

Tomorrow's Paradox: Refining Knowledge by Smarter Information and Communications Technologies while Humans Tend to Become a Limited Factor of Performance



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Abstract

The paper analyzes some challenges of the exponential development of Information and Communications Technologies (ICT) in the Information society (IS) toward Knowledge Based Society (KBS), focusing on the premises of strange evolutions of the inherent interactions between humans and ICT smart machines along the complex and dynamic processes of generating knowledge and refining knowledge, caused by the natural limits of humans.

*The analysis reveals the detailed mechanisms which could lead to abnormal or paradox situations when **ICT smart machines could/should replace humans**. The paradox could appear when using such new technologies to **replace human in order to avoid the consequences of routine stress, fatigue but especially the lack of responsibility in specific applications**.*

*Also, the analysis approaches the main consequence of “data deluge” (overwhelming data “products”), as for an optimal efficiency for IS/KBS, **all these “products” of ICT must be highly “processed” in order to provide useful knowledge and eventually refined knowledge**, but, naturally, the analysis try to answer to the question to **what extent smart machines could/should replace humans**.*

*The paper main conclusion is that the paper title (**Tomorrow's paradox ...**) is intended to generate an alarm signal about the abnormal situation where humankind is almost arrived, as **we have to create such “smart machines” which could help us to get knowledge and refined knowledge designated to fight against ourselves**, i.e. to avoid the consequences of a large diversity of aberrant behaviour generated by the average person or exception individuals.*

Keywords: genome sequencing, big data, data deluge, smart machines, communications and information technology, information society, knowledge based society.

JEL Classification: L63; L86; M15; O13; O33

1. Living and learning in the days of a World full of paradox

Perhaps even the amazing evolution of Information Society (IS) toward Knowledge Based Society (KBS) could be seen as a process full of paradox, as the exponential pace of Information and Communications Technologies (ICT) development generates such dynamic changes in World's general progress, while the Earth is more and more divided in a complex and dramatic diversity of people's living.

Without approaching social or political concrete aspects, we could not ignore their complex connections with the financial, economical and technological World context where ICT have a recognized essential driving role [8] [14][12][11].

In fact the space of this paper is aiming to cover only what we may call the „tip of this iceberg”: the complicate processes of refining knowledge the technological progress generates by the ICT development with the natural support of humans creative potential.

With other words, we try to reveal some challenges of the complex interaction of the main factors implied in the knowledge's creation and refining: humankind versus ICT products and services.

As we already presented [15][12], ICT is a huge leveraging factor of humankind creative potential development and it is important to notice that ICT global influence generates similar interactions (even beyond the typical man-machine) in all IS fields and humankind life.

Here the goal is to identify the actual stage of the mentioned interaction and its directions of possible evolution, as the balance of the two factors influence is more and more dynamic due to ICT performance amazing expansion.

In fact, the ancient concern that humans will be dominated by „machines” is more and more actual, of course in some „benign” forms we will also approach, but our point is not about this “concern”.

In order to get a forecast for an optimal balance and mitigate the challenges (paradox) generated by the mentioned complex interaction, we try to analyze, using some examples, the processes of knowledge's creation and refining where humans and ICT products and services have a tight interaction.

Although the knowledge is omnipresent in IS, while ICT by its products, applications and services is the main source for it, we consider that for present and near future the most prominent challenge for IS/KBS is generated by the huge consequences of so called “big data”, “exa data” or “data deluge”[10][11], as we have already presented [15][12][3].

Even the term of “big data” became a little confusing because of its diverse interpretations and that is why “data deluge” seems to better reflect the reality [data deluge].

The main consequence of “data deluge” is the fact that, for an optimal efficiency for IS/KBS, ***all these “products” of ICT must be highly “processed” in order to provide useful knowledge and eventually refined knowledge.***

We have already approached [15][5] the complex processes, in IS toward KBS, by which data, information, knowledge and finally refined knowledge are sequentially generated, but it is worth to notice the fast pace these are changing.

The humans contribution is and obviously will remain, by definition, fundamental, especially for knowledge and refined knowledge, but in a fast changing ICT/IS/KBS context always we have to re-evaluate ***how much the precision and “quality” of these knowledge is supported/stimulated by ... (ICT) smart machines.***

Our point is very clear confirmed by [2]:

“Humans Turn Data into Wisdom ... The more data that is created, the more knowledge and wisdom people can obtain ... IoT dramatically increases the amount of data available for us to process. This, coupled with the Internet's ability to communicate this data, will enable people to advance even further.”

In this paper we try only to emphasize the dramatic changes which could influence this processes (*advance*), including their most “human” parts (knowledge and refined knowledge), by the impressive progress of (ICT) smart machines.

In a more concrete manner, we may say that, keeping and updating the fundamental role of learning and experiencing for human’s creative potential is only a part of main factors which influence the knowledge and refined knowledge generation processes.

The other part provided by the involved ITC products and services, but the most relevant observation here is that *the contribution of this (ITC) part (i.e. its weight) is unprecedentedly increasing*.

To be even more precise, we have to observe that ICT adds not only a quantitative ever increasing contribution, but our days bring just the cumulated qualitative *unprecedented* technological advance which enable machines to get a higher weight than humans, in some important areas of information/knowledge generation.

Therefore, coming back to the need of **highly processed** “data deluge”, here is the essential point where the mentioned interaction and then the “paradox” appear, as for highly “processing” the huge amount of data ICT is generating, **humans must create “smarter” algorithms and ... technologies**. So a vicious circle is appearing.

Superficially, one could consider that there is no paradox, because there is no **unusual** interaction between humans and ICT, as there is **nothing new when humans create algorithms or technologies** for ICT (but not exclusively).

On the other hand we just observed that, **in creating knowledge and refined knowledge (including smarter algorithms or technologies), humans became more and more dependent on ... smart machines (which are based on smarter algorithms and ... technologies)**.

Starting the analysis with a relevant example could clarify this initial dilemma, as the above usual status is changing very fast with ICT exponential pace of development.

One of the actual fundamental features of ICT amazing development is generated by an **emergent trend where new soft programs and eventually technologies are created, in automate ways, by „smart ICT machines”!**

For an accurate expression we must add that, in fact, when creating **new soft programs and technologies**, the humans benefit more and more from the valuable help of ... smart machines.

With other words, tomorrow some of **soft programs and technologies will be created**

by “smart ICT machines”, i.e. by smart soft programs implementing smart algorithms which were conceived by humans, but people’s contribution is ... decreasing (as machines contribution is increasing) and this way appear ... the **automate ways!**

A first essential question could be: is this trend a negative or a positive evolution?

It is obvious that the answer is not simple because first we should identify the main typical processes associated with the “data deluge „and their challenges.

From the beginning we have to notice the complexity of the problem, as the huge diversity of applications fields, part of them exceeding pure ICT, will lead to an inherent partial approach, i.e. a focus only on some relevant examples/categories.

In order to have at least a simplified picture, we can recall [3] some of the prominent World projects that generate a large amount of data: Large Hadron Collider, Climate Changes Forecast, Human Brain Map, Human Genome. More than all these, clearly the future worst “nightmare” will be the „data deluge” IoT could progressively generate [3][5][12][15].

The real picture is perhaps expressed if we call that the data generated in the last 3 years is comparable with all the rest of humankind history and the estimates for 2020 are of about 44 zettaB generated, 7 billion connected people and 50 billion connected devices [6][2][3][5].

These figures are still far from expressing the real challenge we want to approach in this paper: the mentioned World paradox.

Maybe we get closer observing that the Internet itself, as the biggest ever created source of information, with its exponentially increase of generated data, is still far from being optimally exploited by the humans.

Here is the moment to pay a tribute to the venerable, recently passed, Romanian academician Solomon Marcus, who supported, till his last days, the fair idea that we are still unable to use, for education and research/progress purposes, the amazing opportunities of Internet potential.

Now it seems we came back, but closer, to the complex and dynamic interaction between humankind creative potential and the ICT products and services which help to increase this potential by smart instruments.

In fact **we are in the days when these smart ICT instruments tend to take over more and more from humans creative work and responsibilities.**

Thus we have just arrived to the middle of the problem: **Why, How and To What Extent smart machines could/should replace Humans?**

Part of the answer just has been given in the paper title (**refining knowledge**), but the rest could come from next.

2. Why, How and To What Extent smart machines could/should replace humans?

Of course, from the first Industrial Revolution (steam) machines have naturally replaced, till now, humans, whenever possible, but mainly when effort or routine were the purpose.

The only thing new is the fact that our days brought that incredible technological progress providing the possibility to replace the highest human feature: the intelligence.

Someone could say that still there is nothing new, as artificial intelligence (AI) is an old subject of ICT.

Perhaps now is the moment to approach the most relevant examples, in order to shorten the way to understand where the news are appearing and paradox could be actual.

Among the amazing actual projects where ICT capture humankind attention, the Human Genome approach is going to become in the same time a computing power huge consumer and a “data deluge” source.

Recently, very interesting news shows [1] that an ICT state-of-the-art system led to the possibility of “decoding baby’s genome in 26 hours”, as for newborn babies it is essential to very fast identify genetic disorders – which proved to possibly cause death.

The same news added that *Genome Medicine* published a recent study which announced that the ICT system designed to process genetic “big data” (3.2 billion chips) have progressed to the incredible performance of reducing the necessary time for “*the key analysis step from 15 hours to a mere of 40 minutes*”.

Well, these are indeed spectacular news for ICT performance and exponential pace of development, while enchantment news for humankind health and ... future.

For us, another face of the same news provided the most interesting issue, as the lead researcher Stephen Kingsmore (from Children’s Mercy Hospital in Kansas City, Mo) said [1]:

“Automating medicine to this degree, from genome sequencing to diagnosis, will be necessary if we want to make use of today’s best genetic technologies...

If we’re going to scale this, it has to be on the backs of smart machines...

We want to take humans out of the equation, because we’re the bottleneck.”

Even if we would consider the above example as an isolated case (genome sequencing), the trend of ***taking humans out*** is already started and an undoubted reality, as we above presented about creating new ***soft programs and technologies***.

If someone would have any doubt about this trend, or ***why/how*** this could be possible, we can recall some other well known cases (applications/fields) where smart machines have increasing contribution at creative/intelligent processes (partially ***taking humans out***), most of them tightly linked with ICT: design and technological processes of producing integrated circuits (LSI, VLSI etc.), development of general use soft programs, data mining (and analytics), shapes recognizing (including speech, bio features, weapons etc.), optimization processes, coding/cryptography, security systems, smart robots etc.

Once again, one question it seems that is still appearing: What is real news or paradoxical?

Our opinion is that a substantial step to the answer could be found inside the answer for the last question of this section title: ***To What Extent smart machines could/should replace humans?***

Here we are in the deepest part of the analysis, as the answer is very complex and complicate, just like the question is.

Still we have the advantage of all above analyzed aspects of this dynamic problem humankind and generally IS toward KBS has.

Perhaps the above example [1] is still the most relevant starting point, only because it has an unspoken issue, given by complexity of applications, by mainly due to ***the intersection of three fundamental challenges for ICT/IS/KBS and humankind: performance (maximum speed -minimum time), safety and responsibility***.

It is amazing how much content could hide the three challenges and especially what common issue they could hide.

Speaking of performance is easier, at least in ICT, although the Moore Law is now a real challenge for ICT, because MOS channel(nanometres) are approaching the physical limit, as we have already mentioned many years ago (1988) [15][16][17].

On the other hand, **safety** and **responsibility** are from far much more complex and complicated problems for humankind.

In our example, **safety** is an obvious *paramount issue* (genome sequencing), while **responsibility**, which is also applicable in this case, could be considered *issue of usual relevance*.

Just observing the significance and consequences of this combination (**safety-responsibility**) we could estimate the complexity of the analysis in the general case, at Earth scale.

First observation is that a complicate problem arises when we search the ratio of relevance/applicability **safety vs. responsibility**, as real situations and applications fields in ICT (but not exclusively) could vary so much.

Again we have to use some examples to solve the problem and have some credible estimates useful for conclusions.

We can choose any of the above examples, but the purpose is to emphasize only the cases which are similar to genome sequencing, because only this way we could eventually reveal the paradox, i.e. understand where we have the usual trend already described (generate knowledge and refined knowledge – for example when soft programs and technologies will be created by smart machines) and where/why we consider that a paradox appears.

We already presented [9] the fundamental trend of ICT, where a way to continue the actual ICT exponential pace of development (including Moore's Law) is to learn from nature's research stored in millions years of evolution of living things including humans.

Recent news [18] shows, for example, that, in order to surpass the limits of actual technologies for recording very fast moving scenes, a promising way is given by applying human eye inspired solutions.

Noting that the last example is not necessary very relevant, the paradox could appear when we use such new technologies to **replace human when we want to avoid the consequences of routine stress, fatigue but especially the lack of responsibility in specific applications**.

But when one should consider these as strange situations or even “paradox”?

Our opinion is that we should consider relatively normal a situation when the students surpass their former professors and consequently when a smart machine is surpassing the humans which have created it.

The strange situation/paradox appears when a smart machine is especially designed and has the potential to avoid the consequences of the events where human (as average person or as an exception) could defect or show lack of attention/responsibility in specific (important) applications.

Now it is clear that we already live the days of a World where human's generally performance (and sometime his specific intelligence) is surpassed by smart machines and this way soon we will no more consider this as strange.

As a matter of fact, the paper title (**Tomorrow's paradox ...**) is intended to generate an alarm signal about the abnormal situation where humankind is almost arrived, as **we have to**

create such “smart machines” which could help us to get knowledge and refined knowledge designated to fight against ourselves, i.e. to avoid the consequences of a large diversity of aberrant behaviour generated by the average person or exception individuals.

Speaking about the mentioned “consequences”, there is a lot of potential danger issues, starting from “**limited factor of performance**” in essential areas exceeding ICT and ending to “**limiting** factor of IS/KBS progress”.

Another example [4] shows that IT coding persons, for a reference project, decreased, in the last 20 years, from 250 to 15. More than this, the usual model of *solo coding person* (per project part) changed to *duo coding persons*, in order to avoid “errors”.

If we analyze all these “strange situations”, especially as dynamic of their evolution (number and areas of applying), we could not remain neutral and say “this is life”.

Our paper main message is just at this point (level) where we have to wonder, at least, if not worry about the global consequences of this evolution toward “paradox” (supposing much more than we presented, but we suggested).

In fact one could say: why should we have to do?

The only way we should responsible act in order to avoid “paradox”, by our opinion, is to carefully observe, learn and experience from the environmental reality, adapting every day to the fast changing ICT/IS/KBS context.

Consequently we should strive to adapt our life/work to the “instruments” we create, but above all these we have to do what we still better can do: create knowledge and especially *carefully* refine knowledge.

We think the humans have and must keep this advantage over smart machines, to refine knowledge in responsible, imaginative and preventing ways covering the entire ICT/IS/KBS context – including the design and evolution of smart machines.

Perhaps a last example will reveal the importance of controlling “strange and paradox „generally in ICT/IS/KBS evolution and especially of evaluating the extent *smart machines could/should replace humans*.

Searching the answer at this *perpetual question*, we think that is important to responsibly to meditate at the message incidentally found in [1]: *take humans out of the equation, because we’re the bottleneck*.

Risking going into a complicate area, susceptible to be analyzed in other paper, our last example could arise in the decision making field: *to what extent should we enable machines to be part of the important decisions?*

Of course artificial intelligence and expert systems, as smart assistants for humans in decision processes, are not news, but we have to carefully analyze both sides (ICT vs. human) evolution (progress-stagnation-regress), at Earth scale, in the actual/dynamic context which tends either to apogee or survival [7].

Continuing the lack of responsibility scenario, *over the actual dramatic socio-geo-political reality of the World, one could ask: at what level would it be better to correct humans’ essential decisions by artificial intelligence and expert systems suggestions?*

For a future approach of this last example, we have just to imagine some applicable decision levels and their progressive “consequences”: strategies to develop companies, communities or countries; combat crime, terrorism or “enemy”; environmental-social-political strategies.

3. Conclusions

The exponential development of ICT in IS context toward KBS and the natural limits of humans create the premises of strange evolutions of the inherent interactions between humans and ICT smart machines, along the complex and dynamic processes of generating knowledge and refining knowledge.

Our analysis revealed the detailed mechanism which could lead to abnormal or paradox situations when ***ICT smart machines could/should replace humans***.

The paradox could appear when using such new technologies to ***replace human in order to avoid the consequences of routine stress, fatigue but especially the lack of responsibility in specific applications***.

Perhaps the main conclusion is that the paper title (*Tomorrow's paradox ...*) is intended to generate an alarm signal about the abnormal situation where humankind is almost arrived, as ***we have to create such "smart machines" which could help us to get knowledge and refined knowledge designated to fight against ourselves***, i.e. to avoid the consequences of a large diversity of aberrant behaviour generated by the average person or exception individuals.

Also, among the mentioned "consequences", there is a lot of potential danger issues, starting from ***"limited factor of performance"*** in essential areas exceeding ICT and ending to ***"limiting factor of IS/KBS progress"***.

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