

02.03.2020

Chapter 10: Work Policy and Automation in the 4th Industrial Revolution

Peter Nielsen, Edward Lorenz, Jacob R. Holm

Abstract

xxx

The labor market in Denmark and technological change

With technological change comes social change as technological change affects production, distribution and power in society. Studies of earlier waves of technological change suggest that each wave is associated with a 'structural crisis of adjustment' which can be identified empirically by the social conflicts. These social conflicts emanate in the labor market from increasing job insecurity, downward pressure on wages, and uncertain career prospects, and they may spill over into the political system as, typically, hostility towards immigration (Freeman and Louçã, 2001, see especially section C.3). Labor market policy can mitigate the risk of social conflict by facilitating an inclusive labor market. Labor market policy in Denmark is closely connected to the Danish labor market model. The core of this model is primacy to the social partners concerning wages and employment system (Marsden, 1999). This model is the foundation of the flexicurity system, which is an important lubricator in situations of structural change at the labor market. Together with the active labor market policy it constitutes the so-called 'golden triangle' (Madsen, 2003) of flexicurity. The institutional and organizational relations between the social partners and the state form preconditions of acting as an inclusive part of the national innovation system, shaping the social and economic consequences of what has been called the 4th industrial revolution at the labor market.

Currently, there are at least four significant driving forces that affect the future of work and thus structural developments in the labor market in a forward-looking perspective. These are globalization, technological development, demography and climate change (Dølvik and Steen 2018, ILO 2018). Technological development is special as a driving force, as it can directly or indirectly moderate or enhance the influence of the other drivers on the labor market imbalances. In this way, technological development is of particular interest when considering the labor market of the future and the political opportunities to handle structural challenges.

Technological change often has a limited influence on specific segments in the labor market. However, some technological innovations are universal in such a way that they diffuse broadly in the labor market as part of new production processes, market relationships and skills requirements of the workforce. The electric motor and electrification of industrial production are good examples of the above-mentioned technological innovations. Here, new ways of organizing the work processes (Taylorism) meant that the demand for skills in the labor force was significantly reduced. Freeman and Perez (1988) call the above phenomenon a techno-economic paradigm shift. The development of information and communication technology and in particular technological innovations in the form of artificial intelligence, robotics and the Internet of Things, meets the conditions for a techno-economic paradigm shift. These technologies have been termed drivers of a 4th industrial revolution. Overall, they are expected to have a significant impact

on changes in the structure of the labor market, not least changes in the requirements for the skills of the labor force and the competences to be used in production. Although the technologies are important drivers, they cannot, however, be described as determining the development of the labor market. The labor market is unique in the way that stakeholder relationships and the influence of agents at different levels play a major role in implementing market mechanisms. An essential thesis in this chapter is thus that there is a scope of voluntarism present in the connection between the technological possibilities of digitization and the processes surrounding job development. This means that the effect technological change has on the task contents of jobs and on the number of jobs is not exogenous but depends on the simultaneous choices made by managers, workers and policy makers.

Technologies destroy jobs

A number of studies have found that technological change will replace jobs in the near future. Frey and Osborne (2013) find for the US that jobs highly likely (70% chance or greater) to be automated include almost half (47%) of total employment. Bowles (2014) extended the analysis and found that the figure for Denmark is 49.5%. This result is based on expert assessments of the degree to which tasks in general can be automated with big data and deep learning and doesn't take into account for example differences in task characteristics for the same occupation across firms of different sizes or with a different product mix. Frey and Osborne focus in on the industrial use of machine learning in the form of deep neural nets which they observe opens up new automation possibilities and in particular allows for the automation of tasks, like identifying component defects with image classification or predictive maintenance using machine vibration data, that depend on auditory and perceptual skills that were traditionally considered beyond the scope of automation.¹

Frey and Osborne also note that this process is accelerated by the tendency of modern organizations to focus on measurability. When tasks or tasks' results have to be made measurable, the tasks are typically repeated and standardized which, all else being equal, makes it easier to apply deep learning methods.² Moreover, the increasing focus on measurability means that the increasing amounts of data needed to train neural nets exists. This process is further enhanced by the development of more accurate and cheaper sensors for data collection and processing.

Frey and Osborn's analysis is highly speculative and it has received a great deal of criticism. Arntz et al. (2016) in an analysis of whether the individual tasks and not occupational categories are automated find that only 9% of jobs in the US are at high risk of being fully automated against Frey and Osborn's 47%. Arntz and colleagues' analysis is based on Frey and Osborn's general assessment of the types of tasks that are most susceptible to automation, but combines it with individual level data on workers' abilities and tasks. This radically different result has been reached with an almost identical analysis, where the main difference is moving the focus from occupational job categories to detailed tasks.

There are not many studies yet on the microeconomic effects of automation, but the results in Dauth et al. (2017), Holm et al. (2018) and Bessen et al. (2019) show some of the effects for companies and workers.

¹ For a clear discussion of these differences, see Chollet (2018), the creator of the Keras deep-learning Library. As he notes, in traditional symbolic programming, programmers input rules or a program and data to be processed by the program in order to arrive at an answer. In machine learning the data engineer inputs data and the expected outcome and the system by means of a feedback loop typically over several thousands of iterations 'learns' the rules or mapping between inputs and outputs. This involves optimizing the values for often several millions of weights or parameters. The mapping can then be used with new data to predict new outcomes.

² For a useful discussion of what kinds of tasks are most open to automation with machine learning, see Brynjolfsson, et al. (2018).

Bessen and colleagues focus on what happens to the people who are subjected to automation in the workplace. The interesting result is that the substitution from humans to machines is a process over a number of years. At the time of investment in automation no immediate effect is seen on the workforce, but in subsequent years the employees have increased likelihood of leaving the workplace. This indicates that automation is a process where the employer over time learns which employees can and will adapt, and who can be dispensed with. At the same time, the workers learn whether they can and will adapt or prefer to leave the workplace. Dauth et al. (2017) find a similar result and both studies to some extent show that increased automation makes it harder for young workers to find stable employment, as automating firms tend to not expand the workforce, but rather let the workforce contract as older workers leave the firm. Holm and colleagues, on the other hand, focus on the company level in their study of the effects on the workforce composition. They show how technological and organizational change affect the composition of the workforce, including how technological change is associated with changed work organization, which places new demands on employees' competencies. Both Holm et al. (2018) and Bessen et al. (2019) thus show the importance of adapting competences among the employees.

A number of studies show that the net effect of automation is not uniformly negative. As robots substitute for labor there will be a negative gross effect on equilibrium employment but spill-overs from income effects and complementary innovations counteract the gross decline (Acemoglu and Restrepo 2017; 2018). Empirical tests of the equilibrium prediction suggests that the effect of trade on its own is not sufficient to create a positive net effect on equilibrium employment (Acemoglu and Restrepo 2017). On the other hand, empirical studies of the substitution effect by robots in manufacturing suggest that substitution is more than offset by new jobs in services; although often at a lower wage (Dauth et al., 2017, Graetz and Michaels, 2018; Gregory et al., 2019). This result can also be obtained in a broader analysis studying TFP (Total Factor Productivity) growth and not just the addition of new robots (Autor and Salomons, 2018). However, underneath the net effect a structural displacement exists. Jobs with many routine tasks are substituted, and expanding output creates jobs with fewer routine tasks. In addition, it should be noted that most analyses are undertaken at a more or less aggregate level, and a more disaggregate level of analysis of specific technologies can reveal net effects on jobs that are negative.

Although there is evidence that the overall impact is neutral or even positive, it is very different jobs that are created and displaced. Jobs that are displaced are primarily routine jobs in trades for tradable goods. These are typically jobs with an intermediate salary level. New jobs are also created in the same industries, but these are jobs with low routine content and typically high or low wage levels. At the same time, jobs are created in industries for non-tradable goods.

The room for voluntarism

Holm et al. (2018) demonstrate the relationship within firms between changes in work organization and management practices, and the occupational composition of the workforce. The results are important in relation to the voluntarist thesis. The fact that the company level is important for the understanding of the dynamic labor market effects is also consistent with the analysis in Arntz et al. (2016). The results of Arntz et al. (2016) referred to above, show that the occupational composition of firms' workforces varies, which indicates that the occupational composition is not static, but can be adjusted in line with the technological development. The fact that firms can adjust their workforce and the task content of jobs can be adjusted so that the substitution effect is reduced and labor productivity is increased along with the new technology is a key element of the voluntarist thesis.

The prerequisite for the voluntarist thesis, however, is that the labor force can develop the qualifications and competencies that incorporate new technology complementing tasks. Thus, in general, it becomes

both a matter of developing jobs' task content, which complements technological development, and a matter of labor acquisition of the skills and competences needed to perform the new tasks that complement technological development. The task content of jobs will depend on which technologies are adopted and the manner in which they are adopted. Adopting robots, for example, may mean adopting the traditional industrial robots that perform the same task endlessly and operate fenced off from workers, or adopting collaborative robots that work closely together with workers and can be frequently and inexpensively reprogrammed. Even for a given 'robot' the work organization of the firm will shape the effects on the workforce. If workers have a high degree of discretion and regularly must develop new competencies, then the addition of a robot will entail new programming and monitoring tasks for the production worker. Whereas in a more hierarchical form of work organization it can be expected that the addition of a robot leads to a division of labor where technicians perform the programming and the production worker is reduced to more mundane monitoring. Voluntarism thus entails that there is both a choice of what technology to adopt and a degree of malleability in how it is adopted. The challenge is that the technology develops at considerable speed, so that it is difficult to determine tasks and skills needs in the future. In addition, the development takes place in the companies, which makes it necessary to focus on this level.

However, the Danish labor market has good developmental preconditions for the development and modification of the dynamic voluntarist triangle of change: task content, job organization and applied technologies. Business personnel application surveys thus show a significant use of moving staff between different tasks, in order to ensure that corporate personnel resources meet the needs. Naturally, there will be challenges in managing the change processes, both for the internal relations of the companies and, not least, the relations with the structure of the labor market policy. This is a theme we will look into in the later section on the labor market policy challenges. First, we need to look more closely at how both labor market policy and the Danish labor market has changed in recent years.

Changes in the Danish labor market

The Danish labor market is often related to the flexicurity system, defined as an integrated strategy with the aim to improve flexibility and security at the labor market (European Commission, 2007). The flexibility side of the system has become more or less synonymous with numerical flexibility to and from companies and the security side with the unemployment benefits. This dimension of flexicurity is certainly important, but the concept of flexicurity embraces more than numerical regulation by hiring and firing (Bredgaard and Madsen, 2015). Functional flexibility thus relates to employees change of functions and tasks inside the company. Working time flexibility concerns regulation of working time. Organizational flexibility promotes learning and organizational change and wage flexibility aims at wage regulation. Complementary to these flexibility forms, job security, employment security and income security make up the security side of the multidimensional flexicurity system. A survey from 2010 of private sector companies (GOPA) shows that nearly 70% of companies use functional flexibility at a high or some extent and a similar measurement in 2006 (DISCO) shows that the proportion using functional flexibility in a high or at some degree is 60% of the companies. The surveys thus document that the staff in Danish companies largely have routines for flexible tasks. More recent survey data from the 2019 TASK³ survey show that over a period of just three years 29 percent of all employees who also had a job three years earlier have changed either employer, occupation or both. Of the 29 percent, 25 percentage points have changed employer while 4 percentage points have

³ See Holm, Lorenz and Stamhus (2020) for details on the TASK survey [This is one of the other chapters]

remained with the same employer but have a new occupation. This shows considerable flexibility in the Danish labor market but also functional flexibility within firms.

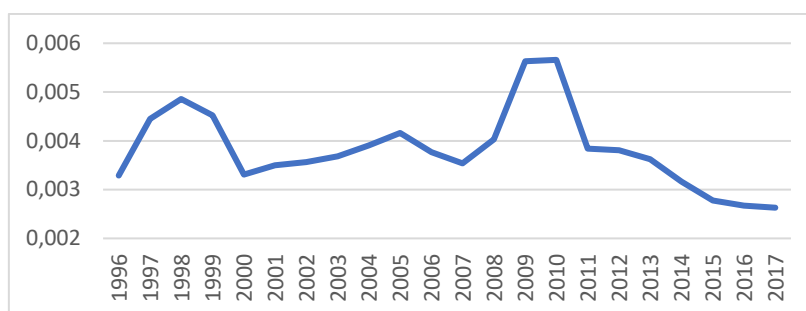
Table 1 – labor market flexibility

| Occupation | Employer | | Total |
|------------|-----------|------|-------|
| | Different | Same | |
| Different | 10 | 4 | 15 |
| Same | 15 | 71 | 85 |
| Total | 25 | 75 | 100 |

Pct of respondents in representative sample. Occupations are defined at the 4-digit ISCO-08 level. Source: The TASK survey.

While employees are thus required to be continuously flexible the qualification instrument of Danish labor market policy has received continuously less emphasis in recent years.⁴ Figure 1 shows the number of full-time equivalent students enrolled in the public Labour Market Education program (AMU) in Denmark per employed person. The number is naturally sensitive to the business cycle and the 2008 crisis clearly stands out. Enrolment decreases during economic expansions and it is clear that enrolment was much lower in the latest expansion from 2013 compared to the previous expansion leading up to the 2008 crisis.

Figure 1: FTE AMU/Employment



Source: Statistics Denmark. www.statistikbanken.dk; VEUAMU1, VEUAMU10, RAS93, RAS07 and RAS309

The recent decline in the emphasis on labor market training mean that firms have had to find other ways of training their workers to use new technologies. Data from the TASK survey shows that formal training only plays a small role for acquiring the skills to work with robots, while formal training is still somewhat important for acquiring skills to work with machine learning and artificial intelligence. The main mechanism for skill acquisition is peer learning in the workplace, which reflects the importance of hands on experience when developing competencies for working with new technologies.

⁴ Recent reports suggest a more favorable development since 2017 with a small expansion in enrolment but these data are at present not yet systematized by Statistics Denmark, and the suggested increase in enrolment is very limited – i.e. 2019 enrolment at the level of 2015 enrolment. For example "Rygterne om AMUs snarlige død er stærkt overdrevne" by Nanna Højlund in A4nu on 22 October 2019.

The importance of peer learning and learning by doing reflect the importance of learning in the current job, and thus also demonstrates the difficulties related to helping the unemployed acquire the competencies for working with new technologies.

Table 2 – Source of competencies in 2019

| Main source of competences | Task | | | | |
|----------------------------|----------------------|---------------|------------------|------------------------------|---------------------------------|
| | Work alongside robot | Control robot | Use data from AI | Receive instructions from AI | Use computer or machine with ML |
| Formal training | 15 | 5 | 25 | 25 | 25 |
| Peer learning | 67 | 84 | 45 | 50 | 33 |
| Learning by doing | 18 | 10 | 30 | 25 | 42 |

Pct of respondents in representative sample. AI: Artificial Intelligence. ML: Machine Learning. Source: The TASK survey.

Peer learning in the workplace is of course only available to persons who already have a job, while formal training must necessarily be more important for the unemployed. However, many of the skills that are needed can only be acquired through problem-solving activity at the workplace. Thus training for the unemployed should also include a workplace activity component. In the TASK survey of 2019 only 10 percent of the unemployed report that their skills are obsolete, but simultaneously 65 percent do not agree that they receive the necessary continuing education for finding a job.

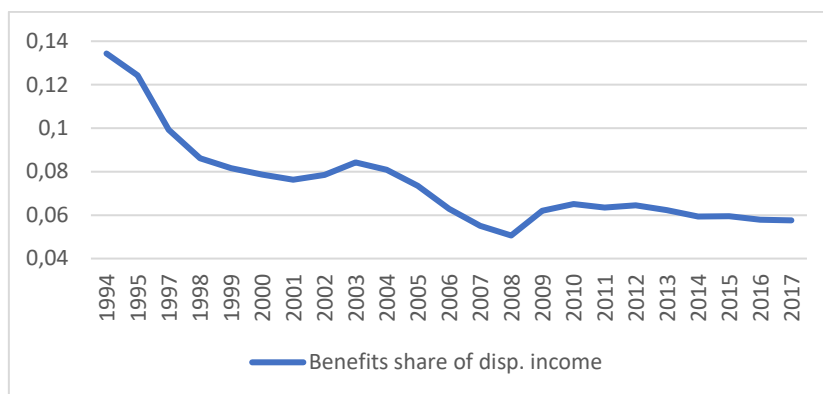
Table 3 – Skills among the unemployed: 2019

| | Pct. agree or strongly agree |
|--|------------------------------|
| My skills are obsolete compared to the jobs being offered. | 10 |
| I receive the necessary continuing education such that I can fill the jobs being offered. | 35 |
| My union helps me acquire the skills required for me to find employment again. | 22 |
| Government assistance helps me acquire the skills necessary for me to find employment again. | 24 |

Pct of respondents in representative sample. Source: The TASK survey.

The descriptive statistics document both the importance and the decline of the qualification instrument of labor market policy in Denmark. In parallel with the decline of the qualification instrument there has been an increase in the emphasis on the motivation instrument in Danish labor market policy. This is primarily seen in a decreasing level of unemployment benefits. Figure 2 shows income from unemployment benefits as a share of total household income in Denmark. While this timeseries is naturally sensitive to the business cycle it is also obvious that there has been a continuous decline. Looking closer at the rate of compensation the variation between occupational groups is substantial. Social and health assistants have an average compensation grade of 70% while engineers have an average compensation rate of 50% (Dagpengekommisionen, 2015).

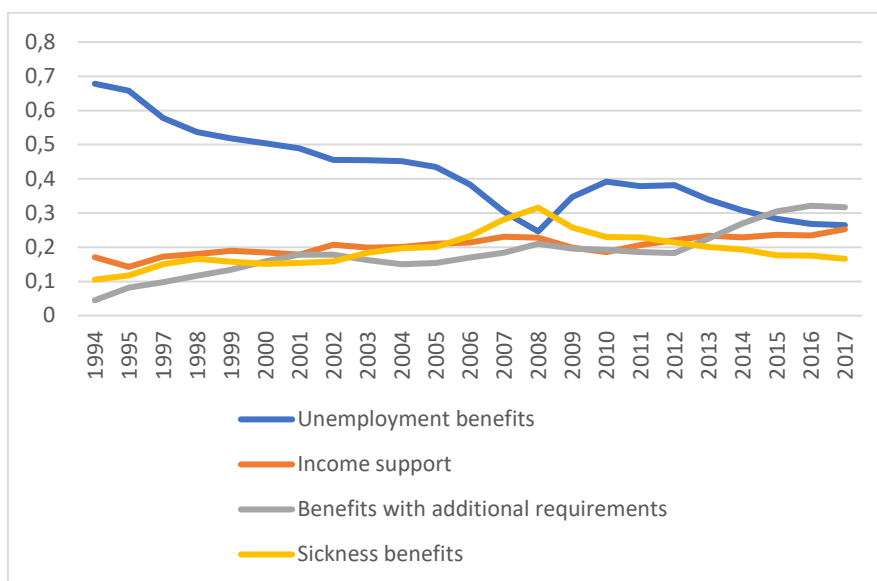
Figure 2: Benefits/Income



Source: Statistics Denmark. www.statistikbanken.dk; INDKF112

The increasing emphasis on the motivation instrument has primarily been effectuated as an effort to make the relatively generous unemployment benefits less accessible, and thus moving the unemployed to other and less generous benefit schemes. Over recent decades the period where one can receive unemployment benefits has been shortened, the amount of paid work required to again be eligible for unemployment benefits has increased, and the requirements one must submit to while receiving unemployment benefits have increased. For example, before 1993 a person could in practice receive unemployment benefits indefinitely. After 1993 the period was restricted to seven years. Then from 1995 it was five years, from 1998 it was four years, and since 2008 the period has been only two years (Arbejdsmarkedskommissionen 2009).

The increasing inaccessibility of unemployment benefits has entailed that unemployment benefits have declined from almost 70% of all benefits in household sector income in 1994 to less than 30% in 2017. Instead, people out of work have been shifted to alternative benefits such as sickness benefits and other benefits with additional requirements, or the much lower income level of income support, which is only available after a person has spent all savings, sold all assets and if there is no partner to support the person. This is seen in figure 3.



Source: Statistics Denmark. www.statistikbanken.dk; INDKF112

Figure 3: Composition of benefits

The decreasing emphasis on the qualification instrument and the increasing emphasis on the motivation instrument arguably entails that Danish labor market policy requires some adjustments in order for the Danish labor market to meet the challenges posed by recent technological change.

Labor market policy and current challenges from technological change

The technological developments at the company level challenge the current labor market policy significantly. Both employed and unemployed need to develop new skills and competences that can ensure that they can continuously interact productively with technological change. In relation to this, it is essential that job dynamics in the labor market play out without major structural imbalances. Labor market policy can be defined as public regulation of labor market structures and functions. Motivation and qualification instruments have been dominant tools in Danish labor market policy. The motivation instruments aim to encourage the unemployed workforce to take up vacancies, and the tools are availability commitments, period of unemployment benefits and mobility provisions. The qualification instruments consists of tools to build up the 'human capital' of the workforce through vocational and labor market education, continuing education and lifelong learning. Historically, the qualification instruments have been important tools in periods of relatively rapid structural change (Nielsen, 1979). This includes an explicit objective to remove economic and social barriers for workers with shorter education when upgrading to better employment opportunities (Jørgensen 2006/7) which also promote economic equality. A significant recognition was that it was appropriate to mix unemployed and employed in adult education. This allowed the unemployed to form network contacts and socialize for the job. However, the motivation instruments have also been used successfully in combination with the qualification instruments to tackle high unemployment in periods of fiscal austerity (Bredgaard et al. 2011).

This is most clearly seen in the labor market reform from 1993, which is often referred to as the start of the active labor market policy in Denmark. The reform included both motivation measures and qualification initiatives as tools aimed at both unemployed and employed in a comprehensive activation line for solving structural problems. This policy also managed to reduce the relatively high unemployment rate at the time. The fundamental principle was a transitional understanding of the labor market, where employment could alternate with upgrading in a more needs-adapted course of working life.

The crucial question is thus whether the labor market education system manages to meet the challenges posed by the workforce's qualification and competence development in order to complement an automated production apparatus that is continuously being renewed. The question is crucial because labor market policy in the period since the turn of the millennium and especially since the financial crisis has been dominated by the motivational instruments. This means that the so-called "work first" principle has been the driving force in the period. The principle implies that the effort focuses on motivation in order to get unemployed into jobs as quickly as possible and thus supporting the quantitative labor supply. This means that economic incentives to work, activation programs and work testing are the dominant policy tools. Qualification initiatives are downplayed as they are not perceived as serving to get the unemployed quickly into jobs. During this period, the labor market policy has developed a relatively short-term and narrow supply-creating horizon. Analyzes (e.g. Jørgensen et al. 2017) indicate a significant erosion of the qualification function in labor market policy, which is reflected in a declining level of activity in the public labor market training programs, among other things, as a result of cutting the economic framework conditions. The level of activity has thus fallen to less than half in the AMU programs since the financial

crises and these are increasingly regarded as educational policy rather than labor market policy instruments. In addition, it has become difficult for companies to use AMU and at the same time limit their opportunity costs in connection with the activity. This creates a self-reinforcing effect that reduces the supply of courses. The declining level of activity goes beyond the opportunities of the short-educated in the labor market, which means that education-conscious companies organize their own tailor-made educational initiatives. Key elements of the labor market's education system are thus not only neglected for a long period but tend towards a decoupling from the labor market policy. Such a decoupling implies a narrow labor market policy, which, in the present form, hardly manages to promote skills development and mobility sufficiently as a lubricant to address the structural challenges of automation in the labor market. However, since the tripartite agreement on VEU in 2017 the trend reversed and a small increase is observed. This is due to the aims of increasing activity, motivation, transparency and coherence.

Future-proofing skills and competence development must be based on how tasks are exposed to automation. Content and scope of tasks are related to the job design resolved at company level and to the industrial relation between the parties in the labor market through the delimitation of occupations as trades in collective agreements etc. In general, it can be said that the more routine tasks are displaced by more varied, problem-solving and knowledge-based tasks. How the occupations evolve is not only unambiguously determined by the new digital technology but is resolved at corporate level by how new tasks replace obsolete tasks in work organization and functional flexibility. This makes it necessary to focus on the company level in order to understand the challenges that lie ahead for the active qualification instrument of labor market policy. Labor market education has traditionally contributed to equipping workers with skills that are geared towards narrowly defined subject or job category skills. Competences, however, equips employees with capacity to utilize learned qualifications for the performance of tasks in the work situation (Høyrup and Petersen 2002). Competence development will thus be the continuous development of knowledge, skills, influence, capacity for action and responsibility in relation to the employees' tasks (Nielsen 2004). Competence development is closely linked to tasks and organization of tasks at the company level.

As decisions on automation take place at company level, the actors and their actions at this level become essential to whether routine intensive occupations evolve with new, more varied and problem-solving tasks that complement new technology, or are displaced. A recent Danish study shows that employees are often involved in technology development and work organization (Nielsen, 2015), which supports that voluntarism exists at the workplace level. Employees of all skill levels are involved in idea development, negotiations, decision making and implementations of changes. The same study finds that about a quarter of employees experience that their professional organization, trade union or collaborative committee participate in the phases of change. Therefore, it would be appropriate if the influence of companies and their employee's involvement is coordinated through the established stakeholder system.

Within the vocational education and training system there is a tradition for involving the social partners of the labor market in central and local boards and educational committees, and to have the social partners involved in implementation of labor market policy. There is thus an established cooperation and governance structure, known as 'the Danish model' to build on if the qualification instrument is to be related to the agents at the company level and their ongoing competence and occupational development. When practice and theory are part of the same integrated education and training program, for example when practice training at the company level is supplemented with formal vocational training and courses, the knowledge element in learning is strengthened for the benefit of problem solving and functional flexibility (Tidemand and Lindstrøm 2003, Nielsen 2004).

The structural challenges associated with new automation technologies mean that the qualification instrument must be realigned, but in a completely new design of the policy. Central to this design will thus be the level of the company, including the employee' and labor market parties' involvement and participation in the companies' technological development, change of work and functional development of occupations. With the company level's central guiding role for competence development and qualification needs, active work policy becomes a more precise term than active labor market policy and at the same time the answer to the automation challenges' structural challenges.

Can qualification and competence development be future-proofed?

There is some evidence that skill development at the company level has been in decline recently. Lorenz, (Holm and Nielsen?) (2020 – other chapter) study recent trends in work organization and find that employees in Denmark have been experiencing a decline in skills development in the job. Labor market education and training could potentially be developed so that they support the development of skills at the company level. A recent Danish government commissioned report (Ekspertgruppen for voksen- efter- og videreuddannels, 2017) emphasizes that it can be advantageous to create a national competence panel, which, overall, must analyze and monitor the entire adult, after-school and further education system. As an experimental scheme, it is recommended to establish collaboration with 3 - 4 competence clusters, in order to develop and test models for how close the cooperation between the companies in the competence clusters and the education system can be organized, so that the educational institutions are able continuously to develop qualification offers that match companies' competence needs; beyond employer involvement in setting curriculum to the development of integrated work learning schemes. In the same way, partnerships between educational institutions and relevant regional actors are to be established, in order to coordinate the regional and local efforts for continuing education. For all employees, it is recommended that, through a personal education account, they should be entitled to up-grading education, and that competences acquired through the performance of work functions (real skills) must be able to be recognized in further education. This is a suggestion for strengthened coordination of the efforts in close interaction with companies that are leading the way in technology development, coupled with a desire that the upgrading of skills must capture the workforce broadly through individual educational accounts, and that competences acquired in the companies are recognized in the education system. At the same time, it is a dynamic effort, which is partly based on analysis and monitoring activities, and partly on a collaboration with a number of competence clusters that must be assumed to be technology-leading. The social partners have an important role in monitoring and supervising proactive planning of education and training. The partners are also expected to finance part of the individual educational accounts within their collective agreements. At the firm level the management and employee representative have a role of screening for basic competences and act as agents in a demand driven vocational education and training system (Ekspertgruppen for voksen- efter- og videreuddannelse, 2017).

For a large part of the workers, problem-solving and continuous learning are part of work (Nielsen 2015). When it comes to formal education, there may be challenges for many unskilled workers who perceive education as negative and demotivating. If the teaching is linked to knowledge and skills of practical problem solving in their work situation, learning becomes close to reality and motivating. A company survey (Fremkom 2016) thus shows that the ability to use what you have learned through courses and education in practice is given high priority by a majority of companies. Another study (DEA 2015) shows that a large part of the unskilled workers actually performs work functions at a higher level than their formal (lack of) education appears to qualify for, and that it is the AMU programs that help to maintain them at this level. The AMU thus turns out to be of importance for how the formally least skilled often manage to perform work functions at a higher level in the companies. The unemployed, however, must be

handled differently in relation to qualification development. The specific competencies are primarily developed in the companies, and therefore the motivation instrument has been increasingly used to get unemployed people to work as soon as possible and let the upgrading work take place in interaction with the companies. It is beyond doubt that there is an important role for employers in skills development for the unemployed both through integrated work learning schemes and workplace activities. However, there is no strong evidence that forced participation based on the threat of forfeiting unemployment benefits ensures the participation or active involvement of the unemployed. Such policies are more likely to make agents focus on short term arrangements to ensure income than to participate in skills development programs. Relatedly, the application of technology and the organizational design are, as mentioned, developed very company-specific, so that a general qualification is very difficult to develop from the top down. Training of workers, both unemployed and employed, must therefore only focus to a certain extent on concrete competences, but first and foremost on competences-to-develop competences. The more specific competencies must be continuously developed in the companies in interaction with development in the organization and use of the technology.

Conclusions

This chapter has focused on the challenges faced by labor market policy from technological change, including the demands made on the skills of the labor force. With this focus, we have discussed the structure of labor market policy and how this can be developed into an active work policy, in which qualification and competence development are continuously future-proofed.

An account of recent research contributions to the understanding of how technological change can be expected to affect the future labor market structure (and vice versa) shows that a significant share of jobs or tasks are vulnerable to automation. The research results are somewhat sensitive to the methodology of the studies, but all studies tend to find some automation potential. The crucial point here is that it is not jobs that are automated but tasks in jobs. Frequently, it will only be some of the tasks that are automated, thereby freeing the worker to take care of other tasks. With the importance of the tasks in the automation analyzes, very different estimates of the effect of automation on employment appear. The methodological insight, however, gives the opportunity to continuously relate critically to the difference in the results. A few studies focus partly on company level and show how technological and organizational changes affect the composition of the workforce and partly on the individual level and show the adaptation of the workforce as a result of automation in the workplace. These studies are interesting as they emphasize the importance of adaptation and development among workers. Similarly, interesting are studies that examine the dynamic effects of automation. Overall, substitution, output and spillover effects entail that automation creates more jobs than it destroys. However, the potential of automation depends entirely on the occupations' content in terms of tasks.

The data presented in the chapter documents the recent evolution of labor market policy in Denmark, and also includes new data showing the importance of different mechanisms for competence acquisition among workers in Denmark. It was documented that over recent decades Danish labor market policy has been increasingly emphasizing the motivation instrument while the qualification instrument has been neglected. However, recent political changes suggest that the qualification emphasis is currently receiving renewed attention. The data also documented the importance of learning at the workplace versus formal training, and that, while the unemployed do not themselves consider their current competencies obsolete, they struggle to upgrade their competencies with the options available to them.

Based on research on the effect of automation on the structure of the labor market, and on our data on Danish labor market policy and Danish workers' competence acquisition, we then discussed the labor market policy challenges. The qualification instrument has been a decisive tool in earlier periods of structural change. However, developments over the past decade also show how the qualification instrument is eroded in the policy, so that the result is a narrow operational labor market policy.

If the qualification and competence development is to be future-proofed, the qualification instrument must be linked to labor market policy, but with a bottom up perspective, with inclusion of both unemployed and employed. Thus, the company level must be the basis for competence development in relation to tasks that develop in parallel with technological change. At the company level, decisions on productivity-enhancing technology development and job organization take place. However, the agents at the company level have a widespread practice of involvement and participation in the decisions about technological change and job organization. Correspondingly, the companies and the other agents of the labor market have practical experience for a collaboration that involves the labor market social partners. The key point, however, is whether vocational and labor market training can develop and maintain a broad and dynamic understanding of competences based on analysis and collaboration with competency clusters of companies and focuses on the development of skills that enable employees to apply and continuously develop the skills that are essential for the management of knowledge and problem-oriented work functions. This applies to all categories of education. A boost of skills in reading, math, collaboration and digital problem solving must form the basis. The crucial thing is that the programs must focus on building higher-order competencies, ie developing the competences-to-develop competences of the labor force, while the companies must focus on the fact that the specific task-related competence development takes place continuously for all employees.

Referencer

Acemoglu, D., and Restrepo, P. (2017). Robots and jobs: Evidence from US labor markets. *NBER working paper*, (w23285).

Acemoglu, D., and Restrepo, P. (2018). The race between man and machine: Implications of technology for growth, factor shares, and employment. *American Economic Review*, 108(6), 1488-1542.

Arbejdsmarkedskommissionen (2009). *Velfærd Kræver Arbejde, Arbejdsmarkedskommissionens anbefalinger – Analyserapport*. Copenhagen. www.amkom.dk

Arntz, M., Gregory, T. og Zierahn, U. (2016). "The risk of automation for jobs in OECD countries: A comparative analysis". OECD Social, Employment and Migration Working Papers. No. 189, OECD Publishing, Paris.

Autor, D. H., and A. Salomons. "Is automation labor-displacing. Productivity growth, employment, and the labor share". *BPEA Conference Drafts*. 2018.

Bessen, J., Goos, M., Salomons, A. og van den Berge, W. (2019). "Automatic reaction – What happens to workers at firms that automate?". Law and Economics Series Paper No. 19-2. Boston University School of Law.

Bowles, J. (2014), *The Computerization of European Jobs*, Bruegel, Brussels.

- Bredgaard, T., Jørgensen, H. Madsen, P.K. and Rasmussen, S. (2011): Dansk Arbejdsmarkedspolitik, Jurist- og økonomforbundets Forlag.
- Bredgaard, T. and Madsen, P.K. (2015): Dansk Flexicurity – Fleksibilitet og sikkerhed på arbejdsmarkedet, Hans Reitzels Forlag.
- Brynjolfsson, E., Mitchell, T., and Rock, D. (2018). What Can Machines Learn, and What Does It Mean for Occupations and the Economy?. In *AEA Papers and Proceedings* (Vol. 108, pp. 43-47).
- Chollet, F. (2017). *Deep Learning with Python*, Shelter Island, NY., Manning Publications (2018)
- Dagpengekommisionen (2015): Kompensationsgraden i dagpengesystemet. Arbejdspapir.
- Dauth, W., Findeisen, S., Südekum, J., and Woessner, N. (2017). German robots-the impact of industrial robots on workers, *IAB Discussion Paper 30/2017*, Institut für Arbeitsmarkt- und Berufsforschung (IAB), Nürnberg
- DEA (2015): Super ufaglærte og super faglærte – kompetenceløft gennem efteruddannelse, Dea rapport.
- Dølvik, J.E. og Steen, R.J. (2018): The Nordic Future of Work – Drivers, institutions and politics, TemaNord 2018:555
- Ekspertgruppen for voksen- efter- og videreuddannelse (2017): Nye kompetencer hele livet - Fremtidens voksen-, efter- og videreuddannelse
- Erhvervsministeriet (2017): "Digitalisering og produktivitet – vækstpotentialet i danske virksomheder".
- European Commission (2007): Mod fælles principper for Flexicurity – Flere og bedre job ved hjælp af fleksibilitet og sikkerhed. COM (2007).
- Freeman C. and Perez C. (1988): Long Waves and Changes in Employment Patterns, in *Structural Change and Labour Market Policy*, Stockholm, ALC.
- Fremkom (2016): Fremtidens kompetencer i Nordjylland <http://fremkom.dk/>
- Freeman, C. and Louçã, D. (2001) "As Time Goes By: From the Industrial Revolutions to the Information Revolution", Oxford University Press, Oxford, UK.
- Frey, C. B., and Osborne, M. (2013). The future of employment, Oxford Martin Programme on Technology and Employment, Oxford University
- Graetz, G., and Michaels, G. "Robots at work." *Review of Economics and Statistics* 100.5 (2018): 753-768.
- Gregory, T., Salomons, A. og Zierahn, U. (2019) "Racing with or against the machine? Evidence from Europe". *IZA Institute for Labor Economics Discussion Paper Series* No. 12063
- Holm, J. R., Lorenz, E. og Nielsen, P. (2018) "Work Organization and Job Polarization". Artikel præsenteret på DRUID Society Conference 2018, København, 11-13 Juni 2018.
- Høyrup, S. and Pedersen, K. (2002): Lærings- og kompetencebegreberne i arbejdslivsforskningen, i Illeris, K (red.): Udspil om læring i arbejdslivet, Roskilde, Roskilde universitetsforlag.
- ILO (2018): Inception Report for the Global Commission on the Future of Work, Geneva.

Jørgensen, H. (2006/7): Arbejdsmarkedspolitikken fornyelse – Innovation eller trussel mod dansk "Flexicurity", Bruxelles og Aalborg.

Jørgensen, H., Klint, M.P., Hovard Pedersen, V., Lassen, M., Buchholt (2017): "Et udfordret AMU system – mod revitalisering og fornyelse", rapport

Madsen, P.K. (2003): The Danish model of Flexicurity – Experiences and lessons to learn. Paper to ETUI conference, Nov. 2003.

Nielsen, P. (1979): "Beskæftigelsespolitikken i 60'erne og 70'erne. Baggrund – Interesses modsætninger – Konsekvenser", Økonomi og Politik, 53. årgang nr. 3: 209 – 258.

Nielsen, P. (2004): Personale i vidensøkonomien – innovation, vidensorganisationer og kompetenceudvikling I det nye årtusinde, Aalborg, Aalborg Universitetsforlag.

Nielsen, P. (2015): Arbejde i forandring – Udviklingslinjer i private og offentlige arbejdsrelationer, bookboon.com

Appendix

In this appendix we give practical examples of the motivation and qualification instruments in Danish labor market policy.

We need to show that “motivation” does not just mean cutting away benefits – ie that it is an actual instrument.

Based on Peter’s email of 17 December:

Labor market policy in Denmark is fundamentally a supply side policy. From around 2000 onwards it has increasingly been dominated by a "work first" principle using control and sanctions. The motivation instruments are thus predominantly threat instruments. Reduction of social protection (and the security side of flexicurity) is part of this regime of increasing the supply of labor. In Denmark there is a relatively weak tradition for policy focusing the demand side, compared to, for example, initiatives like the Finnish workplace development programs. Such programs are more or less unknown in Denmark.

However, there is a resent political discussion on the limits of the supply policy. In this discussion some of the leading neoclassic economists (i.e. Nina Smith, CLS, AU) have interesting opinions.