

Information and Communications Technologies Drive Digital Disruption from Business to Life on Earth -Part 2-



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Abstract

As premises of the digital disruption (DD), the paper shows that Information and Communications Technologies (ICT) is further influencing all areas of humankind activity, determining the crucial role of ICT as main driving factor for the progress of Information Society (IS) toward Knowledge Based Society (KBS) and generally for the life on Earth.

The paper analyses the DD evolution, which is strongly linked with ICT evolution, mainly as content and speed of development, from these factors coming the most of complexity and difficulty of analysing and foreseeing DD, in general DD being a set of dynamic and complex processes, which are interacting with ICT fast growing potential and are depending on the economical/social context. Ultimately, DD is basically generated between two pillars: technology and customer/humankind needs.

The fast changes of the ICT context are one of the factors which determine the DD hardest requirements for the incumbents, because they have to continuously adapt to these rapid and complex changes in order to find the appropriate decisions for their business.

The paper analysis is focused on the general causes of DD and its main driving factors are also detailed by their essential components and directions.

Among these factors, the multiplication power of ICT products and services, generally associated with the digital processing but in reality being much more diverse and complex, is now “multiplied” by the new increasing power of mobile and broadband connectivity which enables unprecedented applications, processing performance and huge amounts of data.

In addition, the challenge to process and storage such amounts of data (provided by IoT and ... more) is analysed, along with solutions oriented on new models, design and algorithms for DD and generally for actual ICT role in IS toward KBS.

As a consequence, the concrete problem the ICT development and generally all the decision makers have is to optimize the development/investments by a complex set of criteria, from revenues to social needs and environment, i.e. it is necessary to continuously adapt and improve the decision processes according to the actual realities and the last estimations of ICT/IS/KBS development, with a deeper approach for the processes which deal with data, information and knowledge. This approach leads to the necessity of using properly refined knowledge for the further development of DD/ICT/IS/KBS. A relevant given example is the field of human genome and generally in genetic engineering, where ICT state-of-the-art products and applications enable long expected results for people’s lives. Also, the

unprecedented performance of advanced AI (“deep learning”) applications could provide one of the most expected contributions to refining knowledge for the surviving race against climate changes.

An actual practical approach for the leaders facing DD is to watch start-ups, which have impressive flexibility and dynamic versus the big companies. Therefore, the leaders have to learn from the opportunities of digital ideas, connectivity and exploiting customer needs and behaviour in the context of ICT “storm” of offers.

In general, “looking at the right data” is the first step toward an optimal “edge” of DD and in the same time the initial phase of the main goal of properly refined knowledge.

The most important conclusion of the paper is that properly refined knowledge should mean, in each domain of development/implementation and in every case, to harmonize (globally optimize) all the policies, projects and applications with state-of-the-art or updated results/requirements from all domains which are or could be involved/affected today or tomorrow, at Earth scale, by DD/ICT development.

Keywords: digital disruption, Internet of Things, information society, knowledge based society, advanced artificial intelligence, start-ups, human genome, mobile and broadband connectivity, Maslow Pyramid.

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

1. Generating Digital Disruption between technological innovations, revenue and customer expectations

The Digital Disruption (DD) complex processes have an actual impressive impact on every industry and generally on humankind life, as Information and Communications Technologies (ICT) are the main driving factor of the progress of the Information Society (IS) toward Knowledge Based Society (KBS), generating complicate and dynamic processes at Earth scale, requiring, as a consequence, a timely analysis due to their crucial importance and exponential speed of development [4][5][6][21].

Remembering Maslow Pyramid, we can observe that in our days, in a very divided and imbalanced World, the basic needs are still important but well covered on the developed side of Earth, while the other side are still facing the lack of their fulfilment.

In the same time, the statistics show that the Maslow Pyramid middle needs are continuously growing, on both sides of the Earth population, i.e. for rich and for poor, among them communication, connectivity and even entertainment being remarkable.

This growing could be a certain indicator of the ICT penetration power and efficiency, among other industries, but in the same time there is possible **a two edge “sword”** effect– as the ICT exponential pace of development could produce negative consequences when policies/investments are not very correct justified[13][8].

Here it is essential to mention that although the above growing is referring to ICT industry, its impact is further influencing all areas of humankind activity and more, as we have already presented the crucial role of ICT as main driving factor of the progress of IS toward KBS and generally for the life on Earth and ... beyond [15].

This way we can consider that DD is basically generated between these two pillars: technology and customer/humankind needs.

As a matter of fact, the real picture of DD is much more complicated and that is why the next analysis is intended to identify the main factors and their relations in DD generation and evolution.

Before any other considerations, it is important to notice that the DD evolution is strongly linked with ICT evolution, mainly as content and speed of development, as from these factors it is coming the most of complexity and difficulty of analysing and foreseeing.

With other words, DD is a set of dynamic and complex processes, which are interacting with ICT fast growing potential and are depending on the economical/social context[16][17].

For example, coming back to Maslow Pyramid, we have to observe that moral needs are on the top, but for many people, including sometimes decision (or policy) makers, these could be “too high” to be considered or reached versus the other needs and therefore “neglected”.

Also from the start it is important to mention that the market rules are still the main factors which influence the development of any industry, but remember also the *two edge “sword” possibility*[16][13][21].

Now the DD general picture between the mentioned pillars is better framed, but an also relevant point of view is given by [14]:

“Just waiting for the end of the digital tsunami is wishful thinking. It cannot be stopped; it can only be surfed on”

This advice is important for the analysis premises, as it express a prominent feature of DD referring to its dynamic and perspective.

In addition, here it is the point to observe that the fast changes of the ICT context are one of the factors which determine the DD hardest requirements for the incumbents, because they have to continuously adapt to these rapid and complex changes in order to find the appropriate decisions.

This challenge is very clear presented along with the corresponding approach and objectives in [11] as:

“The development of new competencies revolves around the capacities to be more agile, people-oriented, innovative, customer-centric, streamlined, efficient and able to induce/leverage opportunities to change the unadapted status quo.

The goal is an ability to move faster from an increased awareness and forecast capability regarding changes to decisions and innovation, keeping in mind those (potential) changes”.

More than theses, the general causes of DD and its main driving factors are also detailed by their essential components and directions:

“Present and future shifts and changes can be induced by several causes, often at the same time, on the levels of customer behaviour and expectations, new economic realities, societal shifts (e.g. aging populations), ecosystem/industry disruption and (the accelerating adoption and innovation regarding) emerging or existing digital technologies.

In practice, end-to-end customer experience optimization, operational flexibility and innovation, are key drivers of digital transformation, along with the development of new revenue sources and information-powered ecosystems of value, leading to business model transformations”.

After the above general considerations, a concrete example [14] could be very useful for understanding the challenge of the ICT speed reflected on DD:

<<“*Books gestate very slowly,” veteran publishing entrepreneur Richard Nash observed at IDPF’s Digital Book 2015 conference at BookExpo America in New York City ... “But the life-cycles of start-ups are much shorter”>>*

Observing the start-ups advice, this example is completed by a relevant link with what we above have called “ICT penetration power and efficiency”, expressing again the amazing evolution and implications of smartphones (“*Mobile is the first screen*”):

“Talk about things that change fast: In just five years, we’ve gone from mobile phones as disruptive ‘second screens’ to being the first, and sometimes only, screen in users’ lives. It goes without saying that software products must work well on smartphones. For novels, that challenge is quite simple. But if you seek to entertain with media, to educate with interactivity or to empower with reference and search, the mobile screen is a tougher beast to satisfy. Alas, customer expectations do not yield to technical complexity”.

Although this example comes from the books industry, it is easy to observe its concrete relevance for all activity domains when emphasizing the *customer expectations* and indicating which should be the incumbents behaviour in order to

“... stay relevant and healthy in a rapidly evolving environment. Publishers must do whatever it takes—including reinventing themselves, hiring outsiders, investing in new media—to be the best players at serving authors and readers by putting them in touch as much and as deep as possible. Books (in any format) are just one of the very many touch-points between authors and readers”.

Coming back to the main features of DD generation, it is important to reveal that although technological innovations, revenue and customer expectations were transparently prominent in the above considerations, the crucial role of ICT in DD generation has very complex and complicate aspects to be, at least shortly, analysed.

In fact it is necessary to reveal the main factors that explain the mentioned “ICT penetration power and efficiency”, as these are the real engines of DD evolution.

In other terms, we have to see some actual features of the above “**technological innovations**”, as ICT development is impressing not only by its exponential pace, but also by the dramatic ways it leverages the development of all industries and areas of humankind activity.

First of all, the multiplication power of ICT products and services [15][20], generally associated with the digital processing but in reality being much more diverse and complex, is now “multiplied” by the new increasing power of mobile and broadband connectivity which generates unprecedented applications and processing performance.

Just for a flavour of this aspect it is worth to imagine how this new power will increase with the emergent IoT and 5G technologies, at Earth scale[7][18][10][9][21].

Some short data could again be useful examples for understanding how much the next performances could mean if we notice what we already have[1]:

“Greater connectivity around the world is one of the factors facilitating disruption. The number of mobile phones in use has increased rapidly over the last fifteen years. By 2016, total volume (mobile phones) increased to 8.5 billion compared to a population of just 7.3 billion. There are more phones in use than people on the planet... The number of smart phones has increased from less than one billion units in 2010, to approximately 3.2 billion last year and 4.1 billion this year. ...We expect the number of phones in use to peak at 9.0 billion in 2020 as the total stock of smart phones increases to just under six billion units”

As mobile phones are only a part of the picture, the contribution of IoT could be only approximately foreseen[1][23]:

“According to our dataset, the number of “Digitally Connected Devices” has increased from less than one billion in 2009 to around 5.0 billion in 2014. We claim 2016 as the year of singularity when the number of digitally connected devices, equalled the number of people on the planet. From a level of around 7.4 billion this year, we forecast the number of digitally connected devices will increase to around 11 billion by 2020, peaking around 15 billion by 2030... According to Gartner, there will be nearly 21 billion devices on the internet of things by 2020. ABI Research estimates that more than 30 billion devices will be wirelessly connected to the internet by 2020. 50 billion appears to be a reasonable assumption assuming our 11 billion digital connected devices is correct”.

Remaining in actuality with ICT performances and features, emphasizing this time the IoT side, a crucial question is arising: how to process and storage such amounts of data (provided by IoT and ... more)?

As we already have presented [15][19], this “iceberg” is one of the dramatic challenges of the future, not only for ICT, but for incumbents and eventually for humankind too.

To imagine just the tip of this “iceberg”, again some numbers [1][23] are here relevant:

“In 2015, we probably produced more every day since the birth of the printing press in the first 555 years. The rate of increase is exponential. Videos, photos, audio messages, blog posts are streaming onto the internet in ever increasing proportion. That’s lots and lots of information and lots of need to store. According to the Cisco Cloud Global Index 2015, annual global data centre traffic will reach 10.4 zettabytes by the end of 2019, up from just over 3.4 zettabytes in 2014. Global cloud traffic will reach 8.6 Zettabytes up from 2.1 ZB over the same period. Data created by the internet of everything will exceed 500 ZettaBytes by 2020 up from 150 ZettaBytes in 2015. That’s over half a Yottabyte each year with more to come. That’s a lot of data. How big is a Zettabyte - think Kilobyte (1) Megabyte (2) - Gigabyte (3) - Terabyte (4) - Petabyte (5) - Exabyte (6) - Zetabyte (7) and still to come yottabyte (8). Figures in brackets are the power factors from the humble Kilobyte. Consider the Encyclopaedia Britannica is approximately 24 GB in total!”

Without considering that our analysis is completed here (far for intending to be exhaustive), we may conclude that the last observations just showed the approximate size and the prominent issues of DD evolution in the general context of actual ICT development.

In fact it is important to observe that the most difficult issues move from “hard” to “soft”, i.e. from applications to models, design and algorithms or, at an other layer, from data to information and knowledge.

2. Find new edges for the digital disruption by ICT power and properly refined knowledge

As a consequence of the above conclusion, it is necessary to further analyse the relevance of models, design and algorithms for DD and generally for actual ICT role in IS toward KBS[21][19][22].

More than this, one could ask which is the relationship between this relevance and the mentioned layer/plan from data to information and knowledge.

Part of the answer is that the mentioned iceberg, although has an impressive tip by its figures (for example 500 ZettaBytes generated by 2020), reveals that, in spite of the performances provided by technology, the decision makers will have to face more and more complex problems in order to efficiently use this technology and especially the huge amount of data provided at Earth scale, even before IoT will become extended as it is foreseen today.

As we have already estimated [19], we have just arrived to the concrete problem the ICT development and generally all the decision makers have: to optimize the development/investments by a complex set of criteria, from revenues to social needs and environment.

To solve these kinds of problems, including the case of DD, simply using analytics and other performant hard or soft technologies seems that soon it will be not enough.

That is why we consider that the optimal solutions must include other “layers/approaches” too.

This way it is now easier to understand the necessity to **find new models, design and algorithms along with a deeper approach for the processes which deal with data, information and knowledge**[21][19].

From the beginning it is important to notice that by “new models” it is not necessary to understand new business models (which is only a particular case), but it is sure that these “new models” will enable, along with the other mentioned components, the DD processes as part of ICT development penetrating all activity domains.

Again an example could clarify the approach of such complex processes, starting from the most relevant scenario, created by the IoT expansion[1]:

<<To the list of digital devices we add home appliances, connected clothing, medical devices, transportation, buildings and cities. Smart bodies, smart homes, smart cars, smart grids, smart farms, smart roads, smart cities ... “Get Smart” will take on a whole new meaning to digital urgency. “Things” as an “inextricable mixture of hardware, software, data and service is the legal definition. People will be connected to the internet via internal and external devices. The pacemaker hooked up to the mainframe offering real time analytics. The digital dispenser offering feedback on medicine consumption and dosage levels. The nano bots coursing through the veins relaying important data on cell

counts, sugar levels and genomic disorders. As the cost of chips fall, along with the cost and time of processing the data, the “nerd nirvana nears”>>

Facing such unprecedented and fascinating scenarios is the most prominent challenge of the near future, for ICT specialists, for incumbents and ... humankind, as the above example is continued:

“Data storage is made available and the data challenge becomes enormous. What secrets to predictive modelling will be extracted from the huge data flow? Access to market has never been easier and cost of acquisition has never been lower. It is an exciting time for those with the right attitude and the right software to process the data and provide the service”.

Apparently, the last observation is optimistic, because the “Access to market has never been easier and cost of acquisition has never been lower”, but the real problem is still, in essence, as we have defined it above: to find “*the right attitude and the right software to process the data*”.

Continuing and paraphrasing the example approach, but adding the fast and ever changing ICT context we have already presented [15], we can say that **“being smart will never be the same”**.

About this never ending complex process challenges, we have already made some considerations, where human mind and AI are in a progressive and dramatic competition [7][22].

At this point we may consider that the premises of this section title are more than clear, with their good and bad parts, but this does not mean that the solutions are also easy to find or understand, in the actual and coming DD/ICT realities.

Perhaps a good start to those solutions is very well expressed by [2]:

“Your company may have used technology to give it an edge by reducing costs, automating existing processes or turning analog business models into electronic channels. But sharpening any edge becomes increasingly difficult over time. After all, as soon as others figure out how to automate the same processes, where’s the edge? How can companies create a new edge, and sustain it, when grinding away at their current strategies delivers fewer and fewer results?”

Remembering the two edge “sword” feature of ICT is only a partial similarity, as any new solution or “miracle” could have negative consequences too and generally a possible competition with other (better) solutions – which is the case intended in the current example of DD.

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Like many others references, this too confirmed the ways to exploit the advantages of digital economy:

“The answer is digitalization. A digitalized business creates value and revenue from digital assets. It goes beyond further rounds of process automation to transform processes,

business models and customer experience by exploiting the pervasive digital connections between systems, people, places and things”

We still consider that this approach is closer to the tip of the mentioned iceberg than to the bottom, i.e. it does not bring details nearing the elaborated solutions, but positively brings a subtle feature of the road to solutions (*“sharpening any edge becomes increasingly difficult over time”*) and shows the cutting technologies for such edges:

“Technologies such as smartphones, tablet computing, social media, big data, analytics, cloud computing, remote sensing and others provide the raw materials to forge a new edge”.

Still, the most practical observation in this case is expressed as a conclusion of the above example:

“Any company today —large or small, old or new — can use this digital technology to create a winning edge for its business and, perhaps, its industry”.

Although this does not near us to the “iceberg” bottom, here it is worth to recall that one of the actual practical approach for the leaders facing DD is to watch start-ups [3]:

“How can companies identify technologies or start-ups that are truly disruptive? It is difficult for companies to distinguish the truly disruptive start-ups from the hype. This is because most start-ups never really achieve critical mass. However, I think what companies can do is pay attention to where start-ups have identified and are addressing a customer pain point. They should ask themselves: “Where are some of these digital start-ups solving a problem for my customers where I’m doing less of a good job? What are the areas where my business model is making our customers unhappy?”

Therefore, one of the actual practical approaches for the leaders facing DD is to watch start-ups, which have impressive flexibility and dynamic versus the big companies. Then the leaders have to learn from the opportunities of digital ideas, connectivity and exploiting customer needs and behaviour in the context of **ICT “storm“ of offers.**

More than this, the real advance comes when making concrete steps toward refined solutions:

“Is there a way in which companies can anticipate potential future disruptions?

Yes, companies can spot the early warning signs of disruption by looking at the right data. There are three categories of data – I call these lagging, current and leading indicators. Lagging indicators are often highly accurate and precise but they only reflect past events that can’t be changed. Most financial information, including profitability, is a lagging indicator. A company’s profits today are a function of what it did for customers and how it responded to competition in the past. Current indicators, on the other hand, are data about where a company stands at the moment. Examples of current indicators include inventory levels or the pipeline of opportunities. Finally, leading indicators provide information on where a company might be headed”.

We consider that measuring such complex processes of DD is one of the interesting challenges, as it provides forward steps to the core of “iceberg”.

To be more concrete, “looking at the right data” is the first step toward an optimal “edge” of DD and in the same time the initial phase of the main goal of properly refined knowledge.

As we have pointed in the first section, the road from data to knowledge is passing through information, but the paradox is that the huge amount of data of the future will just make this path longer and that is why we need better models and algorithms for ICT complex and performant applications[21][7][19][22].

At this phase, the role of Big Data and AI (artificial intelligence) is prominent, but it is worth to notice that actual Big Data applications (usually called data analytics) are sometimes modest versus the goal.

A real progress is expected from *advanced* AI, especially from “deep learning” applications [7][15][19], which eventually will make the most difficult step, from information to knowledge.

From this step, to reach the “properly refined knowledge” it is not only a very difficult, but perhaps a continuously race for optimal solutions, as this goal is itself ever-changing with the complex context of ICT/IS/KBS(i.e. a sort of Fata Morgana).

Still, the last observation does not mean that it is not necessary to continuously adapt and improve the decision processes according to the actual realities and the last estimations of ICT/IS/KBS development.

In a concrete approach, to realize the complex processes which provide properly refined knowledge, a lot of factors and criteria should be implemented.

A relevant example could be the case of the amazing progress we see today in the field of human genome and generally in genetic engineering, where ICT state-of-the-art products and applications enable long expected results for people’s lives.

As a matter of fact we have already presented [7] what impressing **advance the computing power** has induced in the early decoding of genetic disorder at new born babies, in order to increase the chance to save their lives by **critical time** treatment.

Here properly refined knowledge is built up from all prior results and all new conclusions involving both ICT and medical technical and human issues.

More than these, the implementation of the applications should direct the new models and design details for future improvements, but in the same time all the consequences (including the negative ones) must also be considered and harmonized, for the ICT, for e-health, for ethical, for legal, environmental and for other interdisciplinary reasons.

In general, in our opinion, **properly refined knowledge means, in each domain of development/implementation and in every case, to harmonize (globally optimize) all the policies, projects and applications with state-of-the-art or updated results /requirements from all domain which are or could be involved/affected today or tomorrow, at Earth scale.**

Anyway, **it is important to put in top of requirements humankind life on Earth ecosystem, for today and tomorrow, then consider economical, financial or other issues.**

Just imagine what complexity and dramatic implications will have the IoT development at Earth scale, if the same (properly refined knowledge) algorithm would be applied.

The practical question is: Would it be applied (at least with minimal requirements, although it should be more complex)?

As we have already mentioned [13][24], these processes include the essential factors of IS/KBS progress, where ICT is prominent, but humankind survival and Earth ecosystem should be first.

The implications of these decisions include survival and Earth as it is clear that ICT industry itself is going to have a significant contribution to carbon footprint, but the indirect consequences by penetrating all industries and activity fields could have really dramatic effects, if speaking only about climate changes issues, without adding Earth resources fading and complex influence on humankind behaviour, life and evolution [24][18] [13].

It is a matter of responsibility and imagination to understand the importance and complexity of the needed research and monitoring, at Earth scale, for all the above challenges, including first environmental, economical and humankind behaviour/evolution. That is why, the unprecedented performance of *advanced AI* (“deep learning”) applications could provide one of the most expected contributions to refining knowledge for the surviving race against climate changes – to mention only our worst “nightmare”.

In this context, **refining knowledge, including DD evolution, must be a learn-decide-act continue (circle) process including all mentioned steps, state-of-the-art technology and science, along with a lot of ... human wisdom.**

3. Conclusions

Paper’s premises show that ICT impact is further influencing all areas of humankind activity and more, determining the crucial role of ICT as main driving factor of the progress of IS toward KBS and generally for the life on Earth and ... beyond.

In addition, DD evolution is strongly linked with ICT evolution, mainly as content and speed of development, as from these factors it is coming the most of complexity and difficulty of analysing and foreseeing DD, in general DD being a set of dynamic and complex processes, which are interacting with ICT fast growing potential and are depending on the economical/social context. Ultimately, DD is basically generated between two pillars: technology and customer/humankind needs.

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The paper analysis is focused on the general causes of DD and its main driving factors are also detailed by their essential components and directions.

First of all, the multiplication power of ICT products and services, generally associated with the digital processing but in reality being much more diverse and complex, is now “multiplied” by the new increasing power of mobile and broadband connectivity which generates unprecedented applications, processing performance and huge amounts of data.

Subsequently, the challenge to process and storage such amounts of data (provided by IoT and ... more) is analysed, along with the solutions oriented on new models, design and algorithms for DD and generally for actual ICT role in IS toward KBS.

As a consequence, the concrete problem the ICT development and generally all the decision makers have is to optimize the development/investments by a complex set of criteria, from revenues to social needs and environment, i.e. it is necessary to continuously adapt and improve the decision processes according to the actual realities and the last estimations of ICT/IS/KBS development, with a deeper approach for the processes which deal with data, information and knowledge.

This approach leads to the necessity of using properly refined knowledge for the further development of DD/ICT/IS/KBS. A relevant given example is the field of human genome and generally in genetic engineering, where ICT state-of-the-art products and applications enable long expected results for people's lives. Also, the unprecedented performance of *advanced* AI ("deep learning") applications could provide one of the most expected contributions to refining knowledge for the surviving race against climate changes.

The most important conclusion is that properly refined knowledge should mean, in each domain of development/implementation and in every case, to harmonize (globally optimize) all the policies, projects and applications with state-of-the-art or updated results /requirements from all domains which are or could be involved/affected today or tomorrow, at Earth scale, by DD/ICT development.

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