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Determinants of Environmental Risk Management at Work Place during and after Pandemic Situations

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Abstract
The research aims to explore and order the factors of environmental risk management at the workplace during and after the period of a pandemic. The design of the research covers the examination of contemporary literature, data collection, analysis, and implications. Through literature examination, a list of determinants is generated which subsequently is approved by a panel of experts. The panel of experts consists of sixteen members from among the heterogeneous groups of stakeholders (i.e. environmental experts/representatives), drawn based on the purposive sampling technique. The population under study is the stakeholders of the environment. The methodology used is ISM and MICMAC. The results of the studies are aligned with the literature upcoming. As per the findings of ISM, the factor 'level of company operations' falls on Level I and is considered the least critical factor. The factor 'environmental analysis of business activities' falls at Level III and is considered the most important factor. As per MICMAC, the factor 'level of company operations' is categorized as a dependent variable. All the rest variables are linkage variables. Being the first study that explores factors of environmental risk management in the workplace, it adds to the literature valuable insights. The research has insightful implications for ecological regulatory authorities, agencies, the international community, researchers, policymakers, and the persons responsible in the industry for environmental harmony since it provides valuable information/insights for deepening the understanding of the phenomenon.
Keywords: *Environmental Risk, Workplace Risk Management, Pandemic, ISM, MICMAC*

INTRODUCTION

Environment is one of the integral components of human as well as animal health. The recent pandemic of 2019 was no doubt a challenge for global health and the environment. Emerged in Wuhan, China in December 2019, and affected more than 210 countries worldwide, is marked as the first pandemic of such type in human history. It has affected all sectors of life, not only health creating threats to many people's lives. One of the other threats after pandemic is the environmental risk at the workplace which has a global impact. It has negligible short-term impacts on our environment with prospective serious long-run implications (López-Feldman et al., 2020; Cheval et al., 2020). This is true, not just for Latin America, but for all the countries experiencing pitfalls in managing environmental risk. The pandemic of 2019 has influenced every aspect of human life including personal, family, and work life. Sufficient literature is available on drivers, consequences, and management of a pandemic in the context of family and personal life. However, the area of work-life is still under-searched. To be precise, the contemporary literature is lacking concerning factors/determinants commensurate to focus while managing the environmental risk at the workplace. Furthermore, the environmental factors identified to date in the literature are heterogeneous and dynamic. The dynamic nature of environmental factors and policy measures adopted to address them influence the environmental and economic systems of many countries (Sarkodie & Owusu, 2021; Zenios, 2024). Barouki et al. reported that the outbreak of pandemic-19 seemed to be related to urbanization & habitat destruction, intensive livestock farming & trade, and global travel. The available extant research has focused on the association between the pandemic and different environmental factors such as air, water, or land pollution. The two-way relationship has been the focus of various authors who reported mixed results in contexts such as Europe,

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the Middle East, and Asia (Espejo et al., 2020; Altaf & Shahzad, 2021; Yan & Sriboonchitta, 2024). The major contributions to the field are mainly contextual studies focused on developed countries, thus research is lacking in providing insights for the developed nations like Pakistan.

The researchers' community has stressed the need for research on the pandemic-19 implications on environmental risk and its management. For example, Barouki et al. (2021) informed that the European Union initiated the H2020 HERA project aimed at identifying research needs on pandemics like pandemic-19. Also, Vadiati et al. (2022) asserted that researchers and scientists' role is to explore and report a pandemic's determinants, consequences, and possible remedies. Facciolà (2021) stressed the need for spreading awareness of the environmental risk amid pandemics. The alarming cost of bearing environmental risk during the pandemic has allowed us to understand and manage such incidences in the future. Han et al. (2022) reviewed the correlation between pandemic-19 incidence and environmental factors by reviewing 100 articles published since January 2020. Three main findings appear as a result of the review. First, individual environmental factors drive pandemic-19 incidence and vice versa. Second, environmental factors are associated with pandemic-19 transmission. Third, lockdowns imposed during the pandemic have improved air quality, shifted wildlife, and depressed socio-economic growth. The researchers asked for more research to explore the interrelationship between a pandemic and the environment. Environmental aspects of the pandemic including environmental uncertainty, environmental risk, environmental impacts, and environmental risk management have been the focus of the research community since the outbreak of the pandemic. In short, literature on the relationship between a pandemic and the environment is scarce. As the pandemic has taken over the world and its aftershocks are getting severe on almost everything including the workplace and at the time of such crisis, companies are being evaluated on how good the companies are in risk management, the topic under study seems plausible. It is important to keep in mind that the cost we have paid or we are paying to tackle the recent pandemic will help us to prevent the future. The research community must raise awareness for the sake of transparency and cooperation on current imminent issues like the one discussed in this study to save millions of lives at every level and part of the world and help the world be prepared for such future incidences.

To sum up, limited literature on the effects of a pandemic on environmental risk management at the workplace with doubtful results creates the need for additional research. Specifically, a comprehensive picture of the factors that are pertinent to environmental risk management in the context of developing nations is required to be added to the literature. Therefore, the current study fills the void by exploring the determinants of environmental risk in the workplace during/after pandemics in Pakistan. This paper provides a detailed investigation into factors critical to environmental risk management and the implications of handling these factors based on their order of criticalness. Furthermore, the factors discussed in the current study remained untouched in prior research, and if ignored, such factors can amplify problems in the future. To be more specific, the objectives of pursuing the current study are: (i) identifying determinants of environmental risk management at the workplace amid/after the pandemic, (ii) creating a structural hierarchy (rank) of the determinants, (iii) classifying the determinants along driving and dependence power, and (iv) highlighting implications of results. The study uses two techniques of analysis namely ISM and MICMAC. A detailed discussion of methodological approaches is provided in the 'Methodology' section. Briefly, ISM is used to create a structural hierarchy of elements by converting the tacit knowledge of experts into an explicit model of hierarchy (Niazi et al., 2019; Iqbal & Mehmood, 2024). The MICMAC analysis provides information regarding variables' driving and dependence power highlighting the most critical factors that are capable of driving the system and is used as a source of robustness check (Basit, Qazi, & Niazi, 2020a; Niazi et al., 2023b; Al Masri & Wimanda, 2024). The study has implications for a broad range of audiences including workers in hospitals, business organizations, and other elderly care vicinities. Moreover, it has implications for environmental regulatory authorities, society, and the economy at large for policy making. A strategic plan can be formulated involving authorities (e.g. government), policy-makers, and organizations to control the emergence and spread of novel pathogens in the future. The organization of the paper is as: the second section reviews the literature in the context of the current study. The third section discusses methodology and overall research design. The fourth section discusses the analysis, results, and different implications of the current research. Finally, the last section discusses the conclusion drawn based on the chosen research design.

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LITERATURE REVIEW

Since the review of contemporary literature is vital for defining the context and scope of the current research, therefore, authors have conducted a comprehensive review of contemporary and relevant literature. For this purpose, a review is conducted on prestigious publishers such as Google Scholar, ScienceDirect, JStor, Wiley-Online, Taylor & Francis, and Emerald, etc. using keywords including environmental risk, environmental risk management, risk management during COVID-19, pandemic risk management, workplace environmental risk management, etc. From the initial collection of 400 plus publications, a final sample of 200 publications is obtained through filtration based on relevance, importance, and contemporariness. Different sectors are being affected by the pandemic viz. education sector, health sector, production sector, hotel industry, travel & tourism, production sector and customer service sector etc. All the papers that contained information on pandemic, its causes and effects and management were retained for establishing background however, the papers that were related to the workplace purely have been considered for contextual arguments. The critical facts identified during the review are presented following:

Background: Since the inception of the pandemic in 2019, several measures have been in use to prevent or at least reduce the severity of the disease. These measures included the use of preventive equipment such as facemasks, hand sanitizers, etc. and government restrictions in the form of lockdowns, social isolation, closure of borders, etc. Both of the categories of measures have mixed results. For example, the preventive equipment is made out of plastic which has its repercussions on the lives of humans.

Various positive and negative repercussions of this equipment are reported by contemporary researchers. The positive aftermaths include air quality, reduced greenhouse gas emissions, decreased water & noise pollution, and reduced tourism activities, which may assist in the restoration of the ecosystem (Rume & Islam, 2020; Raja & Iqbal, 2019). Improved air quality and decreased water pollution were also reported by (Loh et al., 2021; Saadat et al., 2020; Zambrano-Monserrate et al., 2020, Cheval et al., 2020; Toth & Paskal, 2019; Ali & Audi, 2016). Lock-downs, quarantines, border closures, and traveling measures; such as videoconferencing, to mention a few in an attempt to control the percussion of the pandemic, have reduced air pollution (El Zowalaty, Young, & Järhult, 2020; Otero, 2021). Similarly, Zambrano-Monserrate et al. (2020) discussed the positive as well as negative effects of COVID-19 on the environment in the context of most affected countries including China, USA, Italy, and Spain. The negative aftermaths include increased use and disposal of (un)treated medical waste, disinfectants, and plastics in the form of masks and gloves, which continuously endanger the environment (Rume & Islam, 2020). The massive use of hand sanitizers, masks, and prevention kits has significantly contributed to the increase in land pollution (Loh et al., 2021; Saadat et al., 2020; Zambrano-Monserrate et al., 2020, Cheval et al., 2020; Zheka & Vishnevsky, 2022). Huang and Wang (2022) researched the repercussions of using disposable plastic in the form of facemasks and respiratory equipment that have generated millions of tons of plastic being littered into the environment, which, in turn, produces microplastics through physical, chemical or biological processes and raised issue of contaminated ecosystem. Zambrano-Monserrate et al. (2020) identified various alarming threats including reduced recycling and increased waste of biomedical products further contributing to land and water pollution. Urban and Nakada (2021) conducted a study in Brazil to assess the environmental impacts posed by shifts in solid waste production and management during the pandemic by analyzing data from 30 cities representing a population of more than 53.8 million people (25.4% of the Brazilian population). The solid waste production in the subject cities of Brazil has decreased possibly because of social isolation and reduced activity in commercial areas. However, 35% of medical waste e.g., face masks reported as not being treated properly, which may in turn increase the risk of pandemic spread. Furthermore, recycling programs have been suspended, thus, hindering the safety of natural resources. Also, the sale price for such recyclable materials during this suspension reaches more than 781 thousand dollars. These materials are being disposed of in landfills requiring an extra volume of 19,000 m3 thus reducing the landfill lifespan, and hence causing a double loss: economic and environmental. Sousa (2021) also discussed that although the use of plastics has become vital amid the pandemic, this excessive use of plastics during the pandemic is also polluting our environment, which is making socio-environmental problems worsen such as increased pollution of water bodies.

To cut the story short, all the prevention equipment is made out of plastic or plastic products, which are protective in the short run but seem to create alarming threats in the long run. Furthermore, frequent usage of hand sanitizers

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has increased the chances of antimicrobial resistance thereby increasing the chance for other viral diseases. Irfan et al. (2022) and Loh et al. (2021) stressed that the advantageous environmental effects will not be permanent.

Environmental Risk: The 'Risk' is the occurrence of an uncertain event (the outbreak of pandemic), which might have a negative effect(s) on the outcomes of a phenomenon (environmental risk). The Management of Health and Safety at Work (MHSW) Regulations 1999 require and expect all employers, whether organized or self-employed, to assess the risk of their practices on others who may be affected by their actions. The risk assessment is considered the first step in a risk-management procedure (Yarahmadi, Moridi, & Roumiani, 2016). Since the outbreak of the pandemic, the scientific interest in risk assessment and management has increased. Various researches have come up on the front. For example, Sousa (2021) and Kumar (2021) suggested prevention measures for example, the use of facemasks, gloves, hand sanitizers, soaps, respiratory equipment, and Personal Prevention Equipment (PPE), etc. to avoid emergence and spread. Mahmood et al. (2020) asserted a healthy lifestyle with an efficient immune system as recommended by WHO. On the part of preventive measures, WHO recommended alcohol-based hand sanitizers that have known toxic and hazardous impacts on the environment as is depicted through the American Association of Poison Control Center's report. The report contains 9504 alcoholic hand sanitizer exposure cases in children under the age of 12 years and revealed that exposure to even small amounts of alcoholic hand sanitizers can cause confusion, vomiting, drowsiness, and in severe cases, respiratory arrest, and death in children. In addition to preventive equipment as a measure to reduce control infection and mortality rate, the governments had taken restrictive measures such as lockdowns, closure of borders, and other social activities. In addition to controlling the infection, such actions have had positive impacts (Cheval et al., 2020; Lokhandwala & Gautam, 2020; Ali et al., 2021). Roy and Chaube (2021) explored the environmental impacts of COVID-19. With a lockdown approach and a halt in manufacturing industries, air pollution as well as water pollution levels were recorded on a downtrend. In addition, this crisis also caused major biomedical waste, which is detrimental to our environment. Mishra, Mishra and Arora (2021) stress that the uncontrolled human population and anthropogenic activities to prevent and control this pandemic have impacted the environment. Beig et al. (2020) reported the permanent baseline levels of the two most toxic air pollutants in the top-ranked mega cities of India. Their study also uncovers the association between Coronavirus and different environmental and weather markers. Results revealed a strong association of mortality rate with baseline PM2.5 levels with a moderate negative correlation with maximum temperature during the pandemic period. Choi, Tuel, and Eltahir (2021) suggested that air drying capacity and ultraviolet radiation are probable environmental determinants in shaping the transmission of pandemics at the seasonal time scale e.g., in Germany and India.

Environmental Risk Management: The solution strategies to control the spread of the virus have alarming effects on human life and the environment. There should be a balance between human health and environmental safety. The waste plastic can be converted into usable products through green technologies. Less than half of the respondents from China had positive attitudes toward the source control of pollution caused by these disinfectants (Guo et al., 2021). Huang and Wang (2022) asserted on the concept of circular economy that, when put in practice, the side effects of facemasks could be avoided. Another research performed by Zoran (2021) in the context of Madrid (metropolitan region in Spain) revealed that air temperature, planetary boundary layer height, and ground-level ozone have a significant negative relationship with daily new confirmed cases and deaths. Klemeš (2021) conducted research to assess the energy and environmental impacts due to the production of vaccines for the treatment of the disease. The research findings reveal that the vast consumption of vaccines globally and the related consumption of energy in the production, logistics, and waste treatment of the same results in significant environmental footprints. This significant consumption of energy and environmental impacts deserves the attention of policymakers and the authorities to prepare for confronting future pandemics. Silva et al. (2021) reviewed the literature on the role of a pandemic on macro-plastic pollution and its consequences in terms of human health & environmental pollution and emphasized future measures. The study asserted that it is crucial to shift bio-based plastics to sustainable alternatives. Gasmi et al. (2020) suggested that an individual assessment of dietary & nutritional, medical, lifestyle, and environmental risks, along with the proper relevant risk management strategies, is the solution to deal with the pandemic. To visualize improvements in the environment through prevention tools, the researchers made use of different air quality tools such as satellite images, results of real-time onsite monitoring, and Air Quality Index (AQI) calculated by the central pollution control board. For example, Coccia (2020) developed an index to gauge environmental risk exposure of cities/regions due to pandemics. The

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proposed index is used to indicate cities'/regions' exposure to infectious diseases by incorporating environmental, demographic, climatic, and health risk factors. The index ranges from 0 to 1. It assumes a value of 1 for cities/regions that are weak and can lead to high exposure to a pandemic and it assumes a value of 0 to represent an environment that is strong and reduces the risk of exposure to a pandemic.

The emergence and spread of the coronavirus are majorly caused by activities such as habitat fragmentation, deforestation, biodiversity loss, intensive agriculture/livestock farming, uncontrolled urbanization, pollution, climate change, and bush meat hunting & trading. The meteorological factors including population density and living conditions play a significant role in the evolution, severity, and spread of the virus. The pandemic provides opportunities for learning for the future, such as the importance of environmental sustainability for preventing and controlling such disasters. To prevent the onset and spread of future pandemics, Mishra, Mishra, and Arora (2021) emphasized understanding the environment and environmental risks caused by such pandemics and then controlling those factors that are critical.

Environmental Risk Management at the Workplace: The efforts of researchers in the exploration of the virus's nature, structure, causes, measures, and management are at the boom. Coccia (2021) endeavored to analyze the evolution of Coronavirus. The findings of his study revealed that this crisis-driven field of research contributed 1.2 % of scientific research production in the form of notes and short papers over a short time. Organizations vary in how they perceive and manage the risks posed by such pandemics. Nabe-Nielsen et al. (2021) reported that the fear of transmission of infection and risk management varied among different groups of front-line workers in and outside of hospitals as depicted by differences in risk management strategy and extent. The feelings of workplace security counteracted the negative feelings about exposure to infection. The spread of the pandemic has impacted our socioeconomic development, as well as, environmental risk perception (ERP). Through environmental risk perception (Individual and environmental), new ideas for the orderly recovery of society are culminated. Zhang et al. (2021) investigated environmental risk perception in Chinese cities which suggests environmental risk perception in Chinese cities was increased during the pandemic. Cheval et al. (2020) explained the potential impacts of the pandemic on the environment. They argued that the impacts of a pandemic on cities and public health are expected to continue in the coming years. Risk communication strategies highly depend on understanding of differences in risk judgment of residents of a particular area.

In organizations, one of the primary functions is to protect the employees from exposure to environmental hazards, disasters, and disease outbreaks, more specifically, risks relating to sanitation, drinking water, food safety, vector control, mass gatherings, etc. In this regard, the organizations vary concerning control measures they take to protect the lives of their workers and provide safe working conditions. Dobler, Lajili, and Zéghal (2014) disaggregated US firm-level data on environmental risk into different categories of regulation, operation, and nature. Descriptive findings show the level of environmental risk and its management varies from sector to sector and firm to firm within a sector. A negative association occurs between environmental performance and risk. Active risk management does not contribute to environmental performance. Dobler, Lajili, and Zéghal (2014) stressed that linkages between environmental risk and risk management are worth discussing in more differential ways and beyond industry-level assessments in environmental studies. Ryan et al. (2021) stressed that lack of awareness pertains to existing in understanding the environmental-health workforce connections and capabilities. Janmaimool and Watanabe (2014) explored the association between peoples' perceived risks and the factors of risks including the perception of the probability of environmental contamination, receiving impacts, and the severity of its consequences in the context of Thailand. The analysis included psychological factors such as the ability to control, concerns, experiences, and perceptions about the benefits of controlling risks. The survey revealed rational risk judgments by participants in high-risk communities. Spinelli et al. (2021) explored parenting stress amid the pandemic situation. The outbreak of the pandemic has changed the lifestyle of people all around the world resulting in increasing psychological problems. The findings revealed that the parents of children between the ages of 2 to 14 years reported difficulties they experienced during lockdown including increased levels of household chaos, parenting stress increased parents' involvement in their child's daily life, and decreased children's emotional regulation competencies. These disturbances in family life also affect the work life of people. They tend to show counterproductive behaviors.

Environmental risk management helps firms to achieve and sustain competitive advantage. A study by Sharfman & Fernando, (2008) explained that improved environmental risk management is associated with a lower cost of

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capital as economic performance improves as a result of better resource utilization. The findings of the study suggest that the firms benefit through improvement in environmental risk management practices that help reduce the cost of capital by utilizing more debt to equity. Shaw (2020) identified that the lockdown & stay-at-home orders, physical/social distancing, and other personal care strategies resulted in a large number of unemployed. The implications of such measures are unknown and we need to learn how workers adapt and work in these situations. When things get normal, the employers invite workers back to work which highlights the need for employers to know about the distinctive nature of health, disease vulnerability, environmental hazards, job modification, and differences in work style, social capital, and organizational support. Gillespie et al. (2017) reported the relationship between worker, workplace, and community/environmental factors with violence risks through a cross-sectional approach with 280 employees from six emergency departments in the Midwest United States. Results reveal that over 80% of respondents experienced at least one type of workplace violence whereas approximately 40% experienced all three types. These types of violence can impact all employees regardless of worker, workplace, and community/environmental factors. The important takeaway is that the short-term strategies towards a sustainable way of environmental mitigation are not enough. To cope with the undesirable deterioration of the environment, long-run policies must be ensured.

As a result of the review of the relevant, important, and contemporary literature, authors were able to generate a list of factors subject to changes and finalized by a panel of experts is provided in Table 1. The study is based on the twenty factors given in the table.

Table 1: The Determinants of Environmental Risk Management

Code	Determinant	Description	Source
1	Level of Company Operations	An empirical study described that script proficiency increases through proactive training. A person who has legitimate power should use a proactive strategy.	(Nicod, Llosa, & Bowen, 2020)
2	Availability of Environmental Experts	For making an organization socially responsible, individuals' perception of responsibility leads to a positive image of the organization's success.	(Belinda, westerman, & Bergman, 2018)
3	Environmental Audits	The person who has power should admire the efforts of their workers. A study was conducted for the wellness of programs of various types of incentives like cash, gift cards, and tangible rewards.	(Heninger, Smith, & Wood, 2019)
4	Commitment of Management	The term politics has been used to refer to unlawful, self-serving behavior designed to protect or enhance actors' self-interests.	(Chang, Rosen, & Levy, 2009)
5	Pro-activeness of Management	Refers to judging the organization's benefits on one's position and not for the welfare of the organization. Leaders should take initiative and decisions with the consultation of other members of the association.	(Vervimp, 2003)
6	Statutory Obligations	Technology innovation brings change in communication productivity and performance of NGOs'.	(Mao et al., 2020)
7	Level of Impact of Pandemic on Business	Workers should be literate or train employees in high-tech technology and the latest equipment. They need self-efficacy, knowledge of modern technology, learning, and training experiences on the internet and computers.	(Jokisch et al., 2020)
8	Input by Environmental Specialists	NGOs' have a hierarchical structure. It clarifies the importance of optimal use of resources and meeting the set goals.	(Ghasemi et al., 2020)
9	Engagement with Regulators	Employees must follow the rules, regulations, and procedures in the workplace. Service rules & SOPs make employees responsible, active, and obedient.	(Ozduran &Tanova, 2017)

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10	Attitude towards Environmental Regulatory Compliance	Organizational structure disturbs organizational deed and delivers the basis on which standard operating procedures and practices rest	(Anku-Tsede, 2014)
11	Alternative Measure Available	Insufficient funds affect the continuity of operations and tasks.	(Thomas, 2008)
12	Documentation Required	The historical decline in funding is the major challenge faced by NGOs.	(Thomas, 2008)
13	Severity of Non-Compliance	NGOs are required to re-align their urgencies with donor benefits to compete for donations.	(Thomas, 2008)
14	Nature of Environmental Harm	It is important to train employees with the required skills and capabilities in today's modest situation for the sake of increasing the efficiency of NGOs.	(Kadiresan, 2015)
15	Sensitivity of Environment	Employees should continuously improve themselves with the latest training and education.	(Rothwell, Jackson, Ressler, Jones, & Brower, 2015)
16	Technical Knowledge of Environmental Protection	The performance of an organization improves through employee engagement.	(Tensay,, & Singh, 2020)
17	Likelihood of Success	A high workload is negatively associated with engagement, dedication, interest, and stamina.	(Timms, Graham, & Cottrell, 2007)
18	Financial Implications	To achieve higher performance of employees, Additional allowances enhance the motivation of employees.	(Dobre, 2013)
19	Environmental Representative in Pandemic Management Team	Due to higher turnover rates, organizations face greater losses in productivity and performance.	(Park & Min, 2020)
20	Environmental Analysis of Business Activities	Work behaviors are associated with organizational performance. It increased organizational commitment and involvement.	(Gould-Williams & Mohamed, 2010; Tremblay, Cloutier, Simard, Chenevert, & Vandenberghe, 2010; Wright, Gardner, & Moynihan, 2003)

The list of determinants of environmental risk management at the workplace during the period of pandemic is provided along with their descriptions and sources in Table 1.

METHODOLOGY

The methodology section contains information on the nature & procedure of research, research tools, sampling method, size of the sample, inclusion criteria for recruitment of experts on the panel, method & procedure of data collection, and techniques of analysis. The study uses interpretivism as a research philosophy and induction as a research approach. The study begins with a thorough review of the literature, proceeds with data collection & analysis, and ends up with a conclusion & suggestions. The data are collected at one point in time, hence, a cross-sectional study (Saunders et al., 2015). A review of the literature is performed to identify and extract important determinants for the phenomenon. The data refining involves discussion with the experts of the domain to obtain their approval regarding the determinants' relevance, importance, and inclusion in the study. It is a theory-building approach that follows induction reasoning (Saunders et al., 2015). For analysis, the study uses two independent techniques i.e. ISM and MICMAC where the former is used to establish interrelationships among the determinants and prioritize them based on criticalness while the latter is used to classify the determinants in one of the four

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classes namely: i) independent, ii) dependent, iii) linkage and iv) autonomous (Niazi, Qazi, & Basit, 2019a; Basit et al., 2023).

Inclusion Criteria for Experts: A person is considered an expert if he possesses comprehensive knowledge in his domain and is willing to provide information for understanding and finding a solution to a particular problem (Kloker et al., 2018, Stavraki, 2018). In this regard, an expert is required to possess a minimum of ten years of working experience in his domain, environmental risk management in this case (Silva, 2017). To compose a considerable panel of experts, 15-30 experts are needed for a homogeneous group (Raut et al. 2017) and 5-10 experts are needed for a heterogeneous group (Kloker et al., 2018; Niazi et al., 2019a; Niazi, Qazi, & Basit, 2021). The current study recruits a panel comprising sixteen experts i.e. eight from the workplace, three from academia, and five from environmental agencies (Clayton, 1997; Khan & khan, 2013; Qazi et al., 2021a; Qazi, Niazi, & Basit, 2021).

Method & Procedure of Data Collection: To discuss and get the approval of experts on the panel about the relevance of determinants concerning the phenomenon, three rounds of discussion sessions with the experts on the panel were conducted in their field setting (Shaukat et al., 2021; Qazi et al., 2021). During the first round, a rapport was established and the experts were introduced to the phenomenon and the determinants. During the second round, the expert gave their opinion about addition, deletion, merger, modification, and final approval of determinants. During the third round, information regarding the relationship between determinants (i.e. one-way, two-way, or nil relationship) is obtained which paves the way for analysis. To obtain information about the relationship among determinants, a comprehensive close-ended matrix–type questionnaire (Rashid et al., 2021; Qazi et al., 2020a; Hasan et al., 2019).

Techniques of analysis: The study used two standalone analysis techniques namely ISM and MICMAC, the detailed discussion is provided in upcoming respective sections.

Introducing ISM: ISM was first introduced by Warfield in 1973 and is a commonly used technique of analysis & modeling, applied by Rajan et al. (2021); Majumdar, Garg, & Jain, (2021); Zeinalnezhad et al. (2021); James et al. (2020) and Abbass et al. (2022). It is applied in conundrum situations involving complex issues. It is based on an amalgamation of modeling language of words, diagraphs, and discrete mathematics and is applicable for a variety of issues (Sushil, 2017; Warfield, 1973; Warfield, 1974), specifically, useful in finding solutions to complex problems through conversion of less clear and undistinguishable models into a well-clear and well-defined model (Sushil, 2012). The step-wise procedure usually adopted for ISM (Attri et al., 2013; Thakkar et al., 2008; Warfield, 1973; Niazi et al., 2023a; Niazi, Qazi, & Sandhu, 2019) is explained in the upcoming section.

Introducing MICMAC: MICMAC is a standalone analysis technique, introduced by Godet in 1986 that classifies the determinants in four quadrants as follows: (i) the *autonomous* quadrant contains determinants that have weak driving and weak dependence power, (ii) the *dependent* quadrant contains the determinants that have weak driving power but strong dependence power while, (iii) the *linkage* quadrant contains the determinants that have strong driving and strong dependence power and lastly, (iv) the *independent* quadrant contains the determinants that have strong driving but weak dependence power. The classification scheme of MICMAC is valuable as it provides a base for future research frameworks and augments the results of ISM (Qazi, Niazi, & Inam, 2019; Abbass et al., 2022a).

ANALYSIS, RESULTS & DISCUSSION

Structural Modeling through ISM: For data collection, the experts were directed to record the relationship among the determinants, on a matrix-type questionnaire, in the form of VAXO code where *'V'* indicates the paired relationships from rows to columns while *'A'* indicates the paired relationships from columns to rows. *'O'* stands for no relationship between the rows and columns and lastly, *'X'* stands for a two-way relationship between the rows and the columns. After the collection of data, the individual responses of experts about the direction of the relationship among the determinants were aggregated using the principle of "minority gives way to the majority". For this purpose, data is processed on MS Excel using some functions of aggregation. The aggregation performed thereof is provided in Table 2 (popularly known as the Structural Self Interaction Matrix or simply SSIM).

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Table 2: Aggregated Matrix

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1		A	O	A	A	A	A	A	A	A	O	A	A	A	O	A	A	A	O	A
2			V	V	A	V	A	A	O	V	A	A	V	A	A	O	V	V	A	A
3				X	A	A	A	V	V	A	A	A	V	A	A	A	X	V	A	A
4					X	A	A	A	V	A	A	V	V	A	A	V	A	V	V	A
5						V	V	A	V	A	A	A	A	A	X	A	A	V	X	A
6							X	V	A	A	V	V	V	V	X	A	A	V	V	O
7								A	V	V	V	X	A	X	O	A	V	X	A	A
8									A	X	A	V	V	A	A	V	V	O	X	V
9										V	V	A	V	V	A	V	A	V	A	A
10											O	V	A	V	A	A	A	O	V	A
11												V	V	A	V	V	V	V	O	A
12													A	V	V	O	A	A	V	A
13														V	A	V	A	A	V	A
14															V	A	V	V	X	X
15																V	A	X	O	V
16																	X	V	V	V
17																		V	A	A
18																			V	A
19																				O
20																				

The aggregated responses of experts symbolically appear in Table 2 (SSIM) or are converted into a binary matrix in Table 3 (Basit et al., 2019; Basit, Qazi, & Niazi, 2020).

	V	A	X	O
Rule One:	$i \rightarrow j$	$i \leftarrow j$	$i \leftrightarrow j$	$i \nleftrightarrow j$
	1	0	1	0
Rule Two:	$j \rightarrow i$	$j \leftarrow i$	$j \leftrightarrow i$	$j \nleftrightarrow i$
	0	1	1	0

Table 3: Binary Matrix (Direct Reachability)

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1	1	1	1	0	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0
3	0	0	1	1	0	0	0	1	1	0	0	0	1	0	0	0	1	1	0	0
4	1	0	1	1	1	0	0	0	1	0	0	1	1	0	0	1	0	1	1	0
5	1	1	1	1	1	1	1	0	1	0	0	0	0	0	1	0	0	1	1	0
6	1	0	1	1	0	1	1	1	0	0	1	1	1	1	1	0	0	1	1	0
7	1	1	1	1	0	1	1	0	1	1	1	1	0	1	0	0	1	1	0	0
8	1	1	0	1	1	0	1	1	0	1	0	1	1	0	0	1	1	0	1	1
9	1	0	0	0	0	1	0	1	1	1	1	0	1	1	0	1	0	1	0	0
10	1	0	1	1	1	1	0	1	0	1	0	1	0	1	0	0	0	0	1	0
11	0	1	1	1	1	0	0	1	0	0	1	1	1	0	1	1	1	1	0	0
12	1	1	1	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	1	0
13	1	0	0	0	1	0	1	0	0	1	0	1	1	1	0	1	0	0	1	0
14	1	1	1	1	1	0	1	1	0	0	1	0	0	1	1	0	1	1	1	1
15	0	1	1	1	1	1	0	1	1	1	0	0	1	0	1	1	0	1	0	1
16	1	0	1	0	1	1	1	0	0	1	0	0	0	1	0	1	1	1	1	1
17	1	0	1	1	1	1	0	0	1	1	0	1	1	0	1	1	1	1	0	0
18	1	0	0	0	0	0	1	0	0	0	0	1	1	0	1	0	0	1	1	0
19	0	1	1	0	1	0	1	1	1	0	0	0	0	1	0	0	1	0	1	0
20	1	1	1	1	1	0	1	0	1	1	1	1	1	1	0	0	1	1	0	1

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Once the binary matrix is obtained, the 0s present in the direct reachability matrix are checked for transitivity using MS Excel. The transitive relations are represented by 1* in Table 4.

Table 4: Transitive Binary Matrix:

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Driving
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2	1	1	1	1	1*	1	1*	1*	1*	1	1*	1*	1	1*	1*	1*	1	1	1*	0	19
3	1*	1*	1	1	1*	1*	1*	1	1	1*	1*	1*	1	1*	1*	1*	1	1	1*	1*	20
4	1	1*	1	1	1	1*	1*	1*	1	1*	1*	1	1	1*	1*	1	1*	1	1	1*	20
5	1	1	1	1	1	1	1	1*	1	1*	1*	1*	1*	1*	1	1*	1*	1	1	1*	20
6	1	1*	1	1	1*	1	1	1	1*	1*	1	1	1	1	1	1*	1*	1	1	1*	20
7	1	1	1	1	1*	1	1	1*	1	1	1	1	1*	1	1*	1*	1	1	1*	1*	20
8	1	1	1*	1	1	1*	1	1	1*	1	1*	1	1	1*	1*	1	1	1*	1	1	20
9	1	1*	1*	1*	1*	1	1*	1	1	1	1	1*	1	1	1*	1	1*	1	1*	1*	20
10	1	1*	1	1	1	1	1*	1	1*	1	1*	1	1*	1	1*	1*	1*	1*	1	1*	20
11	1*	1	1	1	1	1*	1*	1	1*	1*	1	1	1	1*	1	1	1	1	1*	1*	20
12	1	1	1	1*	1	1*	1	1*	1	1*	1*	1	1*	1	1	1*	1*	1*	1	1*	20
13	1	1*	1*	1*	1	1*	1	1*	1*	1	1*	1	1	1	1*	1	1*	1*	1	1*	20
14	1	1	1	1	1	1*	1	1	1*	1*	1	1*	1*	1	1	1*	1	1	1	1	20
15	1*	1	1	1	1	1	1*	1	1	1	1*	1*	1	1*	1	1	1*	1	1*	1	20
16	1	1*	1	1*	1	1	1	1*	1*	1	1*	1*	1*	1	1*	1	1	1	1	1	20
17	1	1*	1	1	1	1	1*	1*	1	1	1*	1	1	1*	1	1	1	1	1*	1*	20
18	1	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1	1	1*	1	1*	1*	1	1	1*	20
19	1*	1	1	1*	1	1*	1	1	1	1*	1*	1*	1*	1	1*	1*	1	1*	1	1*	20
20	1	1	1	1	1	1*	1	1*	1	1	1	1	1	1	1*	1*	1	1	1*	1	20
Dependence	20	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	18	

At the next step, the transitive binary matrix is partitioned through the iteration method and as a result, a conical matrix is obtained that is presented in Table 5. Here, it is worth mentioning that the iterations were performed and a directed graph was prepared but, both being optional, have been skipped for brevity in reporting (Abbass et al., 2022; Niazi et al., 2020; Niazi, Qazi, & Basit, 2019b).

Table 5: Conical Matrix

Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Driving
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2	1	1	1	1	1*	1	1*	1*	1*	1	1*	1*	1	1*	1*	1*	1	1	1*	0	19
3	1*	1*	1	1	1*	1*	1*	1	1	1*	1*	1*	1	1*	1*	1*	1	1	1*	1*	20
4	1	1*	1	1	1	1*	1*	1*	1	1*	1*	1	1	1*	1*	1	1*	1	1	1*	20
5	1	1	1	1	1	1	1	1*	1	1*	1*	1*	1*	1*	1	1*	1*	1	1	1*	20
6	1	1*	1	1	1*	1	1	1	1*	1*	1	1	1	1	1	1*	1*	1	1	1*	20
7	1	1	1	1	1*	1	1	1*	1	1	1	1	1*	1	1*	1*	1	1	1*	1*	20
8	1	1	1*	1	1	1*	1	1	1*	1	1*	1	1	1*	1*	1	1	1*	1	1	20
9	1	1*	1*	1*	1*	1	1*	1	1	1	1	1*	1	1	1*	1	1*	1	1*	1*	20
10	1	1*	1	1	1	1	1*	1	1*	1	1*	1	1*	1	1*	1*	1*	1*	1	1*	20
11	1*	1	1	1	1	1*	1*	1	1*	1*	1	1	1	1*	1	1	1	1	1*	1*	20
12	1	1	1	1*	1	1*	1	1*	1	1*	1*	1	1*	1	1	1*	1*	1*	1	1*	20
13	1	1*	1*	1*	1	1*	1	1*	1*	1	1*	1	1	1	1*	1	1*	1*	1	1*	20
14	1	1	1	1	1	1*	1	1	1*	1*	1	1*	1*	1	1	1*	1	1	1	1	20
15	1*	1	1	1	1	1	1*	1	1	1	1*	1*	1	1*	1	1	1*	1	1*	1	20
16	1	1*	1	1*	1	1	1	1*	1*	1	1*	1*	1*	1	1*	1	1	1	1	1	20
17	1	1*	1	1	1	1	1*	1*	1	1	1*	1	1	1*	1	1	1	1	1*	1*	20
18	1	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1	1	1*	1	1*	1*	1	1	1*	20
19	1*	1	1	1*	1	1*	1	1	1	1*	1*	1*	1*	1	1*	1*	1	1*	1	1*	20
20	1	1	1	1	1	1*	1	1*	1	1	1	1	1	1	1*	1*	1	1	1*	1	20
Dependence	20	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	18	

The gray cells on diagonals of the conical matrix represent the extraction of the ISM model, developed based on partitions performed previously.

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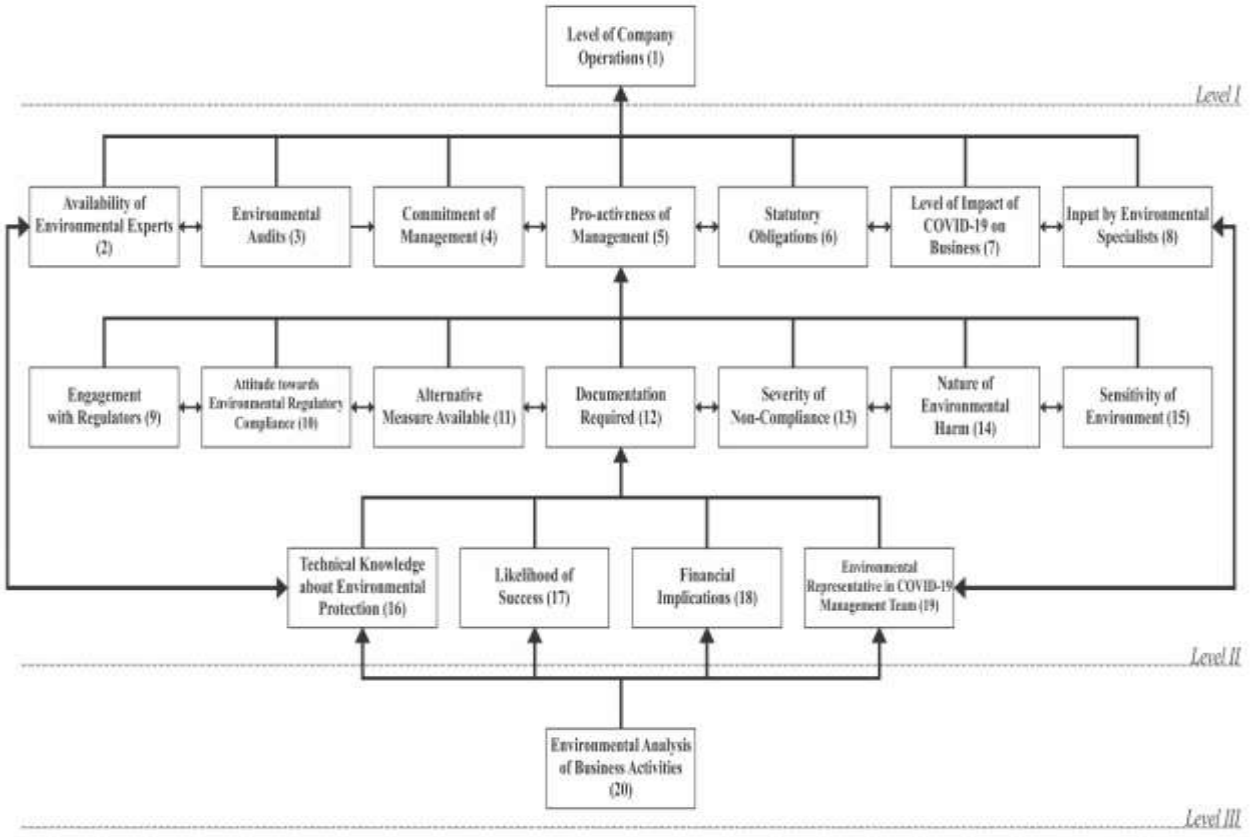

Figure 1: ISM Model. Source: (Constructed by Authors)

The ISM model shows that the determinant namely 'level of company operations' (1) falls on *Level I*. The determinants namely the availability of environmental experts (2), environmental audits (3), the commitment of management (4), pro-activeness of management (5), statutory obligations (6), level of impact of pandemic on business (7), input by environmental specialists (8), engagement with regulators (9), attitude towards environmental regulatory compliance (10), alternative measure available (11), documentation required (12), the severity of non-compliance (13), nature of environmental harm (14), sensitivity of environment (15), technical knowledge about environmental protection (16), the likelihood of success (17), financial implications (18) and environmental representative in pandemic management team (19) fall at *Level II* and the determinant environmental analysis of business activities (20) fall at *Level III*.

Classification through MICMAC: MICMAC is a standalone methodology used for classifying variables into four quadrants namely independent, dependent, autonomous, and linkage based on their driving power and dependence power. Usually, two approaches (i.e. scale-centric and data-centric) are used for applying MICMAC (Figure 2). The current study uses the scale-centric approach as it divides the Cartesian plane based on scale.

The classification obtained through MICMAC shows that the determinant namely the level of company operations (1) falls in the d*ependent* quadrant while the availability of environmental experts (2), environmental audits (3), the commitment of management (4), pro-activeness of management (5), statutory obligations (6), level of impact of pandemic on business (7), input by environmental specialists (8), engagement with regulators (9), attitude towards environmental regulatory compliance (10), alternative measure available (11), documentation required (12), the severity of non-compliance (13), nature of environmental harm (14), the sensitivity of environment (15), technical knowledge about environmental protection (16), the likelihood of success (17), financial implications (18), an environmental representative in pandemic management team (19) and environmental analysis of business activities (20) fall in *linkage* quadrant (Mathiyazhagan & Haq, 2013).

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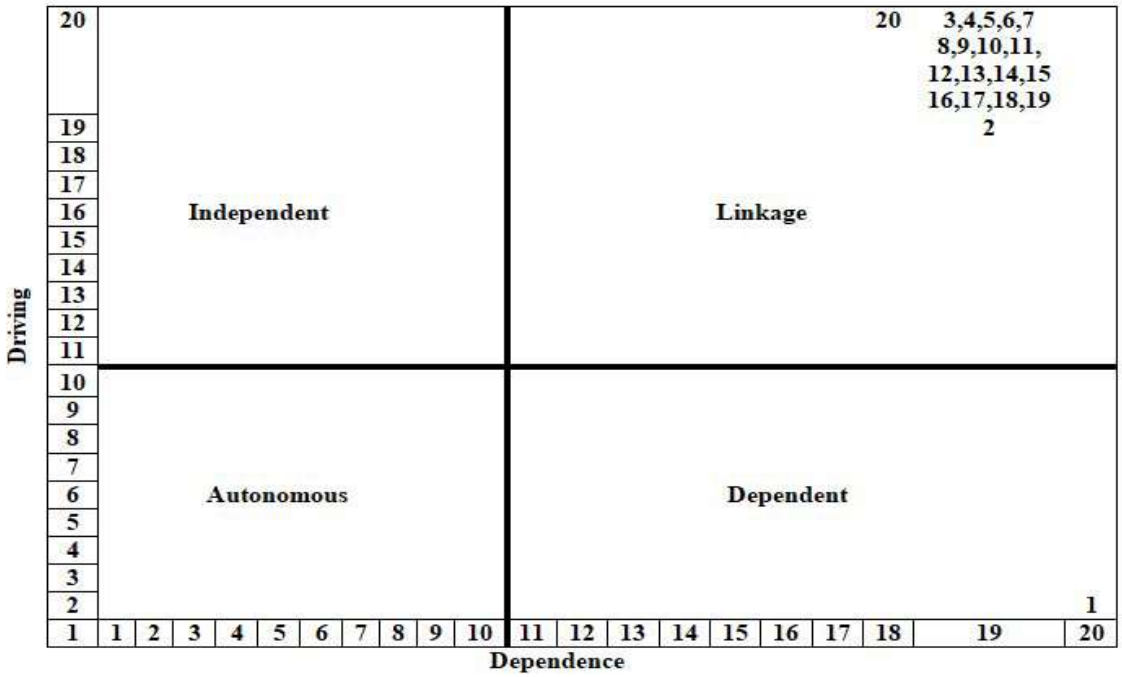

Figure 2: MICMAC Classification (Constructed by Authors)

RESULTS

During the pandemic-19, the environmental risk at the workplace has increased with alarming threats. Environmental risk management is necessary for the economy as well as the environment. Therefore, it is immensely pertinent in this situation to find out the determinants that are useful in managing environmental risk at the workplace. Hence, this research aims to analyze, order, and rank the determinants of environmental risk management at the workplace during the period of the pandemic-19 pandemic situation. In order to achieve the aims of the study, the authors identified and extracted determinants of environmental risk management from the literature viz: level of company operations (1), availability of environmental experts (2), environmental audits (3), commitment of management (4), pro-activeness of management (5), statutory obligations (6), level of impact of pandemic on business (7), input by environmental specialists (8), engagement with regulators (9), attitude towards environmental regulatory compliance (10), alternative measure available (11), documentation required (12), severity of non-compliance (13), nature of environmental harm (14), sensitivity of environment (15), technical knowledge about environmental protection (16), likelihood of success (17), financial implications (18), environmental representative in pandemic management team (19) and environmental analysis of business activities (20) and took approval on determinants' consideration for analysis form a panel of experts of the domain. After obtaining approval, the data is processed and analyzed using standalone methodologies i.e. ISM and MICMAC that are commensurate with the objectives of the study. The ISM procedure develops a structural model that gives information about interrelationships among determinants. It is a bottom-up model that gives information about level-to-level relations and at-level relations. Level-to-level relations stem from the partitioning process of the binary matrix whereas at-level relations stem from sub-matrices as a result of the rearrangement of rows and columns in the final reachability matrix. Furthermore, ISM ranks determinants according to their criticalness; the most critical factors are placed at the bottom of the model while the least critical ones are placed at the top of the model and the factors that possess a medium level of criticalness are placed in the middle of the model. In the current study, results of ISM revealed that the level of company operations (1) falls at *Level I*. Availability of environmental experts (2), environmental audits (3), the commitment of management (4), pro-activeness of management (5), statutory obligations (6), level of impact of pandemic on business (7), input by environmental specialists (8), engagement with regulators (9), attitude towards environmental regulatory compliance (10), alternative measure available (11), documentation required (12), the severity of non-compliance (13), nature of environmental harm (14), the sensitivity of environment (15), technical knowledge about environmental protection

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(16), likelihood of success (17), financial implications (18), environmental representative in pandemic management team (19) fall at *Level II* and, environmental analysis of business activities (20) fall at *Level III*. MICMAC classifies the determinants into four quadrants giving information about determinants' dependence and driving power. MICMAC of the current study reveals that the determinant namely 'level of company operations' falls in the *dependent* quadrant whereas all rest fall in the *linkage* quadrant. The determinants that fall in the *dependent* quadrant of the Cartesian plane possess low driving but high dependence power and are driven by other factors of the system whereas the determinants that fall in the linkage quadrant possess high driving and high dependence power and are considered agile, unstable, uncontrolled, unsettled factors that deserve the careful attention of the authorities as any action on them leads to change in other factors and return to themselves. An abridged presentation of findings obtained through a review of literature augmented with expert opinion, ISM modeling, and MICMAC classification is provided in Table 5.

Table 5: Summary of Findings

Code	Determinant	Driving	Dependence	Effectiveness	Cluster	Level	Comment
1	Level of Company Operations	1	20	-19	Dependent	*I*	
2	Availability of Environmental Experts	19	19	0	Linkage	*II*	
3	Environmental Audits	20	19	1	Linkage	*II*	
4	Commitment of Management	20	19	1	Linkage	*II*	
5	Pro-activeness of Management	20	19	1	Linkage	*II*	
6	Statutory Obligations	20	19	1	Linkage	*II*	
7	Level of Impact of Pandemic on Business	20	19	1	Linkage	*II*	
8	Input by Environmental Specialists	20	19	1	Linkage	*II*	
9	Engagement with Regulators	20	19	1	Linkage	*II*	
10	Attitude towards Environmental Regulatory Compliance	20	19	1	Linkage	*II*	
11	Alternative Measure Available	20	19	1	Linkage	*II*	
12	Documentation Required	20	19	1	Linkage	*II*	
13	Severity of Non-Compliance	20	19	1	Linkage	*II*	
14	Nature of Environmental Harm	20	19	1	Linkage	*II*	
15	Sensitivity of Environment	20	19	1	Linkage	*II*	
16	Technical Knowledge of Environmental Protection	20	19	1	Linkage	*II*	
17	Likelihood of Success	20	19	1	Linkage	*II*	
18	Financial Implications	20	19	1	Linkage	*II*	
19	Environmental Representative in Pandemic Management Team	20	19	1	Linkage	*II*	
20	*Environmental Analysis of Business Activities*	*20*	*18*	*2*	*Linkage*	*III*	*Key Factor*

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Table 5 presents key determinants of environmental risk management, their driving power & dependence power, hierarchal level in the ISM model, effectiveness, and the MICMAC class to which these relate based on driving and dependence power. The most critical factor is highlighted grey and italicized to distinguish.

DISCUSSION

This part of the study discusses the findings of ISM modeling & MICMAC analysis, contributions of the study (i.e. theoretical and practical), limitations, and directions for future research.

Discussion about ISM Modeling: According to *the* system modeling procedure of ISM, the top level of the model contains the least important factors whereas the bottom level of the model contains the most important factors. The factors that occupy middle to top levels of the ISM model vary on the continuum of importance accordingly viz: the upper middle of the model is considered relatively less important whereas the lower middle of the model is considered relatively more important. In this way, the model can be viewed as a bottom-up model. The results of ISM modeling in this study show that the determinants namely 'level of company operations (1)' fall at *Level I* whereas the determinants namely 'availability of environmental experts (2)', 'environmental audits (3)', 'commitment of management (4)', 'pro-activeness of management (5)', 'statutory obligations (6)', 'level of impact of pandemic on business (7)', 'input by environmental specialists (8)', 'engagement with regulators (9)', 'attitude towards environmental regulatory compliance (10)', 'alternative measure available (11)', 'documentation required (12)', 'severity of non-compliance (13)', 'nature of environmental harm (14)', 'sensitivity of environment (15)', 'technical knowledge about environmental protection (16)', 'likelihood of success (17)', 'financial implications (18)', 'environmental representative in pandemic management team (19)' fall at *Level II* and finally the determinant namely 'environmental analysis of business activities (20)' fall at *Level III*. To manage the environmental risk at the workplace arising out pandemic, it is imperative to focus on the determinant coded as 20 i.e. environmental analysis of business activities. The determinant has a high ability to influence other determinants of the system whereas the determinant coded as 1 i.e. level of company operations is the least degree of influence. A large number of determinants occupy the middle section of the model indicating their high connectedness and interaction among them. It means that these determinants merit further investigation/decomposition.

Discussion about MICMAC Analysis: In the study, the determinant namely 'level of company operations (1)' appeared as dependent and all others appeared as linkage factors. The interesting information that one can learn from MICMAC analysis of the study is that the majority of factors 2-20 are clustered in the linkage section which by interpretation means though these factors are connected strongly with others and with themselves in the system, therefore, taking action on them will result in manipulation of the entire system. It also indicates that it is a complex and intricate phenomenon that requires further investigation to get deeper insights. However, it can be learned from the ISM model that the determinant 'environmental analysis of business activities (20)' is critical and hence, ideally should have appeared in the independent cluster, but, since it also has high dependence power that forced this dependent factor to appear in linkage by following the strict definition of MICMAC. Apart from that, this lesson can also be taken that none of the identified determinants appeared autonomous quadrant which necessarily means all the determinants are of high importance, relevance, and pertinence for the phenomenon under study (Mathiyazhagan & Haq, 2013).

Theoretical implications: The study enhances the frontier of literature on environmental risk management at the workplace by adding a duly verified list of determinants, an ISM model, and a theoretical framework underpinned through MICMAC classification. ISM model gives information about the criticalness of determinants of environmental risk management. Similarly, the classification of determinants obtained through MICMAC is also new information in the literature. Furthermore, the variables used in this study are the sum of all the existing literature plus the opinions of experts in the domain which is a novel addition made by the study.

Practical Implication: The study provides some practical implications for the stakeholders. Firstly, it guides the management of companies that are engaged in environmental risk management at their respective workplaces. The management should consider the determinants and their interrelationship reported in this research to devise policies for effective risk management during/after pandemics. Secondly, it provides information to authorities about the dependence and driving power of the determinants by way of MICMAC analysis and hence, develops an understanding to control them accordingly. Thirdly, it provides knowledge to the general workers about the factors that must be taken into care for effective dealing of risk during/after pandemics. Fourthly, for society at

large, it contributes by highlighting the importance of environmental risk management. Finally, it contributes to our economy by highlighting such a sensitive issue which is creating a burden on our economy in the form of extra expenditure to manage unguided issues.

Limitations of the study: Though the study is conducted to address the most important issue of the workplace but still has some upcoming limitations. Firstly, since the study is based on factors extracted from a limited literature and the approval voting of a few experts, therefore, the result should be interpreted accordingly. Secondly, the study is based on interpretivism and is a theory-building study subject to verification through statistical techniques. Finally, the current study presents the picture of environmental risk management in the context of the Pakistani workplace, therefore, interpretation is limited accordingly.

Recommendations for future research: To overcome the aforementioned limitations of the study, the authors are pleased to direct some recommendations for future research. Firstly, to overcome the limitation regarding the data, the potential researcher must explore other repositories not covered in the study (please see the 'Literature Review' section of the study) and must try to get approval from more experts that might enhance the reliability of the findings of the study. Secondly, to overcome the limitation related to methodology, potential researchers should verify the findings of the study using advanced statistical methodologies such as SEM, GRA, TOPSIS, DEMTAIL, VIKOR, AHP, etc. Finally, to overcome the limitation related to the context of the study, potential researchers may replicate the study in the context of other regions, estates, countries, etc. Moreover, they may study these factors in other sectors or workplaces for example at educational institutes, the healthcare sector, and travel & tourism, etc.

Contribution of the study: This study makes valuable additions to the literature by way of i) a duly verified list of determinants of environmental risk management, ii) a structural model of interrelations of the elements of the phenomenon (Figure 1), iii) MICMAC Classification diagram (Figure 2), iv) intra-model relationships, and v) discussion qua reality.

CONCLUSION

The environmental risks have increased at the workplace, especially, after the COVID-19 pandemic and certain factors need to be studied for the management of such risks. The study aims to find the factors that may cause environmental risks at the workplace after pandemic so that these can be handled properly. The overall design of the study consists of identifying determinants of environmental risk management through a review of literature, finalizing a list of determinants through approval voting of experts, ISM modeling, analysis, and Implications. From the literature, a list of environmental factors has been generated in Table 1. The study provides information on structural relationships among the determinants and division of the same along the Cartesian plane by way of ISM modeling and MICMAC analysis respectively. Results of ISM modeling revealed that determinants coded as 1 fall at *Level I*. Determinants coded as 2, 3, 4, 5,6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, and 19 fall at *Level II* and determinant coded as 20 falls at *Level III*. The determinants placed at *Level 1* are the least critical whereas the determinants placed at *Level III* are the most important ones. To be more precise, the determinant namely 'level of company operations' occupying *Level I* is the least critical whereas the determinant namely 'environmental analysis of business activities' occupying the bottom level of the ISM model is the most critical. Any change in the most critical determinant brings a change in the overall system, therefore, it merits the immediate attention of stakeholders. The results of MICMAC show that the determinant coded as 1 is categorized as a *dependent* factor while all the rest determinants coded as 2 to 20 are categorized as *linkage* factors. There is a need to focus on linkage variables as changes in these variables bring change in the overall system by way of affecting other variables that in turn change in themselves. Another lesson to be taken from this research is the empty autonomous quadrant of the MICMAC diagram (Figure 2) which necessarily means all the factors included in the study are relevant, important, and noteworthy. Based on insights provided by this study, the stakeholders of the phenomenon can refine their decisions concerning the phenomenon.

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