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Getting the Measure of Employee-Driven Innovation and Its Workplace Correlates

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Abstract

Innovation is traditionally viewed as an activity which involves a small band of highly skilled workers. By examining the results of a British survey of employees, this article breaks with this approach. It makes two distinctive contributions. First, it provides new insights into the extent to which employees of all kinds come up with ideas about improving the work processes they use, the products they make and services they provide. Secondly, it examines the correlates of this behaviour. The results show that the strength of employee involvement, the nature of workplace support and development and performance management are strongly associated with employees' willingness and ability to come up with innovative ideas. However, some of these features of work have declined in Britain in recent years, while economic outcomes often associated with innovation — such as increased productivity and stronger economic growth — have stalled.

1. Introduction

This article presents and analyses new data on employee-driven innovation in Britain, and is motivated by the increased recognition of the role played by innovation in solving a number of economic challenges, such as slowing productivity and weakening economic growth. The G20's *Innovation Action Plan*, for example, stated that 'innovation is one of the key driving forces … in promoting economic growth, supporting job creation, entrepreneurship and structural reform, [and] enhancing productivity and competitiveness' (G20 2016: 2). In a similar vein, the European Commission (EU) launched its *Innovation Union* strategy in 2010 with the aim of promoting 'change that

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speeds up and improves the way we conceive, develop, produce and access new products, industrial processes and services' (European Commission 2010: 1; European Commission 2015).

Traditional approaches to collecting and analysing innovation data have focused on research and development (R&D) expenditure, patent applications, the share of the population with graduate qualifications and major breakthroughs in product development or service delivery. Such quantitative data are usually collected at the level of the firm and/or nation state, and are presented in terms of international league tables (Dodgson 2017; Edler and Fagerberg 2017). This is known as the 'Science, Technology and Innovation' (STI) approach (Smith 2006).

Another approach is to take a bottom-up perspective which focuses on innovations which arise through the act of 'Doing, Using and Interacting' (DUI) at work (e.g. De Spiegalaere *et al*. 2014; Jensen *et al*. 2007). This approach defines innovation as 'the generation of new ideas, products or processes — including the everyday remaking of jobs and organizational practices — originating from the interaction of employees, who are not assigned to this task' (Nøyrup 2012: 8). By carrying out their daily work tasks, employees throughout the organization may come up with ideas about how they (and others) might work more efficiently and/or improve the product produced and/or services offered. This may, in turn, generate additional value for the business in line with the Schumpeterian notion of innovation as 'novelty that creates economic value' (Schumpeter, 1934, quoted in Nøyrup 2012). Typically, this approach is based on case studies and small-scale survey evidence (e.g. Billett 2012; De Jong and Den Hartog 2010; Halford *et al*. 2019: Table 1).

By presenting and analysing new representative data on the ways and extent to which employees claim to improve work processes, products or services, this article contributes to the development and analysis of DUI-inspired quantitative measures of innovation. The article is structured as follows. Section 2 outlines the measurement approaches which have shaped how the survey data on employee-driven innovation used in this article were collected. The section also outlines what role workplace factors — such as individual and collective voice, the nature of support and development and the use of performance management — might have on employee-driven innovation. The article tests the strength of these associations using data taken from the Skills and Employment Survey 2017 (SES2017), a nationally representative sample survey of working adults aged 20–65 years old in Britain. Section 3 outlines this data source in a little more detail, describes how the data on employee-driven innovation were collected and subsequently validated and provides an account of how the suggested correlates of employee-driven innovation are operationalized. Section 4 presents a descriptive account of the data, the results of multivariate analyses which aim to identify the strength and importance of the suggested correlates and an analysis of how these correlates have changed over the last decade. The results show that employee-driven innovation is higher where employees are more involved in decisions

TABLE 1
Dimensions of Employee-Driven Innovation

(a) Generation of innovative ideas

	Importance of:		
Importance rating	*Keeping up-to-date and applying new knowledge (column %) (1)*	*Developing new or improved work processes, products or services (column %) (2)*	*Developing plans to put new ideas into practice (column %) (3)*
Not at all important (0)	2.5	5.7	7.2
Not very important (1)	5.4	7.5	10.0
Fairly important (2)	11.8	17.3	19.8
Very important (3)	33.2	39.7	39.1
Essential (4)	47.2	29.8	24.0
Number of observations	2,876	2,870	2,875

(b) Action to innovate

Frequency over last year	*Suggestions made about ways of improving the efficiency of work (column %) (1)*	*Individual or group initiative to make improvements to work processes, products or services (column %) (2)*
Not once (0)	28.5	18.5
Once (1)	13.2	10.3
More than once (2)	58.3	71.2
Number of observations	2,855	1,699

(c) Employees' self-assessment of innovative contribution

	Impact of:		
Employee assessment	*Suggestions made about ways of improving the efficiency of work (column %) (1)*	*Problem-solving group contributions to improving work processes, products or services (column %) (2)*	*Consultation meeting contributions to improving work processes, products or services (column %) (3)*
Not relevant/made no impact at all (0)	32.2	62.3	43.4
Not much (1)	14.5	3.2	12.1
A fair amount (2)	40.4	18.5	31.2
A great deal (3)	12.9	16.0	13.3
Number of observations	2,838	1,700	1,706

Source: Skills and Employment Survey 2017 for this table and all others unless specified.

at work; are provided with training, learning and line management support which promotes their willingness and ability to innovate; and are rewarded and assessed according to their performance. Taken together, these three sets of correlates account for almost half of the variation in employee-driven innovation. However, despite the importance of innovation to business performance, some of these correlates have gone into reverse. Between 2006

and 2017 task discretion has declined, employee involvement in organizational decision making has fallen and trade union influence over work organization has weakened. Section 5 concludes the article by arguing that the way in which labour inputs are transformed into outputs at the point of production plays an important role in promoting or discouraging employee-driven innovation. On this basis, the article argues that policy makers need to use their powers to encourage, promote and mandate — where possible — greater employee involvement at work since it is both a feature of work over which policy makers have some influence and is strongly related to employee-driven innovation.

2. Measurement approaches and suggested correlates

Measurement Approaches

R&D data have long been used as a proxy for innovation in, for example, international scoreboards such as those produced by the EU (European Commission 2019). The OECD provides the framework for the collection of such data with guidelines that have been revised on six occasions since they were first published in 1963. These guidelines define R&D as 'creative and systematic work undertaken in order to increase the stock of knowledge … and to devise new applications of available knowledge' (OECD 2015: 44). Given the labour-intensive nature of this activity, R&D expenditure consists mainly of the personnel costs of those involved. These data have a number of advantages. These include the long period over which such data have been collected, the harmonization of data collection across countries and the detailed sub-classifications which facilitates analysis of the characteristics of R&D personnel and sector variation.[1] However, these data measure the inputs into the innovation process and not the outputs which often take a long time to be realized.

Traditionally, patent data have also been used to track and measure innovation. A patent is a public contract between an inventor and a government, whereby the inventor is granted time-limited monopoly rights to exploit the invention without facing competition from 'copy cats'. Like R&D data, patent data have strengths and weaknesses. Their key strength is that patents are only granted for inventions with potential commercial promise. Patent data are also systematic and have a long history. However, patents mark the potential emergence of something new and not necessarily their commercial use. On the other hand, non-patented inventions can be of much greater innovative significance, but since they are not patented they do not appear in patent data.

In response to these criticisms the Community Innovation Survey (CIS) was launched. The first survey in the series took place in 1993 and was originally carried out every four years. However, since 2005, the survey has been carried out biennially. The latest version was carried out in 2017 when over 13,000 manufacturing and selected service sector employers with 10 or more employees in the UK took part (BEIS, 2018). Based on CIS data,

estimates of employers' R&D expenditure and investments in new equipment can be derived. The real novelty of CIS, however, is that it also collects data on product and process innovation carried out by businesses in the previous three years (BEIS 2018). Product innovation is defined as 'the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses' and the process innovation as 'the implementation of a new or significantly improved production or delivery method' (OECD 2005: 48). In contrast to R&D and patent data, this information focuses on outcome changes which are known to managers who respond to the survey. Innovation is measured in much the same way in employer surveys carried out across the world (e.g. Bauernschuster and Falck 2009; Dostie 2018; González *et al*. 2016).

These indicators of innovation, however, are based on a scientific, technical and codified conception of knowledge. This assumes that only a small band of workers are innovators. These individuals are 'restricted to highly skilled professionals and researchers working in the areas of technology and natural sciences' (Møller 2010: 155), hence it is referred to as the 'Science, Technology and Innovation' approach (Smith 2006). The CIS and similar employer-level surveys have a conceptually wider focus. However, by focusing on the employing unit they, too, collect high-level data even when the focus is on non-technological innovations involving non-R&D workers. They tend, therefore, to capture only the largest and most visible changes to work processes, products and/services, and costed and measurable R&D and equipment outlays made by employers.

An alternative, but complementary, approach is to focus on the role played by everyday employees. This is known as the 'Doing, Using and Interacting' (DUI) approach. Its premise is that employees of all types are capable of undertaking innovation, thereby contributing to improvements in work processes, products and/or services. Such innovation is done on the job as employees respond to the challenges of doing their daily work tasks and interacting with others (Jensen *et al*. 2007).

Some scholarly effort has been devoted to the development of survey indicators of employee behaviours which are in line with the DUI approach (e.g. De Jong and Dan Hartog 2010). This literature has been pioneered by work psychologists who define innovation as 'the *intentional introduction and application* within a role, group or organization of ideas, processes or procedures, *new to the relevant unit* of adoption, designed to *significantly benefit* the individual, the group, organization or wider society' (West and Farr 1990: 9, our emphasis). These innovative work behaviours (IWBs) have several features. First, they involve an intentional effort to effect change. Innovation is therefore more than creativity — that is, the production of new and useful ideas about work processes, products and/or services — since it must include the application of ideas at work. Secondly, unlike patents, ideas do not have to be completely novel. So, ideas that are brought from another department within the organization or from outside the organization altogether are still regarded as innovative provided they are new to that

setting. Thirdly, innovation must have a beneficial impact. This might be in the form of personal growth and improved satisfaction for workers, greater cohesiveness and better interpersonal communication among the work group and/or increased productivity for the employing organization.

Based on this definition, work psychologists have attempted to measure IWB by focusing on the different stages of the innovation process (Scott and Bruce 1994). Theoretically, these stages are the exploration, generation, championing and implementation of ideas. The exploration of ideas includes looking for ways to improve existing products, services and/or work processes or thinking about them in different ways. This may generate ideas which involve rearranging or improving existing practices, and hence challenging custom and practice in which there may be vested interests. A champion is therefore often required to push through innovative ideas and overcome resistance. Finally, ideas need to be implemented and make an impact.

While theoretically speaking there are several steps in the innovation process, researchers have tended to use various one-dimensional multiple item scales to capture employees' role in the process (e.g. Basu and Green 1997; Bunce and West 1995; Janssen 2000; Reuvers *et al*. 2008; Yuan and Woodman 2010). However, these studies have typically been based on small samples of employees working in particular departments or in similar businesses. Their primary aim has been to develop measurement instruments. Despite these efforts, how employee-driven innovation is measured is 'still at an evolutionary stage' (De Jong and Den Hartog 2010: 23). This article builds on these efforts by designing and developing survey questions, and using them in a long-running, representative survey of those working in Britain.

Suggested Correlates

The article's second contribution is to examine the correlates of innovation suggested by the existing literature (Bos-Nehles *et al*. 2017). A long-running argument is that workers' restrictive practices, and more particularly trade unions, are a constraint on innovation. Theoretically, this diagnosis is based on neoclassical economic theory. According to this theory, workers exchange their services for a wage and through the medium of an engineering production function, labour is combined with other factors of production to produce output which is then sold. In this world, production is a mechanical and technologically determined process; workers are passive factors of production and labour input is specified in advance by the employer. Collective organizations of workers which carry out wage bargaining on behalf of their members and challenge management's actions at the point of production are 'imperfections' which interfere with this idealized model.

However, a counterargument is that rather than quitting jobs which are undesirable in some way, trade unions allow workers the means to collectively voice their concerns to management. This is known as the exit-voice model (Freeman and Medoff 1984). According to this theory, trade unions act as a conduit through which suggestions that might not be obvious to management

are made about improving work processes, products or services. Greater labour stability also ensures that employees stay longer in post and therefore have more opportunity to exercise collective voice. Furthermore, these effects are even stronger when trade unions have more influence over the way work is organized. The article addresses this debate by testing the argument that increased trade union influence at the workplace is associated with higher levels of employee-driven innovation.

A related suggestion is that employee-driven innovation is raised when workers' ideas are intentionally harnessed through stronger individual employee engagement. Tapping into employees' innovative ideas is a key feature of the AMO (Ability–Motivation–Opportunity) model of management (Appelbaum *et al*. 2000; Huselid 1995). According to this approach, the most effective managers do not rely on discipline alone, but put systems in place to harness the creative potential of their staff by giving them the opportunity to make decisions, the ability to do so and the motivation to act.

The empirical evidence for this strand of literature originates in the US and is based on evidence taken from employer surveys. These show that greater employee involvement is strongly associated with better economic outcomes such as increased productivity. However, the presence of involvement practices alone is not sufficient. What makes the difference is the extent of their use. For example, higher productivity is significantly associated with the percentage of workers who take part in regular decision making meetings rather than whether or not these forums exist (Black and Lynch, 2001). We therefore examine whether these results also apply to employee-driven innovation by examining whether or not higher levels of employee autonomy and empowerment are associated with higher levels of innovation.

The propensity to introduce new products or services has been shown to be associated with the establishment's willingness to encourage employee training (Bauernschuster and Falck 2009). These findings have been confirmed in studies carried out in Canada, Spain, France, UK and Australia (Dostie 2018; Gallié and Legros 2012; González *et al*. 2016). However, these studies have tended to use STI measures of innovation, such as patent applications and R&D expenditure, and are based on employer surveys. By focusing on the role played by ordinary employees in the innovation process, we examine the suggestion that higher levels of training are associated with higher levels of employee-driven innovation. This enables us to examine whether the STI results are replicated using DUI measures of innovation. In addition, we test the associated argument that on-the-job learning is similarly positively associated with employee-driven innovation. The role played by line management support is also examined with leader-member exchange theory suggesting that the greater the mutual trust and liking, the higher the level of innovative behaviour (Amabile 1988).

Another argument is that some businesses are slower than others at adopting best practice techniques. This can have a detrimental effect on innovation-related outcomes such as productivity. To get an insight into

management practices associated with higher productivity in the UK, the Office for National Statistics (ONS) recently undertook a survey of plant managers working in businesses employing 10 or more. Respondents were asked questions about target setting, monitoring and disciplining staff. Business-level estimates of labour productivity were also added to the dataset. This approach takes its inspiration from the Management and Organisational Practices Survey (MOPS) carried out initially by the US Census Bureau and then replicated across the world (Sadun *et al*. 2017). Like those elsewhere, the UK results show that higher productivity businesses are better than lower productivity businesses at monitoring the production process, setting a range of targets to be met and paying closer attention to staff performance (Awano *et al*. 2018). In this article, we test whether these types of management practices are also associated with increased levels of employee innovation.

3. Data source, measures of employee-driven innovation and suggested correlates

Data Source

All the data presented in this article are taken from the SES2017. The 2017 survey is the seventh in a series of nationally representative sample surveys of workers in Britain aged 20–65 years old. A total of 3,306 employed individuals were interviewed in their own homes in 2017 for about an hour. The authors of this article designed the survey, were responsible for its contents and directed the process of data collection.[2] However, the fieldwork was carried out by a market research company (Felstead *et al*. 2015).

The sample was drawn using random probability principles subject to stratification based on a number of socioeconomic indicators. Only one eligible respondent per address was randomly selected for interview, and 50 per cent of those selected completed the survey. A weight was computed to take into account the differential probabilities of sample selection, the over-sampling of certain areas and some small response rate variations between groups (defined by sex, age and occupation). The latter were identified by comparing the survey sample with profile of those taking part in the much larger Labour Force Survey carried out in the second quarter of 2017. All of the descriptive and multivariate analyses presented here use this weight and hence correct for sampling and non-response biases (Felstead *et al*. 2018a,b).

At each iteration of the series, some questions are retired and replaced with new ones on themes of topical relevance. Given the increased interest in innovation and its association with productivity, employee-driven innovation was selected as one of the new themes for inclusion in the 2017 survey. These new questions were directed at the 2,882 employees who took part in the survey. However, question filtering meant that not every employee was asked all of these questions (see below).

Measures of Employee-Driven Innovation

Innovation involves a number of steps and constitutes both a series of acts and outcomes (Dodgson 2017). We followed this approach by designing survey questions focused on the three major steps in the innovative process, namely the generation of ideas, their implementation and their estimated impact.

To collect data on the extent to which employees are expected to come up with ideas, respondents were asked how important three aspects of work were to their jobs: 'keeping up-to-date and applying new knowledge' and therefore having the ability to generate new ideas; 'developing new or improved work processes, products or services' through the act of working; and 'developing plans to put new ideas into practice'. Respondents were asked to respond using a five-point scale ranging from 'essential' to 'not at all important'. We refer to these as the *generation of innovative ideas*. In line with the predictions of employee-driven innovation theorists, very few employees reported that these behaviours were 'not at all important'. While at the other end of the spectrum around a half (47.2 per cent) of employees reported that it was 'essential' for them to keep up-to-date and apply new knowledge to their job and around a quarter (24.0 per cent) reported that developing plans to put new ideas into practice were 'essential' (see Table 1a). To summarize these data for use in the multivariate analysis reported later, we allocate scores ranging from 0 to 4 in accordance with the importance rating respondents gave. From this, we calculate an additive 0–12 summary score for the generation of innovative ideas. The resulting score has a Cronbach's alpha of 0.83 which suggests that its constituent items are closely related.

We also designed questions to tap into the extent to which employees are able to suggest and make improvements on an individual or group basis. Data on the former were collected by asking employees: 'Over the last year have you ever made suggestions to the people you work with, or to your managers, about ways of improving the efficiency with which work is carried out?' Those answering in the affirmative were then asked whether this was once or more than once. Employees can also take the initiative by making changes with or without management permission. To capture this kind of initiative taking, employees who had been in the same job with the same employer for at least one year were asked whether they had — individually or as part of a work group — 'taken the initiative in making improvements to work processes, products or services'. If they had, they were asked if they had done so once or more than once. Again the pattern of results suggests that the implementation of employee-driven innovation is a strong feature of work. Seven out of 10 employees (71.2 per cent) reported taking the initiative more than once in the last year to improve how the work was carried out and/or the products or services produced (see Table 1b). We allocate scores ranging from 0 to 2 in accordance with their frequency and calculate an additive 0–4 summary score for *action to innovate*. The resulting score has a Cronbach's alpha of 0.61 which suggests that its constituent items are moderately related.

In addition, employers sometimes set-up formal mechanisms to collect employees' views about how to improve work processes, products or services (Nøyrup 2012). Therefore, we asked those who had taken part in problem-solving groups and management consultation meetings what contribution employees' views had made. The existing literature rarely examines the outcomes of employee-driven innovation assessed in this way.

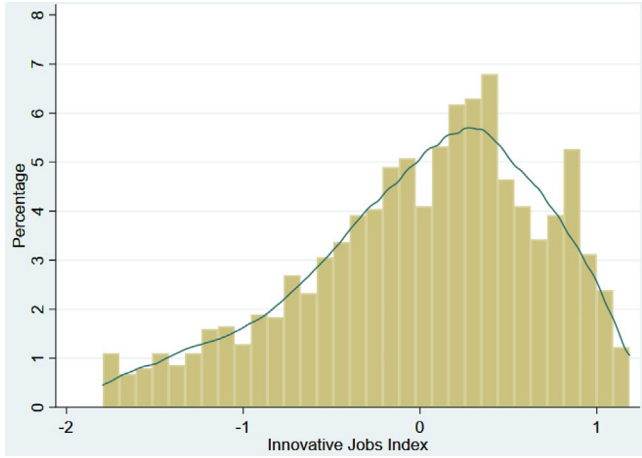
These outcome questions were only asked of employees who had been in the same job with the same employer for at least one year, thereby giving respondents a reasonable time period over which to make a judgement. They were asked to indicate if these ideas contributed 'a great deal', 'a fair amount', 'not much' or made no difference at all to improvements to work processes, products or services. We also asked this impact assessment question to those who had offered personal ideas about 'ways of improving the efficiency with which work is carried out' since these ideas might come through formal suggestion schemes set up by management.

The pattern of responses reflects the fact that not all jobs offer the opportunity to make such interventions through problem-solving groups, consultation meetings and suggestion schemes. Approaching two-thirds (62.3 per cent) of employees, for example, were not able to make meaningful suggestions via problem-solving groups either because such groups did not exist or else employees' views were estimated to have had no impact (see Table 1c, column 2). It is also noteworthy that employees were relatively reticent about claiming to have made 'a great deal' of difference. Again, to summarize, we allocate scores ranging from 0 to 3 in accordance with the impact assessments given, restricting the sample to those who have been in the same job with the same employer for at least one year. From this, we calculate an additive 0–9 summary score for *employees' self-assessment of their innovative contribution*. The resulting score has a Cronbach's alpha of 0.64 which suggests that its constituent items are moderately related.

Finally, the eight survey questions discussed above are standardized and a summative *innovative jobs index* is derived. This approach ensures that each of the eight questions has equal weight in the construction of the summative index with the mean of each question set to 0 and its standard deviation set to 1. However, we only construct the innovative jobs index for those employees eligible to answer all eight questions. The index has a Cronbach's alpha of 0.83 which suggests that the component questions are closely related. It is also negatively skewed with a long tail of low innovation jobs (see Figure 1).

Despite the theoretical preference for a multi-dimensional approach to employee-driven innovation (e.g. Scott and Bruce, 1994), factor analysis on the innovative jobs index confirms that a one-factor solution captures 85.7 per cent proportion of the variation in the component items and there is no statistical support for a two- or three-factor solution (with Eigen values less than 1). However, for completeness, we present evidence on the summary scores of the three dimensions of employee-driven innovation as well as the summary index (cf. Tables 4–7). Hence, the reported sample sizes for the three dimensions and the summary index differ. Question filters were applied at the

FIGURE 1
Innovative Jobs Index.
[Colour figure can be viewed at wileyonlinelibrary.com]



Note: The line is the Kernel density used to smooth non-parametric data plots.
Source: Skills and Employment Survey 2017.

point of data collection and so not all innovation questions were asked of all employees.

One limitation of our approach is that the indicators of employee-driven innovation are based on employees' assessments and may therefore be subject to measurement biases. These include the tendency for respondents to give socially acceptable answers and reporting inaccuracies in using, for example, the response scales offered. Despite this limitation, all four of our measures of innovation correlate positively and significantly with industry variations in logged productivity data. These correlations hold after controlling for a number of factors, most notably the capital intensity of the industry in which respondents work and demographic indicators such as the level of qualification which are also significantly and positively associated with employee-driven innovation (see Table 2). Furthermore, activities related to innovation, such as finding the causes of faults and seeking solutions to problems, are strongly and significantly related to our measures of employee-driven innovation. These results provide validity for the claim that employee-driven innovation can be measured by asking survey questions of those carrying it out.

Suggested Correlates

The second major contribution of this article is an analysis of the strength of the association between features of work and their ability to promote or discourage employee-driven innovation. For this, we examine three types of correlates suggested by the literature.

TABLE 2
External Validity Tests

Independent variables	*Gross value added per hour at two-digit industry level*[a]
Model 1	
Generation of innovative ideas	0.212***
	(0.010)
Capital intensity	0.000***
	(0.000)
Controls[b]	Yes
R^2	0.49
Number of observations	2,808
Model 2	
Action to innovate	0.423***
	(0.026)
Capital intensity	0.000***
	(0.000)
Controls	Yes
R^2	0.48
Number of observations	1.650
Model 3	
Employees' self-assessment of innovative contribution	0.151***
	(0.0151)
Capital intensity	0.000***
	(0.000)
Controls	Yes
R^2	0.44
Number of observations	1,618
Model 4	
Innovative jobs index	0.761***
	(0.048)
Capital intensity	0.000***
	(0.000)
Controls	Yes
R^2	0.49
Number of observations	1,611

[a]The outcome variable is logged gross value added per hour at two-digit industry level (ONS 2018b). Capital intensity per hour worked is also measured at two-digit industry level (ONS 2018a) as are reports of employee innovation. These ONS data are for 2017.
[b]In addition to capital intensity per hour worked, controls are also entered for sex, age, age squared, working time (interacted with sex), marital status, children, region, establishment size, establishment size squared, one-digit occupation and qualification level.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

First, the association that employee involvement — exercised individually or collectively through trade unions — has with employee-driven innovation. This reflects the suggestions made by theorists from the AMO and exit-voice traditions. Individual employee involvement is measured in two ways. One is the extent to which employees exercise discretion over the tasks to be done, how they are to be done, to what standards and with what effort. A second indicator is the extent to which employees report having a say in changes which might affect their work. Employees may be able to have an influence over how work is organized in other ways too, such as through trade unions.

To tap into this collective aspect of employee voice, we derive an index based on responses to the question: 'How much influence do the trade unions in your establishment have over the way work is organised?' (see Table A1 for more detail on how these independent variables are derived and, where appropriate, internally validated).

Secondly, we examine the role played by the nature of the training and learning undertaken given the emphasis AMO theorists place on employees' ability to make suggestions and previous research which suggests a strong association between the incidence of training and innovation as measured by patent activity, R&D expenditure and new product launches. However, instead of relying on whether employees had received training or not, we asked respondents who had participated in training activities over the last year to estimate the extent to which these activities 'make you think harder about different ways of doing your job'. We take those reporting 'a great deal' or 'quite a lot' as undertaking training with employee-driven innovation potential. We treat on-the-job learning similarly by deriving a measure which teases out learning which makes employees 'think harder about different ways of doing your job'. A large majority (84.6 per cent) of employees agreed to some extent that their job required on-going learning, but just over half (56.4 per cent) said that this learning prompted them to think 'a great deal' or 'quite a lot' about how they might make improvements to the way they do their job.

Furthermore, the AMO model of management suggests that to elicit employees' ideas line managers need to create the environment in which employees have the opportunity and motivation to share these ideas. One way of doing so is for managers to be supportive of those in their charge by helping employees to learn, supporting them when under pressure and recognizing the extent of their abilities. SES2017 asks employees to rate the helpfulness of their line manager in each of these respects. From this, an index of line management support is created.

Thirdly, we examine the association between performance management and the willingness and ability of employees to innovate. This builds on the recent work of ONS which has, in turn, been inspired by the worldwide use of MOPS. We use binary measures for work quality targets, meaningful appraisals tied to training and/or pay and performance-related pay.

The analysis also controls for standard demographic and socioeconomic variations such as age, gender and qualification level as well as features of work such as occupation, industry and establishment size. Furthermore, it controls for differences in personality traits (see Table A2). These are derived from a battery of 10 questions designed and validated for use in large-scale surveys (Gosling *et al*. 2003). Respondents were presented with a pair of personality traits and were asked: 'Thinking of the past few weeks, how much of the time has your job made you feel each of the following . . . ?' They were asked to use a seven-point scale in response. Each pair of traits has a negative equivalent which are then reverse scored in the construction of five domains, so that a higher score indicates a more positive outlook. The inclusion of personality

traits controls for systematic biases arising from data collected from employees who may rate their innovation higher or lower as a result of their personal outlook.

4. Descriptive patterns and workplace correlates of employee-driven innovation

Descriptive Patterns

This section begins by taking the summary measure of employee-driven innovation and examining the characteristics of those in the top and bottom quartiles of innovative jobs. These results suggest that women are more likely to be in jobs with high levels of employee-driven innovation — female employees account for just over half (51.3 per cent) of those in the top quartile of the innovative jobs index compared to two-fifths (39.4 per cent) of those in the bottom quartile (see Table 3). Similarly, bivariate analysis suggests that there is a tendency for the youngest and oldest employees to be disproportionately located in jobs which fall in the bottom quarter of the innovation index. The same goes for part-time employees who make up over a quarter (27.2 per cent) of jobs in the bottom quartile, double the proportion of part-time employees in top quartile (13.7 per cent).

The distribution by occupation is more uneven still with the top three occupational groups accounting for three-quarters of the top quartile of innovative jobs compared to around a sixth of jobs in the bottom quartile. There is similar unevenness in terms of industrial distribution — just under half (47.2 per cent) of highly innovative jobs are in public administration, education and health, while around one in three (29.0 per cent) of low innovation jobs are in distribution, hotels and restaurants. Further disaggregation shows that around a sixth (16.1 per cent) of high innovation jobs are in education, while nearly one in seven (13.9 per cent) low innovation jobs are in retail.

Like other studies, we also find that employee-driven innovation is higher among those with higher qualifications and among those working in larger establishments (Dostie 2018; Janssen 2000; Jensen *et al.* 2007). Around two-thirds (67.6 per cent) of those in highly innovative jobs hold tertiary level (i.e. Level 4 or above) qualifications, whereas similarly qualified employees make up just a fifth (20.7 per cent) of those in low innovative jobs. Also employee-driven innovation appears weaker in smaller establishments.

Workplace Correlates

The next step in the analysis is to examine the strength of the association between features of work and the level of employee-driven innovation. To test the suggested connections, we carry out four sets of OLS regressions. Each uses a different dependent variable: three focus on the various stages of the innovation process and the fourth uses our summary measure (see Tables 4–7). In each set of multivariate results, we enter the independent variables in steps.

TABLE 3
Distribution of 'High' and 'Low' Innovative Jobs

	Top quartile of the innovative jobs index (column %) (1)	*Bottom quartile of the innovative jobs index (column %) (2)*
Sex		
Male	48.7	60.6
Female	51.3	39.4
Age		
20–29	9.8	20.8
30–39	22.5	18.7
40–49	31.5	22.2
50–59	29.7	26.5
60–65	6.5	11.8
Working time		
Full-time	86.3	72.9
Part-time	13.7	27.2
Occupation		
Managers, directors and senior officials	21.2	2.7
Professionals	36.7	6.7
Associate professionals	17.4	7.7
Administrative	7.6	11.8
Skilled trades	4.1	13.6
Caring and leisure	6.0	7.3
Sales and customer service	2.2	11.6
Plant and machine operatives	3.6	14.8
Elementary	1.2	23.9
Qualification level		
No qualifications	1.2	18.3
Level 1	2.5	14.8
Level 2	9.4	26.0
Level 3	19.3	20.3
Level 4 and above	67.6	20.7
Establishment size		
Less than 25 employees	22.1	42.2
25–99 employees	31.1	20.8
100–249 employees	12.5	17.6
250 and more employees	34.3	19.3
Industry		
Agriculture, forestry and fishing	0.2	1.0
Energy and water	1.8	1.0
Manufacturing	10.2	12.4
Construction	2.6	10.1
Distribution, hotels and restaurants	9.1	29.0
Transport and communication	10.2	11.7
Banking and finance	16.3	13.8
Public administration, education and health	47.2	18.8
Other services	2.6	2.3

To begin we enter the suggested correlates in themed batches (Models 1, 2 and 3), then they are entered as a complete block (Model 4) and finally we add a range of controls (Model 5). All of the suggested correlates are standardized before they are entered into the regressions (i.e. z-scores are generated with

TABLE 4
Estimated Correlation Coefficients of the Generation of Innovative Ideas

Standardized Scores	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*
(a) Employee involvement					
Job discretion (index)	0.720***			0.531***	0.358***
	(0.062)			(0.056)	(0.056)
Say in workplace changes (index)	0.379***			0.243***	0.138***
	(0.056)			(0.051)	(0.052)
Trade union influence over work organization (index)	0.476***			0.247***	0.203***
	(0.053)			(0.048)	(0.050)
(b) Support and development					
Training which encourages thinking about improving the work process (binary)		0.288***		0.169***	0.116**
		(0.055)		(0.052)	(0.050)
Learning which encourages thinking about improving the work process (binary)		1.053***		0.850***	0.732***
		(0.055)		(0.052)	(0.052)
Line management support (index)		0.246***		0.041	0.107**
		(0.053)		(0.051)	(0.050)
(c) Performance management					
Targets set for work quality (binary)			0.578***	0.331***	0.220***
			(0.057)	(0.052)	(0.051)
Appraisals with impact on training and/or pay (binary)			0.488***	0.314***	0.167***
			(0.057)	(0.051)	(0.051)
Bonus pay (binary)			0.127**	0.102**	0.115**
			(0.053)	(0.047)	(0.051)
Model parameters					
Controls for sex, age, age squared, working time (interacted with sex), one-digit occupation, one-digit industry, education level, establishment size, establishment size squared, region and personality	No	No	No	No	Yes
Constant	8.737***	8.761***	8.748***	8.690***	6.450***
	(0.053)	(0.050)	(0.054)	(0.048)	(0.773)
R^2	0.13	0.22	0.11	0.32	0.40
Number of observations	2,245	2,245	2,245	2,245	2,245

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

mean = 0 and standard deviation = 1). This ensures that they have equal 'weight' in the regressions and therefore allows us to identify variables which are most strongly associated with employee-driven innovation.

A number of patterns emerge from the results.[3] The first is that employee involvement exercised individually and collectively is positively and significantly associated with employees' capacity and willingness to come up with new ideas and suggestions. All of the estimated coefficients are highly significant ($p < 0.01$) and remain so after other suggested correlates and a range of controls are added. Furthermore, the level of job discretion and say in workplace changes is either the most important or second most important

TABLE 5
Estimated Correlation Coefficients of Action to Innovate

Standardized scores	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*
(b) Employee involvement					
Job discretion (index)	0.317***			0.296***	0.201***
	(0.040)			(0.039)	(0.039)
Say in workplace changes (index)	0.326***			0.295***	0.225***
	(0.036)			(0.035)	(0.036)
Trade union influence over work organization (index)	0.151***			0.073**	0.078**
	(0.033)			(0.032)	(0.034)
(b) Support and development					
Training which encourages thinking about improving the work process (binary)		0.156***		0.093**	0.060
		(0.040)		(0.037)	(0.036)
Learning which encourages thinking about improving the work process (binary)		0.227***		0.105***	0.020
		(0.038)		(0.036)	(0.036)
Line management support (index)		0.089**		-0.050	-0.014
		(0.037)		(0.035)	(0.034)
(c) Performance management					
Targets set for work quality (binary)			0.178***	0.123***	0.095***
			(0.038)	(0.036)	(0.036)
Appraisals with impact on training and/or pay (binary)			0.236***	0.209***	0.131***
			(0.038)	(0.035)	(0.036)
Bonus pay (binary)			0.100***	0.074**	0.074**
			(0.035)	(0.032)	(0.034)
Model parameters					
Controls for sex, age, age squared, working time (interacted with sex), one-digit occupation, one-digit industry, education level, establishment size, establishment size squared, region and personality	No	No	No	No	Yes
Constant	2.907***	2.968***	2.932***	2.897***	2.761***
	(0.034)	(0.035)	(0.035)	(0.032)	(0.552)
R^2	0.16	0.07	0.08	0.23	0.34
Number of observations	1,390	1,390	1,390	1,390	1,390

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

variable in the full models presented in Tables 4–7. These results support the predictions of AMO theorists who suggest that individual employee involvement provides the opportunity for employees to innovate at work. They also offer empirical support for exit-voice theorists who argue that the greater the involvement of trade unions in workplace decisions, the more likely employees are to make suggestions and take action to improve work processes, products or services.

In addition to the opportunity to make suggestions and ideas, the literature suggests that employees need to have the ability to do so. This may be enhanced by training and learning which promotes 'thinking outside the box'

TABLE 6
Estimated Correlation Coefficients of Employees' Self-Assessment of Innovative Contribution

Standardized scores	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*
(c) Employee involvement					
Job discretion (index)	0.477***			0.334***	0.237***
	(0.071)			(0.064)	(0.066)
Say in workplace changes (index)	0.809***			0.687***	0.567***
	(0.065)			(0.059)	(0.062)
Trade union influence over work organization (index)	0.523***			0.268***	0.203***
	(0.059)			(0.054)	(0.059)
(b) Support and development					
Training which encourages thinking about improving the work process (binary)		0.322***		0.181***	0.141**
		(0.070)		(0.061)	(0.062)
Learning which encourages thinking about improving the work process (binary)		0.625***		0.342***	0.284***
		(0.067)		(0.061)	(0.062)
Line management support (index)		0.578***		0.301***	0.370***
		(0.064)		(0.058)	(0.058)
(c) Performance management					
Targets set for work quality (binary)			0.523***	0.314***	0.268***
			(0.068)	(0.061)	(0.062)
Appraisals with impact on training and/or pay (binary)			0.659***	0.510***	0.403***
			(0.067)	(0.059)	(0.062)
Bonus pay (binary)			0.133**	0.072	0.085
			(0.062)	(0.054)	(0.059)
Model parameters					
Controls for sex, age, age squared, working time (interacted with sex), one-digit occupation, one-digit industry, education level, establishment size, establishment size squared, region and personality	No	No	No	No	Yes
Constant	3.420***	3.557***	3.478***	3.431***	2.290***
	(0.061)	(0.062)	(0.062)	(0.054)	(0.948)
R^2	0.22	0.19	0.17	0.38	0.44
Number of observations	1,372	1,372	1,372	1,372	1,372

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

and by line managers who create an environment in which those under their charge have the opportunity and motivation to share these ideas. Our second finding is that three out of the four sets of OLS regressions consistently show that there is a strong and positive association between the support and development of employees and their willingness to offer ideas about how to improve work processes, products or services. Moreover, in two of the four full models (cf. Tables 4 and 7) 'learning which encourages thinking about improving the work process' is the variable most strongly associated with employee-driven innovation.[4] As expected, the estimated correlation coefficients weaken as additional independent variables are added to the

TABLE 7
Estimated Coefficients of the Innovative Jobs Index

Standardized scores	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*
(a) Employee involvement					
Job discretion (index)	0.175***			0.133***	0.086***
	(0.018)			(0.015)	(0.015)
Say in workplace changes (index)	0.181***			0.147***	0.113***
	(0.016)			(0.014)	(0.014)
Trade union influence over work organization (index)	0.151***			0.077***	0.063***
	(0.015)			(0.013)	(0.014)
(b) Support and development					
Training which encourages thinking about improving the work process (binary)		0.097***		0.061***	0.041***
		(0.017)		(0.015)	(0.014)
Learning which encourages thinking about improving the work process (binary)		0.234***		0.156***	0.127***
		(0.016)		(0.015)	(0.014)
Line management support (index)		0.108***		0.034**	0.050***
		(0.016)		(0.014)	(0.013)
(c) Performance management					
Targets set for work quality (binary)			0.162***	0.091***	0.069***
			(0.017)	(0.015)	(0.014)
Appraisals with impact on training and/or pay (binary)			0.168***	0.125***	0.082***
			(0.017)	(0.014)	(0.014)
Bonus pay (binary)			0.032**	0.021	0.026*
			(0.016)	(0.013)	(0.014)
Model parameters					
Controls for sex, age, age squared, working time (interacted with sex), one-digit occupation, one-digit industry, education level, establishment size, establishment size squared, region and personality	No	No	No	No	Yes
Constant	0.021	0.061***	0.040**	0.026**	−0.348
	(0.015)	(0.015)	(0.016)	(0.013)	(0.217)
R^2	0.25	0.25	0.19	0.46	0.56
Number of observations	1,367	1,367	1,367	1,367	1,367

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

models. However, only in one out of four cases do the coefficients for support and development become insignificant (see action to innovate, Table 5).

Our third finding is that performance management is positively and significantly associated with levels of employee-driven innovation. This suggests that meaningful appraisals give employees a way of communicating their innovation enhancing ideas to management, and that quality targets and pay bonuses provide the motivation to do so. This provides empirical support for both the AMO model management and the MOPS approach. The former emphasizes the incentive-based nature of bonuses and targets, while the latter emphasizes their disciplinary use in deterring workers from failing to meet specified targets.

TABLE 8
Changes in the Correlates of Employee-Driven Innovation, 2006–2017

	2006	*2012*	*2017*
(a) Employee involvement			
A great deal of influence over:			
- Work effort	56.0	54.3	48.2
- Deciding tasks	33.4	34.2	30.8
- Deciding how to do tasks	47.0	44.9	40.0
- Deciding the quality standards	55.1	57.3	47.5
Job discretion index	2.19	2.19	2.13
A great deal of individual say in workplace changes	13.5	10.9	11.9
Say in workplace changes index	1.08	0.98	1.05
Trade union has a fair amount or more influence over work organization	18.5	17.2	16.2
Trade union influence over work organization index	0.67	0.64	0.58
(b) Support and development			
Training which promotes thinking harder about improving the work process	NA	33.2	32.1
Learning which promotes thinking harder about improving the work process	NA	54.0	56.4
(c) Performance management			
Targets set for work quality	43.6[a]	NA	51.2[a]
Appraisals with impact on training and/or pay	37.8	41.4	37.9
Bonus pay	39.4	37.8	37.8

[a]These data were only collected in 2001 and 2017, so the 2006 column here refers to 2001. These data also focus on those aged 20–60 and not those aged 20–65 as reported in Table A1.
Source: Skills and Employment Survey 2017, 2012 and 2006.

Overall, then, these results are suggestive of a role for trade unions, individual voice, support and development of employees, and performance management in promoting employee-driven innovation. However, the explanatory power of each set of correlates varies in magnitude. The performance management measures account for 19 per cent of the variation in the innovative jobs index, support and development accounts for 25 per cent and employee involvement explains 25 per cent. When the three sets of correlates are taken together they account for 46 per cent of the variation; this rises to over half (56 per cent when the controls such as occupation, industry, establishment size and education level are added (see Table 7).

Since the questions on employee-driven innovation were only asked in the 2017 survey, it is not possible to examine how innovation has changed in the aftermath of the Great Recession. However, there has been a downward shift in many of the correlates which have a positive and statistically significant association with employee-driven innovation. There has, for example, been a downward movement in all aspects of task discretion with an eight percentage point fall between 2006 and 2017 in the proportion reporting having a great deal of influence over how hard they work. There have also been falls in involvement in organizational decision-making and in trade union influence over work organization (see Table 8).

TABLE 9
Trends in Employee Involvement, 2006–2017

	Job discretion index (1)	*Say in workplace index (2)*	*Trade union influence over work organization index (3)*
	Estimated correlation coefficients		
Year (base = 2006)			
2012	−0.014	−0.123***	−0.014
	(0.014)	(0.023)	(0.019)
2017	−0.089***	−0.085***	−0.067***
	(0.014)	(0.023)	(0.018)
Controls for sex, age, age squared, working time (interacted with sex), one-digit occupation, one-digit industry, education level, establishment size, establishment size squared and region	Yes	Yes	Yes
R^2	0.13	0.11	0.17
Number of observations	14,096	12,418	13,091

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.
Note: These are OLS regressions. However, the same pattern of results is produced using ordered probit regressions.
Source: Skills and Employment Survey 2017, 2012 and 2006.

Furthermore, these falls cannot be explained by compositional effects such as shifts in the nature of employment and a more qualified workforce. After controlling for these changes, all three features of employee involvement — job discretion, a say in workplace changes and trade union influence over the organization of work — declined significantly between 2006 and 2017 ($p < 0.01$) (see Table 9).

Trends in the other correlates are less clear-cut. Training intended to promote creative thinking, for example, fell marginally, while on-the-job learning designed to promote creativity rose by a couple of percentage points between 2012 and 2017. Trends in performance management are also mixed with an increase in target setting, a recent decline in meaningful appraisals and little change in bonus pay. On this basis, then, the trends for employee involvement are the most troubling since they explain a quarter of the variation in the innovative jobs index and they are among the most important variables in the models presented. However, job discretion, the level of say in proposed changes at work and the extent of trade union influence over work organization have gone into the sharpest decline of the three sets of correlates examined. Moreover, these trends cannot be explained by compositional changes in the nature of the employment or the type of workers employed.

5. Conclusion

Innovation is traditionally measured in terms of R&D expenditure, patent applications and/or employer-level reports of breakthroughs in product development or service delivery. In this context, the article makes two distinctive contributions. First, it provides a bottom-up perspective to innovation measurement by asking employees about the ideas and suggestions they make about improving work processes, products or services. We have developed survey questions to capture the three stages of the innovation process — the generation of ideas, their implementation and their impact. Secondly, the article examines the correlates of these innovative behaviours. We find that employee involvement exercised individually and/or collectively is positively and significantly associated with employees' capacity and willingness to offer innovative ideas. This finding is in line with theorists who emphasize the positive role of collective voice (e.g. Freeman and Medoff 1984) as well as those who highlight the positive role that individual voice can also play (e.g. Appelbaum *et al*. 2000). Furthermore, these features of work explain a quarter of the variation in the innovative jobs index.

However, despite the benefits of employee involvement, the data suggest that involvement has fallen in Britain over the last decade — task discretion has declined, involvement in organizational decision-making has fallen and trade union influence over work organization has weakened. Yet, previous UK governments have failed to take a lead in reversing these trends. Currently, companies only have to consider ways of taking the workers' views into account when making board level decisions and none of the UK's top 100 listed companies (at the time of writing) have appointed a worker to the board of directors (FRC 2018). These trends and actions run contrary to the evidence on the correlates of employee-driven innovation. That said, the move to lower the threshold at which employers are required on request to inform and consult with employees is a move in the right direction (HM Government 2018: 22).

The evidence in this article also suggests that training and learning which encourages creative thinking has a strong link to innovation as does the presence of target setting and appraisals linked to pay and/or training opportunities. These findings corroborate previous studies on the links that training and performance management have with innovation. In our model, support and development accounts for a quarter of the variation in the innovative jobs index, while performance management explains a fifth of the variation with the complete model explaining in excess of half.

From a policy perspective, the article suggests that supporting a handful of already innovative sectors in the economy in order to strengthen the UK's economic base needs to be complemented by a more general purpose policy response of tapping into employees' knowledge of production, so that improvements in innovation come from all sectors and occupational levels. While targeted government investment in particular high profile sectors might raise performance in these sectors, it is unlikely to trigger a general levelling

up of performance across the economy. On this basis, the House of Commons recently concluded that 'The Government's Industrial Strategy isn't doing enough for the "everyday economy", in sectors such as retail and hospitality where millions of Brits are employed' (Reeves 2019) and where — according to our data — around one in three 'low innovation jobs' are found. Based on evidence presented in this article a campaign is needed to raise the innovative performance of all parts of the economy with increasing individual and collective employee voice at its core.

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Notes

1. For example, since 1993, the Business Enterprise Research and Development (BERD) survey of 'all known R&D performers' in Britain permits this type of analysis (ONS, 2017).
2. www.cardiff.ac.uk/ses2017
3. Ordered probits produce similar results. Furthermore, the use outcome variables which compare each employee's score with the average for those working in the same occupation and industry (at the one-digit level) generate comparable results, although sometimes at lower levels of significance.
4. The complete regressions of the four full models are shown in Table A3.

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Appendix

TABLE A1
Independent Variables, Detailed Descriptions, Internal Validation and Means

Independent variables	*Detailed description*	*Mean*
(a) Employee involvement		
Job discretion (index)	'How much influence do *you personally* have on': how hard you work; deciding what tasks you are to do; deciding how you are to do the task; and deciding the quality standards to which you work'. Allowable responses were: 'a great deal' (3); 'a fair amount' (2); 'not much' (1); and 'none at all' (0). An additive index (0–3) is produced (alpha = 0.79).	2.13
Say in workplace changes (index)	'Suppose there was going to be some decision made at your place of work that changed the way you do your job. Do you think that you personally would have any say in the decision about the change or not?' If yes, 'How much say or chance to influence the decision do you think that you personally would have?' Responses were: 'a great deal' (3); 'quite a lot' (2); and 'just a little' (1). Those reporting 'no say' are given a score of 0 and those reporting 'it depends' to the first question are given a score of 1. An additive index (0–3) is produced.	1.05
Trade union influence over work organization (index)	Respondents who reported trade unions in the workplace were asked: 'How much influence do the trade unions in your establishment have over the way work is organised?' Responses were: 'A great deal' (3): 'a fair amount' (2); 'not much' (1); and 'none at all' (0). We add those who reported no trade unions at the workplace into the last category (0) before producing an index (0–3).	0.58
(b) Support and development		
Training which encourages thinking about improving the work process (binary)	All respondents who participated in training in the last year were asked: 'To what extent did/does that training or education make you think harder about different ways of doing your job?' The five responses were: 'a great deal'; 'quite a lot'; 'to some extent'; 'a little'; and 'not at all'. We create a binary variable based on those who selected one of the first two options.	0.32

(*Continued*).

TABLE A1
Continued

Independent variables	*Detailed description*	*Mean*
Learning which encourages thinking about improving the work process (binary)	All respondents who strongly agreed or agreed with the statement that: 'my job requires learning new things' were asked: 'To what extent do these new things that you learn make you think harder about different ways of doing your job?' The five responses were: 'a great deal'; 'quite a lot'; 'to some extent'; 'a little'; and 'not at all'. We create a binary variable based on those who selected one of the first two options.	0.56
Line management support (index)	'How helpful is your supervisor or manager in: enabling you to learn how to do your job better; supporting you when you are under pressure; and recognizing the extent of your abilities. A five-point response scale was presented: 'a great deal of help' (4); 'quite a lot of help' (3); 'of some help' (2); 'a little help' (1); and 'of no help at all' (0). An additive index is produced (alpha = 0.88).	2.71
(c) Performance management		
Targets set for work quality (binary)	'Are any targets set for improving the quality of your work? A binary variable is created from the yes/no response.	0.53
Appraisals with impact on training and/or pay (binary)	Employees were asked whether there was a formal appraisal system at their place of work and if so whether they had been appraisal in the last 12 months and whether the result affected their earnings and/or training. We create a binary variable based on these responses.	0.38
Bonus pay (binary)	Employees were asked if they 'received any incentive payment, bonus or commission that is linked directly to the performance' of themselves, their work group or the workplace or organization they worked for. We create a binary variable of those who said that they received bonus pay in one or more of these ways.	0.38

Note: These reported means are based on the weighted sample of employees (2,882). However, the regressions reported in Tables 4–8 are based on a subset of this sample due to missing values and filters on the dependent variables (see text).

TABLE A2
Descriptive Statistics of Control Variables

Control variables	*Means*
Demographics	
Male	51.3
Female	48.7
Age (continuous scale)	40.9
Working time	
Full-time working	77.6
Part-time working	22.4
Occupation	
Managers, directors and senior officials	10.1
Professionals	21.2
Associate professionals	14.3
Administrative	10.9
Skilled trades	8.9
Caring and leisure	9.1

(*Continued*)

TABLE A2
Continued

Control variables	*Means*
Sales and customer service	8.5
Plant and machine operatives	6.7
Elementary	10.3
Industry	
Agriculture, forestry and fishing	0.4
Energy and water	1.3
Manufacturing	11.2
Construction	5.8
Distribution, hotels and restaurants	18.8
Transport and communication	9.3
Banking and finance	17.7
Public administration, education and health	33.8
Other services	1.8
Highest qualification held	
No qualifications	5.8
Level 1	7.8
Level 2	17.3
Level 3	22.9
Level 4 and above	46.2
Establishment size	
Less than 25 employees	7.3
25–99 employees	12.0
100–249 employees	13.9
250 and more employees	4.4
Region/country	
East Midlands	7.3
East of England	12.0
London	13.9
North East	4.4
North West	10.5
Scotland	7.8
South East	14.0
South West	8.1
Wales	4.6
West Midlands	8.5
Yorkshire and Humber	9.0
Personality traits	
Extraverted (0–7 scale)	4.9
Agreeable (0–7 scale)	5.1
Conscientious (0–7 scale)	5.9
Emotional (0–7 scale)	5.7
Openness (0–7 scale)	5.0

Note: These reported means are based on the weighted sample of employees (2,882) as per Table A1. The 2017 and others in the Skills and Employment Survey series were tested for their representativeness against the relevant Labour Force Survey for the second quarter of the relevant year. Only minor discrepancies were identified which were then corrected using the weights supplied (see Felstead *et al*. 2018b).

TABLE A3
Complete Regressions of Full Models

	Generation of innovative ideas (1)	*Action to innovate (2)*	*Employees' self-assessment of innovative contribution (3)*	*Innovative jobs index (4)*
Discretion index (*z*-score)	0.358***	0.201***	0.237***	0.086***
	(0.056)	(0.039)	(0.066)	(0.015)
Say index (*z*-score)	0.138***	0.225***	0.567***	0.113***
	(0.052)	(0.036)	(0.062)	(0.014)
Union index (*z*-score)	0.203***	0.078**	0.203***	0.063***
	(0.050)	(0.034)	(0.059)	(0.014)
Creative training (*z*-score)	0.116**	0.060*	0.141**	0.041***
	(0.050)	(0.036)	(0.062)	(0.014)
Creative learning (*z*-score)	0.732***	0.020	0.284***	0.127***
	(0.052)	(0.036)	(0.062)	(0.014)
Support index (*z*-score)	0.107**	−0.014	0.370***	0.050***
	(0.050)	(0.034)	(0.058)	(0.013)
Quality targets (*z*-score)	0.220***	0.095***	0.268***	0.069***
	(0.051)	(0.036)	(0.062)	(0.014)
Appraisals (*z*-score)	0.167***	0.131***	0.403***	0.082***
	(0.051)	(0.036)	(0.062)	(0.014)
Bonus pay (*z*-score)	0.115**	0.074**	0.085	0.026*
	(0.051)	(0.034)	(0.059)	(0.014)
Male (base)	–	–	–	–
	(–)	(–)	(–)	(–)
Female	0.135	0.220***	−0.078	0.029
	(0.116)	(0.081)	(0.140)	(0.032)
Full-time (base)	–	–	–	–
	(−)	(−)	(−)	(−)
Part-time	−0.486**	−0.176	−0.753**	−0.142**
	(0.228)	(0.180)	(0.303)	(0.069)
Female × part-time	0.050	−0.023	0.622*	0.072
	(0.265)	(0.202)	(0.344)	(0.079)
Age	0.032	−0.020	0.000	0.001
	(0.033)	(0.023)	(0.040)	(0.009)
Age squared	−0.000	0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Married	0.053	0.188**	0.187	0.050*
	(0.111)	(0.076)	(0.132)	(0.030)
No children (base)	–	–	–	–
	(−)	(−)	(−)	(−)
Children	0.099	−0.026	−0.098	0.010
	(0.111)	(0.075)	(0.131)	(0.030)
No qualifications (base)	–	–	–	–
	(−)	(−)	(−)	(−)
Level 1 qualifications	0.607**	−0.074	−0.124	0.080
	(0.261)	(0.164)	(0.288)	(0.066)
Level 2 qualifications	0.721***	0.335**	0.400	0.158***
	(0.236)	(0.144)	(0.254)	(0.058)

(*Continued*)

TABLE A3
Continued

	Generation of innovative ideas (1)	*Action to innovate (2)*	*Employees' self-assessment of innovative contribution (3)*	*Innovative jobs index (4)*
Level 3 qualifications	0.545**	0.470***	0.684***	0.199***
	(0.238)	(0.147)	(0.258)	(0.059)
Level 4 and above qualifications	0.595**	0.565***	0.583**	0.235***
	(0.238)	(0.148)	(0.259)	(0.059)
Managers	0.489**	0.211	0.864***	0.195***
	(0.219)	(0.145)	(0.254)	(0.058)
Professionals	0.304	0.213	0.286	0.102
	(0.247)	(0.167)	(0.289)	(0.066)
Associate professionals	0.198	0.009	0.376	0.078
	(0.229)	(0.156)	(0.271)	(0.062)
Administrative	−0.007	−0.081	0.175	0.038
	(0.245)	(0.165)	(0.285)	(0.065)
Skilled trades (base)	–	–	–	–
	(−)	(−)	(−)	(−)
Caring and leisure	0.227	0.026	−0.134	0.006
	(0.267)	(0.180)	(0.313)	(0.071)
Sales	−0.291	−0.125	0.091	−0.052
	(0.273)	(0.193)	(0.332)	(0.076)
Operative	−0.733***	−0.393**	−0.068	−0.194***
	(0.253)	(0.167)	(0.293)	(0.067)
Elementary	−1.171***	−0.326*	0.166	−0.189***
	(0.244)	(0.167)	(0.291)	(0.067)
East Midlands	−0.667**	−0.013	−0.114	−0.054
	(0.266)	(0.179)	(0.309)	(0.070)
East of England	−1.012***	−0.378**	−0.283	−0.222***
	(0.248)	(0.164)	(0.280)	(0.064)
London	−0.274	−0.087	−0.164	−0.055
	(0.246)	(0.166)	(0.284)	(0.065)
North East	−0.780***	0.253	0.399	−0.023
	(0.298)	(0.205)	(0.351)	(0.080)
North West	−0.134	−0.049	−0.054	−0.018
	(0.249)	(0.167)	(0.285)	(0.065)
Scotland	−0.191	−0.700***	−0.535*	−0.166**
	(0.265)	(0.172)	(0.294)	(0.067)
South East	−0.486**	−0.030	−0.163	−0.091
	(0.243)	(0.162)	(0.279)	(0.064)
South West	−0.098	0.103	0.069	0.010
	(0.259)	(0.174)	(0.299)	(0.068)
Wales (base)	–	–	–	–
	(−)	(−)	(−)	(−)
West Midlands	−0.505*	0.078	0.072	−0.044
	(0.259)	(0.172)	(0.296)	(0.068)
Yorkshire and Humber	−0.296	−0.089	−0.349	−0.075
	(0.256)	(0.170)	(0.290)	(0.066)
Agriculture	−2.225**	−0.225	−1.667*	−0.362*
	(0.911)	(0.550)	(0.945)	(0.216)

(*Continued*)

TABLE A3
Continued

	Generation of innovative ideas (1)	*Action to innovate (2)*	*Employees' self-assessment of innovative contribution (3)*	*Innovative jobs index (4)*
Mining	0.727	−0.026	−0.071	0.154
	(0.686)	(0.428)	(0.736)	(0.168)
Manufacturing (base)	–	–	–	–
	(–)	(–)	(–)	(–)
Electricity and gas	0.143	−0.277	−0.119	−0.038
	(0.595)	(0.391)	(0.671)	(0.153)
Water supply	0.415	0.087	−0.780	−0.077
	(0.752)	(0.563)	(1.049)	(0.239)
Construction	−0.144	−0.026	−0.644**	−0.057
	(0.244)	(0.159)	(0.278)	(0.064)
Wholesale and retail	−0.408**	0.003	−0.464*	−0.067
	(0.201)	(0.140)	(0.243)	(0.055)
Transportation	−0.230	−0.172	0.016	−0.010
	(0.241)	(0.160)	(0.274)	(0.063)
Accommodation and food	−0.341	0.030	0.131	−0.090
	(0.276)	(0.190)	(0.332)	(0.076)
Information and communications	0.431	−0.027	−0.023	0.094
	(0.271)	(0.202)	(0.352)	(0.080)
Finance	−0.005	−0.119	−0.787**	−0.109
	(0.267)	(0.186)	(0.329)	(0.076)
Real estate	−0.315	0.302	−0.302	−0.073
	(0.427)	(0.336)	(0.577)	(0.132)
Professional and scientific	−0.131	0.142	0.081	0.053
	(0.242)	(0.170)	(0.292)	(0.067)
Administrative support	−0.303	−0.171	−0.310	−0.056
	(0.248)	(0.191)	(0.322)	(0.073)
Public administration	−0.030	−0.145	−0.012	0.008
	(0.247)	(0.165)	(0.287)	(0.066)
Education	0.103	−0.104	0.151	0.023
	(0.230)	(0.155)	(0.269)	(0.061)
Arts and entertainment	0.159	0.001	0.319	0.074
	(0.203)	(0.138)	(0.239)	(0.055)
Other services	−0.815**	0.047	−0.648	−0.104
	(0.383)	(0.243)	(0.418)	(0.095)
Extraterritorial	−0.197	1.482**	−1.119	0.156
	(1.205)	(0.643)	(1.105)	(0.252)
Establishment size	0.000	−0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Establishment size squared	−0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Extraverted (0–7 scale)	0.054*	−0.008	−0.023	0.004
	(0.032)	(0.022)	(0.038)	(0.009)
Agreeable (0–7 scale)	−0.085***	−0.073***	0.022	−0.018**
	(0.031)	(0.021)	(0.036)	(0.008)
Conscientious (0–7 scale)	0.088**	0.009	−0.022	0.002
	(0.037)	(0.025)	(0.042)	(0.010)

(*Continued*)

TABLE A3
Continued

	Generation of innovative ideas (1)	*Action to innovate (2)*	*Employees' self-assessment of innovative contribution (3)*	*Innovative jobs index (4)*
Emotional (0–7 scale)	0.099**	0.024	0.090*	0.023**
	(0.042)	(0.028)	(0.048)	(0.011)
Openness (0–7 scale)	0.117***	0.066***	0.053	0.024***
	(0.033)	(0.023)	(0.039)	(0.009)
Constant	6.450***	2.761***	2.290**	−0.348
	(0.773)	(0.552)	(0.948)	(0.217)
R^2	0.40	0.34	0.44	0.56
N	2,245	1,390	1,372	1,367

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.