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Timothy Fry, Rebecca Rawson, Uchechukwu Okere

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How the mitigation of environmental impacts affect economic performance in UK manufacturing and construction companies

Timothy Fry, Rebecca Rawson and
Uchechukwu Okere*

University of Derby,
Kedleston Road, Derby, DE22 1GB, UK
Email: tim.fry@cadsltd.co.uk
Email: r.rawson@derby.ac.uk
Email: u.okere@derby.ac.uk
*Corresponding author

Abstract: Manufacturing and construction (M&C) companies cause significant environmental impacts and are under pressure to act. Despite research analysing the relationship between environmental impact mitigation (EIM) and economic performance (EP), findings remain inconclusive. Acknowledging the longevity of the M&C sector, and the uptake of ISO 14001 in UK companies, there is a lack of research analysing this relationship. Research has predominantly used dichotomous measurements for EIM, yet this fails to consider the substantiveness of the approach. This paper develops a multifaceted scoring system to measure the substantiveness of a company's approach to EIM. Using a sample of 58 UK-based publicly-listed M&C companies, the measurement analyses how a substantive approach to EIM affects EP. Correlational tests showed a medium, positive relationship. This implies companies may not need to choose between EIM and profit. The findings and the multifaceted measurement developed have implications for research, stakeholders, and high-level leadership teams.

Keywords: environmental impact mitigation; EIM; economic performance; manufacturing; construction; sustainability; multifaceted scoring system; return on assets; female leadership; carbon disclosure project; CDP; corporate purpose and values; ISO 14001; UK.

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Biographical notes: Timothy Fry is a Development Manager and Sustainability Lead for a property development company. He studied sustainability and environmental management at the University of Derby. It was here he developed an interest in identifying win-win outcomes for business and the environment, as well as low-carbon building design, embodied carbon reduction within construction and optimising efficiency utilising technology.

Rebecca Rawson is a Senior Lecturer in Sustainability and Environmental Management at the University of Derby. She has taught environmental management and geography at foundation, undergraduate and postgraduate

levels for over ten years. Her current research interests include environmental management and sustainable development in practice and environmental sustainability education.

Uchechukwu Okere is Academic Lead in Environmental Management at University of Derby. His research background is in environmental microbiology and ecotoxicology. For his PhD, he investigated the interactions between microorganisms and polycyclic aromatic hydrocarbons (PAHs) in pristine soil environments. Dr Okere currently researches environmental management within organisations and the development of tools and approaches for embedding sustainability in academic curricular and professional trainings.

1 Introduction

Achieving the United Nations (UN) Sustainable Development Goals (SDG) requires balancing economic, social and environmental objectives (UN, 2022). Yet, many businesses, especially those in manufacturing and construction (M&C), have significant adverse environmental impacts (Calero *et al.*, 2021). Paradoxically, a degrading environment presents risks, challenges and costs for businesses. Indeed, it has been estimated that \$44 trillion of global economic value is dependent on ecosystem services (World Economic Forum, 2020), with delayed environmental action increasing risks and financial costs (Furman, 2015). This, plus stakeholder pressure (EY Global, 2020; Wang *et al.*, 2020; Deloitte, 2021; Neate, 2022; Holden, 2022), has made environmental impact mitigation (EIM) a priority for high-level leadership teams (Zhang and Ma, 2021). Consequently, companies are utilising EIM tools, such as International Organization for Standardization (ISO) 14001. With global certifications at almost 350,000 across 170 countries, M&C companies are the largest adopters of ISO 14001 and the UK is within the top five countries for the total number of certifications (ISO, 2021). The key objective of ISO 14001 is to aid companies to identify, manage, monitor and control their environmental impacts through a process of continual improvement (ISO, 2015a). Yet, despite the widespread and increasing adoption of EIM tools (Hojnik and Ruzzier, 2017), the economic impact of adoption remains under debate (Boiral *et al.*, 2018; Sartor *et al.*, 2019; Waxin *et al.*, 2020; Erauskin-Tolosa *et al.*, 2020).

A robust and reliable economic performance (EP) is fundamental to a company's sustainable growth and employee job security (Moizer, 2015). Yet, despite the abundance of research analysing the relationship between EIM and EP, the findings are inconclusive (Boiral *et al.*, 2018; Reis *et al.*, 2018; Sartor *et al.*, 2019). Some researchers identified a positive relationship (Arocena *et al.*, 2020; Wu *et al.*, 2020; Zhang and Ma, 2021), some found a negative relationship (Delmas *et al.*, 2015; Hazudin *et al.*, 2015) and others an insignificant relationship (He *et al.*, 2015). Also, despite the vast industry experience and high uptake of ISO 14001 in the UK (Brain, 2019), there is a paucity of research analysing how EIM affects EP in UK M&C companies.

Despite the risks businesses face from a degrading environment, Heras-Saizarbitoria *et al.* (2016) found that almost half of high-level leadership teams expressed serious doubts about continuing ISO 14001 certification in a period of economic crisis. So, considering the adverse economic effects as a result of COVID-19 (Harari and Keep, 2021), the current state of the UK's economy (Islam, 2022), and the inconclusive

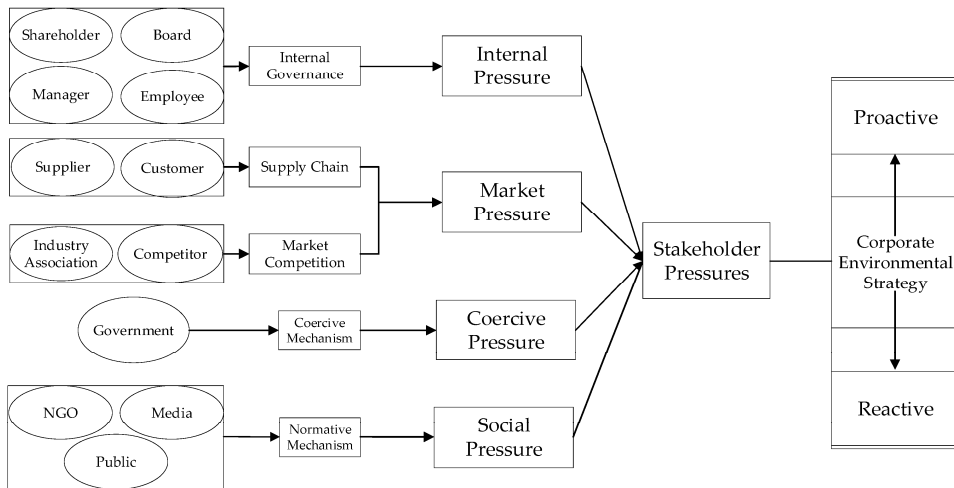
understanding of how EIM affects EP, there could be an increase in companies avoiding certification or recertification and ultimately delaying the urgent action required for environmental protection (Furman, 2015).

ISO 14001 does not require specific levels of environmental performance (EnP), allowing the company to choose the degree of integration (Comoglio and Botta, 2012). Some companies have been attracted to the potential to enhance production efficiency through substantive integration (Russo, 2009), whereas others may adopt it symbolically for external legitimacy, leading to superficial integration (Aravind and Christmann, 2011; Castka and Prajogo, 2013; Ferrón Vilchez, 2017). However, symbolic adoption has been found to produce an EnP comparable to non-certified companies (Aravind and Christmann, 2011), risking confidence in EIM tools (Ferrón Vilchez, 2017). Previous research has predominantly used a dichotomous measurement for EIM (i.e., 'ISO 14001 certified' and 'not certified') (Boiral et al., 2018; Sartor et al., 2019; Erauskin-Tolosa et al., 2020; Aragón-Correa et al., 2020), despite the awareness of varying approaches to implementation (Ferrón Vilchez, 2017; de Junguito and Allur, 2019; Arocena et al., 2020; Zhang and Ma, 2021). Thus, it is postulated that the use of inadequate measurements in prior research may be a contributing factor to the inconsistent conclusions. To achieve a conclusive understanding of how EIM affects EP, a more holistic measurement must be used (Arocena et al., 2020; Zhang and Ma, 2021). The aim of this paper is therefore to develop a multifaceted measurement to better determine how EIM is implemented, and then use it to assess how EIM affects EP in UK-based M&C companies.

2 Literature review

While Adebajo et al. (2016) found EIM tools did not improve manufacturing performance, multiple studies contradict this, finding an improvement in operational processes, enhanced efficiency and reduced operating costs (Lo et al., 2012; Waxin et al., 2020; Camilleri, 2022). Considering this, and the financial benefits of strong stakeholder relationships (Chiarini, 2019; De Mendonca and Zhou, 2019; Neate, 2022), it would appear EIM may enhance EP. Yet, despite the high levels of ISO 14001 adoption (ISO, 2021), its effect on EP remains under debate (Boiral et al., 2018; Sartor et al., 2019; Arocena et al., 2020). As with broader research on EIM and EP, there have been inconsistent results when analysing how ISO 14001 affects a company's ability to generate profits. Results have either been insignificant (Heras-Saizarbitoria et al., 2011; He et al., 2015), negative (Delmas et al., 2015; Hazudin et al., 2015) or positive (de Jong et al., 2014; Qi et al., 2014; Qian and Xing, 2016; Lee et al., 2017; Arocena et al., 2020; Wu et al., 2020; Zhang and Ma, 2021), with stronger positive relationships when public environmental awareness is higher (Arocena et al., 2020; Wu et al., 2020). Likewise, when using cumulative stock market returns as an alternative measurement for EP, the findings were equally varied, with insignificant (El-Mohr et al., 2021), negative (Paulraj and de Jong, 2011), and positive (Delmas et al., 2015; Lee et al., 2017) relationships.

Stakeholders are increasingly expecting companies to be accountable for their sustainability credentials (Holden, 2022; D'Angelo et al., 2023). Wang et al. (2020) explored the relationship between stakeholder pressure and EIM and found that all classifications of pressure (Figure 1) had a positive effect on EIM, with internal stakeholders, and specifically shareholders, being the main drivers.

Figure 1 The classifications of stakeholder pressures to mitigate environmental impacts

Source: Wang et al. (2020)

Corroborating this is the carbon disclosure project (CDP), which was created by investors to encourage disclosure of environmental data and enhance action on climate change (Dickinson, 2020). However, when measuring UK shareholders' responses to companies voluntarily disclosing environmental data, although Alsaifi et al. (2020) identified a positive reaction between 2007 and 2008, they found a negative reaction between 2009 and 2015. Interviews with senior executives at 43 of the world's largest institutional investment firms, however, found that environmental, social, and governance was a top priority (Eccles and Klimenko, 2019). Verifying this is 91% of Boeing's shareholders pressuring the company to detail stronger pathways and targets for net-zero (George, 2022). Furthermore, British climate activist and philanthropist Sir Christopher Hohn promised to use his company's \$44bn of investments to 'force change' (Neate, 2022). Interestingly, while Buallay et al. (2020) found that corporate social responsibility disclosure can negatively affect market performance, in 2021, Hohn's hedge fund had the best performance, achieving a 23.3% gain – more than double the 10.5% average of the top 20 that year (Neate, 2022). Plus, it is anticipated that as the younger and more sustainability-conscious generations accumulate and inherit financial wealth, demand and pressure for sustainable investments will increase (EY Global, 2020).

Mosgaard and Kristensen (2020) found some Danish companies had discontinued ISO 14001 certification due to a lack of interest from customers, a contrasting finding to Wang et al. (2020), who reported customers to be the largest external source of pressure. Intriguingly, the research from Wang et al. was conducted before COVID-19, and while Rousseau and Deschacht (2020) found awareness of environmental topics within Europe remained unchanged during the pandemic, others anticipated it would increase sustainability-minded consumption (Cohen, 2020; Wen et al., 2021). This was corroborated by a survey which found 28% of consumers refrained from buying particular products as a result of ethical or environmental concerns, and of the Generation Z surveyed, 45% had turned their backs on a brand which fails to meet their sustainability expectations (Deloitte, 2021). This is compared to a survey before COVID-19 where Generation Z was the demographic least engaged with environmental issues (Deloitte,

2020). So, with customer satisfaction being crucial for long-term profitability (De Mendonca and Zhou, 2019), failure to appease customers' environmental concerns could have significant economic implications.

With environmental awareness and stakeholder pressure varying by country (Arocena et al., 2020; Orcos et al., 2018), it is important to understand how EIM can affect EP in specific countries. As the birthplace of the industrial revolution, the UK has substantial experience in M&C, which are the sectors with the most ISO 14001 certifications (ISO, 2021). Yet, despite the UK's relatively high ISO 14001 uptake (ISO, 2021) and M&C experience, the limited research analysing the relationship between EIM and EP is particularly concerning considering the increasing coercive pressure on UK companies (NetZeroCarbon, 2021; Holden, 2022). Indeed, for UK manufacturing companies, just one study was found. Treacy et al. (2019) measured EP before and after ISO 14001 certification and found a positive effect on EP. A strength of this study was that it compares EP of both certified and non-certified companies to accurately identify abnormal performance. However, the measurement was dichotomous and failed to consider the company's approach to implementation. Comparing this positive finding to other countries, it contradicts a study of Chinese manufacturing companies (He et al., 2015), but concurs with studies in America (de Jong et al., 2014), Indonesia (Manurung and Rachmat, 2019), Japan (Fujii et al., 2012) and Pakistan (Wu et al., 2020; Ahmad et al., 2021). For UK construction companies, one study was also found. Bailey et al. (2020) explored the perceived effects of ISO 14001 in 49 small and medium companies and found the cost saving benefits were frequently negated by certification costs; a finding that has been recognised as a reason for decertification (Mosgaard and Kristensen, 2020). These findings also corroborate with other research suggesting the availability of resources in larger companies can enable greater economic benefits (Boiral et al., 2018; Sartor et al., 2019; Arocena et al., 2020). The findings by Bailey et al. (2020) are also corroborated by Chiarini (2019) but for medium and large construction companies in Italy, however, Chiarini (2019) contradicts the narrative that larger companies can achieve greater economic benefits. Furthermore, Bailey et al. (2020) did not use an official database to measure EP, as recommended by Boiral et al. (2018), instead collecting the subjective opinion of someone whose position was unknown. These are considered limitations as Comoglio and Botta (2012) conclude few firms quantify the benefits of EIM potentially limiting the accuracy and reliability of the findings. Consequently, to better understand how EIM affects EP in UK M&C companies further research is needed. With the relationship between EIM and EP still inconclusive, it could be argued the rising adoption of ISO 14001 is due to stakeholder pressure.

There are various reasons a company would adopt an EIM tool which results in different approaches to implementation. For example, a company seeking to increase their corporate image and sales may be prone to a symbolic approach to appease stakeholders while avoiding implementation costs (Castka and Prajogo, 2013; Boiral et al., 2018). Whilst a company seeking cost-savings and improved operational efficiency may take a substantive and integrated approach (Russo, 2009). Yet, while a substantive approach can improve EnP (Aravind and Christmann, 2011; Boiral et al., 2018; Erauskin-Tolosa et al., 2020), a symbolic approach generates weak improvements (Aravind and Christmann, 2011; Ferrón Vilchez, 2017), increasing the burden on the environment and reducing confidence in EIM tools (Ferrón Vilchez, 2017). Ultimately, how the EIM tool is implemented impacts its effectiveness. So, to understand how EIM truly affects EP, the company's approach to EIM must be measured.

Research has however, predominantly used a dichotomous measurement for ISO 14001 (Ferrón Vilchez, 2017; Boiral et al., 2018; Sartor et al., 2019; Aragón-Correa et al., 2020; Erauskin-Tolosa et al., 2020) and while this is useful when dealing with large samples, it fails to consider whether a company takes a symbolic or substantive approach. This assumes equal implementation which is not the reality (Ferrón Vilchez, 2017; de Junguitu and Allur, 2019; Zhang and Ma, 2021). Therefore, a dichotomous measurement is insufficient, and it could be argued that this may be a contributing factor to the inconsistent findings on the relationship between EIM and EP. Acknowledging the various approaches to EIM, some studies have developed measurements to assess this. However, there is a lack of uniformity preventing accurate comparison, and feasibility constraints which limits sample size. Iatridis and Kesidou (2018) interviewed companies to explore the ISO 14001 Plan-Do-Check-Act cycle, but interviewing limits the sample size, is subjective and may be influenced by social desirability bias. Zhang and Ma (2021) read two annual reports for each company subjectively assessing the depth of implementation using a scoring system, however, this is time-consuming, and the scoring system details are absent. A meta-analysis by Erauskin-Tolosa et al. (2020) found researchers had used the duration of certification as a measure for a substantive approach to EIM, however, their findings did not support experience as an indicator of greater EnP. Arocena et al. (2020) used the percentage of facilities certified to ISO 14001 as a quick and non-subjective measurement. This works with large samples when using a unified database, provides more insight and accuracy and more closely reflects how substantively the standard is implemented. However, all these measurements fail to consider the presence of key success factors, such as employee commitment and environmental leadership (EL) (Chiarini, 2019; Waxin et al., 2020).

EL is “a process in which, inspired by their own personal values, leaders strive to influence others at all levels of the organization in an effort to benefit the natural environment” [Robertson and Barling, (2015), p.166], and has a positive impact on EIM (Su et al., 2020; Hameed et al., 2021; Rehman et al., 2021). This could be explained by its influence on employee commitment and pro-environmental behaviour (Robertson and Barling, 2013; Graves and Sarkis, 2018; Li et al., 2020; Hameed et al., 2021; Crucke et al., 2021; Wu et al., 2021; Xu et al., 2022), which is identified as a key success factor for effective EIM (Robertson and Barling, 2013; Waxin et al., 2020; Chen et al., 2020; Peng et al., 2021; Mouro and Duarte, 2021) as well as a significant obstacle to substantive implementation (Boiral et al., 2018). These findings explain why the ISO 14001:2015 revision has a strong focus on the commitment and accountability of leadership teams (ISO, 2015b).

Measurements for EL have, however, been inconsistent. Identifying a lack of a standard measurement, Zhang and Ma (2021) used the percentage of female board members, theorising that women generally view environmental and social issues more positively than men (Kabongo et al., 2013) and contribute to the promotion of environmental strategies (Glass et al., 2016; Shoham et al., 2017; Xie et al., 2020). While this measurement can help to understand the potential level of environmental consideration at board level, it is a single data point which fails to measure the actual exhibition of EL. Other studies have developed questionnaires (e.g., Robertson and Barling, 2013; Su et al., 2020; Xu et al., 2022), yet, although able to provide greater accuracy, there is a lack of standardisation and they are resource-intensive which limits the sample size. Therefore, the measurement proposed and used by Zhang and Ma (2021) would be considered current best practice for larger samples and when interviews or large

questionnaires are not feasible. However, because the true exhibition of EL is not measured, a multifaceted measurement would provide more accuracy.

The need to measure how EIM tools are implemented, and the absence of a uniform, feasible, accurate and multifaceted measurement, presents a research opportunity. With such a measurement applied moving forwards, it is postulated that research could generate more reliable and accurate results and a potentially conclusive understanding of how EIM affects EP.

3 Methodology

3.1 Sampling

The target population for this study was UK-based M&C companies. The eligibility criteria and the rationale is outlined in Table 1. A simple random sampling method was adopted to remove selection bias. The sample would ideally have been identified using UK SIC codes, however, this was not feasible due to the lack of access to a unified database. Instead, filters were applied on the London Stock Exchange website removing sectors unrelated to M&C and companies listed after January 2016. The remaining 248 companies were then manually screened and companies with no obvious M&C operations or with non-UK headquarters also being removed. This gave an eligible sample of 117 UK-based M&C companies, publicly-listed before January 2016.

Table 1 A table of the eligibility criteria and the rationale for each

<i>Eligibility criteria</i>	<i>Rationale</i>
Companies with manufacturing or construction operations	- Limited research on UK M&C companies despite the vast industry experience and high certification to ISO 14001 (ISO, 2021). - M&C companies have significant environmental impacts (Calero et al., 2021) and are under pressure to mitigate them (Peakon, 2020; Neate, 2022), but how EIM affects EP is inconclusive.
Listed on the London Stock Exchange before January 2016	- Public companies were recently mandated to provide net-zero plans by 2023 (Holden, 2022), but with limited understanding of how this may affect EP. - Access to five years of regulated economic data. - Observing five years of data provides an understanding of economic effects over time and avoids potential anomalies from external and unrelated factors.
UK-based Headquarters	High-level leadership teams of multinational companies are typically dominated by country-of- origin nationals and are susceptible to the influence of home-country factors (McGahan and Victor, 2009; Arocena et al., 2020). To control for this, only companies with UK-based headquarters were eligible.

To conduct a regression analysis, Glen (2014) suggests at least 10–15 observations for each independent variable, but Green (1991) suggests a minimum sample size of 50, with 8 further observations per term. To meet these stricter requirements a sample of 58 companies was drawn from the 117 eligible companies using an online random generator (dCode, 2019). With disproportionate listings of M&C companies,

46 manufacturing companies and 12 construction companies were selected, representing 50% of the 117 identified as eligible for the study.

3.2 *Variable measurements and data collection*

3.2.1 *EP (return on assets)*

Table 2 outlines the measurement and data collection method used for each variable. Multiple measurements were considered for EP. First, because publicly-listed companies were used, cumulative stock market performance was a viable option and has been used previously (Paulraj and de Jong, 2011; El-Mohr et al., 2021). Plus, the effect ISO 14001 has on stock market performance remains a knowledge gap (Sartor et al., 2019). However, this was disregarded as the stock market is frequently influenced by macroeconomic conditions and investor sentiment (Mohan et al., 2019; Mehta et al., 2021), which can result in using a measurement disassociated from the company's EP.

Table 2 The measurement and data collection method used for each variable

	<i>Measurement</i>	<i>Data collection</i>
Economic performance (EP)	Five-year mean ROA	AJ Bell Youinvest
Environmental impact mitigation (EIM)	Environmental impact mitigation score (EIMS)	Company websites and the CDP website

The second measurement and the one chosen for the study was return on assets (ROA) which measures a company's efficiency to generate profits from its assets. This has been the preferred measurement in prior research (e.g., de Jong et al., 2014; Qian and Xing, 2016; Lee et al., 2017; Riaz et al., 2019; Arocena et al., 2020; Wu et al., 2020; Zhang and Ma, 2021) which helps to compare findings. Plus, an improving ROA means a company is increasing its profitability which better reflects any operational efficiencies gained from substantive integration.

Rather than measuring how ROA in 2021 differed from 2017, the 5-year mean was used as it incorporates each year's performance, increasing the accuracy of the measurement. Also, because the observation period spanned the peak of COVID-19, it offers insight into companies' economic resilience during a period of economic crisis and provides contributions to research in this field. The economic data used to calculate the 5-year mean ROA was collected from the AJ Bell Youinvest website due to the reliability and accuracy of the database.

3.2.2 *Environmental impact mitigation*

There are many ways a company can approach EIM. So, to accurately understand how EIM affects EP, a more holistic measurement is needed. It is theorised that the previous single-faceted measurements are a contributing factor to the inconclusive findings on this relationship. This research develops a multifaceted measurement, better able to measure key success factors for effective EIM. Four research-backed items have been used to establish a scoring system to provide an EIM score (EIMS) for each company (Figure 2). All data was able to be collected online without a questionnaire, which was important for achieving the required sample size. Weighted arithmetic means were used to reflect the expected strength of each item in demonstrating a substantive approach to EIM.

Figure 2 The scoring system used for each item and the weighted arithmetic mean for the EIMS equation (see online version for colours)

CDP Score (2021)		CPD 5-year Change ('17-'21)*		Females on Board (%)		Purpose and Values	
Result	Score	Result	Score	Result	Score	Result	Score
A / A-	100	3	100	50+	100	In both	100
B / B-	80	2	60	40-49	80	In one	50
C / C-	60	1	40	30-39	60	None	0
D / D-	40	0	0	20-29	40		
F	0	<-1	-20	0-19	0		
EIMS Weighting							
20.0%		25.0%		15.0%		40%	

Note: Additional 50 points awarded if A is maintained from 2017 to 2021.

Percentage of female board members

Research has identified a clear relationship between EL and effective EIM (Chiarini, 2019; Su et al., 2020; Hameed et al., 2021; Rehman et al., 2021; Zhang and Ma, 2021). There have been various measurements for EL, though they have mainly been based on detailed questionnaires (Robertson, 2017; Su et al., 2020). While this could offer greater accuracy, it significantly limits the sample size. Therefore, the EIMS uses the percentage of female board members, as used by Zhang and Ma (2021). They theorised that women generally have a more positive view of ethical issues and are more receptive to environmental and social issues (Kabongo et al., 2013). This explains why having females on the board is key to effective EIM (Robertson and Barling, 2013; Xie et al., 2020). This is also supported by Ben-Amar et al. (2017) who found a higher percentage of female board members increased the likelihood of disclosure of environmental data. Therefore, although this may not be as accurate as a detailed questionnaire, it provides a research-backed and easily accessible measurement. For publicly-listed companies, this item can be calculated from the company's website. As shown in Figure 2, if more than 50% of the board is female they are awarded 100 points, 80 for 40–49%, 60 for 30–39% 40 for 20–29% and 0 if under 20%.

Purpose and values

A company's purpose has been referred to as its 'North Star', guiding both short- and long-term decision-making throughout a company [EY Global, (2016), p.20]. A company's values are the foundation of its culture, outlining the expected behaviours and attitudes needed to achieve its vision (Coleman, 2013). Therefore, purpose and values act as regular reference points and inspiration for employees. So, what high-level leadership decide to incorporate into these demonstrates their intended direction, approach and commitment. Both employee and high-level leadership commitment are key success factors for EIM (Chiarini, 2019; Waxin et al., 2019). It is theorised that referencing EIM or environmental improvement within the company's purpose and/or values would establish a culture of pro-environmental behaviour and provide the conditions for successful EIM (Robertson and Barling, 2013; Chiarini, 2019; Waxin et al., 2020; Mouro and Duarte, 2021). However, it should be acknowledged that a lack of reference to this may not reflect a weak approach to EIM. This further demonstrates the importance of a multifaceted measurement. To reflect this, the scoring system does not deduct points for companies with no reference. A company is awarded 100 points if EIM is referenced in

both its purpose and values, and 50 if referenced in one. Data for this was gathered directly from the company's website.

CDP scores

The CDP (2022a) is a platform for companies to disclose their environmental impacts annually, with a score provided for each, from A to D-. It requires those who disclose to measure specific EnP data and is based on the principle that what gets measured, gets managed (Dickinson, 2020). The score is calculated from a comprehensive questionnaire including a company's understanding of risks and opportunities, environmental targets and breakdown of performance (CDP, 2022b). A CDP score is a better measure of a company's approach to EIM than its annual report as it uses the reported data to issue a single score, but it can also be more accurate. For example, Depoers et al. (2016) found that emission disclosures to the CDP were higher than in the annual reports. A limitation of this measurement is that CDP scores are only calculated based on three environmental topics. So, if a company's material environmental impacts, and therefore focus and resource allocation, are based on a different environmental topic, e.g., land degradation, this could lead to inaccurate conclusions about a company's approach to EIM. While this could be one of the reasons that almost 17,000 companies still fail to disclose their environmental data (CDP, 2021), the lack of submission could also indicate a weak approach to EIM. Ultimately, the reason why a company chooses to not disclose is unknown and therefore cannot be accounted for. Also, the fact that not all companies are approached to submit data limits the use of this as a standalone measurement, again justifying the need for a multifaceted measurement.

For this research, the climate change topic was chosen as it is considered the most pressing environmental challenge (UN, 2021), and carbon emissions are a material environmental impact of M&C companies (Calero et al., 2021). The score is updated annually presenting the opportunity for two measurements with both providing a valuable insight into how a company approaches EIM. First, the most recent score shows how a company is currently performing. A company given an A/A- is awarded 100 points, B/B- = 80 points, C/C- = 60 points, D/D- = 40 points and F = 0 points. The second measurement is how the CDP score has changed over 5 years. This shows the direction and pace the company is moving. If a company improved by 3 or more scores (e.g., C to A-) they are awarded 100 points, 60 points for 2 scores, 40 points for 1, 0 points for no change and -20 points if the company has been downgraded. Also, if a company achieved an A in 2017 and maintained it to 2021, they were awarded 50 points.

EIMS calculation

The following equation was used to calculate the EIMS:

$$\text{EIMS} = \frac{(\text{CPD Score} * 20\%) + (\text{CPD 5-year Change} * 25\%) + (\text{Females on Board} * 15\%) + (\text{Purpose \& Values} * 40\%)}{100}$$

The percentage of female board members has the lowest weight as it fails to measure the exhibition of actual EL. The CDP 2021 score was next as it provides a snapshot of the company's EnP. The 5-year change in CDP score, however, demonstrates the direction and rate a company is moving for EIM which is considered a stronger indication of their

approach to EIM, compared to the 1 year snapshot. The CDP scores provide the most rigorous insight into a company's approach to EIM as it is based on comprehensive and measured EnP data. Therefore, the combined total of the CDP scores was given the highest weight. However, the single highest weighted item was referencing EIM in the company's purpose and values. This was because it demonstrates the intention and commitment of high-level leadership to embed a culture of EIM and the likelihood of pro-environmental employee behaviour which are crucial for effective EIM (Robertson and Barling, 2013; Graves and Sarkis, 2018; Waxin et al., 2020; Peng et al., 2021), particularly in M&C companies (Chiarini, 2019; Chen et al., 2020). Furthermore, a company's purpose and values are the guiding light for everyday decision making for employees throughout the business. Collectively, this would amount to much greater impacts than decisions made by board members.

3.3 Statistical analysis

Once the data was collected, DataTab (2022) was used to produce the descriptive statistics and conduct the normal distribution tests and correlation analysis. Because the data for EP did not meet the assumption of normal distribution, the regression analysis was unable to be conducted. Correlation analysis was conducted on EIM and EP as a combined sample as well as by sector. Correlation analysis was also carried out to understand how each item was associated with EP. Finally, the relationships between the EIMS items were analysed to understand how strength in one item is linked to another.

4 Results

4.1 Descriptive statistics and normality test

The means, standard deviations and normal distribution test results are shown in Table 3. When checking for normality in the data, as recommended for samples over 50 the Kolmogorov-Smirnov (Lilliefors Correction) was performed, for samples under 50 a Shapiro-Wilk test was performed (Mishra et al., 2019; Glen, 2022).

4.2 Correlational analysis

4.2.1 EIM and EP (combined)

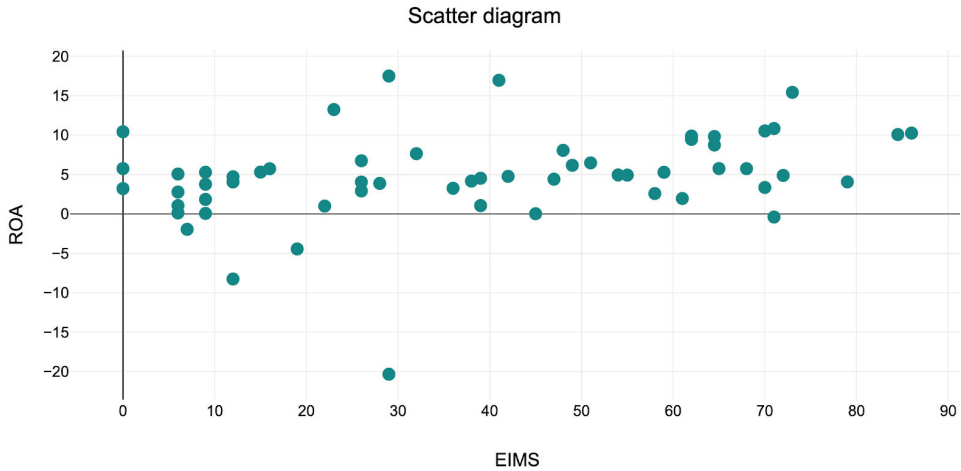
A visual representation of the relationship between EIMS and EP was observed in the form of a scatter diagram which suggested a potentially positive relationship (Figure 3). Because the EP data is not normally distributed the nonparametric Spearman's rank correlation was performed to confirm a relationship. The results showed a medium, positive relationship between the two variables ($r(56) = 0.383$) (Table 4). Also, with the p-value less than the 0.05 significance level ($p = 0.003$), the correlation was deemed statistically significant.

Table 3 Means, standard deviations and normality test results of the studied variables

<i>Variables</i>	<i>N</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>Normality test (p-value)</i>
EIMS	58	38.25	25.4	0.090 ^a
EP	58	4.81	5.75	0.025 ^a
Manufacturing EIMS	46	37.57	27.06	0.003 ^b
Construction EIMS	12	40.88	18.35	0.700 ^b
Manufacturing EP	46	4.26	5.93	< 0.001 ^b
Construction EP	12	6	4.61	0.280 ^b
CDP 2021	58	52.07	39.81	< 0.001 ^a
CDP 5-year change	58	24.31	38.03	< 0.001 ^a
Females on board	58	60	24.28	< 0.001 ^a
Purpose and values	58	31.9	33.37	< 0.001 ^a

Notes: ^aKolmogorov-Smirnov (Lilliefors correction), ^bShapiro-Wilk;
Abbreviations: EIMS = environmental impact mitigation score;
EP = economic performance; CDP = carbon disclosure project.
The same for below.

Figure 3 A scatter diagram illustrating the relationship between EIMS and ROA (see online version for colours)



Source: DataTab (2022)

Table 4 The correlation coefficients between EIMS and EP (combined and by sector)

	<i>N</i>	<i>CDP 2021</i>	<i>CDP change</i>	<i>Females on board</i>	<i>Purpose and values</i>	<i>EP</i>
CDP 2021	58	1.000				
CDP change	58	0.589	1.000			
Females on board	58	0.234	0.080	1.000		
Purpose and values	58	0.515	0.338	0.221	1.000	
EP	58	0.295	0.202	0.214	0.352	1.000

Notes: ^aSpearman correlation, ^bPearson correlation.
*Significant at 0.05 (two-tailed). **Significant at 0.01 (two-tailed).

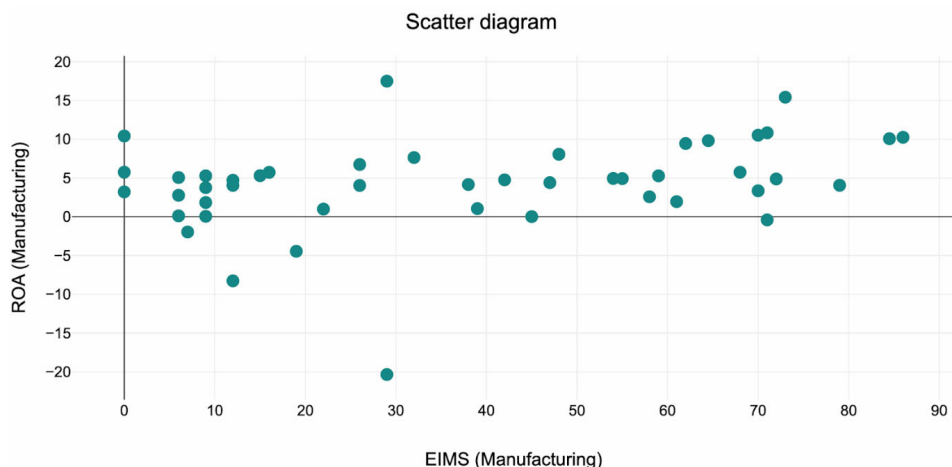
4.2.2 EIM and EP (by sector)

Correlation analysis was repeated for each sector (Table 5). In the manufacturing sample, neither variable was normally distributed (Table 4), and therefore a Spearman's rank correlation was performed. As illustrated in Figure 4, the results also showed a medium positive correlation ($r(44) = 0.334$) (Table 5), also statistically significant at the 0.05 level ($p = 0.023$). In the construction sample, both variables were normally distributed (Table 4), allowing for a Pearson correlation to be performed. Illustrated in Figure 5, the results showed a medium positive correlation ($r(10) = 0.302$) (Table 5), however this was not found to be statistically significant ($p = 0.340$).

Table 5 The correlation coefficients between each EIMS item and with EP

	<i>N</i>	<i>CDP 2021</i>	<i>CDP Change</i>	<i>Females on board</i>	<i>Purpose and values</i>	<i>EP</i>
CDP 2021	58	1.000				
CDP change	58	0.589	1.000			
Females on board	58	0.234	0.080	1.000		
Purpose and values	58	0.515	0.338	0.221	1.000	
EP	58	0.295	0.202	0.214	0.352	1.000

Figure 4 A scatter diagram presenting the relationship between EIMS and EP in manufacturing companies (see online version for colours)

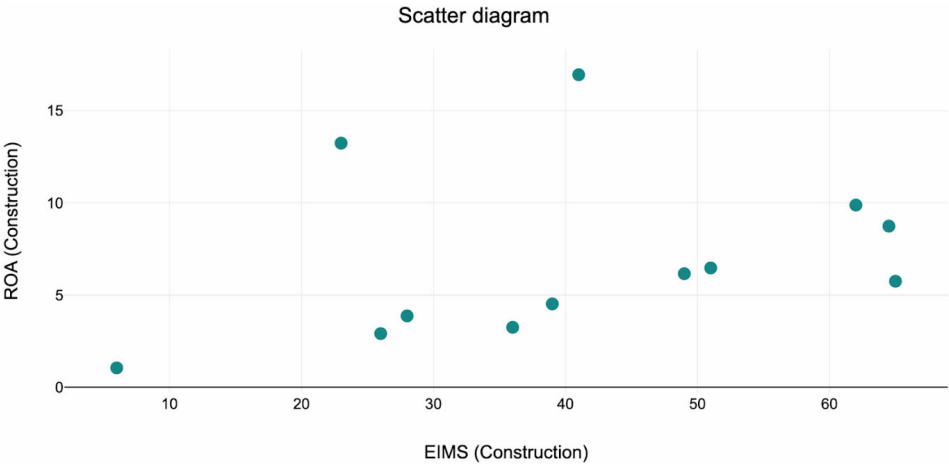


Source: DataTab (2022)

4.2.3 EIM and EP (by EIMS item)

Further analysis was carried out to see how each EIMS item correlated with EP. A Spearman's rank correlation was conducted due the presence of ordinal data and found that all items had a positive association with EP (Table 5). Purpose and values and CDP 2021 had the strongest association with EP while CDP Change and females on the board had the lowest correlation.

Figure 5 A scatter diagram presenting the relationship between EIMS and EP in construction companies (see online version for colours)



Source: DataTab (2022)

4.2.4 Between the EIMS items

The correlation between the EIMS items was also performed (Table 5) and found that all relationships were positive. CDP 2021 and CDP change had the strongest correlation ($r(56) = .589$). A noteworthy finding is that purpose and values had a high, positive correlation with CDP 2021 score ($r(56) = 0.515$) and a medium positive correlation with the CDP change ($r(56) = 0.338$). The percentage of females on the board had the lowest correlations with all items.

4.2.5 Summary

The results found a positive relationship between EIM and EP in both sectors, with a statistically significant result in the manufacturing sample. While all the EIMS items had a positive correlation with ROA, purpose and values had the strongest correlation. Plus, the percentage of females on the board had the lowest correlation with the other EIMS items.

5 Discussion

5.1 EIM and EP

The main finding in this study is that a substantive approach to EIM has a positive correlation with EP (Table 4). This is in line with prior studies (Qian and Xing, 2016; Lee et al., 2017; Arocena et al., 2020; Wu et al., 2020; Zhang and Ma, 2021), but, as expected considering the inconsistency in findings, it contradicts others (Heras-Saizarbitoria et al., 2011; He et al., 2015; Delmas et al., 2015; Hazudin et al., 2015). When comparing the findings with other studies which also measured a company’s approach to EIM, the findings substantiate those by both Arocena et al.

(2020) and Zhang and Ma (2021). Therefore, to the authors' knowledge, the findings in all three studies which have considered how a substantive approach to EIM affects EP have been consistently positive. It is argued that because the measurements used in these studies more accurately measure the variable, these conclusions are also more accurate.

It should be noted the observation period spans an unusually challenging economic period caused by of COVID-19, which impacted businesses in varying ways (Harari and Keep, 2021). This could affect the generalisability of the findings to normal economic conditions. However, it also provides valuable insight on EIM and economic resilience during a global economic downturn, which to the authors' knowledge is a first in the literature. While Heras-Saizarbitoria et al. (2016) found high-level leadership teams had questioned the importance of EIM during an economic crisis, these findings suggest a more substantive approach to EIM can provide greater economic resilience. This also corroborates findings from Alsaifi et al. (2020) that UK investors reacted positively to voluntary disclosure of environmental data during the 2007–2008 financial crisis. Yet, while these findings are promising, correlation does not imply causation and factors could influence this finding (e.g., financial balance sheet health, level of free cash flow, type of products being manufactured, impact from COVID-19, etc.).

In the manufacturing sample, a medium positive relationship was found between EIM and EP (Table 4), suggesting UK manufacturing companies taking a substantive approach to EIM have better EP. This contradicts a study of Chinese manufacturing companies, in which He et al. (2015) identified the cost of implementing EIM tools negated improvements in sales. However, the positive relationship found in this paper supports findings in American (de Jong et al., 2014), Indonesian (Manurung and Rachmat, 2019), Japanese (Fujii et al., 2012) and Pakistani manufacturing companies (Wu et al., 2020; Ahmad et al., 2021). The other study analysing this relationship in UK manufacturing companies was by Treacy et al. (2019) who also identified a positive effect on profitability. A significant difference, however, is that Treacy et al. (2019) used a dichotomous measurement and therefore did not measure how EIM was approached. Therefore, this study's use of a multifaceted measurement offers a unique and encouraging first in literature, which is that a substantive approach to EIM in publicly-listed UK-based manufacturing companies is linked to stronger profitability.

The results for the construction sample also showed a medium positive relationship between EIM and EP (Table 4). However, due to the small sample size, the findings are not statistically significant and generalisations are limited. This positive relationship contradicts the findings by Bailey et al. (2020) on UK construction companies and Chiarini (2019) on Italian construction companies which both found economic benefits are frequently outweighed by implementation costs. A major difference between the studies is that instead of the interview and questionnaire approaches used by Bailey et al. (2020) and Chiarini (2019), the EIMS used unbiased secondary data as recommended by Boiral et al. (2018). Plus, the use of an official database to collect the data for EP provides greater accuracy. While the findings in this study are currently uncorroborated, the differences in methodology avoid the limitations of potential biases found in prior research and may therefore be judged to be more reliable.

The positive relationship between EIM and EP has several implications. The proposition that a substantive approach to EIM can positively affect EP in UK M&C companies suggesting the pursuit of environmental and economic objectives can be harmonious; an outcome concurred by Hart and Ahuja (1996). This is reassuring for businesses at risk of a degrading environment and for publicly-listed UK companies

which were recently mandated to develop net-zero plans by 2023 (Holden, 2022). This potential lack of conflict is also encouraging for the achievement of the SDGs. Additionally, having more substantive approaches to EIM would maintain confidence in EMS standards, which Ferrón Vélchez (2017) had raised concerns about.

5.2 *The EIMS measurement*

The results show that all EIMS items have a positive correlation with EP, with purpose and values and CDP 2021 score having the strongest correlations (Table 5). Referencing EIM within the company's purpose and values may be the strongest reflection of a substantive approach to EIM. However, another possibility, considering the potential of stakeholders to affect a company's EP (De Mendonca and Zhou, 2019; Neate, 2022), of the four EIMS items, a company's purpose and values and CDP score are arguably more visible, easily accessible, and frequently used by stakeholders to assess a company's approach to EIM. So, it may be that the companies referring to EIM in their purpose and values and those with a higher CDP score are satisfying stakeholders and being rewarded accordingly.

Correlation analysis between the EIMS items found all had either small or medium positive relationships (Table 5). For females on the board, the strongest relationship was with the CDP score which supports findings from Ben-Amar et al. (2017), that a higher percentage of females on the board increases the likelihood of carbon disclosure. However, surprisingly, the percentage of females on the board has the lowest correlation with all the EIMS items. This indicates that the EL measurement from Zhang and Ma (2021) had the weakest connection with the other items theorised to reflect a substantive approach to EIM. This is surprising considering the powerful role of leadership in effective EIM (Su et al., 2020; Hameed et al., 2021). It may be that the measurement does not incorporate the position of the females on the board. Due to the nature of the roles, a CEO or a Chief Operational Officer could have a greater ability to inspire, influence and embed EIM strategies into the business than a Chief Financial Officer or Chief Legal Officer. To enhance the EIMS and obtain a more accurate measurement for this item, research could include the role of the females on the board in addition to the percentage.

5.3 *Limitations*

Several limitations were identified. The limited scope of items considered in the EIMS measurement resulted in a percentage of ISO 14001 certified facilities not being considered due to the lack of access to a unified database. Second, as a result of the availability of publicly available data the sample of construction companies used was small and consequently, findings are difficult to generalise. To obtain more confidence on how EIM affects EP in construction companies, further research using a larger sample is needed. Third, the economic data centred on a five-year mean ROA which included the timeframe of the COVID-19 pandemic and may therefore not be fully representative. Finally, there are limitations to direct comparisons to the large body of prior research on the topic using a dichotomous measurement. While this is considered a limitation of the EIMS, the argument remains that to achieve a conclusive understanding on the relationship between EIM and EP future research must consider how EIM strategies are implemented.

There are also limitations identified with the EIMS measurement. First, it will not achieve the highest accuracy possible for some items, such as EL. But the methods needed to achieve this restrict the EIMS feasibility. Second, the equation does not use weighted arithmetic means so does not reflect the extent to which each item may reflect a substantive approach to EIM. This presents an opportunity for further research to enhance this measurement. Finally, despite intentions to enhance the feasibility, the EIMS is more resource-intensive than a dichotomous measurement.

5.4 Recommended research

Several avenues for future research have been identified. First, there would be value reconducting this study using a questionnaire to supplement the EIMS measurement to obtain greater accuracy and confidence in the conclusions. Second, the findings are limited to publicly-listed UK M&C companies. It is recommended further research uses the EIMS to analyse how approaches to EIM in different sectors and countries affects EP. Considering the limitations for comparison against previous literature, there is a need to build a comprehensive pool of evidence utilising the EIMS. With this, it is postulated a more conclusive understanding of how EIM affects EP will likely be achieved. Furthermore, expanding the pool of literature using the EIMS would provide insight into how effective stakeholder pressure is at influencing companies to take a substantive approach to EIM, and how this stakeholder-driven approach to EIM affects EP. This would have benefits for stakeholders, researchers and high-level leadership teams. Third, while research-backed theories were used, the EIMS measurement is novel. To ensure the items accurately measure a company's approach to EIM, it is recommended further research should validate each item to maximise the EIMS' accuracy. The measurements used for the items should also be reviewed, such as, including the roles of females on the board. Plus, identifying the extent each item represents a substantive approach to EIM and enhancing the weighted-average scoring system accordingly would further improve the EIMS. Other items could also be considered, such as the distance between the Environmental Manager and the CEO, the percentage of facilities certified to ISO 14001 or the degree of EIM training provided to employees. Though the feasibility of data collection should also be considered. Critiquing and enhancing the EIMS measurement would provide greater confidence in the research findings as well as helping stakeholders evaluate a company's approach to EIM. Finally, the studies used in the meta-analysis by Wang et al. (2020) assessing the relationship between stakeholder pressure and EIM were all before COVID-19, which appears to have raised awareness and passion for environmental protection (Cohen, 2020; Deloitte, 2021). Therefore, it is recommended further research examines how the level of pressure from each classification of stakeholder may have changed following the pandemic.

6 Conclusions

The aim of this research was to determine how EIM affects EP in UK M&C companies. A review of literature identified previous dichotomous EIM measurements have been insufficient, which may contribute to the inconsistent findings. Despite high ISO 14001 uptake and the long history of UK M&C, limited research has analysed this relationship. To achieve an accurate and reliable understanding of how a UK M&C company's

approach to EIM affects its EP, this study developed a novel multifaceted measurement which considers the presence of key success factors for effective EIM. A framework with 4 research-backed items was designed to assess how substantively a company approaches EIM. The results found a medium positive correlation which was statistically significant for the combined M&C sample and manufacturing sample. The sample of construction companies also showed a medium positive correlation, but this was not statistically significant due to the small sample size, which is identified as a limitation.

All items in the EIMS measurement had a positive correlation with EP, with purpose and values and the CDP 2021 score having the strongest. Therefore, of the items used, a company may generate the most EP benefits by referring to EIM in its purpose and values and seeking a higher CDP score. The percentage of females on the company's board had the lowest correlation and this was a noteworthy finding considering the role of EL in effective EIM. This may be due to the lack of consideration for the position of the females on the board, which is suggested may be a more accurate measurement for this item.

This research has valuable contributions for high-level leadership teams of M&C companies who are under pressure to develop net-zero plans. It highlights the role of high-level leadership in the substantive implementation of EIM, and the potential for this to improve EP. The findings corroborate with previous research showing a positive correlation between EIM and EP. This offers encouragement in that companies may not need to choose between EIM and profit and this lack of conflict should facilitate the achievement of the SDGs. In addition, because the observation period spanned a period of economic crisis due to COVID-19, the positive relationship found demonstrates how a substantive approach to EIM may offer economic resilience at a time high-level leadership teams have previously questioned its value. This paper highlights the important role of EL in the EIM and in doing so develops the current literature base on the concept of EL. Furthermore, these findings contribute to, expand and enhance the limited literature analysing how EIM affects EP in UK M&C companies.

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