The challenge of innovation and the nature of jobs under the pandemic-19

O desafio da inovação e a natureza dos empregos na pandemia-19

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Luís Felipe Maldaner
Ph. D. in Latin America Studies
Institution: Universidade do Vale do Rio do Sinos (UNISINOS)
Address: Av. Unisinos, 950, Cristo Rei, São Leopoldo - RS
E-mail: fmaldaner@unisinos.br

Flávia Siqueira Fiorin
Master Business Administration at Poitiers University
Institution: Tecnopuc Tech Park University (TECNOPUC)
Address: Av. Ipiranga, 6681, Partenon, Porto Alegre - RS, CEP: 90619-900
E-mail: flavia.fiorin@pucrs.br

Daniela Carolina Eckert
Master Business Administration at Poitiers University
Institution: Tecnopuc Tech Park University (TECNOPUC)
Address: Av. Ipiranga, 6681, Partenon, Porto Alegre - RS, CEP: 90619-900
E-mail: daniela.eckert@pucrs.br

ABSTRACT
This article aims to discuss the impact of technological advances on the nature of work in Brazil, under three main aspects: a) the context of innovation processes; b) the introduction of industry 4.0 concept; c) the Covid-19 pandemic. Technological changes, both in the innovation process in the company, and in the advent of industry 4.0, were, to a certain extent, hastened by the emergence of the Covid-19 pandemic. In this sense, the analysis carried out by this study was based on data provided in surveys carried out by IBGE (Brazilian Institute of Geography and Statistics) and by IPEA (Institute of Applied Research). The findings of this research show two main aspects: a) workers in certain areas need to improve new skills, especially with regard to cognitive flexibility and emotional intelligence to support work in this new era of digitalization associated with remote work caused by the pandemic; b) companies will have to rethink their infrastructure and invest in new digital technologies to remain competitive and be able to operate with a portion of their employees working in the home office productively. In addition, they will have the flexibility to manage people in these conditions and obtain the best results from them.
Keywords: nature of jobs, soft skills, industry 4.0, professional profile.

RESUMO
Este artigo visa discutir o impacto dos avanços tecnológicos na natureza do trabalho no Brasil, sob três aspectos principais: a) o contexto dos processos de inovação; b) a introdução do conceito de indústria 4.0; c) a pandemia da Covid-19. As mudanças tecnológicas, tanto no processo de inovação da empresa, como no advento da indústria 4.0, foram, em certa medida, aceleradas pelo surgimento da pandemia da Covid-19. Nesse sentido, a análise realizada por esse estudo baseou-se em dados fornecidos em pesquisas realizadas pelo IBGE (Instituto Brasileiro de Geografia e Estatística) e pelo Ipea (Instituto de Pesquisa Aplicada). Os resultados desta pesquisa mostram dois aspectos principais: a) os trabalhadores em determinadas áreas precisam melhorar novas habilidades, especialmente no que diz respeito à flexibilidade cognitiva e inteligência emocional para apoiar o trabalho nesta nova era de digitalização associada ao trabalho remoto causado pela pandemia; b) as empresas terão de repensar sua infraestrutura e investir em novas tecnologias digitais para se manterem competitivas e serem capazes de operar com uma parte de seus funcionários que trabalham no escritório doméstico de forma produtiva. Além disso, eles terão a flexibilidade de gerenciar pessoas nessas condições e obter os melhores resultados a partir deles.

Palavras-chave: natureza dos trabalhos, soft skills, indústria 4.0, perfil profissional.

1 INTRODUCTION
The World Economic Forum released a Report “The Future of Jobs (2018)” saying that innovation and technology that is coming with the 4th Industrial Revolution will promote several changes jobs, not only in its nature, but also in the format of it.

Considering this trend, it is necessary to think about the labor force. It is important to mention that there are a broadly literature on that subject. Also, it is possible to find some scholars who are predicting a big loss of jobs in the near future. For example, at the WEF Report (2018), the acceleration of adoption of technology will be very spread, as 85% of respondents on its survey will adopt new technology by 2022.

Even though, according to Machado (2017), we are experiencing a reality based in VUCA (Volatility, Uncertainty, Complexity and Ambiguity) dynamics, where it is impossible to predict what is coming next, it is well known that areas of innovation carry a good connection with the technologies and businesses of the future. This proximity is not only in terms of technology, but also in characteristics linked to the development of
soft skills, which are appointed as fundamental to jobs of the future. Technology parks of developing countries can be mentioned as examples of structures that harmoniously mix RD&I and creativity structures, that has been building a favorable environment for the development of soft and technical skills.

From this perspective a question comes out: How people will be prepared for this future? Exploring the relations of work in areas of innovation could bring insights for preparing future careers? Taking in mind that in the coming years the young generation will arrive to the labor market. Thus, the main challenge will be in terms of formal education and soft skills development. This bring a discussion regarding the role of the University which are the main institution that is working on that.

The proposition of this article is to show that there are at least two important aspects to consider when discussing the labor force in developing economies, taking the future jobs, notably in Brazil: one is the nature of jobs, associated with Industry 4.0 technologies. This aspect is related to the changes of jobs. In other words, jobs move from one place to another. The other is the very basic entry experience in the labor market, concerning digital skills in order to work with new technologies and a new model of job relation, based on complex thinking where creativity, collaboration, and critical thinking are required.

Additionally, from 2020, the pandemic of Covid-19 has changed a lot the nature of jobs. Many companies send their workers at home to maintain a social distance to prevent the infection of the virus. This is an aspect that must be considered because many workers are at home office due to maintain a social distance. IBGE (Brazilian Institute of Geography and Statistics) that provide large research regarding Brazilian workers home office. In the beginning of this study, Covid-19 was not there Thus it is an aspect that must be included in this study.

2 LITERATURE REVIEW
2.1 INNOVATION

Even if an organization has an entrepreneurial culture based on innovation, this may not guarantee business sustainability. Many companies with that characteristic
collapse before technological breakthrough changes and market structures, when they do not align properly the innovation possibilities with internal competencies of the organization (CHRISTENSEN, 2001).

Innovations that are distant in scope of organizational core business are more likely to have difficulty in management because their previous experiences do not apply to the challenges and potential risks that arise (CHESBROUGH and ROSENBLOOM, 2002).

Schumpeter (1942) describe innovation as a process that brings a new product or service to the market. At the same time, innovation is a cumulative process, because it can be radical or disruptive (CHRISTENSEN, 1997) and incremental. Even when disruptive innovation occurs, it can be caused by a cumulative and collaborative process, especially in current times where all information is available to everyone through internet.

2.2 4TH INDUSTRIAL REVOLUTION

After the three main waves of industrial revolution, the fourth Industrial revolution can be described as:

“The advent of “cyber-physical systems” involving entirely new capabilities for people and machines. While these capabilities are reliant on the technologies and infrastructure of the Third Industrial Revolution, the Fourth Industrial Revolution represents entirely new ways in which technology becomes embedded within societies and even our human bodies (DAVIS, 2016).”

Together with these broad definitions, the ideas of open innovation, ecosystems of innovation & entrepreneurship, such as STPs and Incubators can help training and preparing people to be ready for the future jobs. Another significant development started in the beginning of the 21st century, which is the democratization of technologies that reduced entry barriers for companies: robotics, 3D printing, big data, artificial intelligence, virtual reality, the blockchain, among others, enabled people to develop concepts that not long ago were only in the realm of capability of large corporations or governments.
Görmüs (2019) discuss in his article the possible effect of Industry 4.0 on employment and the future of work. “In the result of the literature review, it is concluded that with Industry 4.0, there will be an increase in demand for human resources that hold new qualifications and skillsets, however, it will bring with increases in the gig economy with precarious, the lack of bargaining power and legal protection, in non-standard working forms and in unemployment and underemployment risks (Görmüs, 2019, p. 311)”.

In its article, Görmüs (2019), mentioned, citing Kergroach (2017: 8) that new jobs with higher skills created by Industry 4.0 will require new qualifications and new skillsets. In this sense, self-organization, management, teamwork, or communication skills are more likely to increase importance, as it is possible to see on Figure 1.

![Figure 1 - Expected increase or decrease in occupations and industries.](image_url)


However, for most of the industrialized period in the 20th, internal R&D was a strategic asset and an almost insurmountable barrier to entry for smaller companies. Large corporations were able to do research internally, in a closed system, and then take advantage of IP rights and first mover advantages.
2.3 NATURE OF JOBS

There is a conviction that the jobs of the future will change. According to the WEF Report 2018, “nearly 50% of companies expect that automation will lead to some reduction in their full-time workforce by 2022, based on the job profiles of their employee base today”. Automation will move jobs especially from production sector of factories. Even in the administration department of companies, changes will happen, also. IT is already there, but Artificial Intelligence is also arriving and working on repetitive tasks.

According to Bernard Marr (2019), the 4th industrial revolution is fueled by technological innovations such as big data, virtual reality, blockchains, and more. This means that people will need to know at least a minimal level of technology. At the most basic level, as for example, inside the production sector of factories, employees in most roles will be required to access data and determine how to act on it. This requires some technical and soft skills. On a more fundamental level, everyone needs to be able to understand the potential impact of new technologies on their industry, business, and job.

Olsen and Krol (2019: II) describe in their perspective paper that “automation will lead some occupations to become obsolete and new ones to be created, but more generally a more complex division of labor between humans and machines would exist”. This was a finding taking a analysis on a dataset on occupational risk to the Bay Area, they “find that 36 percent of workers are in the high-risk category of automation and 45 percent in the low-risk category, with just 19 percent in the middle-risk category”.

This context pressure future workers to develop technical skills but also soft skills related to complex thinking, since the linear thinking will be increasingly automated by new technologies. Frey & Osborne (2017) examined the risk of computerization on US labor market. And they found, based on their analysis of 702 occupation, that 47 percent of total US employment is at risk.

In other way of thinking Cosmin-Alexandru, George-Sorin &Paul (2015, p.486), discuss that “it has long been assumed that technological progress is one of the surest ways to ensure to improve the overall wellbeing of societies, however recent trends seem to disprove this theory. If this is indeed the case then the way the future of technological
progress unfolds will have a big impact on the way people live and work, which makes further research in the possible outcomes the more relevant”.

2.4 PROFESSIONAL PROFILE

Considering the association of technical skills and complex thinking approach it is possible to describe some skills and abilities that people will need in order to supply the new demand bringing from the jobs of the future, such as:

- Specific and technical knowledge and second and third languages, English and Spanish, for example.
- Socio-environmental skills.
- Live and learn from other cultures.
- Collaborative spirit for continuous improvement.
- Team work.
- Ability to learn from others.
- Professional and personal ethics.
- Analysis and trouble solving capabilities.
- Sense of urgency.

It is well known that it is very hard for a single man or woman can be prepared in high standard in all these skills. However, it is necessary that the newcomers to the labor market, especially the young generation, must work and study hard in order to reach that level.

This findings from author’s observation at companies that are resident in Tecnosinos Tech Park, located in São Leopoldo, Rio Grande do Sul State, South of Brazil. Some of those mentioned above skills are in accordance with Fossen & Sorgner (2019) findings as it is possible to see on figure 2.
Figure 2 - Computerization Bottlenecks and Corresponding Variables from O*Net

<table>
<thead>
<tr>
<th>Computerization bottleneck</th>
<th>O*Net variable</th>
<th>O*Net description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perception and manipulation</td>
<td>Finger dexterity</td>
<td>The ability to make precisely coordinated movements of the fingers of one or both arms, or assemble very small objects.</td>
</tr>
<tr>
<td></td>
<td>Manual dexterity</td>
<td>The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects.</td>
</tr>
<tr>
<td></td>
<td>cramped work space, awkward positions</td>
<td>How often does this job require working in cramped work spaces that requires getting into awkward positions?</td>
</tr>
<tr>
<td>Creative intelligence</td>
<td>Originality</td>
<td>The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.</td>
</tr>
<tr>
<td>Social intelligence</td>
<td>Social perceptiveness</td>
<td>Being aware of others' reactions and understanding why they react as they do.</td>
</tr>
<tr>
<td></td>
<td>Negotiation</td>
<td>Bringing others together and trying to reconcile differences.</td>
</tr>
<tr>
<td></td>
<td>Persuasion</td>
<td>Persuading others to change their minds or behavior.</td>
</tr>
<tr>
<td></td>
<td>Assisting and caring for others</td>
<td>Providing personal assistance, medical attention, emotional support, or other personal care to others such as coworkers, customers, or patients.</td>
</tr>
</tbody>
</table>

Note: This table was adopted from [Frey, Osborn, 2017]. These authors also include a variable “fine arts” as part of the bottleneck “creative intelligence”. We do not use this variable in our analysis because it is coded as “irrelevant” for more than half of the occupations in O*Net. Source: compiled by the authors.

They argument that there is two says to analyze the phenomena of computerization on jobs. In one hand there is a “destructive effects of digitalization substitute human labor, while transformative effects of digitalization complement it (FOSSEN & SORGNER, 2019, p. 10).

The World Economic Forum provide a similar approach describing the 10 top skills that will be needed by the workers in 2020, comparing 2015, as Figure 3 shows. Only 2 skills are new in 2020 list: Emotional Intelligence and Cognitive Flexibility. Service Orientation and Active Listening was excluded. The main reason is that the era of digitalization will request from the workers, a high level of cognitive flexibility and emotional intelligence to deal of the new aspect and the new environmental that will change on their jobs.
Figure 3 – Ten top skills

<table>
<thead>
<tr>
<th>2020</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Complex Problem Solving</td>
<td>1. Complex Problem Solving</td>
</tr>
<tr>
<td>2. Critical Thinking</td>
<td>2. Coordinating with Others</td>
</tr>
<tr>
<td>3. Creativity</td>
<td>3. People Management</td>
</tr>
<tr>
<td>4. People Management</td>
<td>4. Critical Thinking</td>
</tr>
<tr>
<td>5. Coordinating with Others</td>
<td>5. Negotiation</td>
</tr>
<tr>
<td>6. Emotional Intelligence</td>
<td>6. Quality Control</td>
</tr>
<tr>
<td>7. Judgment and Decision Making</td>
<td>7. Service Orientation</td>
</tr>
</tbody>
</table>


O'Donnellan (2019) add some new skills such as Entrepreneurship and innovation as high Cognitive and maintain Service Orientation as Social and Emotional Skills. Also, this author adds Leadership as an important social skill. He classified differently Leadership and Managing Others what in some sense is almost the same.

According to Bernardez (2017, p.8), the transition from the old paradigm to a new way of work is needed, taking in mind that “work collaboration, business transactions, and human interaction to a virtual, mobile, and global environment will require new models and frameworks for effective performance, especially because workers will need to be able to deal with highly flexible, fast-changing (and changeable), customer-centered interfaces tailored to a wide variety of demands and users”.

3 METHOD

The pandemic in Brazil has increased in number of infected and, what is worse, in the number of deaths, reaching in March 2021 more than 280 thousand deaths from the Covid-19 infection. During this period, it has been very difficult to obtain feedback on surveys that are directed to companies, because many people, especially in the administrative area, are working in the home office, which makes it difficult to be responsive to the objective of obtaining data.
According to Gil (2008), the observational method is one of the most used in the social sciences and has some interesting aspects, since it allows a very expressive degree of precision in the social sciences. According to Prodanov and Freitas (2013), descriptive research, in its simplest form, is related to exploratory research, in the sense that they seek a new view of the problem. According to Gil (2008), the documentary research is based on materials that have not yet received an analytical treatment or that can be reworked according to the objectives of the research now carried out.

Thus, this study searched for data in secondary sources, such as documents published by IBGE (Brazilian Institute of Geography and Statistics) and by IPEA (Institute of Applied Economic Research). The reports published by these two Institutes are the most current and provide data based on extensive field research and were produced by highly qualified professionals in obtaining economic and social data. Both, therefore, are of recognized quality.

4 RESULTS AND DISCUSSIONS

The IBGE concluded the PNAD, (National Household Sample Survey) at the end of 2020, where varied data were collected regarding the Brazilian population. For the present study, data related to work and the profile of workers will be considered.

Brazil has 210 million inhabitants. Table 1 shows data on employed persons at the end of 2020, which totaled 84.661 million at the end of 2020. Of these, 94.8% did not have time off work, which corresponds to 80.229 million. In addition, the table shows that 7.330 million people started to work remotely, that is, in the home office, which promoted a substantial change in the skills needed to perform their duties. This number represents 9.1% of occupied people. In some sense, number shows that a major part of occupied people is going to their local of work, working as a normal period of job.

At the same time, it is possible to mention that various types of work do not allow remote work, either due to the lack of technological conditions for this, or because the type of work requires activity with industrial equipment, for example. It is still possible to mention that, to a certain extent, workers are not prepared to perform their duties remotely, which requires a new professional profile, with differentiated capacity and skill,
in the same way as with the demands arising from the implementation of technologies of Industry 4.0.

PNAD also points out that the profile of professionals at work “continues predominantly composed of persons employed in the formal sector, with complete college education, female, white colored and aged between 30 and 39 years (IPEA, 2021, p. 1).”

Table 1 – People occupied in Brazil. (Millions of people and %)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Número de pessoas em</th>
<th>Número de pessoas em</th>
<th>Número de pessoas em</th>
<th>Número de pessoas em</th>
<th>Número de pessoas em</th>
<th>Número de pessoas em</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>maio</td>
<td>junho</td>
<td>julho</td>
<td>agosto</td>
<td>setembro</td>
<td>outubro</td>
</tr>
<tr>
<td>People occupied</td>
<td>84,404</td>
<td>83,449</td>
<td>81,484</td>
<td>82,144</td>
<td>82,934</td>
<td>84,134</td>
</tr>
<tr>
<td>People occupied not absent from</td>
<td>65,441</td>
<td>68,693</td>
<td>71,746</td>
<td>75,454</td>
<td>77,564</td>
<td>79,447</td>
</tr>
<tr>
<td>People occupied exercising activity</td>
<td>8,709</td>
<td>8,694</td>
<td>8,403</td>
<td>8,376</td>
<td>8,073</td>
<td>7,596</td>
</tr>
<tr>
<td>People absent</td>
<td>18,964</td>
<td>14,756</td>
<td>9,737</td>
<td>6,687</td>
<td>5,370</td>
<td>4,432</td>
</tr>
<tr>
<td>People absent due to social distancing</td>
<td>15,725</td>
<td>11,814</td>
<td>6,784</td>
<td>4,146</td>
<td>3,003</td>
<td>2,341</td>
</tr>
<tr>
<td>People absent for other reasons</td>
<td>3,238</td>
<td>2,942</td>
<td>2,953</td>
<td>2,542</td>
<td>2,368</td>
<td>2,346</td>
</tr>
</tbody>
</table>

Source: IPEA, 2020, p. 2

From the perspective of workers receiving wages, Table 2 presents the data separated by sector of activity. It appears that in November 2020, the service sector received the largest share of the wage bill of people in face-to-face activity, 30% of the total. People in remote activity received 17.4% of the total. It can be seen in the case of remote activity that the percentage was reduced in May, when it represented 23% to 17.4% in November.

In particular, the most accurate analysis of this substantial reduction in remote activity is that there was, during the period, an improvement in the contagion indicators of Covid-19 among the Brazilian population, as well as a reduction in the number of deaths. These Covid-19 indicators led companies to a certain reduction in their workers in remote activity, returning them to activity in the company itself.
Additionally, it is important to note that agriculture, as a predominant activity for the formation of the Brazilian GDP, is not very representative in the distribution of income, with only 4.8% of the wage mass of employed persons. It is possible to mention that the agricultural activity has improved technologically in Brazil, with a great increase in productivity, and with a reduction in workers who have a more prepared profile to meet technological demands.

Table 2 – Percentage of the mass of income actually received by people - by sector of activity and in remote work (In%).

<table>
<thead>
<tr>
<th>Categories</th>
<th>Maio</th>
<th>Junho</th>
<th>Julho</th>
<th>Agosto</th>
<th>Setembro</th>
<th>Outubro</th>
<th>Novembro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultura</td>
<td>4.9</td>
<td>5</td>
<td>5</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>Indústria</td>
<td>12.3</td>
<td>12.6</td>
<td>13.2</td>
<td>13.9</td>
<td>14.2</td>
<td>14.7</td>
<td>14.7</td>
</tr>
<tr>
<td>Comércio</td>
<td>8.7</td>
<td>8.8</td>
<td>9.3</td>
<td>10.1</td>
<td>10.4</td>
<td>10.7</td>
<td>10.7</td>
</tr>
<tr>
<td>Serviços</td>
<td>24.8</td>
<td>25.1</td>
<td>26.7</td>
<td>27.6</td>
<td>28.3</td>
<td>29.5</td>
<td>30</td>
</tr>
<tr>
<td>Setor Público</td>
<td>17.2</td>
<td>16.8</td>
<td>16.3</td>
<td>15.8</td>
<td>15.9</td>
<td>16</td>
<td>16.4</td>
</tr>
<tr>
<td>Outros</td>
<td>9.2</td>
<td>9.2</td>
<td>8.1</td>
<td>7.3</td>
<td>6.8</td>
<td>6</td>
<td>6.2</td>
</tr>
<tr>
<td>Teletrabalho</td>
<td>23</td>
<td>22.6</td>
<td>21.4</td>
<td>20.5</td>
<td>19.8</td>
<td>18.3</td>
<td>17.4</td>
</tr>
</tbody>
</table>

Source: IPEA, 2020, p. 4

Another important point of view in the analysis that can be made on the PNAD data, is related to the dynamism of the regions, presenting a great disparity in the development between the Brazilian states and regions. Figure 4 shows the percentage of the wage bill generated by workers in remote activity. Thus, it can be noted that the State of São Paulo has a rate of 22.4%, and the States of Paraná and Rio Grande do Sul, which are part of the Southern region of Brazil, have rates of 14.62% and 14.32% respectively.

This data shows that also in these states the technological development is greater compared to other regions, which also denotes the technological imbalance and that the regional inequalities are quite accentuated. It is important to highlight that Minas Gerais, with 13.3%, also has a good index. Three states in the Northeast have indexes close to
those in the southern region: Bahia, with 14.12%, Piauí with 14.46% and Ceará with 13% stand out in this region. The North and Midwest regions have the lowest indicators.

Figure 4 - Percentage of the mass of income actually received, received by employed persons and does not depart from exercising their activities remotely, by UF (In %).

Elaboração dos autores.

Source: IPEA, 2020, p. 4.

The last point to be highlighted in this study, concerns the education profile of workers in remote activity. Only with the observation of Figure 6 is it possible to observe that the profile of the worker in the home office presents mostly levels of education with higher education, around 70%, followed by the profile of high school education, around 28%.
Figure 6 - Distribution of people in work remotely effectively versus potential telework, by schooling (In %).

Source: IPEA, 2020, p. 8

A very low percentage of workers with a basic education profile are in the home office. This aspect presented by the research is also in line with the literature that mentions the need to adapt and prepare people for work, bearing in mind the technological advances brought by computerization, especially those arising from Industry 4.0 (OLSEN & KROLL, 2019; FOSSEN & SORGNER, 2019; BERNARDEZ, 2017).

5 FINAL REMARKS

Taking the outcomes from the literature review there is a big change in jobs caused by the advent of new technology, especially those coming from the Industry 4.0. Additionally, it is important to mention that the entrepreneurs, that were interviewed in this study, are saying that they need a new kind of worker, that are very familiar with those new technology but also has critical thinking and problem-solving skills. They claim that the University is not preparing students adequately to the jobs they have, mainly in jobs inside companies that are in IT industry.

In addition, it is important to mention that technological advances were already promoting changes in the characteristics of work and in the profile of workers to exercise their functions. This technological basis was also already changing the shape of the internal process, requiring more integration between the teams and, consequently, more
teamwork, requiring, in turn, a change in the professional's behavioral profile. In this case, socio-environmental skills were increasingly being put into practice.

With the emergence of the Covid-19 pandemic, this process of technological change accelerated within companies, since around forty percent of workers in activities, previously developed in offices, moved to the home office, which required skills for professionals. The demand for remote work is greater from the point of view that there is no co-worker beside to solve doubts, or even to interact with new ideas. Virtual meetings are not always productive like face-to-face meetings and so on.

Other limitations of this study are that at the same time technology is bringing a new wave in terms of jobs, it is also bringing a lack of social skills to the young generation. They are using too much social media, and too less talking face to face with others. Thus, they are not developing social skills, such as team working, leadership and the capacity to understand other cultures.
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