

# **NEW HUMAN NEEDS**

## **A lesson from safe sci-fi futures**

Master's Thesis  
in Futures Studies

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# 1 INTRODUCTION

*Audiat et altera pars.*

(May the other side also be heard. A Latin phrase)

## 1.1 Story of the research idea

In 2017 a futurist of a global company asked me what the biggest challenge for the humanity was, in my opinion. I answered ‘Superintelligence,’ but he laughed at that and said, ‘Climate change, *of course*.’ His confidence surprised me and made me wonder if anyone at all had well-grounded answers to the question where the humankind should apply its biggest effort. We can obtain such answers only if we consider the whole picture, for example, a comprehensive list of expected challenges. This is how an idea to explore possible transformations of the humanity holistically came to me. And from that idea, an idea to analyse what these transformations can change in us, human beings, appeared.

## 1.2 Research objective and scope

This research aims to provide a holistic and systematic view on the transformative futures of the humanity and to explore a subset of them with regard to human needs.

I have organized this thesis as follows: First, I map possible transformative changes to the human world, whether they are near or distant. Second, I consider an image of the future where natural humans can choose to remain such and live decent lives. My purpose is to identify probable changes in motivation of humans triggered by transformative changes in their environment. In other words, if our physical bodies stay the same, how can transformations change our minds?

More specifically, the objective of the research is *to identify those new human needs that can appear if (i) the human world goes through one or several transformations, while (ii) natural humans can choose to remain such and live decent lives.*

The research scopes out proposing solutions to possible threats to humankind. For instance, it does not consider alternatives in which all of the humans changed or abandoned their physical bodies and, for example, continue to live as virtual (uploaded) minds only.

### 1.2.1 Key definitions

The definitions below serve the introductory purpose. I will detail some of them in the following chapters.

*Need* – ‘1 A lack of something that is required for survival. 2 A motivational state resulting from the lack of something that an organism requires or desires, also called a drive’ (Colman 2008a). The definition of *need* will be discussed further in the Chapter 2.

*Motivation* – ‘A driving force or forces responsible for the initiation, persistence, direction, and vigour of goal-directed behaviour. It includes the biological drives such as hunger, thirst, sex, and self-preservation, and also social forms of motivation such as need for achievement and need for affiliation’ (Colman 2008b).

*Human world* – the world the entire humankind lives in, including both the humankind itself and its environment, the resources that are effectively available to humans, including immaterial resources such as knowledge, ideas etc. In the absence of known ‘other worlds’, the limiting borders of the human world do not need to be defined for this research.

*Transformation* is a synonym to *change* (see e.g. Collins 2020). I will use *transformation* here in the specified meaning of *radical, fundamental, large scale change*, which will be defined in more detail in Chapter 4.

*Natural human* – a human being whose biological body has not been altered artificially compared to a biological body of the contemporary humans and who originates from humans who met the same requirement when they took part in the production of the given human being.

*Decent life* – a life in which the needs of a human are normally satisfied at least to the same extent as the needs of the contemporary people in the today’s prosperous states, e.g. in the top ten happiest / wealthiest / healthiest etc. countries.

### 1.2.2 Research question

The research aims to answer the following research question:

*What new human needs are likely to appear in the transformed world under the condition that natural humans can choose to stay natural and live decent lives then?*

The research does not pursue a goal of estimating the probability of certain new needs to appear – it rather aims to discover the needs that seem more probable to emerge than not.

It is worth noting that the word *new* is polysemic (see e.g. English Oxford Living Dictionaries 2018). Two particularly relevant meanings are ‘*not existing before*’ and ‘*existing*

*but not discovered before*'. When *new* human needs are mentioned here, it is in the second broader meaning – '*not known before*', irrespective of the fact that they may exist already. Consequently, the word '*appear*' with regard to the new needs can also have two meanings in the research question: '*come into existence*' and/or '*become known, felt or realized*' by some of the natural humans.

In addition to the main research question, this thesis gives an answer to an instrumental question that is likely to have some academic and practical value beyond this work:

What types of transformative changes are possible for the human world? I aim to propose a systemic criterion to distinguish radical changes from those of smaller magnitude, to create a comprehensive list of transformative futures images, to the extent practically possible, and to categorise them further to enable high-level consideration. Thus, an answer to this instrumental question is a classification of *generalized* images of the possible *transformed* world.

### **1.2.3 *Epistemological and ontological stance of the researcher***

This research assumes that nearing 'objective truth' is possible, although subjective and socially constructed phenomena may hinder it, as well as the impossibility to perceive the truth directly, wholly or partially. Critical realism as a metatheoretical approach seems to reflect this assumption (cf. Blackburn 2008a; Bell 2003, 207-214). It predicates reality as existing independently of human knowledge about it, and the plurality of ways to interpret reality.

Epistemologically, critical realism seems to offer a better starting position to learn about the future, compared to some other approaches that have been developing in the recent centuries, such as positivism, pragmatism and relativism. Positivism and pragmatism make advance of knowledge about future problematic: positivism places serious accent on testability of the hypotheses (Hacking 1981, 2) and, similarly, pragmatic maxima requires taking practical consequences into account when clarifying a hypothesis (Hookway, 2013). Practical validation of ideas or evaluation of their consequences is not always possible in futures studies, especially if we discuss far futures. Relativism is not a suitable option either, for it accentuates the importance of the relevant context in interpreting ideas and, as a consequence, limits their relevance, thus making the idea of reaching objective, universal truth hardly possible (Baghramian & Carter, 2015).

Bell (2003, 221-224) implies that even if objective truth is not reached, critical realists believe it may be justified to accept an explanation that withstands existing verification means in the given time and context. Referring to Musgrave (1993, 172, 174), Bell (*ibid.*) concludes that if a statement survives significant efforts to falsify it, it is more reasonable to accept it, even if the statement cannot be validated completely. Such epistemological

and methodological approach fits the purpose of this futures research, especially if we hold the view that predictive knowledge about future is impossible (Amara, 1981). In other words, this research aims for the best possible advance towards objective knowledge by offering some ideas that withstand at least some logical criticism. In the absence of more convincing validation, e.g. certain occurrences whose reality can be verified because they already happened, this representation of reality, or conjectural knowledge, can serve as a substitute for more certain, factual knowledge.

Ontologically, this futures research is possible only if its object – *future human needs* – can be deemed existing. The questions of the reality, nature and properties of *human needs* have already been explored in a large number of other works (see e.g. a concise summary of many relevant theories by Human, Fahrenbach, Kragulj & Savenkov (2017)). I will also discuss these questions in more detail in Chapter 2 below. As for the *future* perspective on the human needs, critical realism offers similar advantages as epistemologically, i.e. it makes possible to explore reality in spite of uncertainty and plurality of possible development paths. By allowing a multitude of reasonably acceptable ideas about objective reality, it also allows progressing from them towards one or several integral ideas of the reality in future.

As for the reality of the future, depending on whether we see time as circular or linear, future can be considered existing or emerging. The reality of the future in *cyclical* time seems to be perceived as certain (Staley 2017, 38), for the future already occurred, is and will be occurring repeatedly. The reality of the future in *linear* time is more debatable, but even if I assume that future does not exist, it is still possible to study the causal mechanisms that exist in present and can influence human motivation in the following moments of linear time. Thus, in both paradigms of time future can be considered possible to study. This research does not account for the nature of time specifically, however, it follows implicitly the Western cultural perspective of linear time. I explore the emerging reality without relying on possible similarities with the past.

As implied above, an important assumption of the research is openness of the future, possibility of many different scenarios to begin unfolding at any given moment of time. Yet, they all are linked to one present and, thus, make part of one reality. Critical realism offers a way to unite these two oppositions – multiplicity with singularity – by supporting the view that only a part of the reality may be observable (Cook & Campbell 1979, 29). Thus, some other parts, such as certain natural laws or mechanisms and their interplay, may not be accessible for immediate perception. Neither positivism (or pragmatism – one of its types) requiring one and only version of objective reality, nor relativism that is comfortable with no common ground between different ideas of reality suit the approach of this study better. Criticality allows illuminating the relevant parts of diverse ideas about human needs and future and using them on the way towards the purpose of the present

study, even if the initial ideas were incompatible with each other. In particular, this research operates with many ideas of the human needs and many ideas of the future, so called futures images.

Critical approach is used not only during the study but also as a way to verify its results. I consider some possible logical arguments against the findings to make sure they withstand at least some likely critique.

#### **1.2.4 General outline of the research**

The research begins by clarifying the key definition of *needs*. I examine known human needs, their typologies and the relationship between needs and related concepts like *desires, values, and cultural dimensions*. The review of *known human needs* will allow distinguishing between those and *new future human needs*, i.e. those that are not known. The question of whether the identified new human needs are already present will be considered in the end of the paper.

I proceed by analysing the research material – scientific literature, science fiction books and films, informal sources – in order to build as comprehensive list of conceivable high impact changes as possible, using the images of the future contained in the data sources.

Based on the economic theory of service-dominant logic (see e.g. Lusch & Vargo 2014), I propose a model of the human world that connects the human needs and the environment. Using this model, I categorize possible changes that are potentially transformative.

I propose a systemic criterion to define what categories of phenomena can be considered *transformative* for the human world in this research. A threshold criterion is necessary because the meaning of *transformative* is too general and would not allow for separation of transformations from just about any type of change.

Using the systemic criterion, I demonstrate how the changes that are relevant for the study may be classified into transformative and non-transformative, depending on their specific content. Some comments are provided to illustrate possible logic.

Finally, I analyse whether each category of transformative changes is likely to cause changes in human needs. Based on the analysis, I draw conclusions about probable new needs of humans.

### 1.3 Research gaps and originality of this research

#### 1.3.1 *No futures research of human needs*

To the best of my knowledge, identification of probable future human needs as defined herein has not been undertaken before. Although the expression *human needs* is frequently mentioned in the futures research, in particular in economic and environmental fields, other related phenomena or aspects of human needs are explored than *needs* as motivational drivers, defined in more detail in subchapter 1.2.1 above and explained further in subchapter 2.1 below.

The word *need* is polysemic, and the introductory definition I chose in subchapter 1.2.1 is not the only possible one. For example, Merriam-Webster dictionary (2018b) contains a set of simpler definitions for English language learners, including ‘*something that a person must have: something that is needed in order to live or succeed or be happy.*’ A substantial share of the extant research seems to use the word *need* in this meaning, thus confusing the need with its satisfier, often material one (see e.g. Anderson 1999, 457; Clark 1994, 180). Following such approach, any specific instance of any phenomenon can be called a distinct *need* if someone needs it. In my opinion, it is not a very accurate use, because, strictly speaking, *a way to satisfy a need* is not a *need*, they are related like means and ends.

Another type of lexical contamination occurs, when *human needs* are understood as the *volume* of material resources needed by the humankind at a given point of time (see e.g. Moriarty & Honnery 2010, 695; McShane 1990, 145). Then change in *human needs* is also viewed narrowly as a quantitative change in the demand for certain resources. In such cases *a measure of the need* is called a *need*. While the purposes of those works can justify such use, I do not aim to analyse quantitative measures of needs here.

Human needs are also studied in connection with motivation. Brief history of motivation studies can be found e.g. in Gollwitzer & Oettingen (2015, 936-938), Cofer & Petri (2019). The word *motivation* has a Latin root *motive* – ‘to stimulate, to move’. One of the main questions for motivation studies is ‘why agents act in one or another way’, what “moves” (motivates) them. *Need* is one of the terms used to denote motivation forces, along with many others. As Weiner (1990, 617) notes, early motivation researchers used experiments to find ‘motors of behaviour’ and explored *needs* in association with such constructs as *instincts*, *drives*, *arousal*, *energization* in 1930-1950s. Later on, as attribution theories, expectancy-value theories, self-determination theories and other theories of intrinsic motivation gained popularity in academic circles, the related concepts of *interests*, *values* and *goals* also received more attention (Lai 2011, 9-11). It is difficult, if not

impossible, to draw fine lines between these closely interrelated concepts. Aiming to explore the futures of human motivation in the most comprehensive manner, I choose to use the *needs* concept as a general name for, hopefully, all possible motivation factors. My choice goes largely in line with the introductory definition given in subchapter 1.2.1 (a ‘need’ is what is required for survival or what is desired); more clarifications will be given in subchapter 2.1.

Some papers in the domains of psychology, healthcare, management, organization etc. explore the future aspect of human needs, for example the relationship between certain conditions in one age or time period and motivation in the older age or time period (e.g. Perrault & Clark 2018; Ross, Arria, Brown, Mullins, Schiffman, Simoni-Wastila & dos-Reis 2018 etc.), the link between the perceptions of future and certain motivational characteristics (e.g. Ntoumanis, Barkoukis, Gucciardi, Chan 2017; Tang, King & Kay 2018 etc.). In distinction to this thesis, such studies consider how *known* needs can exhibit themselves in the lives of individuals as time goes. This thesis attempts to identify future needs that are not known yet.

A small number of works attempt to anticipate the coming changes in the needs of some cultures or other social groups (e.g. Joad 1926; Kanfer, Chen, & Pritchard 2008, 494-518). Like the ones mentioned in the previous paragraph, they tend to discuss some *known* human needs that become more prioritized with time, as well as ways to satisfy the growing aspirations for something.

I have not found any research focused on the future of human *needs* as motivational drivers, i.e. in the meaning given in the subchapter 1.2.1 above, for example about emergence, change or disappearance of certain human needs in future.

### ***1.3.2 No framework or comprehensive typology of transformative changes for humankind***

While some futures research papers are dedicated to transformative futures, it seems near to impossible to distinguish them in the mass of the extant research, because the words *transformation*, *transformative* are used with respect to changes of very different magnitude and in different fields. The word *transformation* is synonymic to *change*, they both are commonly used in futures studies and, thus, it is practically meaningless to try to highlight the futures research dedicated specially to transformative changes.

For example, almost half of the documents published in the Futures journal and found in Scopus database (Elsevier 2018b) contain the word *change* or its derivatives (1838 documents out of total 3805 results) and about one sixth of the same selection contained the word *transform* or its derivatives (672 documents out of total 3805 results) as per 15

November 2018 (Elsevier 2018c). Change and transformation in particular can be seen as an inherent part of the object of futures studies (Bell 2003, 111-112).

Despite the popularity of the words denoting change, comprehensive classifications of possible transformations of the human world are rare. Even if the topic of transformative futures for humanity seems to enjoy a rise in popularity in recent decades, a lion's share of academic publications limit themselves to describing just one type of change or risk. A notable exception is a paper by Baum (2015). He summarizes the global catastrophic risks in eight categories: environmental change, emerging technologies, large-scale violence, pandemics, natural disasters, physics experiments, extraterrestrial encounter and unknowns.

Low interest to the big picture can be due to its complexity or apparent meaninglessness – we can never list *all* possible options. However, mapping possible futures has certain scientific and practical value, and not only for analysis of risks – it is also helpful for studying probable and preferable futures and developing long range plans.

Sharon (2014) presented an attempt to classify possible transformations. He groups the options into four scenarios: dystopic (humans fully control development and use of technology), liberal (moderate use of technology to enhance humans), radical (technology leads to appearance of non-human species) and methodological (technology pre-defines development paths) posthumanism. The author categorizes them further along the humanist – non-humanist axis: dystopic and liberal posthumanism are based on the presumption that humans keep control over the world and their own development, while radical and methodological posthumanism are based on the presumption that such control may no longer remain in the hands of the (same) human race.

Linda Groff (2017) proposed another interesting classification at the Futures of Complex World conference held in Turku in 2017. Groff says there are more than fifteen views or combined perspectives for human transformation in future that can be grouped into five broad areas: (i) *transhumanist / technology-based* views: IT-based, biotech-based, cyborgs or mutants, evolved robotics, AI, genetically engineered humans, nanotech-based, Internet as global brain of humanity, virtual reality, 3D and 4D printing, space exploration; (ii) *civilisation-based* views that emphasize growing complexity of organization of humanity; (iii) *consciousness-based* views describing expanded and evolving consciousness; (iv) *sustainability and Earth-based* views – experiences of interconnect-edness with Earth/Gaia; and (v) *space and possible extraterrestrial* experiences for humans.

Both classifications, however, seem vague and inconsistent. Boundaries drawn by Sharon are blurred: it is difficult to determine to which scenario an event or a trend belongs until its factual implications are known. For example, where is the boundary between liberal and radical posthumanism – at what stage shall the connection of a human brain to a computer be considered not a moderate, but a radical change to humans? Areas listed

by Groff are also overlapping: one area may cause appearance of another one (technology-based changes can lead to implications that are to be classified into other areas) or one phenomenon can be classified into several areas (Internet as the global brain can also be seen as evolution of consciousness).

Two other studies can be helpful for building a comprehensive typology of possible transformations because they consider more than one type of transformative changes. As part of the probabilistic long-term scenario work, the Millennium Project (Glenn 2000, 604-605) suggested 19 factors that might affect the long-term development of humanity and evaluated the likelihood of their impact. Bostrom (2009, 51-68) outlines four families of scenarios for the future of humanity: extinction, recurrent collapse, plateau, and posthumanity, and gives a number of exemplary changes that could lead to one or another family of scenarios. However, examples do not replace a comprehensive typology or a framework.

A practically usable framework shall be clear and non-contradictory, at least formally and, ideally, also in substance.

### ***1.3.3 Originality of this research***

This work differs from the extant research both by the problems it aims to solve, and the approaches used.

This thesis explores needs – a motivational aspect of the mental life of humans – in the radically changed future world that is presumably far away in time. Speaking figuratively, it is the intangible in the invisible. The combination of the far future perspective with an immaterial phenomenon as an object of the study is rare, to the best of my knowledge.

Methodologically, the research is innovatory because it constructs a framework for the analysis of the probable impact of radical changes on the human needs. It also contributes to the futures studies by proposing a framework-based (systemic) definition of radical changes for the human world.

Finally, the study uses science fiction artistic works as the main source of data, which is a disputable experiment, as the attitude of the futures scholars to this data source varies greatly. For example, Bell leaves ‘purely literary’ works outside the scope of the discipline (2003, 242), Lombardo says that ‘science fiction and futures studies exist on a continuum’ (2015, 5; cf. also Miles 1993), and some futurists use science fiction in their research, also as data sources (e.g. Love 2001; Ahlqvist, Uotila & Hietanen 2015). In my view, counting artistic works as a source of ideas about futures helps identifying more futures images and, thus, decreases the risk of partial blindness.

## 1.4 Ethical considerations

The work follows certain ethical norms broadly recognized as common for scientific research, such as pursuit of the truth, integrity of knowledge, acknowledgement of the work of other persons, and honesty.

In addition, the author is guided by some values that are attributable to the futurologist profession, such as respect for equality of all people, including future generations; acting in the interests of the whole humanity; open discussion of values and assumptions; openness about aims and potential impact of the research.

Attention is paid to the worldview that influences the researcher's decisions on what preferable futures can be. Although this research does not focus on desirable futures, much of the discussion is about probable reactions of human beings to change. Such reactions are inevitably connected with human preferences. As the author's worldview can impact the evaluation of preferences and, hence, the probability of certain human reactions, the author's assumptions are given openly along with reasons for their use. When some proposals are made on the basis of the author's free choice – e.g. for illustrative purposes – it is also mentioned explicitly.

I provide the subsequent disclosures and statements in this subchapter to facilitate identification of faults, biases or any other limiting aspects of the work. Following the systemic evaluation framework for futures research suggested by Piirainen, Gonzalez & Bragge (2012, 469-471) who relied on Ulrich's Critical Systems Heuristics (1994), I disclose and declare the following.

This thesis was produced as part of the curriculum of the Futures Studies Master's Program at the University of Turku, Finland. At the time of writing, the author has neither sought nor received any benefits of any kind for this work, except those normally associated with the Master's thesis (a grade).

By doing this research, the author aimed to contribute to the betterment of the whole humankind. The results of the thesis are intended to be made available electronically for open access, and the author may from time to time undertake some effort to inform other people about them. The author presumes that knowledge about future contained in this work can help people take better decisions for whatever interest they pursue. The author also sees the broad awareness of the results of this research as desirable for the humankind.

The author received formal education in the field of futures studies by attending the core and additional courses in futures studies offered by the program above, including the course of Ethics of Futures Studies. By the time of writing the author has spent most of his life in Europe, predominantly in Belarus, and he also received most of his education in that country. The main fields of his studies were, apart from futurology, economics, law, linguistics, maths, and information and communication technologies. The author's

working experience was mainly in the field of linguistic services to international customers, ICT industry, higher education.

Several basic assumptions underlying this research are not explicitly mentioned elsewhere: (i) survival is one of the basic interests of an agent, and (ii) survival of natural humans (without transformation of their bodies or minds) is preferable for at least some of them. Needless to say, the author belongs to human species and can be biased towards anthropocentric views.

## 2 THEORETICAL FOUNDATIONS: TOWARD A MODEL OF HUMAN WORLD

### 2.1 Definition of needs

As mentioned above, the word *need* is polysemic. To avoid confusion, I need to clarify its meaning for this work.

Below are some definitions of *need* from three reputable sources.

‘1 A lack of something that is required for survival. 2 A motivational state resulting from the lack of something that an organism requires or desires, also called a drive.’ (Colman 2008a)

‘need n. 1. a condition of tension in the organism resulting from deprivation of something required for survival, well-being, or personal fulfilment. 2. a substance, state, or any other thing (e.g., food, water, security) whose absence generates this condition.’ (VandenBos & American Psychological Association 2015, 692)

‘Something is needed for some end if the end cannot be achieved without it.’ (Blackburn 2008d)

As seen from the definitions above, lack of something can result from indispensability or optional desires. I intend to use *needs* hereinafter in the meaning that includes *both* indispensable and optional types of needs. To separate between them, I will use *basic needs* for those arising from indispensability – e.g. food, safety – and *optional needs* for those arising from desires – e.g. esteem, belonging, meaningfulness etc. and whose satisfaction is not absolutely necessary for survival.

The first and second definitions above mention a state of the subject experiencing the need, his/her/its feeling or realization of the fact that it needs something. This research takes a stance that the said aspect – state or realization – is sufficient for something to be recognized as a need, but not necessary or definitive for new future needs.

I aim to identify *new* needs, i.e. those that humans *may not be aware of* now and maybe during some time in the future. It is, therefore, possible that humans do not experience certain states with regard to their new needs or do not have any realization of such ones until certain circumstances arrive, for example humans become consciously aware of their new needs as a result of playing virtual games or receiving information from the mass media. Furthermore, as I consider *natural* humans in the images of the transformed world, their basic needs must remain the same and it is their optional needs only that can change. Hence, it is reasonable to expect that, even after a new need emerges, not all humans will experience it immediately. A parallel can be drawn with today: not everyone experiences

or realizes all possible *optional* needs all the time, e.g. the need for esteem or self-actualization. Consequently, this aspect – state or realization – does not always serve as necessary for a *need* to be considered such.

To summarize, *needs* in this work are defined as follows: *a need is lack of something that is required for survival of or is desired by one or more humans*. Thus, *needs* are always *human needs* here, unless stated otherwise.

This definition, however, needs additional clarifications.

First, it is worth mentioning that this research is limited to the needs of healthy adults and does not study the needs that, for example, drug-addicted or mentally impaired people may have.

Second, it might be difficult to choose a level of generalization so as to name needs. For example, if someone desires to eat some potatoes, is it need for potatoes, need for food or a survival need? If someone wants to have a beautiful view out of the window, is it a need for a view, need for aesthetic pleasure or just a particular expression of need for pleasure? I will distinguish, therefore, specific *expressions of needs*, *needs*, and *need groups*.

The first category – *expressions of needs* – are nearing need satisfiers by their meaning – for example, ‘need for potatoes’ or ‘need for a nice view out of the window’. A rule of thumb for identification of expressions of needs can be suggested: expressions of needs change if a satisfier is changed, even to a product competing with the first one in the market – e.g. ‘need for potatoes’ is not synonymic to ‘need for bread’, ‘need for a nice view’ is not synonymic to ‘need for a nice interior’.

The second category that I want to call *needs* denotes distinct generalized types of needs, e.g. need for food, aesthetic need etc. The generalized satisfiers are not specific but belong to one relatively homogeneous category. For instance, satisfiers for aesthetic need can be used more or less interchangeably, and the same applies to satisfiers of need for food. They are not easily interchangeable. For example, satisfiers for aesthetic need cannot satisfy need for food with their aesthetic properties, they must have additional properties (for example, being edible).

Finally, the third category – *need groups* – denotes classes of needs, i.e. some imaginary collections of needs. Grouping of needs may be debatable. As a rule, the content of human motivation cannot be determined solely from the name of the need group. The name of the need group may emphasize a certain quality or attribute of the needs it comprises. In other words, it may answer questions like ‘how something is done’ or ‘for what end’ rather than ‘what is desired / missing’. Although needs in a group can be instrumental to a certain terminal need, such a higher-order need alone may be too general or abstract to be a goal for a specific human action. For example, ‘self-transcendence needs’ as a name for a need group does not convey a meaning of what is missing or wanted and, thus,

does not imply a specific motivational goal. ‘Self-transcendence’ need group is often explained through examples of needs that are grouped under this umbrella term: helping others, protecting the environment etc. Although these needs may have something in common – we can imagine that it is altruism, neglect of egoism – this higher-level characteristic is not a sufficient descriptor for actionable goals. Other examples of possible need groups: ‘collectivism’, ‘long-term orientation’, ‘masculine / feminine values’ etc. Some need groups are relatively well-defined and less debated, e.g. a closed list of needs like ‘biological and physiological ones’. I will consider more ways to group known needs in the subchapter 2.2 below.

I acknowledge that the distinctions between these three levels of generalization are vague and depend on the choice of words – whether something is commonly used as an object for verbs ‘need’, ‘want’ and their synonyms. As a common sense, whatever a human being lacks or wants (and whatever (s)he calls a need) can be regarded as a need. Moreover, as one need can often be instrumental to another (Schwartz 1994, 35), it is difficult to determine the specific content of a need. I leave these problems to the scientists who explore the nature of human needs as their core subject. For this study, I rely on the names and definitions of specific human needs proposed by other need researchers, assuming that such names correspond to reality to a certain extent. I will, however, attempt to distinguish *needs* as I defined them above from *expressions of needs* (need satisfiers) and *need groups* as I review the relevant existing theories in the next sub-section.

## 2.2 What needs are known

As mentioned in the subchapter 1.2.2 above, this research aims to identify *new* human needs and the word *new* is used in the broad meaning ‘not known before’, comprising the undiscovered needs that do not exist yet and that may already exist. To be able to distinguish possible new needs, we need to review the ones already identified by other researchers, i.e. ‘not new’ needs.

Needs and similar concepts (drives, values) are studied by motivational theories. The research aiming to define a finite list of human needs has been scarce. I have identified two relevant attempts: Murray’s and Rokeach’s.

Murray (1938) aimed to deduce needs from the analysis of the entire life cycle of a person. In his opinion, human beings could have twenty-eight universal manifest or latent needs in different stages of their lives: *achievement, exhibition, recognition, acquisition, retention, order, construction, abasement, aggression, autonomy, blame avoidance, contrariance, deference, dominance, harm avoidance, infavoidance (avoidance of the unfavourable, classified as one of the needs in the Power group), counteraction, defendance,*

*infavoidance (classified as one of the needs in the Status Defence group), affiliation, nurturance, play, rejection, sex, succourance, cognizance, exposition.*

Before I present the values proposed by Rokeach (1973), who conducted surveys about *values*, I need to point to similarities and differences between *needs* and *values*. Frameworks and typologies of human *values* broaden the view of human needs, in particular by adding international perspective. One of the meanings of *value* is ‘the worth, usefulness, or importance attached to something’ (VandenBos & American Psychological Association 2015, 1129), which makes it synonymic to my working definition of *need* – something that is essential for / desired by humans. Thus, I can use some research about values for this study, albeit with caution, because another meaning of *value* is ‘a moral, social, or aesthetic principle accepted by an individual or society as a guide to what is good, desirable, or important’ (ibid.). In other words, *value* can also signify *the way something must be*, with more focus on *how* and less focus on *what* (and I am more interested in the latter, in the distinguishing characteristics of the motivational drives).

As a result of the surveys, Rokeach (1973) reduced the initial list of values from 130 to 36: 18 terminal and 18 instrumental ones; and argued that further reduction was not possible. I agree with Schwartz (1994, 35) that the difference between terminal and instrumental values is not meaningful because an end can always be seen as a means to another end. I, therefore, reproduce the Rokeach’ list of values without this separation: *true friendship, mature love, self-respect, happiness, inner harmony, equality, freedom, pleasure, social recognition, wisdom, salvation, family security, national security, a sense of accomplishment, a world of beauty, a world at peace, a comfortable life, an exciting life, cheerfulness, ambition, love, cleanliness, self-control, capability, courage, politeness, honesty, imagination, independence, intellect, broad-mindedness, logic, obedience, helpfulness, responsibility, forgiveness.*

Some other authors helped understand the variety of human needs by developing their classifications. Below I will briefly review the main relevant papers, paying more attention to ideas about the content of the known needs rather than ways to classify or re-classify them.

Need typologies were proposed by several psychological content theories, i.e. theories about ‘the actual thoughts, images, and emotions that occur in conscious experience.’ (VandenBos & American Psychological Association 2015, 242) By far the most known of content theories is Maslow’s hierarchy of needs (1943; 1962; 1970a; 1970b). Maslow argues that humans share at least the following eight needs (‘sets of goals’): (1) biological and physiological, (2) safety, (3) belonging and love, (4) esteem, (5) cognitive, (6) aesthetic, (7) self-actualization – self-fulfilment, realization of one’s potential, and (8) transcendence – serving rather altruistic than egoistic goals, e.g. helping others, nature, universe. Maslow thought that most people pursued their needs in the order above: after one need got relatively satisfied, a person tended to pursue the next one(s) more actively.

Maslow called needs 1-4 above to be *deficiency needs* – when a human being satisfies them, there is no more deficiency in the corresponding satisfiers. The remaining needs were called *being needs*, and Maslow implied that they could never be satiated and, as a person fulfils such needs, (s)he can get even more active in pursuing them. Satisfaction of deficiency needs, in the Maslow's opinion, is necessary for survival, while the same is not true for being needs.

Furthermore, Maslow (1967, 108-109) described a number of values connected to being needs. The list of these values, in my opinion, help understand better what Maslow meant by *transcendence*: truth; goodness; beauty; unity, or wholeness; dichotomy-transcendence; aliveness, or process; uniqueness; perfection; necessity; completion, or finality; justice; order; simplicity; richness, or totality, or comprehensiveness; effortlessness; playfulness; self-sufficiency; meaningfulness.

Maslow's hierarchy of needs has received considerable attention from academics, however, most of criticism and suggestions concerned not the needs, but their order or grouping, e.g. a different sequence by Frame (1996), Y-model by Yang (2003) or ERG theory proposed by Alderfer (1969). The former argued that Maslow's needs belong to three groups – Existence, Relatedness and Growth, and individuals prioritize one or another group based on their preferences and ability to satisfy the needs of a given group, thus not always following the order proposed by Maslow. Late Maslow (1969) himself stated that an order in which needs were chosen to be satisfied could be any, yet this fact is not always mentioned by psychology textbooks (Koltko-Rivera 2006, 302).

Maslow's needs are 'sets of goals' or, in my terminology, need groups, allowing inclusion of needs not mentioned by Maslow, as I will demonstrate below.

Positive regard can be seen as another human need (Rogers 1951). Rogers argues that it is a necessary pre-requisite for self-actualization. Positive regard, ideally, should be unconditional, which differs it from the Maslow's *esteem* need. It can be counter-argued, however, that positive regard is a part of *belonging and love* need, especially if we take into account that Rogers explored the need for positive regard in the context of mental illness (positive regard from the therapist) and childhood (positive regard from parents) – the contexts in which empathy and emotional connection obviously play an important role, and approval of a subject can be seen as part of them.

Kenrick, Griskevicius, Neuberg & Schaller (2010, 293) suggested updating the Maslow's list of needs by considering modern ideas from developmental psychology. Kenrick et al. proposed seven needs: (1a) immediate physiological needs, (2a) self-protection, (3a) affiliation, (4a) status/esteem, (5a) mate acquisition, (6a) mate retention, and (7a) parenting. The needs 5a and 6a can be seen as variants of Maslow's need (3) belonging and love, and the need 7a can result from an individual combination of Maslow's

needs e.g. (7) self-fulfilment, (3) belonging and love etc. Thus, I do not consider Kenrick's et al. update to be sufficiently innovative so as to represent an interest for this research.

Maslow's hierarchy of needs described individuals, not groups. Some authors attempted to liquidate this blank space by developing similar classifications of needs for groups. Similar to deficiency needs and being needs, Herzberg (1964) proposed to classify motivational factors at work into hygiene factors and motivators. Similar to three groups of needs proposed later by Alderfer (1969) (see above), McClelland (1961) proposed Achievement, Affiliation and Power groups of human needs in the managerial context. They can also be compared with Maslow's *self-fulfilment* (Achievement), *belonging and love* (Affiliation), and *esteem* (Power) needs. Barrett (1998) proposed a seven-level hierarchy of consciousness that, in his opinion, fits both individual and group contexts. The seven levels are: survival, relationship, self-esteem, transformation, internal cohesion, making a difference, and service. Less obvious from their names, *transformation* can be compared with Maslow's *cognitive need*, *internal cohesion* with *self-actualization*, and the last two – *making a difference and service* – are similar to *transcendence*.

An interesting content-based alternative to the lists of needs is Schwartz' theoretical model of human values (1987; 1994). It is based on two dichotomies: change – conservation and egoism ('self-enhancement') – altruism ('self-transcendence'). He uses them to organize human values in a circular way on the two-dimensional map – see Figure 1 below.

The surveys used by Schwartz (so called SVS, Schwartz Value Surveys) employed over 56-57 values (Schwartz 1992; 2005). Although he opposed to Rokeach' distinction between terminal and instrumental values (Schwartz 1994, 35), he differentiated them in the surveys by listing 30 values as desirable 'end-states' and 26-27 values as 'ways of acting'. Schwartz did not view them as a finite list of values, but rather as aspects of the ten broad motivational goals that he included into the framework: *conformity, tradition, security, power, achievement, hedonism, stimulation, self-direction, universalism, benevolence*.

I list the 57 values (Schwartz 1992; 1994; Schwartz & Sagiv 1995) here for convenience of the reader, as they can arguably be considered as needs.

Terminal values: *authority, creativity, equality, exciting life, family security, freedom, inner harmony, mature love, meaning in life, national security, pleasure, politeness, privacy, reciprocation of favours, respect for tradition, self-respect, self-discipline, sense of belonging, social justice, social order, social power, social recognition, spiritual life, true friendship, unity with nature, varied life, wealth, wisdom, world at peace, world of beauty*.

Instrumental values: *accepting one's portion in life, ambitious, broad-minded, capable, choosing own goals, clean, curious, daring, devout, enjoying life, forgiving, healthy,*

*helpful, honest, honouring of parents and elders, humble, independent, influential, intelligent, loyal, moderate, obedient, observing social norms, preserving one's public image, protecting the environment, responsible, successful.*

By proposing a 360-degree typology for human needs Schwartz attempts to create a basis for a 'theory of the universal content and structure of values.' (Schwartz 1994, 878) Although the following seems difficult to prove, one can imagine that any new human needs can be accommodated by this model, because the need can be somehow related to the two underpinning dichotomies.

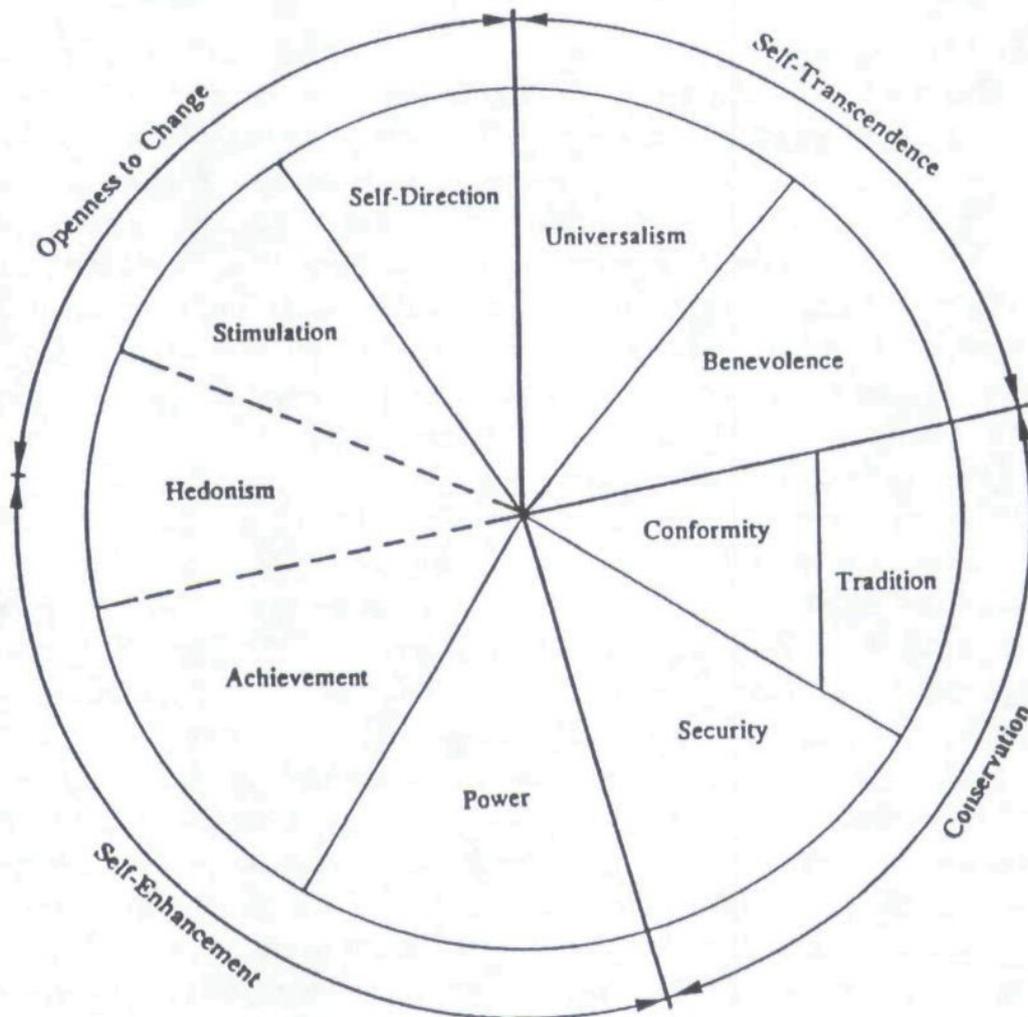


Figure 1 Theoretical model of relations among motivational types of values, higher order value types, and bipolar value dimensions (adapted, with permission, from Schwartz, 1992). (Schwartz 1994)

Certain similarity between the two heterogeneous models – Schwartz' of values and Maslow's of needs – can be noticed if we follow the Schwartz' circle round the clock from the Conservation domain to Self-Transcendence. An important difference, however,

is that Schwartz postulates that humans are unlikely to pursue combinations of opposite needs (1994, 882). Another noteworthy difference is that Schwartz' work aims to combine both individual and group values in one framework.

Similar to Schwartz model, Inglehart-Wenzel cultural map (World Values Survey 2018) ranks values in cultures along two main dimensions: traditional – secular-rational, survival – self-expression. Being less specific than Schwartz' model, this map would not be productive for this research. The same can be said about a number of other frameworks for values that are more about *how* than *what*, including those called 'cultural dimensions' – e. g. Hofstede's (Hofstede 1991; Hofstede, Hofstede, & Minkov 2010), Lewis' (1996), and Trompenaars' (Trompenaars & Hampden-Turner 1998).

Max-Neef (1991) takes further the discussion about interrelationship of needs by also classifying their satisfiers. In his opinion, humans have nine needs: *subsistence, protection, affection, understanding, participation, idleness, creation, identity, freedom*. The satisfiers for them can belong to the types of being, having, doing, interacting, which can be illustrated in a matrix of 36 cells (ibid. 32-33). Max-Neef distinguishes singular and synergic satisfiers from inhibiting, pseudo-satisfiers and destroyers. Singular ones satisfy one need only, while synergic ones contribute to satisfaction of several needs. Inhibiting, pseudo- and destroyer satisfiers, correspondingly, impede satisfaction of other needs, create false impression of satisfaction and may impede true satisfaction, or make it impossible to satisfy one or more needs, e.g. because of fear connected to protection need. This systemic view opens up another dimension of relationships between human needs – not according to their priority or logical compatibility, but through the content of need satisfiers.

If we compare Maslow's and Max-Neef's lists of needs, *participation, idleness, creation, identity* and *freedom* do not seem to have close equivalents among the Maslow's needs, while *subsistence, protection, affection* and *understanding* are similar to Maslow's biological and physiological needs, safety, belongingness and love, and cognitive needs. Both classifications call *needs* what I call *need groups* in this work.

Lexical analysts (see e.g. Aavik & Allik 2002; Renner 2003; Crețu, Burcas & Negovan 2012; Raad, Morales-Vives, Barelds, Oudenhoven, Renner & Timmerman 2016) contrast theory-driven approaches by constructing lists of values from the lexicon of a given language. In the process, the researchers consider up to several hundred values. Although psycho-lexical research has not yet achieved global or broad international scale to be suitable for this study, the findings of Aavik & Allik (2006) deserve some attention. The authors suggest that there are also 'negative' values – things people want to avoid, and that their structure is not symmetric to the one of positive values. I could compare them to the *destroyers* as defined by Max-Neef (1991, 31), but Aavik & Allik propose that negative values are semi-dependent on positive ones, and there may be situations in which human motivation is influenced by an external factor connected to a negative value solely

(e.g. (avoidance of) deception) that does not have its opposite in the structure of positive values.

Coming back to the task in this stage – finding out known needs, I do not need to discriminate any of the typologies above. I will compare the extant knowledge with the identified probable future human needs later in order to check if the identified needs can be considered new.

The range of known needs varies a lot, depending on the approach: some authors name just a few, while others speak about hundreds. While there seems to be no persuasive evidence for Maslow's hierarchy (Wahba & Bridwell 1976, 233), I find it convenient to refer to Maslow's classification of needs in the first place as one of the most comprehensive in the field and sharing obvious similarities with most of other relevant approaches, as I have demonstrated above.

The priority of two need groups – *physiological and biological needs*, and *safety* – was verified (Cofer & Appley 1964, 684) and seems to be a matter of broad academic consensus today. As introduced in the subchapter 2.1 above, I call these two groups together *basic needs* here, in opposition to all other needs that I *optional needs*. Distinguishing between *basic needs* (cf. *security* needs proposed by Schwartz, *subsistence* and *protection* proposed by Max-Neef etc.) and *optional needs*, seems possible in spite of the criticism (Wahba & Bridwell 1976, 234; Leontiev 2008, 451) that Maslow described needs (*need groups* in my terminology here) in a loose, vague language that was not very suitable for scientific verification. First, I will not apply this distinction to filter out any possible future needs. Second, the critics of Maslow's theory focus mostly on the sequence of needs, which is not relevant for this study.

## 2.3 How needs are satisfied

How humans choose to fulfil their needs makes the main object of economics (Robbins 1932, 16), among other social sciences. Economists view humans as economic agents that satisfy their needs by using certain resources. The classification of all resources into *operand* and *operant* ones seems to reflect a well-known dichotomy in the Western philosophy – the one between material and immaterial phenomena. Relying on the definitions given by Lusch & Vargo (2014, 57), we can view *operand* resources as objects, on which action is directed. Many of them are tangible and relatively static, e.g. raw materials, land, products etc. The second ones – *operant* resources – are applied to the first ones by economic agents in order to produce desired effects. *Operant* resources are often intangible and dynamic, e.g. skills, knowledge, technology, capabilities etc.

Resources are always limited, in one way or another, e.g. by their quantity or by cost. One type of limitation is competition for resources between different 'agents'. I put the

word ‘agents’ in inverted commas, because the definition of *agency* remains problematic. Absence or presence of free will is seen as the key condition of agency (Schlosser 2015). Hard determinism denies the existence of free will, while soft determinism, or compatibilism, and libertarianism see narrower or broader presence of free will and choice (Blackburn 2008b). Posthumanist views suggest that agency may be attributed to nonhuman entities such as artificial agents (e.g. Chopra & White 2011), whether or not they are considered persons; software (e.g. Macredie & Keeble 1997; Bodén 2013); animals (e.g. Pearson 2015); or materials (Knappett & Malafouris 2008) that can also be seen as non-autonomous co-agents. In other words, some phenomena that economists typically consider resources can be viewed as agents or co-agents. It is also true from the perspective of resource use, as nonhuman agents and co-agents can influence resource availability and allocation and, thus, possibilities for satisfaction of human needs and, hence, the very choice of needs to be satisfied.

The result of satisfying a human actor’s needs is certain increase in the well-being of the actor, also called *value*. According to the paradigm of the service-dominant logic (Grönroos & Voima 2013, 145), value is ‘always uniquely and both experientially and contextually perceived and determined’ by the beneficiary. In other words, value is always subjective.

### 3 RESEARCH METHODS AND MATERIALS

#### 3.1 Overview of methods used in this work

In order to identify probable human needs in the transformed world, I need to perform two tasks: (i) build a comprehensive typology of possible *transformations*, (ii) suggest probable new *needs* in the transformed world under the condition that *natural humans* can live *decent lives*.

To solve the first problem, I completed the following sequence of steps: (1) building a model of the human world using *systems thinking*; (2) identifying types of changes that seem transformative through *horizon scanning*; (3) filtering out *transformative* changes by checking whether the model of the world tolerates them or needs to be changed if they occur. Finally, to solve the second problem, (4) I continue using the *systems thinking* approach: I apply each of the transformations to the model of the world and check what changes to human needs each type of transformation is likely to cause.

*Systems thinking*, often used as a synonym to *systems theory*, is a holistic approach to studying complex systems. In distinction to an analytical approach where a system is studied by considering its constituent parts, systems thinking focuses on the relationships: between parts of one system, between a system and its environment, and how these relationships develop in time (Hammond 2013, 980). Studying relationships, or exchanges between the system elements, can help identify how change in one element of the system causes change in another element. One way of describing the relationships is through modelling, i.e. ‘generation of a physical, conceptual, or mathematical representation’ of a phenomenon (Rogers, 2019).

I decided to build a model of the world in order to enable distinguishing between transformative and other changes. An alternative approach could be, for example, through a precise, delimiting definition of *transformation*. I found the alternative approach less suitable because of very broad meaning of this word that is synonymic to *change*. By using a model, I can define transformations in a more precise and relevant way.

I selected horizon scanning, or environmental scanning, as the method to identify possible changes that seem transformative. I preferred a non-participatory method of data collection over participatory ones because the topic of this study is likely to be too challenging for a short period of time during which participatory events are conducted. As shown below, transformations are not the easiest things to imagine and just a few types of them were suggested through the course of the recent century. Such ‘ivory tower’ methodological approach that does not require a researcher to be actively engaged in creation of research materials (Fisher 2010, 45), e.g. through interviewing or co-working

with some actors, has another potential benefit of lessening the researcher's impact on the source data.

Step (3) above is based on two previous steps and involves further use of the model, namely logical control of its ability to describe a possibly changed world. If the model requires a significant modification, then the corresponding changes to the world are considered transformative.

After the list of possible transformation types is built, I use logical thinking and systemic approach conceived in the previously built model to suggest probable new human needs that might appear in case of each of the identified transformation types. *Logical thinking* here denotes reflecting reality with theoretical concepts, and reasoning according to the rules of inference suggested by classic (Aristotelian) logics.

An alternative to this step could be pure imagination because the futures research in this field is non-existent, to the best of my knowledge, and neither do relevant methodological practices. Tools that are suitable for more complex phenomena, e.g. scenarios, trend analysis, cross impact analysis etc. are unlikely to be productive for the purpose of this study for the level of uncertainty is extremely high in the far futures. On top of that, as mentioned above, the nature of relationship between human needs and environmental factors remains problematic, and academic views vary between the two opposite concepts – determinism and libertarianism. Such loose foundations would be complicated additionally by unclear time horizons: some transformations can happen instantaneously, while some may take millennia. Hence, the condition of any related factors would be difficult to suggest.

I check the identified new probable needs against the existing knowledge and examine if they can be considered new. To do so, I employ general logical methods, common to formal analysis.

### **3.2 Building a model of the human world using systemic approach**

Oxford Dictionary of Philosophy (Blackburn 2008c) defines a *model* in science as '*A representation of one system by another, usually more familiar, whose workings are supposed analogous to that of the first.*' One might object to the use of the word *system*, which presupposes complexity, in this definition, because not every phenomenon whose behaviour is modelled is seen as complex. A drawing of a ball can serve as a functional model even if the ball is viewed as an indivisible thing.

Modelling is a widely used technique, not only in academic disciplines, but also in everyday life. Merriam-Webster dictionary (2018a) lists fourteen meanings of the word *model*. I, therefore, need to stress explicitly that I use modelling here as a *systemic* method to describe a complex phenomenon.

Systems thinking places emphasis on links and relationships between elements that are significant for a certain purpose, in the opinion of the observer. In distinction to concepts and theories that describe phenomena as isolated, systemic approaches are used to explore interrelationships and interdependencies between parts of complex phenomena.

There are many types of models and approaches to modelling, and common rules are rare if exist at all, except for specific classes of modelling (e.g. deterministic vs. stochastic models in mathematics). Models are created for specific tasks and, therefore, their properties vary infinitely. Researchers choose the level of abstraction, simplification and other parameters, depending on their task.

Leonard & Beer (2009, 9-12) propose that, to create a model, one should first define the purpose of the corresponding system and then outline the system boundaries, structure, relationships etc. In other words, the choice of the system elements to be included into the model depends on their relevance for the system purpose.

To build a model, one needs certain knowledge of the system that is imitated and sufficient knowledge of the analogous system that will be used to imitate the first one.

As for the first, it may be useful to begin from the general classification of systems suggested by Ståhle (2008). She describes three paradigms in systems thinking – *closed*, *open* and *dynamic* systems – and argues that a researcher must define his/her point of departure by referring not to systems thinking in general, which would be meaningless in the absence of a universal systems theory, but to one of these complementary paradigms (ibid. 6).

Ståhle explains the main opposition between *closed* and *open* systems through absence or presence of exchange of matter or energy with the system environment. This difference was a pre-condition of another one – closed systems were seen as controllable and predictable, following certain laws like in Newtonian physics, while open systems tended to be seen as adaptive and less stable, fluctuating around the state of equilibrium. The word *dynamic* in the dynamic systems paradigm refers to internal state of the system. In distinction to the two types above, dynamic systems are seen as having no pre-determined laws or rules to follow, often being imbalanced, but they are self-organizing, self-renewing and self-transforming (ibid. 3-6).

As I explore the system's reactions to changes coming potentially from inside and outside, I cannot be grounded in the view that the human world is a closed system in this study. Whether to view it as an open or dynamic one, depends on the knowledge chosen to be used as the analogous system.

An analogous system must allow making conclusions about human needs when certain changes occur to the environment. Although many humanitarian sciences deal with these interdependencies in one way or another – e.g. psychology, philosophy, politology etc. – it is economic science that integrates the two sides – needs and environment – in its main object, which is the choices that humans make (see, for example, Robbins 1932, 16, or

Samuelson 1967, 5 for definitions of *economics*). I do not want to negate the fact that economics draws on other sciences, when human needs are concerned. Instead, I see economic research as comprising and integrating the relevant knowledge about human needs and environment from many other sciences. Economics also explores this knowledge with the similar purpose as I do – for example, one of the main problems in marketing is identifying existing or potential needs (or *need expressions* as I would call them to avoid confusion with the *needs* as defined herein).

Returning to the choice between an *open* systems paradigm and a *dynamic* one, I conclude that my model will need to represent a *dynamic* system. I will not operate with the needs on the level of one person and the laws governing them, as would be common for the open system paradigm. Instead, I will work with aggregates representing the behaviour of many individuals that can be seen as random on the individual level. It is the case of ‘order out of chaos’ as Nicolis & Prigogine (1977), some of the prominent theorists of self-organizing systems, define them. They claim that self-organization is possible not only in physical systems, but also in social and biological ones (Nicolis & Prigogine, 1989).

Thus, I will use modelling to present the human world through relationships between human needs and the environment. To do so, I will aggregate the relevant individual phenomena that can have largely unpredictable behaviour, and will study the interdependencies between the obtained aggregates, i.e. on macro level.

### **3.3 Identifying tentative types of transformative changes using horizon scanning**

*Horizon scanning, or environmental scanning*, is one of the main futures research methods (Slaughter 2005) and, like modelling, it is used so widely and in so diverse ways that defining it seems a difficult problem. Many authors choose to describe it indirectly, by giving examples of its purposes and implementation, or figurative analogies (Slaughter 1999, 442; Slaughter 2005; Loveridge 2009, 127; Bishop & Hines 2012, 176-180; Rowe, Wright & Derbyshire 2017, 224). Sutherland & Woodroof (2009) define the method as *the systematic search for potential threats and opportunities that are currently poorly recognized*. I find this definition comprehensive enough, not field-dependent, and reflecting the general purpose, the content of the method and its important problem – subjectivity, all of which will be discussed below.

The term *environmental scanning* was originally used for the method, but later the UK government reportedly suggested *horizon scanning* in order to avoid referencing to environmental science (Bishop & Hines 2012, 177). I will use the term *horizon scanning* as a full synonym to *environmental scanning*. In doing so, I disagree with Rowe, Wright &

Derbyshire (2017, 226) who claim that environmental scanning is focused on the *current* environment and short term, while horizon scanning is aimed at identifying *future* changes. This difference between near and far future horizon seems blurred. The content of the method – information search – is unlikely to differ substantially either. Another reasonable option seems to support Bishop & Hines' suggestion to use the word *scanning* for both cases (2012, 177).

Aguilar's work (1967) *Scanning the Business Environment* is considered to be the first notable formal description of the scanning methodology (Gordon & Glenn 2009, 46; Bishop & Hines 2012, 178). In particular, he proposed four styles of scanning, differing by their scope and degree of organization (Choo 1995). Two of them are called *viewing*, to reflect that the scanner does not seek information actively, but chooses to perceive it, e.g. by consuming online or printed news media. *Undirected viewing* refers to a broad scope – a scanner does not discriminate sources by their topic, in distinction to *conditioned viewing*, where a scanner gets acquainted with the sources that are relevant for his/her/its issue or topic – e.g. fashion industry. The other two types of scanning are called *searching* and denote a more active effort of the scanner who seeks information instead of just getting acquainted with whatever catches his/her/its attention. *Informal searching* refers to irregular or limited activity e.g. checking only one type of sources or improving one's potential exposure to the relevant news. *Formal searching* denotes a planned, systematic effort in order to obtain the necessary data, e.g. through use of a comprehensive set of keywords in internet search or through academic research. In Aguilar's terms, I use formal searching, because I follow a specific interest, I search for relevant information actively, and I structure my search in order to improve its effectiveness and efficiency.

Igor Ansoff (1975) influenced the development of the method by proposing the Strategic Early Warning System. As a part of strategic foresight activities, such a system was intended to aid in identifying potential changes, as well as implications of the organization's choices. In order to have as long time as possible before a change occurs, it is vital to begin anticipating it early by noticing so called *weak signals* – "... warnings (*external or internal*), events and developments which are still too incomplete to permit an accurate estimation of their impact and/or to determine their full-fledged responses." (ibid. 12) Hiltunen (2008a) relied on semiotics to suggest a deeper understanding of weak signals through a triadic model of *future sign* – a combination of an issue, a signal i.e. available information about the issue, and interpretation. In other words, Hiltunen proposes a framework connecting the real world, information about it and subjective representations that people may have about the real world. The model of *future sign* may potentially lead to development of metrics for significance of weak signals and, thus, help improve horizon scanning techniques.

Although weak signals have become one of the central elements in scanning and gained significant academic attention (Hiltunen 2008a, 247), I see them as moderately

relevant for this research. First, this study is not limited by any foreseeable *time horizon*, and signs of possible transformative changes that are of interest for this research may be absent in the present. Second, I do not estimate the *probability* of specific scenarios, for evaluation of which weak signals are often sought. I am more interested in *future images* – ideas of specific future states (Slaughter 1995), descriptions of what can happen, even if the probability of a given future state to materialize is extremely low.

Amanatidou et al. (2012) distinguish between bottom-up and top-down approaches to scanning that they call, correspondingly, *exploratory* and *issue-centred* scanning. The difference between the two is the moment when hypotheses about future are developed – before or after the scanning. If a hypothesis – a scenario or an image of the future – is developed before the scanning and the scanning is used to evaluate the probability of the hypothesis to come true, the scanning is called issue-centred. And vice-versa – if the scanning is used to build one or several hypotheses about the future, it is exploratory. The two types of scanning are complementary – as the authors suggest, one can use exploratory scanning first to build the hypotheses and issue-centred scanning later to test them.

This study is based on exploratory scanning because I aim to build a list of transformations *as a result* of the exercise. Amanatidou et al. (ibid.) proposes the following algorithm for this type of scanning: (i) search scoping, (ii) scanning – collecting the data and getting acquainted with it, (iii) preliminary filtering – assessment of the obtained information, (iv) clustering of signals. This sequence of steps is relatively short and includes the phases that seem to be common for all scanning exercises: search scoping that answers the question ‘What do we seek?’, search itself and analysis of search results.

Depending on the scanning purpose, other authors proposed different algorithms for scanning. Day & Schoemaker (2006) suggest a seven-step approach that, in addition to the three common steps I mentioned above, includes additional testing of the scanning results and a series of post-scanning activities to create lasting improvements for an organization. Sutherland, & Woodroof (2009, 524) detail scanning into *scoping, gathering information, spotting signals, watching trends, making sense, and agree the response*. However, these and other examples (Pashiardis 1996; Zhang, Majid & Foo 2010; Guion, 2010; Könnölä, Salo, Cagnin, Carabias & Vilkkumaa 2012) show that the general steps – scoping, searching and analysing – remain present, while the variety of approaches to scanning is practically endless and can be customized according to the needs of the client, usually by adding additional activities to the main three ones. This research has also followed these three main steps.

### 3.3.1 *Scoping, or selection of data sources*

Based on years of research in public policy domain, Molitor (2003) argues there are patterns of change, of which he identified more than one hundred, including patterns for ‘emerging issues’ – series of events developing into major changes and for spreading of ideas. In particular, he implies that the leading advocates of change – i.e. those who begin disseminating certain new ideas are likely to be *innate innovators* (e.g. A. Einstein), *leading experts*, *victims*, *deviant types*, ‘*gloom and doom peddlers*’ (e.g. Club of Rome), *revolutionary-minded types* and others. As for spreading of ideas, Molitor argues that they also follow a certain pattern in written data sources (see Figure 2). The sources that are likely to describe new ideas first are *artistic, poetic works; science fiction; fringe media, underground press; unpublished notes and speeches; monographs, treatises; scientific, technical, professional journals; highly specialized, narrow viewpoint publications* etc.

The results Hiltunen (2008b, 32) obtained as a result of a survey, trying to rank data sources for weak signals, differ noticeably from the propositions of Molitor. Top ten sources include *scientists/researchers, futurists, colleagues, academic and scientific journals, reports of research institutes, consultants in areas other than futures, popular science and economic magazines, television/radio, educational and scientific books, Internet: companies’ or organizations’ web pages*. *Science fiction* was ranked sixteenth, *marginal/underground press* twentieth, *artists* twenty-seventh and *art exhibitions* last out of thirty-six. Hiltunen, however, does not specify the reasons why respondents ranked sources as better or worse, their judgements can be based on the totality of source characteristics, including, for example, source accessibility or convenient form of information, while Molitor emphasizes the order in which ideas appear in different sources.

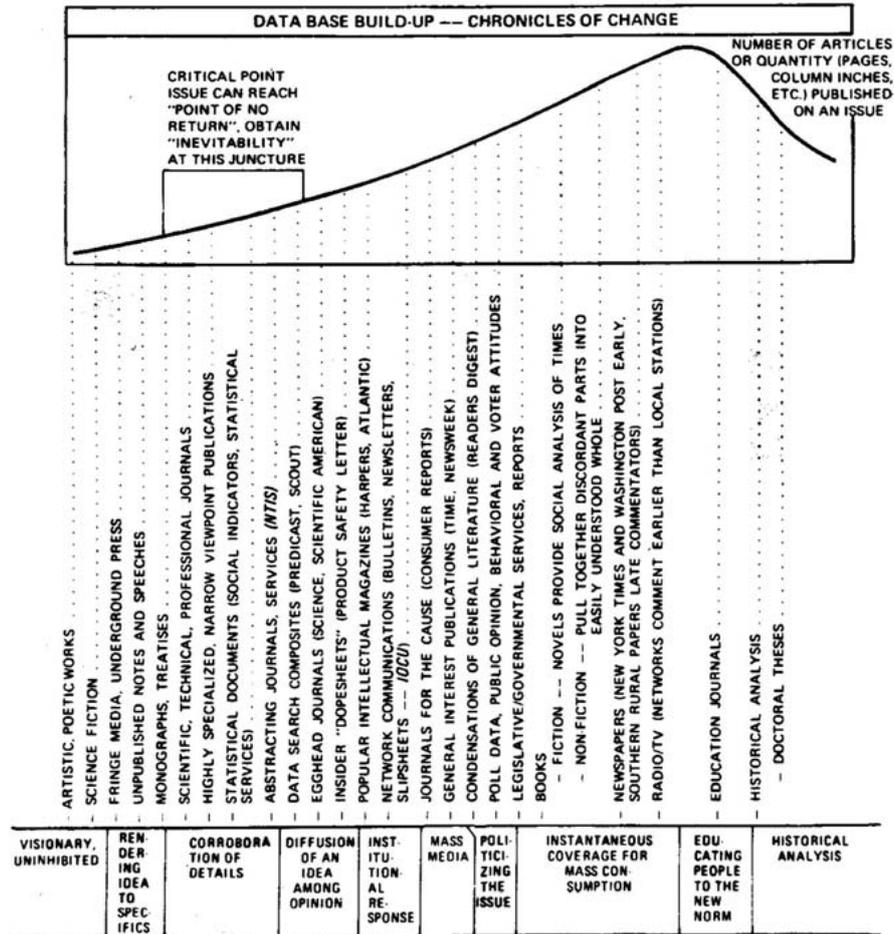


Figure 2 Leading literature. (Molitor 2003)

The taxonomy of sources proposed by Molitor illustrates one of the main difficulties in horizon scanning: early information about new things is not easy to find. As noted by Bishop & Hines (2012, 180-181), it can be compared with a needle in a haystack, because the amount of ‘noise’ is high compared to the amount of the valuable data. Scanners, therefore, always need to prioritize some sources over others, which leads to another problem – subjectivity in filtering. Historically, this problem has been overlooked. For example, works about scanning published in 1970-80s accentuate mostly on the complexity of environment (see e.g. Terry 1977; Thomas 1980; Fahey, King & Narayanan 1981; Narchal, Kittappa & Bhattacharya 1987). Later on, scientists began to turn their looks also inward the scanning subject. Thus, Lauzen (1995) concludes that organizational culture influences scanning structure more than environmental complexity. Furthermore, the personality of the scanner receives attention as a significant factor of the scanning effectiveness. Zhang, Majid & Foo (2010) argue that information literacy skills are important for scanners, and Rahim & Marvel (2011) emphasize the impact of emotional intelligence on scanning outputs, in particular, on information exchange between members of the

scanning teams. Inayatullah (2014, 5) proposes that, to make futures research ‘epistemologically clean’, a researcher shall reveal his/her personality by making known the personal ‘story’ – some important events that shaped him/her. In other words, if we cannot bypass our personality, we should at least reveal it to make possible for others to detect possible influence it produced on the results. Nyman (2011) goes further and argues that a theory of observation and observer needs to be developed to enable finding optimal ways of gathering data about environment. For example, an observer effect that was demonstrated empirically for quantum physics (Buks, Schuster, Heiblum, Mahalu & Umansky 1998) may also be explored for other observation contexts: does the observed reality get affected by the act of observation?

To improve the transparency of this study, I have made the disclosures I deem necessary, in the *Introduction* chapter. I have also detailed my steps and methodological decisions related to scanning below.

The choice of data sources is partly a practical problem. For example, it is near to impossible to reach many early data sources mentioned by Molitor, such as unpublished notes and speeches and underground press. Obviously, written sources and audio/video recordings are technically more accessible than oral or non-recorded sources because of the scarcity of time and other resources that the scanner employs. Therefore, I also had to limit myself to written/recorded sources in this study.

Smith, Cook, & Packer (2010) identified three most important criteria for assessing the value of data sources: *coverage*, *quality* and *efficiency*. They quantified *coverage* as ‘approximate percentage of relevant information’ and *efficiency* as time needed to identify potentially significant data, measured in minutes. The authors used their judgement to evaluate *quality*: they sorted sources into several groups based on the relative reliability, accuracy and objectivity.

These criteria are partially relevant for the study. Although some periodicals are more likely to publish relevant data, their *coverage* is nearly impossible to measure in advance for a less mundane topic like the one hereof. A probability of identifying relevant material for this study in a child’s picture seems not to be lower than in a scientific journal.

When understood as ‘reliability, accuracy and objectivity’, data source *quality* is not of high importance for this work. The purpose of my scanning exercise is to identify possible transformative changes of the human world. I seek diverse images of the future – ideas about what future may be, and I am particularly interested in the images that differ significantly from the today’s world. As I do not limit the study with a particular time horizon, I consider all ideas about future possible. Thus, the *quality* of these ideas is very difficult, if not impossible to evaluate, and I do not make distinctions by this criterion.

Along with that, it needs to be stressed that I seek ideas *about future of the human world*, and they need to be differentiated from ideas about the existing, past or non-human worlds that can be found, for example, in some pieces of fantasy literature. Although no

strict borders can be drawn between fantasy and science fiction, the latter seems to have a more direct connection with the study.

*Efficiency*, or time to identify relevant information, depends not only on the properties of the data source, but also on the tools employed. As digitization megatrend continues, more and more sources become available digitally, some in searchable formats. Accordingly, more possibilities appear for development of automated systems (e.g. outlined by Elofson & Konsynski 1991; Mayer, Steinecke, Quick & Weitzel 2013; Omran & Khorshid 2014), including ones for web-based horizon scanning (e.g. Palomino, Taylor, McBride, Mortimer, Owen & Depledge 2013). Rowe, Wright & Derbyshire (2017, 226) summarize (based on Kahneman 2011, 241; Makridakis & Bakas, 2016) that machines can outperform humans in identifying weak signals. However, the available techniques are mostly quantitative, statistical (see e.g. Priebe, Solka, Marchette, & Bryant 2012) and are aimed at identifying ongoing or near-future changes. A customized idea-generation software, for example, one based on TRIZ (Altshuller's theory of inventive problem solving), could potentially be a useful contributor to the task. Provided that certain technical conditions are present, combining scanning with online games also looks like a promising option for generation of additional ideas about a topic (Gale & Breed 2013). The idea to use pre-developed scenarios for scanning (Rowe, Wright & Derbyshire 2017) seems less useful for this study, because scenarios are likely to work as limitations and kill the purpose of the exploratory exercise – building a comprehensive typology of transformative futures.

The time needed to access a non-digital data source is usually significantly higher than time to detect some relevant data in the digitally accessible data source, even if its format is not searchable. The difference can be dramatic – weeks against seconds. Consequently, I prioritized digitally available sources, although I agree with Culnan (1983) about the importance of all sources, including hardly accessible ones. I used non-digital sources occasionally and sometimes intentionally, when I had grounds to believe that they contained relevant data that I did not detect in the digital ones.

Thus, out of the three most important criteria for selection of sources suggested by Smith, Cook, & Packer (2010) – *coverage*, *quality* and *efficiency* – the last one is the most meaningful for the exercise. When *quality* and *coverage* are extremely difficult to evaluate, the best remaining option seems to explore an extensive variety of sources, taking into account mostly practical limitations such as time and ease of access.

Based on Molitor's taxonomy of leading literature (see Figure 2), I chose three broad types of data sources to explore: *scientific* and *artistic* ones, belonging to a class of formal sources, and *informal* sources that are not classified further. (See Appendix 1 for the list of the scanning data sources.) *Scientific* sources are publications in peer-reviewed journals, conference reports, monographs and similar quality academic sources. *Artistic*

sources include mostly science fiction works and images in them. *Informal* sources include mostly recorded oral messages of scientists, fringe media, narrow-field websites, Wikipedia articles, and other publications not verified by scientists. Informal sources also include reviews or diverse rankings of some artistic sources.

### 3.3.2 *Searching*

Choices of searching techniques depended on the type of the data source.

For scientific sources, I used the search function offered by Scopus research database, a reportedly largest database of peer-reviewed literature (Elsevier 2018a).

Before scanning artistic sources, I got acquainted with a number of reviews and rankings of sci-fi movies, animated cartoons and books (see Appendix 1 for their list). This allowed me to build a list of themes in sci-fi works. I deepened my understanding of the themes by getting acquainted with some representative works recommended by informal sources. I also introduced a random element into my scanning by checking the printed sci-fi books in English and Swedish in the Turku city library, Finland, and in the Ålesund city library, Norway, for additional relevant data.

I used informal data sources to get acquainted with the newest scientific discoveries, universal theories and guesses about how they could be developed further. I paid attention to examples of future states given in discussions and narrow-theme websites.

Overall, informal sources turned to be the most useful of the three I used. I attribute it to the broadness of this category: it included both near-scientific and near-artistic sources.

I followed the principle of data saturation (Saunders et al. 2017, 5) to limit the amount of searching: when data from fifty or more new sources of the same type – scientific, artistic or informal – repeated what has already been identified, I concluded that this type of sources had been explored sufficiently well.

Some authors (e.g. Rij 2010; Sutherland et al. 2012) describe collaborative forms of work as having the potential to improve the results of scanning through data exchange and peer reviews. A natural pre-requisite is several people or organizations interested in the topic and able to contribute to the study. The author did not happen to meet any individuals or organizations with an interest to contribute to the study.

Palomino, Taylor, McBride & Owen (2013) warn about instability of search engine algorithms that can impact the efficiency of the scanning. Although they do not mention it explicitly, it seems clear that the risk is more relevant for repeated scanning exercises that are performed during an extended period of time, e.g. several months. This study is based on one-time exercise – I used each search query once only.

Instability of search engine algorithms is unlikely to significantly impact the reliability of this research results. Search queries were the main instrument of searching for *scientific*

sources as I defined them above. These sources are mostly textual, i.e. it is unlikely that advances in searching non-textual information (images, audio, video) will yield significantly different results. My search queries did not use any other criteria than presence of one or several keywords, then I checked the entire array of results manually. It does not seem very probable that advances in search algorithms will significantly affect the results of such type of check: if a word is present in a text.

The reliability of scanning artistic and informal data sources is more problematic to evaluate in view of low accessibility of many such sources, lingual barriers for getting acquainted with them, and partially random searching techniques I used. Although I applied the principle of data saturation to determine the sufficiency of the search effort, more extensive and efficient searching techniques could bring different results for this phase of work. Subchapter 5.5 *Possible criticism* overviews potential problems of the entire study.

### 3.3.3 *Analysis*

I did qualitative analysis of the content of data sources. Hsieh & Shannon (2005) suggest there are three approaches to it: *conventional*, *directed* and *summative*. Conventional approach aims to describe phenomena the way they are, without a-priori theorizing them. The outputs of conventional analysis can be used to build models or theoretical concepts (Lindqvist 1982). Directed content analysis is typically based on certain framework or theory and explores the given content from that perspective. Research data is classified by categories suggested by the theory, although theory extension or development can be sought. Summative content analysis explores contextual meanings of certain words or other lexical units.

From this perspective, my study is conventional. I did not propose certain categories in advance but developed them based on the findings. For textual sources, I did it by following the steps outlined in the overview of qualitative content techniques by Graneheim & Lundman (2003): choosing a *unit of analysis*, *meaning units*, *condensing* and *coding* that I will describe below. By doing theoretical conceptualization after I have obtained the empirical data, I use a grounded theory methodological approach. Glaser & Strauss (1967) first proposed it. It differs, for example, from the hypothetico-deductive approach, in which a theory is defined first, and then empirical data is used to verify it.

Typically, my *unit of analysis* is an entire text, because the meaning of the relevant elements sometimes cannot be fully understood without their context. Where possible, I used smaller units of analysis – e.g. one or several paragraphs. This choice was common for scientific sources because they often do not detail images of the future, but only give a short description or examples of the ideas of future states.

I searched the data sources for relevant *meaning units*, i.e. words or phrases that described ideas of the future states or their aspects. As I sought images of the *future*, I considered relevant only descriptions of such phenomena that (i) would be impossible today, e.g. interplanetary travel or immortality of people; or, if the phenomena are possible today, but represented obvious deteriorations for natural humans from the current state of the world, e.g. a nuclear catastrophe or a slavery-based political regime, the selection criterion was (ii) the globality of the phenomenon. This way I made a distinction between similar existing phenomena, e.g. local catastrophes and local oppressive political regimes, and transformative ones – similar phenomena that reach a near-global scale. Such selective approach also helped me make sure that the collected descriptions refer to changes.

The relevant meaning units were then *condensed*, i.e. shortened to exclude less important aspects, but still to keep the main idea. I usually selected the remaining words from the *meaning unit(s)*. For example, a description of a parallel world that occupies several pages could be condensed to a short label ‘a parallel world of mental projections’.

After a unit was condensed, I *coded* it by abstracting and assigning it a more general label. If I continue the previous example, ‘a parallel world of mental projections’ would be coded as ‘a parallel world’. This operation of abstraction can be compared with going from species to genus in biological classification – similarly, I went from changes to change types.

If a data source is non-textual or combines text with visual information, e.g. an image, a movie, an animation, I generated a code by following a similar procedure: condensing – i.e. choosing the core aspects of an image, and coding – abstracting and assigning a category to it. Coding of visual information is a qualitative approach used in visual analysis (see e.g. Emmison & Smith 2007; Saldaña 2016) and what elements of an image shall be selected as core ones for coding depends obviously on the research aims. In this study, I selected such elements to code using the same criteria as for the futures images presented with text: (i) impossibility now, or (iii) the globality of the currently limited-scale phenomenon. In case of doubts between several ideas of the future, several codes could be assigned to one visual data source (e.g. ‘cyborgs’ and ‘superintelligence’).

After I assigned codes to all the identified images of the future that seem potentially transformative, I continued to aggregate them into larger groups corresponding to the research needs. First, I separated change types that, obviously, are likely to deteriorate the conditions of the natural humans (e.g. ecological catastrophes) from the rest. This operation was necessary because I explore only futures in which natural humans can choose to stay natural and live decent lives. Second, I categorized the change types into *classes* under the elements of the world model I describe in the next chapter. To do so, I sorted every code into a more general category that corresponded to a part of the model. When a change type did not fit any existing part of the model, I proposed adding a new element to the model.

By connecting the identified change types to the model, I linked them to human needs – the main object of the study.

My way to categorize scanning hits differs from environment structuring frameworks that are often used for classifying the results of the horizon scanning, like Porter's five forces or PEST. Before explaining my reasons for not choosing them, I give a brief explanation of these frameworks, not only for reference, but also because they provided some ideas for development of the world model.

Porter's five forces model (1979) is a framework for microenvironment of a company. It provides that the forces impacting the company's situation are *industry rivalry*, *threat of new entrants*, *threat of substitutes*, *bargaining power of customers*, and *bargaining power of suppliers*. PEST framework and its numerous modifications are frequently used to analyse macroenvironment of an organization. Aguilar (1967) was the first to structure environmental factors into four categories: political, economic, socio-cultural and technological, which resulted in PEST abbreviation. Later, different extensions were suggested and change in the order of letters, which resulted in PESTLE/PESTEL, DESTEP, PESTEC etc., where L stands for legal factors, D for demographic ones, additional E for environmental ones, C for cultural ones.

The frameworks mentioned above cannot be used in this study without alteration because they are not comprehensive enough. Obviously, Porter's five forces model is meant for economic sub-system only and it does not account for other subsystems of the human world and outside it. PEST(EC etc.) framework is more comprehensive, but is built around several aspects of human society rather than the entire world. The above frameworks do not seem to suit well the far future horizon and possible transformative changes related to the entire human world, not only some subsystems. For example, it would hardly make sense to classify appearance of superintelligent extra-terrestrial entities using the PEST(EC etc.) framework.

As mentioned above, I found these frameworks valuable for development of the model of the human world presented in the next chapter. Some phenomena Porter and Aguilar used in structuring micro- and macroenvironments – competition and regulation – seem relevant also for theorising possible transformations of the human world.

## 4 RESULTS

### 4.1 Model of the human world

In addition to describing the whole human world, the model of the human world should serve a link between the external environment and human needs. I will also use the model to determine what changes can be considered transformative to the existing human world.

To serve a link between the environment and human needs, the model shall describe the way they interact, i.e. somehow define the role of the human needs in the world. As human needs apparently do not manifest themselves towards the rest of the world other than through *human* choices, *human* action, a complete description of the role of humans in the world is necessarily a complete description of the human needs' role, too. Furthermore, the reverse logic can be argued for: if we describe the role of humans, then we describe the role of their needs and nothing else. This must be true if we assume that human needs are the only source of human motivation, i.e. that humans have free will, and no superior forces like aliens, deities, bacteria etc. guide human choices.

The way the humans (choose to) satisfy their needs has been described in more detail above (see subchapter 2.3 *How needs are satisfied*), according to the service-dominant logic. Motivated by their needs, people satisfy them by using scarce resources, namely by applying operant resources to operand ones.

Currently, as human beings face no significant competition for resources, they can be considered the only *dominant agents* of their world, i.e. the agents who can define what happens with the rest of the world, in spite of possible opposition from other, less powerful agents. Hence, from the perspective of the human needs, the rest of the world is resources, operant or operand.

Figure 3 below provides a graphic representation of this model of the world: the dominant agents apply operand resources on operant resources, ultimately defining the development of the modern world.

The model does not have any feedback loops – links that would imply certain control over the dominant agents, because such links would imply determinism, partial or complete absence of free will that humans are believed to have. Without going deep into the discussion of *determinism – free will* dichotomy, I will only refer to the service-dominant logic theory again. A possible candidate for a feedback loop from this theory could be *value*, a certain increase in well-being that humans may derive as a result of their behaviour. Value is considered subjective and experiential, *uniquely determined in every instance* (Lusch & Vargo 2014, 57). Such a phenomenon cannot be regarded as a determinant and serve as a meaningful feedback loop. Instead, it can be viewed as another way

to describe free will – an agent makes their choices in an individual way and uniquely in every situation.

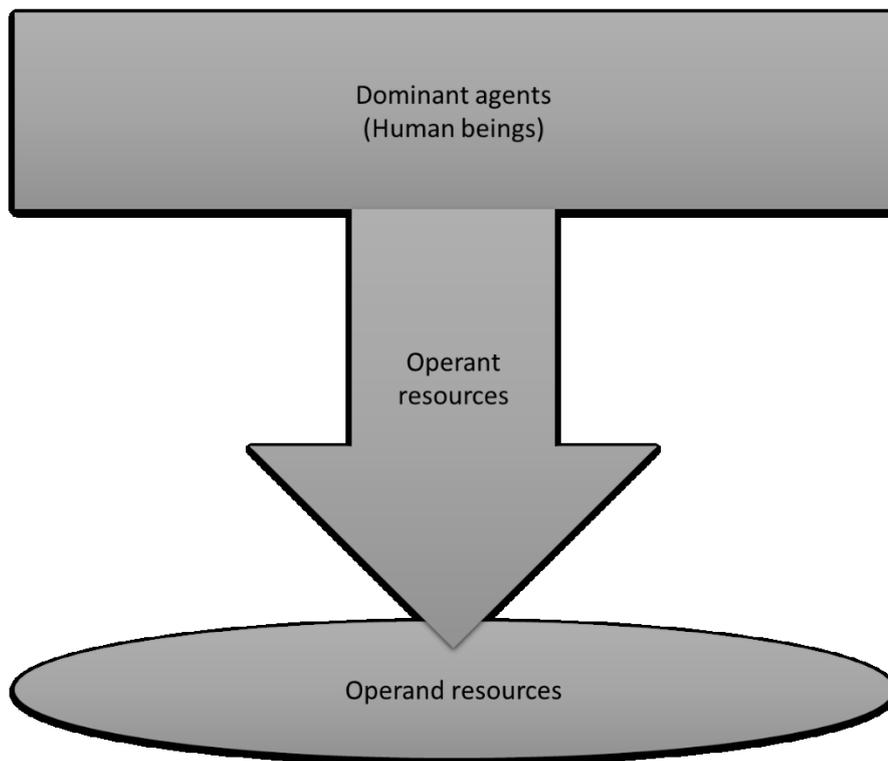


Figure 3 Model of the human world

All the elements of the model – *dominant agents*, *operant* and *operand resources* – can be considered subsystems with one or more components. Obviously, the top-level subsystems of *operant* and *operand resources* include many components – types of the corresponding resources. The *dominant agents* top-level subsystem currently includes one type of agents – human beings, but the environmental frameworks I considered above suggest two possible additions.

By analogy to Porter’s five forces microeconomic framework, one can think of competition to dominant agents. Although humans no longer have *significant* competition, we must not ignore the possibility of its appearance or reappearance. In the past, humans competed for operand resources with many species e.g. animals, plants, microbes etc. Currently people seem to be stronger than other known agents, in the meaning that no other agent type can effectively take resources away from human beings. In the future, however, some existing or new agents may display such capabilities and become significant competitors to humans. Examples of such agents can be entities emerging from the reachable world: bacteria, superintelligence, artificially created human races etc. or from outside, e.g. from the far space or so called ‘parallel’ universes.

Referring to both environmental frameworks mentioned in the previous subchapter, I can also propose an idea of *regulator(s)* to the human world – some force(s) that can alter

the motivation mechanism(s) of natural humans significantly. In distinction to factors that may influence human choices but do not modify the ‘human nature’, e.g. changes in volume of certain resources, *regulators* can change the way the human motivation works. This is a hypothetical concept. The modern human world does not seem to have any scientifically verified regulators, even though the ideas of some entities ruling the human world are not new (e.g. deities, viruses, aliens etc.).

Thus, although *competitors* and *regulators* are non-existing or unknown today, they can be considered theoretical candidates for inclusion into the *dominant agents* top-level subsystem of the model.

## 4.2 Futures images – ideas of significant changes

As a result of horizon scanning, I identified several futures images – ideas about what a significantly changed world may look like in future. As this study is not limited by any specific time horizon, the assumption that *all* of these ideas are possible in the far future seems to be reasonable.

After I generalized and coded these change types, I classified the obtained codes by their relationship to the elements of the model in Table 1. It was done to facilitate further analysis of the transformative potential of the change types.

I listed the codes – change types in the column *Change* of Table 1. Some of them are written in *italics* – this is to mark that such changes seem irrelevant for the study and will not be considered further. They are excluded because they apparently deteriorate the degree to which the needs of natural humans can be satisfied or the possibilities for natural humans to choose to remain such. Such conditions are outside the scope of this research.

*Class* column specifies a class, to which a change type belongs. Three classes – *dominant agents*, *operant resources*, *operand resources* – correspond to the elements of the world model.

*Examples, explanations* column provides some clarifying comments for the convenience of the reader.

Table 1 Possible changes to the human world

<b>Class</b>	<b>Change</b>	<b>Examples, explanations</b>
1. Dominant agents	Aliens	Including living planets, also intelligent planets; superorganisms – multiple organisms of the same species acting in a coordinated manner like one organism; symbiotic organisms

	Altered humans	See examples below – in <i>Alteration of humans</i> , <i>Operant resources</i> category
	Artificial agents	Including simulated (synthetic) consciousness, artificial (synthetic) life
	Demons	Including ghosts
	Hybrids and mutants	Offspring of human and other species, aliens; uplifted species
	<i>Infertility</i>	
	Infomorphs	Entities that consist of information. They have personality, but no physical bodies. Infomorphs include uploaded minds
	Regulators	Scientists, parasites, artificial intelligence, deities, aliens, controllers of simulated reality, aliens, hive mind, progressors – entities from the future who help the existing civilization develop faster or in a certain direction
	<i>Single-gender world</i>	
2. Operant resources	Advanced weapons	Including biotechnology, geoengineering, nanotechnology
	Alteration of humans	Cyborgs; additional or improved senses; intelligence amplification; pantropy – modification of humans for space colonization; fast change of sex; artificial (re)production of human beings: cloning, ectogenesis, parthenogenesis, genetic engineering
	Astronomical engineering	Stellar, planetary engineering, Dyson sphere, terraforming, universe production, energy production
	Clairvoyance	Including precognition, retrocognition
	Controlled plants and animals	Including those controlled remotely, controlled in action or development
	Supermind	Similar to a superorganism (many organisms acting like one), but for minds: multiple minds are acting like one and/or directed from one centre
	Immortality	

	Interplanetary space travel	Faster than light travel and communications; space colonization: embryo colonization, generation ship etc.
	Invisibility	
	Mass surveillance	
	Mind control	Mind reading, memory erasure/editing, mind sharing, mind swap, two or more minds in a body; mind uploading, digital immortality, uploaded astronauts
	Molecular assembler	Disassembling an object into molecules and assembling it back after transportation
	Resizing	Changing the size of the living beings – shrinking or enlargement
	Shapeshifting	An ability to change one's physical appearance completely like, for example, in werewolves
	Superintelligence	As defined by Bostrom (2014, 22), "any intellect that greatly exceeds the cognitive performance of humans in virtually all domains of interest"
	Teleportation	
	Time travel	Including time loop
	Travel to the Earth centre	
	<i>Slavery, reduction of freedom</i>	<i>Birth control, political, theocratic, economic control</i>
3. Operand resources	<i>Apocalypses, catastrophes</i>	<i>including bio- or ecoterrorism, climate or environmental change, world war, pandemics, natural disasters, scientific experiments, extra-terrestrial encounters</i>
	New chemical elements	
	Other worlds or universes	Parallel worlds or universes, artificial worlds, virtual worlds, afterlife
	Portals	Hyperspace, wormholes

## 4.3 Transformative changes

### 4.3.1 Transformation criterion

The next step is to decide what changes can be considered transformative. To do this, I need to define a transformation criterion. If *transformation* is a sort of big change, then I suggest that such change must be bigger than certain threshold.

It seems obvious that a minimal significant change – e.g. a change in one top-level element of the system, when all other top-level elements of the system remain the same, cannot be considered transformative for the entire system. Something is called a system if its parts are connected, related. If a change in one part does not influence these relationships or other system elements through these relationships, the change cannot be called systemic.

Hence, to be considered transformative, a change must occur in more than one top-level element of the system. ‘A change in more than one element’, i.e. a change in either two or three elements, seems to be a sufficient criterion of transformation in the three-element model used here because the majority of elements will need to change then. If the model would include more elements, a higher threshold could be established as a criterion of transformation.

But what exactly shall we consider a ‘change’, a ‘change in one element’? How big or what kind of change is meaningful for exploration of transformations of the world? We need a criterion to establish clearly if a relevant change occurs or not.

I would begin by asking what kind of changes there can be. One of the most general ways to describe changes is to classify them into quantitative and qualitative. Let us consider if each of these change types can be meaningful for our problem.

*Quantitative* change in one top-level element, subsystem of the model, can be understood as an increase/decrease of number of elements in that one subsystem. If such an increase/decrease in one subsystem causes another *quantitative* change in another subsystem, do these two changes together constitute a transformation of the system? My view is ‘no’, for the system still has the same constituents (top-level elements) and functions in the same way. One might say that it is still the same system, just bigger or smaller. A bigger or smaller cat is still a cat. If, for example, there is more fish (operand resources for humans) in the oceans and it leads to an increase in the number of humans (dominant agents) for there is more food for them, the system still has the same parts and the same relationships between them. Thus, I do not consider purely quantitative changes transformative even if they happen in more than one top-level element.

*Qualitative* change, in terms of our model, can be understood as emergence/disappearance of certain types of constituting elements in one subsystem, or emergence/disappearance of entire subsystems. If we continue the analogy with a cat, a qualitative change can happen if it gets wings – a new operand resource. If it cannot fly, we may even still call it a cat. But if it can fly, i.e. it possesses a new operand resource, we have something radically different from a cat.

A change that may be a sign of the transformed world must, therefore, be qualitative. Then the transformation criterion for the world model here can be made more precise: *there is a transformation, if more than one top-level element of the system changed qualitatively.*

For practical convenience, I will use the words *transformation* and *transformative change* as full synonyms below.

### 4.3.2 *Possible transformations*

The purpose of this subchapter is to facilitate building a comprehensive map of the transformed futures, bearing in mind one limiting condition of this research – natural humans shall be able to live decently. Ideally, we need to know all possible transformations, but in practice a broad range of examples may be reasonably sufficient to suggest the generalized categories of transformations. These categories will further be used for analysis of the impact that different types of transformations may have on human needs.

To arrive to the categories, I will use the identified futures images of significant changes from Table 1 as a source material. I will sort them into transformative or non-transformative for illustration purposes, so as to build a reasonably broad tentative list of possible future transformations. Then, based on the obtained examples of transformations, I propose their typology.

When classifying changes into transformative and non-transformative according to the transformation criterion, one needs to know if a certain type of change in one top-level element is likely to be accompanied with a change in another. As already mentioned in epistemological and ontological foundations of this research, the plurality of the futures makes it difficult or impossible to reach certainty in many questions about future. Neither causality, nor conjunction are easy to determine for far futures, especially if we recall a so-called butterfly effect named after a plot in the literary work “A Sound of Thunder” by Ray Bradbury.

In view of the above, two approaches are possible. First, to recognize that anything can lead to anything and, hence, to count all the identified futures images as potentially transformative. Logical enough, then we also need to add that everything else, any phenomenon at all can also become transformative in the far futures. I see nothing wrong in

that, but it leaves us with nothing better than impossibility to explore futures in a meaningful manner. The second approach can be to follow the identified futures images and determine their transformative nature based on the details that were given in the respective data sources. In this case we end up with fewer images of transformations, but they are based on at least someone's intuition, fantasy or scientific hypotheses. An additional argument is that, being known to more or less wide audiences, such ideas also have chances to become self-fulfilling prophecies. To conclude with, the second approach is better than nothing at all, which is practically the case with the first approach. If I continue following the critical realist stance and believe that learning about futures is possible, and that use of reasoning allows nearing the truth, then the second approach seems to offer a first step in this direction.

The second approach is to check the discovered futures images for compatibility with the transformation criterion. Table 2 below presents the results of such analysis. The relevant details of the futures images were used to determine if an image of a change in one top-level element was likely to be accompanied by a change in another top-level element of the model.

If a futures image recurred in several data sources, it was counted as *transformative* if it satisfied the transformation criterion in at least one data source.

Table 2 is organized as follows. The first column, counting from left to right, contains the name of the world model's top-level element, with which a futures image was associated in Table 1 above. The second column contains the name of the corresponding futures image. The third column specifies if the futures image was classified as transformative (*yes*) or non-transformative (*no*). If the futures image was considered transformative, the fourth column lists one or two top-level elements of the world model, in which the accompanying qualitative changes are likely to take place. Finally, the last column gives comments and explanations regarding the reasons of the classifying. The changes that are likely to deteriorate the conditions for natural humans – marked with *italic* font in Table 1 – have been omitted from the scope of further analysis and were not included into Table 2. The changes that were classified as transformative are highlighted with bold font in the second column, for practical convenience only.

Table 2 Transformative change types

<b>Class – top-level element (subsystem)</b>	<b>Change</b>	<b>Likely to be transformative (yes/no)</b>	<b>Likely to be accompanied with a change in top-level element</b>	<b>Comments</b>
1. Dominant agents	<b>Aliens</b>	yes	operant resources	Can have more advanced technologies and/or additional capabilities compared to what humans have.
	<b>Altered humans</b>	yes	operant resources	Can have new capabilities, e.g. be able to fly.
	Artificial agents	no		Unless superintelligent (superintelligence is classified below).
	<b>Demons</b>	yes	operant resources	By definition, they have some abilities that are not available to humans.
	<b>Hybrids and mutants</b>	yes	operant resources	Some of them have abilities to cause storms, be telepathic etc.
	<b>Info-morphs</b>	no		They are ‘limited’ versions of other entities with physical bodies.
	<b>Regulators</b>	yes	operant resources	By definition, they have some new capabilities that the current dominant agents lack: to alter the motivation mechanism of human beings, e.g. living planets with such abilities, parasites etc.
2. Operant resources	Advanced weapons	no		Limited applicability, some similar technologies already exist. The change may be quantitative only.

	<b>Alteration of humans</b>	yes	dominant agents / operand resources	Altered humans are likely to become significant competition or new dominant actors because of their superior abilities compared with natural humans. They may also get access to new operand resources e.g. by being able to live on other planets having such resources.
	<b>Astronomical engineering</b>	yes	operand resources	Likely to enable access to new operand resources on other planets.
	<b>Clairvoyance</b>	yes	dominant agents / operand resources	It is likely to create superpowerful entities, potentially regulators, and to enable/facilitate access to new operand resources, e.g. information that is not available to natural humans at the same time.
	Controlled plants and animals	no		The change may be quantitative only. Potentially insufficient advances for getting access to new operand resources or creating new dominant agents. Some technologies with similar effects exist already.
	<b>Supermind</b>	yes	dominant agents	It is likely to create superpowerful entities, potentially regulators.
	Immortality	no		A quantitative change only.
	<b>Interplanetary space travel</b>	yes	operand resources	Likely to enable access to new operand resources.
	Invisibility	no		Limited applicability, some relevant technologies exist already.

	Mass surveillance	no		The change may be quantitative only. Limited applicability, many relevant technologies exist already.
	<b>Mind control</b>	yes	dominant agents	Similar to altered humans and superminds. By definition, can lead to emergence of regulators.
	<b>Molecular assembler</b>	yes	operand resources	Likely to facilitate access to new operand resources by facilitating interplanetary space travel and enabling replication.
	<b>Resizing</b>	yes	operand resources	Likely to facilitate access to new operand resources by facilitating interplanetary space travel.
	<b>Shapeshifting</b>	yes	dominant agents	This capability may facilitate domination of shapeshifters over other agents because shapeshifting, like alteration of humans, can be a way of obtaining other desired capabilities.
	<b>Superintelligence</b>	yes	dominant agents / operand resources	It is likely to create superpowerful entities, potentially regulators, and to facilitate/enable access to new operand resources.
	<b>Teleportation</b>	yes	operand resources	Likely to facilitate access to new operand resources on other planets.
	<b>Time travel</b>	yes	dominant agents / operand resources	If combined with the ability to change future or past, may lead to emergence of significant competition or regulators and/or enable access to new operand resources, e.g. things from the future that are not

				available to contemporary dominant agents.
	Travel to the Earth centre	no		A quantitative change only, unlikely to enable access to qualitatively new types of operand resources.
3. Operand resources	New chemical elements	no		A quantitative change only, e.g. stronger, lighter, can generate more energy and/or cause certain influence on health and personality. Some similar technologies exist.
	<b>Other worlds or universes</b>	yes	dominant agents	Can be a source of significant competition to humans, e.g. aliens with superior abilities or technologies.
	<b>Portals</b>	yes	operand resources	Similar to interplanetary space travel or time travel, likely to enable access to new operand resources.

#### 4.3.3 *Typology of possible transformations*

Two thirds, or 24 out of the 36 pre-selected futures images, were considered transformative as a result of checking them against the transformation criterion. These remaining futures images are distributed between all the three classes: *dominant agents*, *operand resources* and *operand resources*.

Using the ideas from the Porter's five forces and PEST frameworks, I can further classify the transformations belonging to the *dominant agents* class into two groups: (i) *significant competition* (e.g. aliens, altered humans, demons, living planets, shapeshifters, superorganisms) and (ii) *regulators* (e.g. scientists, parasites, artificial intelligence, deities, aliens, hive mind, progressors, people being in simulated reality). It follows from the difference between the former and the latter that *significant competition* may present a threat to humans and the outcome of possible conflict is not certain, i.e. humans may remain dominant agents, but in the case of more powerful *regulators* – entities capable of influencing human motivation mechanism – human beings lose their position of dominant agents by definition. In other words, *regulators* have a resource that *directly* helps them

dominate over humans, while *significant competition* have some resources that may lead *indirectly* to the same.

To summarize, transformative changes can be (i) *regulators* – actors who are able to manipulate human motivation mechanism, (ii) *significant competition*, (iii) *new operant resources*, and (iv) *new operand resources*. Figure 4 below illustrates a general model of the possible transformed human world. The changes – new elements in the top-level subsystems – are highlighted with bold font. Not all the new elements need to be present in the transformed world – according to the transformation criterion I proposed above, a change in more than one subsystem is sufficient to be considered transformative for the world.

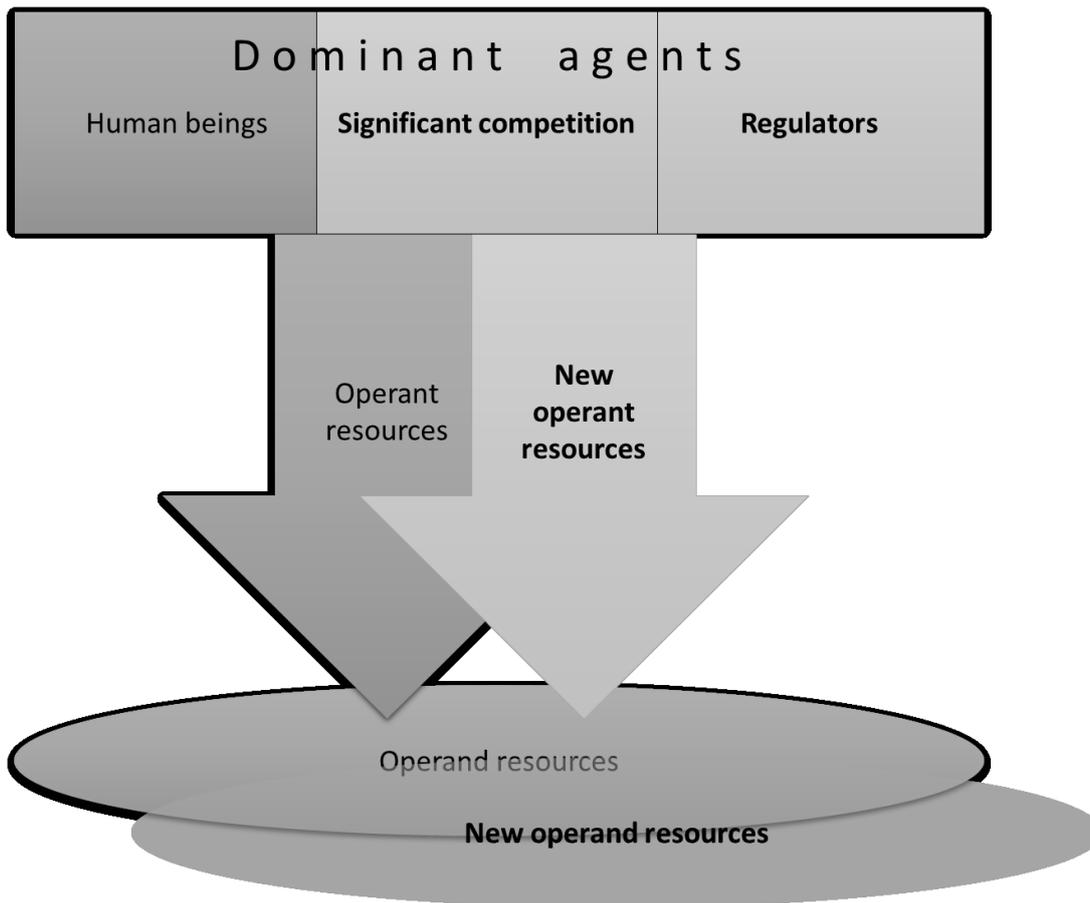


Figure 4 General model of a possible transformed human world

Two side-line observations can be made that highlight the importance of intelligence and transport development for future transformations.

First, if we exclude those transformative changes in the *dominant agents* class over which humans are likely to have no control (e.g. emergence of such regulators and significant competition as aliens, deities, progressors etc.), one can notice that *most* of the remaining types of new *dominant agents* are likely to emerge in connection with the changes classified into the *intelligence-related* subgroup. As emergence of new dominant

agents may lead to competition between them and humans, this observation confirms that *intelligence-related* transformative changes are likely to be associated with high risks for the humankind.

Second, the transformative changes belonging to the classes of *operant resources* and *operand resources* can also be (roughly) resorted into two main subgroups: (i) *intelligence-related changes* (e.g. alteration of humans, mind control, clairvoyance, supermind, superintelligence) and (ii) *transportation-related changes* (e.g. resizing; teleportation; molecular assembler; time travel; interplanetary space travel; astronomical engineering (either products or people need to be transported from/to planets); (access to/from) other worlds or universes; portals). Hence, it seems that high-speed transportation technologies deserve similar attention as intelligence-related developments from anyone interested in transformative changes.

#### 4.4 Probable new human needs

Now that I have identified that all change classes are potentially transformative – *dominant agents*, *operant resources* and *operand resources*, I can analyse whether the transformations of each type can lead to emergence of new human needs.

As mentioned above, possible transformations classified into the *dominant agents* subsystem can be further categorized into emergence of *regulators* and *significant competition*. I defined *regulators* in subchapter 5.1 above as ‘some force(s) that can change the motivation mechanism(s) of natural humans significantly’. Some imaginary examples: an entity able to influence the motivation of people through long-range waves ‘de-activates’ their desire for pro-creation or causes a strong desire to commit a suicide; a parasite living in a human body controls the behaviour of its host by changing the preferences of that human being; aliens able to ‘program’ human reaction for certain signs when a human being comes close enough to a portal – a certain place on the Earth, etc. If regulators do so, the natural humans have no longer the choice to stay such. Such situation is, hence, outside of my research question and I leave it without further consideration. If regulators do not do so or do not do so to all the people, they remain, anyway, a ‘threat’ to existence of natural (unaltered) humans. This case falls into a more general category of emergence of *significant competition*, whose possible impact I consider below.

Arrival of *significant competition* is unlikely to impact human needs, because competition is a historically well-known phenomenon. People competed with their environment and with each other throughout their history. Whether the significant competition defeats humans or gets defeated, whether adversaries choose to cooperate or co-exist without cooperation – these and other paths are not essentially new. It is, therefore, unlikely that the needs of human beings change as a result of emerging significant competition.

New *operant resources* – e.g. skills, knowledge, technologies – also entered the life of people throughout their history. However, unlike adversaries, they seldom went away. Instead, they often build on one another, empowering humans more and more. As resource base grows, the limitations weaken. The cost of acquiring the same good goes down: for example, there might be less urgent need for cooperation, fewer obstacles like natural forces or competition, fewer barriers for large-scale impact, less time needed to reach the same result.

If I take this situation to its extreme, it can be called ‘nothing can stop us’. *If nothing can stop humans from taking any action, what stops them from taking an action with a negative impact on themselves?* Such impact can be caused purposefully or indirectly – e.g. through a sequence of more or less controlled events or through scarcity of resources, which is unlikely to disappear completely. (Even if resource base gets practically unlimited, resources remain scarce in the economic sense for they have certain costs of acquisition and use.)

*If nothing can stop humans from damaging themselves, they need to self-limit.* Whether realized or not, desired or not – this seems to be a new need for the world transformed by the availability of new operant resources, because self-limitation is likely to be required for survival of humans.

The following six paragraphs describe the order of my thinking in more detail. Each of these paragraphs is preceded with the theme thereof written in italic font, to help the reader follow the argument. These themes are given for convenience of reading only, they should not be considered a replacement for the argument itself.

*Humans are more powerful than anything else.* By acquiring new operant resources, humans are likely to make themselves more powerful than any other phenomena. In this case, other phenomena cannot prevent humans from taking any action humans may want. Only humans have the power to do so, i.e. to prevent themselves from taking an action or to limit their own action.

*Humans are effective.* Furthermore, the effectiveness of a human action can be high: a human being is likely to be capable of achieving the aimed result of their action, regardless of other phenomena because human beings are more powerful than any other phenomena.

*Sometimes humans act detrimentally to themselves.* The probability of humans taking an action detrimental to their own interests, from time to time, is higher than zero. This statement is based on what is sometimes called ‘a generally accepted truth’, namely ‘humans make mistakes’. Complexity and dynamism of the human environment, faults of human decision-making abilities, dynamism of human desires, as well as many other reasons make it practically impossible for humans to act, avoiding undesirable consequences completely.

*Some detrimental actions are incompatible with survival of humans.* If humans may take an action that is damaging to their own interests in general, they can also act in a way that is damaging to their survival capability in particular, knowingly or not. As the effectiveness of the human action can be high, such action can effectively deprive humans from the possibility to survive. Hence, not taking such action is necessary for survival of humans.

*Only self-limitation can prevent humans from not surviving.* To ensure the survival of humans, something must prevent them from taking such actions. As concluded above, only humans can prevent themselves from taking an action or limit their action. Thus, it is humans who must do it, i.e. humans must self-limit.

*Why self-limitation can be regarded as a new need.* A need herein is defined above as 'lack of something that is required for survival of or is desired by one or more humans'. As self-limitation is necessary for survival, it can be considered a need. Since self-limitation need has not been identified in the earlier research, it can be considered a new, i.e. previously unknown, need.

Subchapter 2.2 *What needs are known* overviews earlier research in the domain of human needs. Having compared self-limitation by name and, more importantly, by meaning with the needs identified in other works, I was unable to find cases when other researchers regarded self-limitation as a need. Subchapter 5.2. *Novelty of findings* explains how self-limitation is different from several previously identified needs. I included these explanations in response to the questions I received during oral discussions of this study with students and teachers of the Master's Program in Futures Studies of the University of Turku, and during the presentation of this work at the *20<sup>th</sup> Futures Conference: Constructing Social Futures – Responsibility, Sustainability and Power*, which was held in Turku, Finland, on June 12-13, 2019.

Since the need for self-limitation is based on the natural choice to avoid undesirable *futures*, its satisfying is likely to require combining two operant resources. First, the ability to anticipate futures and compare their degree of (un)desirability. Second, the ability to limit one's action.

Self-limitation is a well-known phenomenon that has existed for long, but new operant resources are likely to make the demand for it more pressing, occurring more frequently, and relevant for a broader circle of persons. This need should be understood not as emerging in a certain moment of time – when literally no external barriers are left – but as growing in parallel with the availability and efficiency of operant resources. Moments or periods of time when a human agent is sufficiently powerful to cause damage to oneself by following his/her desires, in the absence of other factors, are encountered immediately after one is born as a child. And, obviously, self-limitation is needed more frequently as we grow.

The opposite to my main conclusion also seems true: external limitations decrease the need for self-limitation. Using the classification of changes in Table 1 above, I can suggest that emergence of regulators or significant competition, higher scarcity of operant or operand resources can all decrease the need for self-limitation.

So-called ‘unknown unknowns’, i.e. phenomena, of which we are not aware, and we do not know it, may challenge the validity of the idea that fewer external limitations increase the need for humans to self-limit. For example, presence of certain natural laws (not discovered yet) restricting the free will of people can be an argument against this proposition.

To the extent that the model of the world proposed here covers ‘unknown unknowns’, the only exception of the proposed direct correlation between the degree of freedom and the need for self-limitation seems to be the emergence of regulators. In this case the presence of correlation is not so clear for, theoretically, regulators can act in a way that improves freedom of action for humans but limits their (humans’) free will.

Otherwise, with the reservations above, the degree of freedom and the need for self-limitation are likely to stay in a positive correlation, and the famous quote of G.B. Shaw ‘Liberty means responsibility,’ can also be understood as ‘Liberty means self-limitation.’

New *operand resources* can influence human motivation either like *operant* ones, the case of which I have just considered, or through emergence of new *dominant agents*, which has also been considered above. Mere availability of certain new operand resources, whether known or unknown, is not a new situation for humans and, therefore, it is unlikely to impact human motivation. People have been discovering new operand resources all through the course of their history, from mineral resources to useful bacteria, from invisible waves to distant stars. It does not seem probable that existence of a new operand resource alone, no matter how special it is, influences human needs, unless this resource is combined with someone’s action, i.e. the change occurs in *dominant agents* or *operant resources* class. Thus, I have already analysed possible impact of this class of transformations on human motivation.

## 5 DISCUSSION

### 5.1 Findings summary

This work achieved two main results. First, it identified the probable new *need for self-limitation*. As development of operant resources continues freeing and empowering humans, they are gaining more possibilities to cause damage to themselves, whether intentionally, knowingly, directly or not. In the absence of past limits and decelerators, they need to become more cautious and limit themselves in the broader range of contexts.

The second result is a comprehensive and non-contradictory *typology of possible transformations*. I sorted them by the top-level subsystems of the world model, and most of the identified possible transformations fell under the subsystems of *operant resources* and *dominant agents*. Another side-line observation is that intelligence and transportation are the fields with which most of the identified potential transformative changes are associated.

In addition, I created a comprehensive list of *transformative* (as defined herein) change types, which allowed building a generalized image of the transformed world that has been safe for natural humans (see Figure 2 above). The identified transformations may lead to emergence of new elements in all the three subsystems of the proposed world model: operant resources, operand resources and new dominant agents (significant competition or regulators).

The research also proposed a systemic criterion to separate between transformative and other changes. Here I present it in the generalized form: *a phenomenon is transformative for a system if it changes qualitatively a significant share of its top-level subsystems – adds or removes some categories of elements in them*. In our case, the system consisted of three subsystems: dominant agents, operant resources, and operand resources – and I assumed that qualitative change in more than one subsystem was a sufficient threshold for a change to be recognized transformative.

### 5.2 Novelty of findings

The proposed typology of possible transformations is the first non-contradictory one, to the best of my knowledge (see *Introduction* for a brief review of other approaches). The subsystems used as categories to classify transformations are not overlapping and, thus, do not create confusion. At the same time, the typology is universal and comprehensive enough to include at least all the transformations I was able to identify.

My work does not invent the phenomenon of self-limitation, but points to it as a human need that has been overlooked so far. Using formal logic, I argue that self-limitation is necessary in the *general* case and its degree is likely to vary in a positive correlation with the degree of freedom. Although I identified the need by analysing hypothetical futures, the conclusion is not restricted to any time frame. The universality of the conclusion is also indirectly supported by the fact that it was preceded by formal logical consideration of the system representing the entire world.

The idea of self-limitation is present in many religions, teachings and scientific works, including ‘The Limits to Growth’ report published in 1972 by the Club of Rome. The authors of the report argued that people need to limit their consumption of natural resources if they want to survive.

Both by individuals and collective entities experience self-limitation need. For example, individuals may limit their working hours and income aspirations so as to spend more time with family. Business monopolies may limit their prices even without external regulation or else they risk undermining their source of income. Similar behaviour can be identified with the dictators – they limit themselves in one way or another in order not to cause a revolt in their country, keeping their position at power. Recently, Facebook, Inc., the world’s most popular social network at the moment, announced it planned to decrease the time its users spend using the network (Isaac, 2018) – presumably, in order to avoid possible accusations of causing indirect damage to them and the likely loss of the user base as a result. Non-use of nuclear and other weapons of mass destruction available to some states is an example of self-limitation in international relations. The ongoing global discussion of climate change and sustainability, including Paris Agreement Under the United Nations Framework Convention on Climate Change (2015), can lead to self-limitation on the global level.

Despite of these and other well-known cases of self-limitation and academic works dedicated to them, self-limitation has not been identified yet as a human need in the earlier research, as can be concluded from the overview in subchapter 2.2.

If I allow myself some speculation, plausible reasons for this non-identification might be that self-limitation is present implicitly in the ideas about other needs. For example, every modern car is expected to have breaks and offer a possibility to stop its movement, yet people think they use cars to move and perceive them primarily as means of transportation, not as stopping machines. Similarly, other needs can be imagined as ‘including a possibility for corresponding self-limitation’.

Another plausible reason is that self-limitation is used instrumentally so broadly, to facilitate reaching many other ends, that a researcher may easily switch their focus towards those other, seemingly more ‘meaningful’ or ‘terminal’ ends and not towards self-limitation that may be seen as (an obvious) means. For example, every time breaks are

used in a car, one may focus on the next or ‘higher’ end, such as driver’s safety, a desire to get out of the car, a desire to fuel it etc.

As mentioned in subchapter 2.2 above, Schwartz (1994, 35) argued against the distinction between terminal and instrumental values, because every ‘terminal’ value can be seen as instrumental to another one. A question may remain whether self-limitation can be seen as necessary for survival or desirable – ‘meaningful’ for the agent when self-limitation is not used to achieve some other ends or, more precisely, when these other ends are unknown to the agent or are not defined specifically enough to make sense as ‘terminal’ ends.

The answer seems to be positive, at least in some contexts. For example, an economic concept of marginal utility (see e.g. Encyclopaedia Britannica 2019) describes the relationship between the satisfaction of a consumer and the number of units of a product the consumer owns. This relationship is inverse (a law of diminishing marginal utility). In other words, the consumer’s satisfaction from the first unit of a product is higher than from the second, satisfaction from the second unit is higher than from the third one, and so on. Whether a product is food, a house or a service, as number of units owned increases, a consumer can reach a state in which satisfaction from the next unit of product is relatively low. Then it may appear meaningless to the consumer to continue acquiring units of that product, even if (s)he can afford them. Simultaneously, an agent may perceive self-limitation as ‘meaningful’, i.e. necessary for survival or desirable, even though further increase of the number of units owned can still increase the agent’s satisfaction slightly.

If I return to the imaginary context of the driver in a car, (s)he also can perceive self-limitation as meaningful enough, especially when their next ends or the higher ones are less specific or not defined at all. For instance, having driven a car for several hours uninterrupted, a driver may stop it and give it a ‘rest’. The driver may not know or be willing to know how high the risk of further driving is. (S)he may also not have any specific ideas what (s)he is going to do next: to drive more or to leave the car. The main reason for stopping the car may be a desire to keep some undefined future options open, for which a car may or may not be needed.

Similar examples can be found about use of other resources, including natural ones: the corresponding decision-makers may not have specific ideas whether and what for they may need these resources in future, yet they may decide to self-limit in using these resources. Self-limitation need can also be compared to sustainability: there may be no well-defined or highly probable ‘terminal’, ‘higher’ ends to achieve for agents practising sustainable approaches, yet it does not prevent sustainability from being widely recognized as a need, to the extent that reputable business organizations serving customers globally call it a modern megatrend (e.g. TRENDONE 2019, Hale 2018).

Self-limitation as a *need*, not a specific *need expression* or a means to satisfy another need, has not been identified in the earlier research. It is different from *transcendence* group of needs suggested by Maslow and *universalism* that Schwartz saw as one of the ten broad motivational goals. Both transcendence and universalism implied that a person is actively aiming for certain goals (values), e.g. wholeness, aliveness etc. suggested by Maslow (1967, 108-109) or unity with nature, world at peace suggested by Schwartz (Schwartz 1992; 1994; Schwartz & Sagiv 1995). Self-limitation is obviously an opposite of active pursuit of a certain goal – it is about refusing from such a pursuit. Hence, it belongs to the domain of negative values proposed by Aavik & Allik (2006).

Self-limitation is also different from seemingly close values: self-control (Rokeach 1973), self-discipline, humble, moderate, responsible (Schwartz 1992; 1994; Schwartz & Sagiv 1995). They relate to self-limitation like possible means to an end. One may need pursuing self-control etc. to be able to self-limit, e.g. in the use of weapons. Yet pursuing the values of self-control etc. may be done for other purposes than self-limitation. These values seem to be similar in meaning to traits, qualities, capacities, while self-limitation is similar to an aim. It appears logical that self-limitation may require not only self-control etc., but also other means e.g. a capacity to evaluate critically the *future impact* of one's actions. In my opinion, self-limitation is closest to *wisdom*, which is also one of the values suggested by Schwartz, but self-limitation is much narrower and more specific.

It would also be erroneous to confuse self-limitation with the values of survival, security, subsistence and similar ones, because self-limitation may be instrumental to a broader range of goals, including transcendental or benevolent ones.

Speaking metaphorically, self-limitation is 'no' to other needs, including cases when there is no competition between other needs, and when 'no' is needed to make 'yes' possible tomorrow.

From the perspective of contemporary institutions, it may also be difficult to view self-limitation as one of the meaningful ends that can be valuable per se. For example, an idea that self-limitation can be desirable even if there is no specific answer 'why', except keeping certain unknown possibilities open, seems to contrast with an idea that managerial practices should be aligned with well-defined key performance indicators. In the worldview that is based on the approaches 'more is better', 'acquiring is good, losing is bad', self-limitation can be seen as weird, against common sense, sometimes necessary evil. Commonly used indicators of betterment, such as GDP, index of happiness, life expectancy, and many other metrics and rankings reflect linear thinking, in which the preferable direction is implicitly or explicitly considered one and only. Recognition of self-limitation as one of the human needs would help explain how such linear views may not correspond to reality. Speaking figuratively, self-limitation offers a point of reversal to other needs, thus converting the linear views of change (and also 'progress', 'betterment') into circular ones. For instance, while the governments of many developed countries are

struggling with the problem of slow economic growth, the very discussion about self-limitation as a common part of human life can point to other options, such as conscious choosing and accepting de-growth from the current levels of material wealth. Institutional recognition of self-limitation as one of the human needs, i.e. the fact that humans sometimes desire and/or need to pause or go back, can open up other, more holistically oriented developmental paths. Using the driver's example, one could say that a driver normally uses both acceleration and breaking, not only acceleration.

Additional research would be required to explore what factors can support broad adoption of self-limitation need as a common, often preferable and/or necessary part of human lives. Without limitation, some plausible ideas of such factors may be: growing popularity of holistic, systemic, cross-disciplinary thinking; knowledge about circular thinking; long-term thinking and futures studies in particular: understanding of uncertainty of futures, better anticipation capabilities on all levels, especially a capability to anticipate risks associated with different degrees of change, and integration of futures thinking into educational activities. Special attention may be needed for cases of unintended self-limitation, i.e. cases when an agent is not fully aware of the fact that they are self-limiting and to what extent. For example, how fears, conform thinking, short-term thinking etc. in combination with low awareness about possible self-limitation may lead to effective self-limitation with more or less desirable effects for the agent themselves and for others.

### **5.3 Practical implications**

Having gone far into the future, I found a lesson that is increasingly relevant today, in all levels – individuals, organizations, countries, the planet. People are finding themselves more and more frequently in situations when they are stronger than their circumstances and virtually nothing limits human action. Geographical, technological, informational and military advantages, even small or temporary, can be combined with the range of other powerful resources and take the agent to the situation of dominance, sometimes global. For example, Frey (ed. by Knight, 2017) puts it that way for his field: “For the first time in history, our ability to measure our biology, and even to act on it, has far surpassed our ability to understand it.”

As mentioned above, self-limitation is something that we need for survival. The conclusion of this research has three main implications for practice.

First, futures thinking skills and knowledge about future are likely to be in higher demand. People will need better and more easily available capacity to explore unintended, indirect consequences and to evaluate diverse choices holistically. Therefore, dissemination of the relevant knowledge and tools, in particular development of futures studies as a science, is what we as a society can expect and shall support.

Second, self-limitation shall increasingly happen at the individual level. Even if the current megatrend of empowerment of individuals discontinues, the empowerment of the humanity as a whole is likely to imply that at least some individuals will have access to immense powers and capabilities. In this regard, corresponding behaviour patterns need to be proposed to the society through education and media. The rule of thumb, a general advice to be promoted on the individual level can be formulated this way: ‘As soon as nothing limits you, you may think of limiting yourself.’

Third, self-limitation shall work on the collective level, too. As history shows so far, the cases of voluntary self-regulation or self-limitation have been rare compared to cases of self-indulgence and moral degradation. Negative examples are many: from obesity that became widespread as availability of nutrition improved, to selfish behaviour of many officials who avoided transparency, to irresponsible behaviour of some states with nuclear power. As risks are likely to grow, I argue that collective controls, means of mass surveillance and control, also preventive, will need to increase to unprecedented levels in future, justified by the purpose of collective survival. As a civilization, we need to make a leap in this field without throwing baby with the bathwater, i.e. weighing the risks carefully and not doing more harm than good.

## 5.4 Academic value

In 2004 the Copenhagen Institute for Futures Studies released ‘Creative Man. The Future Consumer, Employee and Citizen’ – a book where the authors discussed how some choices of modern humans are likely to evolve as their wealth grows. It was argued, in particular, that the change is likely to follow Maslow’s hierarchy of needs, and people will increasingly want to be creative and self-actualize. A natural question: what’s next? I answered it with this paper.

It seems to be the first instance of long-term futures research explicitly focused on human motivation as its main object. I hope that the selected approaches, theoretical and methodological choices serve as a starting point for other researchers interested in the topic. In particular, I combined economic science and systems approach in order to analyse the probable impact of possible future transformations on the human motivation.

The use of an economic theory as a connector between human needs and environment is a novel approach in the respect that I analysed qualitative, not quantitative changes. It might be important to emphasize that I worked on the level of needs, not need satisfiers as is more common in economic studies. Although the choice of economic perspective seems natural, given the problems economics aims to solve, this is also a considerable step away from the dominance of psychologic and linguistic approaches in the studies of human motivation.

I used service-dominant logic as a basis for the world model and for the framework to categorize scanning hits. I see it as an alternative to more traditional PEST or firm environment frameworks that did not suit the objectives of this research. The comprehensive and non-contradictory classification of possible transformations can serve as a practical tool for logical analysis of environmental factors.

The systemic definition of transformation criterion proposed here contributes to more accurate use of the words ‘transformative’ and ‘transformation’ in the scientific context, especially in futures studies. Futures studies as a discipline can bring more value to the end users if the knowledge about future is described more exactly, i.e. when ‘transformative’ and ‘transformation’ function rather as precise terms than vague synonyms to ‘change’.

The conclusion about positive correlation between the need for self-limitation and the availability of operant resources is applicable to a broad range of contexts, as I considered the human condition in the near-to-general form, using broad economic categories as main units of analysis. In particular, I assumed the relevant independent variable – operant resources (and their efficiency) – as positively unlimited, potentially infinite. Although my research was not aimed at the exploration of the situations when the ability of humans to satisfy their needs deteriorates compared to today’s level, the lessening of the need for self-limitation, up to redundancy, is obvious in such conditions. Thus, the positive correlation of the need for self-limitation with the availability of valuable operant resources seems to be valid also for the non-explored contexts.

## **5.5 Possible criticism**

During the scanning exercise, I looked through several hundred scientific papers and informal and artistic data sources that were created in the XIX, XX and XXI centuries. They were in different formats: textual, visual, electronic, printed etc. A reliable possibility of automating this stage of the research, unfortunately, did not exist at the moment of writing, in particular in view of heterogeneity of sources, their formats and other properties. I did not use any software for analysis and relied on my own skills to identify relevant images of the future. This part of the research is the least transparent, for recording every step would be too time-consuming. As a result, risks of human omission or subjectivity are present.

The same can be noticed about sorting the identified futures images – significant changes into transformative or non-transformative. This step was based on the associations between significant changes found in the data sources. Exploration of higher number of data sources could result in different classification outputs and may have improved the credibility of the study.

Some arguments are possible against the non-critical use of data sources based on fantasy and intuition. However, the limits of current human knowledge do not allow to support or deny this possible reproach properly. In particular, I have not been able to identify suitable scientific methods to assess the ‘quality’ of fantasies for research.

An alternative way to identify possible transformations could be generating images of the future or scenarios in a more uniform, more controlled ways, e.g. through futures workshops or specially designed questionnaires. It is difficult to say in advance, which way is more effective, but one can presume that a well-planned formalized process could result in some additional ideas about transformative futures.

The analysis stage of the scanning results is presented in this paper and can be verified using formal logic. I believe that the conclusion about the need for self-limitation is well-grounded, except for the factor that is called ‘unknown unknowns’ – the things we do not know, and we are not aware about that.

The model of the world based on the service-dominant logic could be more precise and potentially more useful if the accumulated knowledge about human motivation would allow describing the way it works. As scientific views about human needs vary from complete determinism to complete libertarianism, improving the model with a clear representation of human motivation seems problematic now.

A more direct way of answering the research question about probable new human needs could be to scan the data sources for those images of the future that are *ideas about future human needs*. One could try to identify examples of future needs from the science fiction and generalize them. Although such an approach seems to reflect well on the validity of the study, I did not choose it because, from the perspective of the service-dominant logic, the value a subject derives – something that improves their wellbeing – is always subjectively experienced, constructed and evaluated. If I had chosen that alternative path, I would have needed to make guesses about the subjective value derived in each identified instance. I considered that approach less reliable.

The author’s background, personal ‘story’ – past experiences and culturally conditioned views could have impacted the research in all stages. Among other fields, the author spent considerable time studying mathematics and economics in his younger years – these sciences are typically associated with rational, logical thinking. It is not excluded that more intuitive, art-based approaches would also be beneficial for the study.

## 5.6 Proposals for future research

This work is a small contribution to the discussion about human needs, values and motivation in general. As demonstrated in chapter 2 above, the researchers are far from being

united about the contents of the needs and values, their variety, relationship with the context and other factors. A comprehensive mapping framework for human motivational drivers would be beneficial for the field. Such framework would include the known needs and/or values, including negative ones, and be predictive or at least allow for inclusion of new ones. With recognition of the extremely challenging nature of this task, I hold an opinion that such framework would be useful for many purposes, including exploration of probable future changes on individual and societal levels.

Particular cases of self-limitation have been better studied in some contexts than in others – can the knowledge about well-known cases of self-limitation be applied in those other contexts? Behaviour of monopolies, abstaining from use of force in international relations, dietary behaviour of individuals are examples of relatively well-studied cases. The conclusions of the corresponding research might be relevant e.g. for the problems of sustainability, domestic violence, economic inequality etc.

As technology continues to empower individuals, organizations and states, studying self-limitation on the collective levels, including global one, seem to be of growing importance. On the one hand, humanity needs to survive, and effective self-limitation may be seen as desirable for security of everyone. On the other hand, some approaches to collective self-limitation can lead to drastic reduction of freedom similar to the dystopia described by George Orwell in his novel *Nineteen Eighty-Four* (1949). Some examples of relevant questions for future research might be the following. What types of collective self-limitation are necessary and sufficient, now and in future? What principles of collective self-limitation shall be observed? What are optimal decision-making mechanisms for collective self-limitation?

Systematic studies of transformative far futures can provide more ideas for exploration of possible and preferred near futures. This research used a typology of transformations ‘as is’, but this one and possible other typologies can also be used to generate new ideas about development paths and to broaden the horizons for the broad public, from students of all ages to professionals and top decision-makers.

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## 6 APPENDIX 1. SCANNING DATA SOURCES

Although the list of data sources below contains several hundred entries, it is still rather representative than complete. In particular, graphic sources (pictures) are not listed here, because most of them were associated with already listed other sources such as books or films, e.g. a DVD cover or a picture in a book. Thousands of scientific articles are also not listed, for practical reasons only – instead, I provide the search queries used to access the same.

### 6.1 Scientific sources

I used the following search queries to find some relevant scientific articles in the Scopus database developed by Elsevier < <https://www.scopus.com/home.uri> > on 24 April 2018.

TITLE-ABS-KEY ( "far futur\*" )

TITLE-ABS-KEY ( antihuman\* )

TITLE-ABS-KEY ( human\* AND future )

TITLE-ABS-KEY ( humanit\* AND future )

TITLE-ABS-KEY ( metahuman\* )

TITLE-ABS-KEY ( posthuman\* )

TITLE-ABS-KEY ( transhuman\* )

### 6.2 Artistic sources

#### 6.2.1 *Films*

Abbate, A. – McAnuff, D. (Producers), Bird, B. (Director) (1999) *The iron giant*. Warner Bros. Feature Animation; United States.

Abrams, J. J. – Burk, B. – Spielberg, S. (Producers), Abrams, J. J. (Director) (2011) *Super 8*. Bad Robot Productions, Amblin Entertainment; United States.

Abrams, J. J. – Lindelof, D. (Producers), Abrams, J. J. (Director) (2009) *Star trek*. Spyglass Entertainment, Bad Robot Productions; United States.

Arad, A. – Feige, K. (Producers), Favreau, J. (Director) (2008) *Iron man*. Marvel Studios, Fairview Entertainment; United States.

Bergman, R. – Stern, J. D. (Producers), Johnson, R. (Director) (2012) *Looper*. Endgame Entertainment, DMG Entertainment, FilmNation Entertainment; United States.

- Blaustein, J. (Producer), Wise, R. (Director) (1951) *The day the Earth stood still*. 20th Century Fox; United States.
- Bodard, M. (Producer), Resnais, A. (Director) (1968) *Je t'aime, je t'aime*. Les Productions Fox Europa, Parc Film; France.
- Cameron, J. – Jaffe, S.-C. (Producers), Bigelow, K. (Director) (1995) *Strange days*. Lightstorm Entertainment; United States.
- Cameron, J. – Landau, J. – Sanchini, R. (Producers), Soderbergh, S. (Director) (2002) *Solaris*. Lightstorm Entertainment; United States.
- Cameron, J. – Landau, J. (Producers), Cameron, J. (Director) (2009) *Avatar*. Lightstorm Entertainment, Dune Entertainment, Ingenious Film Partners; United Kingdom, United States.
- Cameros, E. – Gomez, J. (Producers), Vigalondo, N. (Director) (2007) *Los cronocrímenes (Timecrimes)*. Karbo Vantas Entertainment, Fine Productions, Zip Films; Spain.
- Carpenter, J. (Producer), Carpenter, J. (Director) (1974) *Dark star*. Jack H. Harris Enterprises, University of Southern California; United States.
- Carreras, M. – Hinds, A. – Keys, A. N. (Producers), Losey, J. (Director) (1963) *The damned*. Hammer Film Productions; United Kingdom.
- Carrol, G. – Giler, D. – Hill, W. (Producers), Scott, R. (Director) (1979) *Alien*. 20th Century Fox, Brandywine Productions; United Kingdom, United States.
- Carruth, S. (Producer), Carruth, S. (Director) (2004) *Primer*. StudioCanal; United States.
- Chernin, P. – Clark, D. – Jaffa, R. – Silver, A. (Producers), Reeves, M. (Director) (2017) *War for the planet of the apes*. Chernin Entertainment, TSG Entertainment; United States.
- Cornfeld, S. (Producer), Cronenberg, D. (Director) (1986) *The fly*. 20th Century Fox; United States.
- Cronenberg, D. – Hamori, A. – Lantos, R. (Producers), Cronenberg, D. (Director) (1999) *Existenz*. Canadian Television Fund, Dimension Films, Harold Greenberg Fund, The Movie Network, Natural Nylon, Telefilm Canada, Serendipity Point films, EGC; Canada, France, United Kingdom.
- Cuarón, A. – Heyman, D. (Producers), Cuarón, A. (Director) (2013) *Gravity*. Heyday Films, Esperanto Filmoj; United States.
- Damiani, S. – Dauman, A. – Valio-Cavaglione, A. (Producers), Laloux, R. (Director) (1973) *La Planète sauvage*. Les Films Armorial, Ceskoslovenský Filmexport; Czechoslovakia, France.
- Dauman, A. (Producer), Marker, C. (Director) (1956) *La jetée*. Argos Films; France.
- David, S. (Producer), Anderson, M. (Director) (1976) *Logan's run*. Metro-Goldwyn-Mayer; United States.
- David, S. (Producer), Fleischer, R. (Director) (1966) *Fantastic voyage*. 20<sup>th</sup> Century Fox; United States.

- Davison, J. – Marshall, A. (Producers), Verhoeven, P. (Director) (1997) *Starship troopers*. Touchstone Pictures, Buena Vista International; United States.
- Deeley, M. – Spikings, B. (Producers), Roeg, N. (Director) (1976) *The man who well to Earth*. British Lions Films; United Kingdom.
- Deeley, M. (Producer), Scott, R. (Director) (1982) *Blade runner*. The Ladd Company, Shaw Brothers, Blade Runner Partnership; United States, Hong Kong.
- Demidova, A. (Producer), Tarkovsky, A. (Director) (1984) *Stalker*. Mosfilm; Soviet Union.
- DeVito, D. – Shamberg, M. – Sher, S. – Lyon, G. (Producers), Niccol, A. (Director) (1997) *Gattaca*. Columbia Pictures; United States.
- Devlin, D. (Producer), Emmerich, R. (Director) (1996) *Independence day*. Centropolis Entertainment; United States.
- Ellison, M. – Jonze, S. – Landay, V. (Producers), Jonze, S. (Director) (2013) *Her*. Warner Bros. Pictures; United States.
- Engelman, T. (Producer), Twohy, D. (Director) (2000) *Pitch black*. PolyGram Filmed Entertainment, Interscope Communications, Gramercy Pictures; United States.
- Feitshans, B. – Shusett, R. (Producers), Verhoeven, P. (Director) (1970) *Total recall*. Carolco Pictures; United States.
- Foster, D. – Lawrence, T. (Producers), Carpenter, J. (Director) (1982) *The thing*. Universal Pictures; United States.
- Franco, L. (Producer), Carpenter, J. (Director) (1988) *They live*. Alive Films, Larry Franco Productions; United States.
- Gale, A. H. (Producer), Cameron, J. (Director) (1984) *The terminator*. Hemdale, Pacific Western Productions, Cinema'84; United States.
- Gale, B. – Canton, N. (Producers), Zemeckis, R. (Director) (1985) *Back to the future*. Universal Pictures; United States.
- Garland, A., Macdonald, A. – Reich, A. (Producers), Travis, P. (Director) (2012) *Dredd*. DNA Films, IM Global, Reliance Entertainment; South Africa, United Kingdom.
- Golin, S. – Bregman, A. (Producers), Gondry, M. (Director) (2004) *Eternal sunshine of the spotless mind*. Anonymous Content, This is That; United States.
- Gordon, L. – Silver, J. – Davis, J. (Producers), McTiernan, J. (Director) (1987) *Predator*. Lawrence Gordon Productions, Silver Pictures, Davis Entertainment; United States.
- Gordon, M. – Wynn, J. – Rousselet, P. (Producers), Jones, D. (Director) (2011) *Source code*. The Mark Gordon Company, Vendome Pictures; France, United States.
- Gottfried, H. – Melnick, D. (Producers), Russell, K. (Director) (1980) *Altered states*. Warner Bros.; United States.

- Green, S. – Kavanaugh-Jones, B. – Nichols, J. (Producers), Nichols, J. (Director) (2016) *Midnight special*. Faliro House Productions, Tri-State Pictures, RatPac-Dune Entertainment; United States.
- Grossberg, J. (Producer), Allen, W. (Director) (1973) *Sleeper*. Jack Rollins & Charles H. Joffe Productions, Rollins-Joffe Productions; United States.
- Gruskoff, M. – Hornstein, M. – Trumbull, D. (Producers), Trumbull, D. (Director) (1972) *Silent running*. Universal Pictures; United States.
- Hurd, G. A. (Producer), Cameron, J. (Director) (1986) *Aliens*. 20th Century Fox; United States.
- Hurd, G. A. (Producer), Cameron, J. (Director) (1989) *The abyss*. 20<sup>th</sup> Century Fox; United States.
- Hyams, P. (Producer), Hyams, P. (Director) (1978) *2010: The year we make contact*. Metro-Goldwyn-Mayer; United States.
- Jackson, P. – Cunningham, C. (Producers), Verhoeven, P. (Director) (2009) *District 9*. QED International, WingNut Films; New Zealand, South Africa, United States.
- Jacobs, A. P. (Producer), Schaffner, F. J. (Director) (1968) *Planet of the apes*. 20th Century Fox; United States.
- Jacobson, N. – Kilik, J. (Producers), Lawrence, F. (Director) (2013) *The hunger games: catching fire*. Color Force; United States.
- Johnson, M. – Newirth, C. (Producers), Parisot, D. (Director) (1999) *Galaxy quest*. DreamWorks Pictures, Gran Via Productions; United States.
- Judge, M. – Koplovitz, E. – Nelson, M. (Producers), Judge, M. (Director) (2006) *Idiocracy*. Ternion; United States.
- Kennedy, K. – Spielberg, S. – Curtis, B. (Producers), Spielberg, S. (Director) (2001) *A.I. Artificial Intelligence*. Amblin Entertainment, Stanley Kubrick Productions; United States.
- Kennedy, K. – Spielberg, S. (Producers), Spielberg, S. (Director) (1982) *E.T. the Extra-Terrestrial*. Universal Pictures; United States.
- Keys, A. N. (Producer), Baker, R. W. (Director) (1967) *Quatermass and the pit*. BBC; United Kingdom.
- Korda, A. (Producer), Menzies, W. C. (Director) (1936) *Things to come*. London Film Productions; United Kingdom.
- Kubrick, S. (Producer), Kubrick, S. (Director) (1968) *2001: A space Odyssey*. Stanley Kubrick Productions; United Kingdom.
- Kurtz, G. (Producer), Lucas, G. (Director) (1977) *Star wars*. 20th Century Fox; United States.
- Laemmle, C. (Producer), Whale, J. (Director) (1931) *Frankenstein*. Universal Pictures; United States.

- Lasker, E. (Producer), Nyby, C. (Director) (1951) *The thing from another world*. Winchester Pictures Corporation; United States.
- Laurentiis, D., de (Producer), Hodges, M. (Director) (1980) *Flash Gordon*. Starling Films, Dino De Laurentiis Company; Netherlands, United Kingdom, United States.
- Laurentiis, D., de (Producer), Vadim, R. (Director) (1968) *Barbarella*. Marianne Productions, Dino de Laurentiis, Cinematografica; France.
- Ledoux, P. (Producer), Besson, L. (Director) (1997) *The fifth element*. Gaumont; France.
- Levy, S. – Levine, D. – Ryder, A. – Linde, D. (Producers), Villeneuve, D. (Director) (2016) *Arrival*. FilmNation Entertainment, Lava Bear Films, 21 Laps Entertainment; United States.
- Lewis, E. (Producer), Frankenheimer, J. (Director) (1966) *Seconds*. Joel Productions, John Frankenheimer Productions, Gibraltar Productions; United States.
- Lurie, B. – Perkins, W. P. – Taylor, J. (Producers), McAbee, C. (Director) (2001) *The American astronaut*. BNS Productions, Commodore Films; United States.
- Macdonald, A. – Reich, A. (Producers), Garland, A. (Director) (2014) *Ex machina*. Film4, DNA Films; United Kingdom, United States.
- Macdonald, A. (Producer), Boyle, D. (Director) (2007) *Sunshine*. Moving Picture Company, DNA Films, UK Film Council, Ingenious Film Partners; United Kingdom, United States.
- Märthesheimer, P. – Wesemann, A. (Producers), Fassbinder, R. W. (Director) (1973) *World on a wire*. Westdeutscher Rundfunk; West Germany.
- Maruata, J. – Takiyama, M. (Producers), Kon, S. (Director) (2006) *Paprika*. Madhouse; Japan.
- Maruyama, M. – Yamaki, I. (Producers), Rintaro (Director) (2001) *Metropolis*. Madhouse; Japan.
- McCarthy, P. – Nesmith, M. – Olson, G. T. – Wacks, J. (Producers), Cox, A. (Director) (1984) *Repo man*. Edge City; United States.
- McKittrick, S. – Juvonen, N. – Fields, A. (Producers), Kelly, R. (Director) (2001) *Donnie Darko*. Flower Films; United States.
- Mendel, B. (Producer), Whedon, J. (Director) (2005) *Serenity*. Universal Pictures, Barry Mendel Productions; United States.
- Michelin, A. (Producer), Godard, J.-L. (Director) (1965) *Alphaville*. André Michelin Productions, Filmstudio, Chaumiane; France.
- Milchan, A. (Producer), Gilliam, T. (Director) (1985) *Brazil*. 20th Century Fox, Universal Pictures; United Kingdom, United States.
- Mitchell, D. – Millerr, G. – Voeten, P. J. (Producers), Miller, G. (Director) (2015) *Mad Max: fury road*. Village Roadshow Pictures, Kennedy Miller Mitchell, RatPac-Dune Entertainment; Australia, United States.

- Mizuo, Y. – Matsumoto, K. – Iyadomi, K. – Ishikawa, M. (Producers), Oshii, M. (Director) (1995) *Ghost in the shell*. Production I. G., Bandai Visual, Manga Entertainment; Japan, United Kingdom.
- Molen, G. R. – Curtis, B. – Parges, W. F. – Bont, J., de (Producers), Spielberg, S. (Director) (2002) *Minority report*. DreamWorks Pictures, Amblin Entertainment, Blue Tulip Productions; United States.
- Morris, J. (Producer), Stanton, A. (Director) (2008) *Wall-E*. Walt Disney Pictures, Pixar Animation Studios; United States.
- Nayfack, N. (Producer), Wilcox, F. M. (Director) (1956) *Forbidden planet*. Metro-Goldwyn-Mayer; United States.
- Pal, G. (Producer), Pal, G. (Director) (1960) *The time machine*. Metro-Goldwyn-Mayer, Galaxy Films; United States.
- Pal, G. (Producer), Pichel, I. (Director) (1950) *Destination Moon*. George Pal Productions; United States.
- Park, N. – Bevan, T. – Fellner, E. (Producers), Wright, E. (Director) (2013) *The world's end*. Relativity Media, StudioCanal, Working Title Films, Big Talk Pictures; Japan, United Kingdom, United States.
- Park, N. – Wilson, J. (Producers), Cornish, J. (Director) (2011) *Attack the block*. StudioCanal Features, Film4, UK Film Council, Big Talk Pictures; United Kingdom.
- Philips, J. – Philips, M. (Producers), Spielberg, S. (Director) (1977) *Close encounters of the third kind*. EMI Films; United States.
- Pommer, E. (Producer), Lang, F. (Director) (1927) *Metropolis*. Ufa; Germany.
- Reitman, I. (Producer), Reitman, I. (Director) (1984) *Ghostbusters*. Delphi Films, Black Rhino Productions; United States.
- Richter, W. D. – Canton, N. (Producers), Richter, W. D. (Director) (1984) *The adventures of Buckaroo Banzai across the 8th dimension*. Sherwood Productions; United States.
- Roven, C. (Producer), Gilliam, T. (Director) (1995) *12 monkeys*. Universal Pictures; United States.
- Rudin, S. – Niccol, A. – Feldman, E. S. – Schroeder, A. (Producers), Wier, P. (Director) (1998) *The Truman Show*. Scott Rudin Productions; United States.
- Schmidt, A. (Producer), Verhoeven, P. (Director) (1987) *Robocop*. Orion Pictures; United States.
- Seltzer, W. – Thacher, R. (Producers), Fleisher, R. (Director) (1973) *Soylent green*. Metro-Goldwyn-Mayer; United States.
- Shor, H. – Smith, I. – Smith, T. – Abraham, M. – Newman, E. (Producers), Cuarón, A. (Director) (2006) *Children of men*. Strike Entertainment, Hit and Run Productions; United Kingdom, United States.

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