

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

-Part 1-



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Abstract

The paper analyses the changing and dramatic World context, which determines the premises to be associated with a World new balance with less resources and further the most prominent challenges/requirements/restrictions that should come from the crucial reality of climate changes and global warming along with Earth resources fading. New types of performances, which eventually should be associated with a World new balance with less resources, will be more relevant, at Earth ecosystem scale, than, for example, the usual/technical performances of information and communications technology (ICT) or any industry or human activity field (here the Earth resources should include at least energy and materials, either natural, fossil or created by man, although other subsequent or subtle categories should be added). Generally, identifying the new balance goals, like appropriate optimized solutions, is perhaps the most difficult part, because, from the start, here we could find an extremely complex and complicate problem, even if we put it in a concrete area of ICT (for example artificial intelligence - AI) or other industry, amplified by the new restrictions and uncertainties induced in the changing and dramatic World context. More than these, the new restrictions and uncertainties could come from multi-criteria analyses, including the expected/necessary changes in human behaviours, like consumption or rational use of Earth resources.

Our approach idea is to reconsider and refine knowledge about the fact that now all the known/old negative trends of Earth ecosystem meet the unprecedented critical/crucial stages/levels which the climate changes and Earth resources fading have reached. In physical terms, but with certain obvious limits, this evaluation is similar with the superposition of effects, leading this way to new concrete/value results. Further, such results could be, in fact, higher or even catastrophic, if not known and prevented. The paper goal is still to consider, now and here, starting from unprecedented losses of lives, energy and materials, the impact of ICT on managing/supporting the research of survival solutions for the emerging crises of energy and materials, still noting that, in fact, the human lives are prominent and more, the expected solutions will leverage saving eventually more lives on Earth.

It is worth to recall the link between fossils energy sources, materials and climate changes, as it is largely agreed that the carbon footprint of old technologies of producing energy or materials, along with their use, including transportation industries pollution, are major causes of global warming.

More than these, by using less resources, in the actual dramatic World context, we have to understand that, beyond fossil energy sources or diverse materials, the sustainable new World balance has to include changes of paradigms about consumption and efficiency in general. This could also mean new behaviours about using anything, as long as almost anything we could use/act contains energy and materials (even human effort!), including new (non fossil) energy and materials resources.

Consequently, we have to use less resources not only because they are limited and more expensive, but inherently they could contribute, in diverse ways, to global warming or Earth resources fading. Perhaps this is why we hear today, more often than yesterday, that "the World will be no more what it was". For a confirmation of the realism about the actual Earth context evaluation, although only just for a starting point with simple issues, the IEEE prestige and potential was considered, by analysing some of their solutions proposals on mitigating global warming, at the COP27 event held in Egypt in November 2022. Because the ICT potential is beyond just approaching dramatical challenges and complexity, but, by its advances, it could ease research and find solutions in all human activity areas where inherently the ICT impact is spread at planetary scale, we also analysed another relevant example providing a systemic approach, the Industrial Internet of Things, due to the emerging advances of IoT at Earth scale and to its benefic penetration into all industries first. Considering one of the most important challenges of IoT exploding proliferation, the security/safety, in practice this will become a very complex and complicate problem along with ICT/World actual context, involving a huge research effort, but with promising results in "healthcare, transportation, manufacturing and mining", based on adequate technologies, prototypes, systems, models, methods, and applications".

The remarkable conclusion of the paper first section is that facing the complexity and complication of the actual dramatical World context, even with the ICT instruments advances, is a new level of challenge everywhere, because of the highly dynamic and uncertainty of Earth ecosystem processes, needing deeper timely analyses and even new paradigms to approach it.

The identification and implementation of World new balance with less resources are strongly depending, beyond the Earth natural ecosystem limits, on the complexity which generates their highly dynamic and uncertainty features, where humankind behaviour and evolution are surely basic factors. The traditional “what is best”, people used almost everywhere, now means to consider, as first priority, the Earth resources fading and the mandatory finding of a new balance of all activities with less resources, but also new ways/paradigms of using the known resources (like fossils energy sources and materials) along with the new sustainable alternatives.

One of the subtle, but systemic, contributions of ICT to IS/KBS, beyond products and services, is to lend some of its methods and mechanisms of progress to other areas of human activity [6][9][16]. An actual issue, which is common for ICT/AI advance, but also for World/humankind struggle for a new balance with less resources, is fighting complexity and uncertainty, toward optimizing the World resources and development. We have considered some areas of uncertainty when designing AI as instrument of leveraging the decision processes which could impact the World and generally the humankind future, based on [4] analysis, referring to some usual models and detailed approaches of the basics of AI uncertainty. We have remarked the fundamental difference and correlation between human intelligence (HI) and AI. It is necessary to timely meditate at this AI/HI correlation and its consequences, for both AI potential/future and humankind future [6][9]. Beyond the sophisticated mechanisms of AI and of machine learning (ML), or types of agents they contain, it is important to notice the reflexion of HI features in AI/ML models, which is in fact the territory of continuous improvements for ICT/AI research. Consequently, we have to notice that another feature/challenge of ICT/AI research, also present at HI levels, is the relative separation between risk and ambiguity, as the World processes are very complex and complicate and the transition from known to unknown is the area where ICT/AI have to perform, but sometimes in a vicious circle, in a similar way the refined knowledge is changing, at humankind level, because of the dramatic and dynamic World changes.

As final conclusion, we believe that the reviewed actual World context features require to continue deeper and timely analyses, both for the technical ICT processes and the social/human complex evolutions and challenges, in order to meet useful elements which could leverage the search of solutions for the sustainable identification and implementation of World new balance with less resources.

Keywords: artificial intelligence uncertainty, World new balance, industrial internet of things, refining knowledge, risk and ambiguity, small modular reactors, coal plants, Bayes-optimal agents

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

Knowing yourself is the beginning of all wisdom

— Aristotle

1. Information and communications technology approaches contributions to mitigate World’s dramatical challenges

Decade after decade, information and communications technology (ICT) usually impressed us with its amazing and fast advances, while people’s expectations, encouraged by industry trends and politics, have considered this as a traditional picture of the field.

Following this image, a legitim question could be: Is this the right/expected way for the years to come, considering the actual context of dramatic World changes?

Although the answer is not simple, for a realistic approach we should agree that ICT is only the iceberg tip of the science, technologies and industries evolution for decades, as we also presented [18][25][16].

Starting from this well-known prominent position and its crucial role in Information Society (IS) on the way towards the Knowledge Based Society (KBS), as main factor of the World progress, it seems that few things should/could be changed about ICT exponential development.

Still, in the actual context of dramatic World changes, the Earth resources fading, human actual priority expectations and challenges should be deeply analysed and then the resulted refined knowledge further used for driving the entire Earth ecosystem sustainable evolution [3].

On this way, obviously, ICT development and advances, like artificial intelligence (AI) and Internet of Things (IoT), could and should be also reconsidered by the requirements/restrictions of the new, fast changing and dramatic World context.

Naturally, such realistic approach of the dynamic World present and future should bring the expected actions and appropriate optimized solutions, where ICT remains a prominent factor. Consequently, our analyses/papers will follow this approach, keeping in mind the desired role and the potential of ICT.

Thinking, generally, at goals like **appropriate optimized solutions**, is perhaps the most difficult part, because, from the start, here we could find an extremely complex and complicate problem, even if we put it in a concrete area of ICT (for example AI) or other industry, amplified by the new restrictions and uncertainties induced in the changing and dramatic World context.

In fact, the new types of performances, which eventually should be associated with a

World new balance with less resources, will be more relevant, at Earth ecosystem scale, than, for example, the usual/technical performances of any industry or human activity field. Generally, here the Earth resources should include at least **energy** and materials, either natural, fossil or created by man, although other subsequent or subtle categories should be added [7][8][10][17].

More than these, the new restrictions and uncertainties could come from multi-criteria analyses, including the expected/necessary changes in human behaviours, like consumption or rational use of Earth resources.

Beyond any doubt, the most prominent challenges/requirements/restrictions should come from the crucial reality of climate changes and global warming along with Earth resources fading, as we also presented [18][11]. One of the analyses toughest challenges is the fact that the mentioned multiple criteria are not independent and consequently difficult to be quantified and considered.

Perhaps a dramatic picture of such superposition of causes/effects could be considered while witnessing the horrible destructions of the Russia/Ukraine war or recent Turkey earthquake and thinking, in the same time, but not exclusively, at the above-mentioned climate changes or expected/necessary changes in human behaviours, like consumption or rational use of Earth resources. More than these, the geopolitical/defence implications and trends could add to and complicate this World context.

Although they appear as having less in common, these events and trends inherently reveal the necessity to reconsider the increasing risks for Earth ecosystem and humankind survival, which are generated by the unprecedented losses of lives, **energy** and materials.

Going further, one could say that “unprecedented” is not the case, as wars and earthquakes were and will probably be again.

Here **the point and our approach idea are to reconsider and refine knowledge about the fact that now all the known/old negative trends of Earth ecosystem meet the unprecedented critical/crucial stages/levels which the climate changes and Earth resources fading have reached**. In physical terms, but with certain obvious limits, this evaluation is similar with the superposition of effects, leading this way to new concrete/value results. Further, such results could be, in fact, higher or even catastrophic, if not known and prevented.

Unfortunately, such evaluations are far from being simple or linear/physical simulated (see wars and earthquakes), depending on human subjective behaviour/decisions or random physical processes.

Consequently, all analyses should consider studying and mitigating as much as possible such implications/causes of changing and dramatic World context, where human subjective behaviour/decisions are obviously most cases [10][12].

Reviewing the above complicate context, our paper goal is still to consider, now and here, starting from **unprecedented losses of lives, energy and materials**, the impact of ICT on managing/supporting the research of survival solutions for the emerging crises of **energy and materials**, still noting that, in fact, the human lives are prominent and more, the expected solutions will leverage saving eventually more lives on Earth.

A crucial reality, on this line, is the link between fossils energy sources, materials and on the other side the climate changes, as it is largely agreed that the carbon footprint of old technologies of producing energy or materials, along with their use, including transportation industries pollution, are major causes of global warming.

More than these, by using less resources, in the actual dramatic World context, we have to understand that, beyond fossil energy sources or diverse materials, the sustainable new World balance has to include changes of paradigms about consumption and efficiency in general. This could also mean new behaviours about using anything, as long as almost anything we could use/act contains energy and materials (even human effort!), including new (non fossil) energy and materials resources.

Consequently, we have to use less resources not only because they are limited and more expensive, but inherently they could contribute, in diverse ways, to global warming or Earth resources fading. Perhaps this is why we hear today, more often than yesterday, that **“the World will be no more what it was”**.

As a confirmation of the realism about the actual Earth context evaluation, although next it is just a starting point with simple issues, the IEEE prestige and potential are worth to be considered here, as it is presented by [1]:

“Simple, effective solutions that can help lessen the impact of climate change already exist. Some of them still need to be implemented, though, while others need to be improved.

That’s according to 2023 IEEE President Saifur Rahman, who was among the speakers from engineering organizations at the COP27 event held in Egypt in November. The IEEE Life Fellow spoke during a session addressing the role of technology in delivering an equitable, sustainable, and low-carbon resilient world.

Rahman, a power expert and professor of electrical and computer engineering at Virginia Tech, is the former chair of the IEEE ad hoc committee on climate change. The committee was formed last year to coordinate the organization’s response to the global crisis.

About one-third of emissions globally are produced through electricity generation, and Rahman said his mission is to help reduce that amount through engineering solutions.

At COP27, he said that even though the first legally binding international treaty on climate change, known as the Paris Agreement, was adopted nearly a decade ago, countries have yet to come to a consensus on how to stop burning fossil fuels, among other issues. Some continue to burn coal, for example, because there are no other economically feasible choices for them."

As we already presented [21][18], the optimization of the actual complex context should consider, among others, a proper interpretation of the recent past, including the post Paris Agreement, but adding concrete data like "one-third of emissions globally are produced through electricity generation", or recalling that ICT global carbon footprint exceeded all air flights and they are fast increasing [11].

The Earth reality is still more complicated than a good intention plan and a mature set of advices is further given:

<< "We as technologists from IEEE say, 'If you keep to your positions, you'll never get an agreement,'" he said. "We have come to offer this six-point portfolio of solutions that everybody can live with. We want to be a solution partner so we can have parties at the table to help solve this problem of high carbon emissions globally."

The solutions Rahman outlined were the use of proven methods that reduce electricity usage, making coal plants more efficient, using hydrogen and other storage solutions, promoting more renewables, installing new types of nuclear reactors, and encouraging cross-border power transfers.>>

Entering technical solutions is, in this case, a concrete step towards the expected improvements, but beyond home simple/known measures as switching to LEDs, which use at least 75 percent less energy than incandescent bulbs, industry scale is approached, as it is detailed for the main proposed fields/advices:

<< Shutting down coal power plants completely is unlikely to happen anytime soon, he predicted, especially since many countries are building new ones that have 40-year life spans. Countries that continue to burn coal should do so in high-efficiency power plants, he said. One type is the ultra supercritical coal-fired steam power plant. Conventional coal-fired plants, which make water boil to generate steam that activates a turbine, have an efficiency of about 38 percent. Ultra supercritical plants operate at temperatures and pressures at which the liquid and gas phases of water coexist in equilibrium. It results in higher efficiencies: about 46 percent. Rahman cited the Eemshaven ultra supercritical plant, in Groningen, Netherlands—which was built in 2014. Another efficient option he pointed out is the combined cycle power plant. In its first stage, natural gas is burned in a turbine to make electricity. The heat from the turbine's exhaust is used to produce steam to turn a turbine in the second stage. The resulting two-stage power plant is at least 25 percent more efficient than a single-stage plant.>>

A crucial premise for sustainable solutions, in the actual and future dramatic/dynamic Word context, is to observe that ideal/single ideas are not suitable and consequently we have to search elaborated and integrating systems:

<<To properly balance electricity supply and demand on the power grid, renewables should be integrated into energy generation, transmission, and distribution systems from the very start, Rahman said. He added that the energy from wind, solar, and hydroelectric plants should be stored in batteries so the electricity generated from them during off-peak hours isn't wasted but integrated into energy grids. He also said low-cost, low-carbon hydrogen fuel should be considered as part of the renewable energy mix. The fuel can be used to power cars, supply electricity, and heat homes, all with zero carbon emissions.

"Hydrogen would help emerging economies meet their climate goals, lower their costs, and make their energy grid more resilient," he said.>>

We think that here it is worth to notice a new vision about the old nuclear power, aiming not only a modular solution/implementation, but also considering its unique sustainability feature at Earth scale (carbon neutral by 2050):

<<Rahman conceded there's a stigma that surrounds nuclear power plants because of accidents at Chernobyl, Fukushima, Three Mile Island, and elsewhere. But, he said, without nuclear power, the concept of becoming carbon neutral by 2050 isn't realistic.

"It's not possible in the next 25 years except with nuclear power," he said. "We don't have enough solar energy and wind energy."

Small modular reactors could replace traditional nuclear power plants. SMRs are easier and less expensive to build, and they're safer than today's large nuclear plants, Rahman said. Though small, SMRs are powerful. They have an output of up to 300 megawatts of electricity, or about a quarter of the size of today's typical nuclear plant.

The modular reactors are assembled in factories and shipped to their ultimate location, instead of being built onsite. And unlike traditional nuclear facilities, SMRs don't need to be located near large bodies of water to handle the waste heat discharge. SMRs have not taken off, Rahman says, because of licensing and technical issues.>>

Last but not least, we have to understand that the actual unprecedented critical/crucial stages/levels which the climate changes and Earth resources fading have reached need not only integration/cooperation, but also free access to all worldwide results:

<<Rahman emphasized the need for more cross-border power transfers, as few countries have enough electricity to supply to all their citizens. Many countries already do so.

“The United States buys power from Canada. France sells energy to Italy, Spain, and Switzerland,” Rahman said. “The whole world is one grid. You cannot transition from coal to solar and vice versa unless you transfer power back and forth.” ... During the conference session, Rahman said an IEEE collection of 7,000 papers related to climate change is accessible from the IEEE Xplore Digital Library. IEEE also launched a website that houses additional resources. None of the solutions IEEE proposed are new or untested, Rahman said, but his goal is to “provide a portfolio of solutions acceptable to and deployable in both the emerging economies and the developed countries—which will allow them to sit at the table together and see how much carbon emission can be saved by creative application of already available technologies so that both parties win at the end of the day.”>>

Here we have to point a relevant example of the ways IEEE and generally ICT could contribute, at least by leveraging communication and knowledge sharing, to the World struggle for sustainable solutions to the actual unprecedented challenges at Earth scale, based on international collaboration and solidarity against planetary challenges/dangers, at least **in the 12-th hour**.

Still, the ICT potential is beyond just approaching **dramatical challenges and complexity**, as it could, by its advances, to ease research and find solutions in all human activity areas where inherently the ICT impact is spread at planetary scale.

A relevant example, providing a systemic approach, is *Industrial Internet of Things*, due to the emerging advances of IoT at Earth scale and to its benefic penetration into all industries first, as it is also presented by [2]:

“Industrial Internet of Things (IIoT) aims to achieve higher operational and management efficiencies by bridging machinery, equipment, human resources, and all other actors involved in an industrial environment. This bridging enables data flow over an often complex and heterogeneous communication network. It enables timely decision-making, which affects various aspects of the organization such as business, operations, maintenance, safety, stock, and logistics.”

As it is well known, one of the most important challenges of IoT exploding proliferation is the security/safety, which in practice will become a very complex and complicate problem along with ICT/World actual context, involving a huge research effort, as, summary, further mentioned:

“Industrial safety, especially whenever it is intertwined with the safety of humans, is a critical domain and holds much scope for improvement in the context of IIoT-based solutions for industrial safety management. ... Subsequently, we classify and provide an in-depth analysis of the safety aspects in various application areas of IIoT such as healthcare, transportation, manufacturing, and mining. ... We discuss diverse forms of technologies, prototypes, systems, models, methods, and applications to ensure the safety of individuals and the risks associated with them.”

Facing the complexity and complication of the actual dramatical World context, even with the ICT instruments advances, is a new level of challenge everywhere, because of the highly dynamic and uncertainty of Earth ecosystem processes, needing deeper timely analyses and even new paradigms to approach it.

2. Fighting complexity and uncertainty by ICT, toward optimizing the World resources

Perhaps the most important problem of the processes which aim the identification and implementation of **World new balance with less resources**, is, after the Earth natural ecosystem limits, **the complexity which generates their highly dynamic and uncertainty features**, where humankind behaviours and evolution are surely basic factors.

Considering the new challenges/crises, the complexity and the progressive complication of World context, along with deeper timely analyses, new paradigms to approach the Earth ecosystem processes are needed everywhere the traditional approaches are no more efficient or efficacious [22][19][15][14].

The unprecedented difficulties of deciding what is best for a holistic approach of World evolution increase the role of ICT advances, like AI, IoT and Big Data, as we have already presented [13][24].

Here we have to point, from the beginning, that the traditional “what is best”, people used almost everywhere, now means to consider, as first priority, the Earth resources fading and the mandatory finding of a new balance of all activities with less resources, but also new ways/paradigms of using the known resources (like fossils energy sources and materials) along with the new sustainable alternatives.

A further step is, naturally, to learn how ICT have to evolve in order to reach the expected results/instruments, considering, of course, the same challenges/crises, complexity and progressive complication of World context impacting ICT advances.

As we have repeatedly mentioned, one of the subtle, but systemic, contributions of ICT to IS/KBS, beyond products and services, is to lend some of its methods and mechanisms of progress to other areas of human activity [6][9][16].

This way we have just arrived at the core of an actual issue, which is common for ICT/AI advance, but also for World/humankind struggle for a **new balance with less resources**, i.e., fighting complexity and uncertainty, toward optimizing the World resources and development.

A more concrete image of this issue is also given by analysing some areas of uncertainty when designing AI as instrument of leveraging the decision processes which could impact the World and generally the humankind future [4]:

“The power of AI comes with a lot of responsibilities. It has changed a lot about our world, but the change has been a double-edged sword. It is responsible for a lot of progress, but some risks and unknowns are involved in its use. Because of this duality, most business leaders are unsure how to use and deploy AI systems. Still, they can look to public agencies that have already experienced these uncertainties in AI initiatives for some answers.”

The areas of AI uncertainty are generally large and dynamic, along with the World context evolution, but, basically, some usual model’s further consideration could be useful:

“... Queensland University of Technology has engaged in around 40 projects that deal with AI efforts in the public, private, and non-profit sectors in Australasia and the United States. However, most of the recommendations were drawn from the public sector. This experience allowed them to observe managers’ use of AI first hand, and they found five major areas of uncertainty.”

Among these areas, communicating realistic expectations and assessing how AI fits tasks proved to be very important:

“From these projects, the team found that managers weren’t sure about the outcome of AI initiatives, and there were four main ways they thought about AI:

AI is overhyped

AI can fully automate tasks

No opinion

AI isn’t perfect, but it is getting better every day

The last group has the right idea. Skill training and accountability were the best way to gain support from the first three groups. This education needs to begin with communicating what AI can accomplish and what it can’t...Managers struggled with evaluating how AI fits into their business. It is the degree of discretion that determines how to fit AI into a task. Repetitive, low-level tasks like data entry or facilities operation are examples of a low-discretion take suitable for total automation.”

The World complexity is unfortunately increasing faster than the analyses could follow and consequently much scientific research effort is needed, leading to detailed approaches of the basics of AI uncertainty, as it is also presented by [5]:

“Reasoning about uncertainty is a hallmark of human intelligence. In artificial intelligence, handling uncertainty is critical for developing systems that act rationally and safely. Such systems should know when to be cautious and avoid catastrophic events, and when to take risks to reap greater benefits.”

Here it is worth to remark, from the beginning, the fundamental difference and correlation between human intelligence (HI) and AI.

We consider that, beyond the phrase context, we have to timely meditate at this AI/HI correlation and its consequences, for both AI potential/future and ...humankind future [6][9].

Anyway, the World reality is further presented in the basic terms of AI uncertainty, which could lead to practical approaches for its mitigation when designing the future AI systems:

„But uncertainty comes in different flavours. The economist Frank H. Knight [1] proposed a subtle but important distinction between two fundamental types of uncertainty in decision-making, risk and ambiguity. Risk (i.e., known or closed-world uncertainty) applies to familiar situations where the exact outcome of an event is uncertain but probabilities can be computed, as in roulette wheels and dice.

Knowing the probabilities over outcomes enables reducing randomness to effective certainty (e.g. via computing certainty equivalents). In contrast, ambiguity (i.e., unknown or open-world uncertainty) refers to the uncertainty in unfamiliar situations where the probabilities are not known or cannot be determined, e.g., whether in six years the US president will be a Democrat ...”

The implementation of the mentioned practical approaches has still a long way ahead, as here it is further explained the model to be next studied for future AI applications:

“Bayes-optimal agents are risk-neutral, since they solely attune to the expected return, and ambiguity-neutral, since they act in new situations as if the uncertainty were known. This is in contrast to risk-sensitive agents, which additionally exploit the higher-order moments of the return, and ambiguity-sensitive agents, which act differently when recognizing situations in which they lack knowledge. Humans are also known to be averse to ambiguity and sensitive to risk in ways that aren’t Bayes-optimal, indicating that such sensitivity can confer advantages,

especially in safety-critical situations. How can we extend the meta-learning protocol to generate risk- and ambiguity-sensitive agents? ... by showing that risk- and ambiguity-sensitivity also emerge as the result of an optimization problem using modified meta-training algorithms, which manipulate the experience-generation process of the learner. We empirically test our proposed metatraining algorithms on agents exposed to foundational classes of decision-making experiments and demonstrate that they become sensitive to risk and ambiguity.”

Beyond the sophisticated mechanisms of AI and of machine learning (ML), or types of agents they contain, it is easy to observe here the reflexion of HI features in AI/ML models, which is in fact the territory of continuous improvements for ICT/AI research.

More than these, we have to notice that another feature/challenge of ICT/AI research, also present at HI levels, is the relative separation between *risk and ambiguity*, as the World processes are very complex and complicate and the transition from known to unknown is the area where ICT/AI have to perform, but sometimes in a vicious circle, in a similar way the refined knowledge is changing, at humankind level, because of the dramatic and dynamic World changes.

These are actual World context features that require to continue deeper and timely analyses, both for the technical ICT processes and the social/human complex evolutions and challenges, in order to meet useful elements which could leverage the search of solutions for the sustainable identification and implementation of World new balance with less resources.

3. Conclusions

Although these analyses need to be further continued, some conclusions will point the most important ideas of the above analysed issues.

The new types of performances, which eventually should be associated with a **World new balance with less resources**, will be more relevant, at Earth ecosystem scale, than, for example, the usual/technical performances of any industry or human activity field (here the Earth resources should include at least **energy** and materials, either natural, fossil or created by man, although other subsequent or subtle categories should be added).

Thinking, generally, the **new balance** goals like **appropriate optimized solutions**, is perhaps the most difficult part, because, from the start, here we could find an extremely complex and complicate problem, even if we put it in a concrete area of ICT (for example AI) or other industry, amplified by the new restrictions and uncertainties induced in the changing and dramatic World context. More than these, the new restrictions and uncertainties could come from multi-criteria analyses, including the expected/necessary changes in human behaviours, like consumption or rational use of Earth resources.

Beyond any doubt, the most prominent challenges/requirements/restrictions should come from the crucial reality of climate changes and global warming along with Earth resources fading, as we also presented [18][11]. One of the analyses toughest challenges is the fact that the mentioned multiple criteria are not independent and consequently difficult to be quantified and considered. A dramatic picture of such superposition of causes/effects could be considered while witnessing the horrible destructions of the Russia/Ukraine war or recent Turkey earthquake and thinking, in the same time, but not exclusively, at the above-mentioned climate changes or expected/necessary changes in human behaviours, like consumption or rational use of Earth resources. More than these, the geopolitical/defence implications and trends could add to and complicate this World context.

Although they appear as having less in common, these events and trends inherently reveal the necessity to reconsider the increasing risks for Earth ecosystem and humankind survival, which are generated by the unprecedented losses of lives, **energy** and materials.

About “unprecedented losses”, our approach idea is to reconsider and refine knowledge about the fact that now all the known/old negative trends of Earth ecosystem meet the unprecedented critical/crucial stages/levels which the climate changes and Earth resources fading have reached. In physical terms, but with certain obvious limits, this evaluation is similar with the superposition of effects, leading this way to new concrete/value results. Further, such results could be, in fact, higher or even catastrophic, if not known and prevented.

Unfortunately, such evaluations are far from being simple or linear/physical simulated (see wars and earthquakes), depending on human subjective behaviour/decisions or random physical processes. Consequently, all analyses should consider studying and mitigating as much as possible such implications/causes of changing and dramatic World context, where human subjective behaviour/decisions are obviously most cases.

Referring to this complicate context, our paper goal is still to consider, now and here, starting from **unprecedented losses of lives, energy and materials**, the impact of ICT on managing/supporting the research of survival solutions for the emerging crises of **energy and materials**, still noting that, in fact, the human lives are prominent and more, the expected solutions will leverage saving eventually more lives on Earth.

It is worth to recall the link between fossils energy sources, materials and climate changes, as it is largely agreed that the carbon footprint of old technologies of producing energy or materials, along with their use, including transportation industries pollution, are major causes of global warming.

More than these, by using less resources, in the actual dramatic World context, we have to understand that, beyond fossil energy sources or diverse materials, the sustainable new World balance has to include changes of paradigms about consumption and efficiency in general. This could also mean new behaviours about using anything, as long as almost anything we could use/act contains energy and materials (even human effort!), including new (non fossil) energy and materials resources.

Consequently, we have to use less resources not only because they are limited and more expensive, but inherently they could contribute, in diverse ways, to global warming or Earth resources fading. Perhaps this is why we hear today, more often than yesterday, that *“the World will be no more what it was”*.

For a confirmation of the realism about the actual Earth context evaluation, although only just for a starting point with simple issues, the IEEE prestige and potential was considered, by analysing some of their solutions proposals on mitigating global warming, *at the COP27 event held in Egypt in November 2022 (“reduce electricity usage, making coal plants more efficient, using hydrogen and other storage solutions, promoting more renewables, installing new types of nuclear reactors, and encouraging cross-border power transfers”)*.

As the ICT potential is beyond just approaching **dramatical challenges and complexity**, but, by its advances, it could ease research and find solutions in all human activity areas where inherently the ICT impact is spread at planetary scale, we also analysed another relevant example providing a systemic approach, the *Industrial Internet of Things*, due to the emerging advances of IoT at Earth scale and to its benefic penetration into all industries first. Considering one of the most important challenges of IoT exploding proliferation, the security/safety, in practice this will become a very complex and complicate problem along with ICT/World actual context, involving a huge research effort, but with promising results in *“healthcare, transportation, manufacturing and mining”*, based on adequate” technologies, prototypes, systems, models, methods, and applications”.

A remarkable conclusion of the paper first section was that **facing the complexity and complication of the actual dramatical World context, even with the ICT instruments advances, is a new level of challenge everywhere, because of the highly dynamic and uncertainty of Earth ecosystem processes, needing deeper timely analyses and even new paradigms to approach it.**

Aiming the identification and implementation of **World new balance with less resources**, is strongly depending, beyond the Earth natural ecosystem limits, on **the complexity which generates their highly dynamic and uncertainty features**, where humankind behaviour and evolution are surely basic factors.

The unprecedented difficulties of deciding what is best for a holistic approach of World evolution increase the role of ICT advances, like AI, IoT and Big Data, as we have already presented [13][24].

The traditional “what is best”, people used almost everywhere, now means to consider, as first priority, the Earth resources fading and the mandatory finding of a new balance of all activities with less resources, but also new ways/paradigms of using the known resources (like fossils energy sources and materials) along with the new sustainable alternatives.

One of the subtle, but systemic, contributions of ICT to IS/KBS, beyond products and services, is to lend some of its methods and mechanisms of progress to other areas of human activity [6][9][16]. An actual issue, which is common for ICT/AI advance, but also for World/humankind struggle for a **new balance with less resources**, is fighting complexity and uncertainty, toward optimizing the World resources and development.

We have considered some areas of uncertainty when designing AI as instrument of leveraging the decision processes which could impact the World and generally the humankind future, based on [4] analysis, referring to some usual models and detailed approaches of the basics of AI uncertainty.

Here it is worth to remark the fundamental difference and correlation between human intelligence (HI) and AI. We have to timely meditate at this AI/HI correlation and its consequences, for both AI potential/future and ...humankind future [6][9]. Beyond the sophisticated mechanisms of AI and of machine learning (ML), or types of agents they contain, it is important to notice the reflexion of HI features in AI/ML models, which is in fact the territory of continuous improvements for ICT/AI research. Consequently, we have to notice that another feature/challenge of ICT/AI research, also present at HI levels, is the relative separation between *risk and ambiguity*, as the World processes are very complex and complicate and the transition from known to unknown is the area where ICT/AI have to perform, but sometimes in a vicious circle, in a similar way the refined knowledge is changing, at humankind level, because of the dramatic and dynamic World changes.

Finally, we believe that the reviewed **actual World context features require to continue deeper and timely analyses, both for the technical ICT processes and the social/human complex evolutions and challenges, in order to meet useful elements which could leverage the search of solutions for the sustainable identification and implementation of World new balance with less resources.**

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