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Organisational design practices for achieving environmental sustainability performance: a best-worst method analysis

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Abstract. This study illustrates a ranking of organisational design practices for achieving environmental sustainability performance. Organisations can achieve environmental sustainability with production processes and operations that aim to reduce raw material and energy usage. Thus, organisations may adopt novel technologies and change work practices to achieve such outcomes. To accommodate such changes, organisations use some organisational design practices. Since there is a lack of studies that summarises such practices illustrating the most important to the least important, I decided to conduct a best-worst method. This method allows a ranking of several criteria that, in the study, are represented by organisational design practices, which are retrieved from the literature. The study results show that the development of the R&D function is the best organisational design practice to achieve environmental sustainability performance.

Keywords: organisational design, sustainability, best-worst method.

1 Introduction

Due to the increasing CO₂ emissions on the planet, acting in a sustainable way is a prerogative for organisations. The concept of sustainability was developed by Carlomagno in 1713, which stresses a strategy allowing for a forever, continuous, perpetual use of the forest. “For this reason, the economy needs to be set in a way that allows people to avoid suffering scarcity, and where it is lumbered, we should strive for young growth at its place” [1]. Recently, in 1987, the Brundtland Commission put a major emphasis on sustainable development – a corollary of sustainability – with the motto “meets the needs of the present without compromising the ability of future generations to meet their own needs” [2]. This call for a rethink of how human activities are conducted. Developing a sustainable world is the duty of every human being, especially for organisations that consume natural resources to create value. In this regard, [3] states that organisations consume an increasing quantity of energy and natural resources, especially the manufacturing, which is the core industry in a national economy. This implies that organisations need to change their production processes to achieve a sustainable society. Moreover, this assumption is even more important because organisations aim

to produce an increasing range of products that use an increasing quantity of natural resources. On the other hand, the sustainable development motto is challenging to operationalise [3], opening the creation of several sustainability frameworks, such as the triple bottom line, sustainable development goals and circular economy [4, 5].

Thus, in this study, I consider the concept of sustainability in environmental terms, i.e. organisational actions that aim to reduce natural and energy consumption.

To address this increasing natural resource consumption and act sustainability, organisations adopt and use advanced digital technologies like Industry 4.0 or change work practices [6].

Although the literature reports the benefits of adopting this countermeasure to reduce raw material and energy usage [7], there is a lack of studies illustrating the organisational design practices to accommodate such organisational change [8, 9]. Moreover, since there are many potential organisational design practices, there is also a lack of studies showing the most important - and less one - organisational design practices for environmental sustainability performance [8].

Therefore, I address this gap by conducting an extensive literature review that reveals the organisational design practices for environmental sustainability performance, and consequently, I conduct the best-worst method. This method is a robust multi-criteria decision-making method that allows ranking a group of criteria that, in our study, are the organisational design practices for environmental sustainability performance.

The study addresses the following questions: “What are organisational design practices and their ranking for environmental sustainability performance?”

The remainder of this paper is as follows. In section 2, I illustrate the theoretical framework. I continue illustrating the methodology and the research protocol in section 3. In section 4, I present the results and discuss them. I conclude the article in section 5.

2 Theoretical Framework

In this section, I illustrate the concept of sustainability and the organisational design practices for achieving environmental sustainability performance. Such practices are retrieved from an extensive literature review conducted in April 2022 using Google Scholar and following the procedure by [10]. I used as search keywords: “environmental sustainability” OR “sustainability” AND “organisational design practice*” AND “clean technolog*” OR “green technolog*”. I selected only articles in English. The final query includes 15 articles.

2.1 The concept of sustainability

The concept of sustainability is rooted in the Latin word *sustenerere*, which means to hold up or keep elevated.

Sustainability is historically used as a synonym for sustainable development. In 1713, Carlowitz was the first to use these terms in his first book on forest sciences. He claims that the timber would be “as important as our daily bread”, and this requires to be “used with caution in a way, that there is a balance between timber growth and

lumbering”. This strategy allows for a forever, continuous, perpetual use of the forest. “For this reason, the economy needs to be set in a way that helps people to avoid suffering scarcity, and where it is lumbered, we should strive for young growth at its place“ [1].

The Brundtland Commission rekindled such an idea of sustainable development in 1987 with their historical motto “meets the needs of the present without compromising the ability of future generations to meet their own needs” [2, pg. 43].

However, this motto was difficult to operationalise, pushing several scholars, professionals and the government to create sustainability frameworks. For instance, the triple bottom line considers sustainability achieved when an organisation reduces raw material and energy consumption and supports human capital development [4]. The sustainability development goals divide sustainability into 17 interrelated objectives that need to be achieved. The circular economy considers sustainability achieved when a model of production and consumption supports the sharing, leasing, reusing, repairing, refurbishing and recycling of existing materials and products as long as possible [5].

Therefore, I consider, in this study, the concept of sustainability in environmental terms, i.e. organisational actions that aim to reduce natural and energy consumption [3].

2.2 Organisational design practices for achieving environmental sustainability performance

To achieve environmentally friendly performance, organisations must change their production processes and work practices [11]. Traditionally, organisations aim to produce goods without considering the environmental impacts. Therefore, organisations are innovating their productions with novel technologies to reduce natural use [12]. The literature reveals that this strategy is valid and leads to the reduction of natural resources, longer product life cycle and potential reuse of products [13–15].

These novel production systems are considered socio-technical, implying that such benefits are realised when the management selects a proper technology and workers are prepared to use it effectively [16–18]. To this end, managers must design organisational practices that accommodate such organisational change. [19] for instance, reveal many organisation design practices to support such changes. Such results are corroborated by [20], which show that organisational practices for environmental sustainability performance vary in different contexts.

The extant literature reports seven organisational design practices for environmental sustainability performance:

Hiring a sustainability manager is a c-level or middle management position in charge of developing a strategy to implement sustainability practices in the organisation. He / She strategically plans sustainability actions and develops a corporate sustainability vision and the accompanying goals, targets, and action plans. A sustainability manager also integrates sustainability issues into strategic tasks, and the suitable strategy depends on the relevance of sustainability issues and the organisational context [21]. Thus, such a manager aims to reduce negative organisational environmental impacts and identify opportunities for sustainable behaviour in organisations [22].

Worker empowerment refers to providing a certain degree of autonomy and control to workers in their day-to-day activities. For instance, manufacturing workers operating with advanced Industry 4.0 technologies are empowered, and they conduct operations and technology supervision to reduce technology malfunctions that create waste and energy loss [11]. Similarly, workers can take quality check activities of peers that reduce faulty product creation [23].

Training courses for sustainability. According to the technologies used by the organisation, workers are enrolled in recurring courses that help workers acquire proper knowledge to act sustainability. In training for technologies, workers learn how to use them and are updated on changes in human-computer interfaces [22, 24]. Thus, workers can block them in case of errors and avoid production scraps [25]. In the case of training related to work practices, workers acquire proper knowledge of the entire process they are involved in and understand how not to commit potential errors to reduce paper or production waste [26].

An organisational culture towards green. Organisational culture refers to a set of shared values and norms that controls organisational members' interactions with each other [8]. Management can create a plan to develop "green" value for the organisations. It is possible through the communicational campaign against waste occurring during operations, meetings and organisational events where workers acquire awareness about the environmental policies of the organisations [27].

Developing an R&D function. It is an adaptive unit investigating new technologies, materials, and best practices to improve products and production processes [28]. [29] show that the R&D function can search for eco-friendly technologies to implement in the organisations, finds new raw materials to use in production and find new solutions to make the production cleaner. R&D has an important role in improving the environmental performance of International; Energy Agency figures indicate that technologies and best practices could save between 18 and 26% of current primary energy use in global industry (https://ec.europa.eu/environment/ecoap/about-eco-innovation/research-developments/eu/427_en retrieved: 18/05/2022).

Promoting mutual adjustment. It is the evolving process with which people use their current best judgment of events rather than standardised rules to address problems, guide decision-making, and promote coordination [8]. [30] shows that mutual adjustment can help organisations use technologies that impact the entire organisation to reduce potential issues effectively. [15] shows that such a strategy increases awareness about product development and sustainability practices.

Using Integration roles. The integration role is used to improve cooperation and integration among some organisational departments [8]. This is a valid strategy when an innovation solely impacts some units, leading to environmental sustainability. This is the case with Industry 4.0 technologies that allow using new eco-friendly materials to reduce energy consumption. To this end, the R&D department and production unit need to collaborate strongly, and the integration role is needed [29].

3 Methodology

The best-worst method (BWM) was developed by Prof. Rezaei to solve multi-criteria decision-making (MCDM) based on pairwise comparison [31, 32]. Compared to further MCDM methods, BWM provides two advantages: 1) it needs less pairwise comparison data compared to a full pairwise comparison matrix, and 2) BWM results are more consistent than those of the other MCDM methods, which use a full pairwise comparison matrix. The method has already been utilised in several real-world problems associated with sustainability [33, 34].

The BWM is structured as follows:

Step 1: Identify a set of decision-making criteria. In this step, a set of criteria $\{c_1, c_2, c_3, c_4, \dots\}$ is chosen for making a decision.

Step 2: The best criterion (e.g. most desirable, most important) and the worst criterion (e.g. least desirable, least important) are determined. In this step, the best and the worst criteria are identified by the decision-maker.

Step 3: The preference of the best criterion over all the other criteria is determined based on a score between 1 and 9, where a score of 1 means equal preference between the best criterion and another criterion and a score of 9 means the extreme preference of the best criterion over the other criterion. The result of this step is the vector of Best-to-Others (BO) which would be: $A_B = (a_{B1}, a_{B2}, \dots, a_{Bn})^T$ where a_{Bj} indicates the preference of the best criterion B over criterion j, and it can be deduced that $a_{BB} = 1$

Step 4: The preference of all criteria over the worst criterion is determined based on a score between 1 and 9. The result of this step is the vector of Others-to-Worst (OW) which would be: $A_w = (a_{1W}, a_{2W}, \dots, a_{nW})^T$ where a_{jW} shows the preference of criterion j over the worst criterion W. It also can be deduced that $a_{WW}=1$.

Step 5: The optimal weights is calculated. The optimal weights of the criteria will satisfy the following requirements: For each pair of w_B/w_j and W_j/W_w , the ideal situation is where $w_B/w_j = a_{Bj}$ and $W_j/W_w = a_{jW}$. Therefore, to get as close as possible to the ideal situation, we should minimise the maximum among the set of $\left\{ \left| \frac{w_B}{w_j} - a_{Bj} \right| \text{ and } \left| \frac{W_j}{W_w} - a_{jW} \right| \right\}$, and the problem can be formulated as follows:

$$\begin{aligned} \min \quad & \max_{of j} \quad \left\{ \left| \frac{W_B}{W_j} - a_{Bj} \right|, \left| \frac{W_j}{W_w} - a_{jW} \right| \right\} \\ & \sum_j W_j = 1 \\ & W_j \geq 0, \text{ for all } j \end{aligned}$$

Problem can be transferred to the following linear programming problem:

Min ξ^L

Subject to

$$\left| \frac{W_B}{W_j} - a_{Bj} \right| \leq \xi, \text{ for all } j$$

$$\begin{aligned} \left| \frac{W_j}{W_w} - a_{jw} \right| &\leq \xi, \text{ for all } j \\ \sum_j W_j &= 1 \\ W_j &\geq 0, \text{ for all } j \end{aligned}$$

By solving the above problem, the optimal weights ($w^*_1, w^*_2, \dots, w^*_n$) and ξ^L can be found.

The arithmetic mean is used to amalgamate the responses of a group of individual decision-makers.

The output from these linearisations will be the weights of the organisational design practices for achieving environmental sustainability. These weights are then combined with the arithmetic average, which gives the average weight of each organisational design practice for achieving environmental sustainability.

3.1 Research protocol

To apply such a complex methodology, an extensive literature review was conducted, identifying seven criteria of organisational design practices for achieving environmental sustainability performance. Table 1 summarises such practices that I discussed in 2.2.

Criteria	Reference
Mutual adjustment	[8, 15, 30]
Setting integration role	[8, 29]
Developing an R&D function	[28, 29]
Training	[22, 26]
Organisational culture	[27]
Worker empowerment	[11, 23]
Sustainability manager	[21, 22]

Table 1 Criteria of organisational design practices for achieving environmental sustainability

Secondly, the study sample was identified from a list of contacts that include academics and practitioners that are experts in organisational practices for environmental sustainability performance. The invitation to the study was sent, and 25 respondents accepted to take part of the study. The survey was administered via e-mail with a Google form.

Afterwards, all the responses were checked, and 5 surveys were dropped because they were not correctly filled. Table 2 shows the information on the study sample. All

the respondents are Italian. Thirdly, the best-worst method was performed over 20 surveys. The method follows all the steps highlighted in the methodology section.

Variable	Frequency	Variable	Frequency
Age		Job	
21-29 years old	40%	Industry-worker	70%
30-39 years old	25%	Industry- middle manager	5%
40-49 years old	25%	Researcher	15%
50-59 years old	10%	PhD students	10%
Educational level			
PhD Degree	5%		
University Degree	50%		
8th-grade diploma	5%		
High school diploma	40%		

Table 2 Sample of the study

4 Results, Discussion and study implications

Table 3 shows the results of the BWM. I illustrate the average weight and the consequent ranking.

Criteria	Average weight	Ranking
Acting on Mutual adjustment	0,130	5
Setting an Integration role	0,122	6
Setting R&D function	0,195	1
Training for sustainability	0,132	4
Acting on Organisational culture	0,148	3
Workers Empowerment	0,152	2
Hiring a Sustainability manager	0,120	7

Table 3 Results of BWM: criteria weights for the 20 respondents

According to our study, developing an R&D function is the best criterion for achieving environmental sustainability, with a criterion weight of 0,192. R&D function is followed by worker empowerment and organisational culture with an average weight of 0,152 and 0,148, respectively. Such results imply that R&D has been seen as a way to the environmental sustainability performance because it can discover potential technologies, materials and solutions in the market that are crucial for environmental sustainability performance [28, 29]. Thus, R&D results are pivotal in conjunction with cleaner

technologies that confirm a socio-technical vision where technologies span different operations across the entire organisation [35].

Workers also play a crucial role in achieving environmentally friendly operations because their activities include practices that reduce waste in the organisations, such as technology management for a defect free-production. Therefore, workers are considered a means to achieve such results, especially when they can better control cleaner technologies [11, 23].

A green organisational culture corroborates such reflections because it can be used to create values and a mindset of eco-friendly operations in organisations [27].

Training is also important – this criterion has a weight close to the organisational culture, but lower – implying that dissemination activities can be coupled with training to prepare workers for effective environmental sustainability performance [22, 26]. This also opens novel studies that link environmental sustainability performance with the human resource department, which is the traditional organisational function that deals with activities.

As a result, these criteria stress the vision that some units and workers are crucial to achieving an environmental sustainability outcome, but the environmental organisation need to be disseminated in the entire organisation. However, the organisational endeavour to disseminate such value can be conducted by several managers, not specialistic sustainability managers. Indeed, hiring sustainability managers is the worst and the less important criterion [21, 22]. Such a result implies that various managers can conduct practices toward sustainability without hiring a new manager. Then, this result suggests that sustainability practices can be learnt from the environment and not developed in organisations. Indeed, I found that adaptive unit like R&D is first in the ranking and training – another important criterion - can also be conducted by external consultants.

Finally, the criteria weight of mutual adjustment and integration role are very low, and it is surprising because these criteria can help collaboration in the organisation, particularly in some units. These results are probably due to the novelty and complexity of organisational design practices for achieving environmental sustainability performance that is often conducted by specialistic workers [29]. Thus, the need to integrate units and leverage mutual adjustment is not critical. Nevertheless, novel research is needed to understand the contribution of these two criteria to environmental sustainability performance.

4.1 Implications for researchers

The study provides some implications for researchers. I suggest that future researchers use other MCDM models, together with our framework, to determine the weights and compare the results of these models with our BWM results. A longitudinal study is required to identify whether the criteria rankings would change over time. I also suggest conducting similar studies investigating organisational design practices to achieve the following sustainability framework: triple bottom line, sustainable development goals or circular economy.

Further research is needed to clarify the role of sustainability managers – the worst and less important criterion. Although this position is mainly related to sustainability, the

study shows that decision-makers do not consider them important. I advocate for an exploratory study – in the form of a case study or multiple case studies, or ethnography - that helps understand such a position and provides more evidence on this role in achieving sustainable performance for organisations.

The most important criterion is setting an R&D function that explores the potential organisational practices for environmental sustainability performance. I advocate further research to create a list of R&D activities and the cause-effect relationship between them and environmental sustainability performance.

4.2 Implications for practitioners

The study provides some implications for practitioners. When adopting novel technologies to improve the environmental performance of organisations, practitioners need to revise their organisational design practices to facilitate the use of advanced technologies. To this end, they can use this study as a guideline for organisational design practices for achieving environmental sustainability performance. Moreover, this study helps practitioners advocate proper financial resources for such practices according to their ranking and importance. Organisations have to strongly invest in R&D units and develop a culture oriented towards green. Finally, to support sustainable development, policymakers must provide financial support to organisations conducting R&D activities.

4.3 Study limitation

This study has a number of limitations. It has an exploratory nature and does not aim for statistical generalisation but provides ample room for improvement and a valuable basis for further research into this subject. The study is conducted in Italy, and all the respondents are Italian. Therefore, these findings can vary globally, especially in Asia and America, where the culture towards work is different from Italy.

5 Conclusion

The study is motivated by a lack of studies that summarise and rank the organisational design practices achieving environmental sustainability performance. These practices are needed to change the operations and production process of organisations that are traditionally not sustainable and accommodate the use of more eco-friendly innovations. To this end, I conduct extensive literature and the best-worst method. This method allows the ranking of several criteria that, in this study, are represented organisational design practices to practices for achieving environmental sustainability performance, retrieved from the literature. The results show that the most important organisational design practices for achieving environmental sustainability performance are developing the R&D function, followed by workers empowerment, acting on organisational culture, training for sustainability, acting on mutual adjustment, setting an integration role and hiring a sustainability manager (the worst one). This result implies that

achieving environmental sustainability is an effort of the entire organisation, and mainly for the R&D function and workers. Setting the R&D function is an effective way to the environmental sustainability performance because it can discover new technologies, materials and solutions from the market. Workers are empowered; thus, they can control advanced technologies in production and reduce their malfunction, improving the environmental sustainability performance of the organisation.

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