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Organisational mindfulness as a sustainable driver of employee innovation adoption: Individual and organisational factors

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ABSTRACT

This study investigates the underexplored relationship between mindful organisational infrastructure (psychological safety, team learning, team voice, supportive leadership) and employee innovation adoption, via direct and indirect relationships of organisational mindfulness (a firm's cultural characteristic that makes employees alert to solve issues and improve effective cooperation). We studied this through a survey among 115 managers/owners of Dutch logistics companies, a sector in which employees' occupational health, safety and wellbeing (HSW), and sustainability topics are under pressure. The relationships were investigated using path analysis based on linear regression models. Results show that employee innovation adoption was positively related to supportive leadership, and to the presence of organisational mindfulness. The presence of team voice has an indirect relation with employee innovation adoption as it was mediated by organisational mindfulness. These findings suggest that organisations should facilitate team voice and supportive leadership, as well as organisational mindfulness to successfully achieve employee innovation adoption in order to stay innovative and competitive. A future research agenda and implications for practice are discussed.

1. Introduction

Improving working conditions and promoting the health, safety and wellbeing of workers are gaining momentum as important aspects of corporate social responsibility (CSR) activities, and sustainability of the workforce and firm. At the same time, many organisations seek sustainable and successful ways to adopt and keeping up with the new, rapidly and constantly evolving technologies and digitalisation opportunities. The special issue of Safety Science addresses "sustainability" related to occupational health, safety and wellbeing (HSW). Our contribution understands sustainability as a management value to promote successful employee innovation adoption through the creation of an organisational culture that nurtures engagement of employees. A working environment containing jobs that are designed to enable psychological safety, learning opportunities, voice and supportive leadership, is susceptible to proper HSW management and thus in support of sustainable economic performance and innovation (see also Jain et al., 2018). A crucial element for sustainable work and sustainable business can be organisational mindfulness, a 'reliability and safety management' topic that sits within the scope of Safety Science (e.g. Wears & Roberts, 2019). Volume 120 (December 2019) included a special issue on 'Mindful organizing and its role on safety' (Martínez-Córcoles, 2019). The term collective mindfulness was introduced into the organisational and safety literatures by Weick and colleagues and coming out of their High Reliability theorising (Weick et al., 1999). While some research has been done on organisational mindfulness and sustainability at the societal level in environment research (Ndubisi et al, 2019; Thiermann & Sheate, 2021), still little empirical research and theory is known about this relationship at organisational level in innovation research (Becke, 2014), while practice is seeking for sustainable ways to both innovate and maintain high quality jobs.

Organisational mindfulness, mindful organising or collective mindfulness (Brummans, 2017) are more or less similar concepts stemming from safety and crisis management organisations to prevent disasters and failure, but has hardly been applied to the context of adoption of innovation. The concept of organisational mindfulness includes being alert to weak signals for failure and to base behaviour and decisions on evidence and facts, and at the same time being able to resiliently recover from mishaps and change of direction. High Reliability Organisations (HROs), like first responders, nuclear power plants and aircraft carriers, excel in mindful organising (Tolk et al., 2015; Weick and Sutcliffe, 2015). Yet, organisations that implement innovation, as in for example

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the logistics sector, should also successfully adopt innovations and reduce the risks of failure. In this study we investigate if organisational mindfulness enhances employee innovation adoption among employees in the logistics industry. Our focus is not on innovation adoption in general, but on the actual use of employees to adopt and apply an innovation, thus the 'actual use of an innovation'.

In the logistics industry in The Netherlands there is broad awareness that renewal, like technological and digital innovations, is not always taken up easily by companies (Topsector Logistiek, 2019; Manpower Group, 2015), even though new technological innovations are widely available in the logistics sector. Moreover, maintaining the safety, health and wellbeing of logistics workers worldwide (e.g., warehouse workers at Amazon – see Human Impact Partners, 2021) is an important topic of interest for the sector, unions, policy makers and the media, because the transportation and warehousing accounts for a high number of fatalities (U.S. Bureau of Labor Statistics, cited in Hofstra et al., 2018).

This article, is to our knowledge among the first, to investigate and develop the connection between mindful infrastructure, organisational mindfulness, and employee innovation adoption, which can be seen as a sustainable and responsible practice (Zwetsloot & Starren, 2004) of managing innovation in firms. The main theoretical contribution is the development of a set of four antecedents of organisational mindfulness, such as psychological safety, team learning, supportive leadership and team voice; team voice had a direct influence on organisational mindfulness. This set of antecedents is labelled as mindful infrastructure. The antecedent supportive leadership is, together with organisational mindfulness, related to employee innovation adoption. As such, theoretical concepts of mindfulness stemming from the safety and crisis management literature seem applicable in the field of innovation management. There seems to be possibilities for cross-fertilisation between these disciplines. A more practical contribution is that creating mindful infrastructure enables organisational mindfulness which then stimulates employee innovation behaviour. We assume that this mechanism is relevant for both the context of safety issues and HSW, for the reason that employees may take initiative to effectively deal with issues when the organisation provides them with the proper facilities, i.e. the presence of mindful infrastructure and organisational mindfulness.

The results of the present study will be presented in this article. First, we will discuss the theoretical background of the research. Preceding the unfolding of the results, the methodology and the fieldwork will be explained. In the final sections the conclusions, points of discussion and recommendations are addressed.

1.1. Theoretical and empirical background and research question

Organisational mindfulness is in this study regarded as a feature of an organisation and its culture and not as an individual trait or state, as is the case in the individualised and psychological approaches of mindfulness, also when studied in work settings (Goilean et al., 2020; Reb et al., 2020). The implication is that an organisation has a climate where individual employees have developed a continuous awareness and alertness to analyse the work situation and occurring events on the eventual presence of deviation (Sutcliffe et al., 2016). Organisational mindfulness obviously requires organisation members to have the individual quality to be mindful when needed. We do not investigate the individual level mindfulness but just assume that, when organisational mindfulness is present, the employees have the skills, willingness and propensity to act mindful when needed (Kelemen et al., 2020). Being mindful, aware and alert is critical for innovations to be successful, therefore the innovation-adoption by employees could significantly depend on their mindful behaviour. The purpose of the study is to elaborate if the presence of mindfulness in the organisation boost mindful behaviour, and if that enhance innovation-adoption. To this end we build on the empirical notion that the presence of a 'mindful infrastructure' supported organisational mindfulness, and this was beneficial for a positive perception of 'project success' in executing innovation projects (Oeij et al., 2018).

This section reviews the major elements of our theoretical framework, in which elements of mindful infrastructure are directly related to employee innovation adoption and via organisational mindfulness.

1.2. Employee innovation adoption

By innovation we mean an applied new practice, product or working method, which differs from inventions in the sense that inventions may not get adopted. Innovation adoption is the decision to proceed with the implementation of a new practice, product or working method (Wisdom, et al., 2014), while employee innovation adoption is the preparedness of employees to accept an innovation, that is, they not only intent to use it, but also actually use it in their work. In this study we look at employees who adopt innovation and renewal, whereas most studies that investigate innovation adoption focus on managers (as decision makers) or consumers (as buyers) (Vagnani et al., 2019). More specific, we investigate the actual use of an innovation by employees as our measure of employee innovation adoption. Adoption of innovation requires a change in the behaviour of individuals. Innovations demand learning or unlearning new or old attitudes and behaviours. According to the Theory of Planned Behaviour users of innovations will be inclined to apply a renewal when they perceive it as useful, easy to work with, and beneficial for their work performance (Ajzen, 1991, 2020; Venkatesh and Davis, 2000; Venkatesh et al., 2003). When innovations are perceived as positive in their possible effects, individuals will develop an inclination of acceptance behaviour as an intention, and eventually use the innovation in their work. Three factors determine the intention or the motivation to use the innovation, namely the attitude toward the behaviour, the subjective norm, i.e. what significant others (like supervisors) think of using the innovation or not, and the perceived confidence in successfully applying the innovation (self-efficacy). In such theoretical models, employee innovation adoption is often operationalised as 'the actual use of innovation'. Several theoretical frameworks have examined the innovation process in the past. The Technology Acceptance Theory (Mun et al., 2006; Taherdoost, 2018) indicates that technological aspects of the innovations – like easiness to use and the usefulness for one's work - determine their acceptance, while the Theory of Planned Behaviour (Ajzen, 2020; Venkatesh and Davis, 2000; Tornikoski & Maalaoui, 2019), looks at the motivation of users to change their behaviour and accept renewal. The measure we apply is a combination of the Technology Acceptance Model and the Theory of Planned Behaviour.

1.3. Organisational mindfulness

Innovations are often not adopted by employees. We assume that the presence of organisational mindfulness enhances the uptake of innovations by employees, as it suppresses the inclination to avoid risk-taking and strengthens the capability to respond resiliently to disappointment and mishaps (Oeij et al., 2018). As said, organisational mindfulness is a concept stemming from safety and crisis management organisations to prevent disasters and failure. Whereas organisational mindfulness points to a characteristic of an organisation, and mindful organising to the process of interactions in becoming mindful (Kelemen et al., 2020; Martínez-Córcoles, & Vogus, 2020), we regard both terms –

and collective mindfulness as well - as rather similar, namely as the mindful behaviour of organisational members as an organisational level feature. Vogus and Sutcliffe (2012) make the distinction between organisational mindfulness and mindful organising, where first is an organisational attribute that is top down implemented by top administrators, while the second are communications and interactions on the front line that 'enacts' a social process bottom up. While this distinction may be understandable from a theoretical viewpoint, this is much less the case in practice. Top administrators can behave mindful on the shopfloor and front line employees can constitute organisational norms from below. What exactly is an organisational attribute and what is organisational behaviour, and which organisational member is doing what, seems hard to disentangle in every day's organisational life.

The mindfulness concept as an organisational level feature stresses being alert to weak signals for failure and being able to resiliently recover from mishaps and change of direction. Weick (Weick & Sutcliffe, 2015) created the concept of organisational mindfulness, which is composed of five principles: (1) preoccupation with failure represents a constant attention to mistakes or potential for mistakes and the understanding of mistakes as signs of greater problems looming in the background; (2) reluctance to simplify means to constantly question received information and assumptions in operations, whereby faults are detected; (3) sensitivity to operations means creating and maintaining knowledge about operations at shopfloor level; (4) commitment to resilience includes increasing the ability of employees and the organisation to adapt, improvise, and gain knowledge in order to actually deal with unexpected situations; and (5) deference to expertise represents allocating decision-making power to those persons who have the greatest expertise related to the problem at hand without regard to their formal position in the organisation. These five principles, which together make up organisational mindfulness, help organisation members to detect early signs of approaching threats and enable their adequate problem solving and risk mitigating responses when required.

This behaviour and decisions should be based on evidence and facts, as HROs do to prevent and minimize crises (Brummans, 2017; Tolk et al., 2015; Weick and Sutcliffe, 2015). The question is whether this also helps employees to adopt innovation. Sullivan and Yang (2016) studied the differentiated impact of organisational mindfulness (operationalised as organisational attention and learning) on different types of firm innovation, and contend that organisational mindfulness associates with innovations. Oliver et al. (2017) found strong, significant relationships between collective mindfulness, measured by the 'Mindful Organizing Scale' (Weick and Sutcliffe, 2015) and objective measures of performance, particularly the performance of teams pursuing ambitious, high risk strategies. Earlier, Vogus and Welbourne (2003), in one of the first studies that linked organisational mindfulness to innovation, reported suggestive evidence that organisational mindfulness is associated with a greater number of patents, as an indicator of innovation. Further, a study of innovation teams (Oeij et al., 2018) suggests that organisational mindfulness enables resilient team behaviour in solving critical incidents and thus achieving better project results. Organisational mindfulness not only improves safety, as is the case for studies on HROs (Martínez-Córcoles, & Vogus, 2020), it can also enhance innovation and business goals of organisations (Goilean et al., 2020; Kelemen et al., 2020; Oly Ndubisi and Oly Ndubisi, 2012; Ndubisi et al., 2019; Oeij, 2018).

1.4. Mindful infrastructure

Innovation-adoption is the behaviour of individuals, but this never happens in a vacuum. Employees operate in a working environment. Surroundings create an atmosphere, a working climate, which is constructed by everyone's everyday presence and behaviour on the shopfloor, and is constituting the organisation's corporate culture. Even when you work remotely from home, as so many did during the COVID-19 pandemic. Working environments can enable innovation and creativity when the right elements are presents. We call such an environment a mindful infrastructure (Oeij et al., 2018). Mindful infrastructure is a semi-structure that functions as the organisational facilitation for employee behaviour. Semi-structures are a combination of order, prescriptions, and rules (structure), and the decision latitude to move freely and make autonomous choices. Semi-structures "exhibit partial order, such that some aspects are prescribed and others are not" (Brown & Eisenhardt, 1997: 28). Semi-structures evolve over time and partly reflect the idea of a corporate culture that 'everybody knows how we work here'. Mindful infrastructure is defined as the organisational capacity to anticipate unexpected problems and the capacity to contain such problems, by enabling organisation members to act accordingly (Oeij et al., 2018: 441). We now turn to the question where does it come from.

We differentiate between mindful infrastructure as a characteristic of the organisation ('semi structure') and organisational mindfulness as employee behaviour. Weick et al. (1999), Weick and Sutcliffe (2015), Vogus & Sutcliffe (2012), and Vogus and Iacobucci (2016) state that reliability and safety are a consequence of 'organizing', the process of interaction between persons that constitutes sense and meaning, and, in this case, a collective capability for detecting and correcting errors and unexpected events. Therefore, if the organisational semi-structure precedes how employees will behave, it follows that mindful infrastructure thus precedes organisational mindfulness. But what could constitute mindful infrastructure? From her literature study on HROs, Lekka (2011) made a mind map of the processes and characteristics associated with HROs, and states that HROs 1) foster strong learning, 2) have just cultures, and 3) have 'mindful' leaders at the very top of the organization. We then argued the following. The learning orientation is characterised by continuous (technical) training, root cause analysis of incidents, open communication, and reviewing procedures in line with the organizational knowledge base. Therefore, we see team learning (Edmondson, 1999) as a relevant antecedent. Just culture (Lekka 2011) refers to the notion in which staff are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but where gross negligence, wilful violations and destructive acts are not tolerated. Just culture coincides with two other antecedents, namely team voice and team psychological safety. 'Mindful leadership' in HROs points to leaders who encourage the communication of 'bad news' and the proactive investigation of organizational flaws, and to leaders who balance the pressures of production and business with safety. Thus, supportive leadership can connect such seemingly contradictory goals, and encompasses different styles. Therefore we assume that psychological safety, team learning, team voice and supportive leadership can be regarded as antecedents of organisational mindfulness. Here we partly follow the viewpoint of Sutcliffe et al. (2016), who see psychological safety, leader inclusiveness and learning, amongst other organisational factors, as antecedents of collective mindfulness. Mindful infrastructure ensures the social-relational context of respect and trust, which encourages people to speak up and question interpretation, and counteracts tendencies to act defensively, due to feelings of threat, discomfort or feelings of incompetence, known as 'heedful interrelating' (Sutcliffe & Weick, 2013; Weick & Roberts, 1993). Mindful infrastructure is a necessary but not sufficient condition for organisational mindfulness – 'That infrastructure must be organised and enacted through conduct that enables

organisational members to recognise emerging problems earlier and to manage them more decisively' (Sutcliffe & Weick, 2013, p. 151). Thus, employee innovation adoption might be enabled by behaviours that are founded by the HRO principles to anticipate uncertain events - i.e., innovation and renewal - and to deal with them resiliently.

The elements that are part of the mindful infrastructure, which was tested first in a study of 2018, will be described. That study was the first validation of the concept and was applied to predict a form of innovative problem solving behaviour by innovation teams (labelled as 'innovation resilience behaviour') and the outcome of their innovation projects in terms of their success and progress (Oeij et al., 2018).

1.5. Psychological safety

Psychological safety is a sense of confidence that the employees will not embarrass, reject, or punish someone for speaking up, implying mutual respect and trust among organisation members as an organisation climate (Edmondson, 1999: 354). Psychological safety is important for innovation as a process, where organisation members may have to 'deviate from the norm', depart from their comfort zones, and reflect critically on new and unexpected events. In the case of innovation this element of mindful infrastructure gains importance, considering that organisation memberships, and teamwork when present, are fluid, short-lived and that roles, tasks and hierarchy may be more ambiguous than in non-innovative situations. It is assumed that mindful infrastructure coincides with feelings of safety, which is beneficial for creative and innovative processes, and innovation-adoption, because better use is made of ideas and the (critical) opinions of all organisation members.

1.6. Team learning

Team learning at the group level is an ongoing process of reflection and action, characterised by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions (Edmondson, 1999). In the case of innovation there is newness to the work of employees which may come with uncertainties. To prevent that such uncertainties hinder innovation acceptance, it is deemed relevant that employees can ask questions and are allowed to learn from mistakes without being punished. Practising with innovations to learn how they work is expected to enhance the level of acceptation.

1.7. Team voice

Voice refers to intentionally expressing relevant ideas, information, and opinions about possible improvements, even when others disagree (LePine & Van Dyne, 2001). The function of decision making and autonomy is relevant to self-efficacy and self-determination. Team voice provides employees with influence in decision making, for example, about innovation-adoption. Voice is considered to be a relevant element for problem solving, balancing conflicts and tensions and evoke interpersonal trust. Power, voice and conflicts are thus not necessarily negative aspects of organisations, because they can enhance innovation (Buchanan & Badham, 2008). It seems that mindful infrastructure goes hand in hand with constructive politics, problem solving and the employee voice in decision making. Voice provides employees a certain emancipating power, which may be crucial for the adoption of innovation, whether employees agree or disagree with it.

1.8. Supportive leadership

The original concept of mindful infrastructure advocated complexity leadership (Oeij et al., 2018), since leading innovation may at times be reconciling possibly incommensurable goals, such as innovativeness versus budget and time constraints, attuning diverging interests of stakeholders, diverging talents and backgrounds of involved employees. Plausibly, supportive leadership suffices to support mindful behaviour of employees (Gracia et al., 2020; Kelemen et al., 2020; Martínez-Córcoles, & Vogus, 2020), as support is a major ingredient to motivate individuals. Leadership is the guiding and structuring the work of employees to achieve organisational goals. Innovations leaders are change agents who promote the manifestation of new ideas in a work context by creating a supportive climate for creativity and managing the innovation process (Kremer et al., 2019). There are different approaches to supportive leadership. Leadership to support, for example, influences the working environment of employees, and can create psychological safety and a learning orientation (Edmondson & Harvey, 2017), voice for employees (LePine & Van Dyne, 2001) and both organisational and mental support (Kremer et al., 2019). Leadership to innovate, improves employee, team, and organisational creativity (Hughes et al., 2018). In this context, innovation may refer to the renewing of products, services, work processes or methods, organisational forms and employment relations and not per se to the invention of new products.

The literature promotes several supportive leadership styles as conditional to innovation and to involving employees in corporate change and renewal, such as transformational leadership (Bass, 1990). Transformational leaders work with others and teams to identify needed change, creating a vision to guide the change through inspiration, and executing the change together with organisation members. Transformational leadership serves to enhance the motivation, morale, and job performance of followers. Another supportive leadership style is distributed leadership, or shared, democratic, or collaborative leadership. Such approaches often look at the distribution of leadership roles and are concerned with optimising the distribution of leadership so as to improve organisations. In this case, not one person per se is the leader, but in carrying out tasks the leadership role may shift among participants, as can happen in the case of teamwork, in which leaders can sometimes be followers, and followers be leaders (Spillane, 2006; Spillane & Diamond, 2007; Wang et al, 2014). A final branch to mention is complexity leadership, which is enabling contexts and conditions in an environment in which everything cannot be structured, planned and controlled (Uhl-Bien & Arena, 2017). Leadership enables networked interactions to foster ideas for solutions and learning in order to adapt to newly emerging situations. Leaders do this by connecting groups and ensuring groups share information, enhancing group cohesion. Eventually this makes organisations resilient and agile, or in other words, mindful.

The essence of the discussed examples of supportive leadership, when it comes to innovation, is to motivate and engage employees. We know that supportive leadership enhances collective mindfulness (Sutcliffe et al., 2016). Support from leaders will probably make employees more receptive to renewal.

1.9. Empirical background

Earlier studies in the Dutch logistics industry may corroborate our notion that attention for social and organisational factors, such as mindful infrastructure has a positive impact on employee innovation adoption. One study performed in 2017 showed that a 'socially

Table 1
Means, Standard Deviations and Correlations between the Variables (N = 115).

Variable	Mean (SD)	Cronbach's alpha	1	2	3	4	5
1. Employee innovation adoption	3.4 (0.6)	0.86					
2. Organisational mindfulness	3.3 (0.7)	0.84	0.54*				
3. Team learning	3.1 (0.7)	0.83	0.45*	0.45*			
4. Team voice	3.0 (0.7)	0.90	0.43*	0.51*	0.52*		
5. Psychological safety	4.0 (0.6)	0.81	0.46*	0.60*	0.53*	0.63*	
6. Supportive leadership	3.3 (0.8)	0.86	0.52*	0.52*	0.58*	0.69*	0.60*

* $P < 0.0001$.

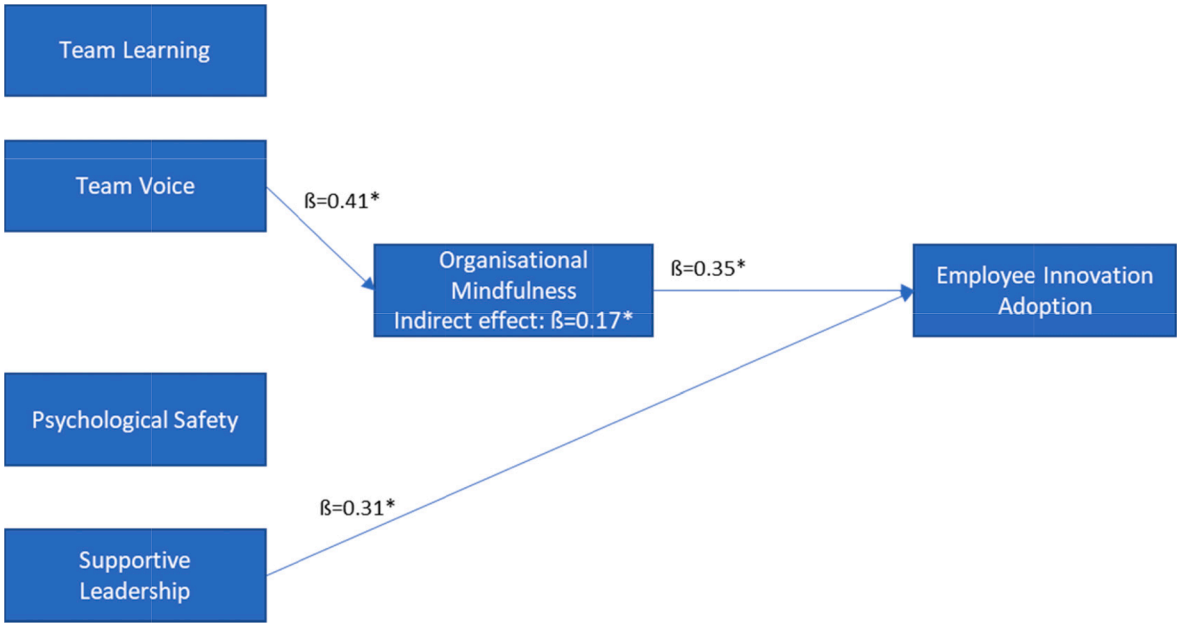

Fig. 1. Path Analysis of work behavioural characteristics on the relationship between organisational characteristics and employee innovation adoption. ß=Beta; *P < 0.05. only significant relationships are presented in Fig. 1.

innovative climate', namely the presence of high job autonomy among employees, team voice, and involvement of employees with operational tasks in decision making (i.e. a climate that featured specific elements of workplace innovation), had a positive influence on employee innovation adoption, which was measured as the actual use of innovation (Putnik et al., 2019b). A follow-up study one year later showed similar results (Putnik et al., 2019a). This study proved that how employees perceive an innovation determined their actual use of the innovation. Of four elements of the Theory of Planned Behaviour (result demonstrability, usefulness, ease of use and subjective norm, Ajzen, 1991; 2020) two played a role for employees to actually use the innovation, the 'ease of use of innovation' according to employees, and seeing the 'importance of the use of innovation' (so called 'subjective norm').

In 2020 another follow-up project started in the logistics industry. From the former studies we knew that innovation-adoption could be given a boost by workplace innovation-related factors, such as the presence of voice, employee engagement, and innovative behaviour. Innovation-adoption is not self-evident. Many innovations or implementations of renewal are not successful, partly because employees do not always accept changes or resist renewal. HROs are 'mindful organisations' that are equipped to deal with newness, albeit in the form of crises, such as 'disasters, riots and hostages' (a popular title of a study on decision making under crisis). HRO thinking not only prevents or minimizes the negative consequences of crises, it also helps overcoming pitfalls in innovation management (Oeij, 2018). The follow-up study of Putnik et al. (2019a) investigated the role of organisational mindfulness in the adoption of innovation by employees in logistics. This study, a re-analysis of the 2017-data, showed that there was an indirect relationship between organisational mindfulness and actual innovation, mediated by the perceived usefulness of the innovation and by the perceived ease of use of the innovation (Oeij, Putnik, Dhondt, Van der Torre et al., 2020).

The contribution of this research is threefold, namely 1) to show that organisational mindfulness is a factor that can influence employee innovation behaviour. The literature of organisational mindfulness and High Reliability organisations is useful for innovation management, but only applied to a limited extent; 2) the study suggests that a working environment, called 'mindful infrastructures', that nourishes team voice and supportive leadership are helpful to enable organisational mindfulness and employee innovation adoption; 3) while most studies into innovation adoption focus on managers as decision makers and consumers as buyers, this investigation stresses employee innovation adoption. In connection to this point, insights are given that behaviours and attitudes of employees can be measured via the consultation of their supervisors, although its validity requires further research.

1.10. Research question and hypotheses

The research question of the study is: What factors of the mindful infrastructure are related to employee innovation adoption, either directly or via organisational mindfulness in the logistics industry? Based on the above reasoning and research we argue that employee innovation adoption is dependent on both organisational factors (i.e. mindful infrastructure) and behavioural factors (i.e. organisational mindfulness). Mindful infrastructure creates a working environment that enables organisational mindfulness of employees, and that, in turn, lowers the threshold of accepting innovation, because it is not something that is threatening but facilitating the execution of the work of employees.

Based on the above theory, line of reasoning and empirical background, we hypothesize:

H1: Mindful infrastructure is positively related to the employee innovation adoption;
H2: Mindful infrastructure is positively related to the organisational mindfulness of employees;
H3: The presence of organisational mindfulness is positively related to employee innovation adoption;
H4: Mindful infrastructure is positively related to employee innovation adoption via organisational mindfulness.

2. Research and method

2.1. Data and data collection

To be able to answer questions about the firm's strategy and policy on innovation, we needed to approach respondents that can overlook the organisation as a whole. For that reason, managers were approached to participate in the questionnaire study and act as informants of their companies. Therefore, the 'perceptions of employees' were measured by asking these managers to evaluate the behaviour of their employees.

Electronic surveys were distributed in 2020 among managers of logistics companies in the Netherlands. Participants were sampled from four different sources: 1) organisations that took part in the Netherlands Employers Work Survey (Dutch abbreviation WEA, https://www.monitorarbeid.tno.nl/en-us/surveys/news/) in 2014 and 2016 and who had agreed to be approached for future research; 2) organisations approached via I & O Research, a research institute that manages LISA (which stands for National Job Information System and is a database containing information about all branches in the Netherlands where paid work is performed) and selected a subsample of logistics companies from LISA, 3) managers of transport and logistics organisations known to the researchers from previous research projects, and 4) contacts with logistics managers of internship coordinators of a vocational education institute that participated in another logistics research on living labs in logistics called 'Sharehouse' (https://www.nwo.nl/en/researchprogrammes/sustainable-living-labs). The survey consisted of items mostly originating from validated scales. The outcomes of the research are based on these managers' perceptions of employee behaviour. In total, 123 completed surveys were returned. A link to the questionnaire has also been distributed via social media and in Logistic newsletters, which was completed by an additional seven participants. For the analyses, we excluded nine companies who did not implement any innovation in the last seven years, and six companies with missing data on one or more of the independent variables. This led to a study population of 115 companies. Although the response rate was low, the purpose of this study was not to develop a representative overview for the logistics sector, but to test our theoretical assumptions on a sample of logistics firms.

Surveys were completed by directors of organisations, financial or commercial managers, HR managers or technical managers who answered the questions about the situation within their organisations. Of all organisations 37% had as main activity transportation, 22% logistics and distribution, 30% 'both' and 12% 'other' (such as production and retail). The average number of employees these firms employ is 78 (median), with an interquartile range from 36 to 160 employees.

3. Measures

3.1. Dependent variable.

Employee innovation adoption concerns the degree to which employees are prepared to actually use the innovation (in their own work). A domain specific scale was constructed based on the Technology Acceptance Model (Mun et al., 2006; Venkatesh et al., 2003) Theory of Planned Behaviour (Azjen, 1991, 2020) which formed a scale (see Table 1), based on seven items with answering categories ranging from 1 (not at all) to 5 (fully). The operationalised items mirror the perception of the importance of innovation (for customers, one's own job), namely perceived effects when applied, perceived usefulness, perceived ease of use, experienced self-efficacy, perceived subjective norm, intention to use the innovation, and the actual use of the innovation. The items formed a robust scale (Cronbach $\alpha = 0.86$). The items of the scale are as follows. "Please indicate the situation in your company for the following statements: 1] The effects of applying the innovation are clearly visible to the employees; 2] The employees find applying the innovation useful, either for themselves or for the customers of the innovation; 3] The ease of use of the innovation is high, either for the employees or for the customers; 4] The employees bring their ideas with confidence, in the process of innovation or renewal; 5] The leadership regularly communicates the importance of innovation to the company to employees; 6] Employees tend to ignore innovations or renewals, and mainly continue as before; 7] The innovations are actually taken up well by the employees.".

3.2. Independent variables

There are four subscales of the *mindful infrastructure* construct, namely team learning, psychological safety, team voice and supportive leadership, which are adapted from the measures of Oeij et al. (2018).

Psychological safety and *team learning* were measured by abbreviated scales developed by Edmondson (1999). Psychological safety (Cronbach $\alpha = 0.81$), is the shared belief that the team is safe for interpersonal risk taking, and suggests a sense of confidence that the team will not embarrass, reject or punish someone for speaking up, implying mutual respect and trust. Team learning (Cronbach $\alpha = 0.83$) is the ongoing process of reflection and action, by asking questions, seeking feedback, experimenting, reflecting on results and discussing errors or unexpected outcomes of actions (Edmondson, 1999). Respondents were asked to evaluate statements on both topics on 5-point Likert scales ranging from 'strongly disagree' (1) to 'strongly agree' (5). The original scale was abbreviated to four items and translated into Dutch.

Team voice is a construct that indicates constructive organizational politics, as it deals with the extent to which team members participate in decision-making, collaboration and commitment. Team voice measures the participation of team members by examining voice and willingness to help and to what extent team members have a say in daily routines. We used the abbreviated voice scale (Cronbach $\alpha = 0.90$) developed by Van Dyne and LePine (1998), with respondents evaluating statements on

5-point Likert scales, ranging from 'strongly disagree' (1) to 'strongly agree' (5). The original scale was abbreviated to four items translated into Dutch.

Supportive leadership concerns the degree to which management offers employees the opportunity to invest in time, space and money for innovative behaviours. A scale was created (Cronbach α = 0.86), based on three items with answering categories ranging from 1 (not at all) to 5 (fully), originating from Kraan et al. (2009). The used question is "Indicate to which degree the following propositions correspond with the situation in your firm: 1) The immediate supervisor gives employees time to develop ideas; 2) The immediate supervisor gives employees the space they need to innovate; 3) Top management is prepared to invest in the innovative efforts of employees".

Organisational mindfulness concerns the ability to discuss work errors and mistakes openly and react fast to unexpected changes, pulling on all team members' expertise, as a form of effective cooperation or teamwork. Derived from the construct of Oeij et al. (2018), called 'Innovation resilience behaviour' (see also Fey & Kock, 2020; 2021), this scale originally measured 18 of 48 selected items of the five Audits of Resilient Performance constituting the 'Mindfulness Organizing Scale' of Weick and Sutcliffe (2015), also applied as the 'Safety Organising Scale' of Vogus and Sutcliffe (2007). It operationalised the five HRO principles, preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience and deference to expertise. Over the years that we applied this construct in Dutch research (Oeij, 2018; Oeij et al., 2018, 2020) the reliability analyses allowed us to drop several of the items. The scale we applied was abbreviated by Oeij et al. (2020) with a satisfactory reliability score, which we applied in the present study (α = 0.84), and is based on four items originating from Weick and Sutcliffe's scale. The answering categories range from 1 (not at all) to 5 (fully). The scale includes the following four items: (1) 'Team members have a good "map" of each person's talents and skills'; (2) 'Team members talk about mistakes and ways to learn from them'; (3) 'When errors happen, as team members we discuss how we could have prevented them'; (4) 'When an unexpected situation like a sudden change or project mishap occurs, as team members we rapidly pool our collective expertise to attempt to resolve it.' By reducing the scale's substantial number of items in previous studies a parsimonious construct was achieved.

3.3. Data analysis

First, we performed the calculation of means, standard deviations and Pearson correlation analyses between variables (Table 1). Absence of multicollinearity was shown by acceptable Variance Inflation Factors between 1,3 and 2.5 .

Second, a path analysis based on multiple linear regressions adjusted for size and main activity of the company was carried out in two stages (Fig. 1). In the first stage, four dimensions of the organisational context called mindful infrastructure (Team Learning, Team Voice, Psychological Safety and Supportive Leadership) were examined in relation to mindful behaviour of the employees (Organisational Mindfulness). In the second stage, all variables (the four Mindful Infrastructure dimensions and Organisational Mindfulness) were separately and simultaneously examined in relation to the employee innovation adoption of employees as the dependent variable. P-value for indirect relationships of Mindful Infrastructure and Employee Innovation Adoption via organisational mindfulness were calculated using the Sobel test (Sobel, 1986). Missing values were deleted in a listwise manner. The results are presented in Fig. 1 in the form of a path-diagram (Hayes and Rockwood, 2017).

4. Results

Employee Innovation Adoption was significantly positively correlated with all variables with correlation coefficients ranging between r=0.43 and 0.54 in the bivariate analysis (Table 1), which is moderate. All other factors were also related to each other with correlations between r = 0.45 and r = 0.69.

In the multivariate analyses of the resulting path analysis (Fig. 1), we observed a direct positive relationship between Supportive Leadership and Employee innovation adoption, and between Organisational Mindfulness and Employee innovation adoption (Annex 1: Tables A2–A3). Team Voice had a positive relationship with Organisational Mindfulness, but the other dimensions of Organisational Infrastructure were not significantly related to Organisational Mindfulness (Annex 1: Table A1). From the Mindful Infrastructure construct we see that Team Voice had an indirect relationship with Employee Innovation Adoption via organisational mindfulness (β=0.17), but that Team Learning and Psychological Safety had no direct nor an indirect relationship with Employee Innovation Adoption (Annex 2: Table A4). The explained variance of the final model is 37% (Adj. r^2 = 0.37).

5. Discussion and recommendations

5.1. Conclusion

Employee Innovation Adoption is positively related to Organisational Mindfulness in the researched sample of logistics firms. Organisational Mindfulness seems to have a direct effect on the adoption of innovation. When Team Voice is present in organisations, we observed that Organisational Mindfulness increases, and this also had a positive effect on Employee Innovation Adoption. Finally there is a direct effect of supportive leadership on Employee Innovation Adoption. Our hypotheses that Mindful Infrastructure will enhance the Employee Innovation Adoption by employees (H1) via Organisational Mindfulness (H4) and that Mindful Infrastructure will enhance the Organisational Mindfulness of employees (H2) seems only partly supported; but the assumption that the presence of Organisational Mindfulness will probably enhance the Employee Innovation Adoption by employees (H3) seems to hold.

The study shows that two elements of mindful infrastructure are relevant to enhance the adoption of innovations by employees. Supportive leadership plausibly has a direct effect on the employee innovation adoption when supervisors offer employees time and room to work on innovation and new ideas, and if top management shows preparedness to invest in innovative efforts of employees. The other element is team voice, which has an effect on employee innovation adoption via organisational mindfulness. Team voice means that employees can make recommendations on innovation, ventilate opinions to others even when these deviate from the general opinion, keep themselves informed about team related issues, and that they can be very outspoken about renewal and change. The presence of supportive leadership and team voice can be seen as relevant ingredients for the corporate culture. Organisational mindfulness is behaviour by employees that is enabled by such a corporate culture. It can trigger a higher alertness to respond to undesired situations. Employees are better aware of the talents and skills of colleagues, are open to discuss mistakes and to learn from those, and also how to prevent mistakes in the future. And in the case of unexpected events they pool their collective resources

to solve the issue. The present study showed that these behaviours promote employee innovation adoption.

6. Contributions and limitations

The contribution of this investigation is the supportive evidence for mindfulness at organisational level for the uptake of innovations by employees. Other studies pointed out that the presence of organisational mindfulness reinforces individual mindfulness, but not per se vice versa (Kelemen et al., 2020; Sutcliffe et al., 2016). The finding that mindful infrastructure (at organisational level), at least for the element of team voice, can contribute to mindful behaviour of employees at organisational level is a result that is congruent with this line of reasoning, and supports earlier studies in this field (Fey & Kock, 2020; 2021; Oeij et al., 2018), also in connection to innovation (Vogus & Welbourne, 2003) and creativity (Cheung et al., 2020) as a topic.

In following the hunch of Sutcliffe et al. (2016) we proposed that mindful infrastructure (psychological safety, team learning, team voice, supportive leadership) is an antecedent of organisational mindfulness. One could contend there is overlap with literature on the psychosocial work environment (Christensen et al., 2020; Niedhammer, Bertrais & Witt, 2021). For instance, if a mindful infrastructure is in place it would often mean that an organisation has policies and procedures to manage psychosocial risk, promoting mental health and wellbeing at work, as well as other positive health and safety outcomes. By showing the relationship between the variables of the mindful infrastructure concept, we found suggestive evidence of an organisational semi-structure (Brown & Eisenhardt, 1997) that goes beyond separate concepts of psychological behaviour. While these separate concepts may induce persons to behavioural change, we see a semi-structure as a building block of organisational design that may have an enduring effect on behaviour, as it not only combats symptoms of undesired work environments but also its causes, as is the case in sociotechnical design theories (Kuipers et al., 2020). We argue that this structural design may contribute in a more substantial way to sustainable healthy work environments. Follow-up research could in more detail investigate how semi-structures and organisational structures affect mindful behaviour, other than the (separate) psychological work environment concepts.

Since our hypotheses were only partly confirmed, we cannot draw firm conclusions. But it seems safe to contend that certain organisational facilitations, policies and regulations are beneficial to such mindful behaviour, especially when they aim to improve team voice. The importance of this result is found in ways to improve the adoption of innovation by employees, under the condition that certain organisational renewals can stimulate such adoption. The earlier studies in the logistics industry into the positive effects of workplace innovation-like interventions on the actual use of innovations are called into memory to get inspired (Putnik et al., 2019a, 2019b). Giving employees a say in change and innovation, like team voice, motivates them to take up such innovation.

A general observation might be that concepts developed in the safety and crisis management literature are useful in the field of innovation management. This could stimulate a cross-fertilisation of ideas for research between the two fields. Safety and crisis organisations deal, for example, with unexpected risks and disasters, while commercial organisations must compete in volatile markets where the success of innovation is never guaranteed. Domain specific forms of mindfulness at the level of organisations can be beneficial for both industries.

Our findings bear relevance for the discussion on sustainability and occupational HSW. When employees are working in jobs that have a good quality of work and are embedded in a mindful working environment it is likely to meet certain standards of human centered work (González-Cantón et al., 2019). It is plausible that corporate management that values the interests of employees, also cares about their employee's occupational HSW and feels responsible for them (Zwetsloot & Starren, 2004), albeit for the sake of successful innovation. Such mindful environments and good quality jobs are expected to minimize psychosocial risks and improve HSW (Jain et al., 2011, 2017), provided that the purpose of innovation can be aligned with sustainable economic development at the same time (Dommerholt et al., 2021). Another implication is that HRO concepts might support sustainability too.

Some limitations of the study are the following. We studied the Dutch context in the logistics industry, but the findings do not allow us to make generalisations about other other contexts. We applied translated and abbreviated versions of constructs that were developed and applied in the English language. Our research lead, for example, to a parsimonious construct of organisational mindfulness but its validity for other contexts should be further investigated. Next to that, we constructed the mindful infrastructure concept as a set of antecedental variables to predict organisational mindfulness. It was only partly corroborated in this dataset, which demands further testing of the relations with future samples. The research examined behaviour change (employee innovation adoption) by asking the managers about behaviour change of their employees. Therefore, the findings assume that manager's perception of employee's individual characteristics, organisational factors, as well as perception of innovation are adequately explaining the uptake of innovation. Inclusion of employee's self-evaluation of these issues would have strengthened our study. The practical difficulty is that employees as respondents likely have a less complete overview of strategies and operational aspects of innovation policies and activities of their own organisation. Another limitation of our research is its cross-sectional nature which prevents us to definitively disentangle cause and effect relations. For that purpose longitudinal research is recommended to examine in the future the causal nature of the relations between mindful infrastructure, organisational mindfulness, and employee innovation adoption. Finally, the limited response rate does not allow us to make generalisations towards the logistics industry as a whole, although that was not the intention.

6.1. Future research agenda

The concepts of mindful infrastructure and organisational mindfulness seems to support employee innovation adoption. Innovation adoption strongly depends on employee involvement and their commitment to the company's business. The relevance of a reciprocal relationship between management and employees, which serves the interests of both organisational stakeholders, could be strengthened through the connection of the concepts of mindful infrastructure and organisational mindfulness with sustainability and HSW-objectives. The topic is underrepresented in safety research but offers opportunities how to improve sustainability and HSW goals. Possible research could investigate how management and employees can cooperate in the most effective way.

One suggestion is to study the implementation and evaluation of HSW interventions (Jain et al., 2017), where these interventions bear the characteristics of mindful infrastructure and organisational mindfulness. Interventions can, for example, be signed with or by employees, or can be characterized by elements that enhance psychological safety, team learning, team voice, supportive leadership, or in such a way that interventions stimulate the five HRO principles of preoccupation with

failure, reluctance to simplify, sensitivity to operations, commitment to resilience and deference to expertise. A measure for sustainability and HSW (e.g. Zwetsloot et al., 2020) goals can be applied to evaluate the effects.

Another line of future research is of a multilevel nature. Organisational mindfulness is connected to a mindful infrastructure, and it is especially based on organisational routines, and key principles that facilitate mindful organising. However, the interplay of different levels important to mindful organising, i.e. the organizational structures, interaction processes, and persons with mindful or less mindful attitudes, has to be analysed and conceptualised more thoroughly (Becke, 2014; Sutcliffe et al., 2016). There should also be a connection with the societal level, that investigates how sustainability and organisational mindfulness can enforce each other. Ideally, these topics should be studied over a longer time period within a longitudinal research design, to better sort out the causality of relations at these different levels. Finally, research is needed to better understand sustainable working lives as people live longer, work longer, and face work transitions during their working careers that may affect their health and employability (Vuori et al, 2015). Organisational mindfulness can be helpful to realise such transitions such that working careers can remain sustainable and healthy.

6.2. Practical implications

Employee innovation adoption is not self-evident. This study strengthens the idea that organisations can benefit from creating a mindful infrastructure enabling organisational mindfulness, which then improves employee innovation adoption. At the same time, employees will feel heard and perform better. Based on our research, we share some pointers and advice for managers in the logistics industry and elsewhere planning to implement innovations in their organisation:

(1) Alfred Chandler (1962) once said that structure follows strategy. In a similar vein one can say, so does culture. Even stronger, culture also follows structure (Karanika-Murray & Oeij, 2017). By this, we mean that based on strategic choices about designing a mindful infrastructure as a rather robust organisational facilitation or semi-structure (Brown & Eisenhardt, 1997) one creates behavioural consequences for organisational mindfulness, that is, for the desired mindful behaviour to improve employee innovation adoption.
(2) Give employees sufficient freedom in the way they carry out their work, give them opportunities to express their opinions, and also involve employees with operational tasks in decision making.
(3) Invest in organisational interventions that strengthen the mindful infrastructure, in particular team voice. Employees who seriously get involved with change and renewal in the organisation are expected to feel motivated to contribute to the organisation's innovation.
(4) Based on our research and the operationalisation of Employee Innovation Adoption, we recommend to take a good look at the process of employee innovation adoption and its elements that can eventually trigger the actual use on an innovation;
    a. Ensure that the innovation is perceived as useful and as adding to the quality of work or productivity of employees, as this is clearly related to a higher chance that innovation will actually be used.
    b. Ensure that innovation is easy to use. If innovation is technological, this would mean that technology should be sufficiently developed and user friendly.
    c. Ensure that employees understand why the innovation is important for the firm's customers.
    d. Ensure that the effects of applying the innovation are visible for employees
    e. Allow employees to utter their ideas and expertise during the process of innovation and implementation; provide them with trust and confidence.
    f. Ensure that the management clearly communicates why the innovation is important for both the firm and the employees; reward employees who take up the innovation.

To end, firms that pay attention to a mindful working environment and good quality jobs to improve employee innovation adoption, will at the same time contribute to sustainable employment and a responsible, sustainable economy, and will therefore also limit the occupational HSW risks.

CRediT authorship contribution statement

Peter R.A. Oeij: Writing – original draft, Supervision, Conceptualization. **Gerben Hulsegge:** Writing – original draft, Methodology, Formal analysis, Conceptualization. **Paul T.Y. Preenen:** Writing – review & editing, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Annex 1. Path analysis

STAGE 1: Presents linear regressions between the four variables of Mindful Infrastructure (*Team Learning, Team Voice, Psychological Safety* and *Supportive Leadership)* in relation to the intermediate-variable *Organisational Mindfulness* (Table A1); and the linear regression between *Organisational Mindfulness* and *Employee innovation adoption* (Table A2)

STAGE 2: Presents a linear regression model between all independent variables and *Employee innovation adoption* (Table A3)

Table A1
Linear regressions between team learning, team voice, psychological safety, supportive leadership in relation to organisational mindfulness.

	Unstandardised coefficient		Standardised coefficients	Confidence intervals	Significance (P-value)
	B	SE	Beta		
Team learning	0.10	0.11	0.10	−0.12–0.33	0.37
Team voice	0.38	0.09	0.41	0.20–0.56	<0.0001
Psychological safety	0.11	0.11	0.09	−0.11–0.32	0.34
Supportive leadership	0.13	0.10	0.15	−0.06–0.33	0.18

*Adjusted for size and main activity of organisation.

Table A2
Linear regressions between organisational mindfulness in relation to employee innovation adoption.

	Unstandardised coefficient		Standardised coefficients	Confidence intervals	Significance (P-value)
	B	SE	Beta		
Organisational mindfulness	0.46	0.07	0.56	0.33–0.59	<0.0001

*Adjusted for size and main activity of organisation.

Table A3
Linear regressions between all elements of the model and employee innovation adoption.

	Unstandardised coefficient		Standardised coefficients	Confidence intervals	Significance (P-value)
	B	SE	Beta		
Team learning	0.08	0.10	0.10	−0.12–0.28	0.41
Team voice	−0.01	0.09	−0.01	−0.18–0.16	0.92
Psychological safety	−0.01	0.10	−0.01	−0.19–0.18	0.95
Supportive leadership	0.22	0.09	0.31	0.05–0.39	0.01
Organisational mindfulness	0.29	0.08	0.35	0.12–0.46	0.001

*Adjusted for size and main activity of organisation.

Annex 2. Indirect effects

See Table A4.

Table A4
Indirect effects of team learning, team voice, psychological safety, supportive leadership with employee innovation adoption via organisational mindfulness.

	Standardised coefficients	SE	p-value
Team learning	0.05	0.05	0.37
Team voice	0.17	0.05	<0.0001
Psychological safety	0.05	0.05	0.32
Supportive leadership	0.06	0.05	0.20

*Adjusted for size and main activity of organisation; p-value caculated using the Sobel-test.

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