# Innovating for Energy Efficiency: Digital Gamification in the European Steel Industry

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## Abstract

The European steel industry, as an energy intensive industry, has significant concerns over energy efficiency and compliance with EU environmental regulations. Hence, across the industry, energy efficiency is a key area of innovation activity. However, responding to climate change measures and finding efficiency gains by technological means is becoming increasingly difficult and so managements are turning attention to modifying i.e. 'greening' worker behaviours. Here, we focus on an innovation that combines a digital technology application with a management strategy i.e. gamification for energy efficiency behaviour modification. Drawing on data from a Horizon 2020 project involving steel plants in Germany, Norway and the UK, we adopt an international comparative approach to examine the implications of differing industrial relations contexts for shaping steel firm engagement with 'green' innovations.

Key words: steel industry, digital innovation, greening, gamification, varieties of capitalism

## Introduction

As part of the transition to a sustainable low carbon economy, the European Union (EU) has strategized for a 32.5 per-cent improvement in energy efficiency by 2030 (from 1990 levels) (European Commission, 2018). Hence, 'green' energy innovations aimed at improving efficiency and cutting carbon emissions have become a principal focus for industry across the EU region. For workers, these innovations may offer a double dividend: protecting industry and thus securing employment, as well as protecting the environment (Uzzell and Räthzel, 2013: 250-251). Yet it is also necessary to be mindful of their potential to transform existing structures and patterns of work in ways detrimental to workers' interests.

In this article we discuss data from a Horizon 2020 project aimed at improving energy efficiency, involving steel firms from Germany, Norway and the UK. We focus on the implications for steelworkers of one of the project's innovations, combining a digital technology application with a management strategy for behaviour modification i.e. gamification. Gamification is a specific term and strategy argued to be different from 'gaming', 'game-playing' or 'games' because its goal must be using 'gaming elements and dynamics' to solve real-world problems e.g. improving energy efficiency (Kim, 2015: 16). However, conceptually there is much to dispute, particularly considering the way the concept of 'games' has been used to illuminate management-worker relations (e.g. Burawoy, 1979). Gamification is understood here as a strategy that comprizes employer-imposed techniques within the workplace for modifying and regulating behaviour for strategic purposes via game rules (Fuchs, 2014: 22). Game elements (points scoring, competition, rules) are used by employers to induce behaviours,

with: ‘the hope… that there is an underlying motivational force at work that can be bottled and redirected towards motivating employees and increasing productivity’ (Nelson, 2012: 23). More specifically, gamification incorporates game elements within a non-gaming software application to engage workers on an emotional level and motivate them (Kim, 2015). It is a project innovation, making use of game mechanics and experience to digitally engage and motivate workers to achieve employer defined goals. In this instance, ‘gamification’ is used to modify behaviour for improved energy efficiency performance, and thereby ‘green’ day-to-day activities, through a mobile digital application that uses a leader-board and virtual rewards, thus tapping into reputation systems and competitions to stimulate emotional needs for the pursuit of success (Blohm and Leimeister, 2013).

The focus on steelworker behaviours and on innovations like digital gamification apps has emerged, in part, because the scope for improving efficiency by innovating the steel production process is diminishing and increasingly expensive (Eurofer, 2015). Digitalization within manufacturing, or Industry 4.0, comprizes ‘cyber-physical systems’ of production configured upon digital networking systems and the centrality of ‘big data’ for ‘smart factories’ (Briken et al., 2017). The ‘digital workplace’ introduces new debates concerned with innovation and digital technologies and the threats (and opportunities) these might pose to workers and employment relations as disruptive technologies (Edwards and Ramirez, 2016). For example, what do new surveillance techniques mean for workers and their representatives, with data on performance, movements and interactions continually monitored? Questions are raised about the ‘power’ and ‘interests’ that foreshadow the insertion of such innovations (Lloyd and Payne, 2019). Important influences, in this regard, are variations in the institutional and regulatory environment and the way country context shapes processes and outcomes in relation to the insertion of workplace innovation.

Hence, we adopt an international comparative approach to examine the institutional frameworks shaping steel firm engagement with digital gamification innovations for energy efficiency behaviour modification. Specifically, we situate our analysis within comparative political economy and the ‘varieties of capitalism’ (VoC) approach, focused on the dichotomy between coordinated market economies (CMEs) and liberal market economies (LMEs) (Hall and Soskice, 2001). Hall and Soskice (2001) delineate differences in economic and political institutions that occur across countries and, in elaborating their framework, provide a basis for interrogating the institutional and regulatory frameworks that contribute to country variation in patterns of innovation and the contours of work, employment and industrial relations. Additionally, we reflect on the industrial sector as an apposite level of analysis, giving consideration to the views of Bechter et al. (2012) and others who argue that the allocation of national models to ‘type’ neglects the importance of the sector specificities.

International comparative approaches on the ‘fourth industrial revolution’ are novel (Neufeind et al., 2018). Here we draw out industrial relations questions to understand the implications for workers and their representatives of digital innovation solutions to climate change (Uzzell and Räthzel, 2013) and the extent to which an industry’s environmental aims (in response to supranational measures), when attempted to be realized through a digital innovation for ‘greening’ worker behaviours and inserted within a sector retaining high levels of worker representation (Beguin, 2015), might prejudice management-worker/worker-to-worker relations. The paper begins by briefly outlining the industry context and engaging with the broad substantive themes informing the analysis. A following section details the research methods, before we summarize the data and set out each case by country/firm. Finally, we offer discussion and conclusions.

## The European Steel Industry Context

Over recent decades, despite significant changes to production processes through innovation necessary to maintain its competitiveness, the European steel sector continually finds itself in difficulties and has turned to the EU to introduce competitiveness-boosting measures. At the same time, the industry (i.e. employer and trade union federations) complains that EU policy towards energy and the environment, including unilateral climate change/energy efficiency goals and associated Directives (e.g. Emissions Trading Scheme, Energy Efficiency Directives), damage international competitiveness (Eurofer, 2015). The environmental agenda has created challenges for the sector and prompted investment in innovations to reduce emissions and improve energy

efficiency, driven also by the need to achieve compliance with EU environmental regulations. Efforts to 'green' the industry have focused on both technological solutions and building environmental awareness and 'green' skills (Evans and Stroud, 2014). But, perhaps the most recent feature of industry innovation aimed at achieving a 'business model transformation' and greater efficiencies – environmental and otherwise – is digitalization (Naujok and Stamm, 2017). Digitalization is claimed to be moving from 'strategic hype' to 'operational reality' within the wider European manufacturing sector (Naujok and Stamm, 2017), and the digital gamification application fits squarely with this new 'reality'.

## Analytical Themes

Institutions and actors are configured differently by country, meaning that we might expect national variation in the processes and outcomes regarding innovation and its adoption (Lloyd and Payne, 2019). Hall and Soskice's (2001) influential account of the way innovation is approached within differing institutional contexts draw a distinction between two types of capitalism, CMEs and LMEs, which vary institutionally and ideologically, with subsequent differences in, for example, patterns of industrial relations and innovation. Briefly, CMEs, including Germany and the Nordic countries, are characterized by strong networks of social institutions that regulate economic action within markets. These typically include powerful employer associations, strong trade unions, networks of cross-shareholding as well as regulatory systems that encourage information-sharing and collaboration at firm and sector-level. Financial systems provide 'patient capital' and firms thus adopt longer-term and developmental perspectives, which facilitate high-trust employment relations. Within LMEs, state policy and regulation ensure that market forces prevail, encouraging short-term low-trust relations between economic actors. In conjunction with institutional factors such as stock-market based financial systems, firms are typically locked into short-term development trajectories (Kemp and Loorbach, 2006). These factors, coupled with weak trade unions, limited employment rights, high job insecurity, managerial predilection for centralized modes of control and unilateral decision-making (Hall and Soskice, 2001) manifest in low-trust and control-based employment relations at firm-level (Godard, 2004).

Such differences in institutional context are argued to result in different patterns of innovation. CME contexts are better for incremental innovation, taking the form of 'continuous but small-scale improvements to existing product lines and production processes' (Hall and Soskice, 2001), facilitated by regulation of economic action in ways described above. In LMEs, the institutional context promotes 'radical innovation', involving 'substantial shifts in production lines, the development of entirely new goods, or major changes to the production process' (p.38-39). Later evidence indicates, however, that radical innovation within CME contexts is increasingly likely (Evans and Stroud, 2014). Indeed, some suggest broader patterns of convergence between CME and LME types are emerging (Hassel, 2014; Streeck and Hassel, 2004).

The sectoral context can be regarded as the fundamental level of organization for negotiating industry issues at both national and European levels. Citing studies that identify increased within-industry international convergence (Katz and Darbishire, 2000) and widening divergence between different industries within national models (Doellgast, 2009), Bechter et al (2012) argue that the focus of comparative institutional studies upon the national level and the allocation of national models to 'type' neglects the importance of the sector as the most relevant level of analysis. They are thus critical of national-level typologies e.g. VoC, which overstate national-level complementarities and coherence and, in the process, underestimate intra-country differences in nations categorized as belonging to one type. The different perspectives are pertinent to our analysis of the conditions upon which technologies might be considered a viable innovation by steel firms (or the sector) for the greening of worker behaviours.

As an area of growing practical application in the service sector, but new to heavy industry, gamification is the latest managerial 'innovation' aimed at improving performance – by, for example, imposing 'fun' on workers (Mollick and Rothbard, 2014). Its growing popularity is driven by promised benefits of enhanced productivity and performance (e.g. KPMG, 2014) – in this case, from

an employer perspective, efficiency and environmental improvements. It is the latest manifestation of the 'humanization of work' agenda, aimed at the attainment of managerial objectives i.e. through the enhancement of employees' effective experiences of work. Such strategies may be perceived as offering 'mutual gains' for employer and employed (Reeves and Read, 2009), but a more critical account is that gamification is a continuation of managerial applications of distraction or alleviation tactics (e.g. Bolton and Houlihan, 2009) and, given the specificities, an exploitative strategy.

The 'digital' aspect of such applications within enterprises, may adopt the structure, look, and feel of a designed video game (for participants), but with the intent of furthering organizational goals (Mollick and Rothbard, 2014). Enterprise gamification applications have two key aspects, deemed the 'front' and 'back' ends (Raftopoulos, 2016). The 'front', user-interactive end refers to motivational aspects. Gamification is thus a conscious managerial application, a 'persuasive technology', focused on achieving attitudinal and behavioural change in players and imbuing the workplace with positive values associated with games (Mollick and Rothbard, 2014). Such systems are heavily reliant on non-financial goal-oriented status rewards e.g. virtual badges, points, levels, leader-boards (Kim, 2015). Further, the interactional elements of the 'front end' system mean that players engage in competition (in this instance on real or potential efficiency savings and environmental regulation compliance), frequently against other 'players' i.e. colleagues. The 'back end' of digital gamification applications – the component that collects and processes data about behaviours – may also prove exploitative as all data on the performance of the user-player are tracked. The scope for enhanced monitoring through technological surveillance, or 'dataveillance' is clearly apparent (Lupton, 2016). Moreover, the visibility of data collected on leader-boards, for example, combined with competitive game elements may mean that players engage in self-monitoring, constantly evaluating their own performance (e.g. on energy consumption and environmental compliance within specific areas of plant operations), which is 'managed via reputation systems and competitions' (Briken et al., 2017: 9-10) with a view to 'optimization' (Mann and Ferenbrok, 2013).

Management use of (digital) gamification means that game aspects (e.g. leader-boards) are used in literal ways to manipulate worker behaviours. But the discussion of 'games' within workplace contexts is not new; as Burawoy (1979) noted, workers' 'relative satisfactions' are derived from games played within (management) limits for 'making-out' (e.g. manipulating production quotas), signalling cooperation with management and the coordination of interests. Here, the act of playing the game is coercive and part of building consent, with conflict between differing interests transformed through the game of 'making out'. From a Marxian perspective, however, enterprise gamification means that workers are diverted into lateral competition against each other: redistributing conflict from a hierarchical to a lateral direction (Burawoy, 1979) e.g. by means of gamifying individual or collective (i.e. team) environmental performance. Indeed, worker consent to engagement with gamification/games may be seen as another facet of 'responsibilization' (Gray, 2002), potentially extending control through enhanced and wider responsibilities as well as shifting accountability.

## Methods

The evidence we discuss derives from a H2020 project aimed at developing energy efficiency innovations for heavy industry, focusing specifically on industrial water circuit (IWC) functions, in two ways: 1) an online platform for modelling IWC optimization, and; 2) gamification software application tools for the management of energy efficiency decisions and behaviours. These innovations were piloted in five industrial sectors (steel, non-ferrous metals, chemicals, paper and pulp and food and beverage), and their adoption encouraged to reduce IWC energy consumption across EU industry. Our specific role was to question our interviewees on energy efficiency more generally and the specific part played by IWCs, as well as capture their perspectives on the potential of the innovation approaches to energy reduction. Hence, the data presented were generated to inform the development of the innovations.

For more direct comparison, we focus exclusively on the steel industry data, generated within three firms – in Germany, Norway and the UK respectively. On site, the research involved observation of production processes and semi-structured interviews with members of senior

management (e.g. HR Management), Operational Management (e.g. Maintenance Manager, Operations Manager), technicians, engineers and operators. Input also came from industry experts in the German and Norwegian cases (i.e. sector engineering research organizations) and supporting evidence from operators and management of the industrial park on which the steel plant in Norway is situated.

The 'worker' or production level interviewees (maintenance manager, operations manager, technicians, engineers and operators) were not asked to divulge their union membership, but the sector has high union density and the likelihood that these participants were union members is strong: Germany at 80% density in steel mills; no specific data on the steel sector in Norway, but 52% generally and thought to be much higher for steel; and UK at 60% (Beguin, 2015; ETUI, 2016). Data from sector trade unions in the UK and Germany, as well as the sector union federation, IndustriALL (Europe), were collected recently during the Covid-19 pandemic, separately from the interviews detailed above and involving telephone and Skype interviews and email correspondence. We corresponded with and telephone interviewed a policy advisor and senior union official from Community for a UK perspective and engaged in email correspondence with a senior union official from IG Metall, Germany, though were unable to involve anyone from Fellesforbundet or Industri Energi in Norway, as the appropriate sector unions. Consultation with IndustriALL-Europe involved email correspondence with three Policy Advisors and a Skype interview with a Senior Policy Advisor.

Data were generated from 26 participants (Table 1). The balance and distribution of site participants are, however, uneven, reflecting access arrangements over which we had little control. Each company acted as gatekeeper and made available to us who *they* viewed would be best placed to discuss the planned innovations. The way the sample was selected at each site has the potential to create bias and thus clear implications for data generation and what inferences might be drawn. The authors' networks were used to access union participants. Interviews focused on aspects of production, environmental and energy policy, the organization of work and training, as well as exploratory questions on innovation and digital gamification. Overall, the data offer the reflections of those who might use the innovations (managers, senior technicians, technicians, engineers, operators) and those responsible for those who might use the innovations (senior managers, managers, senior technicians), alongside trade union perspectives and industry expert commentary.

The case study visits were two days in duration. With some exceptions (i.e. Norway) each interview was recorded, transcribed and translated. Where recording of interviews was not permitted, notes were taken. The researchers were able to cross-check information with follow-up discussions with industry experts and worker representatives involved. Important in the process of analysis was opening-up the themes of the study, as a way of focusing and understanding workplace relations, as well as processes of innovation and energy efficiency practices. The data are informative of the way work is organized in relation to efficiency and, importantly, the capacity for and perspectives on digital gamification innovation, as a 'greening' tool, at each site.

## TABLE ABOUT HERE

## The Cases

In the following, we set out the company data by country, focussing on the salient features of the firms' organization and operation, particularly as these pertain to the scope, capacity and basis for firms' integration of emergent innovations for 'greening'. First, to provide a wider industrial relations context to the case data, the views of IndustriALL, to which the unions involved are affiliated, captures the wider policy position on digitalization, including in relation to its use for resource efficiency. The Policy Brief (IndustriALL, 2015) on digitization captures IndustriALL's position and was confirmed in a skype interview with the Senior Policy Advisor:

> ‘ … [we support] developments in which investment in technology and processes improves the quality, the reliability and the productivity of human work, and the efficient usage of resources (energy and raw materials)…’

Questions remain, however, over control and enhanced surveillance:

> ‘it opens up new possibilities for control over workers but also for cooperation between them… the technical means made available by digital technologies enable a level, a permanence and a frequency of surveillance that is beyond anything experienced so far…. This excessive surveillance is resented by workers.’
>
> (IndustriALL, 2015: 17-22)

More specifically, the Senior Policy Advisor expressed concern over new opportunities for using data to track worker performance (Interview Notes), which is a specific feature of the gamification innovation. IndustriALL thus recognizes that digitalization has benefits, both for workers (greater cooperation) and for efficiency, and thus greening, but expresses concern over issues of greater control and surveillance – themes addressed in what follows.

### *Germany*

*SteelCo.DE*. employs 400 people and its occupational structure divides across Operational and Administrative functions. The former operates team-working across three shifts, with maintenance functions separate from production roles. Our interviewees included maintenance workers. At this site, team meetings are held daily by line-managers, but individual engineers have significant scope for discretion and autonomy, indicative of the high-trust relations in CME contexts (Hall and Soskice, 2001): “we know that everyone here does their best” (Senior Technician – Mechanical). Project and proactive maintenance work require individual team members to show initiative, but in the flexible organization of work, maintenance teams are expected to be responsive (i.e. react) to changing demands (e.g. breakdowns). The Energy and Environment section is organized differently, but in ways that also offer workers high levels of trust. A foreman heads up a small team to ensure compliance with environmental regulations and the promotion of energy efficiency, which is project-led and allows scope for individual environmental workers to work independently. In short, the plant is organized to offer high levels of discretion to workers with clear avenues for them to identify the scope for innovation and continuous improvement (e.g. a bonus-incentivized suggestion scheme).

Being under European, national, federal and municipal jurisdiction, the plant is subject to several layers of environmental legislation and compliance drives innovation. It adopts its own plant-level regulation too, which often goes beyond European strictures. Subsidies form part of EU energy efficiency regulation and the plant innovates to access these, thereby viewing regulation as a ‘beneficial constraint’ (Porter and van der Linde, 1995). Indeed, innovation to improve energy efficiency at *SteelCo.DE* is primarily driven by regulatory and economic (i.e. cost) considerations, but interviewees confirmed reliance (to-date) on technological innovation, rather than targeting worker behaviours. In part, this emphasis reflects the interviewees’ claims that there is limited scope for innovation on IWC energy use:

> ‘…energy use is not something that we have influence over as it is the production processes that draw upon water circuits.’ (Senior Technician – Mechanical)

However, scope was identified for strategizing digital gamification innovations for operations in two ways: maintenance functions, and ‘immediate production factors’. With regard to the former, insufficient levels of maintenance increase energy use and gamifying for optimising maintenance organization and performance behaviours offers, in theory, potential efficiency gains (e.g. through competition of job completion). ‘Immediate production factors’ refer to specific production processes that impact directly upon energy use, which might be targeted by changing operators’ behaviours e.g. when there is a pause in production operators can manually switch-off water supply or pumps and by

doing so reduce energy use. One interviewee reported that some operators do not do this, partly because of scepticism about the reliability of the technology i.e. that the water supply would be re-established. It was commented that digital gamification and associated 'virtual' rewards might help operators to overcome their scepticism, but this operator-behaviour-dependent element of production will soon become an automated process reliant on sensor technology.

Thus, as far as 'immediate production' is concerned, technological innovation solutions are the management default for energy saving and increased energy efficiency decisions. Indeed, interviewees tended to view innovations, such as digital gamification, at worker and foreman level as problematic. For the workers we interviewed, there was concern that competitive elements might undermine existing trust relationship between workers, line-managers and management:

> '…to pit individual teams and sections against each other, then I am not in favour of this [gamification]. That is not something that I would expect my section to back. It is ok to tell certain people or a team if they have performed a job very well and they can talk about this, but this must not involve pointing the finger at the others and saying: you did not do such a good job.' (Senior Technician – Electrical)

However, the Head of Maintenance, who is exposed to a metrics culture that evaluates and rewards performance, including on energy reduction, viewed digital gamification at managerial level to have potential – with managers steered towards decisions that reduce the energy use and/or increase energy efficiency. For our IG Metall correspondent, the focus was more on the limitations of the innovation to change behaviours, which he viewed to be something incremental that 'needs a lot of time [for] training and evaluation'. This senior official perceived such innovations to be one possible means to 'amplify [management] control [with the] misusing of data', but argued that this hinges on data protection law, which was claimed to be good in Europe and enforced in sectors with strong union representation and works councils, such as steel.

### *Norway*

*SteelCo.NO* is located on an industrial park, *IndParkCo*. The steel plant employs 320 people but is part of a larger manufacturing group. There is a complex web of relationships and interdependencies between *IndParkCo*. and the case study site. For example, 30% of *IndParkCo.* is owned by *SteelCo.NO*, which is, at the same time, their customer. *IndParkCo*. sells water and energy to *SteelCo.NO*, which it generates from water turbines. The steel plant separates Operational and Administrative functions, with the former divided between maintenance and production. Operations are split into five shifts and the delayered plant is organized into 'high-trust' forms of working, with autonomous teamworking as the basis of organization. As noted by one interviewee, there is significant use of 'trainees' by the company to supplement the core workforce, which is the result of the Norwegian vocational training system and helps cultivate high trust work-relations (Lloyd and Payne, 2012). Norway sits outside the EU, but its membership of the European Economic Area (EEA) and European Free Trade Agreement (EFTA) means it cooperates with the EU on environmental and climate change goals, complying with related regulations and directives.

At *SteelCo.NO* regulation drives efficiency, but topographical resources (i.e. abundant water) and recycled/by-products (from firms on *IndParkCo.*) make this more easily manageable. Like *SteelCo.DE*, energy saving is primarily a cost related issue, rather than an environmental one. The plant works with energy targets, which are communicated to workers through building them 'into the organization and jobs' (HR Manager), thus signalling a degree of awareness and responsibility on such matters throughout the occupational hierarchy and indicating collaboration and social capital (Hall and Soskice, 2001). However, other similarities with *SteelCo.DE* indicate sector parallels on energy efficiency and production. For example, at both plants there is scope for innovation (technical and social) in stopping water flow and/or the pump when not required and the plant once operated a bonus related innovation suggestion box scheme (discontinued because of cut-backs).

Maintenance work at *SteelCo.NO* is mostly project led (outside of immediate i.e. reactive maintenance) by teams with high levels of discretion on priorities. Reducing costs forms a central aspect, allowing workers to identify scope for innovations (Interview Notes: Senior Technician). Like *SteelCo.DE* innovation is primarily discussed by the interviewees in terms of technical rather than social solutions and the notion of competition between workers through innovations, such as digital gamification, to engage with and tackle energy efficiency goals was not viewed as 'sensible or viable' by interviewees (Interview Notes: Senior Technician). Indeed, as with the site in Germany, the idea of innovations, such as digital gamification, introduced to develop a competitive working environment based on energy savings (and thus their digital monitoring via metrics) seemed anathema, with the potential identified for disruption to working relationships by putting workers and teams in direct competition with each other.

### *United Kingdom*

*SteelCo.UK* directly employs over 4000 workers and organizes across Operational and Administrative functions. The principal division within operations is maintenance and production. Team working is organized in shifts (three) and it employs a flat occupational structure. Work practices are organized for autonomy and discretion. However, the opportunity for workers to function in such ways is heavily circumscribed by plant circumstances. Maintenance at the plant is primarily reactive, rather than proactive: '[we] run pumps until they fail and then they fix them' (Senior Process Engineer). A critical aspect is resource scarcity, which impacts on the efficacy of the maintenance regime and has implications for the various initiatives to improve efficiency and encourage innovation. For example, an incentivized scheme on ideas for process improvements results in work overload and 'initiative fatigue':

> 'There's always issues, we're always fire-fighting, we're constantly looking for ideas and we've had "Weathering the Storm", now we've got [the idea scheme] … there's constant, more and more focus, on delivering improvements and… people have got sick of it.' (Senior Process Engineer)

The interviewees also reported that a major energy-efficiency improvement programme encouraging technical improvements and management and mindset/behaviour strategies had identified a long list of potential projects. However, lack of resources means that the ideas are not always implemented. In line with Porter and van der Linde's (1995) 'beneficial constraints' argument, it is compliance with energy management regulations that plays a part in driving the efficiency programme, but the company's parlous financial position and 'anything that pays back within a year' provides the principal motivation.

There is, moreover, a generalized problem with motivation across the workforce, with one interviewee noting the cumulative effects of being 'overworked and underpaid'. Hence, improving energy efficiency awareness by changing mind-set and behaviours is immediately undermined:

> '…manpower is so stretched, trying to keep the plant operational and people are fire-fighting all the time… it's the same story everywhere. It's the 'nice to have' compared to the plant running so … you have some clever guys who will do some clever things … but as a constant, is this a day-to-day activity? Regrettably, no. And that's because the resource is so stretched. It's a real struggle.' (Senior Process Engineer)

This focus on short-term horizons means that an embedded and sustained longer-term, strategic approach, focused on continuous improvements, is not feasible. The short-term culture orientates management towards projects with a short pay-back period. As an environment for the introduction of the digitalized gamification concept, there are conflicting perspectives – it is acceptable as an innovation strategy, but impracticable. Interviewees said that engineering staff would be interested, but workers would not have the time, given the pressure on resources. As one interviewee put it, the

idea ‘sounds great’ but there would be limited appetite for it because of ‘everything that’s going on – and there is a lot going on….’ (Senior Process Engineer).

It was felt that if input to the digital gamification application was required regularly, this ‘would not happen’ because of time pressures. Another commented that it would be seen as just another vehicle to generate efficiencies, of which there are too many. It was suggested that the concept would work better in a plant that was more progressive in managing energy and the parent company could get sister plants to compete against each other. Indeed, the Operations Manager involved in organising the efficiency programme identified competition between workers and plants as an attractive element of the broader gamification concept for driving energy efficiency. This conflicts with the perspective of Community representatives, who focused on other aspects of such innovations:

> ‘…it would be likely to undermine trust and dignity at work. We’ve had significant issues with use of CCTV surveillance in past, to sack workers etcetera, and I’d see this [digitalized gamification] as an extension of that… In the same way I’d fear data-trails would be used by employers to target and discipline individual workers… if all activities are logged there will always be something that can be picked up.’ (Community Senior Union Official)

This perspective was confirmed by a Community Policy Advisor, but the Operations Manager and engineers (notwithstanding the ‘initiative fatigue’) view the innovation in more benign ways.

## Discussion

In what follows, we assess the extent to which the structure and patterns of work and industrial relations mediate the insertion of emergent innovation for improving efficiency. Innovation must be one of the solutions to climate change but, as Uzzell and Räthzel (2013) note, it is not socially neutral and its incorporation in the workplace has implications for workers and their representatives. We draw upon Hall and Soskice’s (2001) VoC framework to analyse, in comparative ways, the differing institutional contexts that mediate structures of industrial relations and patterns of innovation, drawing conclusions as to the continued validity of distinctive national-level types to inform approaches to innovation when set against the specificities of sectoral arrangements.

The first point to note, on institutional forms, is the distinct variation of approach towards digital gamification innovation within the case study sites. We acknowledge that there are substantial differences in the size and production capacity of the firms visited. Indeed, whilst all case sites are part of larger groups, the UK site employs a workforce ten-times that of our Germany and Norway cases and the proportional level of complexity regarding management of employment relations (and resources) reflects the difference of magnitude. Nonetheless, the German and Norwegian workers from *SteelCo.DE* and *SteelCo.NO* respectively, two firms operating within CME contexts, differ significantly in their perspectives on digital gamification from *SteelCo.UK*, as a firm situated within a LME context (Hall and Soskice, 2001), being more resistant to its potential introduction. In the UK, the sector union, Community, is similarly minded to workers in Germany and Norway. There are, in particular, concerns over surveillance, which are shared by IndustriALL but to a lesser degree by IG Metall.

Our contention is that these different perspectives of workers are mainly attributable to the institutional context within which the firm resides. The high trust relations evident in Norway and Germany, shaped by institutional context – and the knowledgeable, autonomous, loyal employees associated with CME contexts (e.g. Hall and Soskice, 2001) – are underscored by strong participative arrangements and thus demonstrate greater *resistance* to gamification. Of course, the resistance voiced does not mean that disruptive technology will never be inserted. However, worker consent and voice are accompanied by the presence of influential consultation mechanisms for strategic decision making (e.g. works councils) and bolstered by opposition from sector trade unions (i.e. IG Metall) to innovations that will ‘amplify control’. Workers view the (competitive) principles of digital gamification innovations to be potentially disruptive to trust-based relations at team level (albeit

contemplated for use at management level in Germany). The 'coerced consent' to existing patterns of seemingly collaborative relations, produced through 'games' of 'making out' and through which workers largely find their 'relative satisfactions', become threatened by enterprise games (i.e. digital gamification) that place workers directly in competition (on performance) with each other (see Burawoy, 1979) and promise instead greater control, an issue raised also by IndustriALL as a sector level concern.

Thus, despite the potential for enhanced efficiency, which might extend from gamification innovations, our worker interviewees within CME contexts seemingly value more highly their 'relative satisfactions' and the maintenance of trust and collaborative working. What is largely observed within *SteelCo.NO* and *SteelCo.DE* is an employment relationship predicated on high levels of social capital, underscored by the power of social actors and consolidated within strong participative arrangements in these countries, which are consistent with 'dimensions of trust, social relations, commitment to the team and… [clear avenues of]… communication' (Requena, 2003: 334). High trust, as a proxy measure for social capital, is associated with greater worker effort and lower monitoring and surveillance needs (Helliwell and Huang, 2010: 222) and reflects a commitment that derives from cooperative employment relations, enforced (data protection) regulations and treating workers with dignity. In our assessment, in these countries, this commitment weighs against forms of innovation (i.e. digital gamification) that include elements (e.g. competition, surveillance, control) threatening to undermine the seemingly high levels of social capital and trust relations.

In contrast, the pattern of relations predominating within LME contexts foregrounds the appeal of digital gamification and, in principle, its *acceptance* by those interviewed within the UK site. The 'self-tracking' and competitive aspects, which become another area of 'responsibilization' for the individual worker, are of particular appeal to our Operations Manager. Here, the potential is for workers, in relation to co-workers, and indeed plants, to be judged, held accountable and sanctioned, through the augmented processes of 'dataveillance' introduced by digital gamification technology (Lupton, 2016). In an update of Burawoy's 'making out' analysis, workers could become reliant on what Durand and Stewart (1998) discuss as 'survival strategies', as they compete with one another to stay in the game (i.e. employment) and survive management's performance indicators (Tuckman and Whittall, 2002) or, in this case, the back-end surveillance data derived from gamification applications (Lupton, 2016). It is here that Community union (and IndustriALL) representatives identified significant concerns about the dangers of such innovations, and the potential for digital surveillance and the undermining of dignity and trust at work.

As in Germany and Norway, seemingly high trust relations – insofar as work is organized for 'clever guys to do clever things' – can be evidenced in the UK. But, the existing patterns of work intensification discussed by *SteelCo.UK* interviewees predominate: 'manpower is so stretched'. These experiences of work are paralleled by low resource levels and innovation fatigue and reflect a work environment consistent with weak participative arrangements, unilateral decision-making and low-trust and control-based employment relations typical of LME contexts (Hall and Soskice, 2001; Godard, 2004). Hence, the dangers identified by Community struggle to gain purchase and form part of worker narratives. This provides the foundation and environment for our interviewees' acceptance, in principle, of gamification innovations (and absence of resource to challenge or, perhaps, recognize the more negative aspects voiced by Community). And yet, within *SteelCo.UK*, it was also clear that significant impediments to digital gamification innovation were evident, though of a different order from those observed within CME contexts, reflecting the particularities of the CME/LME environments with regard to patterns of innovation.

Approaches to innovation differ across the plants, with the German and UK plants, in particular, standing in contrast to each other. For example, *SteelCo.DE* plans for sensors within its IWC as part of an incremental innovation diffusion mechanism that reflects a supportive environment for long-term investment to encourage organizations to view innovation and automation as central to survival and growth (e.g. cut costs and increase efficiency). Within CME contexts, such approaches are underscored by strong social rights in the support of labour market adjustment, and thus the cushioning of social risks for workers (Lloyd and Payne, 2019). This further binds employer organizations and trade unions in common cause – as reflected in the trust-based relations discussed above, which provide the basis for the rejection (or appropriate agreements for the management) of disruptive and 'radical' innovations. Indeed, introducing digital gamification is, by definition,

'radical' i.e. digitalization represents a high level of discontinuity (Edwards and Ramirez, 2016). And on behaviour change specifically, our IG Metall representative notes that this can only ever be incremental and would require additional time for training and evaluation.

The approach to innovation within *SteelCo.UK* is underscored by the short-termist business model (Hall and Soskice, 2001). Here, 'radical innovation' is promoted, involving 'major changes to the production process', which Hall and Soskice (2001) argue is prevalent within Anglo-Saxon economies. The focus is on the (radical) short-term and innovations based on quick pay-back, which inhibits the sustained longer-term, strategic approach focused on continuous improvements. For a workforce suffering the exigencies of resource efficiencies, 'innovation fatigue' is merely another symptom of a wider malaise. Hence, the obstacle to digital gamification innovations expressed by engineers in the UK context is less based on any specific issues with regard to the innovation, but because of 'everything that's going on – and there is a lot going on….' e.g. innovation overload, lack of resources and cost-cutting.

On questions of comparative political economy, recent literature suggests international convergence and, in this respect, a seemingly inexorable shift towards more market-orientated patterns of organization, informing the frameworks of complementarities upon which firm strategies more generally, and innovation for energy efficiency specifically, are developed (e.g. Hassel, 2014; Streeck and Hassel 2004). Our data suggest, however, that rather than convergence across VoC 'types', approaches to innovation are consistent with, and typical of, the differing institutional and industrial relations contexts within which the companies are located, with precize implications for emergent practice, on digital gamification innovations, within CME and LME contexts.

However, according to Bechter et al (2012: 194), we might expect to find convergence at the level of the sector, at least regarding similar patterns of industrial relations in ways that override geographic types. Underscored by the Europeanization of the steel sector since the European Steel and Coal Community came into effect in 1952, as well as EU regulations, the Single Market and European sector level social-dialogue, a strong framework for the convergence of sector industrial relations is to be expected, and, indeed, it is evidenced to some limited extent. But stronger, in our view, is the specificity of national-sector level participative arrangements, which secure the features of work and employment discussed above, and which signal divergence. Within CME contexts, the participative arrangements at the national-sector level sustain a secure, skilled and high productivity core workforce that is part of decision-making. However, the 'overworked and underpaid' steelworkers within LME contexts indicate fragmented arrangements. As Stroud and Fairbrother (2011) have noted, the strength or weakness of participative arrangements has informed patterns of steel sector restructuring across Europe, which plants might close and where. Similarly, our evidence suggests the likely subordination of worker interests in LME contexts, in efforts to improve efficiency.

A final point relates more specifically to gamification in the workplace. The literature here is limited and divides between the prescriptive material promising performance improvements (e.g. KPMG, 2014) and a growing critical literature, which acknowledges how organizational context shapes the purposes, forms and outcomes of gamification innovations (Hamari et al 2014). At present, the influence of institutional context is largely ignored in the critical literature on enterprise gamification. Hamari et al (2014) suggest, however, that the likelihood of consent to, or any positive effects of, gamification within enterprises is greatly dependent on the context in which gamification is implemented. It is recognized, moreover, that the organizational context and authority structures into which gamification applications are introduced has a highly significant impact on the effects of the innovation, as either positive or negative, including the way data is used (Raftopoulos, 2016).

Indeed, the increasingly fluid movement of data between different applications and networks means that data captured in one application or network for a particular purpose (e.g. efficient behaviours) can easily be transferred into another application, to be used for a different purpose. For example, at the German and UK plants there was some appreciation of the way gamification data on energy use between plants could be shared, though IG Metall, Community and IndustriALL expressed to differing degrees some concern about the way data might be 'mismanaged'. The threat is that digital technologies may display function creep (Lupton, 2016), and in this regard IG Metall highlighted the role of unions in enforcing data protection regulation. Otherwise, whilst workers may consent to the gathering of data over 'green' issues (it might arguably be difficult to refuse to behave

in more environmentally-friendly ways), if the performance data come to be used for other purposes the initial consent may never have been given.

## Concluding Comments

What is brought together in this article is discussion of two significant challenges for steel sector workers and trade unions, greening and digitalization, albeit within the context of limited data and notwithstanding the possibility that managements, wherever located, will not insert innovations to which workers and their representatives may object, particularly if green innovations can demonstrate clear environmental and efficiency benefits. We know that innovation is necessary to address the climate emergency, but, as Uzzell and Räthzel (2013) note, there is a need to avoid reductionist solutions. Two companies (*SteelCo.DE* and *SteelCo.NO*) set within particular institutional contexts recognize energy efficiency concerns, as well as the limitations of 'reductionist solutions'. Here, there is a willingness for worker and union involvement in strategic decisions, which anticipate and control for the potential consequences of emerging innovations aimed at dealing with environmental and efficiency issues – the pattern of industrial relations and participative arrangements within these contexts is a significant factor in this regard. The counter seems true of our third firm (*SteelCo.UK*), where 'low-trust' relations inform a seeming indifference to good employment relations and the potentially negative implications of inserting disruptive efficiency innovations, which the UK's sector unions seem ill-placed to challenge despite opposition they might have. Despite the limitations of 'types' for comparative analysis of country characteristics, a 'country effect' analysis is informative of the industrial relations landscape and the management of digital innovations for greening (Lloyd and Payne, 2019). What our data tell us about is the likelihood of quite different outcomes for workers of processes of green innovation, as evident from the potential insertion of one specific 'reductionist solution' to increasing efficiency within a highly unionized sector that remains ideologically and institutionally differentiated by place.

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**Table 1: Data collected by company/country**

| Company | Country | Interviews* | Total |
|---|---|---|---|
| **SteelCo.NO** | Norway | HR Manager<br>Senior Technician<br>Technician<br>Operators x 2<br><br>Industrial Park Manager<br>Industrial Park Operators<br>Industry Experts x 2 | 8 |
| **SteelCo.DE** | Germany | Maintenance Manager<br>Senior Technician (Electrical)<br>Senior Technician (Mechanical)<br>Environmental Manager<br><br>Industry Experts x 2<br>Trade Union representative (IG Metall) – email correspondence | 7 |
| **SteelCo.UK** | UK | Senior Fuel Engineer<br>Senior Water Engineer<br>Senior Engineer (Energy)<br>Senior Process Engineer<br>Operations Manager (Energy Optimization)<br><br>Trade union representative x 2 (Community) – email correspondence and interview | 7 |
| **IndustriALL** | | Senior Policy Advisor<br>Policy Advisors x 3 – email correspondence | 4 |
| **Total** | | | 26 |

*interview unless otherwise noted