Article

Homo Digitus: Its Dependable and Resilient Smart Ecosystem

Donald Bliss [1], Raymond Garbos [2], Patrick Kane [3], Vyacheslav Kharchenko [4], Thaddeus Kochanski [5] and Andrzej Rucinski [6,*]

1   Municipal Resources, Inc., Portsmouth, NH 03801, USA; donaldpbliss@gmail.com
2   eCollaborative Ventures, Inc., Mont Vernon, NH 03057, USA; rgarbos@yahoo.com
3   Infineon Technologies AG, 85579 Neubiberg, Germany; patrick.kane@infineon.com
4   Department of Computer Systems, Networks and Cybersecurity, National Aerospace University KhAI, 17, Chkalov str., 61070 Kharkiv, Ukraine; v.kharchenko@csn.khai.edu
5   Sensors Signals Systems, Lexington, MA 02421, USA; tedpk@alum.mit.edu
6   Department of Electrical and Computer Engineering, University of New Hampshire, Durham, NH 03824, USA
*   Correspondence: andrzej.rucinski@unh.edu; Tel.: +1-(603)-343-4103

Abstract: This paper evaluates the status quo of modern society and identifies the neglect of humanism as the root cause of many of today's global challenges. Note that "smart cities" are not excluded from this indictment. The "Ptolemaic Universe" offers a means to restore our symbiosis with the environment. The ReSeT model is proposed as a tool to analyze the Ptolemaic Universe. Using ReSeT: Homo Sapiens becomes dependent on AI resulting in Homo Digitalis, with further evolution in concert with AI resulting in Homo Digitus. All of these stages are then analyzed in the context of global trusted dependability (GTD). The wellness domain, provides the design specification framework for Homo Digitus' human-centered and resilient "smart city" ecosystem. This ultimately leads to a better world of increased wellness for Homo Hominus, with better smart cities emphasizing education and science, promoting wisdom and common sense, and rejecting violence. In summary, humanity has generated diverse social structures with erratic outcomes. On the other hand, technology provides a successful foundation for modern society especially in the Pandemic Era. However, technology's contributions are generally not publicly acknowledged. The paper concludes with several initiatives designed to establish a trusted and resilient society.

Keywords: AI; dependability; global trusted dependability; Homo Digitalis; Homo Digitus; Homo Hominus; Homo Sapiens; resilience; smart cities; trust; wellness; wellness signature

1. Introduction

An explosion of "Smart Cities" around the world provides a repository of examples sufficient for drawing conclusions. We suggest reimagining of the concept based on the lessons learned. Smart Cities have turned out to be not that smart after all; unable to mitigate the chaos due to the COVID-19 Pandemic [1–5]. The primary driver behind a typical smart ecosystem is technology, the necessary sine qua non condition to establish a better habitat. However, relying solely on technology itself is not sufficient. From the earliest times, cities exist to improve the lives of the inhabitants and to the extent that they provide a positive increment in "Wellness" to their inhabitants they then prosper.

What of the inhabitants of Smart Cities? In the context of planning, implementing and employing smartness, they are typically either in the background, or nonexistent. Examples are Smart Cities which jeopardize personal freedom, such as the iconic Chinese smart city of Wuxi [6]. Other examples of "Smart-fail," i.e., the failure of smart cities to deliver on their promise include:

- The continuing threat of terrorism and crime despite omnipresent, intrusive video monitoring;

- Natural disasters (e.g., floods, earthquakes, wildfires, etc.) which continue to devastate, despite our knowledge of successful mitigation strategies, such as:
  - Trimming trees along high voltage power line right of ways; clearing underbrush in forest areas;
  - Banning rebuilding in vulnerable coastal zones;
  - Enforcing effective building codes in earthquake and hurricane prone regions.

This failure to accommodate, has continued in the Pandemic Era, despite the fact that technology continues to function well, and is apparently our only surviving tool. However, technologies and technologists are not appreciated by the leadership, and are taken for granted by the public.

Smart Cities must be designed for humans and ought to be both human-centered and environment-sensitive. These observations support the model of the Ptolemaic Universe and the Vitruvian society—inhabited by an evolved human subspecies.

The remainder of the paper is organized as follows. First: The scientific base is described through the introduction of the Ptolemaic Universe, and Global Trusted Dependability (GTD) [7]. Then the ReSeT model is presented as a triad of:

- R, the real world driven by physics
- S, the metaphysical world driven by philosophy
- T, the virtual world driven by mathematics and technology [7].

The Wellness Domain is described and illustrated by human subspecies:

- Modern human (i.e., Homo Sapiens),
- Hypothetical evolutions as introduced in the literature by other authors:
  - Homo Digitus [8],
  - Homo Digitalis [9].

After the investigation of modes of failure, Homo Digitus, is discussed in the context of being the inhabitant of a trusted and resilient living ecosystem. Our concluding remarks suggest a further evolution to Homo Hominus [7], and briefly mention potential initiatives to both:

- Improve universal wellness and smartness;
- Globally expand and extend the discussion of these matters.

1.1. Notes on Anthropological Terminology in Other Contexts

A brief note on the hypothetical human subspecies which are discussed in this paper. The introduction of anthropological-style terminology into a discussion of human society using mathematically founded systems engineering tools has inadvertently lead to some ambiguity of meaning. Specifically, we have used Homo Digitalis, which was introduced as a "term of art" in a book "Homo Digitalis—mennesker og organisationer fra forskning til digital praksis," by Natasha Friis Saxberg, CEO Danish ICT (information and communications technology) Industry Association [10]. The book was published in Denmark, in the Danish language in 2013 and then issued through Amazon as a Kindle electronic talking book in 2015 [11]. Subsequently, Homo Digitalis has taken on various meanings depending on the particular author's scientific discipline. Saxberg's description of her original work as quoted on her Linked-in page (translated by Google) states:

Homo Digitalis—people and organizations from research to digital practice . . . . . . describes the digital universe as a mirror image of human existence filled with opinions and contradictions, possibilities and limitations, where the creation of purpose and value is left to the individual.

The book looks at digital behavior in a broad perspective, which is illustrated through a series of interviews with international researchers and experts in cognitive and social neuroscience, sociology, psychology and philosophy. In this way, an insight into human basic needs is conveyed, and it is described how these affect our behavior in the physical and digital world. [12]

A superficial search of Homo Digitalis using Google [13] reveals in addition to business ventures and organizations using the term, links to several scholarly works in a number of fields with disparate and in some cases contradictory usage. On closer reflection, this is not particularly surprising given that scientific disciplines founded on description and observation, depend on the "luck of the draw." As a consequence, discoveries outside of the typical distribution often get transformed into "classes," despite having in some cases only a single sample. The literature of descriptive astronomy, archeology, anthropology, botany, zoology, etc., is replete with many discoveries which were later overturned, or overtaken by subsequent "accidental discoveries."

1.2. Discovery in the Descriptive Sciences

Prior to the introduction of DNA-based analytical tools, the latter three disciplines (anthropology, botany, zoology) were especially prone to this behavior. For example, scholars long thought that when the Roman Imperial British society collapsed, that all of civilization in the region regressed. However, in the summer of 1939, amateur archeologists unearthed a seventh century Anglo-Saxon ship burial, at Sutton Hoo in Suffolk County, U.K. They found treasures such as: a finely manufactured bejeweled iron and copper alloy helmet, a large cache of coins, and an exquisitely detailed great sword replete with a gold hilt and pommel [14]. Sue Brunning, Curator of Early Medieval European Collections at the British Museum has interpreted Sutton Hoo as transformative [15]:

> *"This single burial in a pretty corner of Suffolk embodied a society of remarkable artistic achievement, complex belief systems and far-reaching international connections, not to mention immense personal power and wealth . . . . The imagery of soaring timber halls, gleaming treasures, powerful kings and spectacular funerals in the Old English poem Beowulf could no longer be read as legends—they were reality, at least for the privileged few in early Anglo-Saxon society."*

1.3. The Use of Homo Digitalis in Related Scholarly Literature

Since many scholars are intrigued by the revolutionary impact of consumer-centric technology on humanity, there have been many attempts to stretch the author's "comfort-zone" to encompass "smart phones" and "social networks." As a consequence, Homo Digitalis has been employed as a "term of art" in many sociological and neuropsychological-based studies of cell-phone addiction, neuroplasticity effects of social media on the structure of the human brain, and even subjects reporting "phantom vibrations" of their phones.

Notably, the review paper by Christian Montag and Sarah Diefenbach, Towards Homo Digitalis: Important Research Issues for Psychology and the Neurosciences at the Dawn of the Internet of Things and the Digital Society [16] states:

> *"Research demonstrating that low conscientiousness is associated with longer WhatsApp usage and higher Internet/smartphone addiction. Participants who have stronger emotional reactions to text messages (e.g., feeling disappointed when messages are not received) are more bothered by phantom vibrations, just as they are more likely to have negative psychological consequences of text message dependency (e.g., thinking life is empty without text messages)."*

> *To present the reader with a short summary of the most important research avenues to be tackled in the near future, according to this review/hypothesis paper, we add the following short bullet points:*

> - *Understand how new forms of self-perception, –reflection, and –presentation affect social communication;*
> - *Find strategies to foster flow experiences in times of a fragmented life style;*
> - *Investigate how the interaction with digital worlds shape human brains and how we can hinder detrimental effects on the human brain;*
> - *Design digital worlds according to our emotional evolutionary heritage to foster well-being in digital societies;*

- *Find meaningful rules for social communication in times of abundant available access to digital distractors;*

Another work in the same time frame, by Adrian Stoicescu, Homo Digitalis—in Search of a Patterned Usage Identity, discusses the digital anthropological characterization of different classes of users of information technology [17]. Stoicescu even has a section entitled Homo Digitalis, where he reviews a number of "digital anthropological studies" about the characterization of how individuals interact with others through the Internet. He concludes his review with:

> *As the discourse on human-computer interaction and computer-mediated communication shows both the methods and the scientific jargon are borrowed from neighbouring science. At the same time, the constant and rapid changed this field is subject to poses new difficulties with every new feature the softwared devices have. This is the reason why, to a much greater extent than any other social science the realities behind the concepts are constantly adapting. Cyber, virtual, digital, online, Internet based and so one proved thus to be challenging concepts which double the complexity of the medium the research is carried out on. These concepts that do not exclude themselves and trying to define very accurately each of the may become a rather far-fetched undertaking. They are as fluid as the realities they define and that is why a conceptual description can only be done in terms of maybe and possibly. The introduction of the homo digitalis identity makes no exception. It is only a class with various way of approximation based exclusively on the present stage of development of the softwared devices incorporating as seen various aspects the earlier described realities.*

2. Materials and Methods

2.1. Mathematically Rigorous Analysis

In contrast to the descriptive sciences, the physical sciences and engineering are disciplines which are founded on experiment and mathematically rigorous theory. As a consequence, they tend to be inherently more systematic and less driven by serendipity. The experimental sciences employ predictive theories which can be tested by comparing a mathematical model of nature against experimental results. For example, the Standard Model of Particle Physics is a theory of fundamental particles and how they interact. It has been verified through several decades of diligent experiments, using the most sophisticated scientific instruments ever created. Numerous Nobel Prizes have been awarded for predictions such as in 2013, jointly to François Englert and Peter Higgs, *"for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider (LHC)"* [18]. Yet, despite this success, purpose-built supercomputers, are right now sifting through the results of literally trillions of proton collisions which happened many meters underneath Geneva Switzerland. Recently the LHCb (Large Hadron Collider beauty) collaboration of people and Artificial Intelligence (AI) technology, may have unearthed transformative results in an esoteric statistical anomaly between electrons and muons. Professor Chris Parkes from the University of Manchester and CERN, spokesperson for the LHCb global collaboration stated [19]: *"If a violation of lepton flavour universality were to be confirmed, it would require a new physical process, such as the existence of new fundamental particles or interactions . . . More studies on related processes are under way using the existing LHCb data. We will be excited to see if they strengthen the intriguing hints in the current results."* Significantly, unlike the chance discovery of Sutton Hoo, the LHCb observations may lead to new fundamental physics, with unknown potential implications.

2.2. Ptolemaic Universe

The current "state of the world" can be characterized as a combat zone, with questionable "smartness," especially since the COVID-19 Pandemic is still expanding [5]. Moreover,

a potential global strategy reset, to reverse the situation is impossible because of our inability to initiate reasonable debate.

In order to diagnose the state of the world, it appears necessary to define some type of a universal virtue code. Sufficient conditions and criteria can then be established for the debate, along with a preliminary assessment of either a positive or negative diagnosis.

The authors denote this analytical context as the Ptolemaic Universe and/or Universum, to emphasize the "centric position" of Homo sapiens in the analysis. The Ptolemaic Universe is based on a triad of domains and their underlying fundamentals:

- Physics for the physical world,
- Philosophy for the metaphysical world,
- Mathematics/technology for the virtual world.

Such an overall model within which humanity exists has been discovered, observed, and studied by the pantheon of historic Wisdom Gurus such as: Plato, Confucius, Moses, Aristotle, Cantor, etc. Their common philosophical denominator is: law and order, guided by wisdom, and accompanied by beauty and goodness.

The late computer scientist and humanist Michael Dertouzos of MIT, put things in context, more than 20 years ago, when he told Scientific American's, Kristin Leutwyler, *"We made a big mistake 300 years ago when we separated technology and humanism. ... It's time to put the two back together"* [20].

We depend on the wisdom gurus' guidance to provide to us a "virtue code" as a metric for human conduct. The remainder of this paper uses the tools of the modern system engineer to characterize the continuing evolution of mankind in the Moore's Law and beyond Era, such as in the review article of brain-inspired computing for a post-Moore's Law [21]. Specifically, we are interested in how can we (as humanity) be viewed as a morphing from the "ground state" of Homo sapiens (before the Coronavirus), to Homo Digitalis, during the Pandemic Era, to Homo Digitus, (after the Corona Virus subsides to a background phenomenon). Ultimately, Homo Hominus, supersedes all, as a visionary concept of mankind in the future [7]. All of the subspecies of Homo Sapiens can then be characterized using the ReSeT model [7].

Dertouzos tried to anticipate our further evolution, when he wrote a brief epilogue in 2001, "Finishing the Unfinished Revolution," to his book which challenged the technologists, The Unfinished Revolution: Human-Centered Computers and What They Can Do for Us [22]. Dertouzos hypothesized a world in 2020 where:

> *"The human-centric technologies will bring computers closer to us and give us power to do more by doing less. But the highest meaning of "human-centric," and its biggest benefit to us will be determined by what we do to achieve the human goals we set. We will be better off and we will be finishing the ultimate Unfinished Revolution if we reach for these goals using all our human dimensions in concert, standing once again in awe before the sunset, the wheel and what may lie behind them"* [23].

2.3. Global Trusted Dependability

The DESSERT series of IEEE conferences (formally known as the *International IEEE Conference Dependable Systems, Services and Technologies*) founded by Ukraine experts in fault tolerant systems, and led by one of us (Prof. Vyacheslav Kharchenko) of the Computer Systems, Networks and Cyber Security (CSNCS) Department, and the Centre for Safety Infrastructure Oriented Research and Analysis at the National Aerospace University, "Kharkiv Aviation Institute", NAU "KhAI," have showcased the ongoing process to develop the GTD scientific discipline framework [24,25].

Examples of global threat vectors which fall under the GTD scientific discipline framework include:

- Chernobyl (human error);
- 9/11 (external terrorism);
- Anarchism and other violent ideologies (internal terrorism);

- COVID-19 Pandemic (human error);
- Hurricane Katrina with the functional failure of New Orleans (natural event exacerbated by human error);
- Great Northern US Blackout of 2003 (human error at several levels).

These have been studied in the context of globally integrated security engineering (GISE) by the CIDLab (Critical Infrastructure Dependability Lab) established by one of us (Prof. Rucinski) within the Department of Electrical and Computer Engineering at the University of New Hampshire [26].

Why did these events happen? The working hypothesis is that they occurred or at least became serious events because of an ill-defined virtue code and the absence of attributes of trust (S) and dependability (R, and T).

2.4. Fault Avoidance:

Global Threat Vectors, as above, have been commonly discussed and evaluated in an ad hoc manner [27], by many including the recent "Department of Homeland Security 2020 Homeland Threat Assessment," released by the US DHS [28]. These types of threats affect the material and virtual stability in the Ptolemaic Universe. Beyond the typical "after-action report," the above examples of neglected and insufficient fault avoidance [29] in the Ptolemaic Universe, can be interpreted in a system-level diagnosable global environment [30–32].

2.5. ReSeT Model:

The Ptolemaic Universe can be modelled as a fractal ecosystem with the decisive roles of initial conditions in: physics (R); mathematics (T); and philosophy (S), leading to a triad-based ReSeT model.

Figure 1 shows the Ptolemaic Universe: with an independent and fault-free core observer monitoring three interconnected nodes (R, S, and T), which are shown as circles. They represent: physics (R); mathematics (T); and philosophy (S), or alternatively: the physical world, the virtual world and the spiritual world, respectively. This assumption is axiomatic, but unrealistic, since an observer is de facto an integral part of the ReSeT model. Note that each node: R, S, and T can be either faulty, or fault free. As much as the fault model can be arbitrarily defined, for the remainder of the paper we define a node to be faulty if the node does not comply with the accepted virtue code.
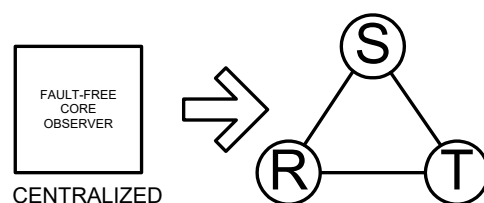

Figure 1. The Ptolemaic Universe triad-based ReSeT model.

As a result of this characterization, the name ReSeT has a deep symbolic meaning. ReSeT calls for the restoration of the best practices in the history of mankind, and the establishment of a universal, comprehensive, and long-term base for defining the essence of humans and their role in the world. This approach can be contrasted with the common practices of: very short term, picture oriented, breaking news oriented, superficial pseudo-culture, pseudo-science, and often uncivilized behavior which we are currently experiencing on a global-scale.

One of the fundamental characteristics of any ReSeT ecosystem including smart cities is safety and security. This leads to the essential question of the optimal balance between liberty and its protection. The proposed solution emphasize trust and dependability.

Dependability assures safety and security, while trust guarantees the Jeffersonian humane principles of the rights to: life, liberty, and to pursue our individual definition of happiness.

At the DESSERT'2020 conference, Rucinski introduced to ReSeT, the concept of Global Trusted Dependability (GTD), derived from dependability theory [33]. To evaluate GTD, a generic canonical GDT architecture includes a network of distributed observers accompanying the core nodes (R, S, T) as illustrated in Figure 1.

Figure 2 shows the three linked distributed observers, each associated with the original R, S, and T nodes. For example: PR {Earth patriots} monitor the state of the environment, PS (Sophians) [34] monitor the state of the culture, and PT (AI experts) monitor the state of the technological infrastructure. Note: green nodes are fault free. Following the principles of the PMC model developed by Preparata, Metze, and Chien [30], each node can:

- Be either faulty or fault free,
- Diagnose any neighboring node,
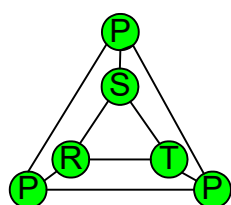- Activate proper recovery procedure in a fully distributed manner.

Figure 2. The global trusted dependability (GTD) architecture with distributed observers.

In the following analysis of societal organization, The P observer node associated with S (PS) represents the government itself. Figure 3 illustrates within the inset ellipse at the sub-node level the expansion of (PS) for the three independent branches of the US-style representative democracy: executive, legislative, and judiciary. In its ideal implementation such a society, with all green principle and observer nodes has been dubbed the Vitruvian society.
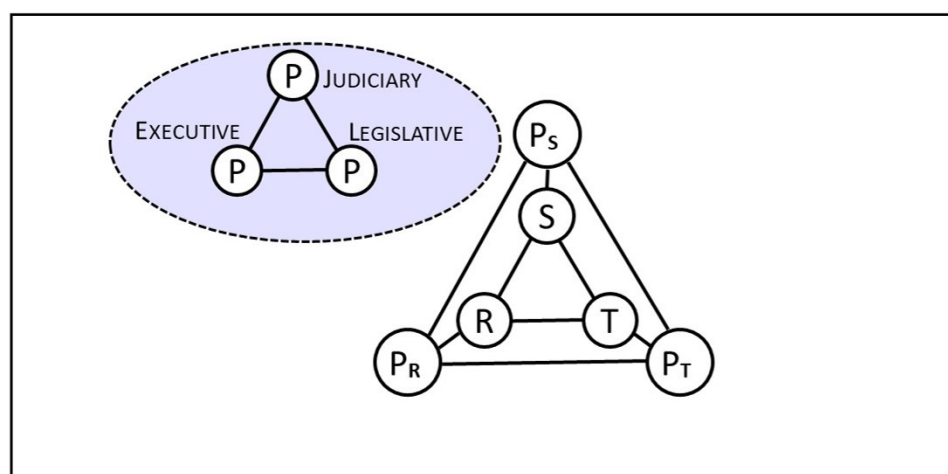

Figure 3. The Vitruvian society as a Preparata, Metze, and Chien (PMC) model.

Following the generic canonical GDT architecture of Figure 2, R (e.g., the economy or other manifestations of the habitat) has an associated observer node (PR) which may represent external influences on the overall physical environment, or the habitat of the populace. For example consider the impact of: military, and/or policing enforcement of taxation, or "pandemic lockdown" restrictions on everyday life. In the same manner, the P observer node associated with T (PT) may represent cybersecurity agencies, or social media companies blocking accounts.

The generic canonical PMC GDT architecture diagram of Figure 2 can be used to represent a number of fault scenarios. Note that in the PMC GDT model single and double faults are tolerated. This fault tolerance holds regardless of which nodes are faulty. In the following scenarios, "good" nodes are shown as green and faulty nodes are shown as red. In ideal democratic states such as the Vitruvian society, all of the sub-nodes of the PS node are green.

Figure 4a illustrates a dictatorship as modeled using the PMC methodology, where both the spiritual node and its associated PS node (i.e., government) are faulty (shown as red). In Figure 4b the model is applied to a pandemic such as the current COVID-19. Here both the R node for the environment (i.e., the economy) and the S node for the culture are faulty and are indicated as Red. However, T, the technology node, and all monitor nodes are working as well as possible and are indicated as green. In Figure 4c, a failure of trust, such as has happened several times in the past year is modeled. There are faults at both PS (government) and PT (e.g., social media), both indicated as red. However, the top level nodes (R, S, T) as well as the real-world's monitor (PR) are working and shown as green.
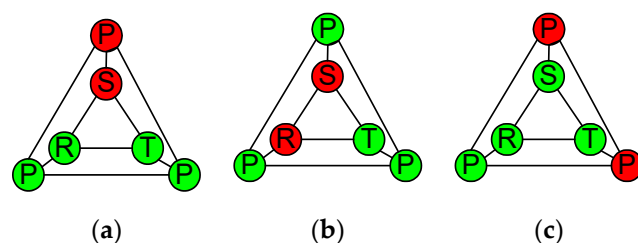

(**a**)   (**b**)   (**c**)

Figure 4. (**a**) A dictatorship as a PMC model; (**b**) the COVID-19 pandemic as a PMC Model; (**c**) a trust failure as a PMC model.

Assuming the presence of faults, topological models can be used to evaluate the evolution of Homo Sapiens in the presence of AI to become the hypothetical sub-species of: Homo Digitalis, and then Homo Digitus. Figure 5. Depicts these models as society evolves along with AI. Note: only the top-level nodes are shown.
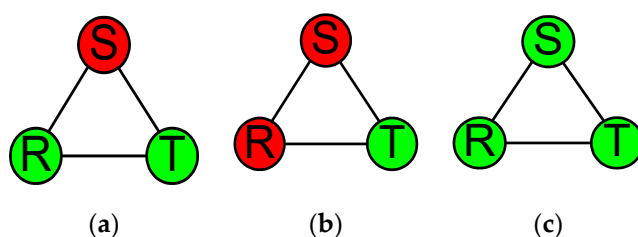

(**a**)   (**b**)   (**c**)

Figure 5. (**a**) Homo Sapiens, Anno Domini 2019; (**b**) Homo Digitalis Anno Domini 2020; (**c**) Homo Digitus Anno Domini 2021.

In Figure 5a, the pre-Pandemic Era, S, the Spiritual domain is suffering, as it has been for quite a while. However R, the real-world (e.g., as measured by growth in GDP, or historically low unemployment in the US and much of the developed world) is doing well. Ignoring Michael Dertouzos' concerns of technology not being human-centric; T, technology is functioning, and leading the way to a continuing improvement in our standard of living.

In Figure 5b, during the Pandemic, the spiritual domain continues to suffer, and the real-world begins to falter due to both the disease itself and the "cure" imposed by government in the form of lockdowns. Technology continues to function, as we become increasingly dependent on: virtual meetings, virtual doctors, virtual dog adoptions, and of course virtual shopping.

Finally in Figure 5c, we have a hopeful "post pandemic," scenario where the spiritual domain and the real-world begin to recover, as people go back to work, school, theatre, museums, restaurants, gyms, etc. While, Pandemic-centric technology, e.g., vaccines and

indoor air cleaning helped us overcome the pandemic; virtual-community technologies helped us endure the pandemic. They are likely to become increasingly important in the post-pandemic modern world.

3. Results

This paper has introduced the concept of faulty nodes associated with our society. The faulty metaphysical world (S) represents the rejection of the universal virtue code, while the faulty real sphere (R) corresponds to decaying Earth resources, and the presence of the COVID-19 pandemic. All of this should be the subject of an open debate protected by a universal first amendment.

Note that by the PMC constructs, the recovery i.e., a transition from Homo Digitalis towards Homo Digitus is impossible, because of the lack of a fault free core representing a majority. Governmental structures (PS) are faulty in both pandemic, and trust failure scenarios of Homo Digitus. However, according to the canonical GTD architecture, if a fault free structure of PS components is added, then recovery becomes possible.

Fault avoidance, as in the work of Romanovsky [30], can be provided by either or both, high value trust associated with the spiritual sphere, or by high value dependability, related to both the material and virtual domains of the model.

In all ReSeT domains, fault tolerance, and failures are characteristics and attributes defined as the negation of assumed standards, such as the virtue code. Some examples of failures include: aggression; virtual guilt; pseudo-science (core Darwinism; Catastrophic Anthropogenic Global Warming); evil ideology (White Supremacism; Identity Socialism; and Anarchism e.g., Antifa); anti-religious bigotry; social media censoring; false news, and "cancel culture." The aforementioned failures become faults in the PMC model and less abstractly in the ReSeT model.

Smart Ecosystems

Smart Ecosystems, which include dependable and resilient smart cities, are described as global trusted dependability architectures. They are highly scalable encompassing individuals in different age groups (e.g., junior, senior), and accommodating different organizational scaling (e.g., household, society, and global).

In Figure 6, human watchdogs monitor the health of an abstract ecosystem. The spiritual sphere S may be guarded by (PS) "Sophians," while AI Experts (PT) monitor the state of AI in the technological virtual world T. The material sphere R in-turn, may be watched over by (PR) scientists, environmentalists, health care providers, etc.
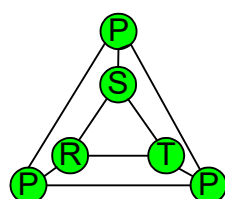

Figure 6. The canonical GTD ecosystem with the P node "watchdogs" for its health.

Figure 7, shows two more concrete examples which are based on a "Smart Apartment" with "bots" to provide support to the human inhabitants. In Figure 7a, three bots, responsible for: security (T1), housekeeping (T2) and health care (T3) function as "guardian angels" for a single tenant H. The resulting fault tolerance, t = 2. In Figure 7b, the same apartment now has two residents, H1 and H2, e.g., a married couple, and is supported by four guardian angels: T1 (security), T2 (housekeeping), T3 and T4 (e-health assistants) for Tenants H1 and H2, respectively.
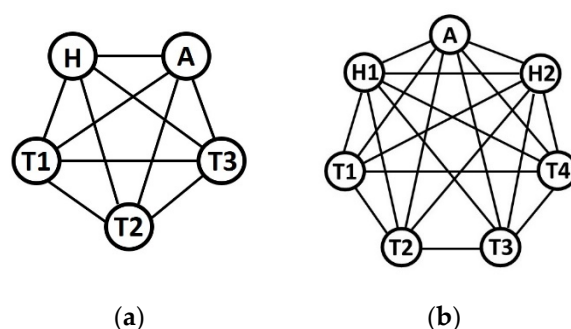
(a) (b)

Figure 7. (**a**) Smart apartment, with one tenant; (**b**) smart apartment with two tenants.

Seemingly paradoxically, adding residents increases the fault tolerance level from t = 2, to t = 3. However, this is just Metcalfe's Law in action, as the "connectivity of the network," i.e., its "value" has increased geometrically with the increasing number of nodes. These examples represent building blocks of any smart city including one inhabited and populated by Homo Digitus and/or Homo Digitalis. This coexistence of the two evolved Homo Sapiens sub-species is consistent with the recent discovery that various homo species including: Homo Sapiens, Neandertal and Denisovans, all coexisted in Europe for millennia [35].

4. Discussion

4.1. Wellness Model

The practicality of the ReSeT model is verified by introducing the corresponding Wellness Model, which expands the R, S, and T domains by defining each formally as a set of classes (categories), with:

- R, associated with:

  - Economy,
  - Housekeeping (environment),
  - Longevity,
  - Innovation.

- Domain T is driven by AI and it also includes the supporting technologies which enable the physical manifestation of the "smartness," e.g., robotics and communications, such as IoT, 5G, etc.
- S Domain consists of classes of: identity, social life, knowledge, and culture.

Each category has its associated attributes. Starting with the identity category, there is a governing and commonly acceptable virtue code with the following structure denoted by:

- My soul: Plato's triad: beauty; wisdom; goodness

  - with individual failures of S classes i.e., identity, social life, knowledge, and culture, impacting S;

- My protection: based on the American rights: life; liberty; happiness;

  - with some other human failures of S affecting individual S;

- My impact: on the outside world as characterized by the virtues of citizenship: curiosity, perfectionism, service;

  - with individual failures of S affecting R and T;

The proposed virtue code introduced above is only for illustrative purposes, since the validation and verification of it is outside the expertise of the authors. However, violation of any virtue code generates failures, which in turn can be introduced into the model. Table 1 illustrates these violations of the hypothetical virtue code and their associated failures.

Table 1. Illustrating the example virtue code and associated failures.

Top Level	Component	Corresponding Failure
Plato's Triad:	Beauty	Offensive Art
	Wisdom	Pseudo-Science; Stupidity
	Goodness	Virtual Guilt; Evil Ideology; Crime
American Rights:	Life	Euthanasia; Killing of Blameless Civilians
	Liberty	Aggression; Coercion; Imposing Ideologies
	Happiness	Force; Abuse; Discrimination
Citizenship:	Curiosity	Censorship; Fake News; "Reality TV"
	Perfectionism	Primitivism
	Service	Disservice: Education; Parenting; Clergy; Politics; Medicine

We note that in Table 1, that even for this arbitrary example, the most decisive failures are associated with goodness.

Table 2 provides a two dimensional version of a torus (Treemap) of the ReSeT topological model for the wellness domain. The ReSeT model, in the context of the wellness domain, is related to, and can be derived from the UN's "17 sustainability goals" [36,37] which are shown pictorially in Figure 8.

Table 2. Illustrating the ReSeT model in the context of the wellness domain.

S	IDENTITY Pirx Club [38] Virtue Code Organization Control	SOCIAL LIFE	KNOWLEDGE GTD LaaS	CULTURE
T GTD and AI and Fractal Computing [39,40]				
R	ECONOMY BaaS	HABITAT Housekeeping Hydrogen Earth protection	LONGEVITY eHealth HaaS	INNOVATION XaaS* (Disruptive) XaaS** (Exponentially Disruptive)

Figure 8. UN 17 Sustainability Goals [37].

Table 2 is a textual representation of the topology of ReSeT as a torus. It expands the R, S, and T with more detailed categories (classes) associated with them:

- R, (economy, habitat, longevity, innovation),
- S, (identity, social life, knowledge, culture),

- T.

Each class is characterized by both: grand challenges (flawless) and grand threat vectors (erroneous). Each category can be evaluated either as faulty, or fault-free according to the proposed universal virtue code associated with the particular identity class. Thus, if the class' compliance with the universal virtue code is positive, there is no failure; otherwise a grand threat vector occurs. While the particular "evaluating entity" depends on the evaluated ecosystem, this entity must always be trusted and dependable. Individual Homo sapiens' societies can be characterized by using different metrics and correspondingly different sophistication levels.

Looking at Table 2, the wellness domain is driven by both the identity box in the upper left corner of the domain, and the innovation box in the lower right corner. Procedures for change are governed by service science [41] and disruptive innovation theory developed by Christensen [42,43] with services such as: BaaS (Business-as-a-Service), HaaS (Health-as-a-Service), LaaS (Learning-as-a-Service), and finally XaaS (Innovation-as-a-Service). Examples of current global initiatives to change the world include projects initiated by: the World Economic Forum [44], and Poland's Lem Institute [45].

4.2. The Wellness Signature

The Wellness Signature (topology driven) can be evaluated as a progression over Time: (Home sapiens => Homo Digitalis => Homo Digitus), and/or as organizational scaling (individual => household => community => nation => global). The Wellness Signature also represents the dependability of different categories, subspecies, etc. It is also possible to assign different axioms of the virtue code to different categories in the wellness domain.

One can apply more sophisticated norms, but in the simplest case the wellness signature can be defined as the sum of ones (1's) associated with each category including T; where satisfying the evaluation is being compliant with the universal virtue code. Therefore, provided that each category of the signature can be either a zero (faulty and/or not satisfying), or a one (fault-free and/or satisfying), then the resultant maximum value of the wellness signature is equal to 9.

One can derive and apply more sophisticated metrics if necessary. For instance, the wellness scheduling (geometry driven) can be represented by a TreeMap with the space allocated to each category representing the time assigned to each activity in each time interval. Such a geometric representation has been used to characterized the US Federal Budget's evolution over several decades [46].

In our wellness signature, innovation should occupy as much area as possible, because it represents free time. In case that there are no innovation activities, i.e., XaaS = Ø; then innovation is characterized by an empty set; and as such it can be considered as a time reserve. Note that the normalized wellness signature determines the trust and dependability in GTD systems.

It is debatable how to prioritize different categories in the wellness domain. They appear to be all equally important, which is typical in any axiomatic system. We propose to emphasize the identity and innovation classes and to highlight XaaS. As we noted previously, XaaS represents X-as-a-Service or in other words Services which need to be invented in order to shape the futuristic societies of Homo Hominus.

The concept of "innovation-on-demand" are encouraged and pursued by: the Cambridge Innovation Center (CIC) [47], and through the Bottom-up Business Opportunity (BUBO), a North Netherlands entrepreneurial discovery process supported by the EC [36]. CiC centers which are located in several regions around the world use AI to monitor trends of trends, essentially an a posteriori approach. In contrast BUBO looks retrospectively from the vision level, i.e., in an a priori manner. The EC's PERISCOPE project [48], which initiated BUBO, has the advantage of the EC's definition of a mutually beneficial domain of a sustainable economy.

Changing the geometry of the wellness TreeMap corresponds to different schedules of development. In both realistic and hypothetical scenarios, the quality of life and conse-

quently its wellness may be improved over time. The wellness model and its underlying theory constitutes the design specification framework for the proposed dependable and resilient smart cities ecosystem which is both down and up scalable according to the Birmingham π Theorem.

As mentioned previously, Homo Sapiens' deficiencies have been emerging well before the current pandemic, driven by the neglect of universal virtue principles. Associated with this phenomenon, is a progressive and accelerating erosion of trust and dependability. The Pandemic's evolution has provided an excellent example of the failure of civilization on a global scale.

Figure 9, illustrates the hypothetical evolution of the pandemic, based on discussions which were held during the 2020 virtual DESSERT conference [49].
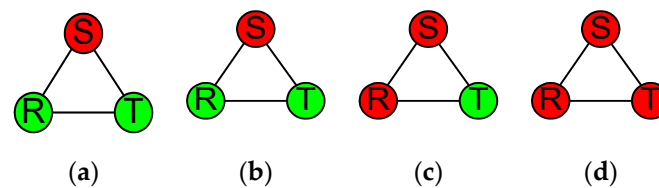

Figure 9. Hypothetical evolution of the pandemic. (**a**) Research at Duke University in 2005; (**b**) research transitions from US to France to the Wuhan Virology Institute (WVI) in China in 2013; (**c**) escape from the WVI in December 2019; (**d**) fully developed global pandemic in March, 2020.

In Figure 9a, S category failure reflects the lack of ethics among scientists studying and modifying the coronavirus in the laboratory, i.e., Gain-of-Function research (GoF) [50]. In Figure 9b, this GoF research now involves non-trusted and non-verifiable laboratories in Europe and Asia. In Figure 9c the COVID-19 escapes from the Wuhan Virology Institute (WVI), either by accident, or via an inherent laboratory procedural failure. In Figure 9d, logistic and organizational failures on a number of levels result in the pandemic's global spread by March, 2020.

Figure 10 shows an example of an evil ideology active in the United States. This is a Homo Digitus case with flawless technology (T) developed as consequence of the pandemic case and as illustrated in Figure 9a–c. In the evil ideology case shown in Figure 10. S and R, are failing with T remaining dependable; (PS) and (PR) are working perfectly. Note that expanding (PS) to the sub-node level (as shown in Figure 3) would result in red S but green R and T. This would still assure dependable operation at a global level since two failures out of the population of six nodes assures a "healthy majority." Meanwhile, the content-agnostic communications media (W3, IoT, 5G, etc.) provides the connectivity which facilitates the whole evil ideology ecosystem.
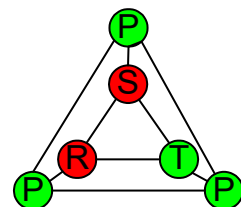

Figure 10. Evil ideology with failed R and S but working T.

On top of the COVID-19 itself, there are negative phenomena which can be dubbed as triple failure societal diseases (3F) based on ill-functioning of R, S, and T. In an example 3F case: failed R represents the pandemic itself; failed S represents the lockdown and extended forced isolation; failed T is related to addiction to the Internet and social media. Without outside intervention in a 3F, recovery is impossible.

4.3. Homo Digitus, Vitruvian Society, and Dependable and Resilient Smart City

The primary motivation for an expected transformation is "back to the future" and the restoration of normal life in the post-pandemic Era. The Pirx Club established in Warsaw, Poland by Grzebyk [38] may serve as a catalyst for Homo Digitus to resurrect through XaaS. The road to recovery, i.e., the establishment of Homo Digitus as the dominant sub-species, as opposed to today's Homo Digitalis; calls for the development of the Vitruvian society.

The Vitruvian Society is a community whose fundamental mission is to symbiotically "evolve" mankind in the AI Era. This on-going process has been distorted by the pandemic. On the other hand, the COVID-19 Pandemic has prompted the world to accelerate the process of adapting to AI and the other manifestations of the virtual world.

Exactly the same improvement process applied to the case of evil ideology is illustrated in Figure 11. (PS) (Sophians, Vitruvians, AI experts, Earth patriots, captains, pilots, guardian angels, etc.) may be represented by the Pirx Club which constitutes the nucleus of the emerging Vitruvian Society. The Pirx Club has no distorted virtue code as opposed to the evil ideology. Pirx's fundamental characteristics are trust and dependability. They can be evaluated based on the wellness signature metrics:

- "Back to the future" driven by identity and innovation:

  o   Specifications: Homo Digitus habitat (ecosystem);
  o   Science: IEEE (globally respected source for technology) [51];
  o   Product 1: Pirx Club ~ Vitruvian Society;
  o   Process 1: Transformation ISSIP XaaS ~ IEEE Futurology Congress;
  o   Product 2: Abrahama (home) and Zatorze (town);
  o   Process 2: Fractal-engineering resulting in T (fractal networking) and R (eHealth)
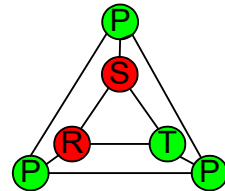
- Merits: Wellness and knowledge

Figure 11. Evil ideology with failed R and S but working T showing improvement.

The wellness domain shown in Table 3 represents a dependable and resilient smart city design specification framework which is isomorphic with the generic Homo Digitus habitat. The goals are to understand the grand challenges represented therein and to unclog the pathways to achieve their solutions. To accomplish this mission, entities such as the Pirx Club, the prototype of the Vitruvian Society, synergistically interact with Vitruvians, Sophians, and bots represented by guardian angels.

Progress toward the goals is, defined by innovation as guarded by identity—thereby facilitating the organic competition of ideas generated by: entities such as CiC, and IEEE (responsible for global standards such as IEEE 802 for wireless networks) [51]; and also by myriads of entrepreneurs and independent inventors located around the globe.

Table 3. Illustrating the dependable and resilient smart city design specification framework.

S & P Sophians	**IDENTITY** Pirx Club Virtue Code Organization Control	SOCIAL LIFE Trusted and Dependable Relationships	KNOWLEDGE GTD LaaS	CULTURE Trusted and Dependable Social Media
T and **P** GTD and AI and Fractal Computing and Networks [39,40] Guardian Angels				
R & P Vitruvians	ECONOMY BUBO BaaS Financial Guardian Angels (Avatars)	ENVIRONMENT Housekeeping Hydrogen Earth protection WATERFRONT DISTRICT Housekeeping Guardian Angels (Avatars)	LONGEVITY eHealth HaaS Health Care Guardian Angels (Avatars)	INNOVATION XaaS* (disruptive) XaaS** (exponentially disruptive) CiC Warsaw

5. Future Developments, Conclusions

Already, there have been several attempts to define a better world in the post-pandemic era, such as the MIT Campaign for a Better World [52]. We propose that a centralized, universally-accessible, mechanism for fostering such a better world, founded on trust and dependability, be established. The past year's celebration of Stanislaw Lem, a Polish science fiction writer, philosopher, and visionary can provide the impetus to initiate the "back to the future" vision.

In 1971, Lem in one of his science fiction works described the Futurology Congress [53,54]. The IEEE is the designated organization to implement a real-world version of such a gathering of the minds, reminiscent of the Solvay Conferences, regularly held in Brussels over the past century, and which helped to foster the physics underlying modern technology [55]. We, and others, have proposed the *First IEEE Futurology Congress* be held in 2022, in Gdansk, Poland, the globally recognized site of the birthplace of solidarity.

Beyond the physical event, we envision the *First IEEE Futurology Congress* ("FC") to be a novel, disruptive, and continuing process. As the prototype of the XaaS prototype, it must be fully accessible on a global scale. A major thread within the FC is devoted to prototype Homo Digitus habitats on varying scales such as:

- GDYNIA2026's Apartment Design Specification Framework—HOME (Kamienica Abrahama), Gdynia, Poland [56],
- Town, (Zatorze) Gdynia, Poland [56],
- Community,
- Hansa Ligue 2.0, in Europe and beyond [57,58].

The corresponding wellness specifications are compliant with the generic specifications. They can be viewed as being representative of both the program of the proposed *First IEEE Futurology Congress*, and the proposed development projects.

Additional proposed projects include: a start-up based both in Boston and Warsaw, to develop a fractal network prototype with an e-Health app. Overall, we expect that solutions improving human wellness at different levels of scalability will arise from "X-prize-like" competitions conducted among Sophians, Vitruvians, and Guardian Angels, with an ever increasing role for the latter.

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