ClinicSearch

Orthopaedics Case Reports

Cruz García Lirios *

Open Access

Research Article

Photovoltaic Installation During the COVID-19 Era

Cruz García Lirios [1], Sonia Sujell Velez Baez [2], Arturo Sánchez Sánchez [3], María Guadalupe Cruz García [3], Adán Sánchez Lopez [3], Víctor Hugo Meriño Córdoba [4]

[1] University of Health Sciences, Mexico City, Mexico.

[2] Autonomous University of Querétaro, San Juan del Rio, Mexico.

[3] Autonomous University of Tlaxcala, Mexico.

[4] Luis Amigó Catholic University, Colombia.

***Correspondence Author:** Cruz García Lirios, University of Health Sciences, Mexico City, Mexico. Email. cruz.garcial@unisa.cdmx.gob.mx

Received Date: March 14, 2025 | Accepted Date: March 20, 2025 | Published Date: April 03, 2025

Citation: Cruz G Lirios, Sonia S V Baez, Arturo S Sánchez, María G C García, Adán S Lopez, et al., (2025), Photovoltaic Installation During the COVID-19 era. *Orthopaedics Case Reports*. 4(2); DOI:10.31579/2835-8465/026

Abstract

The formation of intellectual capital has been observed in its professional and labor extension through professional practices and social service. In the case of learning photovoltaic installations, the formation of intellectual capital has been observed in the management of biosafety protocols as determining factors of individual performance and the quality of organizational service. Therefore, the objective of this work was to analyze the latent learning curve concerning the training practice of installing photovoltaic panels and modules. A longitudinal, observational and correlational work was carried out with a sample of 120 safety sheets filled out by student practitioners and social workers in organizations dedicated to the installation of photovoltaic panels and modules. The results show an increasing linear learning curve, but not significant in terms of the relationships between the variables of time, degree, specialty and collaboration. In relation to the state of the art which highlights the risks inherent to the photovoltaic installation, the present work suggests focusing on the analysis of the specialization that determined the time variable.

Keywords: installation learning; intellectual capital; latent curve; safety data sheets; photovoltaic panels

Introduction

Concern about sustainability has grown in people's minds. The debate since the publication of the World Conservation Strategy in 1980, "Our Common Future", the report of the World Commission on Environment and Development in 1987 and Agenda 21 in 1992 has resulted in the gradual acceptance that sustainability must integrate ecological integrity, economic efficiency and society. equity (Côté & Cohen- Ronethal, 1998).

In Molina Ruiz (2013), it is mentioned that there is an alarming situation, due to the situation of the planets. In Mexico it is possible to see the negative influence of the population impact on the environment (Molina-Ruiz, 2015). It is also possible to observe certain social deterioration and economic problems. Cavagnaro & George (2017) propose a framework in which the three main dimensions of sustainability are recognized.

It is important to promote well-being within organizations (Rocha, Barros & Fernandes, 2024). Within the framework of sustainability, organizations that promote the use of clean energy sometimes find themselves in constant risks that threaten their stability. It is natural that organizations make some mistakes throughout their development and historical trajectory; However, when the customer shows a lack of honesty and fails to share information, the organization spends more resources to correct the error or repair the problem (Kirova & Velikova, 2016). Between organizations it is necessary to create a supportive environment in which interested parties share information with each other.

To survive in the market and achieve profitability, companies need to meet customer requirements and carry out their activities efficiently (Andrejić, Kilibarda & Popović, 2015). However, some customers abuse the organization's goodwill, resulting in additional costs in using the organization's resources.

Sometimes, within organizations, disengaged staff have cheating attitudes that directly affect the organization's performance. In Bohte and Meier (2000), organizational deception is defined as an attempt to manipulate performance criteria; Three main forms of organizational cheating are also identified: 1) taking shortcuts (doing sloppy work); 2) lying (inventing organizational results); and 3) polarized samples (reporting most conductive cases). In the organizational context, another form of organizational deception can be identified, "customer cuddling", which means that a stakeholder within the organization overprotects the customer, providing privileged information and covering up bad behavior by the customer (or supplier) that affects the organization.

Cialdini, Petrova & Goldstein (2004) proposed that organizational dishonesty can increase surveillance and overlap between employee and organizational values and/or reputational degradation. It can also be stated that the dishonesty of the organization can cause the company to go out of business (bankruptcy), loss of customers, loss of suppliers, loss of bank support or credit agents.

The installation of photovoltaic systems requires careful consideration of various socioeconomic and environmental impacts (Yang, Alballa & Khalifa, 2023). Understanding the learning curve of renewable energy sources, such as wind energy, is crucial for effective implementation (Sojaeimehr & Rahmani, 2022). Knowledge of the decay curve of renewable energy sources is essential due to their limited useful life (Kamenopoulos & Tsoutsos, 2015). Increasing the general population's knowledge of natural hazards, such as flooding, is important for mitigation efforts (Inayat et al., 2023). Research in thermal engineering and solar technologies is essential for the development of efficient photovoltaic installations (Moser et al., 2017). The efficiency curves of solar technologies play an important role in determining the effectiveness of solar energy systems (Colli, 2015). Passive and low-energy alternatives, such as solar energy, are important considerations for sustainable building design (Yin & Liu, 2022). Technical skills and in-depth knowledge are necessary for the successful implementation of photovoltaic systems. Easy-to-install photovoltaic systems are being developed to increase the accessibility of solar energy technologies (Tomosk , Haysom & Wright, 2017). Integrating occupant thermal comfort considerations into building design requires knowledge of various heat gains, including radiative, convective, and latent heat.

Safety data sheets (SDS) are essential for the installation of photovoltaic panels and modules to ensure that proper handling and installation procedures are followed (Jahn et al., 2018). The different environmental conditions to which photovoltaic modules may be subject must be considered, especially in building-integrated installations (Wu et al., 2019). An analytical model for PV module performance based on manufacturer data sheets emphasizes the need for accurate information for optimal performance (Li et al., 2023). The impact of air gaps between PV modules and building envelopes on module performance emphasize the importance of proper installation to minimize overheating (Gao et al., 2021). The development of high concentration photovoltaic modules highlights the importance of quality control during the assembly process to guarantee proper operation (Betz et al., 2016). The behavior and fire performance of the backsheets of photovoltaic modules emphasize the need to evaluate the fire reaction characteristics for safety reasons (Merzifonluoglu & Uzgoren, 2018). The potential risks of microcracks in PV modules and their impact on performance highlight the importance of proper handling and maintenance to prevent such problems (Vaverková et al., 2022). In general, the literature emphasizes the importance of safety data sheets and proper installation procedures for photovoltaic panels and modules to ensure optimal performance and safety (Hernández-Callejo, Gallardo -Saavedra & Alonso-Gómez, 2019). Understanding environmental conditions, air gaps, quality control, fire behavior and potential risks such as microcracks are crucial aspects to consider during installation and maintenance of PV systems.

However, the longitudinal analysis of learning from photovoltaic installations has not been observed as a determinant of the quality of service, reputation and image of organizations dedicated to the generation, distribution and installation of CO2-free energy. Therefore, the objective of this work was to establish the learning curve in order to observe the relationships between the variables of time, degree, specialty and collaboration. Such indicators of academic, professional and labor training of intellectual capital will allow us to observe quality standards of educational service in organizations dedicated to the generation, transfer and installation of CO2-free energy where practitioners and social workers attend.

Are there significant differences between the beginning and the end of an observation related to facility learning in a biosafety context such as the pandemic?

This work is based on the assumption that confinement and distancing policies impacted the learning curves of essential jobs such as the installation of CO2-free energy (Guerrero- Liquet et al., 2016). Consequently, significant differences are expected to be observed between the beginning and the end of the theoretical and empirical observation.

Method

Design. A longitudinal, correlational and observational study was carried out with a sample of 120 safety sheets (see Annex A), filled out by practicing students and social workers from a public university in central Mexico, selected based on their training specialty in panels and modules. photovoltaics, as well as for their professional practices and social service in organizations dedicated to the production of carbon dioxide-free energy.

Instrument. The learning and skills of the practitioners and professional servants were observed through safety sheets to establish learning throughout the period in which the effects of the anti-pandemic policies arose from November 2019 to July 2024.

Procedure. Safety sheets were collected weekly to establish learning indicators around the training practice of photovoltaic panel installations. Using the Delphi technique, biosafety expert judges established ratings for the self-reported learning in the safety sheets. In three instances, photovoltaic energy experts rated each item on the safety sheets, assigning a value of -1 to their total disapproval and +1 to their total approval. In the second phase, the scores were compared with the general averages and the experts were asked to reconsider or reiterate their evaluation in a third phase.

Analysis. The data were captured in Excel and processed in JASP version 18 (see Annex B). The coefficients of the latent curve were estimated in order to establish team learning around the installation of photovoltaic panels. Values close to unity were assumed as evidence of non-rejection of the hypothesis related to the significant differences between the latent curve reported in the literature with respect to the observations of the present study.

Results

Latent curve analysis suggests linear learning of a technical skill such as installing photovoltaic panels. The results reveal a continuous, positive, growing and significant learning of the sample with respect to their knowledge and skills in the installation of photovoltaic panels.

The relationship between the time variables suggests the learning of skills and knowledge of the installation of photovoltaic panels. The results demonstrate a linear, constant and significant growth in skills and knowledge related to safety in photovoltaic panel installations.

The regression analysis between the time variables indicates the prediction of one scenario with respect to another before or after in the learning of photovoltaic installations. The results indicate direct, positive, but not significant relationships. That is, although learning prevails as time passes, even when the pandemic also worsens, prior knowledge of biosafety does not determine subsequent knowledge or skill.

The adjustment analysis establishes the differences between the models and their relationships between the variables that make them up. The findings correspond to a non-rejection of the hypothesis related to the differences between the theoretical structure of learning of photovoltaic installations with respect to safety sheets.

The analysis of covariance establishes direct, linear and significant relationships between the variables of time, degree, specialty and collaboration. The results demonstrate the prevalence of relationships close to zero which were interpreted as spurious relationships. It then means that the learning system is not reflected in the security with which the technical skill is carried out.

The latent curve graph suggests an asymmetric growth between the time variables that can be interpreted as a stationary scenario in which the learning of the photovoltaic installations is spurious. The graph suggests that the relationships between the time variables and their regressions by grade, specialty, and collaboration are not significant.

The latent curve model warns that except for the specialty factor that affects the beginning of learning, the other regression relationships are close to zero. Although the time variables show growth in the learning of photovoltaic installations in the field of security, the factors of degree, specialty and collaboration do not seem to be significant in influencing the learning of photovoltaic knowledge and skills.

The values of the parameters and analyzes used suggest the non-rejection of the hypothesis related to the significant differences between the theoretical structure of photovoltaic learning with respect to the observations made in the present work.

Discussion

The contribution of this work to the state of the art lies in the establishment of a model of the latent learning curve around photovoltaic installations during the pandemic. The results suggest the non-rejection of the hypothesis related to the significant differences between the theoretical structure with respect to empirical observations.

In the present work, an increasing, linear, but non-significant learning curve was observed between the variables of time, degree, specialty and collaboration in a sample of engineering students from a public university. Consequently, the academic, professional and work training of practitioners and social workers approaches the state of the art, since the importance of safety, prevention and prediction of risks inherent in the installation of photovoltaic modules and panels is emphasized.

However, this work does not consider other variables such as ethics and gender perspective that would explain the differences in the learning of men and women, as well as the monitoring of biosafety standards and their adjustment to the learning process, knowledge and skills. photovoltaic installation techniques. Consequently, it is necessary to extend the study to the analysis of reports of gender incidents in order to demonstrate the significant differences in learning about the installation of photovoltaic modules and panels.

Conclusion

The objective of this work was to establish the latent learning curve around photovoltaic installations in practitioners and social servants of organizations dedicated to the production, sale and installation of CO_2-free energy. The results demonstrate the prevalence of a growing, linear curve, but not significant in its relationships between time, degree, specialty and collaboration variables. In relation to the state of the art which suggests that biosecurity is central in the prevention of risks associated before, during and after photovoltaic installations, this work warns that only specialization affects the beginning of the learning curve. Consequently, the inclusion of other variables that can increase the predictive power of risks, such as the gender perspective or bioethics, is recognized in order to adjust the model to current organizational and work situations.

References

1. Andrejić, M., Kilibarda, M. & Popović, V. (2015). Logistical failures in the distribution process, 2nd International Logistics.
2. Betz, S., Caneva, S., Weiss, I., & Rowley, P. (2016). Photovoltaic energy competitiveness and risk assessment for the South African residential sector. *Progress in Photovoltaics: Research and Applications*, 24(12):1577-1591.
3. Bohte, J., & Meier, K.J. (2000). Goal displacement: Assessing motivation for organizational deception. Public Administration Review, 60(2):173-182.
4. Cavagnaro, E. and George, H. (2017). The three levels of sustainability. Rutledge.
5. Cialdini, R.B., Petrova, P.K., & Goldstein, NJ (2004). The hidden costs of organizational dishonesty: Companies that engage in unethical practices face far more harmful consequences than is traditionally recognized. The resulting damage can easily outweigh the short-term gains, MIT Sloan Management Review. 45(3):67-73.
6. Colli, A. (2015). Failure mode and effect analysis for photovoltaic systems. *Renewable and Sustainable Energy Reviews*, 50:804-809.
7. Côté, RP and Cohen- Ronethal, E. (1998). Design of eco-industrial parks: a synthesis of some experiences, Journal of Cleaner Production, 6 (3-4):181-188.
8. Gao, J., Guo, F., Li, X., Huang, X., & Men, H. (2021). Risk assessment of offshore photovoltaic projects under probabilistic linguistic environment. *Renewable Energy*, 163:172-187.
9. Guerrero- Liquet, GC, Sánchez-Lozano, JM, García- Cascales, MS, Lamata, MT, & Verdegay, JL (2016). Decision-making for risk management in sustainable renewable energy facilities: A case study in the Dominican Republic. *Sustainability*, 8(5), 455.
10. Hernández-Callejo, L., Gallardo -Saavedra, S., & Alonso-Gómez, V. (2019). A review of photovoltaic systems: Design, operation and maintenance. *Solar Energy*, 188:426-440.
11. Inayat , SM, Zaidia , SMR, Ahmeda , H., Ahmeda , D., Azama , MK, & Arfeenb , ZA (2023). Risk assessment and mitigation strategy of large-scale solar photovoltaic systems in Pakistan. *International Journal of Industrial Engineering and Management*, 14(2):105-121.
12. Jahn, U., Herz, M., Moser, D., Belluardo, G., & Richter, M. (2018). Managing technical risks in PV investments: How to quantify the impact of risk mitigation measures for different PV project phases? *Progress in Photovoltaics: Research and Applications*, 26(8):597-607.
13. Kamenopoulos, S.N., & Tsoutsos, T. (2015). Assessment of the safe operation and maintenance of photovoltaic systems. *Energy*, 93:1633-1638.
14. Kirova, M., & Velikova, P. (2016). Risk management method for small photovoltaic plants. *Management & Marketing*, 11(3):498-512.

15. Li, J., Zhang, Y., Fang, H., & Fang, S. (2023). Risk evaluation of photovoltaic power systems: An improved failure mode and effect analysis under uncertainty. *Journal of Cleaner Production*, 414, 137620.
16. Merzifonluoglu, Y., & Uzgoren, E. (2018). Photovoltaic power plant design considering multiple uncertainties and risks. *Annals of Operations Research*, 262:153-184.
17. Miranda, A.W., & Goldsmith, S. (2017, October). Cyber-physical risk management for PV photovoltaic plants. In *2017 International Carnahan Conference on Security Technology (ICCST)* (pp. 1-8). IEEE.
18. Molina Ruiz, HD (2013). Approach to calculating the carbon footprint in an institution of higher secondary and higher education. Innovation and Technological Development Digital Magazine, 5(3):1-10.
19. Molina Ruiz, HD (2015). Analysis at three levels of the environmental dimension of sustainability in Mexico. Innovation and Technological Development Digital Magazine, 7(4), ISSN: 2007-4786.
20. Moser , D., Del Buono , M., Jahn, U., Herz , M., Richter, M., & De Brabandere , K. (2017). Identification of technical risks in the photovoltaic value chain and quantification of the economic impact. *Progress in Photovoltaics: Research and Applications*, 25(7):592-604.
21. Rocha, F., Barros, T., & Fernandes, G. (2024). Risk Management in Photovoltaic Energy Projects: A Portugal Case Study. *Procedia Computer Science*, 239:1935-1941.
22. Shojaeimehr, S., & Rahmani, D. (2022). Risk management of photovoltaic power plants using a novel fuzzy multi-criteria decision-making method based on prospect theory: A sustainable development approach. *Energy* Conversion *and Management*
23. Tomosk, S., Haysom, J.E., & Wright, D. (2017). Quantifying economic risk in photovoltaic power projects. *Renewable Energy*, 109:422-433.
24. Vaverková, MD, Winkler, J., Uldrijan, D., Ogrodnik, P., Vespalcová, T., Aleksiejuk -Gawron, J., ... & Koda, E. (2022). Fire hazard associated with different types of photovoltaic power plants: Effect of vegetation management. *Renewable and Sustainable Energy Reviews*, 162, 112491.
25. Wu, Y., Ke, Y., Wang, J., Li, L., & Lin, X. (2019). Risk assessment in photovoltaic poverty alleviation projects in China under intuitionistic fuzzy environment. *Journal of Cleaner Production*, 219:587-600.
26. Yang, M., Alballa, T., & Khalifa, HAEW (2023). A comprehensive data analytics framework for risk management in photovoltaic system design projects. *Optik*, 295, 171411.
27. Yin, Y., & Liu, J. (2022). Risk assessment of photovoltaic-Energy storage utilization project based on improved Cloud-TODIM in China. *Energy*, 253, 124177.