Cognitive computing".[274]

What is cognitive intelligence? IBM proposed in their early research papers devoted to AI, that there are parallels and distinctions between Cognitive Computing and Artificial Intelligence and used it as an umbrella term that should behave in a way that can learn and interact naturally with people. [275] Cognitive computing should help human experts make better decisions by penetrating the complexity of Big Data.[276] Magazine *computerworld.com* firmly stated that "cognitive computing" is a marketing malarkey and is highly controversial.[277] From my own observation and research, since 2017 IBM completely erased this term from their websites and publications and started to orient themselves as an expert in deep learning, which is rather term proposed by their competitor Google.

[271] IBM. Watson [online]. *ibm.com.* 2018 [cit. 2018-04-11]. accessible at: https://www.ibm.com/watson/
[272] ROUSE, Margaret. Artificially-intelligent attorney (AI attorney) [online]. SearchEnterpriseAI. June, 2016. [cit. 2018-10-16]. Accessible at: https://searchenterpriseai.techtarget.com/definition/artificially-intelligent-attorney-AI-attorney
[273] RUMNEY, Emma. British bank RBS hires 'digital human' Cora on probation [online]. Reuters. February 21, 2018. [cit. 2018-11-16]. Accessible at: https://www.reuters.com/article/us-rbs-avatar/british-bank-rbs-hires-digital-human-cora-on-probation-idUSKCN1G523L
[274] KOBIELUS, James. Cognitive Computing: Relevant at all Speeds, Scales and Scopes of Thought [online]. IBM Big Data & Analytics Hub. November 1, 2013. [cit. 2018-11-16]. Accessible at: https://www.ibmbigdatahub.com/blog/cognitive-computing-relevant-all-speeds-scales-and-scopes-thought
[275] ROE, Charles. A Brief History of Cognitive Computing [online]. Dataversity. May 8, 2014. [cit. 2018-11-14]. Accessible at: http://www.dataversity.net/brief-history-cognitive-computing/
[276] ROE, Ch. A Brief History of Cognitive Computing [online]. *Dataversity*. May 8, 2014. [cit. 2018-11-16]. Accessible at: http://www.dataversity.net/brief-history-cognitive-computing/
[277] NOYES, K. 5 things you need to know about A.I.: Cognitive, neural and deep, oh my! [online]. Computerworld. March 3, 2016. [cit. 2018-11-14]. Accessible at: https://www.computerworld.com/article/3040563/enterprise-applications/5-things-you-need-to-know-about-ai-cognitive-neural-and-deep-oh-my.html

Watson has a vast healthcare usage and data support as it is used to scan peer-reviewed literature to continually grow its knowledge base. Introduction of IBM Watson Health Cloud should be a global platform, which was built with the aim of helping healthcare providers make timely, evidence-based decisions about health-related issues. It provides variant information and clinical content that is continuously updated based on the latest approved therapeutic options and access individual insights, which capture a more complete picture of the factors that can affect people's health like immunotherapy options, professional guidelines, biomarker-based clinical trial options, genomic databases and relevant publications.[278]

IBM's Watson Analytics might be the most successful "AI project" oriented to business. There are several projects using Watson source code to develop applications according to their needs. To illustrate how it is being used, I will write down several examples, but there are many others:

- The Royal Bank of Scotland created its own digital assistant on Watson's platform, that able to answer over 5,000 customer questions a day. It is named Cora and it can be thought, how customers ask questions and what the most appropriate response is. Cora also knows when to hand over to a human agent if a query is too complicated, so to avoid any misleading information.[279]

- Fukoku Mutual Life Insurance is notable for using IBM Watson to replace dozens of their human insurance brokers. Watson carries out calculations of pay-outs to be made to policyholders and can quickly scan thousands of medical certificates, as well as factoring in the length of stay at the hospital, medical histories and what procedures were undertaken, so it is easier to accurately estimate customers pay-outs and risk.[280]

- Rocket Fuel is marketing company, which announced in autumn 2017, that it has been working with IBM Watson to develop predicting solutions for marketing, which will allow brands to make sure that ads aren't served against

[278] ICS. IBM's Watson Health Cloud could revolutionize healthcare analytics [online]. *Ics.com*. 8 February, 2018. [cit. 2018-10-14]. Accessible at:https://www.ics.ie/news/view/1498

[279] RUMNEY, E. British bank RBS hires 'digital human' Cora on probation [online]. *reuters.com*. February 21, 2018. accessible at: https://www.reuters.com/article/us-rbs-avatar/british-bank-rbs-hires-digital-human-cora-on-probation-idUSKCN1G523L

[280] McCURRY, J. Japanese company replaces office workers with artificial intelligence [online]. *The Guardian*. January 5, 2017. [cit. 2018-11-14]. Accessible at: https://www.theguardian.com/technology/2017/jan/05/japanese-company-replaces-office-workers-artificial-intelligence-ai-fukoku-mutual-life-insurance

content which is critical or negative about them. Rocket Fuel claimed that they should be able to do something they call "brand moments", which allows tracking of sentiment and right places for advertising.[281]

- Wimbledon started to use IBM Watson platform for video editorial, which will choose highlights and do quick video cuts by itself. IBM's Watson engine will pull in information to create video highlights based on crowd noise, social traction, facial recognition and sentiment analysis of players following points to auto-curate highlights packages.

In general, IBM Watson platform is mostly used for customer-service related problems and communication. There are several other collaborations with GlaxoSmithKline, Staples, General Motors or The North Face to help customers to find the best solutions and products available.[282] Watson needs some input data, so usually questionnaire is put first and based on the data acquired from replies, Watson is screening the best output based on data clusters from corporation's servers.

IBM websites didn't announce any cooperation with car manufacturers, they rather established and automotive division, which collaborate with electronics brands such as Panasonic, and with top carmakers such as BMW, to build the underpinning software for self-driving vehicles by 2025. Instead of focusing on one brand, they are trying to make a self-driving platform, which can be sold and adapted to customized needs. IBM took a lead amongst tech companies by openly embracing blockchain technology and there are several attempts to connect Watson with blockchain technology. Their departments are trying to combine IBM Watson IoT and IBM Blockchain to create a mobile-first tracking solution with an immutable ledger of events to support end-to-end auditing across the supply chain. IBM also announced partnership with Stellar protocol to use blockchain technology for financial institutions to clear and settle cross-border payments in seconds.[283] There are no public announcements about cooperation between

[281] TAYLOR, L. Rocket Fuel integrates Watson Discovery with its Predictive Marketing platform [online]. Accessible at: http://rocketfuel.com/au/rocket-fuel-integrates-watson-discovery-with-its-predictive-marketing-platform/

[282] Techworld Staff. How companies are using IBM Watson's AI to power business success [online]. September 7, 2018 [cit. 2018-11-14]. Accessible at: https://www.computerworlduk.com/galleries/it-vendors/innovative-ways-companies-are-using-ibm-watson-3585847/
otocol-proof-code/" https://www.stellar.org/blog/stellar-consensus-protocol-pro

[283] IBM. World Wire [online]. *ibm.com.* 2018. [cit. 2018-09-08]. Accessible at:
https://www.ibm.com/blockchain/solutions/world-wire

their clearing platform and Watson, but I would not be surprise if IBM would not have thought of using acquired data about transactions to feed Watson for some analysis.

5.3 WHAT IF THEY ARE ALL WRONG? IS EUROPE THE KEY?

In the previous chapter I compile a research of AI-related activities of the biggest names in tech to prove, they are working tirelessly to keep up the momentum of technological progression. I consider Google as the biggest leader in AI and as the creator of innovation and philosophical system, which makes information for free for the sake of user's engagement. Google digitized almost all available books, made free translator for more than 100 languages, reconstructed the topography of planet and remake the individual streets. Google bought YouTube, collects your mail and can predict big global events through our searches.

During the outcry of Apple's privacy leaks, CEO of Apple Tim Cook backfired on the Google, that Apple is not marketizing user's data as Google does, saying in the press conference: "*A few years ago, users of Internet services began to realise that when an online service is free, you're not the customer. You're the product.*[284]

So, is it that bad to have our services for free? Not, but we should be aware that our liberty and freedom is threatened. George Glider put it this way:

"*Google must demur. If the path to knowledge is the infinitely fast processing of all data, if the mind – that engine by which we pursue the truth of things – is simply a logic machine, then the combination of algorithm and data can produce one and only one result. Such a vision is not only deterministic, but the truth can be found only by the centralized processing of all the data in the world, then all the data in the world must, by the order implied, be gathered into one-fold with one shepherd. Google may talk a good game about privacy, but private data are the mortal enemy of its system of the world.*" [285]

As we noted in the fig. 6, there are several cross-competitive corporations taking place between tech companies, that are data-driven as the goal is centralized ownership of data for processing. Good public relations are necessary, therefore CEO of these companies are signing documents like 23 Asilomar AI Principles and other ethically

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[284] WARMAN, Matt. Apple goes public on privacy policy [online]. The Telegraph. September 18, 2014. [cit. 2018-11-10]. Accessible at: https://www.telegraph.co.uk/technology/apple/11102870/Apple-goes-public-on-privacy-policy.html

[285] GLIDER, G. *Life after television*. WW Norton & Co., Inc., (1994). p.74

motivated declarations.[286] In 2016 Google, Facebook, Amazon, IBM, and Microsoft have come together to form a new organisation known as the Partnership on Artificial Intelligence to Benefit People and Society to ensure that AI will be developed safely, ethically, and transparently. [287] However, it is publicly well-documented that U.S government is using Amazon's Recognition system for facial recognition and Google is involved in "Project Maven" under which Google is supplying the U.S. military with AI technology for drone bombers and post-bombing analysis. [288][289] Google is apparently setting back from the contract and in 2019 want to withdraw for the bad publicity and series of resignation in the company, but Amazon is showing no sign of backing off from its marketing and sales of facial recognition to law enforcement agencies and other government bodies.[290]

Privacy issues can be controversial, but I would like to argue here similarly with George Gilder's (2018) book *Life After Google,* that the general idea of big data, that can be compile in a single place (cloud) with comprehensive algorithms to analyse them will be proven as a false conceptual construct. [291] The fundamental principles of chaos theory and thermodynamics will put big tech companies into constraints as consumption of electrical power and radiating heats, along with megatons of hardware will not be able to compete with decentralized and blockchain based networks. I would like to claim in this thesis, that this is the way global society will be governing and that this will be the major disruptive force in the society for the sake of creating real Artificial intelligence.

The European Union, in April of 2018, released an AI roadmap. Having acknowledged the crucial need for a boost of AI in the EU, European commission is dedicated to support investment and reconsider its strict legislation.[292] According to EU commission report The Age of Artificial Intelligence: Towards a European Strategy for

[286]*Asilomar AI Principles*. 2017 Asilomar conference [online]. futureoflife.org, 2018. [cit. 2018-10-14]. Accessible at:https://futureoflife.org/ai-principles/?cn-reloaded=1

[287] SHEAD, Sam. US tech giants unite to ensure AI is developer safely and ethically [online]. *Business Insider*. September 28, 2016. [cit. 2018-10-14]. Accessible at: http://uk.businessinsider.com/google-facebook-amazon-microsoft-ibm-ai-safety-2016-9?r=UK&IR=T

[288] ALLEN, G. C. Project Maven brings AI to the fight against ISIS. *Bulletin of the Atomic Scientists*. (2017).
[289] PERALA, Alex. Amazon Exec Defends Sale of Facial Recognition to Police in Internal Meeting [online]. *Find Biometrics*. November 9, 2018. [cit. 2018-11-11]. Accessible at: https://findbiometrics.com/amazon-exec-defends-sale-facial-recognition-police-501196/

[290] STATT, Nick. Amazon told employees it would continue to sell facial recognition software to law enforcement [online]. *The Verge*. November 8, 2018. [cit. 2018-11-11]. Accessible at: https://www.theverge.com/2018/11/8/18077292/amazon-rekognition-jeff-bezos-andrew-jassy-facial-recognition-ice-rights-violations

[291] GLIDER, G. *Life after television*. WW Norton & Co., Inc., 1994.

[292] European Commision. *A European approach on Artificial Intelligence Brussels* [online]. Brussels. 25 April 2018 [cit. 2018-09-18]. accessible at: http://europa.eu/rapid/press-release_MEMO-18-3363_en.htm

Human-Centric Machines only 4% of world data is stored in the EU.[293] Is Europe becoming subordinated to the geopolitical algorithms of China and The USA? It really seems that way.

Even though EU is diligently regulating and monitoring the digital ecosystem, which recently culminated into the application of The General Data Protection Regulation (GDPR) to ensure data protection, there many voices such as Nicolas Berggruen, chairman of the Berggruen Institute and *The Washing Post* commentator, that are concerned about Europe lacking a comparable innovation ecosystem and missing integrated digital marketplace. In essence, thinks Nicolas Berggruen, Europe has become a colony of the American tech industry.[294] The only counter recent countermeasures were made on June 2018, when EU announced foundation of CLAIRE: A European Vision for Artificial Intelligence, a cross-border collaboration of the best researches in the field of AI, which should seek and strengthen European excellence in AI research and innovation.[295]

The European Union is lacking behind the development of AI but is surprisingly the leading power in adoption of blockchain technology and have already done many successful legal ratifications to allow start-ups and governments to experiment with technology. The EU established The European Union Blockchain Observatory and Forum, which literally proclaim to accelerate blockchain innovation and the development of the blockchain ecosystem within the EU, and so help cement Europe's position as a global leader in this transformative new technology and you can easily follow every blockchain project on the continent and elsewhere, which proves the EU as a blockchain hegemon. [296]

We have analysed in the thesis the weak role of the EU in case of data storage and research of AI, but I believe EU will become the powerhouse of a completely new chapter of this era, like the development of the internet. If privacy is the issue, then blockchain,

[293] The European Political Strategy Centre (EPSC), the European Commission's in-house think tank. *The Age of Artificial Intelligence :Towards a European Strategy for Human-Centric Machines* [online]. Issue 29. Brussels. 27 March, 2018 [cit. 2018-09-18]. accessible at:
https://ec.europa.eu/epsc/sites/epsc/files/epsc_strategicnote_ai.pdf
[294] BEGGRUEN, N. A wakeup call for Europe [online]. *The Washington Post*. September 27, 2018 [cit. 2018-09-21]. accessible at:
https://www.washingtonpost.com/news/theworldpost/wp/2018/09/27/europe/?utm_term=.d1002f277db1
[295] Confederation Of Laboratories For Artificial Intelligence Research In Europe. *claire-ai.org*. Claire [online]. Brussels. 18 June 2018 [cit. 2018-09-06]. accessible at: https://claire-ai.org/about/
[296] *EU Blockchain Forum*. An initiative of European Commission's in-house think tank [online]. Brussels. 27 March, 2018 [cit. 2018-09-18]. accessible at: https://www.eublockchainforum.eu/initiative-map

Dapps and P2P networks provides the best solution to the management of secure and user-owned data for the purpose of developing AI. But are there any projects based on this idea already?

5.3.1 ADDITIONAL CASE STUDY 9: SINGULARITYNET

SingularityNet is company that aims to make decentralized platform, powered by native cryptocurrency, and built with the vision to improve the governance of private and public using artificial intelligence and decentralized services. Their vision is to become the key protocol for networking AI and machine learning tools to form a coordinated Artificial General Intelligence.[297]

SingularityNET is programmed as an open-source protocol using blockchain and its other advantages to make a global decentralized market of coordinated AI services, so anyone can access AI tech, become stakeholder or participated on the network's development. The idea behind that is to create market open space so that anybody can add an AI/machine learning service. A blockchain-based framework is designed to serve the needs of AI agents to interact with each other and with external customers. The main idea is to make connected AI solution with each other, thus AI being a collaborative solution by a distributed group of intelligent agents, interacting with each other and work together on a complicated issue. Hence AI can become a collaborative solution by a distributed group of intelligent agents, interacting with each other and work together on a complicated issue.[298].

To be more illustrative, this company tries to connect different AI solution to come together and become transferable intelligence. For example, we can have a neural network able to process sounds and speech recognition, but it does not include algorithms for playing chess or predict weather. All these types are built on a different architecture are cannot be commutable, therefore SingularityNet tries to make a platform where all these programs can emerge into one entity by using node processing power to enable everyday usage beyond high-processing GPU-equipped private and governmental sector.[299]

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[297] GOERTZEL, Ben, et al. SingularityNET: A decentralized, open market and inter-network for AIs. 2017. p.1-3

[298] GOERTZEL, Ben, et al. SingularityNET: A decentralized, open market and inter-network for AIs. 2017. p.1-3
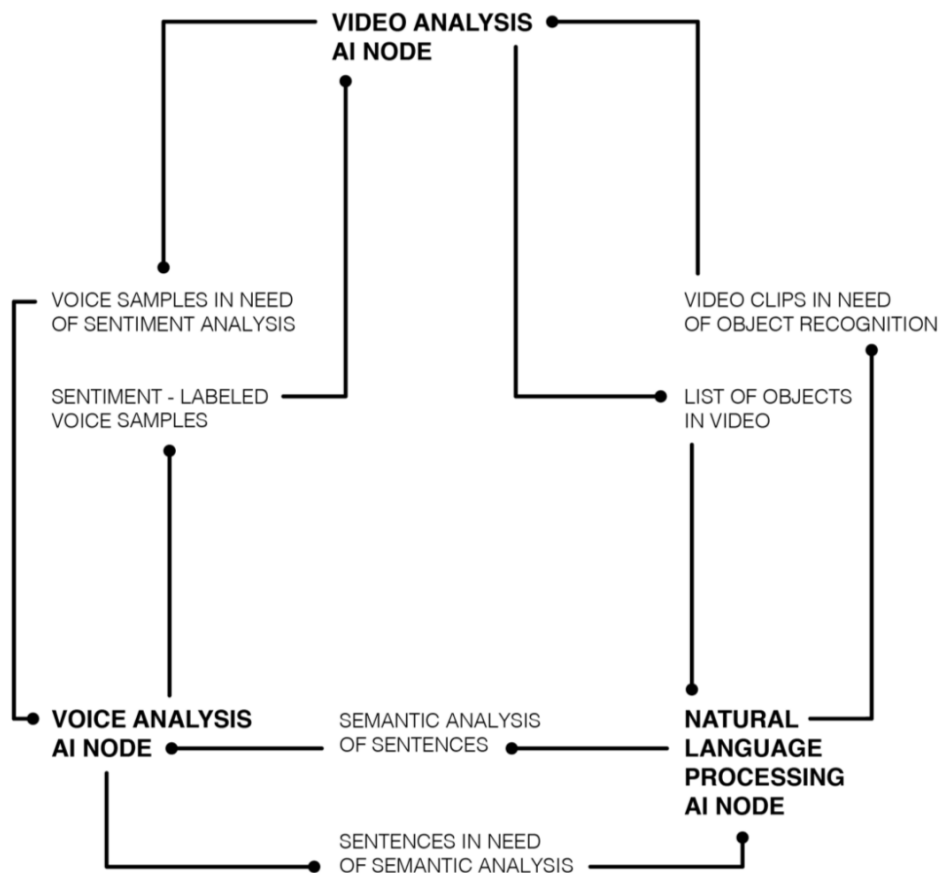
[299] ref.142, p.2

Figure 10 Example of multi-agent network of coworking AI's. Source: https://singularitynet.io/

In their *whitepaper* [300] they stated following philosophy:

„SingularityNET meets an acute and accelerating market need. In the current economic and technological context, every business needs AI, but off-the-shelf AIs will rarely match a business's needs. Only tech giants can hire armies of developers to build custom AIs, and even they have a hard time hiring enough AI experts to meet demand. SingularityNET provides an automated process enabling each business to connect existing AI tools together to build the solution it needs. By providing an easy means of configuring tools, it offers both customization and availability, while reducing the reduplication of effort involved in proprietary development, making the development process more efficient.''[301]

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[300] In a cryptospace, a whitepaper usually describes a theory and philosophy behind a new piece of technology or behind a new project in general. A whitepaper is in-depth report that presents a problem and provides a solution.

[301] GOERTZEL, Ben, et al. SingularityNET: A decentralized, open market and inter-network for AIs. 2017. p.10

Therefore, this platform should make a layer and the groundwork for the emergence of a future self-modifying, decentralized artificial cognitive organism powered by neural network calculation, and the data model training process, that will not need to consume a large amount of computing resources, therefore even small consumers can benefit from accessing neural network computing power at a low cost. To summarize the main advantages should be a minimal latency, more efficient training and less power consumption.

SingularityNet will through the complex interactions between agents, e.g. uploaded AI on the blockchain, provide interacting platform, which will subcontract pieces of their services to each other, thus enabling through decentralization and more sophisticated and complex system. Agents can benefit between each other and cooperate on a multiple task together independently based on their rating. I suggest that this will allow the desired AGI if any machine learning algorithm is implemented on the top of this strata of transactions and data flow. Agent will be instructed by the ratings and advertisements and select independently potential partners. In the reference implementation this is a probabilistic selection based on rating, but Agents are free to override this logic.[302]

In other words, SingularitNet is trying to undermine the monopoly of tech giants over AI by basically allowing any company or AI researcher to monetize their AI solutions and get access to a variety of AI algorithms through the network. Blockchain and smart contract supports data exchange and sharing across different algorithms, states and workplaces and the goal is, after establishing this network, to build AGI on the top of this structure.

5.4   CONCLUSION TO CHAPTER 5

This chapter should shortly illustrate what are the tendencies of Chinese private and public sector regarding the AGI. I chose particularly Tencent, Alibaba and SenseTime due to their significant market shares and their reputation as a major leader with the giant investments in AI-related projects. Paradoxically, I would like to emphasize here, that their model is no different than with the tech giants like Facebook, Google and Amazon

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[302] GOERTZEL, Ben, et al. SingularityNET: A decentralized, open market and inter-network for AIs. 2017. p.14

in the Western world. Hierarchical organizations with the intention of creating centralized AI based on the collection of big data clusters and complicit in providing data to third parties, are a model that will not provide the desired outcome of emergent AGI, not mentioning their close cooperation with the government and its surveillance. Even though in Western countries these topics are relatively more publicly discussed, is already well-known that tech-companies are frequently trading or passing data to the third parties. They are closely monitor activities of their users and using the data to achieve their internal goals.

In my opinion, this is problematic, and I suggest that the current model of AI is not effective, nor wanted. As AI becomes more present in every aspect of our daily lives, we continue to lose control over the process and content we consume and actions we take, however if there will be a global move toward decentralized AI platforms like SingularityNet, but there are other like DeepChain Brain. AI can be globally managed by transparency and privacy. Additionally, it will give everyone the chance to be an active member of one of the most impactful technologies of our time and have a right to decide about the network by a fair share of a vote. The vision is therefore a collective intelligence.

A collective intelligence is shared or group intelligence that emerges from the collaboration, collective efforts, and competition of many individuals and appears in consensus decision making.[303] I argue that the goal should be a creation of a collective intelligence (CI), that would be powered by a global input data from a global, decentralized network of individual users. Neither company, not government should be accountable for making AI, but rather AI should reflect a global CI and everybody should be responsible for its healthy development. This solution is not only limited to AI but can expand to other fields of society. There are other applications of so-called Western model and holding its philosophy. For an example project Terra0 has a vision to intelligently control and manage forests in Germany using blockchain technology and the smart contracts. A smart contract on the Ethereum regulate inputs and outputs of a forest in Germany. The piece of land would be purchased by the initiators, signing then the forest over to itself. This would make the forest indebted towards the initiators, while drones and satellites should monitor the growth of the forest, providing documentation to

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[303] LÉVY, Pierre. *Collective intelligence*. New York: Plenum/Harper Collins, 1997.

determine periodically how much wood can be produced from it, and sold. This whole process will be governed by an intelligent entity separated from the human labour. By a legal means Terra0 is trying to propose a non-human agent as legal entity, that should be allowed to administer capital and therefore able of claiming the right to property. With the income generated the forest would eventually pay off its debt, becoming the only shareholder of its own capital.[304]

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CONCLUSION

The objective of this thesis was to analyse and foretaste the impact of disruptive forces caused by Artificial Intelligence in global management. The sub-sequential task was to compare Asian and Western companies to reach conclusion about the "bigger picture" of the AI development. In this thesis, I analysed the resulting consequences within the technology of Artificial Intelligence itself that, I believe, will transform organizations and societies into the network, in order to lay down a new stratum for another complex system to freely emerge. A priori, I refused to analyse the usage of AI in management, since my research concluded message of the word "AI" as today's application by organizations and companies is mainly expert systems and machine-learning algorithms that lack actual "intelligence". Therefore, I focused more in depth towards the structural changes within organizations in general to achieve the final form of AGI. Throughout the thesis, I argue in favour of my hypothesis, which means that the emergence of Artificial General Intelligence will cause major disruption in global society, companies and governments. To prove my point efficiently I argued through highly complex systems, which should be self-managed through interacting communities, by using peer-to-peer networks and blockchain. My hypothetical argument must be proven by innovation and actual usage, as well as application of previously described architecture in the future.

There were several limitations of this work, since all the discussed topics have happened very recently, and I did not describe every given concept in detail. However, I believe, my argument was straightforward, e.g. it shows what are the tendencies within the field of AI and favours self-organizing, decentralized networks in comparison with hierarchical and monopolistic attitudes imposed by today's tech companies. Another limitation was my focus on new technologies, which is not supported by an enough academic sources and scientific literature. In addition, I was trying to generalise only a narrow part of a very broad argument, which includes many multidisciplinary approaches.

I also believe I provided original insight into the development of AI by comparing the initiative made by Chinese and Western companies, by confronting it with the more secured and private approach using DAPPs, blockchain and P2P, in order to achieve a fairer and nonhierarchically-dependent system. This means that the Artificial General Intelligence can emerge from healthier environment than through the data-collection used by corporations and state-run research. In my opinion, the way this research can be conducted further is to make mathematical models by using entropy-oriented calculus to describe how society is modelled and if there are indeed tendencies into more decentralized global scheme of societal order. Admittedly, the absence of any mathematical foundation makes my work unnecessary. On the other hand, I believe that I have been able, at least within the theoretical discipline, to structurize the argument in favor of different approach towards global management and hopefully, I can ignite other minds into the exploration of what could be the possible way to eventually evoke the Artificial General Intelligence into existence.

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LIST OF ABBREVIATIONS

AGI	Artificial General Intelligence
AI	Artificial Intelligence
CI	Collective Intelligence
CSC	Credit Social System
DAPPS	Decentralized Applications
DVCS	Decentralized Version Control Systems
ML	Machine Learning
NLP	Natural Language Processing
INM	In-network Management
P2P	Peer-to-Peer
R&D	Research and Development
SCS	Social Credit System
Q&A	Questions and Answers

LIST OF FIGURES