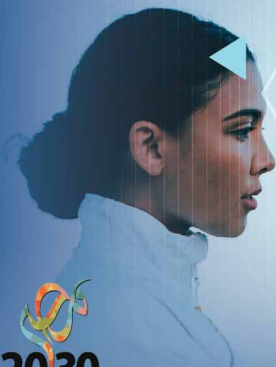


Implications of the Fourth industrial revolution on Women in Information and Communications Technology: In-depth analysis on the Future of work



March 2021

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List of Abbreviation

WEC: World Economic Forum

ICT: Information and Communication Technology

STEM: Science , Technology, Engineering and Mathematics

4IR: Fourth Industrial Revolution

NTI: National Telecommunications Institute

ELCC : e-Learning Competence Center

ITI: Information and Technology Institute

MOSS: Ministry of Social Solidarity

NSB: Nasser Social Bank

MCIT: Ministry of Communication and Information Technology

ITIDA: Technology Industry Development Authority

TIEC: Technology Innovation and Entrepreneurship Center



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I- Introduction

Technology is bringing opportunity, paving the way to create new jobs, increasing productivity, and improving public service delivery. The 2019 World Development Report: The Changing Nature of Work by the World Bank shows that people in developed countries are optimistic about the benefits from technology to the workplace and quality of life however, they remain anxious about its sweeping impact on employment. Manufacturing jobs will be lost to automation in advanced and some middle-income countries, as well as routine and "codifiable" tasks which make a large spectrum of vulnerable workers[1]. It is estimated that by 2030, due to automation up to 375 million workers may need to switch occupational categories globally, and 72 million workers may need to switch in developing countries. Changes in net occupational growth or decline imply that a very large number of people may need to shift occupational categories and learn new skills in the years ahead.[2] Helping individuals transition from the declining occupations to growing ones will be a largescale challenge especially for women where studies found out that they are the most vulnerable to these changes. Unlike men, women occupy the bigger category in medium and low paid –jobs; the kind of jobs that will face slower growth in demand in the future. [2]

Egypt is home to 48.7 million women, and improvements to their conditions will have a significant impact on the country's economic and social progress[3]. To date, Egypt has closed only 62.9% of its gender gap, according to the World Economic Forum (WEF) gender gap index. Much has yet to be done to grant equal opportunities to women. Although education attainment as well as health and survival enjoy much closer to parity (96.1% and 95.7% respectively), economic participation and opportunity for women has



regressed. This percentages is expected to increase given the expectations that women are represented more in roles that will be automated, the insufficiency of women entering professions where wage growth is the most pronounced like technology, beside perennial problem of insufficient care infrastructure and access to capital [4].

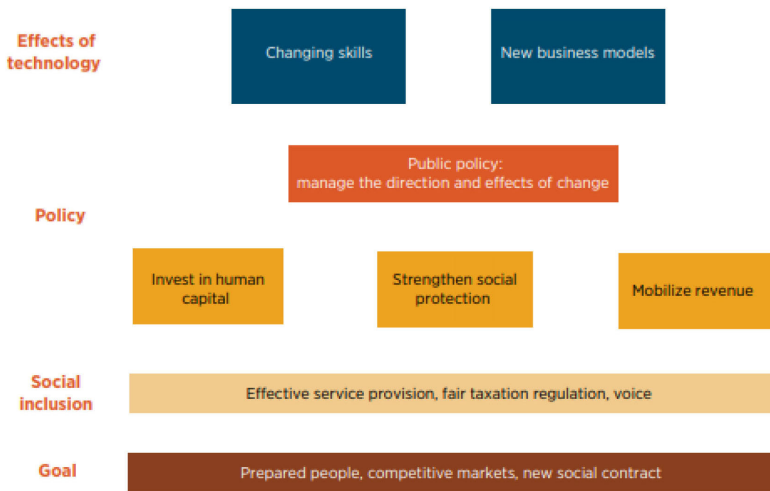
While there are many studies suggesting “what” the future would bring to women in the labor markets, not as much has been devoted to “how” policies can help them be prepared for the changing nature of future jobs. The 2019 WDR suggests three tracks/areas for policy action to respond to the upcoming technological changes

1. Invest in human capital especially in disadvantaged groups and early childhood education to develop the new skills that are increasingly in demand in the labor market, such as high-order cognitive and socio-behavioral skills
2. Strengthen social protection to ensure universal coverage and protection that does not fully depend on having formal wage employment
3. Revenue mobilization by upgrading taxation systems, where needed, to provide fiscal space to finance human capital development and social protection.

This policy paper elaborates on these areas from the gender perspective to enable Egyptian women in the era of the industrial revolution through in-depth interviews with key women leaders in the Information and Communications Technology (ICT) sector.



Figure (1): Responding to the changing nature of work



Source: WDR 2019 team.

Long-established barriers will make it harder for women to make the transition as they have less time to reskill or search for employment because they spend more time than men on unpaid care work; they are less mobile due to physical safety, infrastructure, and legal challenges; and have lower access to digital technology and participation in STEM fields than men. Removing all barriers to grant equal access to women and men to opportunities should be a first step to leveraging untapped human talent of women in the country. However, there is no one-size-fits-all approach to achieve this, and a set of effective digital skills policies is needed to be in relation to gaps and concerns about widening social inequalities in the labor market. [5].



II. Methodology

The study encompasses a qualitative approach, to investigate the impact of the fourth industrial revolution on women labor future in Egypt within the new era of automation depending on primary data-collection, in addition to exploring other secondary data from academic literature, articles, and reports as secondary sources tackling this issue. The primary data is collected through conducting four in depth interviews with key female figures in ICT sector representing different angles for the issue at stake. The study induces insights on three main inquires. (i) The potential impact of the industrial revolution on women participation in labor market in Egypt (ii) Verify the adequacy of the current level of females' skills to face the coming challenges and investigate further skills and potentials for women to make the best of the coming changes. (iii) Depict some gender specific policies for the government for women to unleash their potential and foster their participation in ICT labor market in the future. The choice of the interviewees came based on their previous and wide experience in ICT sector, as well as being working females in the field covering the three side of the triangle; education, training and employment in order to have different perspectives to the issue subject of research according to their filed of specialization. Two of the interviews have a wide experience in education and training sector in ICT. The other two interviewees represent the private sector with more hands-on experience on the labor market and agility of female calibers for future jobs on practical grounds. The data gathered is analyzed using thematic analysis model for analysis qualitative data.



III. The ICT Fourth industrial revolution and women in the labor market

a. Definition and scope of the 4th industrial revolution

vannual Davos meeting of WEF from 2016, by Schwab who argued that it is a technological revolution. It is “characterized by a much more ubiquitous and mobile Internet, by smaller and more powerful sensors that have become cheaper, and by artificial intelligence and machine learning”; and one may see its evolution in a world in which virtual and physical systems are intertwined in manufacturing, services, and other human activities[6].

Table (1): Main characteristics of industrial revolutions

Period	Transition Period	Energy Resource	Main Achievement	Technical	Main Industries	Developed	Transport Means
I: 1760-1900	1860-1900	Coal	Steam Engine		Textile, Steel		Train
II: 1900-1960	1940-1960	Oil Electricity	Internal Combustion Engine		Metallurgy, Auto, Machine Building		Train, Car
III: 1960-2000	1980-2000	Nuclear Energy Natural Gas	Computers, Robots		Auto, Chemistry		Car, Plane
IV: 2000-	2000-2010	Green Energies	Internet, 3D Printer, Genetic Engineering		High Industries	Tech	Electric Car, Ultra-Fast Train

Source: Priscearu, P. (2016). "Challenges of the Fourth Industrial Revolution." *Knowledge Horizons. Economics*, 8(1), 57-62. Web

Industrial revolutions have moved from the mechanization of production using water and steam power in the first industrial revolution, to the mass production in the second using electric power, and then to the automation of production in third using electronics and information technology, resulting in a great improvement in the standards of living for most people around the world. As such, there is great potential to have much bigger improvements from the



capability of advancing technology coming forth from the latest industrial revolution than the first three industrial revolutions summed together[6], [7].

As explained by Schwab (2016) the Fourth Industrial Revolution "is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres. It is disrupting almost every industry in every country. And the breadth and depth of these changes herald the transformation of entire systems of production, management, and governance." [7]. As such this revolution will cause a disruptive innovation affecting all core industries and sectors, such as education, health and business. Having billions of people connected by mobile devices, with unprecedented processing power, storage capacity, and access to knowledge creates unlimited possibilities which will be magnified by the new technological breakthrough in fields such as artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing. [8]

Accordingly, as expected the Fourth Industrial Revolution (4IR) will lead to a growth miracle, with long-term gains in efficiency and productivity, declines in costs of transportation, communication and trade; and improved effectiveness in logistics and global supply chains.[7]. However, inequality is an evitable outcome of technological advancements. This what happened since the late 90's in most developed countries. Inequality usually increases and median workers usually cannot keep up and fall behind. [9]. The upcoming technology advancements will lead to major labor market disruptions in the future. Talents will be the critical factor of production rather than capital. This will give rise to a job market increasingly segregated into "low-skill/low-pay" and "high-skill/high-pay" segments, which in turn will lead to an increase in social tensions.[10]



b. Projected impact of 4IR on Women in the labor market

Technology has the potential to improve living standards, but its effects are not manifesting themselves equally across the globe. Employees and workers in some sectors benefit handsomely from technological progress, whereas those in others are displaced and have to retool to survive. By 2030, estimates show that there will be more than 375 million workers around the world, and 72 million in developing countries seeking to switch occupational categories due to automation. Changes in net occupational growth or decline imply that a very large number of people may need to shift occupational categories and learn new skills in the years ahead.[2]

A recent report by McKinsey stated that occupations like office support occupations, customer interaction jobs, assembly line workers, dishwashers, food preparation workers, drivers, are most susceptible to automation. On the other hands demand on other jobs like health-care providers, professionals such as engineers, scientists, accountants, and analysts, IT professionals and other technology specialists, educators_ especially in emerging economies with young populations_, artists, performers, and entertainers, builders, manual and service jobs in unpredictable environments such as home health aides and gardeners will also grow. However technology wont only create new jobs and displace others, it will reshape the skills profile of the existing jobs. [1]

The transition from the declining occupations to growing ones will be a largescale challenge especially for women where studies found out that they are the most vulnerable to these changes. Still women are underrepresented in paid workforce especially in sectors with high return / high status jobs despite rising levels of education, as, women have less than two-thirds of the economic opportunity that men have on average globally. [11]



According to the WDR2019, women are still excluded from work in several societies. Across the world, 49 percent of females 15+ are employed, compared to 75 percent of men. Gender imbalances persist in influential positions as less than a fifth of firms have woman top manager. Generally, women work in less economically productive sectors and in occupations with potentially lower on-the-job learning opportunities. Although gender parity has improved around the world, major differences persist. Women face sector-specific legal restrictions in obtaining jobs across many countries. Sixty-five economies restrict women from mining jobs; 47 impose restrictions in manufacturing; and 37 restrict women from construction jobs. Furthermore, in 29 of 189 economies women cannot work the same hours as men.

Accordingly, as shown in figure (2) women have a relatively higher presence in the declining occupations both clerical support and services and sales occupations (44 %). Yet still men outnumber women in all occupations. Across occupations, the lowest presence of women is as plant and machine operators and assemblers, where women fill just 16 percent of such positions. Most female managers of formal firms in emerging economies are in the retail sector. Women generally face lower payoffs from work experience (1.9 percent) than men (3.1 percent). [1]



Figure(2): Distribution of employees by gender in different occupations



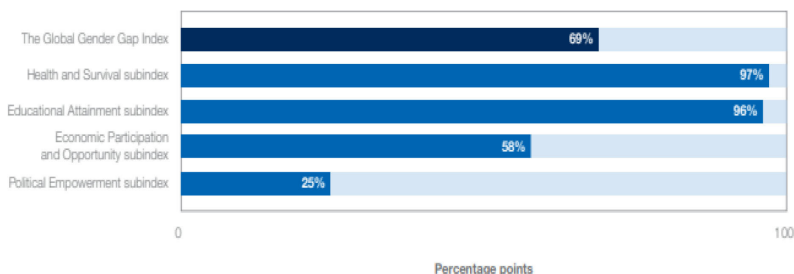
Source: WDR 2019 team, using household and labor force survey data from the World Bank's International Income Distribution Data Set.

Hence, although there are some improvements in the status of women in the economy, a considerable gap remains in the economic opportunities available to women and men. This is verified as well in the economic forum Gender Gap Index[4]. There are some improvements for women in education attainment, health and survival sub index shown in Figure (3) where 96.1% and 95.7% of the gap (respectively) is closed so far. However, the gap between women and men remain significantly larger on Political Empowerment, where only 24.7% of the gap is closed to date, and on Economic Participation and Opportunity, 58% of the gap has been closed so far, and it has slightly widened since last year. The dispersion between the best performing countries and those at the bottom of the ranking is substantial. While the top 10 countries have closed at least 80% of the gap, the bottom 10 countries have only closed 40% of the gap between men and women in the workplace.



Figure (3): The state of the gender gaps

Percentage of the gender gap closed to date, 2020



Digital economy might be an opportunity to bridge the gender gap in labor force participation and can open opportunities for women to achieve their aspirations while contributing to the GDP through creating and sustaining decent jobs [12]. Some platforms expand the supply of labor by increasing opportunities for new, flexible types of work that complement traditional forms of employment in the gig economy. Workers set their own hours for most platforms. The flexibility inherent in platform work also enables more women to participate in the labor force. Finally, digital platforms enable firms to exploit underused physical and human capacity, transforming dead capital into active capital. [1]

IV. Status of women in labor force in Egypt challenges and opportunities

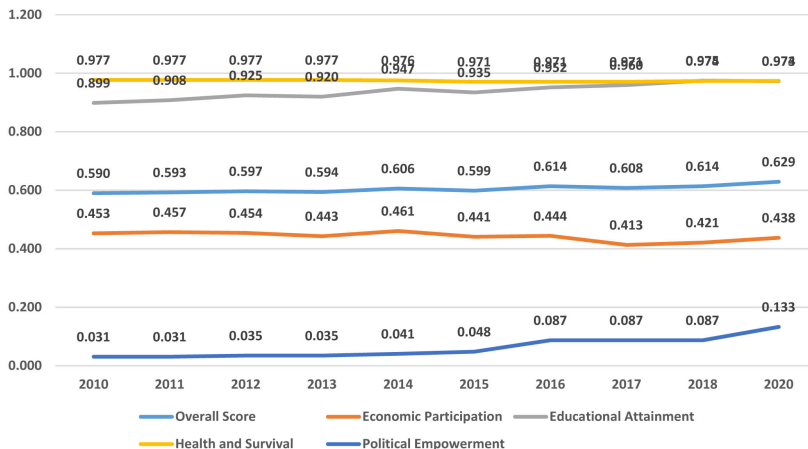
a. Women participation in labor market in Egypt: barriers and challenges

Egypt is home to 48.7 million women, and improvements to their conditions will have a significant impact on the country's economic and social progress. According to latest report on gender gap index Egypt still has a



way to go to grant women equal opportunities and closing the gender gap especially in political empowerment and economic participation aspects. Egypt rank is 134th closing 62.9% in its gender Gap. Women participation in economic opportunities is still weak, Egypt ranked the 140 among countries where only 24.7 % of women are in labor force, out of which about 20% are on a part-time contract. Further, very few women are in managerial roles (7.1%) and their presence among firms' owners and top managers is also extremely limited (2.4% and 4.9%, respectively). Differences in income (which include wage and non-wage revenues) between men and women are still large. It is estimated that the income of an average of a man income is about 3.8 times that of an average woman. Removing all barriers that grant equal access to women and men to internships should be a first step to leveraging untapped human talent of women in the country. [4]

Figure (4): Egypt Gender Gap Scores development (2010-2020)



Source: World economic forum 2019, Global gender Gap report.



Although female and male enrolment in education is almost alike, yet there is a wide gap between female and males in participation in labor market participation. Based on the recent report on Gender gap index females enrollment in primary, secondary, and tertiary education is 98.8%, 83.1%, and 35.8% respectively compared to males enrollment 98.3%, 82.5% and 34.6% however women participation in the labor forces is only 24.7% compared to 77% for males . Further, there is a wider gap between females and males in estimated earned income and senior positions.

Females in Egypt have higher unemployment rate of 23.1% compared to 7.8% unemployment rate for males in 2018 [13]. Furthermore, the education level of unemployed women is higher than that of their male counterparts. According to CAPMAS statistical year Book (2017), the unemployment rate for female who graduated from university or above is much higher at 37.2% in 2016 compared to 26.5% for males. Usually job opportunities for formal work for women in private sectors are limited; in addition, the available number of jobs in public sectors are relatively smaller than the number of annual university graduates. Therefore, many women are queuing for jobs in public sectors or are forced to work in informal sectors with inappropriate working environments and low wages [14].

Additionally, females are highly concentrated in jobs in agriculture and services sectors, 36.7% and 56.5% respectively while poorly participating in the industrial sectors with an employment rate reaches 6.8 compared with an employment rate of 31.7% for males in 2018.[13]. and having less existence in firms' ownership (2.4%) and top management positions (4.9%) Figure (6) and Figure (7).



Figure (5): Distribution of employees by sex and sector in 2018

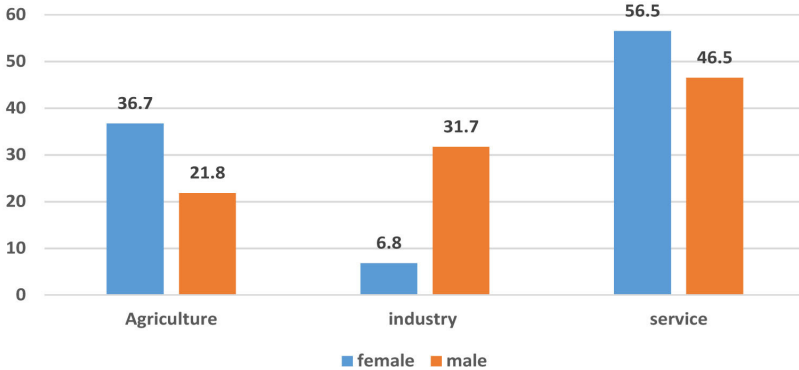


Figure (6): Firms with female majority ownership, % firms

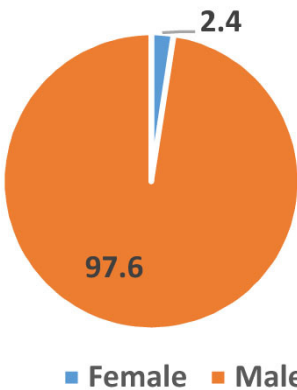
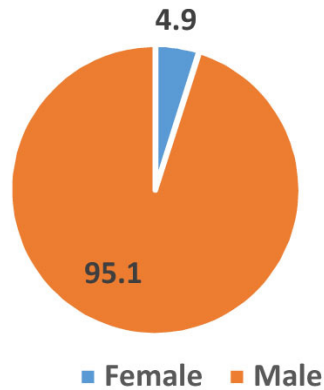


Figure (7): Firms with female top managers, % firms



Given the challenges, women face in labor market digital economy might be an opportunity to bridge the gender gap in Egypt and can open opportunities for women.



Opportunities and initiatives to foster women employment in Egypt using ICT

In Egypt ICT is a main catalyst for promotion of gender equality, working on closing the gender digital divide has been at the center of ICT national strategy in terms of the different dimensions: access and use of ICT, capacity – building opportunities and employment.

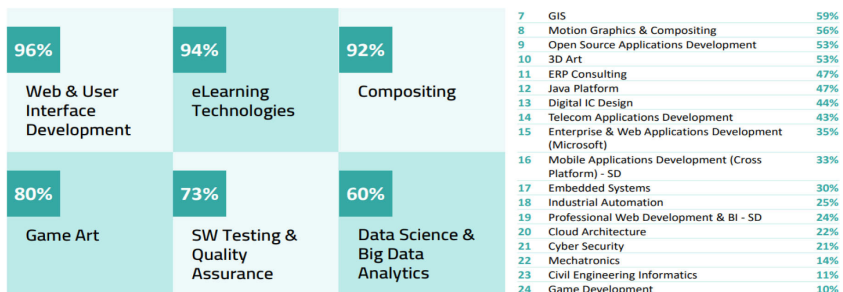
In terms of access and use of ICT the gap in digital literacy has been reduced between males and females in urban and rural areas in Egypt, it is even become nonexistent among youth below 25 years of age[15]. In terms of capacity, building Egypt has adopted many initiatives to raise the competitive edge of Egyptian calibers. Through developing their skills in ICT and provide them with hands-on experience enabling them meeting the current and future market demand. There is a diversified list of specialized programs and institutions among which are The Information Technology Institute that provide a diversified set of national capacity building programs, to develop youth capabilities and skills through university education, post-graduate training and professional advanced coaching. The National Telecommunication Institute (NTI), which provide high quality education and training services for telecommunication engineers. e-Learning Competence Center (ELCC) aims to support Egypt's overall education reform and entrepreneurship development through the effective use of ICTs with a special focus on harnessing the e-learning technologies and maximizing the potential for collaborative Public Private Partnerships (PPP).



Box (1): Information Technology Institute 9-months Professional Diploma Scholarship

The ITI 9-Month Professional Training Program is offered as a full-fledged scholarship by the Egyptain Ministry of Communications and Information Technology through the Information Technology Institute for selected Egyptian university graduates within five calendar years of their graduation. It was specially made for students to offer them an excellent ICT training, enabling them for lucrative job opportunities in Egypt and regional ICT markets, as it has qualified over 15,000 ICT professionals representing over 30% of the Egyptian ICT sector. Each year more than 25 tracks like Embedded Systems, IOT, Big Data, Game Development, Animation & Film making, etc.. are available. Due to its high-quality standards, several international universities like University of Paderborn in Germany and Egypt – Japan University of Science and Technology, accredit 9-Month program as a pre-master's degree. Likewise, the employability rate of this Program exceeds 80% before even receiving their grade.

ITI Technology Domain Female Beneficiaries based on the ITI database





In terms of improving employability, this has been conducted two main avenues: First linking trainees with the job markets and tailor training programs through outreaching and collaborating with the industry. For example, a new program called “Wazeefa Tech”, has been launched in collaboration between MCIT and the Ministry of Social Solidarity (MoSS), based on the “Income Share Agreement” model. “Learn First... Pay Later”. The program ends with a job opportunity for interns, after the successful completion of the three-month training program. The cost of the program will be covered by Nasser Social Bank (NSB) at zero-interest loan. Through the program, companies will be able to fulfill their hiring needs with a flow of qualified calibers. In addition, they can reduce investment expenses spent on the training of newly hired fresh graduates.

The second avenue is providing incubations for startups Egyptian Information Technology Industry Development Authority (ITIDA), a governmental entity aiming at paving the way for the diffusion of the e-business services and supporting an export-oriented IT sector. It enables and support startups through professional training and consultation to grow with their business. It gives them the opportunity to pitch their ideas and those successful can receive a financial support, office space, cloud services, and access to investors. They can also have access to professional one-on-one consultancy services in several business and technical fields, such as; finance, digital marketing, sales, business development, marketing, intellectual property and legal. In addition, there are programs in the area of innovation and entrepreneurship directed to university students in ICT specializations who are aspiring to be future innovators and entrepreneurs, either through establishing their own innovative start-ups or through manifesting skills that are highly required by local and multinational companies. A recent



Technology Learning Initiative under presidential auspices “Next Technology Leaders (NTL)” is aiming at building and certifying capacity young calibers on the latest information, communications, and electronics technologies; in Graphic designing, Android developing, machine learning, Digital marketing, Cybersecurity, Embedded system, Big data analytics among others. To-date, there are around 1,880 participants in these courses, 35% of which were women.

Box (2): (هي-رائدة) "Heya Ra'eda" In TIEC Supporting Women Entrepreneurs

It is a program to support early stage women entrepreneurs operating in the ICT sector, where it targets. women entrepreneurs whose product is technology or the entrepreneurs who use technology as an assistive factor to commercialize their products.

The main target is to induce the basic business development functions as a secondary practical skill set allowing them to –efficiently– run a successful operation, eliminating the waste on resources and opportunities, and help onboard them on other entrepreneurship programs within TIEC and the ecosystem at large.

It is a five-days program where women get hands-on training on business validation, business modeling and key technology elements in addition to experience sharing, marketing skills and products pricing techniques.

The Women Entrepreneurship program in TIEC (هي-رائدة) is a yearlong program. The target of the program is to train women entrepreneurs on startup methodologies and concepts wherever they are throughout the 27 Egyptian governorates. Starting from 2017, 209 women have been graduated with many success stories in establishing and running their business.

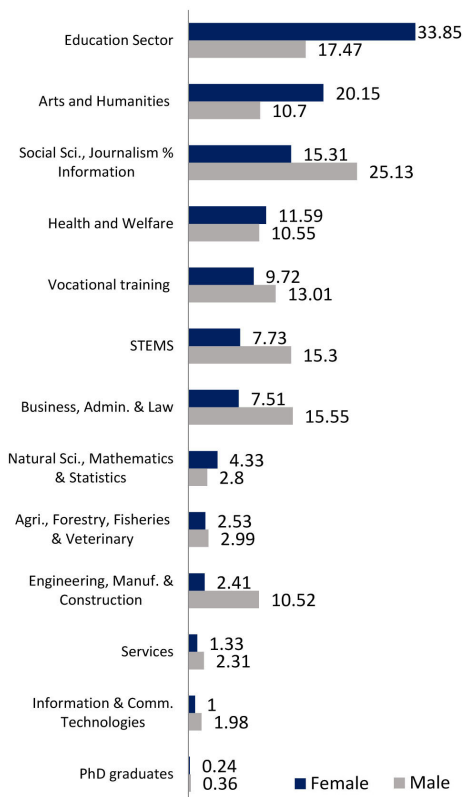


Though ICT sector has provided wide opportunities for women in Egypt, yet with the great changes in technologies and the 4th industrial revolutions there is no enough evidence how women in Egypt can adopt or to what extent they would be negatively affected especially given their poor representation in fields that will witness high demand in the future.

According to WEF recent studies women usually goes to less technical fields like education, arts and humanities, and health and welfare, a wide gender gap in favor of males is present in most other fields, including business, administration and law and engineering, manufacturing and construction. The gap is also noticeable in vocational training and STEMS attainment.

Further, the percentage of females among professionals and administrators working in the ICT sector decreased from 28% in 2011/2012

Figure (8): Education & Skills in Egypt





to half this percentage in 2018/2019 reflecting that more efforts are needed to attract more women to jobs in the ICT sectors [12].

Digital technology will generate a set of disruptions in the labor market and their net effect on women empowerment need to be studied. Digital technology provides a wider set of opportunities for women, it enables her to work from home hence enabling her maintain her role in her family as care giver. However females working in the informal sector, or in occupations threatened by technological revolution might fail to join the formal sector if they do not acquire the needed skills and subsequently female unemployment might increase. Accordingly, as stated in Othman (2019) Successful public policies for digital jobs should be segmented to reflect different types of digital work, namely, ICT intensive, ICT dependent, and ICT-enhanced:

- ICT-intensive jobs that are directly focused on ICTs.
- ICT-dependent jobs that use digital technologies to varying degrees and are made possible by ICTs.
- ICT-enhanced jobs that use digital technologies to varying degrees but could be performed without ICTs.

A qualitative assessment to capture the insights on future of women labor in ICT sector in Egypt with key female figures in the ICT sector has been conducted and analyzed in the coming section.

V. The reflection of the 4th industrial revolution on Women in Egypt - Thematic analysis

Impact of technological innovation on labor market in Egypt from the interviewees' opinion

This section includes the views of four females experts in the ICT sector; education, training and employment :List of interviews:



Rasha Tantawy, Entrepreneurship Support Department Head, Technology Innovation and Entrepreneurship Center (TIEC) Egypt.

Heba Saleh, Chairwoman of Information and Technology Institute (ITI), the training arm of the Ministry of Communications and Information Technology (MCIT) of Egypt.

Hoda Mansour, Managing Director, SAP Egypt.

Asma Hosny, Co-Founder and CEO at Wasla Misr and former CEO of Information Technology Industrial Development Agency (ITIDA) Egypt.

There is an optimistic perspective in general on the potential impact of the coming technological revolution on labor market in Egypt taking in consideration more than one factor. First, Egypt has the human capital needed, young population, where more than 60% are less than thirty years old. Second, new reforms in education system is on the way to equip the coming generations with the right skills. Third, the evolvement of skills set where more and more people are adopting quickly to the use of the technology tool; the recent situation caused by COVID-19 is an example where many companies adopted quickly on working remotely. The country is enforcing the use of technology, digitalizing services and payment hence Egypt will be more adopted and capable of coping and better utilizing the technology in the future. Fourth, the expected pace by which the massive changes in labor market will reach Egypt compared to other developed countries. Innovation and Technological waves will not affect labor in Egypt only but all over the world, yet the interviewees expect that the pace will be much slower taking in consideration the cost of these new technologies versus the labor cost. For example, the occupations that will be highly threatened are those that can be completely replaced by computers, but at the same time they can be reskilled to do other jobs that the



technology cannot take over. Asma Hosny gives an example of translators, though there are applications that can do this job, yet the phrasing is a talent that is hard to be replaced. Early reskilling and retraining can save these people from losing their jobs. Further, Heba Saleh stated that it is already time to have solidarity programs for the unskilled whether men or women who are threatened to lose their jobs due to technological advancement and cannot be retrained. She is proposing that big firms causing labor market disruption like Amazon should finance this.

Finally, given the population structure of other developed countries and the increasing demand for skills to follow up with the new industrial revolution. This will create a new working models like remote working where employees are hired overseas, which is different from the freelancing models. Andela¹ for example has more than 200 Egyptian software engineers working from home. In particular, this last factor is considered as a great opportunity for women in Egypt. New working models as remote working and freelancing eliminate the hindering factors for women participation in labor markets of fulfilling their social role as caregivers for their families. Unlike men, women prefer these models of employment given the flexibility they provide. Further women poor participation rates in employment can be attributed their lack of preference not because they don't have the opportunity. In Egypt, there are many opportunities for women in the labor market and it is her choice to pursue or not. Taking for example percentage of girls in education in schools

¹ Andela is an engineering-as-a-service business that helps companies build remote teams quickly and cost-effectively. We have 1,000+ software engineers working as full-time, embedded members of development teams at over 200 leading tech companies. Andela's engineers work from Nigeria, Kenya, Uganda, Rwanda, Egypt and Ghana. The company is headquartered in New York, has a globally distributed leadership team, and is backed by investors including Spark Capital, Generation Investment Management, Serena Ventures, Chan Zuckerberg Education, and Omidyar Network.(Andela.com).



or universities it is either 50% or more. Also a verification on that is the employment pyramid, where at the base "junior levels" there are as many women as men, yet percentage of women decrease as we climb the pyramid to more c-level and senior positions due to cultural and societal factors like marriage and other family commitments. Hence, with the new working models like remote and freelancing, which, in her views, will represent around 40% of working models in 2020, there will be no discrimination according to gender; skills will be the only determinate factor for employers. As stated by Heba Saleh, it is time "we need to stop talking about gender equality and start talking about skills equality". Further they see women calibers everywhere; especially the ICT and programing sector which is full of competent females especially in education and training; former mangers of institutions in ICT sector in Egypt are women, including in ITI, ITIDA, the Minister consultants and advisors. Women are in all specializations including doctors, engineers, and teachers among many other disciplines and there are women working in new technologies including AI and robotics. For example, as stated by. Hoda Mansour, "half our employees in SAP company are women and SAP is a very advanced in terms of technology". Technology is an enabling and empowering factor even for artistic, crafted and talented women, it enables them to grow their small businesses and open up to larger market inside and outside of Egypt. In general, all the participants agree that the coming changes is not a challenge yet, but more of an opportunity for women in the future. As quoted by Asmaa Hosny "the only challenge we as Egyptian women face is to leave our kids to go to work and once it's done, we can succeed in whatever challenge we face".

However, there is a consent that new set of skills will be required for the upcoming occupations whether for men or women. All participants agree on the importance of including cognitive, analytical thinking, coding



especially before university education. To be equipped with the right skills for the coming technological changes STEM skills, Science, Technology, Engineering, and Mathematics is an essential. Further Heba Saleh added the "A" to be "STEAM" as those who are artistic, crafters and innovators are not replaceable by technology. Occupations that requires imagination, crafting and literal skills required for maintenance for autonomous cars or Robots, etc. Moreover, Rasha Tantawy adds leadership and communication skills especially for girls as based on her experience women need to enhance their self-esteem and confidence. As quoted by Rasha "our trainees in Heya ra'da" do not believe they can make mass production and succeed in their businesses, they lack confidence in their capabilities".

When asked whether men are more likely to work in new occupations that involves the deployment of next-generation technology for instance, AI specialists and roboticists, rather than women in Egypt. Hoda Mansour representing the industry point of view sees that there is no difference between men and women in terms of skills preferences, she sees that women can be certified and work in any occupation. They already have women working with high advanced technologies. Other interviewees see that women prefer certain fields. For example, in universities female students prefer computer or civil engineering over mechanic or electrical engineering. As stated by Heba Saleh, in ITI there are more female students, yet they are more likely to join specialization like e-learning, embedded systems, graphics and quality assurance and testing rather than mechatronics. She attributed that to imbedded preference rather than unavailability of opportunities in these fields. However, new technology offers new opportunities for women through remote working and freelancing. This is more encouraging for women than men. She can make money from home and at the same time fulfil her social responsibilities unlike



men who usually do not like to work from home. This opportunity is offered only in ICT sector, a doctor for example, cannot work from home. Computer engineer tools are the internet and skills, and this breaks the idea of gender inequality. In this new realm, companies are only looking for skills and quality.

Further women are better in multitasking. They have emotional intelligence and better equipped by certain capabilities like parallelism, multitasking, organizing and attention to details. These are the traits of a good programmer. The good ones can pay attention to details of the back threads, the space the function took from the memory and how to minimize the memory taken on the machine for function operation. Further occupations they can excel at are coding, building platforms and data analytics. Women are hard workers in general, however; it is time to stop put pressure on her to put double the normal efforts just to prove her competency and capabilities. If such perception is changed, women can then excel in any occupation and in any field.

The only discrepancy women face in the labor market that was raised out was in leadership and top management positions, where men are preferred over women for these occupations, though the situation is slowly improving now than before. There are many successful female figures in top management positions in multinational companies as noted by Hoda Mansour. On the other side Heba Saleh see that the dearth of women in senior positions returns to social conditions and family commitments rather than discrepancy towards women.

For policy recommendation for boosting women employability given the challenges of the coming industrial revolution, insights can be grouped in four main categories:



- i. **Educational and Training programs:** all participants agree on the importance of training women especially at early ages from school on cognitive skills, coding, analytical thinking and leadership so this should be considered in the educational policies and reform. Children camps where girls get acquainted with new technologies and practicing it to develop passion and interest. Further tailored training programs for women only, as noted by Rasha Tantawy "women usually get comfortable around women", according to her experience, many women applied in "Heya Ra'da" training program though it was available before yet as mixed gender programs. Also developing online courses in ITI they have "Mahara tec" providing ITI programs online for all and especially for women who prefer to stay home.
- ii. **Empower women in business** by encouraging co working spaces for women to practice freelancing. For example in ITI they have an initiative by creating co-working spaces in their branches in the governorates since they find that although they included freelancing in their training program since 2013, yet the percentage of graduates women engaged in freelancing is low. Therefore, they designed the co working spaces where they can mingle with others experienced in the field of freelancing to gain insights and know how to create her profile and market their skills and talents. In the same line of thoughts are the establishment of women based incubators where they can get incubated for one year, learn business communication and also be provided with a work space in which the female entrepreneurs can have all



facilities and internet access. Additionally, establishing childcare facilities/kindergarten is essential where they can leave their kids safe and also the provision of safe means of transportation

- iii. **Reskilling programs** for those who will be laid off due to technological change. Especially for the positions that technology will completely take over like operators in call center, clerks, administrative jobs and ICT-enhanced jobs that use digital technologies to varying degrees.
- iv. **Solidarity Social insurance systems** is required to enable those poor in skills to have basic income salary. This was raised in the World Bank report where new models of social protection programs is required in such timing. Big technological firms responsible for job market disruptions should finance this.
- v. **Accompanying Measures for economic activity**, one of the participants call for measures to oblige private sector have a women quota in their companies, another asks for considering putting measures to ensure a minimum representation of women on boards; especially on the boards of private and public sector companies and banks. Another calls for rehabilitation centers for women who had stayed for some time at home due to family conditions, to facilitate the transition to the labor market and have a suitable job. and as quoted by Rasha Tantawy "Money on women is very well spent".
- vi. **Media Campaigns** to change the perceptions and encourage women participation in labor force, disseminating new working models and skills required for the future.



VI. The way forward for empowering women through ICT

The coming fourth industrial revolution although accompanied with many challenges for labor markets in general and for women in particular, yet it entails numerous opportunities especially for women which gives an optimistic perspective if women are well prepared and equipped with the required skills. Although numbers show dearth of women in terms of participation in economic activities, however this can be partially attributed to lack of preferences or awareness of the existing possibilities, and not necessarily due to lack of opportunities. Women in Egypt are often the primary caregivers for both children and ageing relatives. However, the technology advancement can be seen as a privilege for women on two fronts: the automation is unlikely to affect and displace artistic occupations, where women excel at and, it entails the expansion of the gig economy where the percentage of remote employment will increase if not being the prominent working model. Hence providing the flexibility preferred by many women.

Meanwhile, to make the best use of ICT sector advancements Egypt needs to build an ecosystem that supports women navigating the disruptions of the Fourth Industrial Revolution. This ecosystem should cover core features that can best meet the challenges and maximize the opportunities of the Fourth Industrial Revolution. As verified in the World Bank report "Protecting All: Risk Sharing for a Diverse and Diversifying World of Work." [16] "Rather than protect workers from change, governments can shift efforts to protecting them for change: supporting job transitions and re-employment". Aligned by the framework presented in a study by the World Bank [17], preparing and protecting women for technological change can be conducted through considering the following layout:



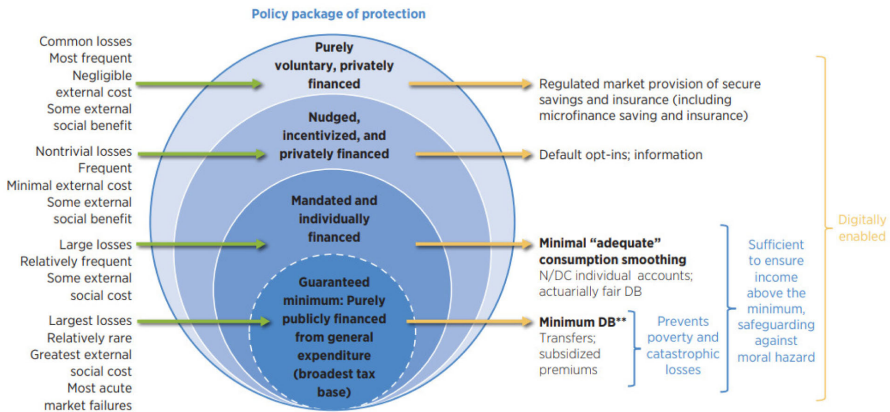
First: awareness and lifelong learning; leveraging the level of awareness of women on the upcoming changes; opportunities, challenges and skills requirements. This can be conducted through media messages in television series and other forms of campaigns. Media is the most influential tool in changing people perceptions. Revealing the opportunities and the returns of education, models and examples of women establishing their business or work from their home, the new skills and level of satisfactions and empowerment that follows is important messages to deliver. Exposure to employment opportunities as well can reveal the returns on education investment and induce parents to keep their girls in schools. For example, research has found that that in low-resource settings, the mere visibility to work opportunities can bolster the case for education, especially for girls' schooling, since knowing about the required education and basic skills has incentivized parents to keep their daughters in school for longer[11].

Second: Women Capacity Building Technology has become a language that girls must master from an early age, enabling girls to be digitally fluent whether through schools, summer camps or online training courses, this will set their minds and alter the way they interact and think of their future. Increasing the STEM-literacy is certainly very important for mastering the fourth industrial revolution. This should be accompanied by other skills to connect theory with applications and experimental learning, and science to humanities like creative, critical thinking and non-cognitive skills. Encouraging new forms of employment like freelancing and remote working, and support women in business by providing co-working spaces, with technical guidance and consultancy. Government could take some measures to increase the number of women by putting quota system for the private sector, encourage the establishment of programs for reskilling women to be reenrolled in the labor market, design on-job training programs for women.



Third: Social Protection. The provision of comprehensive social protection package for women, for those threatened to lose their jobs, and to adopt the new work modality of telecommuting and freelancing. The comprehensive policy package of protection from risk and uncertainty presentenced in the World Bank report " Protecting All: Risk Sharing for a Diverse and Diversifying World of Work provides a good framework for this package. The policy package proposed consists of segments, where each one of these segments is defined according to the nature of shocks people faces. The proposed package is with a publicly financed, guaranteed-minimum risk-pooling mechanism at its core and additional layers of mandated, nudged, and voluntary insurance (figure9).

Figure (9): The proposed comprehensive policy package of protection from risk and uncertainty in the World Bank report



Source: Truman Packard, et al, (2019), "Protecting All: Risk Sharing for a Diverse and Diversifying World of Work." World Bank.



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