Integrating Digital Transformation with Sustainability: How to Define a Net-Zero Performance Measurement System

Abstract

Climate change presents an urgent global crisis with significant implications across all regions and sectors and the need for concerted efforts to mitigate its effects and transition towards a net-zero emission society is one of the key challenges of our time. This conceptual paper aims to discuss how digital transformation can support performance measurement in search of a net-zero performance for organizations. Based on a comprehensive literature review, we identify the main aspects related to digital transformation that would allow companies to have their Net Zero Performance Measurement System (NZ-PMS) and propose a preliminary framework to help them define this system.

Primary Track
Sustainable and Responsible Business

Secondary Track
Performance Management

Keywords
Sustainability; Digital Transformation; Net Zero; Performance Measurement

Words count: 1,973

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1. Introduction

Climate change has become a global crisis, exerting its effects across all nations and continents. (UN, 2023). The tangible effects of climate change are increasingly evident. The tangible consequences of climate change are becoming increasingly apparent. According to the IPCC (2023), human-caused climate change is already influencing numerous weather and climate extremes in all regions across the globe. Evidence from the report indicates growing shifts in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones and, consequently, climate change has caused substantial damages, and increasingly irreversible losses, in terrestrial, freshwater, cryospheric and coastal and open ocean ecosystems. The human-generated greenhouse gas emissions are the primary drivers of this phenomenon, and their levels have now reached unprecedented highs in recorded history (UN, 2023)

Authors like Lee et al. (2023), Ogwumike et al. (2024), Mohammad et al. (2023) suggest that the transition towards a net-zero emission society has the potential to significantly decrease concentrations of greenhouse in the atmosphere, thereby aiding in the mitigation of global warming and its associated climate disruptions. While the journey towards achieving net-zero emissions may be challenging, the rewards are invaluable in terms of preserving the planet and ensuring a sustainable and prosperous future for future generations (Tang et al., 2023).

This imperative extends to the corporate realm, where sustainability has become a paramount concern for businesses worldwide. As Han et al. (2023) remark, effective management practices are indispensable for achieving the net-zero targets, as they facilitate the implementation of sustainable initiatives and foster a corporate ethos underscored by a resolute commitment to environmental responsibility. In this perspective, companies must define to what extent their strategy is oriented to sustainability in their different aspects (Orsato, 2006) and how effective they are doing this (Gates & German, 2010). To manage their performance, measuring sustainability aspects becomes essential for those companies (Atkinson, 2000; Pintér et al., 2012). The good news here is that there is a plethora of sustainability assessment methods and tools (Singh et al., 2012). The downside is that there should be appropriate criteria for the proper definition of how to measure corporate sustainability regarding not only identifying indicators (Azzone & Noce, 1996; Niemeijer & De Groot, 2008) but also aiming the implementation of a Corporate Sustainability Performance Measurement System (SPMS) (Searcy, 2012).

Given this urgent need for companies to measure their net-zero performance and the inherent complexity of this theme, it is possible to imagine that new ways to effectively do it will arise. It is the case of Digital Transformation (DT). DT is increasingly recognized as a key enabler of sustainability and achieving net-zero emissions. Integrating digital technologies not only enhances operational efficiency and competitiveness but also plays a pivotal role in promoting sustainable practices and achieving net-zero. By leveraging data analytics, organizations can optimize resource

utilization, reduce energy consumption, and minimize waste, contributing to environmental sustainability and achieving net-zero goals (Govindan, 2023). Digital transformation enables the development of smart and eco-friendly solutions, such as energy-efficient technologies, smart grids, and sustainable supply chain management. Moreover, digital platforms facilitate collaboration and communication, fostering a global awareness of sustainable practices and encouraging the exchange of ideas to address environmental challenges. The synergy between digital transformation and sustainability is crucial for creating a resilient and environmentally conscious future where technological advancements are harnessed to drive positive ecological and social impact (Kraus et al., 2021; Okorie et al., 2023).

Therefore, this developmental article aims to answer the following research question: how digital transformation can support performance measurement in search of net-zero? To achieve our goal, we developed a comprehensive literature review by delineating some preliminary aspects of a Net Zero Performance Measurement System (NZ-PMS) based on the use of Digital Transformation.

2. Theoretical Background

1.1. Performance Measurement

Even though performance measurement (PM) constitutes one of the most important aspects of a firm's managerial system (Kaplan & Norton, 1996; Simons, 2000; Neely, 2007), literature still faces several challenges both theoretically and practically (Bititci, Garengo, Dörfler, & Nudurupati, 2012; Micheli & Mari, 2013, Melnyk, Bititci, Platts, Tobias & Andersen, 2014), turning PM a subject that needs to be constantly revisited (Carneiro-da-Cunha, Hourneaux Junior, and Correa, 2016; Sureka, Kumar, Mangla, & Hourneaux Junior, 2020; Aguilera, De Massis, Fini, & Vismara, 2024).

PM can be defined as "the ongoing monitoring and reporting of program accomplishments, particularly progress toward pre-established goals" (US-GAO, 2011) or in another perspective, it consists of how organisations verify the efficiency and effectiveness of their organisational activities (Neely, Adams, & Kennerley, 2007). PM as a theme has been scrutinized by many scholars through time. Some studies try to consolidate the variety of its aspects and perspectives. Table 1 summarizes some of these works.

Table 1. Main aspects of PM identified in the literature.

Theme	Aspect	Author(s)
Performance Measurement	Strategic Orientation	Kaplan & Norton, 1992; Atkinson, Waterhouse, & Wells, 1997; Henri, 2009
	Multidimensionality	Bourne et al., 2000; Richard et al., 2009
	Integrative framework	Ghalayini & Noble, 1996; Kaplan & Norton, 1992; 1996
	Balancing different types of measures and indicators	Simons, 2000; Kaplan & Norton, 1992; 1996
	Inclusion of organisational stakeholders and external environmental aspects	Atkinson et al., 1997; Neely et al., 2002; Richard et al., 2009)
	Legitimisation of a firm's actions by presenting its outcomes and impacts both internally and externally	Henri, 2009

Source: the authors, based on Carneiro-da-Cunha, Hourneaux Junior, and Correa (2016).

1.2. Digital Transformation (DT)

Digital transformation plays a crucial role in realizing a future with net-zero emissions. However, digital transformation is currently in a nascent stage and requires technology infrastructure and strategies that align seamlessly with the overarching business strategy (Viets & Hagemeier, 2023; Cao et al., 2023; Manny et al, 2021; Kolodynskyi et al, 2018). Also, the integration of sustainable practices across the entire supply chain eco-system can be complex. Ensuring that suppliers and partners align with net-zero goals requires coordination and collaboration (Abou Maroun et al, 2019; Briscoe et al, 2011; Li et al, 2012; Govindan, 2023).

Digital transformation (DT) encompasses using digital technologies to facilitate significant advancements in business, such as improving customer experiences or innovating new business models (Piccinini et al., 2015). It Leverages emerging digital technologies like social media, mobile applications, analytics, and embedded devices is employed to bring about substantial business enhancements. These improvements may include enriching customer experiences, optimizing operations, or innovating new business models (Horlacher & Hess, 2016). The digital transformation theme has undergone examination by numerous scholars over time. Existing research aims to consolidate the diverse aspects and perspectives within this domain. Table 2 provides a summary of some of these studies.

Table 2. Main aspects of DT identified in the literature.

Theme	Aspect	Author(s)
Digital Transformation	Technology infrastructure/Strategy	Manny et al, 2021; Kolodynskyi et al, 2018; Sia et al, 2016; Sebastian et al, 2017; Matt et al, 2015
	Digital data and ecosystem	Li et al, 2012; Oliveira et al, 2019; Briscoe et al, 2011; Kira et al, 2021
	Digital skills and culture	Allman & Blank, 2021; Carlisle et al, 2023; Wanitchayaporn, 2021; Antonopoulou et al, 2021
	Digital technologies (AI, Blockchain, Simulation, visualise, etc.)	Martínez-Caro et al, 2020; Abou Maroun et al, 2019; Argyroudis et al, 2022; Maroun & Daniel, 2019
	Smart Decision making	Govindan, 2023; Daniel & Merigo, 2021; Sarker, 2021; Daniel et al, 2019

Source: the authors.

1.3. Net Zero

The emergence of the net zero agenda is garnering increasing attention from scholars and practitioners (Gallotta et al, 2024). As suggested by Kingston (2021); Lee et al. (2023), Ogwumike et al. (2024), Mohammad et al. (2023) various industrial decarbonization frameworks have emerged for evaluating the transition to a net-zero landscape. Although several authors have explored multiple themes linked to net-zero transition, the practical implementation remains a challenge. As mentioned in the HM Government (2021), innovation is a central approach to delivering net zero and it will require a step change in the rate of new technologies and processes being developed and deployed into the market and being adopted by businesses and consumers. The emergence of the net zero agenda has prompted a parallel surge in the discourse surrounding eco-innovation, as scholars and practitioners alike recognize the pivotal role of innovative solutions in transitioning towards sustainable futures.

In this perspective, eco-innovation refers to the emergence of pioneering products, methodologies, and organizational paradigms aimed towards mitigating ecological impacts, enhancing societal compliance and advancing the principles of sustainable development (Vasconcelos-Garcia & Carrilho-Nunes, 2024, Antonioli et al., 2013; He et al., 2018; Mahmood et al., 2022; Paparoidamis et al., 2019). At the same time, global supply chains are increasingly influenced by environmental awareness, which, in turn, impacts a firm's selection of suppliers. Consequently, suppliers face pressure from buyers to minimize their environmental footprint (OECD, 2018). From this angle, green supply chains (GSCs) strive to reduce their carbon footprint while optimizing resource utilization across various stages, including material sourcing, processing, packaging, storage, transportation, product usage, and end-of-life disposal (Srivastava, 2007).

Some studies try to consolidate the variety of its aspects and perspectives. Table 3 summarizes some of these works.

Table 3. Main aspects of NZ identified in the literature.

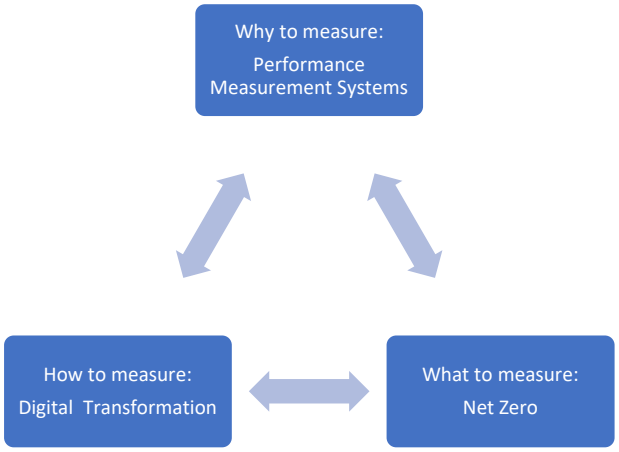
Theme	Aspect	Author(s)
Net Zero	Net zero transition	Kingston (2021); Lee et al. (2023), Ogwumike et al. (2024), Mohammad et al. (2023)
	Eco-innovation	Vasconcelos-Garcia & Carrilho-Nunes, 2024, Antonioli et al., 2013; He et al., 2018; Mahmood et al., 2022; Paparoidamis et al., 2019
	Sustainable supply chains	Tumpa et al. (2019), OECD (2018), Grant et al. (2023)
	Assessment and Reporting	GHG (2011), GRI (2020), Machado et al (2023), Chiarini (2017)

Source: the authors.

3. Findings and Discussion

In this developmental paper, we aim to provide insights into the question: how digital transformation can support performance measurement in search of net zero? Figure 1 represents the rationale behind it.

Figure 1. Research themes relationship.



Source: the authors.

Therefore, we propose the following discussion to understand better how this system should be defined.

Why to measure? Performance Measurement Systems

"What gets measured, gets managed". The famous saying has increased importance when addressing topics such as sustainability and climate change. The need for precise, accurate, accountable, and timely access to what is happening in the organization has never been so urgent. Moreover, knowing how and what to effectively and efficiently measure organizational performance becomes critical not only for management itself, but also for communicating and disclosing this performance to society.

How to measure? Digital Transformation

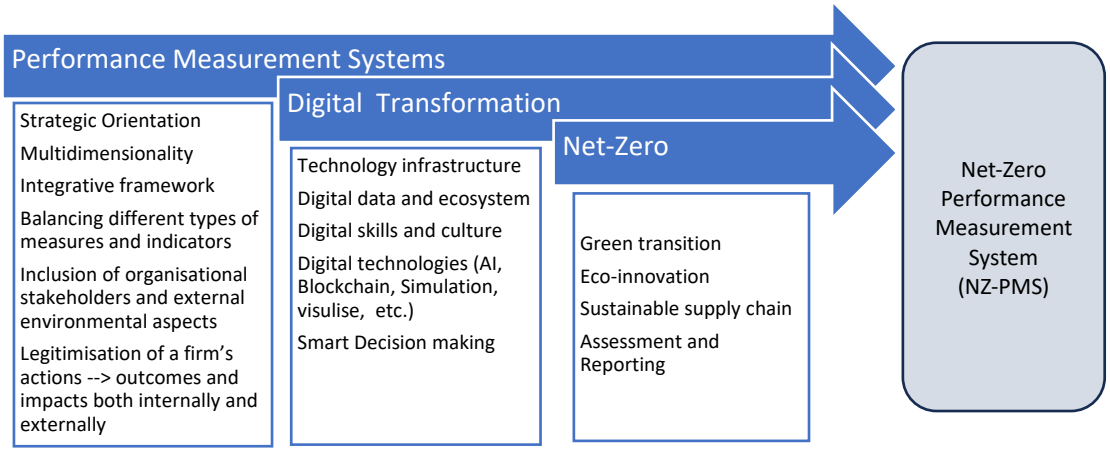
Digital transformation acts as an enabler of sustainability efforts by providing tools, technologies, and data-driven insights to support the transition to net zero. Digital solutions can streamline processes, improve efficiency, and facilitate informed decision-making across all aspects of sustainability. Moreover, DT facilitates the integration of data and analytics into performance measurement systems, enabling organizations to track, analyze, and report on their progress toward net zero targets in real-time. Digital platforms can aggregate data from various sources, apply advanced analytics techniques, and generate actionable insights to drive continuous improvement.

What to measure? Net-zero

Measuring the adoption of digital transformation for sustainability and net-zero goals involves assessing the extent to which organizations integrate eco-friendly and socially responsible practices into their digital initiatives. Examples of some key metrics and methods to measure digital transformation adoption in the context of sustainability and net zero are Environmental impact assessment (i.e. measure and track carbon footprint), Energy efficiency metrics, Renewable energy usage, waste reduction, remote work and travel reduction, Supply chain sustainability metrics, Data privacy and security compliance, among others.

Therefore, according to the literature (see Tables 1, 2 and 3), several aspects must be considered when defining a NZ-PMS. Figure 2 represents the rationale behind those aspects.

Figure 2. NZ-PMS configuration.



Source: the authors.

Then, we can propose that a NZ-PMS is "the process of collecting, analyzing, and evaluating the efficiency and effectiveness of all the net-zero oriented activities using digital transformation as a means to facilitate and enhance this process". These three themes (net zero, digital transformation, and performance measurement) are interconnected. Thus, a NZ-PMS may enhance corporate sustainability, optimize resource utilization, and drive organizational performance, among other benefits.

4. Conclusion, Limitations, and Future Work

In conclusion, this article has explored the intersection of digital transformation, performance measurement, and the pursuit of net-zero emissions. We began by examining the urgent need for organizations to address climate change by adopting net-zero targets and the challenges associated with measuring and managing net-zero performance. Recognizing the complexity of this task, we then turned to digital transformation as a potential solution, highlighting its role in enhancing sustainability practices and supporting the transition to a net-zero emission society.

In this perspective, digital transformation offers a range of innovative tools and technologies that can facilitate the collection, analysis, and reporting of sustainability data, enabling organizations to gain deeper insights into their net-zero performance. From advanced data analytics to smart sensors and IoT devices, digital solutions provide new opportunities for organizations to monitor and manage their environmental impact in real-time. Integrating these technologies into performance measurement systems can enhance transparency, accountability, and stakeholder engagement. By leveraging digital platforms for reporting and communication, organizations can foster greater trust and collaboration with stakeholders, driving collective action towards achieving net-zero goals.

This research has proposed a framework to fundament a PZ-PMS. This framework provides a structured approach for organizations to define, measure, and manage their net-zero performance, guiding them towards sustainable and resilient business practices.

As a natural limitation, especially in a developmental paper, this conceptual framework needs validation. Future research aims to conduct an empirical validation of the proposed framework for a Net Zero Performance Measurement System (NZ-PMS) based on digital transformation. This could involve implementing the framework in real-world organizational settings and assessing its effectiveness in tracking and managing net-zero performance. By undertaking in-depth case studies of organizations, this could provide valuable insights into best practices, challenges, and lessons learned in the implementation process.

References

Abou Maroun, E., Daniel, J., Zowghi, D., & Talaei-Khoei, A. (2019). Blockchain in supply chain management: Australian manufacturer case study. In Service Research and Innovation: 7th Australian Symposium, ASSRI 2018, Sydney, NSW, Australia, September 6, 2018, and Wollongong, NSW, Australia, December 14, 2018, Revised Selected Papers 7 (pp. 93-107). Springer International Publishing.

Allmann, K., & Blank, G. (2021). Rethinking digital skills in the era of compulsory computing: methods, measurement, policy and theory. Information, Communication & Society, 24(5), 633-648.

Antonioli, D., Mancinelli, S. and Mazzanti, M. (2013) 'Is environmental innovation embedded within high-performance organisational changes? the role of Human Resource Management and complementarity in Green Business Strategies', Research Policy, 42(4), pp. 975–988. doi:10.1016/j.respol.2012.12.005.

Antonopoulou, H., Halkiopoulos, C., Barlou, O., & Beligiannis, G. N. (2021). Transformational leadership and digital skills in higher education institutes: during the COVID-19 pandemic. Emerging science journal, 5(1), 1-15.
Argyroudis, S. A., Mitoulis, S. A., Chatzi, E., Baker, J. W., Brilakis, I., Gkoumas, K., Linkov, I. (2022). Digital technologies can enhance climate resilience of critical infrastructure. Climate Risk Management, 35, 100387.
Atkinson, G. (2000). "Measuring Corporate Sustainability", *Journal of Environmental Planning and Management* 43, 2: 235–52. https://doi.org/10.1080/09640560010694.
Bititci, U. S., Garengo, P., Dörfler, V., & Nudurupati, S. (2012). Performance measurement: Challenges for tomorrow. International Journal of Management Reviews, 14, 305–327. https://doi.org/10.1111/j.1468-2370.2011.00318.x
Briscoe, G., Sadedin, S., & De Wilde, P. (2011). Digital ecosystems: Ecosystem-oriented architectures. Natural Computing, 10, 1143-1194.
Cao, L., Hu, P., Li, X., Sun, H., Zhang, J., & Zhang, C. (2023). Digital technologies for net-zero energy transition: a preliminary study. Carbon Neutrality, 2(1), 7.
Carlisle, S., Ivanov, S., & Dijkmans, C. (2023). The digital skills divide: evidence from the European tourism industry. Journal of Tourism Futures, 9(2), 240-266.
Carneiro-Da-Cunha, J. A., Hourneaux Jr, F., & Corrêa, H. L. (2016). Evolution and chronology of the organisational performance measurement field. International Journal of Business Performance Management, 17(2), 223-240, https://doi.org/10.1504/IJBPM.2016.075553
Chiarini, A (2017). Environmental policies for evaluating suppliers' performance based on GRI indicators. Business Strategy and Environment, 26, 1, 98-111.
Daniel, J., & Merigo, J. M. (2021). Developing a new multidimensional model for selecting strategic plans in balanced scorecard. Journal of Intelligent & Fuzzy Systems, 40(2), 1817-1826.
Daniel, J., Naderpour, M., & Lin, C. T. (2018). A fuzzy multilayer assessment method for EFQM. IEEE Transactions on Fuzzy Systems, 27(6), 1252-1262.
Frank, Alejandro Germ´an, Dalenogare, Lucas Santos, Ayala, N´estor Fabi´an, 2019. Industry 4.0 technologies: implementation patterns in manufacturing companies. Int. J. Prod. Econ. 210 (January), 15–26.
Gallotta, B., Baranova, P., Paterson, F. (2024). Pro-environmental enterprise support: Developing a framework to unlock the potential of SMEs in sustainability transitions. Journal of Local Economy.
Gates, S. (2010). "Integrating Sustainability Measures into Strategic Performance Measurement Systems", Management Accounting Quarterly, 11, 3:1-7.
Govindan, K. (2023). How digitalization transforms the traditional circular economy to a smart circular economy for achieving SDGs and net zero. Transportation Research Part E: Logistics and Transportation Review, 177, 103147.
Grant, D. B., Trautrims, A., & Wong, C. Y. (2023). Sustainable Logistics and Supply Chain Management: Principles and practices for Sustainable Operations and Management. London: KoganPage.
Greenhouse Gas Protocol (GHG): Product life cycle accounting and reporting standard. (2011). Washington, DC: World Resources Institute.
GRI: Global Reporting Initiative (2020). Business reporting on the SDGs. Available at https://www.globalreporting.org/information/SDGs/Pages/Reporting-on-the-SDGs.aspx. Accessed on 23 February 2024.
Han, D., Teng, F., & Jia, R. (2023). Achieving the goal of net-zero requires both resource efficiency and efficient business management. Resources Policy, 86, 104203. doi:10.1016/j.resourpol.2023.104203

He, F. et al. (2018) 'Contemporary Corporate eco-innovation research: A systematic review', Journal of Cleaner Production, 174, pp. 502–526. doi:10.1016/j.jclepro.2017.10.314.
Horlacher, A., & Hess, T. (2016, January). What does a chief digital officer do? Managerial tasks and roles of a new C-level position in the context of digital transformation. In 2016 49th Hawaii International Conference on System Sciences (HICSS) (pp. 5126-5135). IEEE.
IPCC (2023). 'IPCC, 2023: Sections. In: Climate Change 2023: Synthesis Report'. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC. Geneva, Switzerland, pp. 35-115, doi: 10.59327/IPCC/AR6-9789291691647
Kaplan, R.S. & Norton, D. P. (1996). The Balanced Scorecard: Translating Strategy into Action. Boston: Harvard Business School Press, 1996, 322 p.
Kingston, A., & Bird, A. (2021). Sustainable Leadership. In Manufacturing Management (Vol. 2021, Issues 1–2, pp. 22–23). Mark Allen Group. https://doi.org/10.12968/s2514-9768(22)90061-4
Kira, B., Sinha, V., & Srinivasan, S. (2021). Regulating digital ecosystems: bridging the gap between competition policy and data protection. Industrial and Corporate Change, 30(5), 1337-1360.
Kolodynskyi, S., Drakokhrust, T., & Bashynska, M. (2018). The innovative infrastructure of economic development in the framework of international digital transformation. Baltic Journal of Economic Studies, 4(4), 166-172.
Kraus, S., Jones, P., Kailer, N., Weinmann, A., Chaparro-Banegas, N., & Roig-Tierno, N. (2021). Digital transformation: An overview of the current state of the art of research. Sage Open, 11(3), 21582440211047576.
Lee, C.-C., Wang, F. and Chang, Y.-F. (2023) 'Towards net-zero emissions: Can green bond policy promote green innovation and green space?', Energy Economics, 121, p. 106675. doi:10.1016/j.eneco.2023.106675.
Li, W., Badr, Y., & Biennier, F. (2012, October). Digital ecosystems: challenges and prospects. In proceedings of the international conference on management of Emergent Digital EcoSystems (pp. 117-122).
Machado, M.C. et al. (2023) 'Can global reporting initiative reports reveal companies' Green Supply Chain Management Practices?', Journal of Cleaner Production, 383, p. 135554. doi:10.1016/j.jclepro.2022.135554.
Mahmood, N. et al. (2022) 'Role of environmental regulations and eco-innovation in energy structure transition for green growth: Evidence from OECD', Technological Forecasting and Social Change, 183, p. 121890. doi:10.1016/j.techfore.2022.121890.
Manny, L., Duygan, M., Fischer, M., & Rieckermann, J. (2021). Barriers to the digital transformation of infrastructure sectors. Policy Sciences, 54, 943-983.
Maroun, E., Daniel, J., (2019). Opportunities for use of blockchain technology in supply chains: Australian manufacturer case study. In International Conference on Industrial Engineering and Operations Management.
Martínez-Caro, E., Cegarra-Navarro, J. G., & Alfonso-Ruiz, F. J. (2020). Digital technologies and firm performance: The role of digital organisational culture. Technological Forecasting and Social Change, 154, 119962.
Matt, C., Hess, T., & Benlian, A. (2015). Digital transformation strategies. Business & information systems engineering, 57, 339-343.

Melnyk, S. A., Bititci, U., Platts, K., Tobias, J., & Andersen, B. (2014). Is performance measurement and management fit for the future? Management Accounting Research, 25, 173–186. https://doi.org/10.1016/j.mar.2013.07.007

Micheli, P., & Mari, L. (2013). The theory and practice of performance measurement. Management Accounting Research, 25, 2: 147-156. https://doi.org/10.1016/j.mar.2013.07.005

Mohammed, B. U., Wiysahnyuy, Y. S., Ashraf, N., Mempouo, B., & Mengata, G. M. (2023). Pathways for efficient transition into net zero energy buildings (nzeb) in Sub-Sahara Africa. case study: Cameroon, Senegal, and Côte d'Ivoire. Energy and Buildings, 296, 113422. doi:10.1016/j.enbuild.2023.113422

Neely, A.; Kennerley, M.; Adams, C. Performance measurement frameworks: a review in Neely, A. (ed.) Business performance measurement: unifying theories and integrating practices. Cambridge: University Press, 2007, 2a. ed.

Niemeijer, D. & De Groot, R. S. (2008). "A Conceptual Framework for Selecting Environmental Indicator Sets". Ecological Indicators, 8, 1: 14–25. https://doi.org/10.1016/j.ecolind.2006.11.012

Ogwumike, C., Akponeware, A., Oyewole, A., Dawood, H., Pinedo-Cuenca, R., Ling-Chin, J., Roskilly, A., Dawood, N. (2024) 'Transitioning or tinkering at a net-zero economy? introducing an assessment framework for industrial cluster decarbonisation in the United Kingdom', Energy Research & Social Science, 110, p. 103459. doi:10.1016/j.erss.2024.103459.

Okorie, O., Russell, J., Cherrington, R., Fisher, O., & Charnley, F. (2023). Digital transformation and the circular economy: Creating a competitive advantage from the transition towards Net Zero Manufacturing. Resources, Conservation and Recycling, 189, 106756.

OECD (2018), Environmental Policy Toolkit for SME Greening in EU Eastern Partnership Countries, OECD Green Growth Studies, OECD Publishing, Paris, https://doi.org/10.1787/9789264293199-en.

Oliveira, M. I. S., Barros Lima, G. D. F., & Farias Lóscio, B. (2019). Investigations into data ecosystems: a systematic mapping study. Knowledge and Information Systems, 61, 589-630.

Orsato, R. J. (2009). "When Does It Pay to Be Green?" California Management Review, 127-143. https://doi.org/10.1057/9780230236851_1.

Paparoidamis, N.G. et al. (2019) 'Being innovative while being green: An experimental inquiry into how consumers respond to eco-innovative product designs', Journal of Product Innovation Management, 36(6), pp. 824–847. doi:10.1111/jpim.12509.

Piccinini, E., Hanelt, A., Gregory, R., & Kolbe, L. (2015). Transforming industrial business: the impact of digital transformation on automotive organizations.

Pintér, L., Hardi, P., Martinuzzi, A. & Hall, J. (2012). "Bellagio STAMP: Principles for Sustainability Assessment and Measurement". Ecological Indicators, 17: 20–28. https://doi.org/10.1016/j.ecolind.2011.07.001.

Sarker, I. H. (2021). Data science and analytics: an overview from data-driven smart computing, decision-making and applications perspective. SN Computer Science, 2(5), 377.

Sebastian, I. M., Mocker, M., Ross, J. W., Moloney, K. G., Beath, C., & Fonstad, N. O. (2017). How Big Old Companies Navigate Digital Transformation. MIS Q. Exec. 42, 150–154.

Searcy, C. (2012). "Corporate Sustainability Performance Measurement Systems: A Review and Research Agenda". Journal of Business Ethics, 107, 3: 239–53. https://doi.org/10.1007/s10551-011-1038-z.

Sia, S. K., Soh, C., & Weill, P. (2016). How DBS Bank Pursued a Digital Business Strategy. MIS Quarterly Executive, 15(2).
Singh, R. K., Murty, H.R., Gupta, S.K. & Dikshit, A.K. (2012). "An Overview of Sustainability Assessment Methodologies", Ecological Indicators, 15, 1: 281–99. https://doi.org/10.1016/j.ecolind.2011.01.007.
Sureka, R.; Kumar, S.; Mangla, S. K.; Hourneaux Junior, F. (2020). Fifteen Years of International Journal of Productivity and Performance Management (2004-2018). The International Journal of Productivity and Performance Management, Vol. 70 No. 5, pp. 1092-1117. https://doi.org/10.1108/IJPPM-11-2019-0530
Tang, W., Mai, L. and Li, M. (2023) 'Green Innovation and resource efficiency to meet net-zero emission', Resources Policy, 86, p. 104231. doi:10.1016/j.resourpol.2023.104231.
Tumpa, T.J., Ali, S.M., Rahman, Md.H., Paul, S.K., Chowdhury, P. and Rehman Khan, S.A. (2019). Barriers to green supply chain management: An emerging economy context. Journal of Cleaner Production, 236, p.117617. doi:10.1016/j.jclepro.2019.117617.
United Nations Environment Programme (2023). Emissions Gap Report 2023: Broken Record – Temperatures hit new highs, yet world fails to cut emissions (again). https://wedocs.unep.org/20.500.11822/43922.
US-GAO – United States Government Accountability Office (2011). Government Performance and Results Act: Performance Measurement and Evaluation: Definitions and Relationships. available in https://www.gao.gov/products/gao-11-646sp
Vasconcelos-Garcia, M. and Carrilho-Nunes, I. (2024) 'Internationalisation and digitalisation as drivers for eco-innovation in the European Union', Structural Change and Economic Dynamics, 70, pp. 245–256. doi:10.1016/j.strueco.2024.02.010.
Viets, A., & Hagemeier, L. (2023). Chief Digital Officers and Environmental Performance in Complex Settings. Available in https://aisel.aisnet.org/icis2023/gov_strategy/gov_strategy/6/
Wanitchayaporn, S. (2021, July). Developing digital skills and working in a New Normal. The 13th NPRU National Academic Conference Nakhon Pathom Rajabhat University.