https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

Understanding organisational culture and digitalisation in the wind energy sector

Sarah Barber[1], Anna Maria Sempreviva[2], Jeff Clerc[3], and Anne Hegemann[4]

[1]Eastern Switzerland University of Applied Sciences, Switzerland
[2]Technical University of Denmark, Denmark
[3]National Renewable Energy Laboratory, USA
[4]Badenova, Germany

Correspondence: Sarah Barber (sarah.barber@ost.ch)

Abstract. Digitalisation is a key enabler for accelerating global wind energy deployment; however, digital technologies can create tension between old values and new ones, making so-called "digital organisational culture" a prerequisite for the success of these technologies. This work aims to understand how organisational culture is related with digitalisation by organisations in the wind energy sector. To answer this question, a literature review was first performed to gain an overview of organisational culture and digitalisation of wind energy. Then the literature review was complemented by an online survey, conducted between March and September 2024. The online survey was addressed to stakeholders from the wind energy sector from 17 countries. The results show that teams, rather than whole organisations, are the stronger engines of digitalisation culture, and companies outperform universities and research and technology organisations. Size has little bearing on cultural readiness, and digital momentum rises bottom-up while large organisations lag in funding and tools. Large organisations supply more formal training, small ones give better support to unsure staff, and team culture depends more on its leaders and members than on hierarchy or number of employees. Qualitative comments identify the main barriers to digitalisation to be lack of resources, vague strategies, siloed structures, risk-averse leaders, and weak digital skills. Suggested solutions include earmarking time and money, creating explicit strategies, improving communication and leadership, rewarding innovation, and investing in targeted training or specialist hires. Finally, a list of recommendations and implementation suggestions are presented, intended to help team leaders and relevant decision-makers in fostering digitalisation.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

1 Introduction

Digitalisation is widely recognised as a key enabler for accelerating global wind energy deployment, through its potential to improve efficiency, create insights, and develop products and services (Clifton et al., 2023). Recently, digitalisation was named one of the five "megatrends" in wind energy[1]. However, digital technologies can create tension between old values and new ones, as their introduction leads to an anticipated change and disruption, which in turn give rise to concerns. This makes so-called "digital organisational culture" a prerequisite for the success of these technologies (Martínez-Caro et al., 2020). "Organisational culture" refers to an organisation's beliefs, values and attitudes, and how these influence the behaviour of its employees (McDermott and Stock, 1999). "Digital organisational culture" refers to aspects of organisational culture that specifically influence digitalisation, such as a culture of digital innovation and a transparent digital strategy (Martínez-Caro et al., 2020). A recent study showed that organisational culture is one of the three main challenges to digitalisation in wind energy (Clifton et al., 2023), and that aspects of organisational culture such as open feedback processes, positive handling of failures, creativity, and innovation can have a large impact on digitalisation, e.g. by affecting how readily data is shared, how digital technologies are tried and tested, or how AI-based systems and digital twins are designed and used. At the same time, particular challenges in the wind energy sector such as extreme siloed attitudes (Barber et al., 2022, 2023) could make implementing a digital organisational culture difficult.

Previous research from other industries also shows that digitalisation depends on organisational culture, and in particular on cultivating values that reward experimentation, transparency and cross-boundary learning. For example, a case study of large German manufacturers found that Industry 4.0 projects gradually nudged company cultures toward greater collectivism, long-term orientation and tolerance for failure, but only when the middle management reinforced top-level digital vision (Pfaff et al., 2023). In banking, it was shown how limited cross-functional collaboration and low levels of agile leadership stalled the digital ambitions of an Indonesian regional bank (Wintarto et al., 2024), and how a supportive digital culture links to higher employee performance in private banks (Mahayani and Darma, 2025). In healthcare, a qualitative study of Australian health-service managers identified cultural barriers such as resistance to change, low trust and siloed data governance as the main obstacles to realising the benefits of digital technologies (Brommeyer et al., 2024).

As well as organisational culture influencing digitalisation, digitalisation also influences organisational culture. In fact, there is likely to be an interplay between these effects. Recent work showed, for example, that when SMEs embed analytics, cloud, and automation, shared values shift toward experimentation, speed, and continuous learning (Hasan et al., 2025). Furthermore, digital project tools have been shown to flatten hierarchies and normalise cross-functional teaming, but only when senior leaders frame technology adoption as a cultural, not purely technical, change (Soncco et al., 2025). Finally, digital workplaces have been linked to higher employee innovative behaviour, but only when the surrounding culture actively rewards risk-taking and knowledge sharing (Bindel Sibassaha et al., 2025).

Overall, the current literature indicates that there is a link between organisational culture and digitalisation. However, to date little is known about organisational culture and digitalisation in the wind energy sector, and founded studies and systematic

[1] https://etipwind.eu/publications/#FMT202410

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

data are lacking. This work addresses this gap by studying the interplay between how organisational culture can influence digitalisation, and how digitalisation can influence organisational culture in the wind energy sector. It is based on the IEA Wind Task 43 Culture Questionnaire survey, which is first introduced in Section 2. The results are presented in Section 3, examined in Section 4, and discussed in Section 5. Finally, Section 6 summarises the conclusions of the work. This paper expands on the work presented at WESC2025 (Barber et al., 2025).

2 The IEA Wind Task 43 Culture Questionnaire survey

IEA Wind Task 43[2] is part of the International Energy Agency's (IEA) Wind Technology Collaboration Programme, an international cooperation of 22 countries and two sponsor members that share information and research activities to advance wind energy deployment[3]. IEA Wind Task 43 focuses on the topic of digitalisation, acting as a digital transformation catalyst by driving open collaboration within and beyond the wind community.

In order to gain first insights on organisational values and digitalisation in organisations in the wind energy sector, the "IEA Wind Task 43 Culture Questionnaire" survey was conducted between March and September 2024. The survey was conducted online and managed through the EUSurvey portal. It was aimed at employees in the wind energy sector, as well as employers. A convenience sampling strategy was employed due to the absence of a comprehensive or systematic address database of wind energy organisations in the participating countries. The survey was developed and pretested by the research team. Participation was voluntary and participants were informed about the handling of the data and the purposes of the study. The survey included questions on the following topics:

- Respondent demographics
- Perceived overall level of how well the culture in the respondents' organisation and team foster digitalisation
- Perceived level of implementation of 15 different aspects of organisational culture that could be linked to digitalisation, both in the respondents' immediate team and in their top-level organisation
- Ranking of the top three aspects of organisational culture the respondents would like to see both their organisation and their team support more
- Open-ended questions focused on barriers to fostering digitalisation through organisational culture and ideas for solutions to overcome these barriers

The 15 aspects of organisational culture considered important for fostering digitalisation were defined based on the literature review, expert knowledge of the research team and a pre-survey with the members of IEA Wind Task 43 (Table 1). The survey distinguished between organisational culture in teams as well as in organisations by dividing questions for "teams" and "organisations". Because organisations tend to be more complex in reality, we supported respondents in answering the questions by giving the following explanation of the differentiation between organisation and team: *Your organisation refers to the organisation you referred to when registering your details. It is the organisation you work for, who provide you with*

[2]https://iea-wind.org/task43/
[3]https://iea-wind.org/

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

support and structures related to general activities such as employment, career development, expenses, travel, etc. Your team refers to the people you work with on a regular basis within your organisation. It can be the team you manage or the team you work within, depending on your situation. If you have the situation that your team IS your organisation (only the case if your organisation is so small that there are not any separate teams), then you can choose "not applicable" on questions related to team."

Please find the entire survey on the EU Survey website[4].

Aspect	**Description**
Open feedback culture	Giving constructive feedback is encouraged and supported
Collaborative culture	Collaboration within and beyond the organisation is encouraged and/or rewarded
Creative culture	Creativity is supported
Innovation culture	Innovation is supported
Positive failure culture	Room to try things out, take risks, make mistakes
Digital culture	Visible positive attitude towards, and encouragement of digitalisation efforts
Open feedback culture	Giving constructive feedback is encouraged and supported
Effective change management	A systematic approach to dealing with the change in the organisation
Availability of digital skills training	Anything ranging from content creation, e-commerce, network security, UX/UI design, digital marketing, social media marketing, data analytics, data visualisation, programming skills, data engineering
Availability of communication training	Any course related to communication
Availability of leadership training	Any course related to leadership
Support for uncertain staff members in fostering digitalisation	Such as fear of being replaced by AI or not having the skills to use digital tools
Availability of digital experts	The availability of digital experts (digitally capable people) and their possibility to share knowledge
Existence of a digitalisation strategy	A specific strategy to foster digitalisation
Availabilty of digitalisation budget	Such as budget For implementing something in the digitalisation strategy

Table 1. The 15 aspects of organisational culture considered important for fostering digitalisation.

There were a total of 92 responses from 17 countries, with 63% residing in Europe and 34% in North America. Some of the other important demographics relevant to this study are shown in Figure 1. The respondents were evenly distributed between universities or research and technology organisations (RTOs) (51%) and other organisations (49%) (Figure 1(a)). 66% belonged to teams under ten people (Figure 1(b)), and 51% belonged to organisations under 1'000 employees (Figure 1(c)). Additionally, 66% of the respondents were male, lower than the proportion of men in the wind energy workforce found in an

[4]https://ec.europa.eu/eusurvey/runner/IEAWindTask43CultureSurvey2024

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

IRENA report in 2020 of 79% (IRENA). Therefore, women are overrepresented in this survey compared to the sector as a whole. This observation is not examined further here.

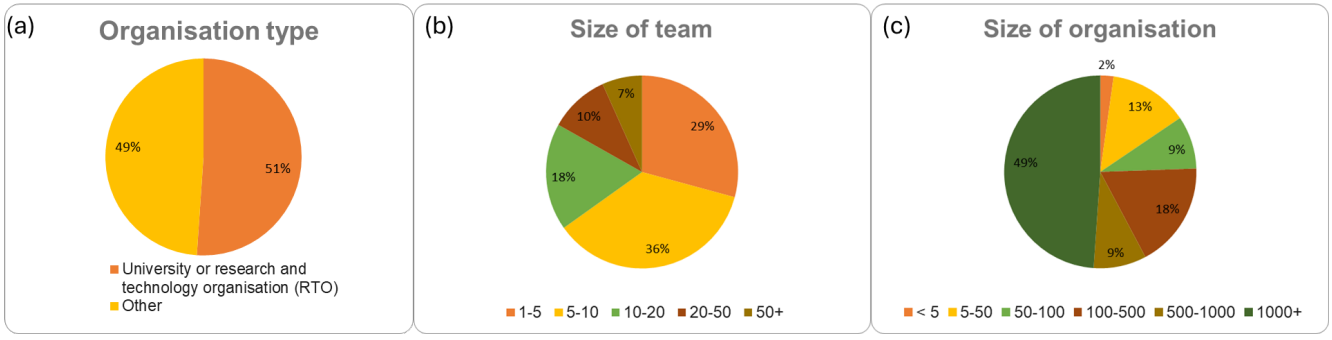


Figure 1. Key demographics of the respondents.

3 Results

In this section, the results of the perceived level of implementation of the 15 aspects of organisational culture are first shown, then the rankings of needed support, followed by the open-ended questions.

3.1 Overall perception

Figure 2 shows the perceived overall level of how well the culture in the respondents' organisation and team foster digitalisation on a scale of 1-5 (1 = not at all implemented; 5 = implemented very well), calculated by averaging the scores over all the respondents and then over the following sub-set pairs:

- Organisation type: "Universities / RTO" and "Other organisation types"
- Organisation size: "Small organisation size" (below 1'000 employees) and "Large organisation size (1'000 employees and above)
- "Small team size" (below 10 team members) and "Large team size" (10 team members and above)

The error bars show the standard error, SE_x for each aspect, x, for both team and organisation, calculated as follows:

$$SE_{\bar{x}} = \frac{s}{\sqrt{N}} \tag{1}$$

where s = standard deviation, N = number of samples, and $\bar{x}$ = average score for aspect x. The t value is then calculated to test the significance between two given average scores $\bar{x}_A$ and $\bar{x}_B$ as follows:

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

$$t = \frac{\bar{x}_A - \bar{x}_B}{\sqrt{\frac{s_A^2}{N_A} + \frac{s_B^2}{N_B}}} \tag{2}$$

If the t value is above 1.96 for a given difference $\bar{x}_A - \bar{x}_B$, it is significant at the 5% confidence level.

For this data, t values have been calculated by taking the difference between the average scores for team and organisation for $\bar{x}_A - \bar{x}_B$ in Equation (2) for all respondents and the sub-sets results. The resulting t values are all above 1.96, except for $t = 1.90$ for the sub-set "Team size above 10".

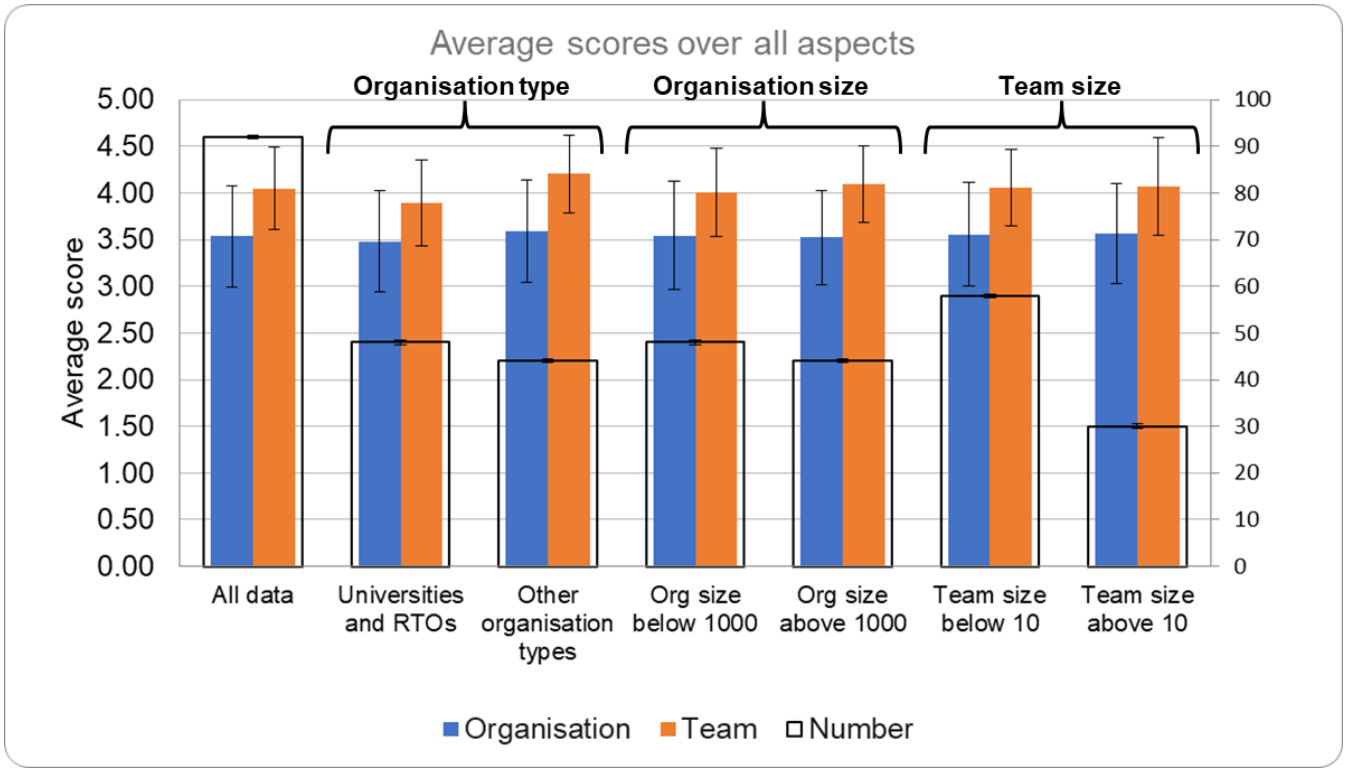
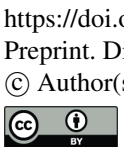


Figure 2. Overall perception of how well organisation (blue) and team (orange) culture foster digitalisation.

3.2 The 15 aspects of organisational culture

For the 15 aspects of organisational culture, respondents were asked to rate the perceived level of implementation of each aspect on their immediate team and in their top-level organisation on a scale of 1-5 (1 = not at all implemented; 5 = implemented very well). The average scores for each aspect were obtained by first multiplying each score from 1-5 by their relative frequency across all respondents, and then summing the results.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025



eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

Figure 3 shows individual average scores of the 15 aspects of organisational culture for all the respondents, split into team (orange) and organisation (blue). The error bars show the standard error, SE_x for each aspect, x, for both team and organisation, calculated using Equation (1) above. The t value for the largest difference between scores of 1.9 (calculated by subtracting the lowest score of 2.47, obtained for "Digitalisation budget for organisation", from the highest score of 4.37, obtained for "Collaborative culture in team") was calculated to be 9.6, which is significant at the 5% confidence level. The reverse of this calculation shows that a difference of average scores of less than 0.38 is no longer significant.

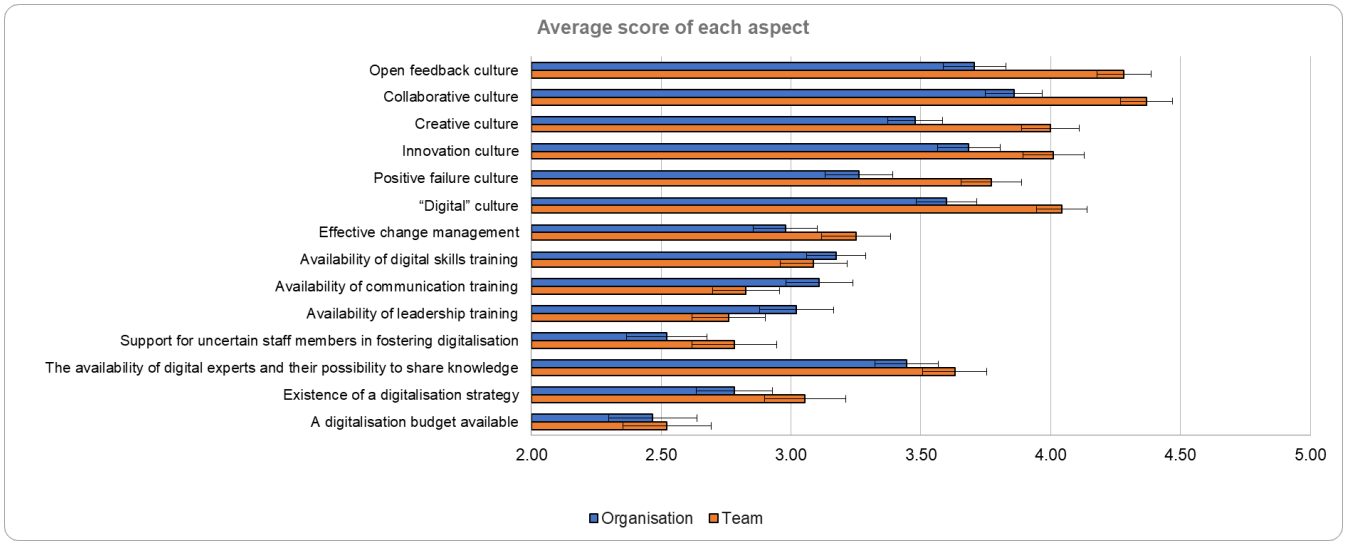


Figure 3. Individual scores for the perceived level of implementation of 15 different aspects of organisational culture for all respondents, for immediate teams in orange and for the top-level organisation in blue. Error bars show the standard errors.

The next three figures show the individual scores for the team on the upper plot (a) and for the organisation on the lower plot (b), for the three sub-sets. The error bars are not shown for clarity, but in each case the results for SE_x and t are comparable to the full dataset.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

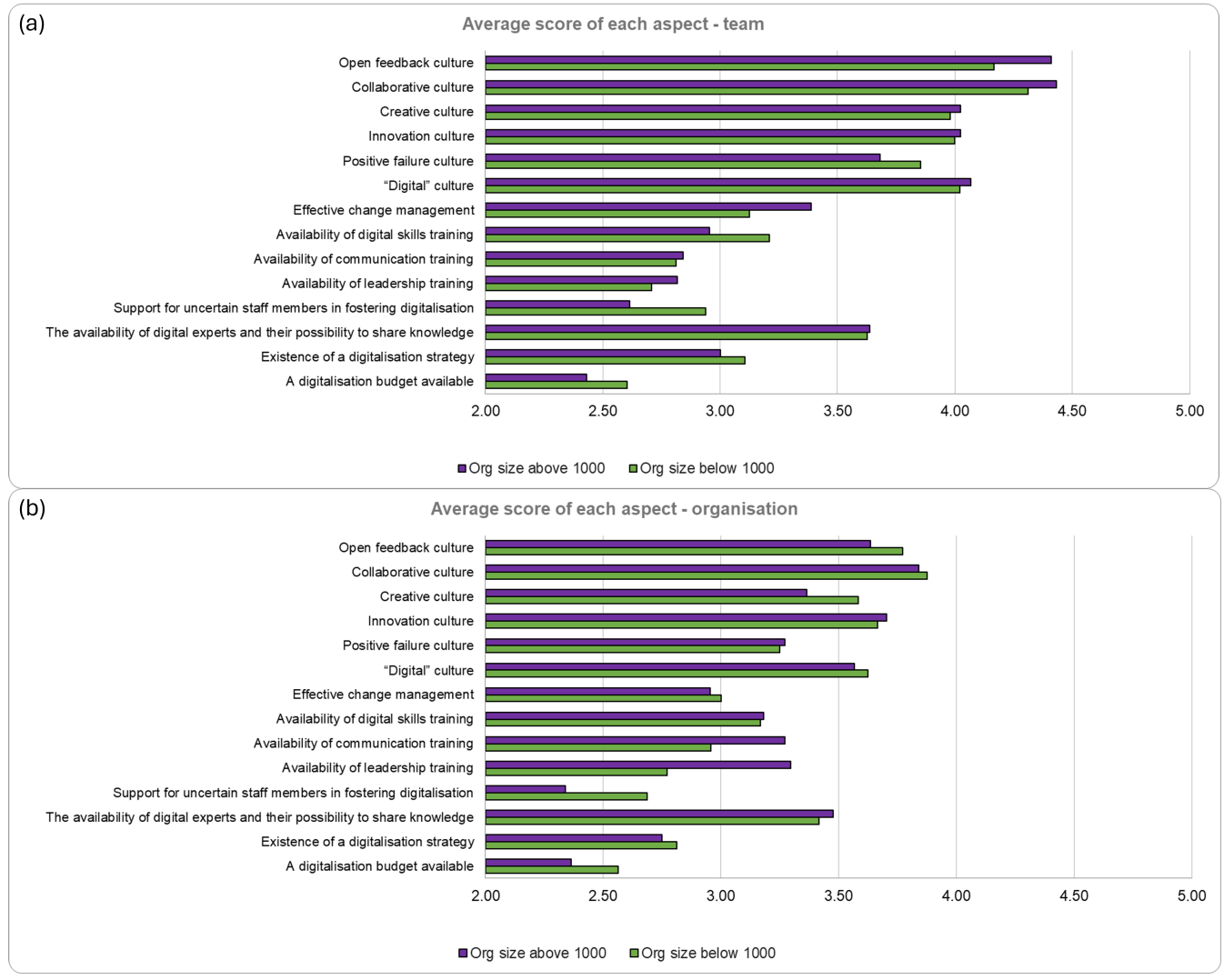


Figure 4. Individual scores for the perceived level of implementation of 15 different aspects of organisational culture for the respondents split into "Organisation size", for (a) immediate teams and (b) the top-level organisation.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

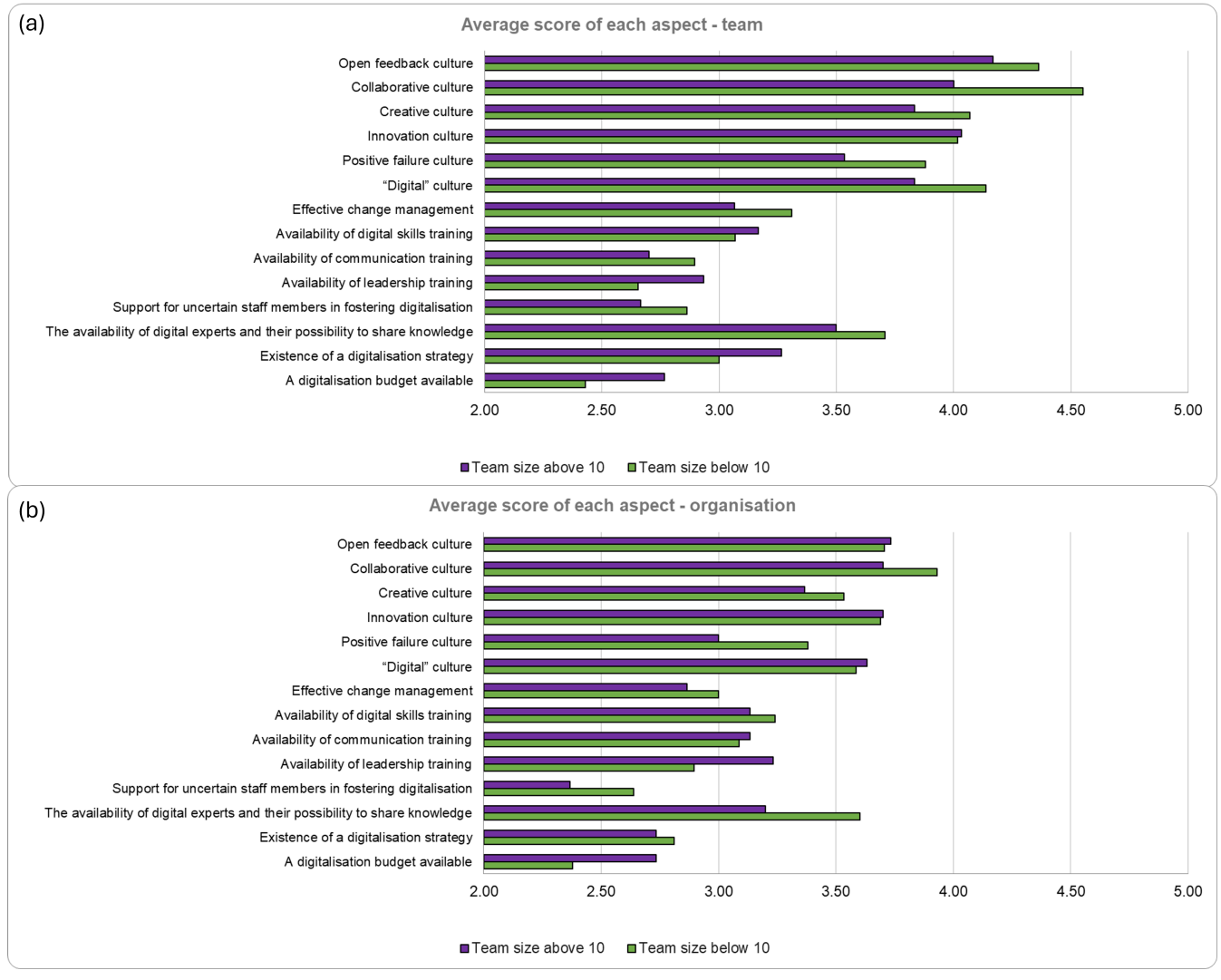


Figure 5. Individual scores for the perceived level of implementation of 15 different aspects of organisational culture for the respondents split into "Team size", for (a) immediate teams and (b) the top-level organisation.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

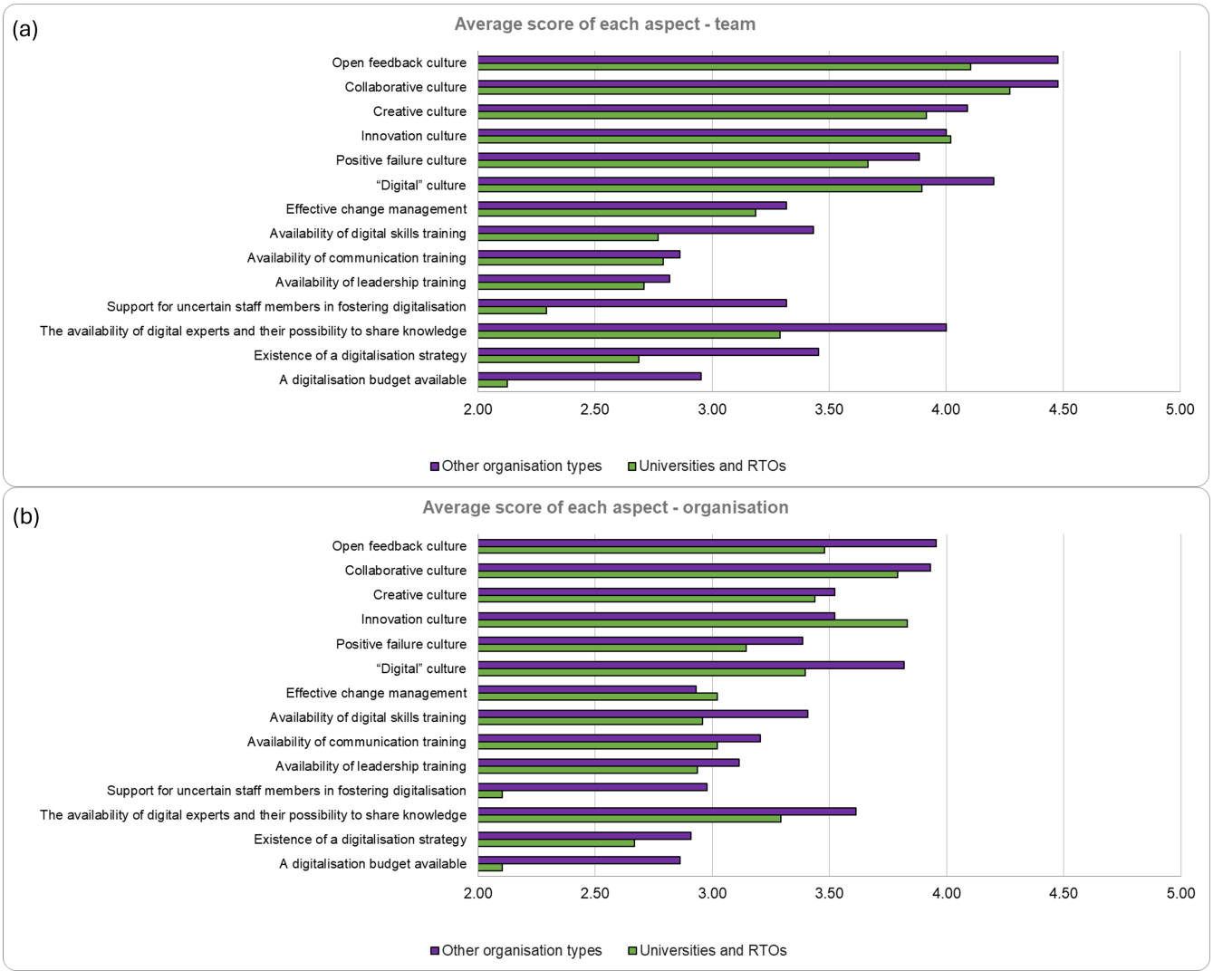


Figure 6. Individual scores for the perceived level of implementation of 15 different aspects of organisational culture for the respondents split into "Organisation type", for (a) immediate teams and (b) the top-level organisation.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

3.3 Rankings

For the ranking questions, each respondent ranked the top three aspects they would like to see both their organisation and their team support more. The top-ranked aspect was assigned a score of three, the second-ranked aspect a score of two, and the third-ranked aspect a score of one. The scores for each aspect were then added up for all respondents and normalised by dividing the individual scores by the total. The resulting are displayed in Figure 7. The ranking scores were also split into the sub-sets examined in Section 3.1, with the results shown in terms of the top three scoring aspects for each sub-set in Table 2. The aspects are coloured thematically.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

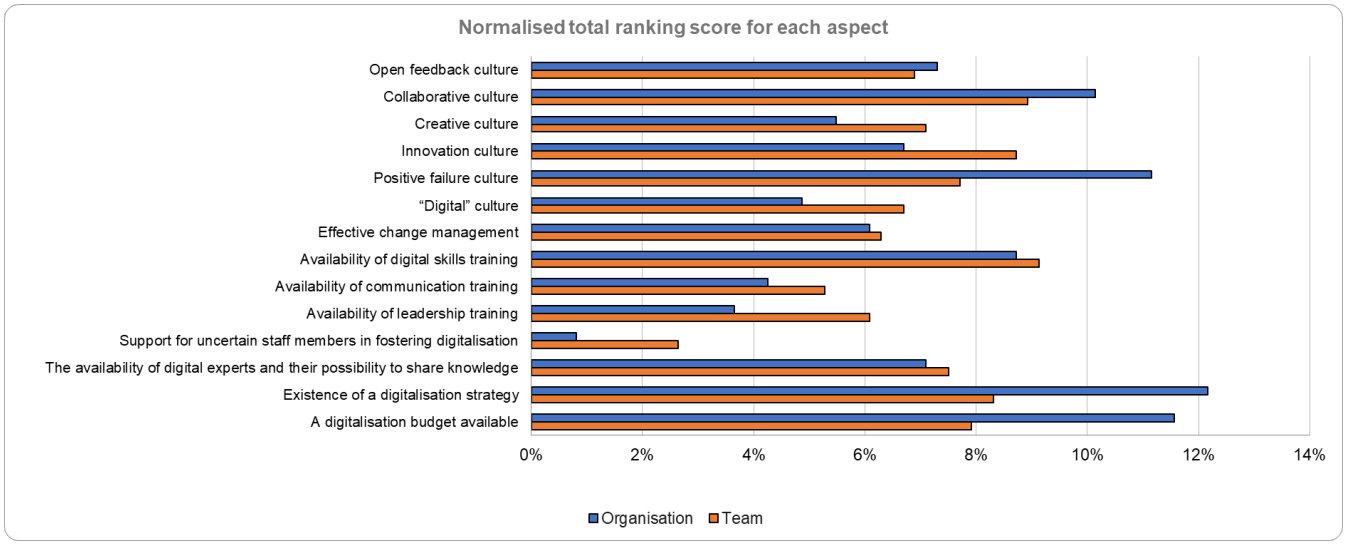


Figure 7. Summary of the normalised ranking scores for the top three aspects respondents would like to see both their organisation and their team support more.

	Organisation			Team		
Data subset	**Rank 1**	**Rank 2**	**Rank 3**	**Rank 1**	**Rank 2**	**Rank 3**
All data	Digitalisation budget	Digitalisation strategy	Positive failure culture	Digital skills training	Collaborative culture	Innovation culture
Organisation type – uni / RTO	Digital skills training	Digitalisation budget	Positive failure culture	Digital skills training	Positive failure culture	Innovation culture
Organisation type – other	Digitalisation strategy	Digitalisation budget	Positive failure culture	Collaborative culture	Digitalisation strategy	Digitalisation budget
Organisation size – small	Digitalisation strategy	Collaborative culture	Positive failure culture	Digital skills training	Collaborative culture	Open feedback culture
Organisation size – large	Digitalisation budget	Positive failure culture	Digitalisation strategy	Digitalisation budget	Innovation culture	Digitalisation strategy
Team size – small	Digitalisation strategy	Positive failure culture	Collaborative culture	Digital skills training	Open feedback culture	Digitalisation strategy
Team size – large	Digitalisation budget	Digitalisation strategy	Digital experts	Innovation culture	Digitalisation budget	Digital experts

Table 2. Top-three factors for each data subset (cells tinted by thematic family).

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

3.4 Open-ended questions

The responses to the questions "What are the main barriers in your team or organisation to improving these aspects?" and "For these difficulties, what ideas for solutions do you have?" are summarised in Figure 8. The answers are divided into five main categories related to the areas of resources, strategy, organisation, leadership, and skills. The barriers are shown in white boxes, and suggested solutions in grey boxes. As no significant difference was found between the team and organisation level, the answers were combined.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

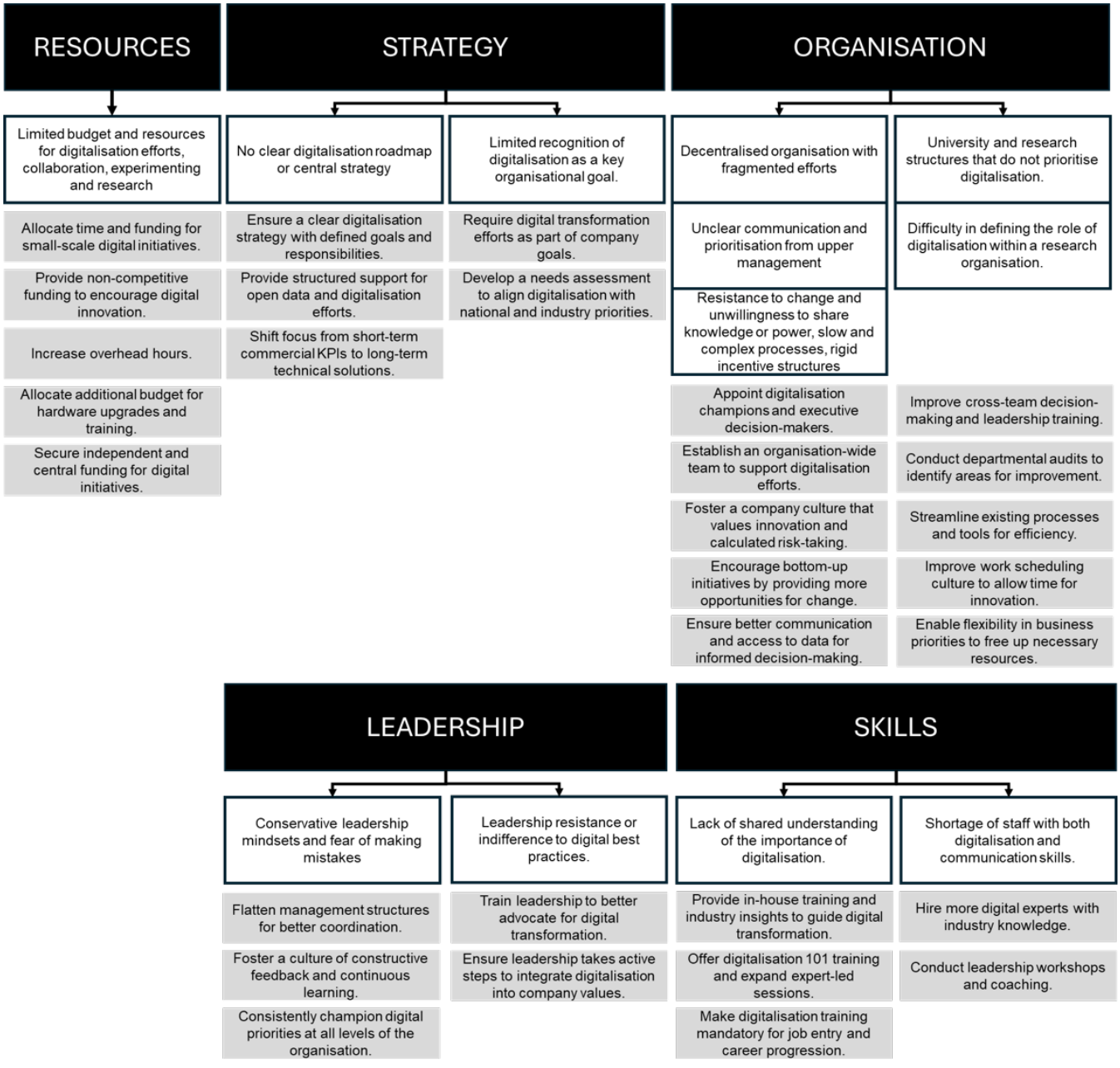


Figure 8. Summary of the open-ended questions asked in the survey.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

4 Interpretation

In this section, the results of the perceived level of implementation of the 15 aspects of organisational culture are interpreted, then the rankings of needed support, followed by analysis of the open-ended questions and a summary of findings.

4.1 Overall perception

For the overall perception results (Fig. 2), it can be seen that teams generally score higher than organisations, with the average score over all aspects for team 0.51 higher than organisation. This indicates that teams are generally able to create a culture conducive to digitalisation better than organisations. Overall, the trend in overall scores of all the data mentioned above remains similar, with the average scores over all aspects for teams being between 0.42 and 0.61 higher than for organisation. For organisation type, universities / RTOs generally score lower than other organisation types, with a difference in average scores of 0.11 for organisation and 0.31 for team. This indicates that companies are able to more effectively enable a digital organisational culture than universities and RTOs, especially within individual teams. For organisation size and team size, there is very little difference between the two chosen groups, indicating that the overall perceived level of implementation of organisational culture aspects relevant to digitalisation does not depend on team or organisation size.

4.2 The 15 aspects of organisational culture

For all respondents, the individual scores show that culture-related scores are relatively higher than the other aspects for both team and organisation, and the availability of a digitalisation budget and support for uncertain staff members are particularly low (Figure 3). This indicates that organisations are reacting to digitalisation “bottom-up”, and they are lagging behind in providing the necessary resources and support. It also indicates that organisations may not set aside a generic digitalisation budget, but instead rely on improvements resulting from digitalisation of a particular area to commercially justify a project. The main differences between team and organisation can be seen in the culture-related aspects, for which team consistently scores higher, with the difference ranging from 0.33 for innovation culture to 0.58 for open feedback culture. This supports the above hypothesis that organisations are lagging behind teams in developing a digital culture. The only aspects for which organisation scores higher than team are for the three training-related aspects, leadership, communication and digital skills training, which would be expected to be provided by the organisation.

For organisation size (Figure 4), the main differences between individual scores can be seen for the organisation. In particular, the availability of leadership and communication training is scored higher for large organisations than small ones (the difference for leadership training is 0.53 and for communication training 0.31). On the other hand, support for uncertain staff members in fostering digitalisation is higher for small organisations than for large ones (with a difference of 0.35). These differences indicate that large organisations are more able to provide staff training, but small organisations support uncertain staff members more effectively. On the team level, the differences are similar to or smaller than on the organisation level, showing that the implementation of different aspects of culture related to digitalisation depends less on organisation size for teams than for

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

the overall organisation. This may be because team culture tends to be driven by the team leaders and members, and is less influenced by the organisation itself.

For team size (Figure 5), small teams observe higher collaborative culture (difference: 0.55) and digital culture (difference: 0.31) scores, and lower availability of digitalisation budget (0.34), digitalisation strategy (0.27) and leadership training (0.27) than large teams. On the organisation level, these trends are partly matched; people in small teams perceive a better collaborative culture within the organisation than people in large teams (difference: 0.30), as for on the team level, but this is not the case for digital culture. Instead, people in small teams perceive a better positive failure culture (difference: 0.38), support for uncertain staff members (0.27) and availability of digital experts (0.40) than people in large teams. Furthermore, small teams observe lower availability of digitalisation budget (0.35) and leadership training (0.33) for both team and organisation. However, the gap between small and large teams for digitalisation strategy is smaller than on the team level. Overall, the results indicate that organisations could foster digitalisation in small teams by providing them with more digitalisation budget, a clearer digitalisation strategy and more leadership training, and foster digitalisation in large teams by enabling a better failure culture, and providing support for uncertain staff members and access to digital experts.

For organisation type (Figure 6), higher scores for digitalisation budget, digitalisation strategy, availability of digital experts, support for uncertain staff members, availability of digital skills training, digital culture and open feedback culture can be seen for other organisation types compared to universities and RTOs on both the team and organisation level. The highest difference in scores for these aspects are 0.88 for support for uncertain staff members, 0.76 for the availability of a digitalisation budget, and 0.71 for the availability of digital experts, all at the team level. For the organisation level, the main differences are in the support for uncertain staff members, availability of digitalisation budget, and open feedback culture, digital culture. This indicates that universities and RTOs particularly need to work on fostering digitalisation, and should focus on supporting uncertain staff members, providing a digitalisation budget and making digital experts available to teams, as well as by fostering an open feedback culture and a digital culture in top-level organisations.

4.3 Rankings

For the rankings (Figure 7), it can be seen that the range of scores is higher for the organisation level than for the team level, with the organisation scores ranging from 1% to 12% and the team scores ranging from 3% to 9%. This shows lower consensus regarding those aspects respondents would most like to see their team supporting, with relatively higher consensus on organisation priorities. Secondly, it can be observed that digitalisation strategy, digitalisation budget, positive failure culture and collaborative culture rank highest, meaning that respondents would like to see their organisations (and teams, to a lesser extent) supporting these aspects more. Thirdly, we see that support for uncertain staff members scores very low (1% for organisation and 3% for team), and availability of leadership training and communication training score fairly low (between 4% and 6%), meaning that support of these aspects is not important to the respondents, on average. It is interesting that support for uncertain staff members was perceived as one of the least fostered aspects in Section 3.1 (Figure 3), but appears as the least important aspect that respondents would like to see their organisation or team support more. This indicates that this aspect is not perceived as being important to fostering digitalisation, or perhaps it wasn't understood clearly. The same can be said, to a lesser extent,

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

for availability of leadership and communication training. Finally, the fact that digitalisation strategy and digitalisation budget are ranked so highly for organisation, and at the same time have low overall implementation scores in Figure 3, mean that they are two of the most important aspects that need focusing on in order to foster digitalisation in organisations.

The top three scoring aspects for each sub-set (Table 2) highlight some differences between priorities for different sub-sets. Across every slice of the data, budget, strategy and skills are prioritised, yet their order of importance depend on the sub-set. People within smaller organisations and smaller teams firstly want from their organisation a clear digital strategy, then a constructive attitude toward failure and. For their teams, they want ready access to digital skills training and open feedback loops. People in large organisations and large teams gravitate first toward hard resources, ranking a dedicated digitalisation budget from the organisation above all else. They echo that financial concern for their teams, but also add two distinctive wishes: a stronger innovation culture and reliable access to in-house digital experts. People at universities and RTOs prioritise digital skills training, followed by budget and a positive-failure culture, whereas people in other organisations want a digital strategy and budget from their organisation, and prioritise collaborative culture ahead of those resource-oriented factors for on the team level.

4.4 Open-ended questions

The main barriers and solutions found for the five main categories (Figure 8) are summarised below:

- **Resources:** The main barrier is perceived to be related to insufficient budget and resources for digitalisation efforts, collaboration, experimenting and research. It is suggested that this barrier could be overcome by allocating time and funding for small-scale digital initiatives, providing non-competitive funding to encourage digital innovation, increasing overhead hours, allocating additional budget for hardware upgrades and training, and securing independent and central funding for digital initiatives.
- **Strategy:** One barrier is perceived to be a lack of digitalisation roadmap or central strategy, which could be overcome by ensuring a clear digitalisation strategy with defined goals and responsibilities, providing structured support for open data and digitalisation efforts and shifting the focus from short-term commercial KPIs to long-term technical solutions. A second barrier is perceived to be limited recognition of digitalisation as a key organisational goal, which could be overcome by requiring digital transformation efforts as part of company goals and developing a needs assessment to align digitalisation with national and industry priorities.
- **Organisation:** One category of barrier relevant to "organisation" included a decentralised organisation with fragmented efforts, unclear communication and prioritisation from upper management, resistance to change and unwillingness to share knowledge or power, slow and complex processes, and rigid incentive structures. Solutions to overcome these barriers were suggested to be appointing digitalisation champions and executive decision-makers, establishing an organisation-wide team to support digitalisation efforts, fostering a company culture that values innovation and calculated risk-taking, encouraging bottom-up initiatives by providing more opportunities for change, and ensuring better communication and access to data for informed decision-making. A second category of barrier relevant to "organisation" were related to universities and RTOs, and included university and research structures that do not prioritise digitalisation, as well as the difficulty in defining the

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

role of digitalisation within a research organisation. Suggested solutions included improving cross-team decision-making and leadership training, conducting departmental audits to identify areas for improvement, streamlining existing processes and tools for efficiency, improving work scheduling culture to allow time for innovation, and enabling flexibility in business priorities to free up necessary resources.

- **Leadership:** In this category, barriers were found to be conservative leadership mindsets and fear of making mistakes, solved by flattening management structures for better coordination, fostering a culture of constructive feedback and continuous learning, and consistently champion digital priorities at all levels of the organisation. Other barriers included leadership resistance and indifference to digital best practices, solved by training leadership to better advocate for digital transformation, and ensuring leadership takes active steps to integrate digitalisation into company values.
- **Skills:** One barrier was found to be the lack of shared understanding of the importance of digitalisation, solved by providing in-house training and industry insights to guide digital transformation, offering digitalisation 101 training and expand expert-led sessions, and making digitalisation training mandatory for job entry and career progression. A second barrier was a shortage of staff with both digitalisation and communication skills, solved by hiring more digital experts with industry knowledge, and conducting leadership workshops and coaching.

In summary, the main barriers to improving digitalisation were found to be limited resources and funding, lack of a clear strategy, fragmented organisational structures, conservative leadership, and insufficient digital skills. To overcome these, suggested solutions include allocating dedicated funding and time, creating clear digital strategies, improving communication and leadership, fostering a culture of innovation, and providing targeted digital training and hiring experts.

In general, a few observations about these responses can be made. First, the comments about leadership are expected to be very subjective, and could hint at other underlying issues, which should be investigated more in the future. Next, we observe that a lack of comments about demonstrating the value of digitalisation or how it might contribute to commercial or organisation success and thus be allocated a higher priority. In some areas, it seems digitalisation should be pursued despite, or even rather than, commercial objectives. The reasons for this should be further investigated. Furthermore, the solutions seem to be suggesting that digitalisation should be imposed by directive. It is interesting that other strategies are not explored. Finally, it seems that the respondents view the word "digitalisation" to be a well-defined topic, which can be advocated for and trained in. In the experience of the authors, and noted in previous work such as Clifton et al. (2023) and (Barber et al., 2023), this may not be so clearly the case, and should be investigated further.

Further studies could delve deeper into the priorities of these barriers and solutions for different sub-sets of data, as well as into overlaps or contradictions between the suggestions in the different categories. Individual interviews with some of the respondents could provide a further understanding of the suggestions.

4.5 Summary of findings

It was found that teams generally foster digitalisation through their organisational culture more effectively than entire organisations, with companies outperforming universities and RTOs. Team or organisation size was found to have little impact on

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

overall cultural readiness for digitalisation. The results indicated that digitalisation progresses bottom-up, with organisations slow to provide needed resources. Large organisations offer more training, while smaller ones better support uncertain staff. Team culture is shaped more by leaders and members than by organisational size or structure.

Overall, respondents show far less agreement about what their organisations should strengthen than about their teams, yet across the board they most want greater organisational support for a digital strategy, a dedicated digitalisation budget, and cultures that are collaborative and tolerant of failure, while leadership courses, communication training and help for uncertain staff matter least. When the data is split by size and sector, the same three levers, budget, strategy and skills, dominate but in different orders: small entities put strategy first, universities/RTOs elevate skills training, and large organisations and teams prioritise budget (with big teams also calling for stronger innovation culture and in-house digital-expert access).

The qualitative analysis showed that the main barriers to improving digitalisation were found to be limited resources and funding, lack of a clear strategy, fragmented organisational structures, conservative leadership, and insufficient digital skills. To overcome these, suggested solutions include allocating dedicated funding and time, creating clear digital strategies, improving communication and leadership, fostering a culture of innovation, and providing targeted digital training and hiring experts.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

5 Discussion

5.1 Recommendations and implementation suggestions

Based on the findings of the survey, recommendations and concrete implementation suggestions are made in Table 3. These suggestions are intended to help team leaders and organisational culture decision-makers in fostering digitalisation. They were obtained by taking each finding and brainstorming ideas for implementation in the research team, which includes a Human Resources expert. Finally, the results were split into "Recommendations" (what to do) and "Implementation suggestions (how to get started), based on the time frame of each suggestion.

Findings	Recommendation (What to do)	Implementation suggestion (How to start)
Teams foster digital-readiness better than entire organisations	Empower teams with true ownership for digital transformation, including clear goal-setting, decision-making authority, and accountability for resource use. Make team success stories visible and integrate them into strategic communications.	– Introduce “digital pioneers” within teams with an annual experimentation budget (e.g., 10k), access to tools, and protected time for pilots. – Establish peer-learning formats such as “Show and Fail” sessions or internal demo days to foster cross-team visibility.
Limited budget and slow processes for funding bottom-up digital initiatives	Create a centralised support hub with digitalisation expertise, decision-making capacity, and agile budget access to actively enable team-initiated digital ideas (without conflicting with empowering teams)	– Launch a small “Digital Sandbox” micro-grant scheme with rapid approval cycles – Establish an “Innovation Helpdesk” (e.g., 2 FTEs) that pre-screens MVP ideas, approves funding within five working days, and proactively escalates barriers. – Maintain a digital dashboard to track and communicate supported initiatives across the company.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

No organisation-wide digitalisation strategy	Publish a clear, multi-year roadmap with goals, owners and milestones; embed open data checkpoints (specific points in the project timeline where datasets are released publicly) and long-term Key Performance Indicators	– Form a cross-functional steering committee – Release a multi-year roadmap with regular Objectives and Key Results (OKRs) – Track open data compliance on the executive dashboard
Digitalisation not recognised as a core corporate objective	Make digital transformation a required goal in every business unit; align needs assessments to national and industry priorities	– Embed digital goals in annual scorecards – Benchmark each business unit against external peers to surface the largest gaps
Fragmented, decentralised structure with slow processes and resistance to change	Appoint a Chief Digital Officer and "digital ambassadors"; create a central Digital Office and improve data access; roll out a self-service data lake and collaboration portal	– Staff the Digital Office with a project manager, enterprise architect and data lead – Host regular innovation town-halls and idea challenges
Universities and RTOs lag behind in digital culture	Apply proven team practices; improve leadership capability and cross-team decision-making	– Run regular "show-and-share" demonstrations of team workflows – Compile an internal digital playbook in a shared knowledge base – Rotate "digital champions" between teams to cross-pollinate ideas
Conservative or indifferent leadership blocks digitalisation	Flatten decision layers, train leaders to champion digitalisation, and normalise constructive feedback and continuous learning	– Reduce approval layers for pilot projects – Deliver a brief multi-session executive digital-literacy programme – Hold regular "fail-fast / learn-fast" review sessions

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

Lack of shared understanding of the importance of digitalisation	Provide mandatory "Digital 101" onboarding, expert-led sessions and concise e-learning	– Build bite-sized learning modules tracked in the human resources information system – Host regular expert webinars open to all employees – Require basic certification for promotion to higher roles
Shortage of employees who combine digital and communication skills	Recruit domain-aware digitalisation experts and boost soft-skills coaching	– Launch a targeted recruitment campaign led jointly by human resources and the Chief Digital Officer – For universities and RTOs: Partner with industry for secondments and guest lectures – Create mentoring programmes pairing technical leads with communications coaches
Lack of support for uncertain staff in large organisations	Design hybrid learning formats that combine digital skills training with emotional readiness – for instance, "tech fluency & digital resilience" or "psychological safety in transformation".	– Combine mandatory modules (e.g., tool literacy, cyber hygiene) with optional drop-in sessions ("Digital Friday Clinics") and implement "Learning Circles" at the team level. – In smaller entities, pair younger digital natives with senior professionals for mutual mentoring.
Divergent priorities by size and sector (respondents want small entities to focus on strategy, universities to focus on skills, and large entities to prioritise budget)	Create a "digitalisation maturity profile" per unit (team, department, site) highlighting strengths, barriers, and leverage points – and make them visible on the intranet with regular updates.	– Integrate digital goals into OKRs or target-setting systems that reflect specific local levers. – In large orgs, institutionalise an annual "Digital Culture Ritual" including storytelling, a fail-forward night, and recognition of the boldest digital teams.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

Respondents value collaboration and tolerance of failure more in their teams more than in their top-level organisations	Institutionalise experimentation and blameless learning at the organisational level	– Introduce "failure credits" that can be redeemed for future funding when lessons are shared – Add the number of experiments run to organisational OKRs – Run regular retrospectives

Table 3: Summary of findings, recommendations and implementation suggestions.

5.2 Bi-directional interplay between digitalisation and organisational culture

In the introduction of this paper, it was mentioned that previous work in other industries show that organisational culture can influence digitalisation, but also that digitalisation can influence organisational culture. An interplay between these factors was suggested. The results in Table 3 above confirm this interplay, as discussed below. Culturally cohesive teams, which are characterised by collaborative norms, tolerant attitudes toward failure, and leader-driven support, were perceived to outperform their parent organisations in adopting digitalisation practices, suggesting that an appropriate culture is a prerequisite for successful digitalisation. However, the deficits exposed by digital projects (absence of strategy, fragmented structures, skill gaps) prompt structural changes such as dedicated budgets, organisation-wide roadmaps, in-house experts, which institutionalise the same collaborative, innovation-oriented behaviours at scale, which in turn re-shape the culture. Differences by size and sector further illustrate this loop: large organisations are perceived to respond to digital needs with formal training that embeds learning into the culture, whereas small entities and universities stress strategy or skills, signalling that digital needs lead to a recalibration of the cultural priorities. The strong need for budgets, strategies and failure-tolerant climates, combined with the negligible emphasis on generic leadership courses, indicates that digitalisation both draws upon and actively moulds cultural conditions. Thus, the results confirm that culture influences the success of digital initiatives, while those initiatives, through the resources and practices they require, feed back to transform organisational culture in a mutually reinforcing cycle.

5.3 Limitations of the study

Due to the lack of an international address register or data on employees in the wind energy sector, a convenience sampling strategy was chosen. It is therefore not possible to draw any conclusions about the representativeness or generalisability of the study results. However, the study deals with a field that is currently still under-researched and thus offers a valuable starting point for future studies. Potential sampling bias is addressed by reporting sample characteristics in Section 2. Furthermore, the results were shown to be statistically significant using t tests.

As well as this, the study may not have considered important contextual variables, such as different political or economic conditions in the participating countries or cultural differences. However, this would go beyond the scope of this study and can be investigated in follow-up studies.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

Finally, the survey only represents a snapshot and no conclusions can be drawn about developments or changes over time. Longitudinal data would make this possible. To gain a longitudinal data base for future studies, additional survey waves need to be conducted in future.

5.4 Future trends

Since designing the survey, several trends related to organisational culture and digitalisation have emerged. In particular, recent trends in AI, and especially generative AI such as Large Language Models (LLMs), are expected to have a significant impact on organisational culture. At the recent IEA Wind Task 43 Annual General Meeting 2025[5], experts from academia and industry indicated several expected positive effects of generative AI on organisational culture (including improving training, efficiency, collective knowledge, and democratising use cases within organisations) and well as negative effects (including job security and obsoleteness, over-reliance, deskilling workers, less value of true expertise, loss of trust, hindering learning, algorithm bias). These effects should be further studied. Other effects to be studied in the future could include remote working, political trends, digital offshoring, and digital fatigue.

6 Conclusions

Digitalisation is a key enabler for accelerating global wind energy deployment; however, digital technologies can create tension between old values and new ones, making so-called "digital organisational culture" a prerequisite for the success of these technologies. Previous literature revealed the importance or organisational culture in digitalisation of wind energy, but a lack of relevant studies in wind energy or related fields was found in the literature. This work therefore studied the interplay between how organisational culture can influence digitalisation, and how digitalisation can influence organisational culture in the wind energy sector. It was based on an analysis of the results of the IEA Wind Task 43 Culture Questionnaire survey, which ran between March 2024 and September 2024.

The results showed that teams, rather than whole organisations, are the stronger engines of digitalisation culture, and companies outperform universities and RTOs. Size has little bearing on cultural readiness, and digital momentum rises bottom-up and large organisations lag in funding and tools. Large organisations supply more formal training, small ones give better support to unsure staff, and team culture depends more on its leaders and members than on hierarchy or number of employees. It was interesting to observe that the respondents disagreed far less about what their teams need than about what their organisations should improve. Across every group, three aspects dominate: a clear digital strategy, an allocated budget, and a culture that encourages collaboration and accepts failure. Leadership courses, general communication training, and extra help for hesitant staff trail far behind. Priority shifts by context: small entities put strategy first; universities/RTOs prioritise skills programmes; large organisations and teams rank budget highest, with large teams also calling for stronger innovation culture and in-house digitalisation experts. Qualitative comments identified the main barriers to digitalisation to be lack of resources, vague strategies, siloed structures, risk-averse leaders, and weak digital skills. Suggested solutions include earmarking time and money,

[5]https://iea-wind.org/task43/

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

creating explicit strategies, improving communication and leadership, rewarding innovation, and investing in targeted training or specialist hires.

The results allowed us to create a list of recommendations and implementation suggestions, intended to help team leaders and relevant decision-makers in fostering digitalisation. This then enabled us to confirm the hypothesised bi-directional interplay between organisational culture and digitalisation. In the future, emerging trends such as AI and hybrid workplaces will be examined, and the survey will be repeated in order to identify trends in organisational values associated with digitalisation in wind energy sector.

Data availability. The IEA Wind Task 43 Questionnaire and survey data is freely available on Zenodo (Barber, 2025)

Author contributions. Sarah Barber: project lead, survey design, analysis and interpretation; Anna Maria Sempreviva: survey design, data interpretation and discussion; Jeff Clerc: survey design, data interpretation and discussion; Anne Hegemann: survey design, data interpretation and discussion, definition of implementation suggestions

Competing interests. The authors declare no conflict of interest. The content of the published work is the responsibility of the authors.

Disclaimer. Declaration of the use of generative AI: In this work, ChatGPT-o3 was used to support the team grouping the results of the open-ended questions and in creating the structure of Table 3. Ethics statement: The participation in the IEA Wind Task 43 Questionnaire survey was voluntary. Participants have been informed about the study goals, data protection and data usage in advance and gave their informed consent.

Acknowledgements. This work took place as part of IEA Wind Task 43. We would like to acknowledge the support of the IEA Wind Leadership Team and other members of IEA Wind Task 43. Thanks also to Lisa Kortmann and Des Farren for their valuable feedback.

https://doi.org/10.5194/wes-2025-159
Preprint. Discussion started: 11 September 2025

eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS

References

Barber, S.: The IEA Wind Task 43 Culture Questionnaire - raw data, https://doi.org/10.5281/zenodo.16926008, 2025.

Barber, S., Lima, L. A. M., Sakagami, Y., Quick, J., Latiffianti, E., Liu, Y., Ferrari, R., Letzgus, S., Zhang, X., and Hammer, F.: Enabling Co-Innovation for a Successful Digital Transformation in Wind Energy Using a New Digital Ecosystem and a Fault Detection Case Study, Energies, 15, https://doi.org/10.3390/en15155638, 2022.

Barber, S., Sempreviva, A. M., Sheng, S., Farren, D., and Zappalá, D.: A use-case-driven approach for demonstrating the added value of digitalisation in wind energy, Journal of Physics: Conference Series, 2507, 012 002, https://doi.org/10.1088/1742-6596/2507/1/012002, 2023.

Barber, S., Sempreviva, A. M., and Clerc, J.: The influence of organisational culture on digitalisation in the wind energy sector, https://doi.org/10.5281/zenodo.15751956, 2025.

Bindel Sibassaha, J. L., Pea-Assounga, J. B. B., and Bambi, P. D. R.: Influence of digital transformation on employee innovative behavior: roles of challenging appraisal, organizational culture support, and transformational leadership style, Frontiers in Psychology, Volume 16 - 2025, https://doi.org/10.3389/fpsyg.2025.1532977, 2025.

Brommeyer, M., Whittaker, M., and Liang, Z.: Organizational Factors Driving the Realization of Digital Health Transformation Benefits from Health Service Managers: A Qualitative Study, Journal of Healthcare Leadership, 16, 455–472, https://doi.org/10.2147/jhl.s487589, 2024.

Clifton, A., Barber, S., Bray, A., Enevoldsen, P., Fields, J., Sempreviva, A. M., Williams, L., Quick, J., Purdue, M., Totaro, P., and Ding, Y.: Grand challenges in the digitalisation of wind energy, Wind Energy Science, 8, 947–974, https://doi.org/10.5194/wes-8-947-2023, 2023.

Hasan, E. F., Alzuod, M. A., Al Jasimee, K. H., Alshdaifat, S. M., Hijazin, A. F., and Khrais, L. T.: The Role of Organizational Culture in Digital Transformation and Modern Accounting Practices Among Jordanian SMEs, Journal of Risk and Financial Management, 18, https://doi.org/10.3390/jrfm18030147, 2025.

IRENA: Wind Energy: A Gender Perspective, IRENA, /-/media/Files/IRENA/Agency/Publication/2020/Jan/IRENA_Wind_gender_2020.pdf.

Mahayani, M. and Darma, G. S.: Digital Banking, Digital Culture, Organizational Learning, Innovation, and Employee Performance, Jurnal Manajemen, 29, 66–87, https://doi.org/10.24912/jm.v29i1.2357, 2025.

Martínez-Caro, E., Cegarra-Navarro, J. G., and Alfonso-Ruiz, F. J.: Digital technologies and firm performance: The role of digital organisational culture, Technological Forecasting and Social Change, 154, 119 962, https://doi.org/https://doi.org/10.1016/j.techfore.2020.119962, 2020.

McDermott, C. M. and Stock, G. N.: Organizational culture and advanced manufacturing technology implementation, Journal of Operations Management, 17, 521–533, https://doi.org/https://doi.org/10.1016/S0272-6963(99)00008-X, 1999.

Pfaff, Y. M., Wohlleber, A. J., Münch, C., Küffner, C., and Hartmann, E.: How Digital Transformation Impacts Organizational Culture – A Multi-hierarchical Perspective on the Manufacturing Sector, Computers & Industrial Engineering, 183, 109 432, https://doi.org/10.1016/j.cie.2023.109432, 2023.

Soncco, J., Rodríguez, C., and Fernández, C.: Organizational culture and digital transformation in the management of Information Technology projects: A case study., Technology Rain Journal, 4, https://doi.org/10.55204/trj.v4i1.e57, 2025.

Wintarto, R., Meiliani, M., and Carolin, A.: Digital Organisational Culture: Capturing Local Banking in Digital Transformation, International Journal of Social Science and Business, 7, 1022–1029, https://doi.org/10.23887/ijssb.v7i4.72306, 2024.