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SPECIAL ISSUE ARTICLE

# Food for thought: Robots, jobs and skills in food and drink processing in Norway and the UK

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## Abstract

There is intense debate surrounding digitalisation and its implications for work. However, empirical research within established workplaces, especially international comparative studies, remains limited. This article uses cross-country research to further analysis of the *relative importance* of different institutions, actors and power relations in shaping digitalisation and worker outcomes. Through a multi-level approach, it compares the use of industrial robots in the food and drink processing sector in Norway and the UK. Drawing on qualitative research, it explores the pace of digitalisation, the process of implementation and job and skills outcomes. The study finds strong national differences in the pace of digitalisation, and the role of unions in the process of implementation. In Norway, union power at workplace and national level, embedded in institutional arrangements, underpins more advanced use of technology and improved outcomes for workers.

**KEYWORDS**

digitalisation, food and drink processing, jobs, Norway, robots, skills, UK

# INTRODUCTION

Nightmarish predictions of mass unemployment from digitalisation (Ford, 2015; Frey & Osborne, 2017) have re-energised old debates on the relationship between technology, work and skills (Beirne & Ramsay, 1992; Davies, 1986). Initial claims of large-scale job losses betrayed a latent technological determinism, leading many critics to re-emphasise the 'social shaping of technology' and alternative possibilities for worker outcomes (Neufeind et al., 2018). The workplace is a key site of contestation between management, workers and their representatives over the use of technology (Edwards & Ramirez, 2016; Howcroft & Taylor, 2014), and operates within specific sectors and national institutional contexts shaped by evolving power relations between state, capital and labour. The interplay of factors shaping technology, work organisation and skill is complex with many potential influences at multiple levels (Francis & Grootings, 1989; Lloyd & Payne, 2016). However, with little empirical research on the adoption and use of digital technologies in established workplaces, it is difficult to draw conclusions about institutional and power-based effects in the current context, and the conditions under which better worker outcomes might be achieved.

This article seeks to contribute to the development of a more effective analysis of the *relative importance* of different institutions, actors and power relations in shaping digitalisation and worker outcomes. Using international comparative research that integrates the macro-level (national institutions), meso-level (sector) and micro-level (workplace), it extends the emerging cross-national studies on 'country effects' (Lloyd & Payne, 2016) and 'how companies cope with automation under different conditions' (Krzywdzinski 2017: 251). This multi-level approach is used to compare robotics in the workplace within the food and drink processing sector in the UK and Norway, countries with starkly contrasting economic and labour market institutions. It explores the pace of digitalisation, the role of workers and their representatives in implementation, and outcomes for jobs and skills for production operatives.

There are two good reasons for such a comparison. First, the Industry 4.0 debate, with its focus on 'smart', 'cyber-physical systems', mobile robots and cobots, often neglects less digitally mature sectors (Cirillo & Zayas, 2019). In food and drink processing, industrial robots are still the 'new' form of automation and there remain high numbers of manual workers deemed particularly vulnerable to job loss (Frey & Osbourne, 2017). Second, we might expect significant country differences when comparing 'neoliberal' UK, with its weakly regulated labour markets and uneven union presence, and 'social democratic' Norway where unions are far stronger and more influential. How institutional and power-based effects play out in particular sectors and workplaces, given existing institutional and policy parameters, remains an empirical question.

The findings indicate strong national differences in the pace of digitalisation, and the role of workplace actors in the process of implementation. In Norway, union power at workplace and national level, embedded in institutional arrangements, is central to explaining more advanced take-up of technology and improved outcomes for workers compared to the UK. However, these gains have to be continually defended, both politically and at the workplace. If union power, at multiple levels, is critical to achieving better worker outcomes, this leads to an important discussion of how or if progress can be achieved in less well-organised workplaces and countries that lack similar supports. However, we argue that the starting point for addressing the prospects for change is to first demonstrate that better alternatives exist and why (Lloyd & Payne, 2016).

The article begins by addressing recent studies of digitalisation and outlines the framework of analysis. Key factors are identified which are likely to be important in shaping the pace of digitalisation, the process of implementation, and outcomes for work and skills. The next sections outline central features of the institutional contexts in the food and drink processing sectors in Norway and the UK and the research methods. Drawing on qualitative research in five plants, the findings are analysed in relation to the pace of change, implementation and outcomes. The final section discusses the contribution to debates on the role of institutions, actors and power in shaping digital technologies and the prospects for improvements in worker outcomes.

## PRODUCTION WORK: A FRAMEWORK FOR ANALYSIS

In the recent automation literature, production workers are widely identified as highly vulnerable to digitalisation. According to Frey and Osborne (2017: 265), industrial robots are already able to take over 'the routine tasks of most operatives in manufacturing', with food and tobacco operatives accorded a 91% probability of replacement. For 'routine' manual work, the main technological constraint is how quickly robots can overcome automation 'bottlenecks' still requiring human dexterity. Others stress that jobs comprise multiple elements, only some of which may be automatable (Autor, 2015), producing more conservative estimates of job destruction (Arntz et al., 2016). Despite widely varying predictions, such approaches are prone to technological determinism and do not study how jobs are actually changing inside workplaces (Krzywdzinski, 2017).

The alternative view is that technology is 'socially shaped' (MacKenzie & Wajcman, 1999), with recent critical studies once again challenging predictions of mass technological unemployment, and returning to the central question of the relationship between technology and job quality outcomes (Edwards & Ramirez, 2016; Thompson, 2020). There are widespread concerns in the literature that capital accumulation imperatives will encourage employers to deploy digital technologies to intensify work and managerial control through the standardisation of tasks and heightened surveillance (Fleming, 2019; Gallie, 2017). It is also recognised that digital technologies could be used to remove repetitive tasks, enhance skills and, at a societal level, reduce working hours and enable workers to share productivity gains (Edwards & Ramirez, 2016; Krzywdzinski, 2017; Warhurst & Hunt, 2019). Outcomes are not pre-determined by technology, as its design and use depend on actors operating within particular social and political environments. Managerial approaches in the workplace, therefore, are likely to vary (Child, 1972), and may be contested or resisted by workers and any representatives.

A central issue for Edwards and Ramirez (2016) is that workers must decide *when* they should 'embrace or resist' new technology. Drawing upon Orlikowski's (1992) 'soft determinism', they suggest that technologies have effects and constraints on their use, with varying scope for workers to shape outcomes depending on the 'intrinsic' properties of the technology in question. 'Immanence' effects that flow directly from technology *design* need not necessarily be negative for workers, but where they are, unions must address design itself, an area where traditionally they have had little influence (Edwards & Ramirez, 2016: 111–112). Even where technologies have detrimental effects, there will be space for workers and unions to resist, demand compensation, or seek positive changes. Edwards and Ramirez's approach is helpful in articulating the nature of technologies but the focus is on workers' ability to decipher constraints and opportunities rather than on the conditions under which workers have the power to resist or shape their use.

In developing a conceptual framework that can contribute to explaining outcomes, we draw on an interrelated analysis that emphasises the centrality of institutions, actors and power at multiple levels (Francis & Grootings, 1989; Lloyd & Payne, 2016). At national level, institutions, regulations and welfare systems influence power relations within workplaces and affect how management, workers and their representatives deal with technology. These national effects are mediated by sectoral dynamics and organisational level actors. Given the range of potential influences on the take-up and use of technology – both 'technological' and 'social' – exploring the role of institutions and power is far from straightforward. International comparisons offer a promising way forwards, with the potential to identify which elements matter most.

## INSTITUTIONS, ACTORS AND POWER

There are a number of studies that focus on digitalisation or technology more broadly that offer useful insights into how institutions, actors and power relations shape the pace of digitalisation, the process of implementation and outcomes for workers.

In relation to the *pace of digitalisation*, technologists still struggle to design robots that can match humans for mobility and dexterity, or which are able to replicate workers' tacit knowledge of the production process (Pfeiffer, 2016; Upchurch, 2018). These technical barriers are partly 'socially shaped' as research and development favours certain industries and products (MacKenzie & Wajcman, 1999). Take-up of technology depends on managers' estimate of perceived benefits, the resources available, the cost of capital compared to labour and having the skills for installation and operation. Implementation can be complex, disruptive and risky (Hirsch-Kreinsen, 2016). These factors are shaped by institutions and power relations. Labour market institutions, including collective bargaining, and the relative power of workers are critical to the 'price of labour'. High wages can be an incentive to automate or, alternatively, firms may eschew investment when faced with shareholder demands for short-term profits, or because it remains cheaper to continue with labour-intensive processes (Lewis & Bell, 2019; Upchurch, 2018). Previous studies find country variation in the pace of technological change (Daly et al., 1985; Freeman, 2004) reflecting, in part, institutional and power differences.

A recent contribution is Fleming's (2019: 24) concept of 'bounded automation' which sees the pace of digitalisation constrained by the 'price of labour, organisational power relations and the nature of the task itself' (2019: 28). Low wages, fuelled by deregulation and de-unionisation, are said to undermine organisations' incentives to automate, while management is likely to use digitalisation to weaken strong and resistive unions. The framework highlights key elements affecting digitalisation with power being a 'salient factor' (2019: 27). However, the primary concern is the pace of automation rather than the ability of workers to shape positive outcomes. Focusing mainly on neoliberal economies, there is also little discussion of countries with alternative institutional arrangements and stronger unions.

Whether, and under what conditions, workers can influence *the implementation of technology* in support of better jobs is a key question. Management are reluctant to relinquish their prerogatives in relation to investment decisions or cede control over the organisation of production and worker effort, even where high skill work may require greater worker autonomy (Beirne & Ramsay, 1992; Edwards & Ramirez, 2016). However, some form of participation may be offered to tap into workers' situated knowledge, help with implementation, or to secure workers' acceptance (Beirne & Ramsay, 1992). Such management-initiated participation need not necessarily be illusory or harmful to workers, although effective participation is more likely where independent unions strengthen the opportunity for workers' interests to be considered.

The last period of substantive research exploring unions' role in shaping technology was the era of micro-electronics in the 1980s. In the UK, unions were largely reactive and experiments with 'new technology agreements' afforded little influence (Beirne & Ramsay, 1992). In countries with codetermination or work environmental legislation, such as Germany, Sweden and Norway, there is evidence that a joint approach between unions and management met with greater success (Deutsch, 1986). Together with labour market and welfare regulations that provide security and training supports for workers, such arrangements reflect historic class settlements founded on, and defended through, the societal strength of organised labour. Arguably, a ‘threshold’ may be reached where ‘working-class associational power begins to have positive effects on capitalists’ interests’ (Wright, 2000: 959), including securing workers’ consent to technological rationalisation through sharing productivity gains (see also Streeck, 1997). How far such ‘positive class compromises’ (Wright, 2000) can be sustained is an enduring question. To determine whether such settlements continue to shape outcomes in a new context of digitalisation requires empirical research at workplace level (Dølvik & Steen, 2018). Manufacturing has often been seen as the cornerstone of these settlements in Germany and the Nordic countries, and it is here that we find the few contemporary workplace studies concerned with digitalisation and production work.

These studies offer insights into *work and skill outcomes*, suggesting incremental and mixed changes. Rolandsson et al.'s (2019) research in Nordic companies finds evidence of ‘skills upgrading’ for some operatives as they take on more of the management of the production process and some tasks of engineers. However, they are cautious about the extent of change, noting that ‘surveying production processes via a panel or an ipad… does not necessarily entail qualified tasks and challenges’ (Rolandson et al., 2019: 20). Warnhoff and de Paiva Lareiro (2019) highlight an increase in basic software skills together with a loss of ‘experiential knowledge’ and autonomy. Achtenhagen and Achtenhagen’s (2019: 229) study of German food manufacturers concluded that operatives required new skills to set up and operate equipment, ‘interpret display data’, and understand the ‘overall logic’ of the process, yet this went alongside reduced task variety and periods of ‘boredom’. This nascent literature focuses on skill and task changes, but the challenge for research is also to explain why outcomes occur.

A useful starting point for analysing how institutions, actors and power shape technology outcomes is to draw on past international comparative studies. The path-breaking research on ‘societal effects’ showed that firms using similar technology in different countries could have distinct patterns of organisational and skill structures (Maurice et al., 1980). German workplaces encouraged skill polyvalence among production workers and a greater span of control compared to similar workers in France. These differences were said to reflect interrelated national ‘spheres’ that included industrial relations and education and training systems, linked to class relations and power in wider society. Other comparative studies have given more prominence to the vocational education and training (VET) system, for example in explaining the UK’s low productivity and tendency to use lower skilled workers, or conversely supporting high skill work in Germany (Daly et al., 1985; Finegold & Soskice, 1988).

The literature on national employment regimes emphasises the power resources of organised labour within the political system and the workplace as critical for the diffusion of better forms of work organisation (Gallie, 2017; Lloyd & Payne, 2016). In the Nordic countries, the large proportion of jobs with high task discretion and learning intensity is attributed to inclusive systems of collective bargaining, employment rights and welfare, and the influence of unions in workplace decision-making. A high and flat wage distribution purportedly encourages investment in technology as a means of improving productivity and competitiveness, while relatively generous unemployment benefits provide support for displaced workers (Dølvik & Steen, 2018). Rolandson et al.’s (2019) recent case studies suggest union-management partnerships at workplace level endure, with pro-technology unions pushing for workers to be trained on new digital technologies.

International comparative research on digitalisation remains incredibly sparse. Focusing on Germany, Krzywdzinski (2017: 251) explores digital automation in automotive supplier plants, finding higher skill use in Germany and more semi-skilled, precarious work in Central Eastern European countries. These differences are traced, not to the role of unions, but Germany's high-quality VET system and the positioning of German plants as leads in the ‘ramp out’ of new technologies, though the direction of causality is uncertain. The analysis is constrained by relying on membership as an 'indicator of union strength' and influence, and the author concedes that unions' role in job design is 'hard' to determine (2017: 262–3). Nevertheless, the study underlines the value of cross-national comparisons in unpicking institutional effects, along with the challenges in explaining varied outcomes.

International comparative research can advance understanding of the role that societal institutions and power dynamics play in shaping the pace of digitalisation, implementation and outcomes but must avoid institutional determinism. National institutional features, for example collective bargaining coverage, do not apply evenly across sectors or workplaces. Employers within a sector are also faced with different constraints and opportunities, such as product markets, that are likely to affect the use of technology. How much space exists for employer agency within existing institutional arrangements is an important question when addressing possibilities for better worker outcomes within specific sectors.

## FOOD AND DRINK PROCESSING IN NORWAY AND THE UK

Part of the 'Nordic model', organised labour remains particularly strong in Norway with a highly co-ordinated, multi-level system of collective bargaining and extensive welfare provision (Løken et al., 2013). Labour costs are amongst the highest in the world, and unions have traditionally been pro-technology, supported by legal and collective rights on co-determination. There is a well-regarded VET system, rooted in social partnership, with a strong apprenticeship system and opportunities for 'unskilled' workers to acquire certification as skilled workers (Lloyd & Payne, 2016).

The UK is a neoliberal economy with relatively weak unions, a lightly regulated labour market, weak employer coordination, low unemployment benefits, and a much-criticised VET system. Collective bargaining over technological change has been relatively rare (Beirne & Ramsay, 1992; van Wanrooy et al., 2013). Low and declining union membership, limited company bargaining and marginalisation from public policy have restricted union influence, nationally and at the workplace. Relatively low labour costs, weak employment protections and shareholder short-termism have long been implicated in the UK's poor productivity record and are often seen as a drag on investment (Lewis & Bell, 2019).

Food and drink processing is the largest manufacturing employer in the UK (435,000 employees) and Norway (53,000 employees), accounting for 19% and 24% of manufacturing employment, respectively (Eurostat, 2020). Although employment fluctuates with economic cycles, there are similar numbers employed today as 30 years ago. Sector labour market institutions reflect the national picture. In Norway, union density in manufacturing is around 50%, and sector collective agreements cover 56% of workers (Nergaard, 2020). Interviews with industry stakeholders indicate similar levels in food and drink. While many smaller employers do not sign a collective agreement, most follow the minimum pay tariffs. In 2019, this was 180NOK per hour (approximately £14) for non-shift work (NNN, 2018), with a median hourly wage for operatives of 230NOK (£17.50).[1.]

In the UK, the sector has a reputation for many low-paid, low-skill jobs and poor working conditions (Heasman & Morley, 2017; James & Lloyd, 2008a). There is no sector-level bargaining. In food manufacturing, union membership is around 17% (DBEIS, 2019), and collective bargaining coverage between 26% and 30% (Wilson, 2013). Median hourly pay for food, drink and tobacco operatives was £9.31, only just half that of operatives in Norway, with four in ten low paid[2.] (ASHE, 2019). Many organisations rely heavily on migrant labour and agency workers (Heasman & Morley, 2017; James & Lloyd, 2008a), whereas in Norway migrants appear concentrated in areas such as fish processing (Friberg & Midtbøen, 2018).

Automation has a long history in this sector, however, much of the European industry, particularly SMEs, still rely on manual processes. Worldwide, robot use is increasing but accounts for only three per cent of installations (IFR, 2019: 13), with most used for packing and palletising rather than pick-and-place food handling (Bader & Rahimifard, 2018). As many food ingredients are fragile, sticky and irregularly shaped, technology designers confront significant challenges, while stringent hygiene requirements limit transfer of robotic tools from other sectors (Lien, 2013).

In the UK, automation has often lagged behind other European countries, and varies significantly across organisations (Heasman & Morley, 2017; Lloyd & Payne, 2019). The adoption of 'smart', cyber-physical systems remains limited, despite some companies said to be 'aspirational' (Thomas et al., 2018: 7). There are fears the industry is falling behind its European competitors (FDF, 2016: 8), amid long-standing problems of short-termism and intense cost and flexibility pressures from powerful supermarkets (James & Lloyd, 2008b). The potential closure of migration routes 'post-Brexit', along with increases in the national minimum wage, threaten to weaken supplies of cheap labour. This is a major source of industry concern (FDF, 2016), even allowing that it might encourage more automation (Lloyd & Payne, 2019; Thomas et al., 2018).

In Norway, the industry is very profitable but its reputation is that of a 'technological laggard' (Braadland & Haukes, 2000: 5). Nevertheless, investment levels are significantly above the UK, with gross value added per worker over 40% higher (Eurostat, 2020). High wages are seen by industry stakeholders as incentivising digital automation, although some companies remain technologically 'backward', regarding robots as 'too expensive' (Lloyd & Payne, 2019: 218). Despite Norway being amongst the top-ranking countries for digitalisation, it has relatively few robots in manufacturing, reflecting the country's industrial structure and dominance of SMEs (Iris Group, 2015).

Higher labour costs would suggest Norwegian plants will be further ahead on digital automation compared with the UK. Given supportive institutions and union power, we would also expect workers in Norway to have more influence over implementation and outcomes. The UK sector appears to be a classic example of how permissive employment regulation has 'blunted the incentive for firms to automate and encouraged the move to low-cost, labour-intensive technologies' (Spencer & Slater, 2020: 126). Weak employment regulations, however, provide organisations in theory with greater scope for 'strategic choice' (Child, 1972), including whether and how they use and implement new technology.

## RESEARCH METHODS

To explore the pace of digitalisation, the process of implementation, and outcomes for jobs and skills, five workplace case studies were undertaken in 2018–19, three in Norway (N-Drinks1, N-Drinks2, N-Food) and two in the UK (UK-Drinks, UK-Food). Establishments were selected where robots were in use, with companies identified through web searches and industry contacts. In Norway, the three participating workplaces were accessed through the food workers' union, and each was covered by a collective agreement. The UK cases came from direct contact with company managers, and were non-unionised. While matched cases with similar products and union presence would have been ideal, international comparisons inevitably require some compromise (Francis & Grootings, 1989), especially in a sector where access is challenging (Heasman & Morley, 2017).

Three plants (N-Drinks-1, N-Drinks2, UK-Drinks) were in the drinks sector, with automated bottling processes and robotics predominantly used for packing and palletising. The other two plants were in food processing. UK-Food used a small number of robots primarily to place 'hand-packed' sandwiches into small boxes. N-Food was producing a range of confectionary, with robots deployed for pick-and-place, packing and palletising operations. All workplaces employed at least 200 workers

**TABLE 1** Case studies and interviews

| Case study | UK-Food | UK-Drinks | N-Drinks1 | N-Drinks2 | N-Food |
|---|---|---|---|---|---|
| Company ownership | UK privately owned | UK privately owned | Norwegian cooperative | Foreign MNC | Norwegian MNC |
| Plant main product | Sandwiches | Drinks processor | Drinks processor | Drinks processor | Confectionary |
| Plant worker representation | Employee committee | Employee committee | Unions | Unions | Unions |
| Plant employment | 1500 | 200 | 200 | 800 | 250 |
| Interviews | Production manager<br>Packing manager<br>Packing team leader<br>Operative/employee rep<br>Operative<br>Maintenance engineer | HR manager<br>Production manager<br>Supervisor (ex-operative)<br>Trainer (ex-operative)<br>Automation engineer | Production manager<br>Union convenor<br>Union plant rep<br>Lab worker<br>Operative<br>3 union officials | Production director<br>HR director<br>Supply chain director<br>Lean manager<br>Union convenor<br>2 union reps<br>2 Operatives<br>Feedback meeting includes managing director | Plant manager<br>Union convenor<br>Technical manager<br>Maintenance engineer<br>Operative/safety rep<br>2 Operatives |

**TABLE 2** Technologies and job changes

| Plant | Main robot technologies | First robots introduced | Employment change | Cause of employment change | Job loss predictions (automation) |
|---|---|---|---|---|---|
| N-Drinks1 | Packing, palletising | Late–1990s | 40 (1990s) to 200 | Company concentration | Limited |
| N-Drinks2 | Packing, feeding, palletising | Mid–1980s | 3500 (1980s) to 800 | Mainly automation | Limited |
| N-Food | Pick and place, packaging, palletising | Early 1980s | 900 (1990s) to 250 | Automation | Limited |
| UK-Drinks | Feeding, packing, palletising | Mid–2010s | 40 (2000s) to 200 | Expansion 'young' company | 50 next 5 years |
| UK-Food | Secondary packing | Mid–2010s | 400 (1990s) to 1500 | Market growth | 375 next 5 years |

Source: Interviews, company reports.

and, except for UK-Drinks, were part of larger companies (Table 1). The products of all the plants were primarily aimed at the mid-market, and were produced in high volumes. Traditionally operative jobs in these plants in both countries did not require any qualifications.

Semi-structured interviews were undertaken with 36 participants including managers, trainers, engineers, technicians, union/employee representatives, and production operatives. Three were group interviews involving union representatives at N-Drinks1 and N-Drinks2, and managers at UK-Drinks. Interviews with managers, engineers and worker representatives lasted around an hour, and those with operatives between 20 and 45 min. Managers were questioned about drivers of robotic automation, the implementation process, and the impact on the business, jobs and skills. Engineers and technicians were asked about technical challenges, their work and that of operatives. Interviews with worker representatives and operatives focused on their role in implementation and the impact on work and skills. Guided tours of the production facilities took place in all sites, with opportunities to observe the robots and operatives at work, ask questions and take notes.

All interviews, except one, were audio-recorded and transcribed verbatim. A coding schema was designed with key themes (e.g. ‘drivers’, ‘barriers’, ‘job losses’, ‘skill implications’) derived from the research questions and analytical framework. To aid consistency and reliability of data analysis, the schema was adapted using a small sample of interviews, with new codes (e.g. ‘unchanged jobs’) added following discussions between the researchers to ensure key data was not missed. Where clarification was necessary, points were followed-up via email with key contacts. Field notes provided valuable contextual information that could be cross-checked with interviews to strengthen validity. Companies were given pseudonyms. Precise data on employment, ownership and products are withheld to maintain anonymity. The next sections present the main findings across three dimensions: the pace of digitalisation, the process of change, and the impact on the tasks and skills of operatives.

## THE PACE OF DIGITALISATION

The Norwegian plants were more automated than those in the UK, having a lower proportion of jobs primarily involving physical manual labour. Robots were first installed in the three plants in the 1980s or 1990s, whereas they had been introduced in the two UK workplaces only in the last five years (see Table 2). At N-Drinks1 and N-Drinks2, a process of incremental change had seen older machines replaced with upgraded computer-controlled versions. More substantive developments involved robots being installed for packaging and palletising, replacing large numbers of manual tasks. N-Food had varied production lines with robots that included pick-and-place, feeders and mould-laying, alongside more general packaging and palletising. A range of manual tasks remain, such as rolling out ingredients and removing defective products. UK-Drinks, a single-site company, had expanded rapidly over the past 10 years, installing new lines, computerised-control systems and palletising robots. However, it retains one area of hand-packing involving 60 workers. The sandwich producer, UK-Food, had recently introduced eight robots for secondary packaging. It contrasts significantly with the other workplaces in having a very high proportion of workers engaged in repetitive, manual sandwich-making and packing.

N-Drinks2 and N-Food have experienced substantial job losses from automation over a 30-year period. The last major change at N-Drinks2 involved the introduction of a robotic picking system in 2011 when 120 manual packers were reduced to 18 machine operatives. Changes have been more gradual at N-Food, with compulsory redundancies normally avoided. The recent installation of robots on one line had reduced operatives from 21 to six. The other three plants have experienced employment growth. At N-Drinks1, the company had closed other units and concentrated production in this site. At UK-Drinks, expansion into new markets had increased employment, even though automation had saved labour; for example, on one line the number of operatives was reduced from five to three. UK-Food has grown substantially over the last 30 years, tapping into the market for ‘pre-pack’ sandwiches. The recent use of robots has led to a small reduction in employment, managed through labour turnover and reducing agency workers.

There are a range of incentives and barriers to using robotics in these plants. The primary ones are the cost of technology relative to estimated savings, and the availability of funds for investment. In the Norwegian plants, managers and union representatives emphasised that automation was imperative to enhance productivity and maintain cost-competitiveness in the context of high wages. Pay at the plants, which includes additions for tenure, shift work, unsocial hours and ‘skilled’ status, was between £22 and £25 per hour. The production director at N-Drinks2 explained:

> Norway is a high-cost country. If we are not able to develop in terms of automation and be more efficient with less people… very easily production of certain products are moved out from Norway.

In the two UK plants, there was no evidence that labour costs were a primary driver for investment. UK-Drinks paid direct workers £12.50 an hour (including shift premiums) and interviewees pointed to robotics being used to expand production. At UK-Food, profitability was sustained through low wages, with pay below £9 an hour and a workforce comprised mainly of migrants (20%) and local ethnic minorities. As a maintenance engineer noted: ‘we've no real need to go to automation. It sounds terrible… labour's been cheap enough for us to get and plentiful, and we're still making very good money.’ An increase in other local job opportunities, combined with uncertainty over Brexit, was making recruitment more challenging. The production manager felt that a factory environment was not attractive and, consequently, automation had moved up the agenda as ‘we're not going to have the people.’

The scope for further automation at the plants is varied. For the more automated Norwegian plants, the easy wins have largely been achieved, with remaining processes more difficult to automate or affording limited returns. At N-Food, for example, a supplier had recently offered a new photo-technology but the licence fee proved ‘much too high for us… compared to what we believe we can get back’ (technical manager). In the Norwegian plants, interviewees felt investment in digital technologies would not impact significantly on employment over the next 15 years. With substantial numbers of workers undertaking manual, repetitive tasks, the UK plants have greater scope for automation. At UK-Drinks, 60 workers, predominantly agency workers paid the minimum wage (£8.21), were hand-packing bottles. Using robots could reduce numbers to eight but, as the production manager explained, ‘the payback at the moment isn't there’. At UK-Food, there were plans to gradually introduce robots into the sandwich-making area which the production manager believed could, if successful, reduce staffing by a quarter (350 jobs) over five years.

Examples were provided across the plants of operative tasks that could not currently be automated. The most affected was UK-Food where managers highlighted the lack of suitable technology that could meet the hygiene and handling requirements of sandwich-making. As robotics were slow to develop, management had decided to collaborate with designers to develop bespoke solutions, such as robotic ‘gripper heads’. The production manager was frustrated at the lack of progress: ‘the amount of time we've had to put in to make them work is huge.’ In the other plants, problematic tasks were identified, such as tasting, sampling, manipulation of products, adding ingredients to batches, or undertaking quality control tests. At N-Food, the technical manager questioned the accuracy of automated quality checks for sticky products of different shape and size, insisting ‘we're not convinced at the moment.’ At UK-Drinks, where seals on cartons had to be manually checked, there is no existing technology available.

There is little evidence that robots are going to sweep away most operative jobs in these plants, even within a 15-year timeframe. The findings suggest incremental rather than radical change, with significant constraints on automating many tasks. Norwegian plants are already more automated reflecting higher wages, while those in the UK potentially have greater scope. In the UK, the pace of automation has been impeded by a reliance on cheap, flexible labour which may become more challenging with labour mobility restrictions following Brexit.

## THE PROCESS OF IMPLEMENTATION

This section examines how far workers and/or their representatives were able to influence the implementation of robots. In the Norwegian plants, unions were involved in 'partnership-style' relationships with local managers. At N-Drinks2, this approach had developed following a period of company restructuring in the 1990s which had seen the union develop a pro-technology stance. One of the company's plants in another country had been closed following a strike over technology, and workers were said to have 'lost everything' (union rep). In consultation with members, unions at N-Drinks2 had decided not to 'fight technology', despite the prospect of significant redundancies, but to 'be a part of the process'. The union had negotiated agreements which included existing operatives being trained on robotic technology rather than technicians, and a minimum staffing level in each department and shift. A union representative explained:

> we always say we want future technology with today's people… keep not the number of employees but the same employees… we are well paid, we are well organised and we are still doing the work.

The union has representation on technology steering groups and in the boardroom, and also presents ideas for new technologies to management. The managing director referred to 'close cooperation' involving 'tough discussions'. With union backing, management had also developed an alternative redundancy package, providing displaced workers with a steady income while being helped to find alternative employment.

At N-Drinks1, the union convenor, with members' support, had joined the management board eight years previously. The convenor spoke of a 'close system' based on 'mutual respect' that had worked well for both sides:

> until now we have had a fair share of the profit… when we increase productivity, we expect to follow with the wages… we have to become more effective and we have to keep costs as low as possible.

As part of a joint management-union process of presenting investment proposals to head office, managers and workers are asked to put forward recommendations.

> 'what do you need next year, what's smart, what's old and can they improve us in the future?'… We sit together [with the union] and talk about it
>
> (production manager)

At N-Food, there is less formal union involvement in workplace management. The union convenor insisted, however, they were 'very much involved', with management sharing monthly figures. Engagement over technology issues is more *ad hoc*, although there are regular discussions on management plans. Unlike at the two drinks plants, unions are not directly involved in compiling the priority investment list sent to head office. Instead, this is decided by managers, with input on ‘risky’ tasks from the Environmental Health and Safety (EHS) department.

There is greater variation in direct worker involvement. At N-Drinks2, the workers interviewed felt they had little direct say in decisions over technology, though they acknowledged the role the union played in negotiations. One former operative noted that ‘[technology] was just sort of implemented’ but highlighted recent moves to engage operatives in groups that visit suppliers, make recommendations, and help embed new technology. Direct worker involvement in implementation was most evident at N-Food, where there was an established history of using ‘project groups’ comprising at least one operative, an EHS representative, the department manager, an engineer, and a technician. Once an area has been identified for investment, a group explores the technological requirements and may visit suppliers before making recommendations.

> they discuss ‘how should we do it? How should the layout be? How should it look?’… we get quotations, we read through and we have an evaluation together.
>
> (technical manager, N-Food)

The plant manager stressed ‘the benefit of having good involvement’ for workers’ motivation and ‘ownership of the process’. Operatives also identified positive aspects, as one commented, ‘we can say what we mean, and if we feel that this machine is not right for us’, while another highlighted safety issues that might be ‘overlooked if cost was a primary motivation’.

In the non-unionised UK plants, there were few opportunities for workers to engage in decisions around technology. At UK-Drinks, the company was owner-managed and had recently embarked on a formalisation of employment practices, with the appointment of its first human resource (HR) manager. A monthly ‘employee forum’ was established, consisting of one employee from each department, to communicate basic information and identify workers’ concerns. As the HR manager said:

> we do power-point presentations, and perhaps some information they might find helpful… some operational statistics… and we go round the room and make notes of all their concerns.

Issues raised by workers were cited as ‘asking for an extra microwave’ or ‘wifi access’ in the canteen.

At UK-Food, there is a site consultative committee with employee representatives from different areas of the factory. Representatives receive training, and are allocated a few hours each month to perform this role. An employee representative explained that low pay was an ongoing complaint, exacerbated by recent cuts in shift and overtime rates following an increase in the national minimum wage. When raised at the committee, reps were told that ‘there's nothing we can do about it… it's the food industry.’ The committee was dominated by day-to-day issues, such as ‘vending machines’ in the staff canteen (employee rep), or ‘more loos’ (engineer). However, issues of safety were also raised and, in some cases, resolved. The decision to introduce robots was also communicated through the committee, primarily to allay concerns around job losses.

> we had slideshows, graphs of where things were going to go…They said there would be no redundancies because… we needn’t employ as many temps… they really drilled into us nobody would be made redundant
>
> (employee rep)

Reps were not asked for their views, but rather were expected to talk to workers, providing reassurance, and 'explain this is what the change is' (team leader).

There was no direct worker involvement in the introduction of robots in either UK plant. At UK-Drinks, investment decisions lay with the owner, although the production manager was able to make recommendations. With the owner taking a 'hands-on' approach and being present on site, there were opportunities for workers to raise issues informally over problems with the technology and equipment, even if they were not necessarily acted on. At UK-Food, a team leader explained that there was no discussion about the way robots would be used or installed, 'that's all decided for us.'

The research indicates major contrasts in workers' ability to influence technological change. Norwegian workers, through their unions, have significant involvement in plant-level decisions, and some direct participation in the implementation process. In the UK, there was no evidence of production workers being actively engaged in either.

## JOB AND SKILLS OUTCOMES

The impact of robots on job roles depends on the tasks being replaced. Production workers transferred to working with robots fall into two groups: those previously undertaking manual tasks of packing, picking and feeding, and those previously running automated (non-robotic) lines. For the former, although more likely to lose their jobs, the robots bring positive 'immanence' effects (Edwards & Ramirez, 2016) by reducing repetitive and physically strenuous activities, such as lifting and placing. The impact was not directly measured, but manual handling problems and sickness absence were said to have significantly reduced. A supervisor at UK-Drinks captures the general view:

> [Before] I had a quite bad experience with people coming daily to work and doing this job. If you imagine stacking 50 tonnes a day… It's not for people, this kind of job.

At N-Drinks2 and N-Food, where there had been substantial job losses, unions sought to ensure the new roles overseeing robotic lines were filled by displaced workers. At N-Drinks2, training took between three and six months to enable a hand-packer to move to these roles. Selection for retraining was based on seniority and ability to speak Norwegian, with workers given time to acquire the necessary skills. In both countries, ability to speak the native language was a central requirement for robot operative roles, as opposed to a manual packer, as the job required communication with other workers and departments, and the reading of instructions or manuals.

Both UK plants retrained some packing or filling workers, while also recruiting externally. The production manager at UK-Drinks explained how the company was transitioning from 'a bums-on-seats mentality' to a more structured recruitment process focused on obtaining the 'right people' by offering direct employment contracts. A trainer described this requirement as someone with 'a bit of common sense… physically fit… and speaks reasonably good English'. Recruitment had previously been mainly through temporary agencies, with some workers transferred to direct employment over time. Paying close to the minimum wage, turnover had been high and agency workers often had weak English language skills. This approach was not a problem for packing tasks but presented challenges when transferring workers to the more complex line operative job, which typically involved around six months training.

At UK-Food, manual packing workers who showed ability on existing machines were asked if they wanted to train on the packing robots. The scope of the job was far more limited than at the other plants, reflected in one week of on-the-job training and the company's willingness to use agency workers in these positions. The operative uses a touch screen for monitoring, checks packing quality and product codes, feeds material into the robot, and keeps the area clean. An engineer felt this was ‘not overly complex… they don't have technical adjustments to make… it tells them on the screen, wind this handle until that number says this.’

For those operatives who already oversaw automated lines or worked in off-line positions (not the case for UK-Food), it is more difficult to identify changes to skills. In the Norwegian cases, it is further complicated as robotic technologies had been introduced over 30 years and roles varied depending on department and position in the production process. There was evidence of a loss of some skills from recent changes. At the three drinks companies, computerised-controlled valve systems and monitoring with in-built safeguards had replaced manual turning which had required individual judgement. Workers no longer undertook mechanical adjustments as had happened frequently in the past when lines broke down (UK-Drinks, N-Drinks2). Other skills were harder to specify, with workers describing the loss of ‘feeling’ or ‘knowledge’ of the product or the ‘difficulty’ previously involved in cooking (N-Food).

When identifying new skills, interviewees typically focused on digital requirements. These skills were not considered particularly complex and were frequently likened to those required to use applications on home computers or smart phones. N-Drinks2 had the highest demands, with interviewees referring to more time spent monitoring and controlling production through a computer, using a more ‘complicated menu system’ (operative). For operatives in other plants, they primarily used touch screens. A trainer at UK-Drinks spoke of ‘a bit of screenwork’ and a ‘Q&A system’ requiring ‘more keyboard skills’ which was almost ‘nothing’. Across the cases, younger workers were said to find the transition easier, being more accustomed to using technology in their private lives, while for some older workers, this could be challenging.

Greater job complexity can arise where workers use digital skills *in combination with* experiential knowledge of the product and/or process when making adjustments or identifying problems. For existing operatives, much of this knowledge is not new, although in the Norwegian plants interviewees mentioned the need for a broader understanding of the system, and ability to analyse increased data output. At N-Food, the technical manager referred to ‘more analytical knowledge… understanding of the process’. At N-Drinks2, the supply chain director explained how operatives ‘have to check up everything… if somewhere it's stopping, so then you have to find out where it is and why’. At UK-Food, demands were far more limited. Managers relied on operatives to ‘know them pieces of kit inside out’ (packing manager) and report any malfunctions, but these problems were immediately passed to a higher-graded worker to rectify. Across the plants, for most operatives already overseeing automated lines, the introduction of robots did not involve substantially greater skill demands.

Country differences were identified in work organisation, however, with implications for skills. Norwegian operatives were responsible for line changes, and, in most cases undertook a broader range of tasks and had more responsibilities than in the UK. At N-Drinks1, four operatives were taken off the production line to help plan maintenance, conduct minor repairs and train others, with the aim that standard operatives would eventually undertake these tasks themselves. Operatives in Norway also worked without supervisors, reporting directly to departmental managers. High labour costs incentivise employers to use fewer workers more productively, while unions strive to ensure workers are reskilled to take on additional responsibilities. In the UK plants, line changes were undertaken by a higher-graded worker or team leader. There is also an additional supervisory layer, with the widespread use of team leaders and supervisors undertaking organisational tasks and directly overseeing workers.

## DISCUSSION AND CONCLUSION

The findings offer important insights into the role of institutions, actors and power relations in shaping the pace of digitalisation, the process of implementation, and outcomes for work and skills. In terms of the *pace of digitalisation*, this study challenges the hype surrounding cataclysmic job losses, and finds strong country differences. The Norwegian plants emerge as early adopters, driven by high labour costs, but with little evidence of any recent acceleration. If anything, investment appears to be slowing as substituting labour becomes harder where lines have few workers. In the UK, the study underlines that low wages and permissive employment regulation present barriers to automation (Spencer & Slater, 2020). With more labour-intensive plants, however, there is greater scope for automation, provided employers are willing to invest. Whether 'Brexit' stems the supply of cheap, migrant labour and tips firms' cost-calculus remains to be seen. In both countries, continuity in industry employment levels is possible, given limits to automation presented by firms' investment horizons, the nature of certain products and tasks (Pfeiffer, 2016; Upchurch, 2018), and firms' ability to create new markets.

There is also evidence of national differences in the role of workplace actors in the *process of implementation*. The Norwegian cases reveal close partnerships between local management and unions. This is not a cosy relationship, with unions insisting they have significant power resources to challenge management, nevertheless their stance is a pragmatic one. Unions' strategic approach focuses on plant competitiveness and productivity, a fair share of profit for labour, and commitments to training existing workers to operate new technology. Workers have benefited from enhanced wages, and unions have some involvement in the selection of technology and implementation. In the non-unionised UK plants, there is little sign of workplace managers using the 'flexibility' of 'the UK model' to provide workers with a voice in planning or implementation. Employee representative bodies were used mainly by management to disseminate information. These non-union plants are not atypical across the UK, and we might expect a similar story in other firms where unions are absent. Furthermore, any 'sharing' of productivity gains from automation depends solely on management discretion.

Turning to *outcomes for work and skills*, the study highlights positive 'immanence' effects (Edwards & Ramirez, 2016) with some robots replacing physically strenuous and repetitive tasks. Interestingly, technology-driven surveillance and monitoring did not emerge as major concerns. Echoing other studies of production work (Warnhoff & de Paiva Lareiro, 2019), some traditional skills have been lost and new ones added. While new digital skills were required, the level was not particularly demanding, and contrasts with the considerable policy-angst surrounding purported widespread deficits (OECD, 2016). National differences in skills and work organisation did emerge, with Norwegian workplaces characterised by flatter structures, and most operatives having enhanced roles and responsibilities compared to the UK.

Explaining these outcomes is difficult as changes in some plants span 30 years. However, there is evidence that union power matters. At workplace level, although union representatives in Norway are not systematically included in job design decisions, examples emerged of their involvement. At one plant, unions had ensured 'unskilled workers' would be retrained to operate robots, thereby expanding job tasks and skills of operatives upwards. In all the Norwegian case studies, unions pushed management to remove repetitive and dangerous tasks. These workplace unions are supported by broader societal union power that underpins high wages and participation rights, incentivising firms to make more productive use of workers' skills, and a VET system that assists workplace upskilling. High welfare benefits improve the chances of technological change being managed consensually.

These findings make a significant contribution to analysing the relative importance of institutions, actors and power in shaping technological change. Developing previous approaches emphasising the centrality of power (Fleming, 2019; Howcroft & Taylor, 2014), we argue that it is the *associational* *power of organised labour* at multiple levels that is critical. Echoing Gallie's (2017) work on job design, we extend the analysis to consider how power shapes the way workplace actors deal with digital technologies. In Norway, union power is central in underpinning and defending institutional arrangements that provide 'beneficial constraints' on employers (Streeck, 1997). National regulations and collective agreements provide workplace unions with rights to engage in decisions around technology use, and social welfare and training provision mitigates risks for workers facing job loss. In the UK, union weakness can be seen in an inability to secure institutional supports for collective bargaining, a relatively low minimum wage and few regulatory constraints on insecure forms of employment, and low unemployment benefits. Many workplaces are without unions and workers are unlikely to have much influence in technological change, while unionised workplaces have to rely on their own organisational capacity, lacking any regulatory or institutional support.

Institutional and national power-based relations are important in shaping union-management relations but there is also space for agency among workplace actors. There are differences across Norwegian organisations in the mobilising capacity of local unions, the approach of plant management, and the broader competitive strategy of the company. A few food companies resist union organisation and try to flout regulations, particularly when employing migrants, but these are on the margins. In the UK, some companies adopt better approaches to their workforce or work with unions to develop 'partnership-style' arrangements which might encompass technological change. The difficulty is mainstreaming and sustaining a unionised partnership approach without the state providing institutional and regulatory supports (Lewis & Bell, 2019).

The Norwegian societal model and class settlement (Wright, 2000) relies on sharing benefits with those in less productive sectors and those outside of the labour market through high taxation and redistribution. Such gains are always under threat and have to be continually defended, both politically and at the workplace. At workplace level, the evidence suggests the 'micro-tier' of the Norwegian model appears to be adapting well to the digital economy (Dølvik & Steen, 2018; Rolandson et al., 2019). However, with fewer workers to replace and less potential for further productivity improvements, the returns to additional capital investment may become more limited (Upchurch, 2018). Job losses have eroded the traditional membership base, and cost-pressures are ever present. Nevertheless, Norway highlights that alternative possibilities exist and opens up important questions around how more progressive approaches to digitalisation might be achieved in the UK, given its very different starting point. The 'Catch-22' is that policies to bolster unions in the UK, along with stronger employment regulation, a high minimum wage and robust welfare protection, depend on a government willing to intervene and unions powerful enough to mobilise for change.

This research is one of very few international comparative studies of digitalisation in traditional workplaces, yet has certain limitations. There are challenges comparing Norwegian workplaces with a long experience of using robots with UK plants that have only recently introduced them. In exploring the role of actors and power relations, the study would have benefitted from the inclusion of unionised workplaces in the UK, those listed on the stock exchange, and less organised establishments in Norway. This article, nevertheless, offers vital insights into digitalisation in a sector sorely neglected in Industry 4.0 debates (Cirillo & Zayas, 2019). Food and drink processing is often considered an unpromising environment within which to advance job quality, but Norway shows what can be done in a context of digitalisation. Many commentators stress the importance of shaping technology to benefit workers, it is hoped more studies will illuminate the conditions under which this becomes possible.

## DATA AVAILABILITY STATEMENT

Authors elect not to share data.

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## ENDNOTES

1. Low pay (2/3rds median wage) calculated by authors at 165 NOK per hour (Statistics Norway).
2. Below two-thirds median hourly pay.

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