

Using Information and Communications Technology Advances to Leverage the Search of the World New Balance with Less Resources

-Part 3-



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Abstract

The paper analyses the context of World dramatical crises, which is facing unprecedented phases of global warming, Earth resources fading, social unbalances or geopolitical crises. Practically, if we obviously could not prevent and avoid all this “flood” of emerging consequences and disasters, we should use all human and technological resources and potential in order to find updated ways to reduce their impact on Earth and humankind present and future, including information and communication technology (ICT) advances like artificial intelligence (AI), Internet of Things etc. The role of ICT in the Information Society (IS) on the way towards the Knowledge Based Society (KBS) is largely recognized, but this, naturally, should be updated by the appropriate refined knowledge and solutions/applications, oriented for the dynamic World context changes/crises. Although AI actually is dramatically influencing a large range of IS/KBS domains, perhaps inside ICT areas the impact could be crucial, adding then major implications in all Earth zones where ICT products, applications and services have global penetration, as we analysed for some examples. First, the approach of AI on global industries seems to have similarities with ICT models, where terms of infrastructure, message or personalization could suggest the specific benefits of AI, but more than these, a further integration is needed for different scenarios (customer employee and infrastructure focused). A more concrete approach/example, belonging to the prestigious organization of IEEE (World larger organization of professionals), is pointing the crucial role of engineers in this global striving against „all odds”, even by pointing some crucial areas of human needs, like water, energy or sustainable farming.

Further, we have analysed some trends in ICT to discover the efficient innovation that could prevent or minimize (if not avoid) the consequences of actual or future World crises, which are, in realistic expression, caused by the unprecedented high level of complexity, incertitude and critical unbalances the Earth ecosystem and humankind evolution reached. This way, identifying such hidden links, between visible events/trends and potential critical evolutions could be a first, but essential, step in preventing and also in finding appropriate innovation approaches. Along with the complex problem of Digital transformation, crucial for all business context, it was confirmed the subtle approach of ICT models (to learn from), which provide success (as network infrastructures, applications and services) at Earth scale, due to the methods and algorithms used (to measure and analyse) before any implementation/investment phase. Another example/project, pointed some directions for AI/ML development, but it is confirming that an essential feature of ICT development, oriented for approaching the challenges of World crises, Earth ecosystem and even humankind (species) evolution, is the proper refining of knowledge, as crucial field of research and optimization for identifying factors that determine uncertainty. We think that such targets are extremely difficult in the complex, complicate but also very dynamic Earth ecosystem context, leading to the idea that timely and deeper analyses should be continued, along with the innovation approaches efforts which are needed at all levels of IS/KBS, in order to leverage the proper refined knowledge and stimulate all factors to follow the rational actions, before it is too late

Keywords: Artificial intelligence, Telcos, Network experience, Sustainable farming, Machine learning, Digital transformation, Knowledge based society, Uncertainty

JEL Classification: L63; L86; M15; O31; O33

“The only true wisdom is in knowing you know nothing” (Socrates)

1. ICT is searching updated development optimization solutions in the World's changing context

Watching the dramatic changes of the World context, people would ask sometimes if it is the case of just wondering or rather acting when seeing everyday news?

Some of us will probably say that, anyway, it is better to think and deeply think, beyond today picture, about present, past and future, before any other options.

We also agree that, among the general options, we should consider several approaches: Expecting so much from history lessons, people's reasoning and technologies potential is the answer? Or a better and democratic advising of incumbents' decisions? Perhaps we should understand that, today more than traditionally, *there are more and more questions than answers*.

Recalling just few of the recent shocking news, we should naturally ask: How to prevent and combat disasters like Canadian, Greece and Hawaii fires, Russia barbarian aggression and huge destructions in Ukraine (with international resources/food consequences) or even the Frankfurt instant flood in august 2023?

As we already approached [3][11], the optimization of the World ecosystem, facing unprecedented phases of global warming, Earth resources fading, social unbalances or geopolitical crises, is unlikely possible, even if we strive to use all human and technological potential, including *information and communication technology (ICT)* advances like artificial intelligence (AI), Internet of Things etc.

Consequently, the realistic approach is, of course, to integrate all relevant information, to refine knowledge and to imagine ways to minimize the consequences of the dramatical evolutions.

With simple words, if we obviously could not prevent and avoid all this “flood” of emerging consequences and disasters, we should use all human and technological resources and potential in order to find updated ways to reduce their impact on Earth and humankind present and future [7][8][10][14][6][9][15][17][18].

Coming back to where people are “expecting so much from”, the role of ICT in the Information Society (IS) on the way towards the Knowledge Based Society (KBS) is largely recognized, but this, naturally, should be updated by the appropriate refined knowledge and solutions/applications, oriented for the dynamic World context changes/crises we already have partially mentioned [3][16][19].

The real major challenges still continue to come and extend, along with events, dangers and disasters which are caused by the accumulation of complex factors/situations, generated mainly by humankind and unfortunately unlikely to be completely discontinued without a global understanding and action towards enabling radical decisions from incumbents.

This way, one of the main purposes of ICT could be to enable the complex knowledge refining processes, linking and empowering all humankind potential of reasoning and research, having the Earth ecosystem survival as global aim and using ICT advances, like AI, to provide the speed and efficiency requested by the critical/ultimate urgency we are in, if we want to avoid no-return phases of World decline [6][9][11].

It is still clear that the paramount importance of such global target does not automatically simplify the huge complications of making it possible and fast, but we all could least timely analyse, at different levels, the best solutions to be integrated/oriented in this direction with the appropriate timing and strategies.

Witnessing the ICT impressing evolutions of the last decades, we could also try to lend from its potential, lessons and algorithms to realize innovations and breakthroughs in order to leverage the huge planetary efforts for these targets, either by technology or education/knowledge means [20][21].

Undoubtedly, it is not simple to identify the right ICT development/targets, but this should be one of the priorities of analyses to be timely done, as we further intend, by some relevant examples.

Although artificial intelligence (AI) actually is dramatically influencing a large range of IS/KBS domains, perhaps inside ICT areas the impact could be crucial, adding major implications in all Earth zones where ICT products, applications and services have global penetration, as it is also detailed presented by [1]:

“Artificial intelligence, when deployed at scale, can help telcos protect core revenues and drive margin growth. But capturing this opportunity will require a wholly different approach. Artificial intelligence (AI) is unlocking use cases that are transforming industries across a wide swath of the world’s economy. From infrastructure that “self-heals” to radically reimagined (and touchless) customer service and experience; from large scale hyper-personalization to automatically created marketing messages and images leveraging. Generative AI tools like ChatGPT—it is all a reality today. These AI solutions can powerfully augment and sometimes radically outperform most traditional business roles.”

We have to notice the approach of AI on global industries by the similarity with ICT models, where terms of infrastructure, message or personalization could suggest the specific benefits of AI, but more than these, a further integration is needed for different scenarios:

„While isolated applications of the technology can help individual departments improve, it’s AI connected holistically at all levels and departments that will be key to protecting core revenue and driving margin growth in even the most difficult of environments. Imagine the following not-sodistant scenarios:

— Customer focused: Sarah, a New Yorker, is a high average revenue per user (ARPU) customer. Aware that Sarah spends half of her phone usage time on fitness apps, the AI creates an enticing customized upgrade offer that includes a six-month credit applicable to her favorite fitness subscription and NYCspecific perks, such as a ticket to an upcoming concert sponsored by the operator... „

Although, naturally, the focus starts with the customer approach, the challenges on labour market are also considered:

„Employee focused: When Trevor, an associate in a telco mall store, logs in at the start of his shift, he receives a celebratory notification congratulating him on his high-quality interactions with customers the previous day. And because the AI detected that Trevor is underperforming peers in accessory and device protection attach rates, he receives a notification pointing him to coaching resources specifically created to enhance performance in those metrics...”

Last, but not the least, the infrastructure optimization could benefit from AI implementation, by correlating network experience scores with dynamic investments decisions:

„Infrastructure focused: Lucile, director of a capital planning team, uses AI to inform highly targeted network investment decisions based on a granular understanding of customer-level network experience scores strongly correlated to commercial outcomes (for example, churn). The AI provides tactical recommendations of what and where to build based on where customers use the network and on automatically computed thresholds after which new investments have marginal impact on experience and commercial outcomes for the operator.”

A more concrete approach/example, aiming some of the above large objectives of the World challenging context, is approaching the hardest problems (global warming, Earth resources fading), but starting from simple ideas [2]:

„THE INSTITUTE Earth is in a nerve-wracking phase. Global warming is a major topic and humans are starting to see the effects, like extreme weather events. In 2017, Hurricane Maria hit Caribbean communities and left millions of people without power and shelter for months. Humans are searching for ways to fix the damage being done to our environment, and engineers are making major strides towards this goal. Below are three ways engineers are improving the planet.”

Before analysing the three proposed areas/ideas, it is worth to observe the source of these ideas, belonging to the prestigious organization of IEEE (World largest organization of professionals) and pointing the crucial role of (ICT) engineers in this global striving against „all odds”, even by pointing some simple, but crucial, areas of human needs, like *water, energy or farming*:

„Clean water is not accessible to everyone. According to the World Health Organization (WHO), 785 million people did not have access to a basic clean drinking water service in 2017. Engineers are creating technology that will bring clean water to those who need. The Warka Tower, for instance, is a 10-meter tower designed to collect and harvest potable water from the air, generate electrical energy from sunlight and even sustain a modular edible garden through an integrated irrigation system. The tower, built with biodegradable and recyclable materials, works through gravity, condensation and evaporation without the need for external power. Eventually, similar towers could provide clean water to any town that needs it. Engineers are also working on implementing smart technology to track the health of water pumps. When a pump isn't working, an alert is sent via smartphone app so that engineers can fix it quickly. In the absence an alert system, water pumps can go months without being serviced.”

It is worth to notice that not only water, but all materials, including pumps and service, have benefits from this autonomic ecological high-tech approach (an integrated irrigation system). A further sustainable approach covers the long expected *clean energy*, as it is further presented:

„No matter what form it comes in, solar, wind or water, the world needs to move toward clean energy harvesting. Engineers are bringing clean energy to the forefront with inventions like solar panels, wind turbines and hydropumps. Engineers have also created grid-tie systems to go hand in hand with clean energy generation. Grid-tie systems allow consumers who harvest their own clean energy to sell the extra energy they produce to utility companies. This energy can then be used by consumers who don't generate their own energy, creating a collaborative strategy that benefits a whole community.”

Combining the basics (air, water, energy) with ICT/AI advances, a World sustainability target could be approached, as *automation is one step towards smart farming* (oriented to sustainable farming):

„As the world's population grows, producing sufficient food is becoming increasingly difficult. Engineers are working to find solutions to avert worldwide food shortages. One strategy is to implement sustainable farming, which comes in many forms. Hydroponic, aeroponic and aquaponic farming were all developed by engineers to make it easier to grow food. All three types allow food to be grown in an indoor environment, increasing the amount produced. Engineers are also creating smart farms that use technology to streamline and improve farming. Automation is one step towards smart farming; it opens the potential to speed up the farming process and eliminate human error. From tillers to sorting machines to tractors, almost every farming machine can be automated. Smart farms can also employ drones to plant seeds, spray crops and keep real-time analysis of fields. In sum, engineers are trying to help

humanity, from sustainable farming to clean energy to clean water. They are working on making the Earth a better place for everyone, now and into the future.”

In this case, we observe the increasing potential of drones, supported by ICT advances and all optimization features provided in this huge domain of human activity (farming), but it is also important to recall the crucial role of engineers – a pillar for the expected innovation approaches expected to save the Earth.

Finally, we can notice the essential link between the first example, pointing **ICT advances with AI and its huge potential to impact concrete actual challenging areas, just by leveraging with new features even older areas/ideas like those from the second example.**

This way we have just emphasised (the tip of an iceberg!) the innovation approaches such links could offer for ICT and further for expected benefits in all IS/KBS challenging areas of present and future World.

2. Learning again from ICT lessons

As many times before, we have used the *tip of an iceberg* metaphor in order to suggest the hidden existence of something that could mean much more than we actually perceive it [24][26].

In fact, this usual and old situation (*Deja vu*) could have a crucial relevance in the striving efforts of ICT (and beyond) to discover the efficient innovation that could prevent or minimize (if not avoid) the consequences of actual or future World crises, which are, in realistic expression, caused by the unprecedented high level of complexity, incertitude and critical unbalances the Earth ecosystem and humankind evolution reached.

This way, identifying such hidden links, between visible events/trends and potential critical evolutions could be a first, but essential, step in preventing crises and also in finding appropriate **innovation approaches**.

Although it is not very evident, such way of thinking could be extrapolated in order to benefit from similar experiences we could learn inside ICT development evolutions, recalling the remarkable potential of ICT advances to export from their mechanisms of progress and optimization toward other IS/KBS domains [23][24][25].

Still, ICT should provide, with priority, instruments and solutions to respond at the economy and IS/KBS challenges, confronted with general uncertainty of the business context of World crises, but in the same time with the necessity of adapting to the mandatory changes required by the digital transformation, as it is also presented by [4]:

<< “If you can’t measure it, you can’t improve it.” This quote could not find better applicability than in today’s hyperconverged hybrid networks, evolving applications, and service infrastructures. Digital transformation is the essence of these rapidly evolving ecosystems and key to competitiveness for most enterprises today. Success and agility in such environments depend on the ability to measure and analyse how distributed, disaggregated network infrastructures, applications and services perform before going live, as well as during their production life cycle.>>

Here, along with the complex problem of *Digital transformation*, crucial for all business context, we notice again the subtle approach of ICT models (to learn from), which provide success (as network infrastructures, applications and services) at Earth scale, due to the methods and algorithms used (to measure and analyse) before any implementation/investment phase:

“Enterprises scarcely perform testing and validation, and usually do so before or immediately after the introduction of a network architecture, device, or service. Almost no testing occurs after the fact. This incomplete testing leaves doubts, uncertainty, and blind spots

when it comes to performance and scale limits and potentially broken functionality, misconfigurations and security gaps. Nobody wants to face these issues deep in production phases and pay the price to fix them. Past research shows that early discovery of issues provides massive savings, with some finding that bugs discovered in development are 90 to 100 times less expensive to fix than when found in maintenance.”

Fortunately, the academic world is also implied in the mentioned global effort, complementing the ICT advances in spectacular ways of identifying the above desired links and innovations in the complicate landscape of the World challenges.

The next example/project, developed at the *Carnegie Mellon University Software Engineering Institute*, is relevant, not only because the project is also linked with actual defence requirements, but because it is pointing one of the subtle **innovation approaches of ICT** advances: *Knowing When You Don't Know*. [5]:

“The DoD increasingly deploys artificial intelligence (AI) systems to perform mission-critical tasks. The backbone of many of these AI systems consists of machine learning (ML) models that make predictions about their environment. Unfortunately, even state-of-the-art ML models can make inaccurate inferences in scenarios that involve uncertainty. Many common models do not accurately estimate uncertainty for their predictions. This can produce incorrect results; worse, it makes it harder to predict when ML systems will be wrong.”

Further, in a straightforward manner, the solution for such complex and complicate kinds of problems is pointed in practical approaching ways:

“To solve this problem, ML systems must be able to quantify, reason about, and rectify uncertainty in their predictions. This project will benchmark methods for quantifying uncertainty. It will also create techniques to identify changes in deployment environments that cause uncertainty. Finally, it will develop methodologies, tools, and best practices for rectifying the causes of uncertainty in models that become uncertain. This work will improve the robustness, reliability, and maintainability of ML systems.”

Here the main idea is not only to point some directions for AI/ML development, but it is confirming, as we also presented [26], that **an essential feature of ICT development, in the general IS/KBS context, oriented for efficacy and efficiency when approaching the challenges of World crises, Earth ecosystem and even humankind (species) evolution, is the properly refining of knowledge (be able to quantify, reason about, and rectify uncertainty).**

We also consider that a crucial field of research and optimization, ICT could leverage, is *create techniques to identify changes in deployment environments that cause uncertainty*, i.e., to combat and mitigate one of the toughest challenges of World crises.

It is sure that such targets are extremely difficult in the complex, complicate but also very dynamic Earth ecosystem context, leading to the conclusion that timely and deeper analyses should be continued, along with the innovation approaches efforts which are needed at all levels of IS/KBS, in order to leverage the proper refined knowledge and stimulate all factors to follow the rational actions, before it is too late.

3. Conclusions

The optimization of the World ecosystem, facing unprecedented phases of global warming, Earth resources fading, social unbalances or geopolitical crises, is unlikely possible, even if we strive to use all human and technological potential, including *information and communication technology (ICT)* advances like artificial intelligence (AI), Internet of Things etc. Consequently, the realistic approach is, of course, to integrate all relevant information, to refine knowledge and to imagine ways to minimize the consequences of the dramatical evolutions. Practically, if we obviously could not prevent and avoid all this “flood” of emerging

consequences and disasters, we should use all human and technological resources and potential in order to find updated ways to reduce their impact on Earth and humankind present and future.

The fact that people are “expecting so much from” the role of ICT in the Information Society (IS) on the way towards the Knowledge Based Society (KBS) is largely recognized, but this, naturally, should be updated by the appropriate refined knowledge and solutions/applications, oriented for the dynamic World context changes/crises we already have partially mentioned.

The real major challenges still continue to come and extend, along with events, dangers and disasters which are caused by the accumulation of complex factors/situations, generated mainly by humankind and unfortunately unlikely to be completely discontinued without a global understanding and action towards enabling radical decisions from incumbents. This way, one of the main purposes of ICT could be to enable the complex knowledge refining processes, linking and empowering all humankind potential of reasoning and research, having the Earth ecosystem survival as global aim and using ICT advances, like AI, to provide the speed and efficiency requested by the critical/ultimate urgency we are in, if we want to avoid no-return phases of World decline.

The paramount importance of such global target does not automatically simplify the huge complications of making it possible and fast, but we all could least timely analyse, at different levels, the best solutions to be integrated/oriented in this direction with the appropriate timing and strategies.

Witnessing the ICT impressing evolutions of the last decades, we could also try to lend from its potential, lessons and algorithms to realize innovations and breakthroughs in order to leverage the huge planetary efforts for these targets, either by technology or education/knowledge means.

It is not simple to identify the right ICT development/targets, but this should be one of the priorities of analyses to be timely done, as we intended, by some relevant examples.

Although artificial intelligence (AI) actually is dramatically influencing a large range of IS/KBS domains, perhaps inside ICT areas the impact could be crucial, adding major implications in all Earth zones where ICT products, applications and services have global penetration, as it is also detailed presented by [1]. Here, the approach of AI on global industries seems to have similarities with ICT models, where terms of infrastructure, message or personalization could suggest the specific benefits of AI, but more than these, a further integration is needed for different scenarios (*customer, employee and infrastructure focused*).

A more concrete approach/example, aiming some of the above large objectives of the World challenging context, is approaching the hardest problems (global warming, Earth resources fading), is belonging to the prestigious organization of IEEE (World largest organization of professionals) and is pointing the crucial role of (ICT) engineers in this global striving against „*all odds*”, even by pointing some simple, but crucial, areas of human needs, like *water, energy or farming*. Combining the basics (air, water, energy) with ICT/AI advances, a World sustainability target could be approached, as *automation is one step towards smart farming* (oriented to *sustainable farming*). From this case, we observe the increasing potential of drones, supported by ICT advances and all optimization features provided in this huge domain of human activity (*farming*), but it is also important to recall the crucial role of engineers – a pillar for the expected innovation approaches expected to save the Earth.

Finally, we can notice the essential link between the first example, pointing **ICT advances with AI and its huge potential to impact concrete actual challenging areas, just by leveraging with new features even older areas/ideas like those from the second example. This way we have just emphasised (*the tip of an iceberg!*) the innovation approaches such links could offer for ICT and further for expected benefits in all IS/KBS challenging areas of present and future World.**

Further, we have analysed some trends in ICT to discover the efficient innovation that could prevent or minimize (if not avoid) the consequences of actual or future World crises, which are, in realistic expression, caused by the unprecedented high level of complexity, incertitude and critical unbalances the Earth ecosystem and humankind evolution reached. This way, identifying such hidden links, between visible events/trends and potential critical evolutions could be a first, but essential, step-in preventing crises and also in finding appropriate **innovation approaches**. Although it is not very evident, such way of thinking could be extrapolated in order to benefit from similar experiences we could learn inside ICT development evolutions, recalling the remarkable potential of ICT advances to export from their mechanisms of progress and optimization toward other IS/KBS domains.

The analysis of the example from [4] revealed that ICT should provide, with priority, instruments and solutions to respond at the economy and IS/KBS challenges, confronted with general uncertainty of the business context of World crises, but in the same time with the necessity of adapting to the mandatory changes required by the *digital transformation*. This case, along with the complex problem of *digital transformation*, crucial for all business context, confirmed again the subtle approach of ICT models (to learn from), which provide success (as network infrastructures, applications and services) at Earth scale, due to the methods and algorithms used (*to measure and analyse*) before any implementation/investment phase.

Another analysed example showed that, fortunately, the academic world is also implied in the mentioned global effort, complementing the ICT advances in spectacular ways of identifying the above desired links and innovations in the complicate landscape of the World challenges. This example/project, developed at the *Carnegie Mellon University Software Engineering Institute*, is relevant, not only because the project is also linked with actual defence requirements, but because it is pointing one of the subtle **innovation approaches** of ICT advances: *Knowing When You Don't Know* [5]. Here the main idea is not only to point some directions for AI/ML development, but it is confirming, as we also presented [26], that **an essential feature of ICT development, in the general IS/KBS context, oriented for efficacy and efficiency when approaching the challenges of World crises, Earth ecosystem and even humankind (species) evolution, is the properly refining of knowledge**, as crucial field of research and optimization for identifying factors that determine *uncertainty*.

As a final conclusion, we think that such targets are extremely difficult in the complex, complicate but also very dynamic Earth ecosystem context, leading to the idea that timely and deeper analyses should be continued, along with the innovation approaches efforts which are needed at all levels of IS/KBS, in order to leverage the proper refined knowledge and stimulate all factors to follow the rational actions, before it is too late.

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