

TECHNOLOGICAL DEVELOPMENTS RESHAPE THE FUTURE OF LABOR MARKET SKILLS IN SWEDEN

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PREFACE ¹

A particular focus of this paper is on arriving at a better understanding of the effect of the Fourth Industrial Revolution's, including automation and digitalization on the labor market in Sweden, and determine the future skills needed for the workers.

The new technology created new job opportunities for wholly new tasks, opening up opportunities for an entirely new range of workers. At the same time, technological development reduced the number of workers required for certain work tasks, which the increased demand for new roles will offset the decreasing demand for others. However, these net gains are not a foregone conclusion. They entail difficult transitions for many workers and the need for proactive investment in developing skills of workers. As well as, preparing the workers by developing the education, knowledge, and skills to adaptive with the new requirements of the future labor market.

To prevent potential negative impacts of technology changes on the workforce. It is important that companies play a pivotal role in supporting the existing workforce through reskilling and upskilling. As well as, the role of government to create an enabling environment to assist in these efforts and develop the education system and skills needed to adaptive with technological developments. In order to truly rise to the challenge of formulating a winning workforce strategy for the Fourth Industrial Revolution and to close skills gaps.

THE NEW TECHNOLOGICAL LANDSCAPE

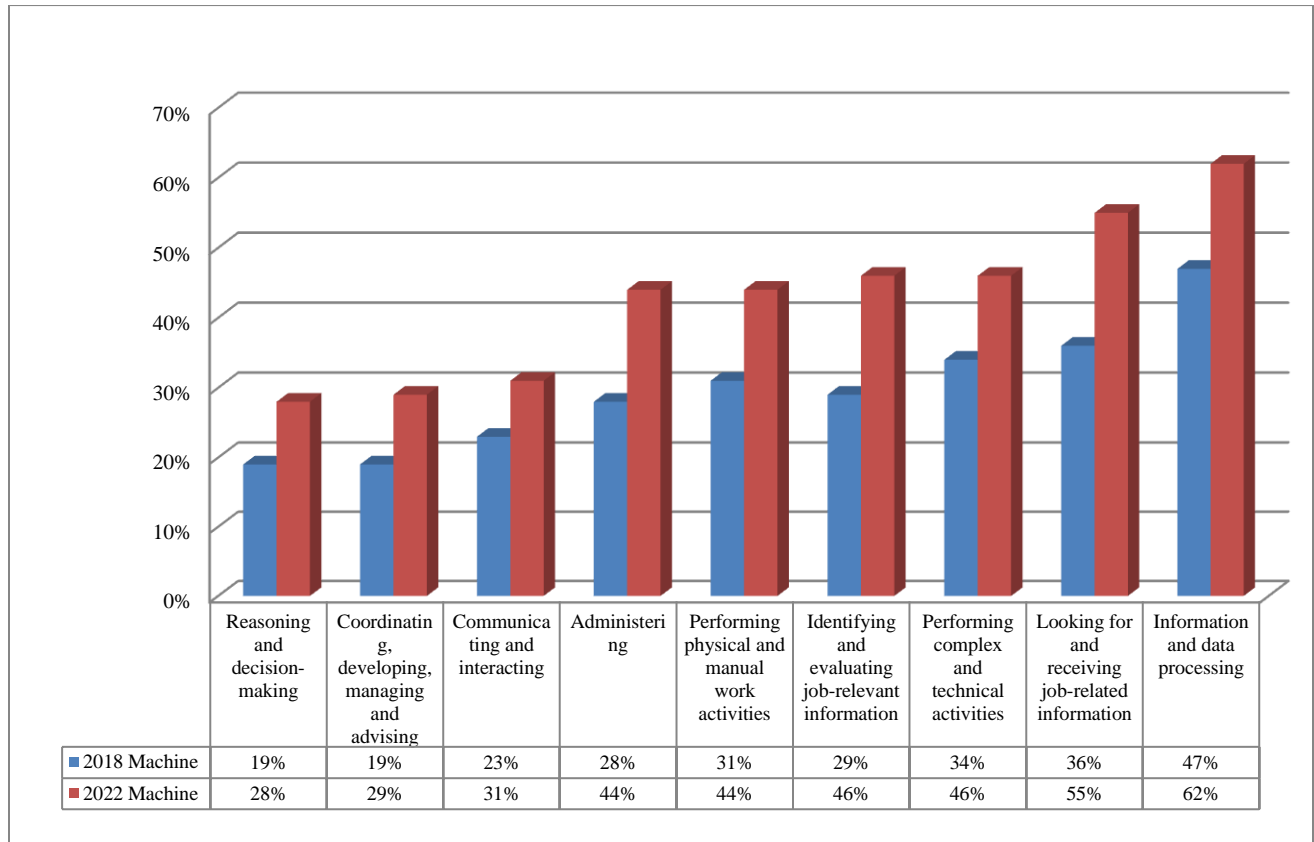
World Economic Forum report indicated that four technological advances: ubiquitous high-speed mobile internet, artificial intelligence, widespread adoption of big data analytics, and cloud technology. Represent drivers positively affecting business growth, and set to dominate the period 2018–2022.

The technological development contributes to shifting on the frontier between humans and machines. In 2022 the projected that technological developments, machines, and algorithms will increase their contribution to specific tasks 62% of organization's information and data processing tasks will be performed by machines compared to 47% in 2018. Even the tasks that

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remained overwhelmingly human, like communicating and interacting will become more dependent on machines from 23% in 2018 to 31% in 2022.

Figure 1: Ratio of human-machine working hour, 2018 vs. 2022 (projected)



Source of data: Future of Jobs Survey (2018). World economic forum, the future of job report, Centre for the New Economy and Society, P11.

Technological developments are reshaping the skills needed for work and increased the demand for specific roles that are significantly based on and enhanced by the use of technology. Automation and digitalization led to a reskilling imperative for workers to adaptive with technological change.

Companies have many strategies for addressing skills gaps to adapt to new technologies. The major strategies are: hire new permanent staff with skills relevant to new technologies, look to automate the work, and retrain existing employees.

The relation between new technology, jobs, and skills are complex feedback loop because the technologies can create new jobs and demand for specialist skills, and on the other hand, can also displace entire roles when certain tasks become automated. As well as, skills gaps speed up the

trends towards automation in some cases but can also pose barriers to the adoption of new technologies and therefore impede business growth (World Economic Forum, 2018).

Nevertheless, robots are replacing workers most easily when it comes to routine tasks, but it is far from clear to what extent. Overall, technological change that replaces routine work is estimated to have created more than 23 million jobs across Europe from 1999 to 2016, or almost half of the total increase in employment over the same period.

The World Bank introduced a model of changing work explains the relationship between automation and innovation, and their role to reshape the future labor market. The digital technologies enable companies to automate, replacing labor with machines for production. The innovation and expanding the number of tasks and products, lead to increase the demand on the labor and skills intensity of the new sectors or tasks that emerge. Thus automation has disproportionately reduced the demand for less skilled workers, and the innovation process has generally favored the more educated. So the question is whether workers displaced by automation will have the required skills for new jobs created by innovation. The overall future of employment will be determined by the battle between automation and innovation (World Bank Group, 2019).

CLASSIFICATION FRAMEWORK FOR JOBS AND SKILLS

Occupational Information Network (O*NET) framework for analysis jobs, skills, and tasks, was developed using research on job and organizational analysis, provides a framework that identifies the most important types of information about work and integrates them into a theoretically and empirically sound system.

O*NET was developed by the US Department of Labor in collaboration with its Bureau of Labor Statistics' Standard Classification of Occupations (SOC) and remains the most extensive and respected classification of its kind. In its unabridged form, the O*NET-SOC taxonomy includes detailed information on 974 individual occupations in the United States, grouped into approximately 20 broader job families, which are regularly revised and updated for new and emerging occupations to keep up with the changing occupational landscape.

These descriptors are organized into six major domains, which enable to focus on areas of information that specify the key attributes and characteristics of workers and occupations ([The O*NET Content Model](#)).

Table 1: Description of skills and jobs requirements, based on O*NET content model

Major Domains	Variables	Description
Worker Characteristics	Abilities, Occupational Interests,	Comprise enduring characteristics and attributes of individuals such as (Cognitive, Psychomotor, Physical,

	Work Values, and Work Styles.	and Sensory Abilities) that may influence how they perform tasks and how they acquire work-relevant knowledge and skills required for effective work performance.
Worker Requirements	Basic Skills, Cross-Functional Skills, Knowledge, and Education.	Indicate to work-related attributes acquired and/or developed through experience and education. Knowledge represents the acquisition of facts and principles about a domain of information. Experience lays the foundation for establishing procedures to work with given knowledge. These procedures are more commonly known as skills, which may be further divided into basic skills, such as reading, facilitate the acquisition of new knowledge. Cross-functional skills, such as problem-solving, extend across several domains of activities.
Experience Requirements	Experience and Training, Basic Skills - Entry Requirement, Cross-Functional Skills - Entry Requirement, and Licensing.	This domain includes information about the typical experiential backgrounds of workers in an occupation or group of occupations including certification, licensure, and training data.
Occupational Requirements	Generalized Work Activities, Intermediate Work Activities, Detailed Work Activities, Organizational Context, and Work Context.	A comprehensive set of variables or detailed elements that describe what various occupations require. Contextual variables such as the physical, social, or structural context of work that may impose specific demands on the worker or activities
Workforce Characteristics	Labor Market Information and Occupational Outlook.	Variables that define and describe the general characteristics of occupations that may influence occupational requirements.
Occupation-Specific Information	Title, Description, Alternate Titles, Tasks, Technology Skills, and Tools.	Variables or other Content Model elements of selected or specific occupations. Includes requirements such as work-related knowledge, skills, and tasks in addition to the machines, equipment, tools, software, and information technology workers may use in their workplace.

Source: [The O*NET Content Model](#).

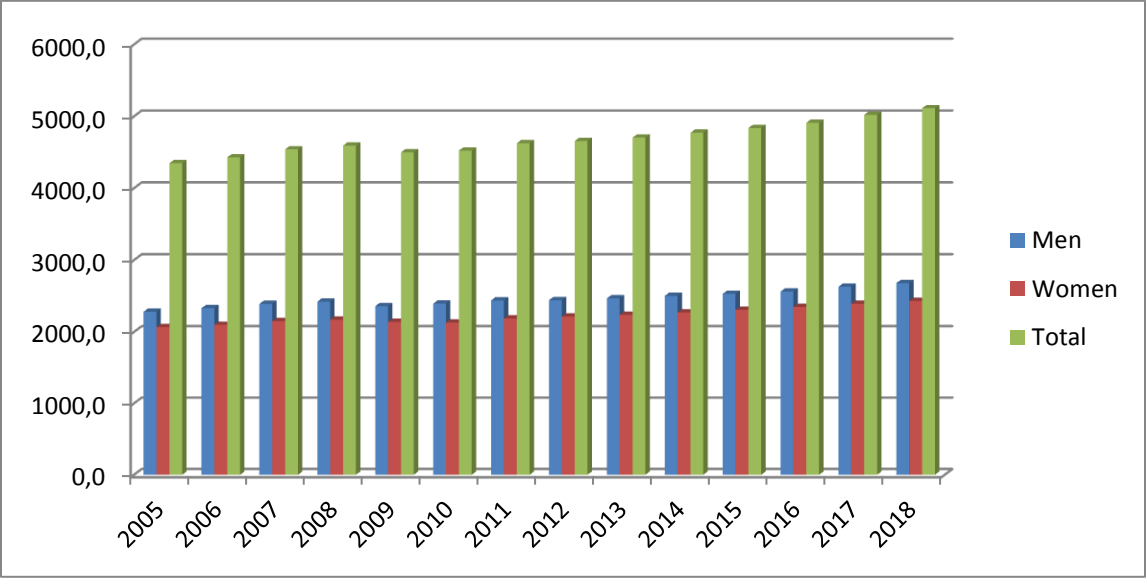
Investing in human capital is the priority to make the most of the opportunities created by technological developments. Three types of skills are increasingly important in labor markets: advanced cognitive skills such as complex problem solving, sociobehavioral skills such as teamwork, and skill combinations that are predictive of adaptabilities such as reasoning and self-efficacy. Building these skills requires strong human capital foundations and lifelong learning. Human skills will likewise retain or increase their value.

To adapt to the changing nature of work, people, businesses and governments must strengthen human capital and ensure that they have the basic skills required for the labor market. The growing role of technology in business means that all types of jobs require more advanced knowledge skills (World Bank Group, 2019).

OVERVIEW OF THE LABOR MARKET IN SWEDEN

The number of employed persons in Sweden increased from 4347.6 thousand in 2005 to 5112.8 thousand in 2018, the number of employees increased continuously from 2011. Employed persons in Sweden averaged 4766.4 thousand during the last 10 years from 2009 to 2018.

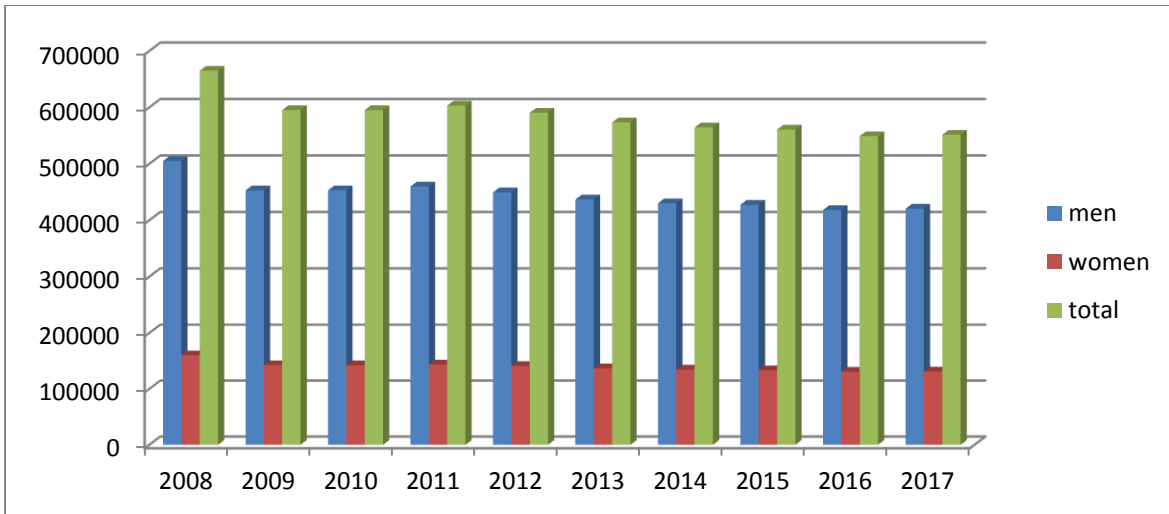
Figure 2: Number of employed persons in Sweden



Source of data: [Statistics Sweden \(SCB\)](#)

The number of workers in the manufacturing sector decreased from 664990 in 2008 to 551403 in 2017. Technological developments and automation contribute to decrease the demand on workforce in manufacturing sector in Sweden. Where the impact of technological developments seems more pronounced in the manufacturing sector.

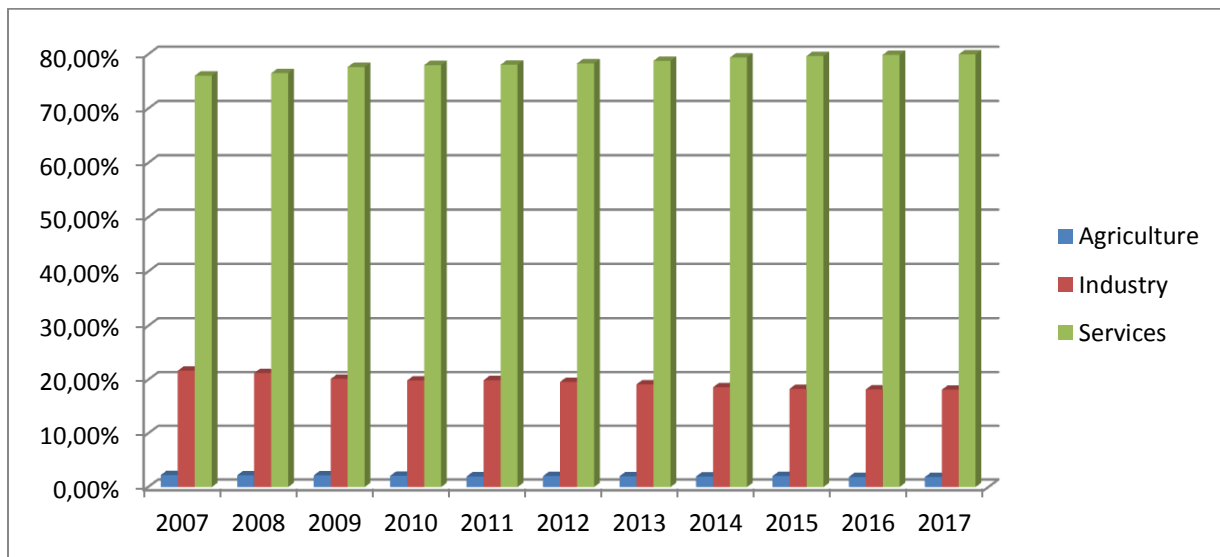
Figure 3: Number of employees in manufacturing sector Sweden from 2008-2017



Source of data: [Statistics Sweden \(SCB\)](#)

On the other hand, figure 4 shows the continuous increase in the percentage of workers in the services sector from 76.07% in 2007 to 80% in 2017, at the expense of the continuous decline in the percentage of workers in the industrial sector from 21.69% in 2007 to 18.14% in 2017, and also the decline in the percentage of workers in the agricultural sector from 2.25% in 2007 to 1.87% in 2017.

Figure 4: Distribution of employment by economic sector in Sweden from 2007-2017



Source of data: [Statista, The Statistics Portal](#).

THE LABOR MARKET SKILLS IN SWEDEN

Sweden is one of the most competitive economies in the world. One of the most important factors in the competitiveness of the Swedish economy is the competence of human resources. In order to achieve Stability and growth in the economy, Sweden seeks to develop and enhance

skills. As well as, emphasize the importance of ensuring the full development and utilize population skills.

Skills development focuses on two aspects. Firstly, through developing education to prepare individuals for the future job market, and emphasis upon ensuring that young people continue in education, training and complete their studies.

The World Bank’s human capital index highlights the link between investments in health and education and the productivity of future workers. Investments in early childhood, including in nutrition, health, protection, and education, lay strong foundations for the future acquisition of higher-order cognitive and sociobehavioral skills.

Human capital consists of the knowledge and skills, that people accumulate over their lives, enabling them to realize their potential as productive members of society. Health also is an important component of human capital (Human Capital Index, 2018).

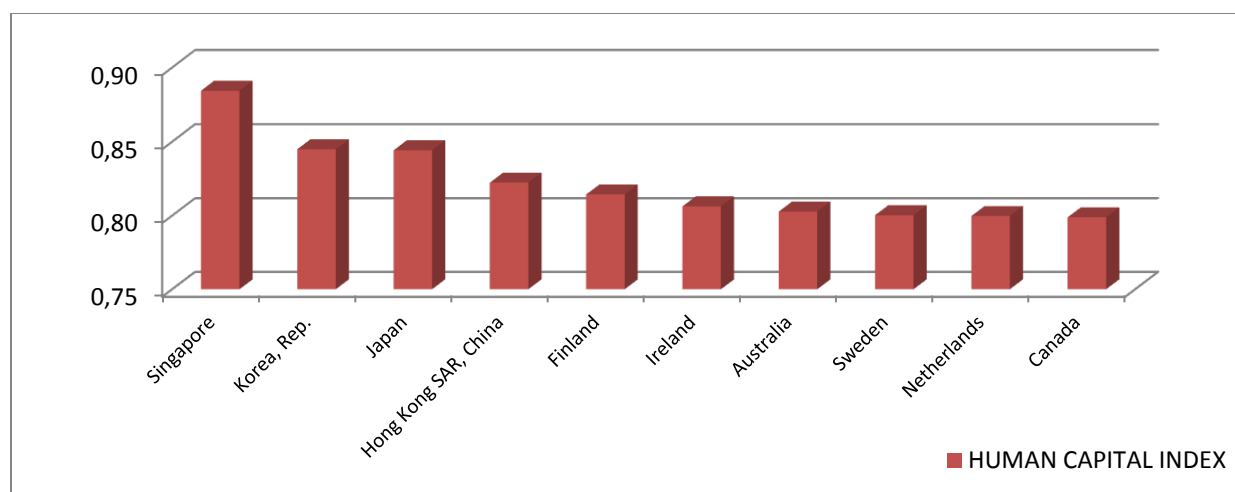
Table 2: Human Capital Index and Components, 2018.

<i>Country Name</i>	<i>Probability of Survival to Age 5</i>	<i>Expected Years of School</i>	<i>Harmonized Test Scores</i>	<i>Learning-Adjusted Years of School</i>	<i>Fraction of Kids Under 5 Not Stunted</i>	<i>Adult Survival Rate</i>	<i>HUMAN CAPITAL INDEX</i>
<i>Singapore</i>	<i>1.00</i>	<i>13.9</i>	<i>581</i>	<i>12.9</i>	<i>..</i>	<i>0.95</i>	<i>0.88</i>
<i>Korea, Rep.</i>	<i>1.00</i>	<i>13.6</i>	<i>563</i>	<i>12.2</i>	<i>0.98</i>	<i>0.94</i>	<i>0.84</i>
<i>Japan</i>	<i>1.00</i>	<i>13.6</i>	<i>563</i>	<i>12.3</i>	<i>0.93</i>	<i>0.94</i>	<i>0.84</i>
<i>Hong Kong SAR, China</i>	<i>0.99</i>	<i>13.4</i>	<i>562</i>	<i>12.1</i>	<i>..</i>	<i>0.95</i>	<i>0.82</i>
<i>Finland</i>	<i>1.00</i>	<i>13.7</i>	<i>548</i>	<i>12.0</i>	<i>..</i>	<i>0.93</i>	<i>0.81</i>
<i>Ireland</i>	<i>1.00</i>	<i>13.7</i>	<i>538</i>	<i>11.8</i>	<i>..</i>	<i>0.95</i>	<i>0.81</i>
<i>Australia</i>	<i>1.00</i>	<i>13.8</i>	<i>524</i>	<i>11.6</i>	<i>0.98</i>	<i>0.95</i>	<i>0.80</i>
<i>Sweden</i>	<i>1.00</i>	<i>13.9</i>	<i>525</i>	<i>11.7</i>	<i>..</i>	<i>0.95</i>	<i>0.80</i>
<i>Netherlands</i>	<i>1.00</i>	<i>13.8</i>	<i>530</i>	<i>11.7</i>	<i>..</i>	<i>0.94</i>	<i>0.80</i>
<i>Canada</i>	<i>0.99</i>	<i>13.7</i>	<i>537</i>	<i>11.7</i>	<i>..</i>	<i>0.94</i>	<i>0.80</i>

Source of data: [The World Bank, Human Capital Index, 2018.](#)

Sweden was among the top ten countries on The World Bank’s human capital index in 2018 and ranked eighth with value (0.80), and the first one was Singapore.

Figure 5: Sweden rank in Human Capital Index, 2018



Source of data: [The World Bank, Human Capital Index, 2018](#).

Regarding human development index 2018 that includes an analysis of the state of human development snapshots of current conditions, as well as long-term trends in human development indicators. The Index consists of life expectancy at birth, expected years of schooling, mean years of schooling, and cross-national income (GNI) per capita. Sweden was ranked seventh of 189 country and territories with value (0.933) and the first one was Norway (0.953).

Table 3: Human Development Index, 2018.

Rank	Country	Human Development Index (HDI) value	Life expectancy at birth (years) SDG3	Expected years of schooling (years) SDG 4.3	Mean years of schooling (years) SDG 4.6	Cross national income (GNI) per capita (PPP\$)SDG 8.5
1	Norway	0.953	82.3	17.9	12.6	68,012
2	Switzerland	0.944	83.5	16.2	13.4	57,625
3	Australia	0.939	83.1	22.9	12.9	43,560
4	Ireland	0.938	81.6	19.6	12.5	53,754
5	Germany	0.936	81.2	17	14.1	46,136
6	Iceland	0.935	82.9	19.3	12.4	45,810
7	Hong Kong, China (SAR)	0.933	84.1	16.3	12	58,420
7	Sweden	0.933	82.6	17.6	12.4	47,766
9	Singapore	0.932	83.2	16.2	11.5	82,503

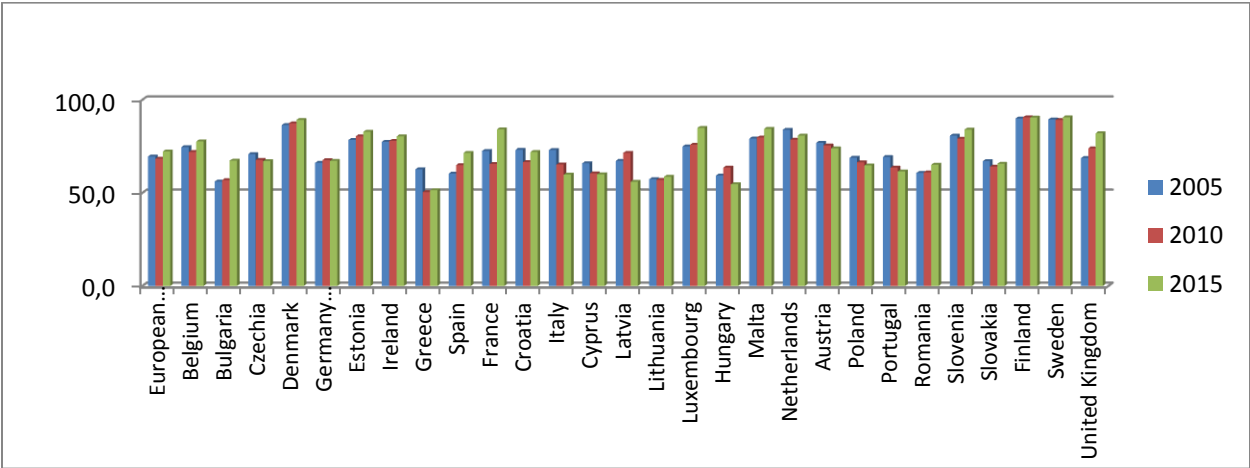
10	Netherlands	0.931	82	18	12.2	47,900
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Source: [Human Development Index \(HDI\) 2018, United Nation Development Programme.](#)

The second aspect of skills development is to ensure lifelong learning and continuing skills development for workers throughout working life.

Employed persons whose job involves improving their skills was stable in Sweden during 10 years from 89.4% in 2005 to 89.1% in 2010, and reached to 90.6% in 2015 and it was the highest level in Europe union. This indicates that Swedish companies’ commitment to developing workers skills, which represent one of the basic principles of work.

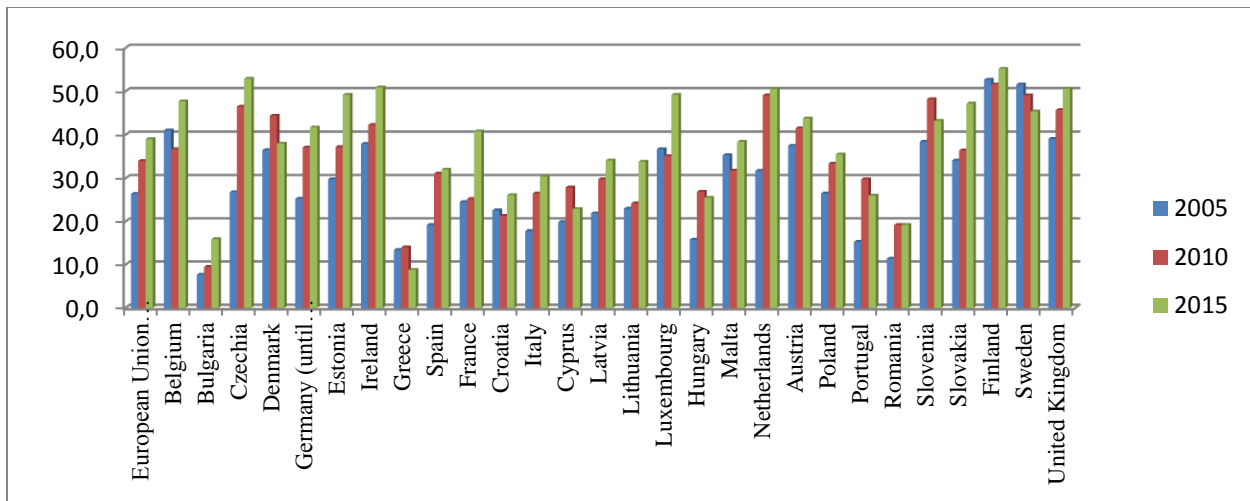
Figure 6: Percentage of employed persons whose job involves improving their skills in the Europe Union.



Source of data: [European Foundation for the Improvement of Living and Working Conditions \(Eurofound\)/Eurostat](#)

Employed persons participating in job-related non-formal education and training in the past 12 months in Sweden decreased from 51.6% in 2005 to 45.4% in 2015. Sweden ranked 10 between Europe Union countries, and the highest one was Finland at 55.2%. It refers to the necessity of increasing workers participating in job-related non-formal education and training in Swedish companies.

Figure 7: Percentage of employed persons participating in job-related non-formal education and training in the past 12 months

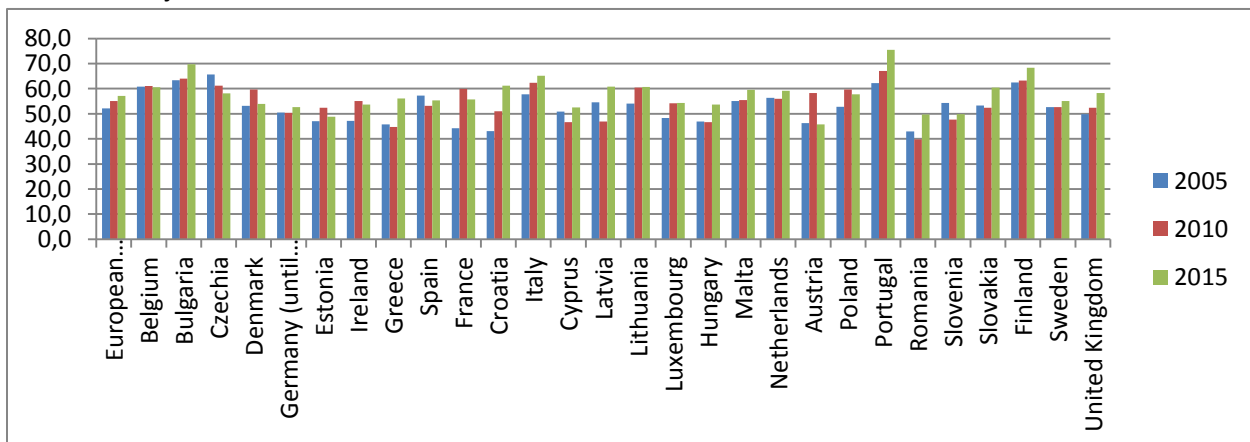


Source of data: [European Foundation for the Improvement of Living and Working Conditions \(Eurofound\)/Eurostat](#)

Changes in the business environment, such as globalization, digitalization, and automation, represent opportunities for growth and business expansion. At the same time, intense international competition and accelerating technological developments also pose major challenges to the Swedish labor market, which require developing and learning new skills for workers throughout their working lives to adapt to future labor market requirements. Job security lies not only in the length of employment, but to great extent skills determine a person's chances for employment, good working conditions, and mobility in the labor market. Access to skills is also crucial for companies' opportunities to develop and grow. Stability and growth in the Swedish labor market require the cooperation of all relevant actors to strengthen opportunities for continuing skills development and lifelong learning ([Uppdrag: Framtid](#)).

Employed persons having the opportunity to use their knowledge and skills in their current job in Sweden were approximately stable during last 10 years, from 52.7% in 2005 to 55.1% in 2015, and it was low and less than Europe union average (28 countries) which was 57.1% in 2015.

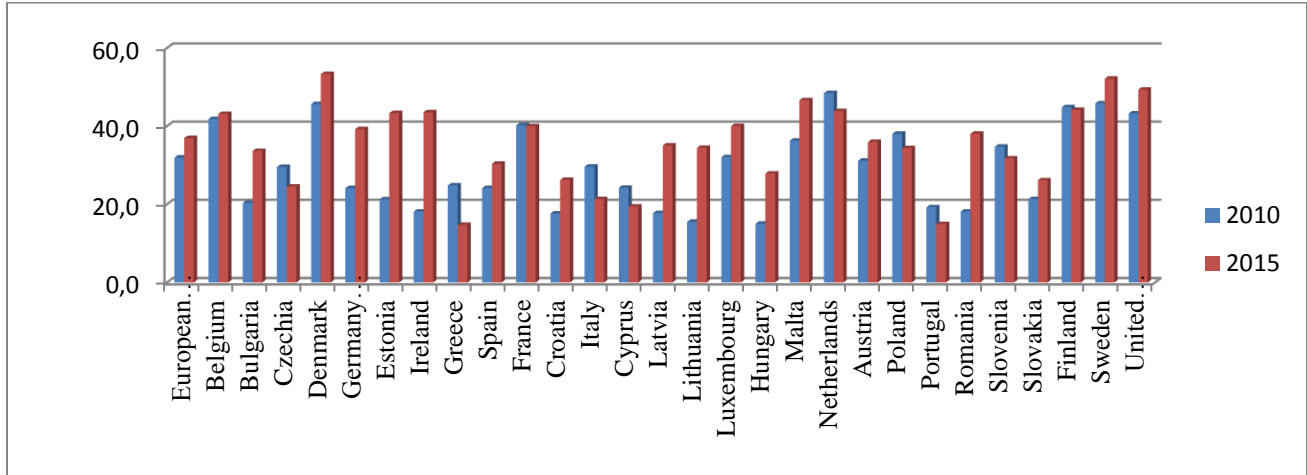
Figure 8: Percentage of employed persons having the opportunity to use their knowledge and skills in their current job



Source of data: [European Foundation for the Improvement of Living and Working Conditions \(Eurofound\)/Eurostat](#)

Employed persons whose work experience and job skills would be helpful to find another job increased from 45.8% in 2010 to 52.1% in 2015, Sweden ranked second after Denmark which was 53.3% in 2015.

Figure 9: Percentage of employed persons whose work experience and job skills would be helpful to find another job

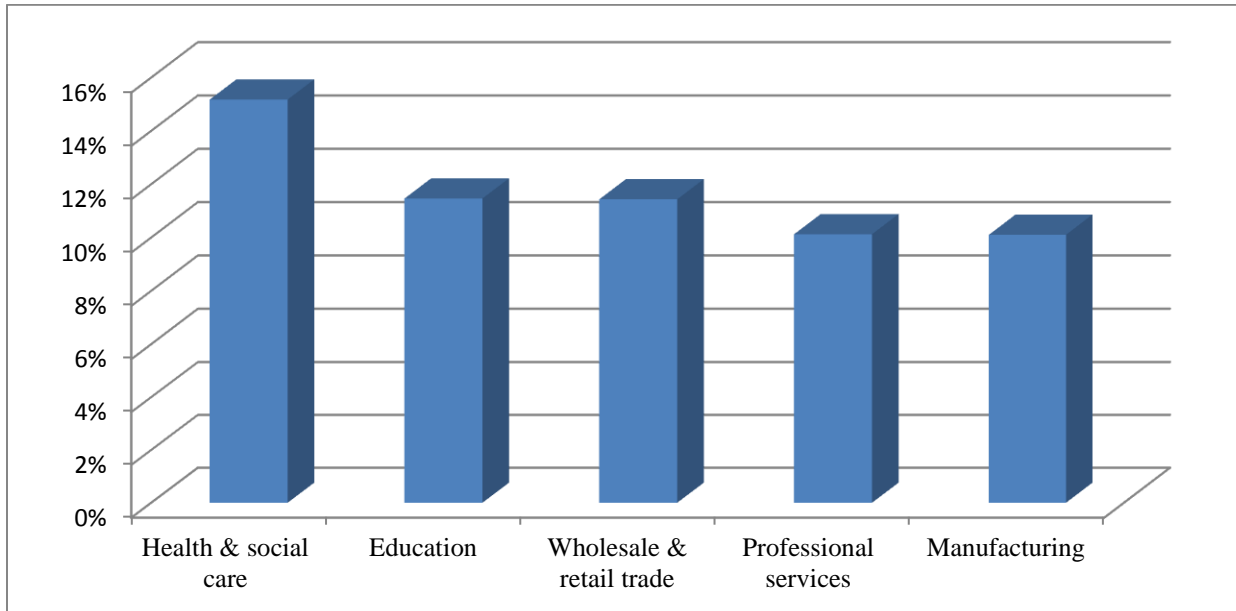


Source of data: [European Foundation for the Improvement of Living and Working Conditions \(Eurofound\)/Eurostat](#)

FUTURE TRENDS IN SWEDEN LABOR MARKET

Health and social care have the largest share of employment in Sweden 2017 which was (15.17%). Education, wholesale and retail trade were (11.46%, 11.43%) respectively. The lowest share of employment was in professional services and manufacturing (10.12%, 10.10%) respectively. Employment in the manufacturing sector was the lowest in Sweden.

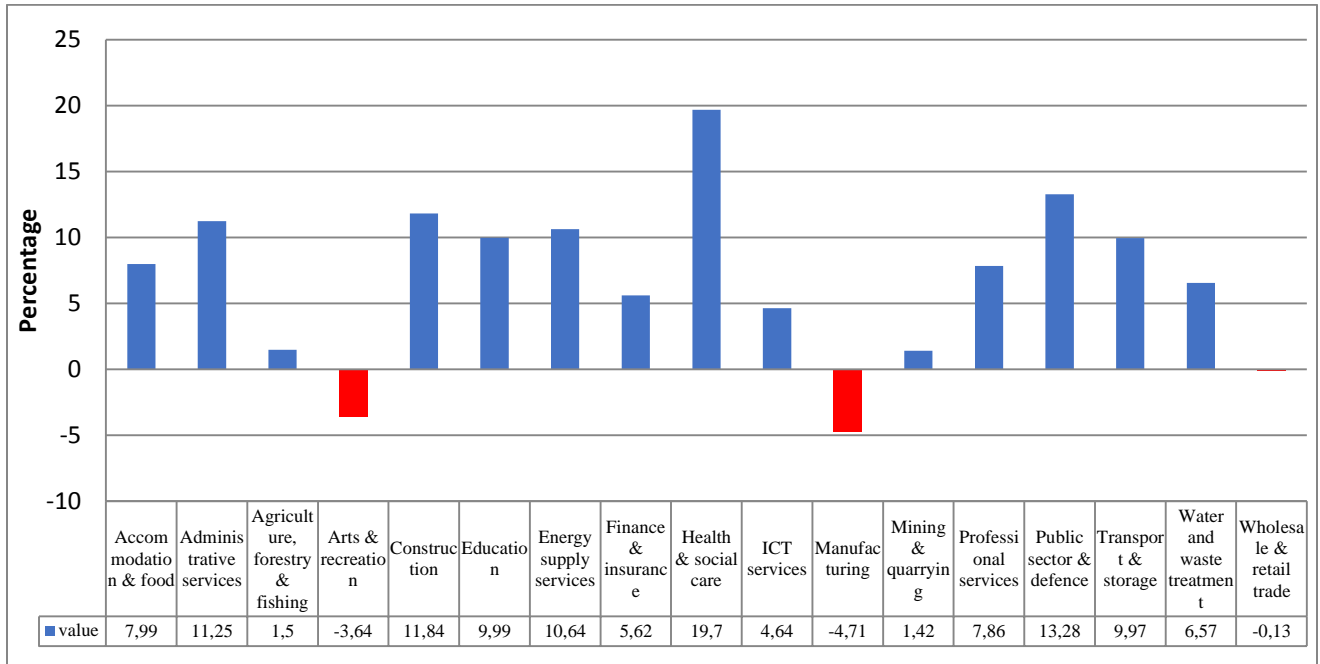
Figure 10: Sectors with the largest share in employment in Sweden in 2017



Source of data: [Skills Panorama: Inspiring choices on skills and jobs in Europe](#).

Future employment growth average in Sweden over the period 2016-2030 is estimated at 6.7%. The minimum is (-4.7%) for Manufacturing, this indicates to the effects of digitalization and automation on the Manufacturing sector in Sweden, and the shifting more to automate human tasks, which leads to reduce the demand on workers. While the maximum is (19.7%) for Health and social care, this may be due to the increase of older people, the continuous pursuit of improving the quality of health and social care services, and thus the need for more staff, where health and social care sector represents the largest share of employment in Sweden.

Figure 11: Future employment growth (in %) in Sweden in 2016-2030 across sectors

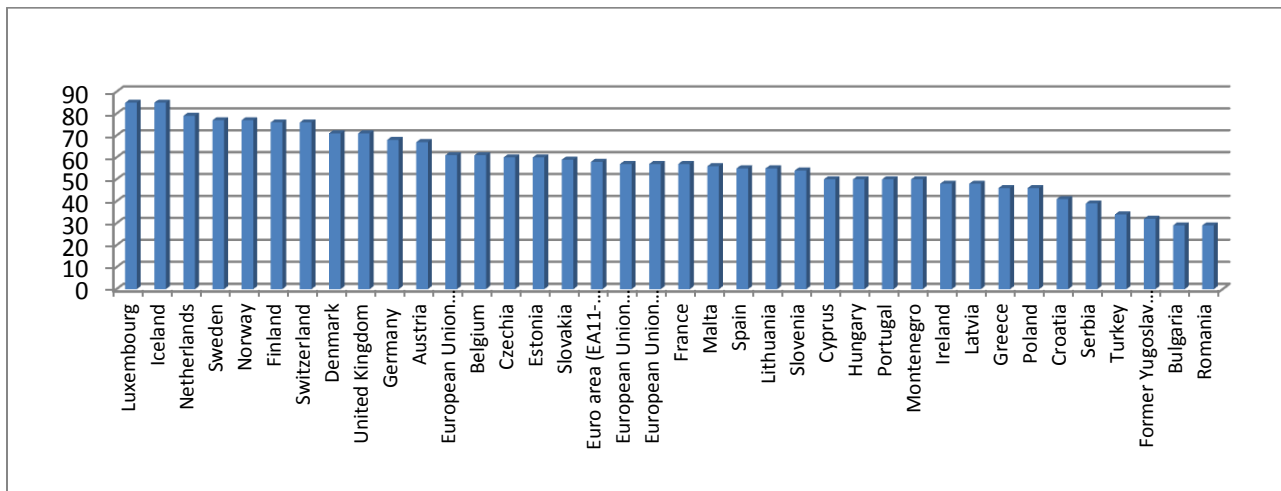


Source of data: Skills Panorama: Inspiring choices on skills and jobs in Europe.

ENHANCING DIGITAL SKILLS

The Organization for Economic Cooperation and Development (OECD) indicates the leading role of Sweden in the diffusion and use of digital technologies. Internet use by individuals and businesses is widespread, and Swedish individuals who have basic or overall digital skills in 2017 were (77%).

Figure 12: Percentage of individuals who have basic or above basic overall digital skills in 2017



Source of data: Eurostat

Sweden has been able to take advantage of digital transformation, and rely on it to achieve strong economic performance in recent years. Which enabled Sweden to achieve the highest share of value added produced by the information and communication technologies (ICTs) sector among OECD countries, and Sweden is among the top ten exporters of ICT services worldwide.

Swedish companies can be relying upon its technological infrastructure, and knowledge and skills to move up along global value chains in manufacturing, by focusing their activities on high value-added services, e.g. product design and marketing, rather than on production activities.

Technological developments represent important opportunities for Swedish companies in many fields. In order to achieve optimum utilization of these opportunities; individuals skills must be developed to achieve the effective utilization of these technological opportunities, and enable them to adapt to the requirements of digitalization era. This requires a major focus on enhancing basic skills and developing digital skills. As well as, higher order thinking competencies, social skills, and emotional skills.

Sweden seeks to maintain its technological progress, take advantage of technological opportunities, and achieve digital sustainability. In order to achieve that, Sweden adopted a comprehensive digital strategy through it; Sweden seeks to be the best in the world in the use of digitalization opportunities, as well as to reach the lowest unemployment rate in Europe by 2020. The strategy sets five targets: digital competence, digital security, digital innovation, digital leadership, and digital infrastructure.

Table 4: For a Sustainable Digital Sweden: Five Targets

Targets	Description
Digital competence	In Sweden, everyone will be able to develop and use his/her digital skills.
Digital security	In Sweden, there are the best conditions for everyone to safely participate, take responsibility, and have the confidence in the digital society.
Digital innovation	In Sweden, there are the best conditions for digitally driven innovations to be developed, disseminated and used.
Digital leadership	In Sweden, improvements in efficiency and quality through digitalization should be relevant, purposeful and lawful.
Digital infrastructure	The whole of Sweden should have access to infrastructure allowing for fast broadband, stable mobile services and supporting digitalization.

Source: OECD, Reviews of Digital Transformation, Going Digital in Sweden, 2018, P 29 /Government Offices of Sweden (2017b), “For Sustainable Digital Transformation in Sweden: A Digital Strategy”.

In October 2017, the Ministry of Education and Research launched a National Digitalization Strategy for the School System. The strategy has three focus areas: digital literacy for everyone in the school system, equal access and use, as well as research and follow-up on digitalization opportunities. Each area includes a goal and several objectives to be achieved by 2022.

The strategy aims to prepare a qualified workforce for the digital future, and capable of achieving the technical excellence of Sweden. By ensuring that all students have the skills they need for their future career (OECD, 2018).

CONCLUSION

This paper investigated how technological developments including automation and digitalization influence on the job market, and its role to reshape the future of labor market skills in Sweden. Technological developments created new job opportunities for wholly new tasks, at the same time, technological advancement reduced the number of workers required for certain work tasks. In order to reduce the negative impact of technology on the labor market, the efforts of all relevant actors, represented by the government, companies and trade unions, must be combined through reskilling and upskilling of workers skills, developing the education system and skills needed to adaptive with technological developments.

Sweden seeks to maintain its technological superiority and achieve the optimal utilization of technological developments through investing in human resources and developing their knowledge, experience, and lifelong learning. Skills development focuses on two aspects; the first through developing education to prepare individuals for the future job market, and adopting a national digitalization strategy for the school system. The second aspect is to ensure lifelong learning and continuing skills development for workers throughout working life, which contribute to prepare and develop a qualified workforce to deal with and adapt to future digital labor market requirements.

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