Octobre 2022

Energy efficiency via Industry 4.0: A way to increase organizational resilience in the post-COVID era. A scoping review

Mehdi Bensouda
Laboratoire de Recherche et d’Etudes en Management, Entrepreneuriat et Finance (LAREMEF), Sidi Mohamed Ben Abdellah University, Fez, Morocco
mehdi.bensouda@usmba.ac.ma

Mimoun Benali
Laboratoire de Recherche et d’Etudes en Management, Entrepreneuriat et Finance (LAREMEF), Sidi Mohamed Ben Abdellah University, Fez, Morocco
mimoun.benali@usmba.ac.ma

Abstract—Times of crisis unquestionably reduce economic and social well-being. However, throughout history, companies have been able to survive, to adapt and to grow from sudden and detrimental circumstances mainly through their organizational resilience. Energy efficiency has always been a lifeline for companies during times of crises, a way to reinforce organizational resilience. COVID-19 crisis produced disastrous effects on the global economy. Simultaneously, Industry 4.0 which generates a substantial energy efficiency potential, has gained credibility as a viable path to organizational resilience.

Keywords—Energy efficiency, COVID-19, Organizational resilience, Industry 4.0.

I. INTRODUCTION

COVID 19 began in late 2019, and in March 2020, this infectious disease is declared by the WHO to be a “pandemic” due to its extensive worldwide spread. The pandemic has had a deleterious impact on health systems throughout the world, with a spillover effect on all facets of human life (Kanda and Kivimaa, 2020). Simultaneously, various studies have found that COVID-19 symptoms are worsened by air pollution (Newman, 2020), and an international recognition of the vulnerability and the unsustainability of the current socioeconomic system and its dependence on the environment is growing at an unprecedented speed (Gusheva and de Gooyert, 2021).

In this context, it has been observed that companies that were oriented towards energy efficiency vectors, such as industry 4.0 and were remarkably resilient (Czifr and Molnár, 2021), industry 4.0 has boosted companies’ revenues while tackling climate change and achieving the sustainable development goal 7 “SDG 7”, particularly SDG 7.3 “the improvement of energy efficiency”.

II. METHOD

This article is based on a scoping review that aims to present how energy efficiency could be a lever for organizational resilience during times of crisis through industry 4.0 technologies.

For this scoping review, a literature search in Science Direct and Google Scholar was conducted from the beginning of 2022 since June 2022. Search terms were identical throughout all databases and included: “Energy efficiency” AND “organizational resilience”, “Energy efficiency” AND “COVID”, and “Industry 4.0” AND “organizational resilience”. The considered articles were not systematically selected, and we do not assume that the exhaustivity of the review. The results of our scoping review were classified according to the following energy efficiency themes: Background: (1) What is organizational resilience, (2) Energy efficiency: A historical avenue to organizational resilience, (3) Industry 4.0 and organizational resilience, (4) The way forward for Moroccan industry sector: The case of Fez smart factory, (5) Reasons to believe in energy efficiency’s bright future.

III. BACKGROUND: WHAT IS ORGANIZATIONAL RESILIENCE?

In the existing literature, there is some inconsistency when it comes to defining organizational resilience (Duchek, 2014). This disparity between the authors revolves around the following points:

For several academics, resilience is the mere capacity to bounce back from sudden, unpredictable, distressing, and detrimental circumstances and to pick up where they were previously dropped (Lengnick-Hall et al., 2011).

For other scholars, organizational resilience goes beyond restoration, it incorporates the enhancement of new capabilities and to reinforcement of the ability to generate new opportunities during times of crisis (Lengnick-Hall et al., 2011).

For a third group of scholars, organizational resilience transcends the capabilities previously mentioned, to include the capability to anticipate crises, which implies the identification of potential source of risk (Somers, 2009).
In a nutshell, organizational resilience could be defined as the ability of an organization to: Anticipate risks, successfully cope with unpredictable circumstances to generate dynamic capabilities that elicit organizational learning (Duchek, 2014).

A deep understanding of the features of organizations that make them resilient is necessary.

- Anticipation capabilities:

The first dimension of organizational resilience is “the anticipation capability”. Before a crisis strikes, organizations should be able to identify internal signals or signals from their environment and to proactively adjust before a crisis takes place. The anticipation dimension covers organizational capabilities to observe the environment, to identify potential possible risks and prepare for unexpected occurrences. In the literature, these capabilities are referred to as “weak signals acquisition” and “environmental scanning” (Ansoff, 1975).

- Coping capabilities:

The second dimension of organizational resilience is “coping capabilities”. The coping capabilities are divided into different but equally important capabilities.

-Accepting: The literature states that the first step to cope with a crisis is the acceptance of facts, which means that the organization must be fully aware of the failure of the current system (Catalan and Robert, 2011).

-Searching for solution: In the process of searching for solution, organizations should combine sensemaking and action. In this respect, organizations try to understand the crisis unfolded then to act in accordance. It is necessary to have constant feedback between sensemaking and action with the purpose of finding the best solution (Kendra and Wachtendorf, 2003).

-Implement solutions: Once the optimal solution is found, the next step would be to implement it. It is imperative for an effective solution’ implementation to have a shared vision within the organization, the solution must be known by all, and each one should be aware of his task, which requires a strong organizational communication (Weick, 1993).

- Adaptation capabilities:

Adaption implies learning. Learning should take place in wake of the crisis, organizations should reflect on the crisis, its sources, and implications. Then, the accumulated experience should be integrated into organizations’ knowledge base to avoid or at least to mitigate a potential future crisis (Madni, 2009).

IV. ENERGY EFFICIENCY: A HISTORICAL AVENUE TO ORGANIZATIONAL RESILIENCE

Throughout history, a strong relationship is clearly distinguishable between periods of crisis and the acceleration of “energy efficiency practices” (Selcuk and Durusoy, 2019).

This relationship is apparent during the financial crises of 1901 and 1907. Back then, energy efficiency was regarded as a solution to allow industries to rebound from the crisis while responding to the social pressures of the time related to limiting waste (Dunlop, 2019).

During the second half of the 20th century, environmentalists have expressed strong criticism of energy waste and pollution resulting from it, and the effects of the two oil crises of the 1970s strengthened the relationship between “times of crisis” and energy efficiency’s practices. During that time, energy efficiency was considered as a way towards sustainable economies, this led to the institutionalization of this concept, the emergence of news laws, regulations, and jobs related to energy efficiency, and innovations supporting economic growth without having a negative effect on the environment (Lutzenhiser, 2014). Energy efficiency then becomes a win-win concept, combining economic growth with a positive environmental impact. Thus, energy efficiency was defined as a "path to soft energy", and as a core component of "energy transition" (Dunlop, 2019).

After the 2008 financial crisis, innovation’s level has increased, and energy efficiency applications has become more acclaimed due to their impact on environmental performance, energy security and energy consumption, energy efficiency is then considered the most profitable path to sustainability (Selcuk and Durusoy, 2019). Thus, reflections about the emergence of a “sixth wave of innovation” began to arise (Silva and Di Serio, 2016), especially following innovations that took place during this period, such as industry 4.0 which was initiated in 2011 and the concept of smart cities which has been flourishing since 2014. It is noteworthy that energy efficiency is a core component of industry 4.0 and smart cities. This rise of digital and green technologies could be explained by the mounting pressure back then to opt for a “green recovery” (Gusheva and de Gooyert, 2021), a concept according to which an economic recession represents an opportunity to recompose and transform the economy while neutralizing its environmental impact (Omri et al., 2015). In this regard, Barack Obama and many other world leaders tried after the financial crisis, to revive their economies while addressing global warming challenges (Bogojević, 2020).

However, efforts to green the recovery have been put on hold, and the transition to sustainability has stagnated, essentially because many governments have opted for a “quick rebound” over a “green recovery”, favoring a “bounce back” to pre-
crisis practices and processes (Gusheva and de Gooyert, 2021).

From the above, an enthusiasm has always been noticed during times of crisis, which could be explained by the following reasons:

- Energy efficiency practices are easy to implement and to develop in different business sectors, with relatively low cost, which makes energy efficiency an affordable, readily available, quickly achievable and a profitable resource (Çengel, 2010).

- The lack of financial recourses that characterize times of crisis, pushes companies to look inward to learn, to innovate, and to explore novel opportunities, including energy efficiency’s ones (Gusheva and de Gooyert, 2021).

Thus, energy efficiency has always been a lifeline for companies during times of crises, but also an appetizing option that reinforces organizational resilience.

V. INDUSTRY 4.0 AND ORGANIZATIONAL RESILIENCE

Energy efficiency in the industrial sector is instrumental in achieving both “economic performance” and “environmental sustainability” (Lins and Oliveira, 2017). Industry 4.0 is still a newly developed concept resulting from the use of new technologies, which bring a great potential of energy efficiency (Chen et al., 2021).

Industry 4.0 is inherently linked to Smart factories, IT technologies, intelligent systems for energy management (Culot et al., 2020).

According to the existing literature, smart factories increase organizational resilience (Xu et al., 2018), because they create a multidisciplinary environment that allows continuous learning allowing to avoid or at least to mitigate potential crises (Ivanov and Dolgúi, 2020).

IT technologies increase organizational resilience since they allow a greater efficiency in the use of production resources (Gilchrist, 2016).

Intelligent systems for energy management increase organizational resilience by programming intensive production during favorable electricity tariffs (Jeschke et al., 2017).

Thus, industry 4.0 generates a substantial energy efficiency potential through new technologies above mentioned.

Industry 4.0 had an inflection point during the pandemic. Companies that had implemented industry 4.0 practices prior to COVID-19 have been able to provide better responses to the health crisis (György and Zsolt, 2020), these practices have contributed to reduce the shock of the pandemic, namely technologies enabling remote working and collaboration. These practices have helped companies to continue their activities and to gain competitive advantage during COVID-19. Thus, industry 4.0 has been a win for early adopters (Lepore et al., 2021).

Companies that had not implemented Industry 4.0 prior to COVID-19 found themselves struggling during the outbreak, in the absence of digital technologies to support them (Lepore et al., 2021).

Unsurprisingly, and given the negative impact of COVID-19, companies are increasingly shifting their priorities from a purely productivity focus to a flexibility, adaptability, and resilience focus, which makes industry 4.0 a viable path to organizational resilience (György and Zsolt, 2020).

VI. THE WAY FORWARD FOR MOROCCAN INDUSTRY SECTOR: THE CASE OF FEZ SMART FACTORY (FSF)

Industry 4.0 is built around the concept of “smart factory”, also known as intelligent or digital factory (Stock and Seliger, 2016), functioning largely with no human force (Lasi et al., 2014).

Smart factories are manufacturing environments where processes are assisted by intelligent systems providing constant production flow (Lucke et al., 2008). Smart factories create, upload, receive, and analyze the data to execute the required tasks for production, regardless of how challenging the external circumstances are (Lasi et al., 2014). Thus, smart factories are more adapted to face crises and more resilient once a crisis strikes (Osterrieder et al., 2019).

COVID-19 has increased the awareness of Moroccan industrial companies and Moroccan authorities regarding industry 4.0, and particularly smart factories (Tissir et al., 2020).

In April 2021, The Moroccan Ministry of Industry, Trade, and Digital Technologies, the Digital Development Agency (DDA), and the Euro-Mediterranean University of Fez (UEMF), have signed a Memorandum of Understanding (MoU) to implement and advance the state of automation in Morocco “Fez Smart Factory” (Dryef, 2021).

Fez Smart Factory is a Smart Ecosystem for a development of Sustainable Industry via « Industry 4.0 », which aims to help the existing industrial companies to shift to smart factories, to help new industrial companies to implement...
Fez Smart Factory will allow Morocco to stimulate economic growth through innovation, as well as reap the benefits provided by automation. The parties involved aim to implement the adoption of the latest industry 4.0 technologies.

The MoU will also help improve SME’s manufacturing abilities and productivity, through increased support for scientific research and innovation, and due to effective cooperation and sharing of knowledge.

Thus, COVID-19 crisis is more and more considered as a blessing in disguise for Moroccan industrial companies. By implementing industry 4.0 technologies, Moroccan industrial companies become more competitive, while enhancing employees’ working conditions and protecting environment (Tissir et al., 2020).

VII. REASONS TO BELIEVE IN ENERGY EFFICIENCY’S BRIGHT FUTURE

There are several reasons to believe that energy efficiency solutions would continue to gain momentum, these opportunities would accelerate the transition to a more sustainable future:

The first reason is historical. Structural changes accelerate during times of crisis, and we believe that the devastating effects of the 2008 financial crisis followed by COVID-19 challenges, have exposed the vulnerability of our current socioeconomic system, and have reinforced the consensus regarding the necessity to move to a more flexible system.

The second reason is related to the unprecedented international political commitment to sustainability. In this regard, several countries have formally committed to the Paris Agreements and the SDGs (Kuzemko et al., 2020). With the advent of COVID-19, the digital/green transformation prevails on political agendas as a way to tackle climate change.

The third reason is that countries are engaging a “green recovery” from COVID-19 (Bensouda and Benali, 2021). In this regard, 40 countries representing 80% of the global energy consumption, have stated that clean energy technologies are a core component of their COVID-19 recovery plans (Boons et al., 2020).

The fourth reason is the increasing attractiveness of energy efficiency’s vectors during the health crisis (Gössling et al., 2020). Digital/green technologies have attracted substantial private venture capital funding (Gössling et al., 2020).

The fifth reason is the difficulty of a “bouncing back” to certain pre-COVID-19 practices (Boons et al., 2020). Some irreversible changes are taking place and are leading us to a “new normality” (Gössling et al., 2020) forcing companies to rethink their organizational routines (Hall et al., 2020), which would generate more sustainable practices (Boons et al., 2020).

VIII. CONCLUSION

Times of crisis unquestionably reduce economic and social well-being. However, a crisis leads to a change in the existing patterns, and to an organizational transformation. These sudden unpredictable and distressing events are thus opportunities for organizational learning.

Energy efficiency has always been a lifeline for companies during times of crises because energy efficiency practices are easy to implement and to develop in different business sectors, with relatively low cost, which makes energy efficiency an affordable, readily available, quickly achievable and a profitable resource. Energy efficiency practices also increase organizational resilience during times of crisis, this is due to the lack of financial recourses that characterize crises, which pushes companies to look inward to learn, to innovate, and to explore novel opportunities.

Industry 4.0 provides a huge energy efficiency potential and helps companies to simultaneously achieve “economic performance” and “environmental sustainability”, and ultimately to achieve organizational resilience.

IX. REFERENCES


Catalan, Caroline, and Benoit Robert. 2011. “Evaluation of...
organizational resilience: application in Quebec.” Proceedings of the fourth resilience engineering symposium 1: 50-58.


Lucke, Dominik, Carmen Constantinescu, and Engelbert Westkämper. 2008. “Smart factory-a step towards the next generation of manufacturing.” Manufacturing
 systems and technologies for the new frontier 1: 115-118.
https://doi.org/10.1007/978-1-84800-267-8_23
https://doi.org/10.1016/j.erss.2014.03.011
https://doi:10.1109/JSYST.2009.2017397
https://doi.org/10.5281/zenodo.5730618
https://doi:10.5430/rwe.v10n3p78
https://doi.org/10.1016/j.rai.2016.03.005
https://doi.org/10.1111/j.1468-5973.2009.00558.x
https://doi.org/10.1016/j.procir.2016.01.129