Labor Market Risks of Industry 4.0, Digitization, Robots and AI

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Abstract – **Digitization changes our world. Industry 4.0, the digital transformation of manufacturing changes the labor market. The impacts of rapid technology development of the fourth industrial revolution present huge challenges for the society and for policy makers. Are we facing reduction of employment by automation rendering human work force uncompetitive with machines? Can creation of new fields of employment, new types of jobs compensate for the loss of traditional labor market requirements?**

I. INTRODUCTION

Industry 4.0 solutions involve a growing share of jobs in developed economies. Methods and processes of future manufacturing, and those of the digital economy would change the human resources requirements completely. Demand for a large set of jobs would diminish or even disappear. It is expected however, that new technology, new business models and new societal challenges would not only change current jobs and current roles, but create new employment opportunities, including requirements for new types of jobs.
Under the continuously changing conditions of a rapidly changing word, predicting the overall balance over a long time is impossible. Policy based on long term prediction would not solve labor market issues either, nor societal challenges. Society needs slower change rates, and at least a close-to-balance steady state situation to avoid disturbance or collapse.

Traditionally, loss of jobs due to increase in industrial productivity as a result of automation, e.g. were balanced by increase in production volumes. Fierce competition, and achieving a deemed or real plateau of production volumes have lead to efforts of reducing production costs.
Relocation of the production from developed countries into emerging countries resulted in a gradual loss of jobs in Europe. At an estimated share of 15% of industrial production in the GDP of Western Europe, approximately 5 million industrial jobs have been lost in the recent 15 years [1].

EFFECTS OF DIGITIZATION

Digitization facilitates the presence of information globally with very short delays. Global phenomena have stronger effects on competition. These developments polarize the world, and deepen the gaps in several dimensions, e.g.:

- Countries and regions with a competitive advantage, first of all in the fields of new enabling technologies
- Economies adopting new technologies faster, than others
- Enterprises using new digital technology vs. companies without skilled human resources
- Employees with marketable new technology skills vs. workers lacking behind
- Employees working in new emerging fields and branches

The polarization is reflected on the labor market shown by increasing employment in low and high wage, and a decrease in the middle wage segments [2] (*see fig. 1.*). People hard to be substituted, achieve high income. Low income jobs can be done by most of the people.

PREDICTIONS

Experience in a historical view show, that society could follow major rearrangement of production factors, and industrial revolutions with a longer delay only. These circumstances lead to economy and societal crisis, even collapse.

Industry 4.0 experts have set up several models to predict the effects of digitization onto the labor market.

According to a study of the EU Commission DG for Internal Policies [3], effects of digitization on the labor market can be decomposed to the following areas: job dynamics; working conditions; skills needed; and EU and national policies.
Factors for creating new jobs include: development of new products, machines and increased competitiveness.

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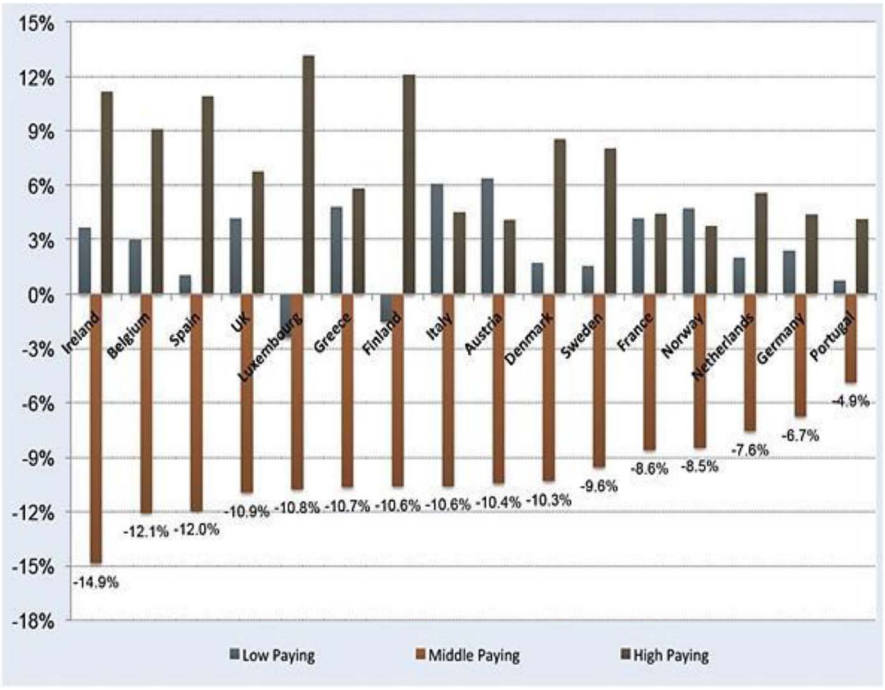

Figure 1. Change in employment shares in low, middle and high payed segments in 16 EU member states between 1993, and 2010 show a polarization of the labor market: increasing employment in low and high wage, and a decrease in the middle wage segments [2].

Digitization can lead to

- job losses due to increased productivity, and actually substituting human work force
- relocation and outsourcing of jobs to emerging countries with lower labor costs
- offshoring, effecting ICT industry at an estimated share of 0.8%.

According to forecasts of Cedefop:

- jobs created: 8.5 million knowledge intensive, plus 2 million elementary
- loss of jobs: 4 million skilled manual jobs

Roland Berger assumed in their model an adoption rate of "Industry 4.0 solutions" of 50% by 2035 [1]. Starting form a number of employees in Germany of 25 million, they took the following major general factors into consideration at predicting future employment.

Productivity development, including cost reduction, and introduction of digital solutions (provides for a loss of 2.5m jobs).

Low competitiveness of developed countries leads to transfer of production to more competitive regions, in majority of cases based on a low-cost/low-wage model (loss of 2.7 million jobs).

Technology investment into Industry 4.0 (loss of 2.9 million jobs).

Industry 4.0 could bring new model of competitiveness by automation, robotization, thus, making it possible to avoid high costs of labor inland. Investments in new technology, new products and new services should be the positive effects (accounting for approximately 10m jobs). We can draw a balance at a small positive effect in industry, with an increased share of Industry 4.0 solutions.

A study of BCG [4] set up models of employment, and predicts a changing occupational structure in manufacturing. R&D, human interface design, IT and data integration, logistics, robotics and automation are candidates for high-growth fields of employment. Industrial data scientist, and robot coordinator are examples of new work roles.

According to model calculations, assuming scenarios with estimated additional revenues due to Industry 4.0 between 0.5 and 1.5 percent, the industrial employment could change between a loss of 1.8 million, and an increase of 6.0 million jobs between 2015 and 2025 in Germany.

COMPANY HR-POLICY RESPONSE

Companies should adapt their HR activities to the rapidly changing labor market conditions. Suggested human resources strategies and measures for companies include:

- strategic planning of HR
- attracting new work force targeted to Industry 4.0, prepare for competition for talent.
- retaining and retraining employees
- developing and introducing new organizational and work models;

EDUCATION AND TRAINING

There is a knowledge and skill gap between labor market requirements and the work force available. Estimations show a large number of missing IT professionals (EU: 850,000; Germany: 120,000; Hungary: 22,000).

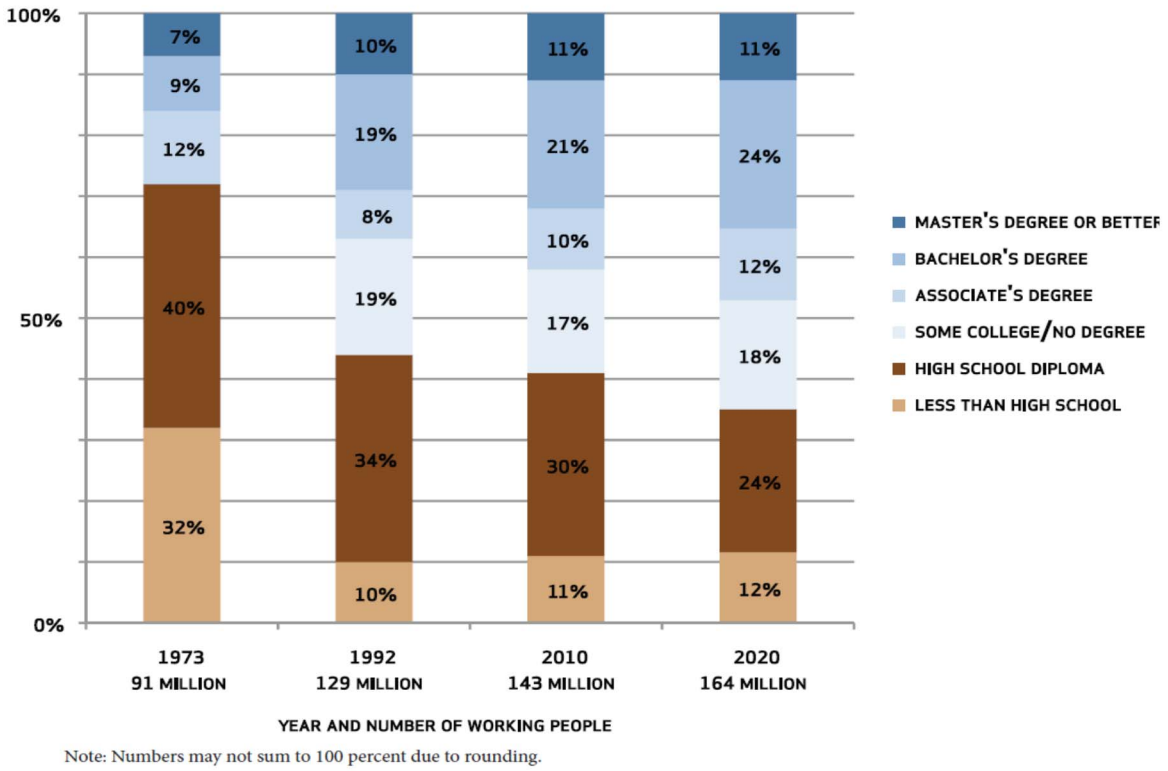

Figure 2. Predictions of qualification demand by 2020 in the US labor market: a defiitive growth of the demand for higher educated profesionals (BSc, MSc, PhD) is forecasted [5]

The chart presents predictions for future educational demand of the US labor market [5] (*see figure 2.*). Demand for highly educated (BSc, MSc, and PhD) work force shows a definitive growth, and stagnation at medium levels.

Suggested changes in training and education system as a response to digitization should include the following major action lines.

- Strengthen science, technology, engineering, mathematics (STEM) education.
- Providing for a more flexible, wider set of knowledge and skills for dynamically changing, and many times complex roles at work.
- Regularly update, start new, including interdisciplinary curricula in higher education.
- Introduce new forms of education, including life-long-learning; open and on-line courses; cooperation of company and academy;

NOW, AND BEYOND 2030

Time range of most current concepts, strategies, predictions, estimations, and plans spread until 2025, and 2030. What are the major factors for future considerations?

Traditional competition between men, and men emerged from the demand for cheap work force, leading to regional and global relocation of human resources. This process leads to regional inequalities.

The need for highly educated coworkers with knowledge of the newest technologies, and up-to-date digital skills rearranges income distribution. Inequalities between domains of society lead to tensions, societal and political problems.

Machines have started their competition with men by getting stronger, and faster. They are supposed to be precise, being never ill, having no personal needs. Gradual replacement of men at physical work, as we know it from the history, has caused societal problems in the past several times. But still, the domain of intelligent work could have been preserved.

What if machines would be more intelligent, than humans? Work would be reorganized from men towards intelligent machines.

What would be left? Would there be need for any human work? Should machines be more intelligent, than humans?

Development of artificial intelligence is a huge opportunity, but a major threat at the same time:

“AI, our last invention?” J. Barratt.

“We must pay the closest attention to AI because it could bear more dangers than nuclear weapons” – Elon Musk, Tesla Motors.

The point of singularity, when the machine intelligence supersedes human intelligence, is estimated between 2040, and 2100.

The Oxford Martin Programme survey [6,7], executed in the US, set up a list of computerisable probabilities of 702 jobs. It identified occupation fields being endangered by digitization, and computerization. According to the overall conclusion, 47% of total US employment is at risk in the next 10-20 years.
The survey pointed occupational fields presenting bottlenecks to computerization:

- Perception and Manipulation
- Creative Intelligence (originality, fine arts)
- Social Intelligence (Perceptiveness, negotiation skills, cooperation with others)

The results can be interpreted in a context of current technology level only.
The right question is probably not, if human could be substituted at a specific job. It is probably just a matter of time.
We have seen that creation of new types of jobs are predicted. Do we have time enough? Can we keep the balance between loss of jobs, and creation of new occupations? Will we be able to keep a sustainable process of new job creation at an increasing competitiveness of robots?

CONCLUSION

Digitization will create new jobs, change current jobs. Jobs will also be lost, and/or relocated to other regions. Forecasting the balance seems to be impossible, models might help understand the overall processes.
Digitization will spread into various branches at different speeds depending on complexity of automation and that of business models.
It is expected, that medium-wage jobs are at highest risk of replacement by intelligent machines.
Digitization presents huge opportunities, challenges and risks. Winners and losers at the race with digital transformation can emerge at all levels: individuals, companies, branches, countries, governments, societies. Managing challenges and risks of digitization is a joint responsibility of all stakeholders.

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