

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

-Part 1-



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Abstract

The paper presents the complex context of the consequences of Information and Communications Technologies (ICT) evolution and its prominent phases, digitization, digital economy, digital transformation and digital disruption, focusing on later. The content of these phases are analyzed based on relevant references, considering also their time sensitive implications of ICT exponential pace. An essential conclusion of the analysis is that the understanding and the realistic approach of the multiple implications of DD could dramatically influence the future of any company/organization and beyond ... of humankind. This conclusion could be considered a synthetic/generic answer for the generic question “Why DD?”, based on the above analysis which presented why, how and when DD appeared and subsequently why it deserves to be deeply analyzed.

The analysis also approached the criteria which could differentiate these relevant milestones in the complex processes of ICT impact on digital economy and generally on Information society (IS) toward Knowledge Based Society (KBS), along with consequences on humankind life and evolution on Earth.

The second section of the paper is focused on the necessary awareness and forecast capabilities in order to continuously improve the decision processes and the overall efficiency of digital economy. The paper presented the typical scenario for DD, where business is reimagined based on the innovation of (business) activities by introducing new digital technologies (innovations) and new model of business, using imagination and relevant refined information, which represent the main ingredients of the successful DD.

It is also presented the specific solution for media industry: streaming their products and services using the advantage of performant ITC which offer wideband support and a lot of digital features for a better customer experience. In the same time it is remarked the double systemic role of ICT in IS/KBS, by technologies, products and services for all industries and activity fields, but on the other hand as replicated model of design, operation and development (precision multiplication).

The analysis revealed the fundamental consequences of the fact that ICT development exponential pace is faster than humankind could deeply analyze and real time react against all long term implications of such evolution, showing that the latency of the pace of transformation in organizations is one of the crucial evidences of author general estimation about the limited capacity to react before is too late.

Another feature of the actual DD, linked with the “zero marginal cost” trend, is changing of business model from selling products to selling services by subscription, a trend typical for ITC, now extended to other fields.

We consider that the pace of changing/dropping complex products and services (like smartphones), especially when they include important resources, is a negative consequence of ICT exponential pace that could not lead to a sustainable development of IS/KBS on Earth.

The analysis also presented the importance of the approaches, studies and even methodologies intended for quantifying the global impact of digital transformations and DD on digital economy.

A special conclusion refers to the importance of holistic approach and the attention paid to the continuous improvement of the model for assessing such complex and complicated processes of digital economy, like DD, but it is worth to extend that to ICT in general, in the context of their driving role in IS toward KBS.

Keywords: *digitization, digital economy, digital transformation, digital disruption, business model, innovation, smartphone, data analytics, customer experience, agriculture, Internet of Things.*

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

1. Why digital disruption?

The amazing evolution of Information and Communications Technologies (ICT), as main driving factor of the progress of the Information society (IS) toward Knowledge Based Society (KBS), generates complex and dynamic processes at Earth scale, but on the other hand it requires a continuous analysis due to its crucial importance and exponential speed.

Facing these challenges is more and more difficult and an inspired approach could be as shortly expressed by Nigel Moulton[1]:

"Stuff that seems like science-fiction is here now ... If we think about it in the right way, it's actually quite profound"

We consider that this approach is very relevant for the main and profound idea of our paper, which is intended to analyse the complex long-term consequences of ICT exponential development for both business/economy and humankind on Earth.

In this context, digitization, digital economy, digital transformation and digital disruption are not new terms, but their content is also time sensitive considering ICT exponential pace.

The above terms just show evolution steps for answering the complicate and generic question we debate: **Why digital disruption?** Naturally, the answer will be built step by step, considering both semantic and time sides of the question.

Although in this aria there are many definitions, some generic references are useful to illustrate the dynamic differences of the terms.

For digitization, beyond the basic technical significance meaning the transformation of analogue signal into digital one, a well-documented definition is given by [2]:

<< Digitization, however complex as a phenomenon, has multiple facets. First, digitization marks the diffusion of a wide range of digital technologies (such as the internet, web 2.0, internet of things, analytics, or still cloud technologies), into the core of organisations, for the benefit of improved performance (Koellinger, 2008). Second, “digitization” is claimed to belong to the set of disruptive innovations (Christensen, 1997), whereby a) entrants use digital technologies to build new business models as detriment to market incumbents, while b) incumbents would be better off, either by not reacting at all, or by aggressively embracing the disruption (Downes and Nunes, 2013; Wessel and Christensen, 2012). >>

It is important to observe that the above opinions also expressed the evolution towards disruption by introducing the essential role of disruptive innovations which leads the steps close to digital disruption.

Still, we have to observe that the main content of the definition is the mention of digital technologies (ICT) which are implemented in the organisations and the possible decisions incumbents could take.

Based on the large picture of the above definition, the next step is to have a reference for the digital economy, as expressed in [3]:

<<The digital economy is the share of total economic output derived from a number of broad “digital” inputs. These digital inputs include digital skills, digital equipment (hardware, software and communications equipment) and the intermediate digital goods and services used in production. Such broad measures reflect the foundations of the digital economy>>

The main merit of this definition is that it includes, along with the digital details, a functional model based on clear output and input, which, **nota bene**, is taken from ... electronics/automation.

Now we could consider that, generally, the digital economy is what we have seen growing in the last decades, but it is more and more important to identify the relevant phases/steps and results of this evolution.

With other words, the analysis arrived in the most relative and difficult area, where we have to approach the metrics or criteria which could differentiate the relevant milestones in the complex processes of ICT impact on digital economy and generally IS/KBS, along with consequences on humankind life and evolution on Earth.

Obviously, the “relevant milestones” could lead to another analysis and selection so we will have to limit to the paper space and aim, considering the most relevant the mentioned **digital transformation and digital disruption**, as prominent steps of the digital age, i.e. where ICT drive IS toward KBS.

Digital transformation is a generic term referring to the leveraging and systemic changes ICT induce in the entire economy and generally in the IS.

One of the most accurate definitions of digital transformation is given in [7] as: **“Digital transformation is the profound and accelerating transformation of business activities, processes, competencies and models to fully leverage the changes and opportunities of digital technologies and their impact across society in a strategic and prioritized way, with present and future shifts in mind.”**

A special attention must be given to another generic term, almost universal today, as “**digital technologies**” mainly include ICT but an accurate approach should also include many other activity fields.

That is why, as we already presented [11] [18], we consider also important to reveal that the role of ICT in IS/KBS is multiplied by their subsequent applications and influence on all humankind activities and generally on life on Earth.

A confirmation of this approach and the opportunity of paper title are also given in [7] as:

“Digital technologies – and the ways we use them in our personal lives, work and society – have changed the face of business and will continue to do so. This has always been so but the pace at which it is happening is accelerating and faster than the pace of transformation in organizations”

Another **crucial opinion**, we have presented in [11] [9], could be observed in the last quotation as revealing the above mentioned difference we are looking for among the analysed changes: *the pace it is happening with*.

On the other hand we have to point out that our opinion [9] has considered more than *the pace of transformation in organizations*, revealing **the fundamental consequences of the fact that ICT development exponential pace is faster than humankind could deeply analyze and real time react against all long term implications of such evolution**.

Still, it is also benefic the obvious fact that the latency of *the pace of transformation in organizations* is **one of the crucial evidences of our general estimation about the limited capacity to react before is too late**.

Here we have just arrived, having the necessary basics, to the last and most relevant term/step of our analysis: ***the digital disruption (DD)***.

DD is in fact the actual phase (step) of the digital age we live in and our paper is focussing on it just because it has dramatic consequences either positive (intended) or negative, generally on business/economy, but further we will analyse how these implications could extend beyond, to humankind life and evolution on Earth.

It is worth to mention that DD is a milestone in the evolution of digital transformation, often considered the 3-th wave, after first of Internet and second of Web 2.0.

As actual prominent wave, DD phase is considered a hyperscaling by its unusual impact, much above the level of companies performances, generally affecting the business models.

Just like the other discussed terms, DD has a diversity of definitions with minimal differences, so one of the most detailed is next [8]:

“Digital disruption is a transformation that is caused by emerging digital technologies and business models. These innovative new technologies and models can impact the value of existing products and services offered in the industry. This is why the term ‘disruption’ is used, as the emergence of these new digital products/services/businesses disrupts the current market and causes the need for re-evaluation.”

It is important to notice that the DD represent just the “apogee” of the evolution we above have presented, i.e. from the inherent impact of ICT (digitization) on digital economy to successive digital transformations which eventually reach the stage where the values of *products/services* and even the business models suffer radical changes, i.e. *disruptions of the current market generating the need for re-evaluation of the business*.

Also, we have to point that the concrete consequences of DD could be positives (up to prominence on market) when the incumbents understand the need and adopt the appropriate changes, or negative (down to exit from market) on the opposite case.

Perhaps not very clear, but very important, the need for re-evaluation must be further detailed because here is the most useful point of analyzing DD.

In fact, re-evaluation is the essence of DD, because it includes the key to positive an evolution, but, like any key, it is difficult to get and this is what we are going to further discuss.

Anyway, nothing could be too much when we have to underline the crucial importance of DD for digital economy, but above all for the IS toward KBS.

Then comes a first essential conclusion, as the understanding and the realistic approach of the multiple implications of DD could dramatically influence the future of any company/organization and beyond ... of humankind.

We think this conclusion could be considered a synthetic/generic answer to the generic question “Why DD?”, based on the above analysis which presented why, how and when DD appeared and subsequently why it deserves to be deeply analyzed.

If our last estimations for DD importance and content could appear overdone, let's see how DD, after clearly defined, is perceived and approached in diverse cases, in order to have a further analysis of the most appropriated solutions for DD challenges and finally a realistic forecast of its global consequences.

2. Watching digital disruption everywhere on Earth

The above analysis regarding the evolution of ICT and generally of the digital technologies and their impact on IS/KBS arrived to DD phase, which produces the actual prominent milestone, but further we have to focus on the necessary awareness and forecast capabilities in order to continuously improve the decision processes and the overall efficiency of digital economy.

More than these, DD is a global challenge and an opportunity to optimize the evolution of humankind, beyond the economy criteria, as life on Earth is already facing dramatic premises generated by climate changes, resources fading and social/political imbalance.

As we have already presented [9][11], the solutions for these challenges/premises are not simple to find, but we have to **carefully and continuously watch the ICT exponential evolution implications in all IS/KBS fields, especially when these appear with high dynamic and amplitude, which is the actual case of DD.**

These are the coordinates of the next analysis, focused on the complex processes of DD and aiming the identification of the main principles of best practice providing optimal transformation, efficiency and efficacy for companies, organizations and humankind experience through this challenging phase of IS toward KBS, **everywhere on Earth.**

A remarkable and detailed approach of this general objective for DD is presented in [7] as:

“Present and future shifts and changes can be induced by several causes, often at the same time, on the levels of customer behavior 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”.

We consider here that a special importance have the flexibility and innovation, as we have already presented [18] the crucial role of imagination (which provides both flexibility and innovation).

As a matter of fact, the innovation of (business) activities by introducing new digital technologies (innovations) and new model of business, using imagination and relevant refined information, which represent the main ingredients of the successful DD, as will be obvious by the next examples.

In [10] the role of imagination is more than prominent:

<<Complete re-imagination is in Sinofsky's view the “last stage of technology disruption...when a category or technology is reimagined from the ground up.”

Think of how other industries are being disrupted. Uber, the world's largest taxi company, owns no vehicles. Facebook, the world's most popular media owner, creates no content. Alibaba, the most valuable retailer, has no inventory. And Airbnb, the world's largest accommodation provider, owns no real estate.>>

We have to notice the direct link between the apogee of digital transformations and DD (last stage of technology disruption), before remark the most known actual examples of successful DD.

It is also remarkable that these cases are also impressive by their common “unimaginable” performance of operating with success in businesses without owning the main asset of that business, this way making DD a real wonder.

In reality, this is not always the case, nor the target of usual DD, but of course it is the ideal approach because its maximal efficiency.

The typical scenario of DD for a business, product or technology is also very clear approached by the same Steven Sinofsky (a former Microsoft President) [10]:

“Re-imagining a technology or product is a return to first principles. It is about looking at the underlying assumptions and essentially rethinking all of them at once.”

Among different industries there are also differences and things could not happen in the same way, but media industry is one of the most dynamic and influenced by ITC, as it is confirmed by [2]:

“The typical industry case of such digital turbulences is media. In music for example, P2P, then downloading and recently, streaming digital technologies have all been eroding the CD technology, with new business models such as all-you-can-eat subscription models being pushed by new entrants to disrupt the incumbent record companies (see Moreau, 2013). As a response to stop the pressure on their revenue shrinkage, most of the major record labels had to significantly reinvent themselves and jump on streaming aggressively as their new major source of revenue. Warner among others was the first to announce that streaming was the primary revenue platform recently and that streaming revenue growth over-compensated for the fall of other music distributions.”

The scenario is now completed with the specific solution for media industry: streaming their products and services using the advantage of performant ICT, which offer wideband support and a lot of digital facilities for a better customer experience.

Another feature of the actual DD is changing of business model from selling products to selling services by subscription, a trend typical for ITC [15], now extended to other fields [10]:

“Time and again, from cell phone minutes to cable TV, markets have shown that products with zero marginal cost (like digital copies of content) ultimately become subscription markets. This will be true of virtually all markets with digital services as products. People no longer want to buy digital goods, but they'll subscribe to your service in order to get them.”

It is interesting to observe the trend of “zero marginal cost”, where the photos is the earliest example as N. Moulton said [1]:

“Take for example the 35mm camera and film. The number of pictures I could take used to be dependent on the amount of film I had - and film was expensive because it was a chemical process. You then 'indexed' them according to time, date and location. Now we carry high definition still and video cameras in our pockets. The marginal cost of taking a picture is now zero because the cost of taking one picture is the same as taking 1000 pictures”

The trend is now extending and there are signals that this could affect one of the most profitable markets [10]:

“... just wait for the Moore’s Law to kick in and see what happens to the prices of smartphones in two to four years”

Although it is not sure if and when this opinion will be confirmed by reality (the trend is well known for ICT products just because of the Moore Law), it represents an issue leading to a challenge we have presented [9], but now the DD could generate new implications.

Concretely, we consider that the pace of changing/dropping complex products and services (like smartphones), especially when they include important resources, is a negative consequence of ICT exponential pace that could not lead to a sustainable development of IS/KBS on Earth.

As we have mentioned above, paper analysis can cover only the most relevant issues of DD, so **everywhere on Earth** could be a lot, but for sure food and agriculture will cover much of humankind challenges, including those affected by DD [12]:

“The world doesn’t have enough food, so anything that can be done to increase the efficiency of farming is welcome. In addition, many believe that there will soon be a strong backlash against the mentality that “any quality of food is OK as long as it’s low cost.” Case in point, a number of countries have already introduced a “sugar tax” on food that is made more appealing through the addition of sugar.

Increasing precision is a common theme with digitization. It will be used in medicine and in lease-charging, wherein consumers pay per use of a vehicle versus per amount of time (meaning, if you drive like a maniac, you will be charged accordingly). And it will be used in farming. High-resolution cameras on drones will film the farm while data analytics determine precisely where fertilizer, pesticide, seeds, slug control and water need to be applied. This precision application will likely be performed by robots.”

Here we must detail at least two essential issues, confirming our previous analysis, but in the very dynamic context of DD.

First, it is the general challenge of resource fading we repeatedly presented as prominent in development of ICT for IS/KBS [9] [11].

It is now the case to notice the positive contribution of ICT at the sustainable development of agriculture (without forgetting the opposite cases), by unprecedented performant technologies like precision cameras, communications drones, artificial intelligence/robots and data analytics.

Second is the double systemic role of ICT in IS/KBS, by technologies, products and services for all industries and activity fields, but on the other hand as replicated model of design, operation and development (*precision multiplication*).

The technologies, products and services are now available to optimize the business/industrial/social processes/applications in all activity areas, including healthcare and education to name the most interesting for humankind life.

Perhaps there are less visible implications of ICT as design, developing and operation models in a diversity of fields, including medicine, biotechnology, education and arts for example, where algorithms, *multiplication of logic and precision* are used just like in ICT systems, devices or services.

If a concrete example is necessary, let's think at **the sensors networks applications, exploding by IoT, which could control/optimize practically anything, anytime and everywhere on Earth**, noticing that *many of such applications were not only impossible in the recent past, but in addition they were inconceivable before ICT started similar applications and models of operation.*

As a matter of fact, this amazing set of performances is the result of integrating the actual ICT main components, first including artificial intelligence (**AI**), **IoT**, **Cloud**, **Big Data**.

All these factors and especially AI and Big Data, without counting the potential support of future 5G mobile communications networks and IoT, provide new spectacular models of design and research, remarkable examples, among other, being the human genome decoding and interpretations or the monitoring of Earth ecosystems [4] [6][14].

The relevance of these aspects for our analysis is given by the fact that DD evolutions, implementing these performant technologies, could dramatically influence IS/KBS huge domains, from industry to education, healthcare and environment.

On the same line, watching DD everywhere on Earth gives us the chance to have realistic forecasts and then optimal solutions for the generated challenges in the above mentioned domains and ... beyond. What we could consider beyond obviously includes many issues, but perhaps the most important is to observe how all the DD potential implications will affect humankind life and eventually evolution.

If this aspect is not very concrete, an example will create a good start for the content and importance of this approach [10]:

"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."

Our opinion is that beyond this evidence we have to observe the disruption potential of DD and generally of ICT to change the people's behaviour and step by step their creative potential and ... health [18].

Starting from "technical complexity" it is important to observe that the usual trend of offering to consumer a facile experience is not generally always the best solutions on long term, because now it is largely recognized that many of the benefits of AI and generally ICT that apparently ease the people's lives have also a negative effect on long term, here including not only the dependence of TV or smartphone, the progressive lack of physical activity, but the lack of intellectual effort which are lowering the creative potential of humankind.

The real danger is increasing in the context of the DD actual trends just because this kind of customer expectations is used by start-ups and companies in order to have an immediate advantage over competition.

Anyway it is obvious that the market rules have to be respected, but the essential idea is to carefully watch over the balance between positive and negative implications of their approaches for DD, considering as much as possible not only the immediate revenue but also the criteria for a sustainable development of their business and generally of IS/KBS [5][13][16].

In such decision processes, sometimes the last approach could appear unpractical, especially when, for short time, the customers have a positive reaction, but generally it is better to consider all long term consequences, including the humankind and Earth resources/ecosystems evolution. The complexity of estimation for "all long term consequences" is obviously increasing as ICT exponential pace and horizontal impact on IS/KBS are also increasing, but this must not discourage analysis and optimization approaches, as this paper is promoting.

More than these, confirming our approach and paper opportunity, there are interesting and useful approaches, studies and even methodologies intended for quantifying the global impact of digital transformations and DD on digital economy [3]:

“Typically, measures of the digital or Internet economy have focused largely on technology infrastructure, IT and communications sector investment, ecommerce, and broadband penetration rates. But this does not account for the whole scope of digital. Using a ground-breaking model that assesses how digital is adding value throughout the entire economy—by tracing the use of digital skills, equipment and intermediate goods and services in the production of all goods and services—we have been able to derive a more comprehensive and rounded view of what constitutes a digital economy”

We consider that a special importance has the above holistic approach and the attention paid to the continuous improvement of the model for assessing such complex and complicated processes of digital economy, like DD, but it is worth to extend that to ICT in general, in the context of their driving role in IS toward KBS, as we already approached [9][15].

Reaching such significant and important points, regarding the large and complex picture of DD, it is necessary to further continue and develop the analyses of DD in the dynamic context of ICT exponential development, based on the only partial approaches of this paper.

3. Conclusions

The paper presents the complex context of the consequences of ICT evolution and its prominent phases, digitization, digital economy, digital transformation and digital disruption, with the main focus on DD.

The definitions and the content of these phases are analyzed based on relevant references, considering also their time sensitive implications of ICT exponential pace and approaching the criteria which could differentiate these relevant milestones in the complex processes of ICT impact on digital economy and generally IS/KBS, along with consequences on humankind life and evolution on Earth.

An essential conclusion of the analysis is that the understanding and the realistic approach of the multiple implications of DD could dramatically influence the future of any company/organization and beyond ... of humankind. This conclusion could be considered a synthetic/generic answer for the generic question “Why DD?”, based on the above analysis which presented why, how and when DD appeared and subsequently why it deserves to be deeply analyzed.

An aim of the paper is focused on the necessary awareness and forecast capabilities in order to continuously improve the decision processes and the overall efficiency of digital economy. This way the paper presented the typical scenario for DD, where business is reimaged based on the innovation of (business) activities by introducing new digital technologies (innovations) and new model of business, using imagination and relevant refined information, which represent the main ingredients of the successful DD. It is also presented the specific solution for media industry: streaming their products and services using the advantage of performant ITC which offer wideband support and a lot of digital ways for a better customer experience.

The analysis revealed **the fundamental consequences of the fact that ICT development exponential pace is faster than humankind could deeply analyze and real time react against all long term implications of such evolution, showing** that the latency

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The analysis also revealed the importance of the approaches, studies and even methodologies intended for quantifying the global impact of digital transformations and DD on digital economy.

A special importance was given to the holistic approach and the attention paid to the continuous improvement of the model for assessing such complex and complicated processes of digital economy, like DD, but it is worth to extend that to ICT in general, in the context of their driving role in IS toward KBS.

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