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INNOVATION DOSSIER
Radical technological innovation and organizational change: the institutionalization of resilient organizations and substantive forms of work

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Abstract

This dossier-article presents a reflection on the institutionalization of resilient organizations. It assumes that organizational change is the reinvention of a new system of rules and norms to encourage new behavior and coexistence, as well as necessary forms of negotiation. The organizational change results in the collaboration of the individuals in the institution and the implementation of new technological solutions. This study is dedicated to the thematic issue "Innovation in Emerging Economy Organizations," and its objective is aligned with the purpose expressed by the issue's guest editors Bernardes, Borini and Figueiredo (2019), i.e., to promote the establishment of a critical research agenda on the field of innovation and organizations strategy in emerging economies, discussing its implications for the Brazilian academy. An introduction to the study of Technological Innovation in Scientific Communication is presented encompassing scientific research, scientific publications. and digital technology.

Keywords: Technological Innovation. Resilience. Organizations Development.

Inovação tecnológica radical e mudança organizacional: a institucionalização de organizações resilientes e formas de trabalho mais substantivas

Resumo

Este artigo-dossiê apresenta inicialmente uma reflexão sobre a institucionalização de organizações resilientes, uma vez que a mudança organizacional é a reinvenção de um novo sistema de regras e normas com o propósito de encorajar novas condutas e convívios e formas de negociação necessárias e, no que concerne, lograr a colaboração dos indivíduos na organização e a execução de novas soluções tecnológicas. Dedicando-se ao número temático "Inovação em Organizações de Economias Emergentes", o propósito, conforme expresso pelos editores convidados desta edição, Bernardes, Borini e Figueiredo (2019), é instigar uma contemplação orientada à estruturação de uma agenda de pesquisa crítica sobre a área das estratégias de inovação e das organizações em economias emergentes e suas implicações originais na academia brasileira. Uma introdução ao estudo da inovação tecnológica na comunicação científica é apresentada, englobando pesquisa científica, publicações científicas e tecnologia digital.

Palavras-chave: Inovação tecnológica. Resiliência. Organizações. Desenvolvimento.

Innovación tecnológica radical y cambio organizacional: la institucionalización de organizaciones resilientes y formas de trabajo más sustantivas

Resumen

Este artículo-dossier presenta inicialmente una reflexión en lo que respecta a la institucionalización de organizaciones resilientes en el sentido de que el cambio organizacional es la reinvención de un nuevo sistema de reglas y normas con el propósito de estimular nuevas conductas, formas de convivencia y de negociación necesarias, y lograr la colaboración de los individuos en la organización y ejecución de nuevas soluciones tecnológicas. En lo que se refiere al número temático "Innovación en Organizaciones de Economías Emergentes" el propósito, de acuerdo con los editores invitados de esta edición –Bernardes, Borini y Figueiredo (2019)–, es instigar una contemplación orientada hacia la estructuración de una agenda de investigación crítica sobre el área de estrategias de innovación y de las organizaciones en economías emergentes y sus implicaciones originales en la academia brasileña. Se presenta una introducción al estudio de la Innovación Tecnológica en la Comunicación Científica que engloba investigación científica, publicaciones científicas y tecnología digital.

Palabras clave: Innovación Tecnológica. Resiliencia. Organizaciones. Desarrollo.

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INTRODUCTION

Based on the work by Crozier (1987) and in line with the special issue of the Brazilian academic journal Cadernos EBAPE.BR on resilience, it is possible to argue that organizational change is the reinvention of a system of rules and norms to stimulate new behaviors and interactions, as well as necessary forms of negotiation, obtaining the collaboration of individuals in the organization and the implementation of new technological solutions. It is not only a technical change. It is about establishing new forms of negotiation, control of resources, values, communication, and social and work practices that lead to and facilitate the implementation of new and more complex technology, beyond mere technical change (VASCONCELOS, CYRINO, CARVALHO et al., 2017).

As for the implementation of new forms of work and new technologies, it is essential to adopt direct and open communication to solve deadlocks and clear the path for changes, such as the Habermasian communication. Another example of communication and dialogue in the organization involves innovative teams, especially those engaged in R&D in the high-level scientific and technological innovation process, whose communication has many principles of the so-called Habermasian communicative action (VASCONCELOS, CYRINO, CARVALHO et al., 2017).

Technological innovation processes and knowledge are generated through these types of communication, which seek a scientific and/or social truth and goes beyond mere strategic interest.

According to the authors:

> "A Psychodynamic perspective suggests that once one embraces the identity of a learning organization, the organization actors must accept that identity formation is never closed and that the organization will develop a series of identities through time that reflect the organization´s and its members evolving self-concepts" (BROWN and STARKEY, 2000, p. 108).
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> "From a consulting perspective, it is important to blend psychoanalytic approaches with a careful diagnosis of the social tensions inside and outside the organization" (VASCONCELOS and VASCONCELOS, 2002, p. 78).

Charles Heckscher (1994) points out a collaborative or post-bureaucratic company, in which the dialogue between teams aims to understand fundamental issues, contributing to the exchange of knowledge and innovation.

> The linchpin of the collaborative enterprise, the base of its increased power, is that it enables people to use their knowledge and capability to advance the common mission. Where subordinates know more than their bosses about certain problems, where they are working on multiple teams which give them different perspectives, where they understand in depth the changing needs of customers, it is essential for the success of the system that they feel able to challenge their bosses, to propose new ideas, to criticize and argue when necessary. It is a kind of open dialogue (HECKSCHER, 1994, p. 11).

Mintzberg, for example, discussed the future power of organizational forms structured as adhocracies. In his book "Structure in fives: Designing Effective Organizations," the author showed that the support staff pushes toward collaboration (and innovation) in the decision-making process. It pushes toward coordination based on mutual adjustment – structuring the organization as an adhocracy (VASCONCELOS, CYRINO, CARVALHO et al., 2017).

> [...] a highly organic structure, with little formalization of behavior; specialized jobs based on expert training; a tendency to group the specialists in functional units for housekeeping purposes but to deploy them in small project teams to do their work; a reliance on teams, on task forces, and on integrating managers of various sorts in order to encourage mutual adjustment, the key mechanism of coordination, within and between these teams; and considerable decentralization to and within these teams, which are located at various places in the organization and involve various mixtures of line managers and staff and operating experts. To innovate means to break away from established patterns. Thus the innovative organization cannot rely on any form of standardization for coordination. In other words, it must avoid all the trappings of the bureaucratic structure (MINTZBERG, 1994, p. 283).

These organizations would be stronger, with the capacity to innovate and to successfully respond to situations of change and disruption, achieving a new degree of stability and complexity. Therefore, resilient organizational systems have a questioning profile, inquisitive and critical reasoning, communication that facilitates understanding questions, and inspiring trust around such questions, i.e., a Habermasian communication (VASCONCELOS, CYRINO, CARVALHO et al., 2017).

Technological disruption is not necessarily a break with the organization's history or with the human organizational community. Individuals who have been in the organization for many years can be encouraged to change and integrate with new activities, new technologies, and new ways of working, whenever possible.

How to implement change? Agents of change

Heckscher (2007) is one of the critical authors exploring the concept of agents of change. The author says that organizations are changing due to the ongoing transformations in the world and society. The information and knowledge society, permeated by complexity, speed, and continuous change, leads firms to be less bureaucratic and more collaborative. Bureaucracy poses a rigid system of rules and norms, hierarchy of command, and performance standards that force the organization to be made of specialists, harming the opportunities of collaboration since individuals perform their tasks locally and continuously. Heckscher defends the collaborative company, in which the teams are formed based on different experiences and knowledge, and integrated into the team projects. Such teams may be temporary, coming from different places – the team members often do not know each other –, but work in collaboration using their skills for a common purpose. For the author, the organization's challenges to achieve its performance indicators include collaboration.

One of the challenges for organizations, according to Heckscher (2007), is the development of the capacity to stimulate people with different skills and visions to work together.

Heckscher (2007) points out some significant differences in the concepts around the idea of 'collaborative company,' in which the speed and synergy among the stakeholders (several agents involved in a project, or a program) are important for businesses based on knowledge and cooperation.

> "Cooperation occurs among local and stable members. The organization's boundaries are closed, and the members have homogeneous skills" (HECKSCHER, 2007, p. 2-5, our translation).
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> "Extended collaboration occurs when the relationship among members of the organizations are fluid, and there is changing membership. The boundaries are more flexible in members that have a diversity of skills and capabilities. In this case, the teams are often formed by collaborators external to the organization, as business partners. Extended collaborations are similar to a network, such as in a "cluster," where members are collaborating basically with their experiences and knowledge. In this synergy, they manage to achieve a superior result" (HECKSCHER, 2007, p. 2-5, our translation).
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> "The frontier of human productive capacity today is the power of extended collaboration – the ability to work together beyond the scope of small groups" (HECKSCHER, 2007, p. 2-5).

Heckscher (2007) addresses the main dimensions that collaborative companies must consider to gain competence and competitiveness:

a) the strategy for setting objectives and targets should be considered for a period of 3 to 5 years;

b) structure conceived as a formalized set of responsibilities, roles, and rules;

c) culture as a standard of expectation shared among members of a group, instructing how to act and react to situations from the perspective of flexible responses to adaptive challenges;

d) infrastructure as the medium that supports culture and structure, including a career system, training, awards, and communication system that support the empowerment of people to understand each other and the organization.

One of the distinctions the author makes when comparing twentieth-century firms with emerging organizations is that, regarding strategy, the first group aimed for mass production, whereas the second focused on solutions. The first type of structure is bureaucratic, while the second type is collaborative. In the culture of organizations oriented to mass production, it is possible to observe paternalism in the relationships. Regarding the firms focused on the solution, it stands out the notion of contribution and delivery.

Heckscher emphasizes the concept of collaboration:

> "Collaboration means 'working together.' This implies much more than 'living together;' it involves a shared objective that cannot be reached without the contribution of all. Thus it necessarily implies processes of dialogue and negotiation, of exchanges of views and sharing of information, of building from individual views towards a shared consensus" (HECKSCHER, 2007, p. 2).

A relationship between the transformational model, paradox, organization, and agents of change is necessary, considering the purpose of this article. In the organizational context, when the possibility of collaboration is blocked, there may be cognitive paradoxes, i.e., contradictory and opposite elements that do not make sense when considered together and simultaneously by individuals or groups. In this case, it may be necessary to act as facilitators of change, that is, individuals who act to coordinate the communication between different groups of the organization when they have a different and contradictory understanding of the organizational reality, representing it oppositely and preventing any common action.

At that moment, the agent of change's role is key when diagnosing difficulties that hinder effective communication among the individuals in the system. The agent will conduct an organizational diagnosis by first mapping the different representations of the various groups. Then, they will interpret these different representations by building a network of meanings relative to the representation of each group, to understand how these different patterns are interrelated.

After the diagnosis, the agent of change will begin a process of negotiating meanings to build, gradually, a joint and shared vision of reality. This will help members of the organization to engage in common action.

When it is not possible to build a consensual view of reality, other solutions may be adopted, such as establishing ways to live with the paradox. There are several possible situations: the two paradoxical dimensions can be situated in different spheres of the organization, or they can be situated at different times in the process of organizational change (LEWIS, 2000).

Thus, according to Smith and Lewis (2011), there are two ways of dealing with cognitive paradoxes in organizations: carrying out the so-called paradox management (the paradox is "solved" by building a common vision that allows a shared understanding of reality) or learning to live with the paradoxical dimensions. Several authors are advocating for the latter, such as Luscher, Lewis and Ingram (2006), who understand the organization as a complex system in a changing society, therefore, subject to logical contradictions all the time. Thus, the so-called "order" is an illusion, because "chaos" and the tendency to entropy will always be present. Based on this last view of organizational paradoxes, there would be no "paradox management." In this perspective, individuals in an organization should learn to deal with different and paradoxical dimensions, and with the cognitive discomfort that this condition may pose.

It is up to the agent of change to be professionally trained to facilitate these communication processes, enabling organizational actors to offer solutions and ways of living with these dimensions.

However, it is important to stress that it is not just a matter of living with two paradoxical dimensions, but with multiple dimensions at the same time. It is, in fact, a multidimensional view.

Lewis (2000) analyzes the studies by Merton (1970), arguing that, as a result of every social action and the creation of rules and forms of control in the organization, a cognitive dimension will be accentuated by a specific set of these same rules and standards. Over time, there will be an opposite reaction to the regulation of this dimension reinforced by the rule. As an example, rules that reinforce management policies that centralize procedures in the organization will create social pressures for decentralization; management policies aimed at procedures of differentiation will generate pressures for the integration dimension. Therefore, paradoxes are inherent to social action in multiple dimensions and cannot be ignored in the manager's activity.

Examples of successful change through Habermasian communication: the Montreal Protocol and the Paris Agreement

Global warming and the environment: history

In his book "Billions and Billions: Thoughts on Life and Death at the Brink of the Millenniums," Carl Sagan (2009) shows that the dangerous consequence of burning fossil fuels – coal, oil, or natural gas – is the combination of carbon from these fuels with the oxygen from the air. The combination of one atom of carbon (C) with one molecule of oxygen (O2) originates a molecule of carbon dioxide, CO2 (C+O=CO2), a gas that causes the greenhouse effect on Earth.

Sagan (2009) demonstrates that the Earth heats according to the degree of sun brightness and the reflection from the planet. The Earth reflects part of the light and heat received from the sun into space. Anything that is not reflected back into space is absorbed by the ground, clouds, and air. The human being's life depends on a balance of invisible gases that maintain the greenhouse effect – some greenhouse effect is essential to conserve the planet's heat and its average temperature, considering the seasons, of 13 degrees Celsius. However, the excessive release of carbon dioxide can significantly increase the greenhouse effect, causing the Earth to overheat over the centuries. The result of this phenomenon is an increase in temperature, as is observed for instance, on planet Venus, where the atmosphere with a large quantity of carbon dioxide causes temperatures of an average of 450 degrees Celsius, unsuitable for human life.

Sagan's (2009) work shows that, as the Earth's population and humanity's technological capacity increase, a more significant amount of absorbent gases is released into the infrared spectrum, affecting the greenhouse effect. There are natural mechanisms that remove gases from the air, but the gases have been released into the atmosphere at a faster pace than the capacity of such mechanisms to compensate. By burning fossil fuels and destroying forests (considering that trees eliminate carbon dioxide and convert it into the wood), humans are responsible for introducing seven billion tons of carbon dioxide into the air each year. Methane, another greenhouse gas, has increased in the atmosphere due to agriculture and industry. The increase in chlorofluorocarbons at a rate of 3.5% per year also contributes to heating the planet by decreasing the ozone layer in the atmosphere.

Thus, during the twentieth century, the average temperature of the Earth must have increased by a few tenths of a degree Celsius.

If humanity continues to burn fossil fuels at this rate, by the end of the twenty-first century, the level of carbon dioxide is expected to double in the atmosphere. These data are confirmed by the Geophysical Fluid Dynamics Laboratory of the National Oceanic and Atmospheric Administration of the U.S. Government (NOAA), in Princeton; the NASA Goddard Institute for Space Studies, in New York (USA); the National Center for Atmospheric Research in Boulder, Colorado (USA); the Lawrence Livermore National Laboratory of the U.S. Department of Energy, in California; the Hadley Center for Climate Prediction and Research (United Kingdom); and the Max Planck Institute for Meteorology in Hamburg (Germany). The forecast, in 2009, was that the temperature would increase between 1 and 4 degrees Celsius.

The temperatures on the planet are the highest in the last 150,000 years, and there are several consequences of global warming, such as severe droughts, violent storms, and floods. Thus, urgent measures must be taken to reduce global warming and pollution, preserving all species on the planet, including humankind and our 10.000 years of history as a civilization. Scientists, astronomers, biologists, chemists, physicists, geographers, among others, from scientific laboratories that are among the best in the world, point out the need to control the greenhouse effect, pollution, and global warming, for the preservation of humanity.

It is possible to argue that there is a synergy between natural science disciplines and business administration and public administration and economics. These changes demand radical innovations that allow the generation of energy through clean and renewable sources (such as wind, solar, and hydroelectric power), as well as the adaptation of industries and forms of work (including agriculture and livestock) to operate with clean technologies. Forms of sustainable consumption, education of populations, smart and planned cities, electric cars with recyclable or solar batteries, birth control and control of diseases, and the advances on artificial intelligence and 4.0 smart factories are interconnected. These are joint measures observed in the fields of public administration, the nonprofit sector, and business administration when engaged in sustainability, or sustainable innovation and social justice (education and health) for the global population.

Global warming and the needs this problem entails are recognized by the scientific community, who pressure governments to sign international agreements such as the United Nations Conference on Environment and Development (ECO-92) in Rio de Janeiro, the Kyoto Protocol, or the recent Paris Agreement, which was signed by 196 countries. The USA signed the Paris

Agreement during the administration of President Obama, withdrawing from the agreement a few years later, during President Trump's administration. Despite the American federal government's position, US large and highly profitable corporations such as Microsoft, Facebook, Apple, IBM, Alphabet (Google), and Amazon, as well as state governments (New York and California, for instance), continue to support the Agreement. These entities keep adopting sustainable measures, purchasing energy from renewable sources, and supporting suppliers that take the same actions. The goal of the New York and California state governments is to use energy 100% from renewable sources by the middle of the twenty-first century. This measure by some state governments in the US is called *We are still in*, referring to the maintenance of the commitment made with the other countries that signed the Paris Agreement to preserve the planet and manage global warming.

The issue about the goals established in such agreements and protocols lies in **how** to proceed to achieve them and be successful in tackling global warming. According to Sagan (2009), scientific research at the end of the 2000s showed the USA and Russia (and countries that were part of the Soviet Union) as the largest emitters of carbon dioxide in the world, followed by a group of developing countries and then the countires of Western Europe and Japan. For the author, Japan is one of the nations with the most efficient use of fossil fuels on the planet (SAGAN, 2009).

Regarding the political perspective, politicians are demanded to present a longer-term vision, beyond their mandate and the electoral benefits resulting from their actions. When considering a realistic hope, many scientists point out the need for concrete actions over the next 50 or 60 years to avoid the consequences of global warming. A humanistic and democratic perspective is required, such as the one proposed by Habermas when discussing his idea of communicative action. Politicians should overcome the simplistic electoral interests, taking into account the need for concrete actions within a global action plan (as posed by the Conference of the Parties (COP21) or the so-called Paris Agreement), in order to avoid the problems related to the greenhouse effect.

Political players are expected to overcome immediate and selfish interests related to holding power and take into account the interests of the planet and humankind as a whole. Therefore, it is crucial to develop and follow action strategies engaging all sectors – public administration, the business community, and civil society.

As well as working to eliminate its causes, scientists propose measures to monitor the problems' aggravation. In this sense, they suggest monitoring activities and others such as controlling carbon dioxide and greenhouse gases (GHG) emission; changing the industry and ways of working, considering the use of clean technologies, environmental protection, population's education toward sustainable consumption, sustainable development, as well as actions focused on health, birth control, and developing smart cities.

For Sagan (2009), monitoring actions such as systematically verifying the sun, atmosphere, land, and oceans, are crucial. These actions may be conducted in space, in oceans, by ships, airplanes, and sensors, checking pollution, forests, deserts, sea level, ozone layer chemistry, and other indicators. The developments may be observed and monitored by the Robotic Earth Observation System[1], from the National Aeronautics and Space Administration (NASA), as well as by the European Space Agency (ESA) and agencies of other nations.

According to scientific data, it takes almost a century for the effects of two-thirds of GHGs currently released to be felt on the planet. Long-term actions must be taken, starting today, with a view to the development perspective of future generations, reinforcing the need for a humanistic perspective.

One of the ways to popularize science discoveries has been opening courses and colleges such as the Singularity University, located in Silicon Valley. The program offers short courses and lectures for decision-makers in companies, high-level executives, directors, and entrepreneurs. It aims to raise awareness among this public – which has the power to decide in the right direction – offering tools for them to support, finance, and promote technological developments to protect the environment and achieve sustainable development.

Therefore, it is crucial to disseminate this scientific perspective and enable decision-makers to access the latest science discoveries. Another important measure is to fund and support start-ups that develop technological solutions for sustainable innovation, as well as the consequent development of new professions and knowledge aligned with values committed to sustainable development.

[1] Earth Observation System (EOS) is a NASA program that consists of a series of artificial satellites. Its missions and scientific instruments are aimed at the long-range observation of the Earth's surface, as well as its biosphere, atmosphere, and oceans.

Energy and innovation

The field of transportation has a crucial role in reducing the consumption of fossil fuels. The evolution of the sector since the 1970s (Sagan, 2009), resulting in the creation of more efficient cars (consuming less fuel), was a first step in the direction of eliminating carbon dioxide emissions in the atmosphere. The industry has contributed in this sense, producing cars that run on less polluting fuel like ethanol (in the case of Brazil), and vehicles with smaller and more economical engines (working with different types of fuel). However, the protection of the planet, in contrast with the global economy, requires more than these measures.

The design of a new type of safe, fast, fuel-efficient, clean car has also been a constant strain on major American car manufacturers located in Detroit.

The development of a reliable electric car with a recyclable battery (without the use of the poisonous lead acid) and that can reach a few hundred kilometers with an electric charge (provided that the electricity is generated by renewable sources) has been a project of the General Motors Company since 1996, as stated by its president at the time, Denis Milano (SAGAN, 2009). Many technological developments were made later in the case of electric cars, as shown throughout this work. Electric cars, autonomous vehicles, connected to the Internet of Things, are products currently on the agenda of several car-makers. The industry has presented more expensive and sophisticated models, such as those of BMW and Porsche, as well as more economical, such as the vehicles produced by Renault-Nissan, and products that are halfway between the two, like Tesla, by Elon Musk. There are also cars with engines running on solar power, and the concept of services associated with these vehicles, which will be addressed in this article.

Other energy sources

One of the alternative sources of energy is nuclear power[2], which does not release GHG. There are nuclear ships and nuclear power plants with costs that are similar to that of coal plants.

However, Sagan (2009) points out the cases of Three Mile Island and Chernobyl, warning about the risks of disasters posed by the radioactivity released in the nuclear power production process, and the issue of the disposal of radioactive waste. The half-lives of many radioisotopes last for centuries or millennia, which is dangerous radioactive waste. The alternative is to bury this radioactive waste safely so that it does not leak. In addition, the use of uranium and plutonium can be adopted in nuclear weapons, which is dangerous. In France and Japan, most of the energy is generated by nuclear power plants.

There is another type of nuclear plant operating based on nuclear fusion, i.e., the union of nuclei of the atoms. The fusion power plants could operate with seawater, a virtually inexhaustible stock, without the generation of GHG, radioactive waste, and without using uranium and plutonium. It is, however, a technology, not yet developed, and would take decades to happen on a commercial scale, while the problem of global warming must be solved quickly. Cold fusion is also a possibility.

Wind and solar power

It is estimated that all the energy consumed in the USA could be generated by wind towers installed in 10% of the American territory with more intense wind.

Solar power is permanently available, does not generate greenhouse effects, and needs minimum maintenance.

Solar power can also be used to generate hydrogen fuel from water. When burned, hydrogen simply regenerates water. Electric-solar or photovoltaic power has long been used to propel spacecraft close to Earth and throughout the internal solar system.

Sagan (2009) argues that solar power is the best alternative source of renewable energy available.

[2] Nuclear power is produced from the principle of nuclear fission, which is a spontaneous or provoked nuclear reaction where an atom, usually heavy, is divided into two parts of comparable masses, releasing neutrons and large quantities of energy (our translation of the concept retrieved from the online dictionary of Portuguese Language *Aurélio*).

The political and economic issues

In his paper "A Piece of Heaven is Missing," Sagan (2009) shows that ozone is generated by electricity when it passes through the air. The air is composed of O_2 (oxygen) and O_2 + energy = O + O. However, the loose oxygen atoms (O) combine easily with other atoms around it, and in this case, O + O_2 + C (catalyst) = O_3 + catalyst. O_3 = ozone layer.

The Earth has an ozone layer protecting the planet in its atmosphere, and the evolution of the home appliance industry has generated innovations that damage this protective layer, jeopardizing the integrity of the Earth. Refrigerators, for example, operated using gas from molecules created by German and American scientists, chlorofluorocarbons $CFCl_3$. These molecules were also used in air conditioning systems and present in spray cans, insulating foam, industrial solvents and cleaning materials in the microelectronic industry. The corporation DuPont was one of the largest manufacturers using these elements, and they have been used for decades without any idea about the danger the chemicals caused to nature.

When released, chlorine destroys ozone molecules and rests intact, i.e., a chlorine atom can destroy over 100,000 ozone molecules before it is eliminated in nature.

O_2 + UV light = 2O
2Cl (of CFC) + $2O_3$ = 2 ClO + $2O_2$
2ClO + 2O = 2Cl (regenerating C) + $2O_2$, summarizing, the basic outcome is that $2O_3$ turns into $3O_2$.

Ozone is produced at 25km altitude and is the Earth's protective shield against the sun's ultraviolet rays, which may cause skin cancer. In addition, the depletion of the ozone layer kills phytoplankton, microscopic organisms responsible for eliminating CO_2 from Earth.

This problem is that CFC lasts for a century.

The work by the scientist Sherwood Howland and the efforts of the Natural Resources Defense Council, based in Washington, led to measures to ban the use of CFCs in 1978, in countries such as the USA, Canada, Norway, and Sweden.

The withdrawal of CFCs from the market was subject to resistance from DuPont, which sold USD 600 million of equipment using CFCs per year. The company stopped funding scientific congresses and meetings and stopped paying for ads in scientific journals. The data was irrefutable, however, and the logic of protecting the environment prevailed.

It was confirmed that two-thirds of the ozone over Antarctica has disappeared, which was corroborated by a NASA satellite in 1985. The ozone layer is replenished in the winter, but in the spring it gradually disappears.

DuPont only discontinued the use of CFCs entirely in 2000, based on economic reasons, despite the warnings.

The succcess of the Montreal Protocol and the Habermasian communication

In September 1987, many of the nations that produced CFCs, including the US, met in Montreal for an agreement on producing and using the element, an agreement later reinforced by pacts signed in London and Copenhagen. At the time, 156 nations signed the treaty. Meanwhile, further research led by DuPont found a replacement element, hydrochlorofluorocarbon (HCFC), with similar molecules, but involving hydrogen atoms. This event proved the value of the private sector investment to develop technology and innovation considering the environmental protection. The city of Berkeley, California, banned white insulation with CFCs and McDonald's replaced the materials in their package that used the most dangerous CFCs.

The point is that it is necessary to eliminate all CFCs on Earth and still wait a century for the atmosphere to be clean. The measure is, therefore, a crucial action for humankind, an act that, although apparently impossible, is achievable in the same way as an existence theorem (where something seems impossible, but it can actually be accomplished) (SAGAN, 2009). NASA missions (Nimbus satellites and others) are essential to monitor the level of our ozone layer, which is fortunately gradually recovering (SAGAN, 2009). The Montreal protocol was a success, proving that democratic and honest communication among all those focused on scientific facts, and thinking based not only on immediate economic interests, but the well-being of the planet and humanity, can lead to real progress regarding environmental protection. It is possible therefore to innovate in a sustainable way, adopting a substantial and Habermasian communication.

The Paris Agreement: another success of the Habermasian communication

The Paris Agreement was approved by the 195 countries that are part of the United Nations Framework Convention on Climate Change (UNFCCC) in December 2015, and states their commitment to reduce GHG emissions for sustainable development. The countries agreed to keep the increase in global average temperature at less than 2 degrees Celsius, above pre-industrial levels, and to make efforts to establish limits regarding the increase in temperature to 1.5 degrees Celsius, above pre-industrial levels.

Jean Tirole (2017), Nobel Prize in Economics, analyzes the progress made and the imperative need to maintain global warming at the level between 1.5 and 2 degrees Celsius. The 2015 Paris Agreement, signed by 195 countries, successfully established ambitious goals in this direction. Emerging countries, in particular, committed to control GHG emissions and the agreement states specific emission targets for each country.

To achieve the goals, Tirole (2017) proposes: clear targets for different countries regarding carbon emissions; 'green audits' to monitor compliance with the goals; implementation of carbon emission tax (Sweden was one of the first countries to introduce such a tax) and establishing a universal price on emissions.

According to the Paris Agreement, the expectation is that after 2050, there will be no more GHG emissions, and the global temperature will increase to a maximum of 1.5 degree Celsius. Humanity needs to develop a dialogue in which the interests of the planet and the environment prevail. It would be a Habermas-inspired dialogue involving ethical, pragmatic, and democratic communication.

Brazil's national determined contribution in the Paris Agreement

After approval by the National Congress, Brazil concluded, on September 12, 2016, the process of ratification of the Paris Agreement. On September 21, the document was delivered to the United Nations. The Brazilian goals then ceased to be a set of 'intentions' and became official 'commitments.' These commitments are known as the 'national determined contribution' (NDC).

Brazil's NDC states that the country has to reduce its GHG emissions by 37% below 2005 levels by 2025, and 43% below 2005 levels by 2030 as a subsequent contribution. The country committed to increasing by approximately 18% the participation of sustainable bioenergy in its energy matrix by 2030, restoring 12 million hectares of forests, and achieving an estimated 45% participation of renewable energy in its energy matrix by 2030.

Another successful initiative adopting the concept of deliberative citizenship

According to Tenório (2008), deliberative citizenship means:

> "[...] that the legitimacy of political decisions must originate in discussion processes, guided by the principles of inclusion, pluralism, equal participation, autonomy, and the common good" (TENÓRIO, 2008, p. 105, our translation).

An example of institutionalized deliberative citizenship is the city of Bordeaux, in France. The local government, in each of the city's regions, offers citizens spaces for debates per theme and specific groups. The participants elaborate proposals that are analyzed by decision-makers and implemented whenever possible. The proposals are elaborated based on democratic and participatory debate, focusing on solutions that aim for the common good. The local government provides feedback to citizens regarding the status of the implementation processes.

Decision-making complexity in the Digital Era

The Fourth Industrial Revolution, or Industry 4.0, makes Big Data (computers such as IBM's Watson, for example) a fundamental tool for analyzing large amounts of data, helping decision-makers, and supporting the monitoring of data on climate and the environment. As already mentioned, communication between countries and stakeholders must go beyond mere immediate economic and political interests. It must consider the long-term goals for humanity and the planet and be supported on sharing

data and scientific facts to allow decision-making. However, the agreements must avoid naïve positioning and provide for green taxes, audits, and sanctions for those who do not meet the established goals. On the other hand, developing countries must count on resources to be able to meet their goals, benefiting from mechanisms such as appropriate funding to conduct the respective activities. According to Jean Tirole:

> Trust is important. There is the need for Internet users to have confidence in the digital ecosystem. This trust must apply at two levels: There is too much choice, too much information, to many people to interact with nowadays. Platforms are there to guide us and make up for our limited capacity to pay attention. This raises the question of the reliability of their recommendations. The second issue is the use made of personal data. This data is now a powerful economic and political asset for those who possess it. It will not always be used as we would wish, which raises the complex question of property rights over this data (TIROLE, 2017, p. 401).

It is also important to reflect on which services will not be needed anymore, which professions will disappear, and which will remain when intelligent software and robots replace qualified and unqualified people. The idea is that many other professions will emerge as technology evolves.

> The social acceptability of digitalization depends on us believing that our data will not be used against us, that the online platforms we will use will respect the terms of our contract with them, and that their recommendations will be reliable. In short, it is based on trust (TIROLE, 2017, p. 402).

Thus, in the digital economy, computers and artificial intelligence are innovations that aim to help the human being to deal with the increasing complexity and to make strategic decisions.

Quantum computers to deal with complexity

Since the 1960s, based on Moore's Law, the size of transistors has dropped, and the processing power has doubled every one or two years. The limits of miniaturization of silicon structures were reached, and technology advances based on quantum computing. Instead of working with zeros and ones (the binary language of regular computers), quantum machines use the cloud of probabilities for the position of a subatomic particle.

Currently, the Watson artificial intelligence system, which uses machine learning to develop strategies and analyzes large amounts of data, has come not to be more intelligent than human but to make human decisions more intelligent. Thus, Big Data, Internet of Things, and cloud computing, advanced robotics, artificial intelligence, 3D printing, hybrid manufacturing, and augmented reality (use of virtual assistant that dialogues, answers questions regarding maintenance tasks in the industry, for example) are radical innovations. They are produced through double looping learning, questioning paradigms, business model reengineering, and change people's behavior, as discussed in the first part of this work.

In the face of robotics and automation, considering the technological advances, human beings will work in jobs that are yet to be created, in tasks that require creativity and innovation.

Solar power

At the beginning of the century, the world hardly used electricity originated from sunlight. The curved roof developed by the Swiss Federal Institute of Technology is one of the most significant recent technological advances. The creation consists of several layers of concrete at least 12 cm thick, and a thin layer of polymers that absorb sunlight and turn it into energy.

Tesla also developed a sunroof, placing panels instead of tiles in the roof, which lower the cost of having solar panels on top of tiles as happens with regular roofs. There are also transparent solar panels, which can be placed on windows, car windows, and even on the screen of cell phones.

There are futuristic projects such as that of the University of Strathclyde, Scotland, which considers placing solar panels in satellites in Earth orbit to capture sunlight. In orbit, the plates could capture sunlight continuously (with only 44 hours of the

night a year). The accumulated energy would be sent to Earth by an intense infrared laser beam or by a microwave cone, but the cost of the solution remains prohibitive for many years (COHEN and BEREZOVSKY, 2017).

In terms of energy, many countries are looking to do studies with nuclear fusion plants, which would create much fewer problems than nuclear fission plants.

Nuclear fusion power

After announcing the creation of super-hot plasma in June, the British company Tokamak Energy has stated that the commercial supply of electricity by nuclear fusion should be a reality from 2030.

The company's promise is the outcome of a successful test, which recording the highest temperature reached by human-made plasma: 15 million degrees Celsius (as hot as the center of the sun). The reaction was generated in the ST40 reactor, where the material was confined in a vacuum chamber and kept within powerful magnetic fields.

Excited by the result, the company's scientists are preparing to produce an even hotter plasma of about 100 million degrees Celsius. This is the first step to start operating at temperatures necessary for nuclear fusion.

Tokamak Energy is one of the largest companies in the world developing fusion power. The goal is to implement the project before the middle of the 2040s, which is the period established by the competitor French International Thermonuclear Experimental Reactor (ITER) to start producing its first plasma. Therefore, Tokamak Energy plans to launch a new reactor in 2025, which will be built specially to produce a large number of megawatts of fusion power.

The transformation of hydrogen into helium by nuclear fusion is the primary reaction observed in the stars that are shining for billions of years – hence the idea of building a fusion reactor resembles the image of a "star in a jar."

ITER is a civil nuclear reactor project located in Cadarache, France, aiming to industrialize nuclear fusion. The project coordinates efforts with 35 countries in the European Union, India, Japan, China, Russia, South Korea, the United States, and Switzerland. It is the largest scientific project in the world today. The project budget went from 5 to 19 billion euros.

The first plasma will start operating in December 2025, and the emission of the first plasma in deuterium-tritium is expected for 2035. Before the fusion plant is industrialized, it will be necessary to build another reactor for research and operation demonstration, similar to a production reactor (ITER, 2019).

Nuclear fusion also happens in hydrogen bombs, in which plutonium fission devices, at very high temperatures, melt the element, resulting in an explosion, hundreds or thousands of times more powerful than a nuclear bomb, which works via fission.

Controlled fusion projects like those of ITER and Tokamak Energy will fuse hydrogen fuel at much higher temperatures and at much lower pressures than those occurring inside the sun, transforming hydrogen atoms, which fuse, into helium, and release large amounts of energy in the process, thus replicating what occurs in the sun and other stars.

Supporters of nuclear fusion say that this type of power generation could make other sources obsolete. This is because it is possible to produce large amounts of electricity for a relatively small amount of deuterium and tritium, heavy isotopes of hydrogen that are relatively abundant in seawater.

In theory, nuclear fusion reactors can produce much less radioactive waste than fission reactors. Furthermore, according to the ITER project, nuclear accidents like those in Chernobyl or Fukushima cannot happen under these conditions.

Helium, produced in fusion, is a non-radioactive gas. All residues left over from the merger are treated and have a half-life of only a few dozen years. Treated and stored, they can be recycled after 100 years. This is a much shorter duration of waste compared to that of nuclear fission plants. There is also no risk of a nuclear explosion, considering that the amount of fuel present in the reactor only allows the combustion to be fed for a few seconds. Any disturbance leads to an immediate shutdown of the reactor, with no risk in the fusion or explosion process. There is also no risk of contamination on a large scale (ITER, 2009).

The problem with nuclear fission plants is the danger of accidents, which do not exist in the fusion plant, according to scientists. In addition, the duration for hundreds of thousands of years of the radioactive waste produced in fission plants is a problem that does not occur, as mentioned here, in fusion plants.

In the scientists' view, if electricity can be generated in this way 50 years from now, it will undoubtedly be a scientific advance towards replacing plants based on nuclear fission.

Cars powered by renewable/sustainable energy

In addition to electric cars, another innovation is cars powered by the production of hydrogen by electrolysis. The energy for electrolysis can come from renewable sources such as solar panels, wind turbines, hydroelectric, and geothermal plants. Honda, General Motors, and Toyota announced the commercialization of these cars by 2020.

Porsche, in Leipzig, creates hybrid versions combining combustion and electric models, emitting 75% CO_2 and able to reach 275 km/h. The company also develops, in Stuttgart, the Mission E, a 100% electric car.

BMW designed its future operation on four pillars: an autonomous car, connectivity, electrification, and services. One example is Drivenow, a car-sharing system present in 13 cities in Europe, with 1.5 million customers (BMW i3 Electric Vehicle Model).

In this system, the vehicle is located and rented through a mobile application. The driving license is validated at a BMW service point, and the cost is calculated on the minutes of use. The user then leaves the car in one of the designated parking places in the city. The company's priorities are, in this order: electrification, connectivity, and autonomous driving.

There is a change in the behavior of individuals with the use of shared vehicles, which increases urban mobility. Governments, such as Germany, promote incentives for electric cars, offering subsidies of 4,000 euros to the buyer and determines that, by 2030, the production of cars with combustion engines will have to stop. In France and the United Kingdom, the date is 2040.

Some aspects to consider:

- Volkswagen intends to have an electric version of all the company's models at affordable prices by 2030;
- Tesla, founded in 2003 in the USA by South African entrepreneur Elon Musk, sold 50,931 units of its electric car in 2016;
- What defines an automaker is the ability to deal with the complexity of integrating different partners to build a safe vehicle;
- German startup Sono Motors has a project to launch a solar-powered car. It made two prototypes and agreed with a third-party factory;
- BMW, Intel, and Mobileye (Intel's Israeli artificial intelligence company), are developing an autonomous car;
- Renault, with the 'Drive the Future' plan, wants to offer an electric and connected car at a reasonable price. Its goal is to produce 5 million vehicles per annum starting in 2022, bringing together all its brands: Renault, Dacia, Renault Samsung, Alpine, and Lada, reaching 70 billion euros in revenues;

Renault Nissan wants to produce electric, autonomous, and connected car at an excellent price, investing 18 billion euros in research and development.

Innovation in education

Minerva Schools, in Silicon Valley, under the leadership of Stephen M. Kosslyn, trains the best problem solvers, using technology to improve education. The schools focus on creating four competencies: a) critical thinking; b) creative thinking; c) learning to communicate; and d) interact effectively with people and institutions. The exam to assess these competencies is the Collegiate Learning Assessment (CLA +).

Cornell Tech in New York selects the best startups created by students and funds them. The top four startups of the year receive USD100,000 and venture capital investments.

The evolution of technology is disruptive: today, a smartphone is 1,000 times faster and 1 million times cheaper than a 1970s supercomputer. **Change in the human community does not have to be as disruptive as in technology.**

Singularity University, created less than ten years ago in Silicon Valley, attracts entrepreneurs and executives interested in new technologies and their impact, seeking to leverage the potential of startups. It was created by Larry Page (from Alphabet holding, owner of Google) and physicist Peter Diamandis. The facility is located at a NASA research center in Mufett Field, Silicon Valley. There are 80 students per class, and the organization offers opportunities such as startup acceleration programs (with analysis of products and services and participation of executives from Microsoft and Google), contact with professors like Craig Venter, from the University of San Diego (who sequenced the human genome), and networking to approach and obtain venture capital financing. Singularity University is about influencing decision-makers regarding the direction of current disruptive innovations.

Currently, the four most valuable companies in the world are technological empires: Apple, Alphabet, Microsoft, and Amazon.

The Launchpad, the Google business acceleration program created in 2016 and operating in emerging countries, is typically a six-month-long program, of which two weeks are in San Francisco, with mentors and experts in the areas of marketing and product development. Google offers USD 50,000 for the startup to use as it pleases and USD 100,000 in credits to purchase services from Google itself. In addition to improving products, startups can receive venture capital investments.

Corporations approach startups because they fear the "Kodak effect:" being surprised by a disruptive technology that ends their business overnight. When investing in acceleration programs, companies establish partnerships with startups and have a chance to close deals before the competition. Microsoft, IBM, Oracle, and Cisco also have programs to accelerate digital companies. The same is observed in the cases of Coca-Cola, Airbus, and Disney.

There are currently 579 active accelerators in the world; 11,300 startups have already undergone acceleration programs, and about USD 207 billion has been invested since 2005.

Startups are very innovative and high-risk businesses. The bankruptcy of these companies is high in Brazil: 74% close after five years. Those that survive (26%) demonstrate viability and innovation.

Thus, countries that have invested in national innovation ecosystems, connecting people, resources, policies, and organizations, gain an advantage when the industry migrates to the production (and use) of high-value items, given the level of innovation on them.

In Brazil, the industrial sector currently accounts for 21% of GDP. In the USA, a unicorn (a startup that reached the value of USD 1 billion) has a 1% chance of existing, taking into account all open startups. In Brazil, there is a 0.02% chance of a startup becoming a unicorn. The country has four unicorn startups: 99 (urban mobility application; created in 2012); PagSeguro (a means of payments; created in 2006), Nubank (credit; created in 2013), Brex (credit; created in 2017). All of these startups reached USD 1 billion in 2018.

The government of President Macron in France created Station F in Paris, a large incubator for promising startups. In Madrid, the 13,000-square-meter La Nave space, dedicated to startups and acceleration courses, has already generated success stories such as Cabify (the Spanish version of Uber), which has already raised USD 100 million in investments and is present in more

than 11 countries. In Rio de Janeiro, a space for startups and start-up acceleration courses in Porto Maravilha (renovated space in the port of Rio de Janeiro) also aims to fulfill this purpose.

Companies that have a startup acceleration program, using corporate venture capital, invest in others that are innovating and developing technologies with a high potential for success. In this case, the relationship between the startup and the investing company must be well managed to have a win-win relationship. For the corporation, proximity to startups allows: (1) speed, since young companies operate fast through a condensed decision chain and agile methodologies, inspiring the corporation to execute innovation faster; (2) recognize new technologies and markets so that they can innovate before competitors; (3) stimulus, with the rapid growth characteristic of startups, to be less risk averse and more focused on performance indicators, and (4) to approach new generations, since large corporations are perceived as less attractive by young professionals (AVENA, 2018).

For the startup, the proximity to the corporations allows: (1) greater credibility, since the large corporation as a customer or partner validates the startup's business model, product or service; (2) leveraging the relationship between startups and the media (3) helping in negotiating with suppliers; and (4) financing option via share transfer (AVENA, 2018).

As presented above, there are possible technological disruptions to be foreseen, as these are radical innovations carried out by the company itself. Just as it is possible to predict the disruptions caused by the company due to radical technological innovation, it is also possible to predict the different impacts that the new technology will have on the organization and on society in general, through scenario planning. These events change the ways of working and interacting, transforming the organization so it can accompany the technological evolution – which will also cause changes in the coordination of the human work in the company. There is no need, however, for disruptions regarding the company's human system.

Internet of Things – IoT

The Internet of Things (IoT) is physical objects enveloped by a digital layer – from a lamp and lock to a turbine or an entire vehicle. They are devices that have, simultaneously, some degree of computing, communication, and control capacity.

Communication:

Intelligent things can communicate wirelessly with each other and form networks of interconnected objects.

Identification:

Intelligent things are identified with a digital name – relationships between things can be specified in the digital domain whenever physical interconnection cannot be established (AVENA, 2018).

Interaction:

Intelligent things can interact with the environment through detection and actuation features whenever present.

IoT allows broad applicability in many productive sectors, such as environmental monitoring, smart cities, smart businesses, smart homes, medical care, security, and surveillance (AVENA, 2018).

IoT can help both in economic terms, in reducing the consumption of resources (electricity, water), and in social terms, such as reducing carbon emissions, both essential to residents' level of satisfaction, through sensors that are used both to monitor resource consumption as to proactively detect users' needs in various subsystems, such as turning off lighting, heating, and cooling (AVENA, 2018).

Smart cities refer to the optimization of the use of city infrastructure and the quality of life of its citizens through an advanced communication infrastructure and new services in the urban scenario. Examples are monitoring to optimize car traffic in large cities, climate control, and electricity control.

Environmental monitoring can allow technology to process information in real-time to check natural phenomena and processes such as temperature, wind, precipitation, river height, and seamlessly integrate this heterogeneous data into global applications. In this sense, IoT technology helps to gather facts and provide elements to help in decision-making.

IoT technologies can improve assisted living solutions by collecting patient health data that is transmitted to remote medical centers. There are, for example, sensors that are used for prevention in clothing or smartphones.

The Radio Frequency Identification (RFID) technology, developed at the beginning of the IoT, is used in inventory management, goods identification and tracking in addition to the use of biosensors that monitor parameters such as temperature and bacterial composition in order to guarantee product's quality.

General Electric's history

General Electric (GE) is a real giant corporation. It is the world's largest manufacturer of small and large engines for commercial and military aircraft. It is known as one of the world's largest manufacturers of household equipment (refrigerators and freezers, fast ovens and microwaves, electric and gas stoves, washing machines and dryers, dishwashers, garbage disposers and compactors, air conditioners, and water purification systems), marketed under the brands Monogram, Profile Performance, Profile, GE, and Hotpoint, among other products with third-party brands. It has operations in more than 100 countries, distributing products in 180 countries and employing more than 327,000 people worldwide. It produces more than 800 product lines, from lamps to powerful airplane turbines, and locomotives.

In the book Winning, J. Welch and S. Welch (2005) show how General Electric sought, in its management, to institutionalize the principle of openness in the organization – with natural politeness, and, at the same time, valuing the area of people management, less bureaucracy in the evaluation of people, and honest feedback for each person. In accordance with the company's differentiation policy, 20% of employees were classified as having superior performance, 70% as competent with the possibility of promotion, and 10% as having the lowest performance. Frankness and integrity in business are institutionalized values in the company, and integrity is considered the commitment to not only follow the law but also to keep promises. In surveys at other companies, Welch and Welch (2005) claim that only 20% of people, at most, acknowledge that there is openness in their organizations.

GE also has the principle of hiring people who, in addition to being honest, are intelligent and possess the qualities of Elegance, Eloquence, Efficiency, and Success – positive energy, positively influencing colleagues, customers, and subordinates; ability to perform tasks well and deliver concrete results with success and passion for what they do, really dedicating themselves to work.

Timeline[3]

1886 – Transfer of the Edison Laboratory (now a national monument in the US) to West Orange, New Jersey, creating a new way of doing business, with a group of people instead of one individual, they could invent, build, and market products.

1876 – Edison and a group of employees, invented a telegraph able to send four messages at once and modernized the telephone, to speak and listen at the same time.

1878 – Thomas Alva Edison, together with Grosvenor P. Lowery (Western Union consultant), founded the Edison Electric Light Company in Menlo Park, New Jersey. The company aimed to develop a commercially viable lighting system.

1879 – Thomas Alva Edison developed the first carbon filament lamp, with a current socket using special high voltage dynamos, which remained on for 40 hours.

[3] An in-depth view on the landmarks of GE through time is available on the company's website at <https://www.ge.com/brand/ and <http://mundodasmarcas.blogspot.com/2006/06/general-electric-imagitanion-at-work.html>.

1880 (end of the decade) – Entry into the British market with its subsidiary, Edison Swan; in Germany, through Algemeine Edison Gesellschaft; and in Italy under the mediation of Societá Edison per la Fabricazione delle Lampade.

1892 – Merger of Edison General Electric Company and Thomas Houston Electric Company (founded in 1883), designed by banker J. P. Morgan, originated the General Electric Company.

1896 – Listed on the Dow Jones industrial index for its success in several areas.

1900 – First company to open a private laboratory for scientific research in Schenectady, NY.

1908 – Pioneer in the construction of electric locomotives (means of transport to Grand Central Terminal in New York).

1914 – GE executed the entire control system and electrical installation of the Panama Canal.

1922 – Inauguration of one of the first radio stations in the United States.

1927 – Installed the refrigerator production department.

1932 – Creation of the plastic development division and the air conditioning division.

1940s – Another innovation, the construction of the first jet aircraft in the United States, the model 1 A.

1969 – Demonstration of the company's power when the Apollo Project (which took the man to the Moon), involved 37 operations of the company and more than 6,000 employees.

1970s – GE was going through a sensitive period, as competition no longer allowed the company's technologies to stand out in the market together with the need for speed and continuous improvement that required the elimination of internal operating barriers to achieving more effective communication and shorter response time.

1981 – Jack Welch[4] took over as the company's president in a task to recover the organization's reputation.

1986 – Acquisition of RCA Corporation, including the NBC television network.

2001 – Jack Welch left GE's presidency. He built a leaner, stronger, and more competitive corporation with fewer people, business units, and managerial levels, working with fewer managers. The company gained value from a market price of USD 14 billion to USD 410 billion. 2001 was also the year GE launched the **GE Reveal™** lamps.

2002 – Launch of the ultrasound system with 3D images in real-time.

2007 – The company was under the command of Jeff Immelt (former head of GE's medical division and former vice president of plastics). More than half of global sales came from outside the United States at this time. In one decade, GE had opened its first three research centers outside the United States in India (Bangalore), China (Shanghai), and Germany (Munich).

2008 – GE announced the immediate reorganization of its operations in four divisions, reducing from the six divisions at that time. The objective was to increase businesses' efficiency and profitability. The technology division, for instance, absorbs the operations related to aviation, transportation, and sanitary assistance; the energy division absorbed the operations related to the sectors of energy and water, as well as the capital division, including all activities associated with the financial services provided.

[4] Some of the actions carried out by Jack Welch for the recovery of GE: he removed the company from the small household appliances business, reduced the workforce from 404 thousand to 229 thousand (which marked the end of the old non-dismissal policy), closed 73 factories and eliminated 232 products, sold 12 billion in GE businesses and bought others that were valued at 26 billion; he combined GE's European interests in appliances, medical equipment, electrical distribution, and power systems with the unrelated General Electric Company of Britain, driving the company's market success from USD12 billion to over USD 100 billion. When Welch took over as GE's president, the company had 350 business units. His practices led the company to operate with only 12: aircraft engines, appliances, and air conditioning, financial services, electrical distribution, industrial systems, information services (internet and intranet), systems transport, and the NBC TV network.

Slogans

Imagination at Work – 2003

Proven products for the 80´s from a proven team – 1980

One of the biggest names in almost everything – 1979

Progress for People – 1974

Progress is our most important product – 1965

You can put your confidence in General Electric – 1953

Main company data:

a) Origin: United States

b) Foundation: 1892

c) Founder: Thomas Edison

d) World Headquarters: Fairfield, Connecticut

e) Brand owner: General Electric Co.

f) Publicly traded: yes

g) Chairman/CEO: Jeffey Immelt

h) Revenue: USD 172.79 billion (2007)

i) Market value: USD 288.5 billion (2008)

j) Brand value: USD 53.08 billion (2008)

k) Global presence: more than 180 countries

l) Employees: 327,000

m) Segment: conglomerate

n) Main products: household appliances, aircraft turbines, locomotives, industrial automation, power generation

o) Icons: the founder, Thomas Edison

p) Slogan: Imagination at work

q) Website: www.ge.com

General Electric in Brazil

GE has been operating in Brazil since 1919, with eight industrial facilities in the country, in the states of São Paulo (headquarters), Minas Gerais, and Rio de Janeiro, in addition to sales and marketing offices in other locations. The company employs around 8,000 people and all of its eleven businesses, to a greater or lesser extent, have activities in Brazil, from maintenance for airplane engines to power generation, through financial services, domestic appliances, diagnostic imaging equipment, and engineering plastics, offering to the Brazilian market the most advanced technology in products and services.

Ecoimagination program

This program started in December 2004, when President Jeffey Immelt determined that all areas of the company should be engaged in environmentally friendly products, from turbine manufacturing to financial services. The initiative was launched in May 2005. The objective was to turn environmental challenges into stimulating innovation and sources of revenue, in addition to reducing the company's ecological footprint. General Electric's vision is expressed by the motto *Green is Green*: investing in sustainable innovation to build a better world and being profitable.

Social responsibility

The GE Foundation, created in 1953, is a philanthropic organization from General Electric, which invests in quality education-based programs. On average, GE invests USD 550,000 per year in Brazil. The company's corporate social responsibility program counts on the continued engagement of businesspeople to assume ethical behavior and collaborate for economic development while increasing the quality of life of their employees and their families, the local community and society as a whole.

GE Projects

a) **Junior Achievement:** among the programs supported by the GE Foundation, the initiative aims at teaching entrepreneurship to young students at school, encouraging complementary educational.

b) **Reading circle:** the project supports young people in developing their identity, community, and citizenship through reading and group debate, creating an environment where they can share experiences, expand knowledge, and exchange ideas, increasing the vocabulary and networking. These meetings take place once a month for 2 hours each inside the GE's office (training room). Volunteers work in a participatory way with groups of 10 to 15 young people, since small groups form friendly environments to establish a dialogue with the youth and to create bonds with other young people and volunteers.

c) ***Fortalecer* Project:** support to 40 social organizations (30 appointed by Abrinq and ten appointed by GE volunteers). The organizations work in networks, encouraging the protection of rights and the exercise of citizenship of children and adolescents.

d) **Information Network**: improve the quality of public education, qualifying teaching coordinators and pedagogical assistants from the municipal education system so that they can offer continuous training for teachers. This project has already been implemented in all schools in São Paulo (capital).

GE Volunteers

GE Volunteers is an organization that was created in 1928 to encourage the participation of volunteers (GE employees) in the different communities where GE operates. The GE Volunteers project started in Brazil in 1997. The organization is governed by local boards and, in Brazil, there are five of them, in São Paulo, Campinas, Rio de Janeiro, Petrópolis, and Contagem. According to internal data, during the period from 1997 to 2007, more than 250 social projects and campaigns were carried out. About 112,000 hours were donated, 93,000 people benefited, and more than USD 710,000 invested. Worldwide, there are more than 140 local GE Volunteers boards in 37 countries. Each board is responsible for the mobilization and planning of the volunteering activity in projects that serve the local communities.

- Clothing Campaign: every year, for one month, boxes are placed in the offices, where employees can donate warm clothes. The donations are designated to a different organization each year, institutions that make sure the clothes reach people in need.
- Christmas Campaign: takes place every year throughout November and December. Each year the campaign has a different target audience and entity.
- Paint Day: GE's global initiative that aims to make the environment of several hospitals around the world more cheerful. In this project, employees dedicate one morning to entertaining children in hospitals.
- Be Yourself a 'Volunteacher:' is a partnership of GE Volunteers, Gerdau, and EFALL Engenharia Elétrica LTDA, which aims to use English teaching as an educational tool, helping pre-adolescents and adolescents to achieve, with autonomy, their ideals, and a better future.
- Community Day: an initiative of GE Volunteers of São Paulo: one day of each month is dedicated to social activities in previously selected institutions.

In 2003, GE Elfun Volunteers started the project that benefited children from 4 to 14 years old in the Jacarezinho community (Rio de Janeiro), next to the GE lamp factory. The socio-educational program benefited around two thousand public school

students, whose objective is to integrate themes such as hygiene, citizenship, self-esteem, nutrition, and preventive health into the school curriculum.

GE's human resources sector

a) People management: four stages model, flat career structure;

b) 360-degree assessment – people are assessed by everyone they work with;

c) Bureaucratic organization.

In the administration of Jack Welch, the company opted for:

- being the first or second in the various sectors in the business in which it operates, restructuring operations, innovating, or closing markets where it will not have a chance to be either the first or the second-best placed in the sector;
- implementing a culture of openness in the organization and fighting against bureaucracy, aiming at post-bureaucracy (see the work by Heckscher, 2007, and the concept of adhocracy by Mintzberg, 1994);
- classifying people, in the management system, as follows: outstanding performance (20%), competent (70%), with lower performance (10%).

In Jack Welch's view, it was possible to implement such a culture after ten years of efforts to institutionalize the values 'frankness' and 'sincerity' in meetings and in the organization, using the example of leaders, managers, and senior management. The company also aimed at honest and transparent management, demanding the fulfillment of all these values (frankness with courtesy and politeness).

After the process of classifying employees, those among the 20% presenting outstanding performance received attention, training, high salaries, and promotions, since they were the ones considered to have higher potential, and more capable and innovative. The 70% were also treated with importance, received training, information, and, through a people management policy based on meritocracy, they accessed incentives, benefits, and counted on a career plan. The best potentials and talents were stimulated to become part of the top 20%. The 10% considered 'not promising,' were encouraged to leave the company, find new paths where they could develop professionally.

Thus, to innovate, GE intended to have an institutionalized culture in open and frank communication – defined here as Habermasian. Each employee knew, frankly, their situation in the company, taking note of their possibilities and their evaluation. The goal was to innovate.

The organization implemented the concept of 'learning organization,' with an open culture, in the sense that innovation does not occur to please researchers intellectually, but because it must have a social function, according to the company's vision, contributing to the Ecomagination vision (sustainable innovation for a better world, and being profitable).

Innovation requires a lean organization, with an informal structure that allows fast communication with everyone when seeking solutions. Projects must be directed toward a specific purpose and must be "sold" within a process of searching for opportunities, in the style of the 'Garbage Can Model.' This means that solutions exist even before the problem; something is created, and then it is verified what the invention is for; perhaps the invention will be useful to tackle a future problem or seize opportunities.

GE states that "the innovation process takes place in both directions. When the invention is transformed into something concrete, then there is innovation. Some factors are important in this process: it is necessary to 'rethink the organization' by proposing new solutions and continuously inquiring about the 'current state of affairs.' GE declares to have a structure of organizational learning, focused on the market, but a structure that can also insert inventions in the market" (WELCH, 2005).

This type of culture, which aims to institutionalize a practice of frank communication, was found in sectors of IBM in the values "respect for the individual," "search for excellence" and "speak frankly," according to the article by Vasconcelos (1993).

Crotonville: the center of excellence in training for the best GE executives

Located within the small town of Ossining, in an area of 220,000 square meters, Crotonville is responsible for training all executives considered to be the company's leading talents. Those chosen to be trained in this location know that the company is investing in them.

Throughout its 130-year history, GE has never hired any president from outside the company. They were all trained internally and went through the training programs conducted in Crotonville.

The training center is similar to a traditional university campus. However, a closer look shows that the classes are based on real problems and are far from being just theories that, in general, are not used in real life. This is because the purpose of Crotonville is to teach executives and help them to produce good results for the company. Many of the problems addressed during the learning sessions are cases from the company itself, to develop the critical and analytical abilities of managers.

A study day at this training center is quite arduous, starting at 8 am and ending in the late afternoon. Socializing among executives studying in Crottonville is very important, and they also engage in tasks involving teamwork. Most teachers are ex-GE executives who know the company's biggest challenges and reflect together with students looking for solutions. In addition to theory, students also seek practical and applied solutions for GE, exchanging experiences. Jack Welch invested a lot in revitalizing this training center.

Ecoimagination

The concern with sustainability focuses on sustainable innovation, which seeks to meet the current population needs, without compromising natural resources, allowing legacy for future generations.

GE wants to create sustainable products in all its lines, both to preserve the environment and create a better world, at the same time as keeping a profitable business ("Green is Green").

Thus, all programs must count on environmentally friendly products, from the manufacture of turbines to financial services.

Over time, GE wants to be an innovative sustainable organization that manufactures environmentally friendly products and acts for social, economic, and environmental protection.

Through the Ecomagination program – launched in 2005 – General Electric seeks to solve tomorrow's problems today, to create a clearer and cleaner environment, without pollution and radiation. Imagination is used to let ideas flow and create new perspectives in the main innovation areas of the company, with appropriate technologies to address such issues. The idea is based on the "win-win game," where everyone wins with sustainable innovation.

GE has 36,000 professionals in its research and development centers. Among the new ideas are turbines that release less GHG and home automation equipment that reduce water and energy consumption. In 2007, sales of products related to sustainable innovation corresponded to almost 10% of the company's global sales, growing three times faster than the average rate observed for other GE products. The intention is to invest USD 1.5 billion in research and obtain USD 25 billion in sales, which was planned to be achieved by 2010.

The generation of clean energy corresponds to half of the sales of Ecomagination products, a number obtained due to the sale of equipment for the wind power industry. GE is considered the largest renewable energy company in the world, with revenues of around USD 10 billion per year in this segment.

Together with Boeing, the company develops turbines that, in addition to being quieter, help to reduce emissions from airline aircraft. Desalination technology (seawater recycling), is considered one of GE's most promising technologies. The company also created locomotives with diesel engines, designed to reduce gas emissions by up to 40% since consuming less fuel (the engines consume 9% less than the ones of the current operational fleet for a greater distance, an achievement obtained due to the company's effort in R&D).

It is, therefore, a company that intends to reduce its bureaucracy, adopt adhocracy in its various innovation units, and develop increasingly sustainable innovation, being profitable and contributing to a more sustainable world.

Scientific research, scientific publications, and digital technology

Technological innovation in scientific communication

According to Amorim-Borher, Ávila, Castro, et al. (2007), in the last decades, the evolution of technological innovation processes in a globalized context occupies a central role in countries' competitiveness. It is particularly interesting to observe the studies carried out and gaining space in domestic and international journals, discussing innovation indicators, research and development based on theoretical approaches, the participation of different sectors, and national and international comparative analyses. The highly competitive economic environment leads the company to rely on its ability to innovate faster than its competitors, studying new ways and strategies to strengthen innovation.

A study by Gomes (1999) showed that the main characteristic of the technological innovation process is the hierarchical structuring action that takes place on four levels: individual, organization, technology, and the scientific field.

Electronic journals, disseminated thanks to technological innovation, facilitate not only the access and circulation of knowledge inside and outside the hosting base country but also the storage of local information (GOMES, 1999).

Ribeiro and Correa (2014), through a bibliometric and social network study, identified that the most prominent research areas: science, technology and innovation policies, innovation management, and technological and organizational change. These areas represented 53% of all studies in academic journals that approached "technological innovation" as the main theme.

The creation of specific journals on innovation, as well as the elaboration of 'call for papers' addressing the subject, contribute to the academic and institutional debate and the improvement of Brazilian science and national development (RIBEIRO and CORREA, 2014).

Another aspect worth mentioning is the computerization of academic journals, the implementation of electronic systems for the submission, management, and publication of scientific journals online, such as Open Journal System/ Electronic System for Journal Publishing (OJS/SEER)[5], ScholarOne, facilitating the accessibility and monitoring of editorial steps by authors, reviewers, and managers. This technological innovation process provides credible data – such as statistical and altimetric data – from the electronic hosting platforms.

Ribeiro and Correa (2014) emphasize that academic research is relevant as it allows greater perception and clarity about how academic themes and areas of knowledge are studied and disseminated in national and international academic literature. This is especially true considering the theme "Innovation," which is not yet exhausted academically, whether in congresses, journals, research groups, calls for papers, encouraging new researchers in the area.

Digital technology

The Digital Era began in 1973 with the use of cell phones. In 1981 IBM launched the first personal computer. In 1984, Apple produced the Macintosh, and the Internet started to be disseminated in the 1990s. The use of computers and the Internet were, for example, considered strategic instruments for other innovations that were emerging, such as search engines, content marketing, social network marketing, inbound marketing.

One of the biggest changes in human interaction in the current scenario is the recent proliferation of social media. Real-world social relationships are migrating to virtual platforms, resulting in online communities that bring people together from different locations. This movement had enabled individuals to share knowledge, entertain each other, and provide dialogues between different cultures (BUDDEN, ANTHONY, BUDDEN, et al., 2011). Therefore, it is increasingly necessary for organizations

[5] "OJS/SEER is a system that manages the editorial flow from the submission of the manuscript by the author, including the entire review process involving reviewers, editors, and authors, until the publication of the issue on the web. It is free software, open-source, which is being adopted by thousands of journals worldwide, according to the PKP" (Public Knowledge Project CONTENTMIND, 2014).

to consider these aspects not only in their communication strategies with their customers but also as a source of research and dissemination of scientific publications.

In this new scenario, changes in consumer behavior have pushed companies to rethink their strategies. Modern technologies allow companies to work and implement innovative ways of communicating and co-creating content with consumers. To maximize their value, companies are increasingly considering their consumers as their most valuable asset. In this way, the most successful companies achieve such success because they stand out during each stage of the consumer's life cycle: from the acquisition of new buyers, increasing their value over time, to turning them into brand advocates.

The implementation of marketing programs to increase interaction with costumers on social media, as well as the consolidation of bonds among individuals, are relevant strategies to speed the diffusion of technologies (RIBEIRO and CORREA, 2014).

For Cassiolato, Brito and Vargas (2005, p. 513):

> [...] innovation is increasingly understood as a process that results from complex interactions at local, national, and global levels between individuals, firms, and other organizations aimed at the search for new knowledge.

The Oslo Manual, edited by the Organization for Economic Cooperation and Development (OECD), with the Proposal of Guidelines for Collecting and Interpreting Technological Innovation Data, aims to guide and standardize concepts, methodologies, and construction of statistics and research indicators of R&D in industrialized countries. It defines four areas of innovation that encompass a wide range of changes in companies' activities: product, process, organizational, and marketing innovations (OCDE, 2005).

In the third edition of the Oslo Manual, the innovation measurement structure is expanded adopting three significant perspectives, namely: greater emphasis on interactions with other companies and institutions in the innovation process; relevance of innovation, being validated in industries with R&D areas that are less intensive, for example, services and the low-tech manufacturing industry; alteration of some aspects of structure (definitions and relevant activities) to better condition the service sector and, consequently, provide better development of the definition of innovation in order to include organizational and marketing innovation. The next topic addressed in this article refers to marketing innovation (OCDE, 2005).

Theoretical review of digital media between 2000 and today

Lamberton and Stephen (2016) show that the theme of digital media has been explored throughout the evolution of the studies and, therefore, it is worthwhile providing a brief theoretical review of the research published between 2000 and the present day.

The period from 2000 to 2004 was the era in which digital media prepared and helped to build the buyer's behavior, using the internet as a platform for individual externalization, as a search tool, support for decisions, and as an intelligence marketing instrument – in the context of e-commerce.

The period from 2005 to 2010 was considered the Era when consumers formed the Digital and Social Media Marketing (DSMM): online WOW (individual expression with a degree of importance for digital marketing), and networks involving user-generated content (UGC), one of the more attractive marketing trends, a key for brands to convey the authenticity millennials want, and a competitive advantage for marketers to increase sales. In this sense, Coleman, Katz, and Menzel (1957) and Van den Bulte and Lilien (2001) ratify that the information does not necessarily spread because an initial transmitter ("seed") has a disproportionately large number of social contacts (social hub), but due to the characteristics of its audience (how susceptible to social influence is the public), defining the entry of digital networks as tools for information and value.

Era 3, of social media, marked between 2011 and 2014, reveals that the consumer is increasingly connected and is an agent that can amplify or weaken the effects of actions, especially those of marketing.

The New Era (2015-2016) is rooted in the post-digital world, revisiting the expression of the consumer and the internet as a tool and the positive impact on sales; in this scenario, for example, mobile displays are highlighted for being more effective as a form of advertising (BART, STEPHEN and SARVARY, 2014).

As for the Era 4, the focus so far is on the upgrade of the capacity of obtaining perception throughout all sphered of government grading the ability to gain insights in all spheres, looking at the ways consumers search and learn in new contexts.

CONCLUSION

The type of communication we describe to promote change – Habermasian communication, with democratic deliberative citizenship, focus on facts, and sincere sharing of results – is used in innovation tasks by innovation teams that share scientific knowledge to innovate in research and development and in the departments of companies that take care of the social actions and measures to protect the environment, as well as in corporate education, training in the company. In these interactions, this type of communication is more likely to occur, especially in innovation teams, since, if communication does not occur in this way, there will be no innovation.

As we saw in the Editorial "Social Management and Deliberative Citizenship: Convergence of Research Themes," Vasconcelos and Irigaray (2019) point out:

> In the work Tem Razão a Administração? (TENÓRIO, 2016, p. 160), Fernando Tenório, shows the influence of the most prominent scholars of the Frankfurt School (Max Horkheimer, Theodor Adorno, Herbert Marcuse – critics of the instrumental rationality – and Jürgen Habermas – with his focus on communicative rationality), in his definition of social management. For Tenório, "the adjective 'social' qualifying the noun 'management,' is understood as the privileged space of social relationship in which everyone has the right to speak, without any coercion" (TENÓRIO, 2016, p. 162). The author discusses the term 'deliberative citizenship,' present in the concept of social management, establishing that "[...] legitimacy of decisions must originate in processes of discussion guided by the principles of inclusion, pluralism, participatory equality, autonomy and common good."

This communication may be adopted in the management of change, with communication facilitators, so that groups that did not work together before can learn how to do it, resolving paradoxes if possible, and developing a joint, convergent vision about the company's future (as in the definition of agents of change mentioned above).

There are examples of this type of Habermasian communication focusing on environmental protection, serving the interests of humanity and the planet. One of these examples refers to the Montreal Protocol, in which, based on scientific facts collected by NASA on the ozone layer, it was necessary to reason beyond mere immediate economic and political interest. Governments and corporations held meetings, agreed that CFC should be removed, and companies invested in research and development, generating sustainable innovation.

Another example is the Paris Agreement, involving 195 countries. As in the case of the Montreal Protocol, scientific data led these countries to dialogue and reach an understanding of issues related to the environment, accepting concrete measures to act in the direction of preserving humanity and the planet. This happened consciously, as funds and subsidies were designated to allow accomplishing these measures, implement green audits, and there was the creation of specific legislation (TIROLE, 2017).

Actions such as thematic citizens' meetings as the ones carried out in Bordeaux, France, where it is possible to collect suggestions to guide concrete measures, are examples of deliberative citizenship using the Habermas' concepts.

In companies, efforts aimed at environmental protection and social justice are also examples of corporate deliberative citizenship in the definition of actions aimed at society. Actions aimed at educating children, such as those carried out by Natura Institute, are examples of this type of initiative. According to the national household sample survey (PNAD), Brazil has

2.5 million children and adolescents between 4 and 17 years old that are out of school, which represents about 6% of the total population in this age range (50 million people).

In order to tackle this issue, the Natura Institute develops online courses to train and support elementary school teachers and offers support to a network of 770 schools in the country for integral education aimed at including these children and reducing these problems.

The theoretical assumption is that the most resilient organizations (the ones that better face radical changes), redesigning strategies, are closer to the model of post-bureaucratic organizations and a more substantive, frank, and democratic communication.

As observed in the discussion on post-bureaucratic organizations (Heckscher, 1994), this type of institution adopts the consensus based on trust as social regulation. It is a consensus that comes from recognizing the high technical capacity of team coordinators and co-workers. When there is disagreement, the team coordinator arbitrates the best solution (since the coordinators are the ultimate responsibility for the decision), but the high-level team debates solutions, and everyone is heard. Conflicts of ideas can occur, but this does not mean there is conflict among people.

Knowledge, information, and recognition of the collaborator's technical capacity are the key factors for reaching consensus on a solution — for example, task forces, product development teams, problem-solving groups, innovation teams.

Dialogue is defined more by the use of influence regarding knowledge and ideas and less by the use of power. People influence decisions based more on their ability to persuade, on their high-level technical knowledge, and less on their ability to command.

It is considered essential to disseminate information about the company's strategy at all levels of the organization because it is about organizational transparency and the concept of network organization, people with high technical knowledge, interconnected and quick access to each other.

The choice of the interlocutor is determined by the type of problem to be solved and not the hierarchical position. Values, such as autonomy and internal entrepreneurship, are fundamental. These are teams focused on results, and people participating in several teams at different times and different situations (relational and communication skills of employees are valued elements).

The profile of the global executive points to intelligent, well-informed individuals, with a high capacity for strategic action, self-organization (autonomy), working with multicultural teams, communicating in the new digital language and learning new content and innovating. Often this professional has high purchasing power.

According to Mintzberg (1994), adhocracy is the most conducive form of organization.

The characteristics of adhocracy are as follows:

- strong organic structure;
- little formalization of behavior;
- work specialization based on formal and highly horizontal training;
- interconnection instruments, stimulating mutual adjustment – a key mechanism for internal and team coordination (IT systems of the Enterprise Resource Planning – ERP – type, knowledge management platforms, strategic committees, and organizational memory); holographic effect (MORGAN, 1996);
- bringing together specialists from working units into small project teams, seeking internal organization;
- selective decentralization of the teams located in the organization at different points, covering different groups formed by line managers, advisors, and operational specialists.

New IT systems induce new forms of human interaction and communication. In a post-industrial society, as shown by Domenico de Masi (2003) in his book A Sociedade Pós-Industrial (the post-industrial society):

- the organization of the State occurs through representative democracies; between neoliberalism and the European welfare state;

- the main resources are intelligence, knowledge, creativity, information, scientific and cultural laboratories;
- the dominant economic sector is the tertiary (services) sector;
- the resources are electronics, information technology, biogenetics, intellectual and appropriate technologies;
- the element of cohesion is the programmed solidarity, multiple communication networks, participation, systemic view of the world;
- the relationship with time and space is oriented towards the future, the pace of work is the result of individual choice;
- society is interconnected through formal and informal communication networks;
- virtual organization is a type of network organization.

New information and knowledge technologies, such as cell phones, the internet, email, social networks, chats, and videoconferences, are essential. They push for new forms of human interaction, mixing the individual's private life and the public sphere, and demanding faster and constant responses. The digital economy, as Tirole (2018) shows, has its characteristics that will change society as a whole.

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