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RESEARCH PAPER

Sustainability Risk Framework for Universities In the Context of Covid-19 Pandemic

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ABSTRACT
In today's world, COVID-19 pandemic has affected many organizations. Pandemic issues have created financial and social problems for businesses. Crisis and risk management have a significant impact on reducing consequences of pandemics. Rapid response to risk enhances the performance of organizations in times of crisis. Therefore, a framework to provide risk treatment in a pandemic crisis seems essential. To do this, this paper presents a framework to identify risk factors posed by pandemics. In this regard, comprehensive risk factors frameworks by considering sustainability concept are illustrated for university. Then, identified risk factors are evaluated by best–worst methodology (BWM) and then the important risks are recognized. Using the importance of risk and the strengths and weaknesses of the business, solutions to reduce the impact of risks are suggested to managers. The results of this paper can incorporated in order to enhance resiliency of the organization in front of the pandemics from social, environmental, and financial viewpoints.

KEYWORDS: *Best–worst methodology; COVID-19; Risk assessment; Risk treatment; Sustainability.*

1. Introduction

Pandemic disease is one of the problems that can affect the whole world. Since late 2019, the world has been faced with an unknown virus called COVID-19. As the disease increased and the virus spread, the disease became a pandemic [1]. Thus, the world is facing many crises due to pandemic consequences. In this regards, risk management concept will be very worthwhile in controlling such crisis. In the pandemic ahead; the world is facing economic, social, and environmental problems [2].

The COVID-19 pandemic has led to significant changes and fluctuations in businesses. To protect the organization's strategic framework, the organization's goals must been also changed or improved. This disease causes unstable organizational conditions, risk, and uncertainty. With the rapid development of the COVID-19, organizations are concerned with how to survive. Service-oriented organizations, such as universities, should identify the risk factors to maintain their current conditions and use them to develop new strategies or improve previous ones [3]. This issue is uniquely challenging for industries that rely heavily on face-to-face interaction, covering a wide range of sectors, from banking and insurance to education centers. Maintaining physical distance and reducing unnecessary operations is essential for health [4]. This has led governments to impose a nationwide lockdown and close almost all centers. Universities and educational centers have also faced obstacles due to this closure. In uncertain situation, service organizations need long-term strategic planning, risk identification, and ultimately flexibility to improve the economic situation [2]. Moreover, Businesses need to prepare for competition and excellence in a world where today's emergencies make this much more prominent.

Sustainable development has become a necessity in our current context, as it can take into account the potential risks imposed on the environmental, social and economic-financial environments, given the degree of uncertainty in the future [5].

Due to the importance of risk assessment for the survival of the organization in a pandemic situation, this paper presents a risk evaluation

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framework by considering sustainability concept for universities in the COVID-19 pandemic situation. To do this, sustainability-relate risk factors are identified and classified into sustainability dimensions. Then, weight of each factor is calculated by best-worst method (BWM). Finally, treatment solutions are derived for important risks. The resiliency of the universities can be enhanced by incorporation the suggested treatments in the pandemic situation.

The rest of this paper is organized as follows. Related literatures reviews are described in Section 2. The Proposed sustainability-relate COVID 19 risks framework and results are parented in Section 3. Finally, conclusion and future researchers are provided in Section 4.

2. Literatures Reviews

Risk assessment for the survival of the organization in a pandemic situation is necessary. The current state of the world is such that there are many risk issues due to the outbreak of COVID19. Study in the field of risk and risk assessment is undeniable. Several researches conducted a risk assessment to overcome risk consequences. Moreover, considering the sustainability issues can help managers to enhance the resiliency of the organization from economic, environmental, and social viewpoints. In this regards, Aven and Bouder [6] considered risk regarding COVID-19 pandemic and investigated that risk science is an essential knowledge to COVID-19 problems. Gargalo et al. [7] introduced a risk assessment framework based on economic and environmental dimensions of sustainability concepts. They used Mont Carlo technique in their proposed framework. Miemczyk and Luzzini [8] investigate the relation between sustainability practices and risk assessment by structural equation modeling (SEM). Anand et al. [9] presented a framework in order to sustainability risk assessment. They identify the relation among sustainability risk assessment parameters by using graph theory. Torres-Ruiz and Ravi Ravindran [10] proposed a risk assessment framework for supplier portfolio. To do this, they applied a decision making modeling to evaluate sustainability risks. Sajjad and Chan [11] proposed a risk assessment framework by considering resilience and sustainability issues. Resilience and sustainable development goals can be achieve through their proposed framework. Xu et al. [12] considered supply chain risk assessment. They considered operational, environmental and social risks. Zhou and Griffiths [13] considered exposure, hazard, and vulnerability as elements of the risk to evaluate risks by tacking to account sustainability issues.

As mention before, risk evaluation is important in pandemic disease such as COVID-19. Due to the spread of the COVID-19 and the quarantine of most places in the world, there is a fear of exposure to COVID-19 among people [14]. According to literature reviews risk perception of COVID-19 is very high among different people [15]. Moreover, Personal experience with the virus has key role in risk perception. Due to the disease risk and its effects on people's lives, identifying of factors related to risk perception of COVID-19 is necessary. To do this, Yıldırım and Güler [14] proposed a method based on factor analysis and used 8-item SARS risk perception scale considered by Brug et al. [16]. Then, they identified two factors namely cognitive and emotional dimensions that can be applied as a measure for perceived risk of COVID-19. Dryhurst et al. [15] identified risk perception in different country. In this regards, they considered risk perception as dependent measure [15]. De Bruin et al. [17] introduced risk mitigation analyses for COVID19 pandemic. They considered some measures such as "mobility restrictions"," physical distancing", "hygienic measures", "socio-economic restrictions", "communication and international support mechanisms" [17]. Chakraborty and Ghosh [18] use hybrid ARIMA-Wavelet-based Forecasting (WBF) model to forecast the daily COVID-19 cases in five countries. Their results can be considered as a warning system to overcome COVID-19. Also, they used regression model to assess risk of COVID-19. Based on their results, "number of COVID-19 cases", "number of people of age > 65 years age", "lockdown time", and "number of hospital beds" are recognized as significance influencing factors on the case fatality rate (CFR). Choi [19] investigated risk analysis for logistics systems to cope COVID-19 and considered the different risk associated with logistic system. Sharma et al. [20] have provided a framework to enhance survivability in COVID-19 situation. They use weight assessment ratio analysis (SWARA) method to recognize important factors to survive.

Wong and Jensen [21] considered trust as important factor in pandemic and studied the interaction between trust in government, risk perceptions and public compliance. Asteris et al. [22] developed a heuristic model to assess the risk among different countries. This model is based on the number of reported deaths from COVID-19. They believed that the number of reported death is related to the "quality of the

health system in each area", "the age distribution of population", "geographical and environmental factors". Chang and McAleer [23] evaluated the global health security index. Then, they mentioned that this evaluation can be a preparation for countries' action's performance against pandemic such as COVID-19. The indexed based on some 140 questions was classified as "prevention", "detection and reporting", "rapid response", "health system", "compliance with international norms", and "risk environment". Their study illustrated that rapid response had the largest impact on the Global Health Security (GHS) index score, and the smallest impact was from prevention and risk environment. Schröder [24] implemented the COVID-19 risk assessment by the approach related to the public health. This study assigned 4 groups to the risk according to the National Institutes of Health (NIH) guidelines. A risk assessment method evaluated the interaction with the human and the environment, which uses several criteria including "pathogen risk groups", "host range and emerging diseases", "routes of transmission", "infectious dose", "communicability", "case fatality ratio", and "persistence". This paper stated three elements for risk mitigation which are "engineering controls", "administrative controls", and "personal protective equipment (PPE)". Walsh [25] had mentioned complex damages caused by the COVID-19. The authors focused on making a positive viewpoint to life and effective transformation during COVID-19 pandemic.

Risk assessment and sustainability concepts have been considered in many studies. Giannakis and Papadopoulos [5] examined supply chain risks associated with sustainability in three dimensions namely social, environmental and financial; also, they provide a framework of sustainability-related risks. They used the failure mode and effect analysis (FMEA) method to assess risk and identify the causes of risk. This paper stated that there are four main answers to risk treatment, including; "avoid", "control", "share", and "retain". The results showed that internal risks are more important than external. Krysiak [26] used a criterion for sustainability under uncertainty. This study illustrated that the criterion link between the risk management tools and sustainability. As mentioned, the COVID-19 pandemic has affected sustainability issues in different supply chains [27]. To do this, Karmaker et al. [27] considered supply chain disruptions in COVID-19 pandemic and to overcome it, sustainability issues have been taken into account. In this regards, they used fuzzy theory, Pareto analysis, and total interpretive structural modelling (TISM). They explored the drivers of sustainable supply chain to overcome COVID-19 pandemic disruptions. Finally, policy development, development of health protocols, and financial support were recognized as effective derives on sustainability in the face of the COVID19 pandemic. One of the factors that affect the sustainability development goals is clean cooking energy strategies [28]. Household fuel use is one of the factors that affect sustainability. COVID-19 pandemic have a significance impact on clean fuel programs. In this regards, Ravindra et al. [28] considered the effect of COVID-19 on clean fuel programs in India. De Sousa Jabbour et al. [29] addressed challenges regarding COVID19 pandemic to enhance sustainability and resilience. Petzold et al. [30] noted that many of the problems such as health-related, social, economic were caused by COVID-19 pandemic. Also, they investigated; COVID-19 has caused problems such as psychological distress, anxiety, and depression. In their study, demographics, protective, and risk factors had been considered as well as experiences factors regarding COVID-19.

Huynh [31] examined the role of socioeconomic factors as well as social media utilization on perception of COVID-19 risk. Obrenovic et al. [32] introduced an "enterprise effectiveness and sustainability model" for overcoming pandemics. They stated some factors such as advanced technologies, flexibility, distributed leadership, and etc. have important role in suitability of business within pandemic crisis. Shammi et al. [33] examined issues that affect sustainability goals. They suggested that partial lockdown with businesses, maintaining social distance, and observing health requirements were a best solution to sustain during COVID-19. Rume and Islam [34] investigated the positive and negative impacts of the COVID-19 on environment. This study showed that the COVID-19 improves "air quality", and "reduces greenhouse gases (GHGs) emission", "water pollution and noise", and "transportation and industrial activities". Also, there is some negative effects, including "increase of medical waste", "haphazard disposal of personal protective equipment (PPE)", and "lessens recycling activities". Mori et al. [35] identified the environmental factors of sustainability and classify into 33 groups namely "short-term", "medium-term", and "long-term environment and sustainability" challenges in Japan. Ryan et al. [2] developed a framework of social determinants of health system resilience based on Maslow hierarchy of needs. These

needs are classified into 5 groups including "physiological needs", "safety needs", "social needs", "and esteem needs "," self-actualization"; then, the possible impact of COVID-19 lockdown on individuals and society are considered. Bryce et al. [36] proposed the dynamics and strategic patterns in COVID-19 pandemic. This study stated that investment in development of resilience through financial resources and strategic orientation is very important issue in pandemic. PeConga [37] noted that the COVID-19 pandemic affects the social dimensions of people's lives around the world, and that this pandemic also has significant negative effects on individuals' mental health. They asserted that "social support", "adaptive meaning", and "direct social behaviors" can have powerful effects on resilience in individuals and society. Prime et al. [38] developed a conceptual framework based on human development and family functioning to address social issues due to COVID-19 pandemic. In this framework family is the center of process against the COVID-19 pandemic situation.

Based on literatures reviews, investigating and evaluating the risk of service-oriented organizations in the COVID-19 pandemic is essential. Educational centers such as universities have been negatively affected from financially, socially, and environmentally viewpoints in COVID-19 pandemic. Therefore, it is necessary to propose sustainability-relate risk framework in the pandemic situation to overcome the consequences of pandemic. To do this, sustainability-relate risk framework is proposed to identify sustainability-relate risk for universities and suggested appropriated treatments.

3. Proposed Sustainability-Relate Risk Framework

The proposed framework to assess the risks that universities face during the COVID-19 is illustrated in this section. Fig. 1 shows the schematic view of the proposed framework to provide improvement solutions to organization during pandemic.

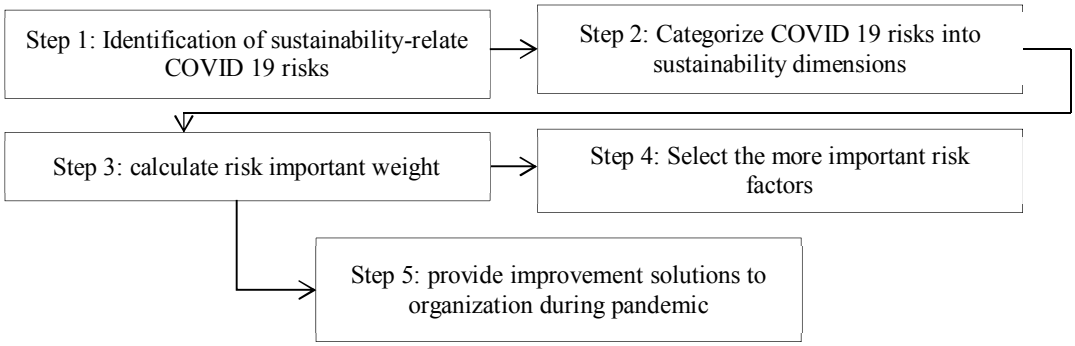

Fig. 1. Proposed sustainability-relate risk framework during the COVID-19

The proposed framework illustrates a risk assessment to overcome the consequences of COVID-19 and improve the organizational resilience in the presence of pandemics. To suggest risk treatment, risks related to COVID-19 are identified based on previous studies and expert's opinions. In order to more effectively manage the risk and crisis ahead, risks are categorized into three dimensions of sustainability concept namely economic, social, and environmental. This classification gives managers more power to manage crisis and survive in crisis situations. In additions, decisions to overcome risk can be made better by focusing on each dimension. After risk determination, risk prioritize is performed. In this regards, best-worst method (BWM) is applied. Then, according to risk importance weights, appropriated treatments are derived to enhance organizational resilience in the presence of pandemics.

3.1. COVID-19 pandemic

COVID-19 pandemic has affected almost every aspect of the world. The effects of the epidemic were far greater than initially anticipated. This condition has affected businesses and companies and caused environmental, social and financial risks. Businesses need to make efficient decisions to avoid the risks ahead, so the importance of risk management is felt more than ever [39]. Businesses need to have a comprehensive risk management plan to survive in COVID-19 pandemic crisis. Governments have implemented short-term and long-term business nationwide lockdown to prevent the rise of COVID-19 cases [40]. This has caused companies to face various obstacles. It should be noted that business

closures and telecommuting led to changes in the employee's and businesses' performance.

3.2. Sustainability related risk of COVID-19

It is clear that the COVID-19 pandemic has had adverse effects on the economy, the environment and society. Thus, there are several risks and threats that if not addressed and timely management, will have irreparable effects. It is necessary for organizations to effectively implement risk management in crisis satiation. COVID-19 pandemic has become a global crisis in a short period of time and has significantly changed different levels of human and business life, in terms of socially, environmentally, and economically [39]. COVID-19 pandemic has become a driving force for organizations to review the company's activities and assess the related risks [32]. Social, environmental, and economical interactions have been affected by this pandemic, so the risks posed by the COVID-19 crisis are a major threat to businesses and firms.

Tab. 1. Sustainability related risk of COVID-19

Sustainability dimension	Indicator	Reference
Financial	Reduce admission of international students	[41;42]
	Postponement of investment academic projects due to the closure of universities	[43;44;45]
	Postponing students' research – Reduction of university income from students	[45]
	Rental income reduction from accommodation	[46]
	Costs to support online and remote learning	[44;47]
Social	Negative impact of not accessing to friends	[2]
	Restrictions on migration and participation in social events	[48]
	High rates of symptoms of anxiety, stress and depression	[49]
Environment	Endangering physical health (by detergent)	Experts' opinions
	Increased medical waste	[50;51;52;53]
	Decline in waste recycling with increase in incineration and landfilling	[54]
	Increased ecological risk to natural ecosystems due to the use of disinfectants	[55]
	Plastic pollution	[56;51;57;53]

3.2.1. Risk identification

Sustainability-relate risks in context of COVID-19 for universities are identified and categorized into three dimensions of sustainability concept namely economic, social, and environmental. Table 1 shows the classification of COVID-19 risks.

As seen in Table 1, sustainability related risks of COVID-19 are identified based on previous studies and experts' opinions. These recognized risks can be related to universities' activities. A significant number of applied academic projects in industry and business have been discontinued due to the closure of universities in COVID-19, and this has caused significant financial losses to higher education institutions and universities. In addition, international students, due to nationwide quarantine, may not use the services and facilities provided by the university fully or use less, which causes financial and economic impact to the university. In addition, universities are closed and cannot use facilities such as renting a conference room, using the university spaces, and holding academic courses, which has reduced the university's income. Most importantly, due to the closure of universities, students and professors cannot use the facilities of the university laboratory and other research facilities. This has led to a decrease in the number of student research and a significant impact on the part of the university income that depends on this research.

In the COVID-19 crisis, governments have to temporarily lock down some centers. In this regard, almost most universities as well as educational centers are permanently closed, and educational services can only be provided via online facilities; consequently, teachers have to work at home which leads to less involved in social communities. Online education faces challenges that cause high level of tension between teachers and students. Also, due to

global quarantine, people are less able to attend social events and also less likely to visit friends and family. All of these factors increase anxiety in people and are considered as a social-related risk factor.

The outbreak of COVID-19, as mentioned earlier, has overshadowed the environment issues and created threats to environment. In university organization, Use of disinfectants harms the environment. Moreover, it can be negative effect on water and soil. Also, medical and plastic waste due to use of mask and gloves are increased. Due to the need for disinfection and use of water, the pattern of water consumption has also been affected.

Based on the above, it is necessary to evaluate risks that the universities face during COVID-19. Therefore, in the next section, the important of each risk is calculated based on experts' opinions and BWM.

3.2.2. Risk prioritization

The importance of each risk factor is calculated in this section by BWM. This method has been introduced by Rezaei [58]. According to Rezaei [58], Compared to previous models such as AHP, this model produces more reliable results, more consistent comparisons, and needs less comparison data. Also, this method has been applied in different studies, such as application of this method in risk assessment [59]; sustainability supply chain [60]; supplier selection [61]; and crisis management [62]. Therefore, this model is applied in this paper to prioritize risk factors. Based on this method, the preferences of the most important risk factor over the other risk as well as the preference of risk factor over the least important risk are achieved by expert's opinions. Finally, by applying Model 1 (Eq.1 to Eq.5), introduced by Rezaei [63] the important degree of the each risk factor is calculated.

Model (1)

$$\min \psi \tag{1}$$

$$s.t.$$

$$\left| w_B - a_{Bj} w_j \right| \le \psi \quad j = 1,...,k \tag{2}$$

$$\left| w_j - a_{jW} w_W \right| \le \psi \quad j = 1,...,k \tag{3}$$

$$\sum_{j=1}^{k} w_j = 1 \tag{4}$$

$$w_j \ge 0 \quad j = 1,\ldots,k \tag{5}$$

In the above model, w_j shows the important degree of jth risk factor. Also a_{Bj} and a_{jW} illustrate the preferences of the most important risk factor over the other risk and the preference of risk factor over the least important risk respectively. It should be noted that, ψ is considered as a consistency criterion of the comparisons. Close value to zero for this criterion shows the high level of consistency.

After calculating of each risk factor of sustainability dimension, the most important risk factors associated to each dimension are selected based on experts' opinions as important risk in context of COVID-19. In the next section, appropriated actions are provided to overcome and reduce the negative impact of these important risk factors. Table 2 shows the calculated weight of risk factor for each dimension. It should be noted that consistency of the comparisons has been confirmed.

As seen in Table 2, "postponement of investment academic projects due to the closure of universities" and "postponing students' research – reduction of university income from students" are selected as influential economic risk factors. Also, "negative impact of not accessing to friends" and "high rates of symptoms of anxiety, stress and depression" are selected as important social risk factors. Finally, "increased medical waste" and "plastic pollution" are chosen as important environmental risk factor according to weigh score. After the selecting the important risk of each sustainability dimensions, appropriated treatments are suggested to managers regarding each important risk.

Tab. 2. Important weight of each risk factor

Sustainability dimension	Indicator	Weight
Financial	Reduce admission of international students	0.098
	Postponement of investment academic projects due to the closure of universities	0.345
	Postponing students' research – Reduction of university income from students	0.281
	Rental income reduction from accommodation	0.092
	Costs to support online and remote learning	0.184
Social	Negative impact of not accessing to friends	0.402
	Restrictions on migration and participation in social events	0.132
	High rates of symptoms of anxiety, stress and depression	0.333
Environment	Endangering physical health (detergent)	0.133
	Increased medical waste	0.301
	Decline in waste recycling with increase in incineration and landfilling	0.108
	Increased ecological risk to natural ecosystems due to the use of disinfectants	0.260
	Plastic pollution	0.331

3.3. Risk treatments

The important risks of each sustainability dimension are examined based on BWM results. In this section, appropriated treatments based on experts' opinions and similar cases in previous studies are provided for each sustainability dimension separately. The suggested treatment can be considered as management solutions to enhance the performance and resilience of the organization in times of crisis.

First, the economic dimension is examined and appropriated treatments are provided as follows. As mentioned in the previous section, "postponement of investment academic projects due to the closure of universities" and "postponing students' research – reduction of university income from students" is considered as important risk factors regarding finance dimension. COVID-19 pandemic has influenced many aspects of academic research, including the closure of university laboratories and libraries as well as the absence of professors and students. According to the studies conducted, it can be found that disruption in university research can be considered as a significant risk in the financial dimension that affects university income. To deal with this risk, universities should have a risk management approach so that research can continue smoothly in order to prevent university's income reduction. Therefore, this paper provides some suggestions and treatments as solutions that help university to implement the risk management. To do this, conducting applied research related to COVID-19 as an applicable solution, which includes innovations and topics that are useful in the short term, can attract the opinion of investors and the government to invest in this applied research [45]. As mentioned earlier, COVID- 19 caused the closure of educational centers, so the virtual world is used as a tool for education goals. Therefore, it is necessary to provide a strong online infrastructure for meetings and international conferences [64]. Moreover, enhancement of the virtual infrastructure, development of a system to negotiate with industry, and also identifying research opportunities as well as attracting industry managers to implement industrial projects are some capable and applicable strategies for universities to overcome the above risks associated with COVID-19 pandemic. Universities need to consider a combination of the above several strategies that can assist them to perform effectively in the COVID-19 crisis.

With the spread of the global COVID-19 disease, many social problems are emerging and growing drastically that affect mental health. Universities and educational institutions are no exception, as the high number of reports of depression and high stress among students is evidence of this. With the closure of universities and the use of online education, students are less motivated to study and continue their education. This is forced to increase anxiety among students due to the nationwide closures and restricted social communication [65]. According to the BWM results, "negative impact of not accessing to friends" and "high rates of symptoms of anxiety, stress and depression" are recognized as important risk factors from social view point. To

reduce the negative impact of not accessing to friends, using social media and increasing your communication skills are suggested. Moreover, to decrease the symptoms of anxiety, stress and depression in the COVID-19 situations, physical exercises can be applied to care body. Also, avoiding painful news and rumors about the disease can help you relax. Additionally, communication with friends and helping those affected by the disease can reduce the level of the stress and depression. Therefore, social media and virtual communication can be effective in overcoming the consequences of the social risks regarding COVID-19 at universities. Finally, development of a counseling center at university can also help to solve problems caused by pandemics.

As previously mentioned, COVID-19 has also had a negative impact on the environment. After prioritizing the environmental risk factors, "increased medical waste" and "plastic pollution" are identified as important factors. Consumption of personal protective equipment (masks, gloves, and etc.) and use of disposable plastic containers among university staff has led to an increase in medical and plastic waste. A fast and appropriated waste transportation system [66] can help to reduce the negative impact of these. In addition, temporary incinerator installation can be used for waste management [67]. Disinfecting at source and transporting to the disposal site [68] can be considered as reduction solutions for the negative impact of the medical waste on environment. The use of disposable containers and their recycling after disinfection reduces pollution to the environment.

The above treatments regarding each sustainability dimensions can be applied to reduce the negative impact of the COVID-19 on universities from sustainability view point. Managers and decision makers can implement the suggested treatment to increase resilience in pandemic situations. It is worth noting that improving the performance of the organization, university, will be achieved by simultaneously focusing on all three dimensions of sustainability. Hence, with appropriated planning and risk management, the consequences of pandemics can be minimized.

4. Conclusions

Most companies are not prepared for the long-term effects of crises and their related risks on employee well-being, the business environment, and the firm economy; this unpreparedness is due to uncertainty and lack of knowledge about the sustainability related risks. A systematic risk assessment and management can help managers to enhance resilience in crisis. In this regards, this paper presented sustainability-relate risk framework to improve the performance of universities in front of COVID-19. Issues that threaten universities in this pandemic were classified into sustainability dimensions. Managers must focus on important risk and apply appropriated and on time treatments to survive in crises situation. In this regards, risk factors were recognized and classified into sustainability dimensions. Then, these factors were prioritized by using BWM and important risks from each dimension were selected and suitable treatments were provided to overcome them. To do this, the problem of research projects reduction, as financial risks, can be solved by implementation of the suggested treatment such as development of the applicable area research regarding COVID-19 as well as development of the virtual tools. By development of the counseling centers at university and identifying staff and students affected by the pandemic can overcome the consequences of the crisis ahead. Moreover, waste and energy management can help to reduce the environmental risks.

It should be noted that time becomes significantly important in crisis situation, and the implementation of organizational processes as soon as possible can help significantly to the resilience and stability of the organization. In this regards, a framework was presented in this paper to increase managers' awareness, which help the decision makers to act in time and survive in COVID-19 pandemic. Due to the uncertainty in COVID-19 behavior, it is suggested to consider fuzzy theory as future studies. Also, preforming risk analysis and incorporating business continuity management can be suggested for future researches.

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