

# AN ESG-BASED APPROACH TO SUPPLY CHAIN MANAGEMENT

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**Abstract.** In response to the current competitive landscape, companies seek to redefine their business vision, abandoning the exclusive pursuit of profit in favour of including sustainable development objectives. Initially, a Systematic Literature Review (SLR) was conducted to identify criteria and topics related to Corporate Sustainability (ESG - Environmental, Social and Governance). Then, the Fuzzy Delphi method was applied to classify and filter the most relevant topics, considering the uncertainty and subjectivity inherent to the experts' assessments. The aim is to identify relevant themes from literature and tailor them to the organization's specific needs, providing a tailored approach to sustainable supply chain management. Integrating these topics in the supply chain seeks to promote sustainable and responsible practices, contributing to the effective implementation of sustainability strategies in the company's business context.

**Keywords:** ESG; Supply Chain Management; Managerial Sustainability; ESG Criteria; ESG topics; MCDM.

## 1 Introduction

The ESG (Environmental, Social, and Governance) concept represents a holistic approach involving environmental, social, and corporate governance criteria. This paradigm emerged from the concept of responsible investment and is characterized by a strategy and practice that integrates these criteria into investment decisions [1; 2]. In this context, ESG assessment is gaining prominence to recognize and quantify the social value intrinsic to an organization's environmental, social, and corporate management. In this way, the orientation by ESG criteria has been increasingly adopted by investors and other financial market agents, reflecting a movement towards more sustainable and responsible investment practices. This trend not only highlights a shift in investment paradigms but also highlights the importance of considering the long-term impacts of corporate activities on the environment, society, and corporate governance [3; 4; 5], and it highlights the vital influence of rating agencies in assessing corporate sustainability for academia and business. By broadening their evaluation criteria, they

provide valuable insights, promote more responsible practices and provide transparency to investors. The inclusion of sustainable criteria highlights the importance of sustainability in investment decision-making and business management and can also boost companies' reputation and financial performance in the long term [6; 7]. Investors' growing interest in ESG assessments and sustainable performance directly influences their capital injection decisions, highlighting the importance of the topic in the business context. The consideration of these criteria reflects the concern for companies' environmental and social impacts and the perception that responsible practices contribute to long-term financial performance. This underscores the growing need for companies to adopt sustainable measures to attract investment and ensure their viability and competitiveness in the market [8; 9]. The application of sustainable management tools facilitates comprehensive and objective analyses, considering financial, social, environmental, and governance aspects, resulting in more informed decisions aligned with the objectives and values of stakeholders and promoting effective use of resources and investments [10]. In the ESG context, several tools meet different needs, ranging from the classification of companies for green investments, performance evaluation, and risk analysis to priority strategies [11; 12; 13; 14]. In line with these tools, multi-criteria methods can be adopted, offering a systematic approach for decision-makers, such as investors and board members, when selecting options based on relevant criteria. This study aims to search the literature for criteria associated with each dimension of the ESG pillars (environmental, social and governance), selecting them to apply the concepts that best align with sustainable supply chain management. In this way, it is possible to lay a solid foundation for developing a useful and versatile tool, based on multi-criteria methods, for sustainable supply chain management. This tool will be aligned with ESG principles and the company's values, thus contributing to more responsible and efficient practices.

## **2 Methodological procedures**

This research adopts a qualitative approach through the Systematic Literature Review (SLR) that aims to gather the basic and necessary information from previous work to structure the mind map [15; 16] to investigate the ESG field and establish criteria [17; 18; 19]. In addition, it incorporates quantitative approaches, such as Fuzzy Delphi, to select relevant criteria and assign them significant weights. SLR was performed in two stages; The first focused on defining the criteria, and the second on exploring the themes to which these criteria are linked. Both databases used were Scopus and Web of Science (WoS). They are the main databases currently used due to the large number of documents [20; 21; 22], and the methodology used follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol. The flowchart of the PRISMA method is shown in Figure 1.

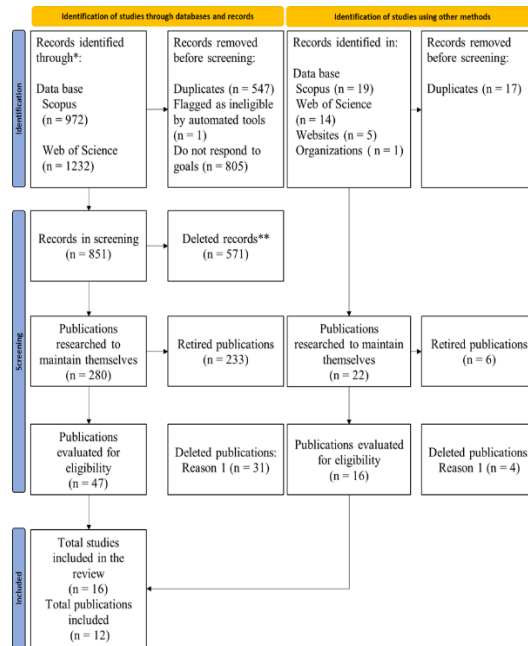


Figure 1. Prisma Method.

In the first stage of the SLR, the search string was used: (TITLE-ABS-KEY ("environmental, social and governance" OR "ESG") AND TITLE-ABS-KEY ("environmental" OR "social" OR "governance") AND TITLE-ABS-KEY ("fundamental\*" OR "principle\*" OR "foundation\*" OR "pillar\*" OR "categories" OR "theme\*")), which resulted in 2204 documents. Excluding duplicate documents and those that did not serve the purpose of the SLR, it resulted in 851 records for screening. Then, filters were applied according to the type of document (only articles), source (only published in journals), stage of publication (final stage) and language (only articles in English), which resulted in 280 articles. After filtering and analyzing the title and abstract, eligible articles were identified. At this stage, 47 articles were selected for complete reading, and after the analysis, only 16 articles were included in the SLR for the selection of ESG criteria. In the second phase, we searched for articles identifying which topics each of the selected criteria corresponded to. When this preliminary search was carried out, it was observed that all articles that dealt with ESG topics were applied using the multicriteria method. For this, the following search string was used: (TITLE-ABS-KEY ("environmental, social and governance") AND TITLE-ABS-KEY (multicriteria OR mcdm)), resulting in 33 records; after deleting the duplicate documents, 16 articles were evaluated by title and abstract, six articles were excluded for not meeting the scope of the search. As a result, the ten resulting records were read in full, where only six were included in the second SLR stage. Analyzing these articles, we identified 5 ESG information providers [23; 24; 25; 26; 27], which were also used to classify ESG criteria into themes, and as a complement, 1 ABNT document was used

[28], all aligned with the purpose of the present study. As a result, SLR evaluated 28 registries to select ESG criteria and themes. Finally, the Fuzzy Delphi method was used to classify these criteria. The Delphi method, initially conceived by Dalkey and Helmer (1963), underwent an evolution proposed by Murray, Pipino and Gigch (1985), who proposed the application of the theory Fuzzy as an innovation, aiming not only to reduce the costs associated with implementation, but also to improve the convergence of the original method. This multi-criteria method aims to achieve consensus among expert evaluations and, by integrating the theory of Fuzzy, it is possible to carry out this process more efficiently in a single round of responses [29; 30]. The application of the Fuzzy Delphi is divided into 4 steps:

- i. Apply the questionnaire with the experts [29] - Each criterion  $i$ ,  $i \in S$  will have an answer  $R_i$  for experts  $k$ ;
- ii. Fuzzy triangular value (NFTS) of each criterion from the experts' answers, where  $L_i$  is the minimum value,  $U_i$  is the maximum value of the rating of all experts (equation 1 and 3) and  $M_i$  is the geometric mean of the rating of all experts for the criterion  $i$  (equation 2) [29**Erro! Fonte de referência não encontrada.**]:

$$L_i = \text{Min}(L_i) \quad (1)$$

$$M_i = (R_{i1} \times R_{i2} \times \dots \times R_{ik})^{\frac{1}{k}} \quad (2)$$

$$U_i = \text{Max}(L_{ik}) \quad (3)$$

- iii. Defuzzify the NFTS to obtain only one explicit value, using the center of gravity method to convert the NFTS (equation 4) [3029]:

$$D_i = \frac{L_i + M_i + U_i}{3} \quad (4)$$

- iv. Set the cutoff value  $\alpha$  to filter out the most relevant results and exclude the least relevant ones [29].

The Fuzzy Delphi can be used to obtain weights related to relevant criteria and attributes, allowing the selection of the most significant ones for the subsequent phases of a search [31;32;33]. Within this study's scope, the Fuzzy Delphi application is aimed at determining the weights associated with ESG themes and pillars, with the purpose of filtering them for further application in the management of sustainable suppliers.

### 3 Results and Discussion

The implementation of the SLR made it possible to identify 95 evaluation criteria based on ESG principles. Due to this large number of criteria, they were classified by themes.

For this, a second stage of research in the SLR was applied; the result of this classification can be seen in Table 1.

**Table 1** – ESG themes identified by SLR

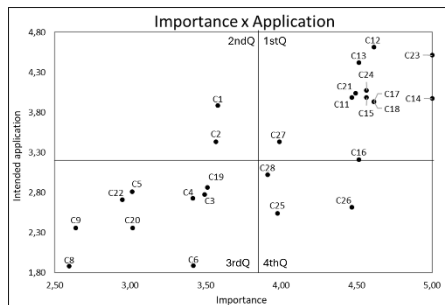
	<b>Theme</b>	<b>References</b>
<b>Environmental</b>	C1 - Pollution and Waste	[13; 24; 25; 26; 27; 36; 37]
	C2 - Use of Resources	[13; 23; 25; 26; 27; 36; 37; 38]
	C3 - Biodiversity and Ecosystem Services	[13; 25; 27]
	C4 - Emissions	[23; 25; 26; 36; 37]
	C5 - Climate Change	[13; 24; 25; 26; 27]
	C6 - Innovation	[23; 36; 38]
	C7 - Environmental Impact Assessment	[13; 36]
	C8 - Eco-Products/Process Strategies	[13; 36]
	C9 - Environmental Management and Pollution Prevention	[24; 25]
	C10 - Investment	[37; 39]
<b>Social</b>	C11 - Community Score	[13; 23; 26; 36; 37; 38]
	C12 - Human Rights	[13; 23; 24; 26; 36; 37; 38]
	C13 - Product Liability	[23; 27]
	C14 - Customer Satisfaction	[13; 23; 26; 27; 37]
	C15 - Promotion of Social Responsibility in the Value Chain	[25]
	C16 - Human Resource Management	[13; 37]
	C17 - Workforce	[23]
	C18 - Employee Satisfaction	[13; 23; 24; 27; 36; 37]
	C19 - Social and Political Contribution	[13; 24; 37]
	C20 - Social Dialogue and Territorial Development	[25]
<b>Governance</b>	C21 - Shareholders' Rights	[23; 36; 37]
	C22 - Regulatory Compliance	[13; 23; 26; 40]
	C23 - Business Conduct	[24; 25; 27; 38]
	C24 - Ethics and Values	[13; 25; 28; 36; 37]
	C25 - Corporate Governance	[13; 23; 24; 25; 27; 36; 37; 38]
	C26 - Transparency in Management	[25]
	C27 - Control and Management Practices	[23; 25; 26]
	C28 - Stakeholder Engagement	[36; 38; 41]

The themes and criteria identified in the literature were used to elaborate on the 28 questions of the survey (in addition to the questions related to the company and the respondents' data). Each question was associated with a specific theme and required three different answers: importance, which referred to the relevance of the topic in the context of the company; application, related to the practical implementation of the theme in the company; and application intention, in case the company has plans for the application of the theme. Each of these answers followed a Likert scale: for Importance, ranging from 1 (Irrelevant) to 5 (Indispensable); for Application, ranging from 1 (We do not apply) to 5 (We always apply); and for the Application Claim, ranging from 1 (No application deadline) to 5 (Very short term). These questions were administered to seven experts from the selected company, including a director, three managers, and three experts from the company's ESG committee. Table 2 shows the results of the Fuzzy Delphi method calculations with the survey application's data.

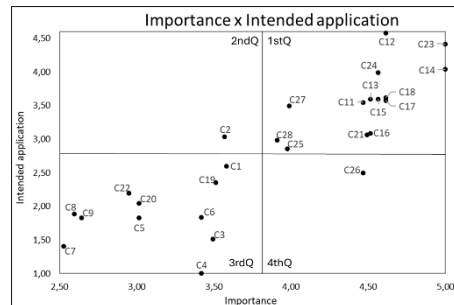
**Table 2** – Results of the calculations of the Fuzzy Delphi method.

				$D_i$			
Theme	Importance	Application	Intended application	Theme	Importance	Application	Intended application
C1	3,58	<b>3,88</b>	2,59	C15	<b>4,56</b>	<b>3,99</b>	<b>3,59</b>
C2	3,57	<b>3,44</b>	<b>3,03</b>	C16	<b>4,51</b>	<b>3,21</b>	<b>3,08</b>
C3	3,49	2,78	1,51	C17	<b>4,61</b>	<b>3,93</b>	<b>3,57</b>
C4	3,42	2,73	1,00	C18	<b>4,61</b>	<b>3,93</b>	<b>3,62</b>
C5	3,01	2,81	1,83	C19	3,51	2,86	2,35
C6	3,42	1,89	1,84	C20	3,02	2,36	2,05
C7	2,53	1,80	1,40	C21	<b>4,49</b>	<b>4,04</b>	<b>3,07</b>
C8	2,59	1,88	1,88	C22	2,95	2,71	2,20
C9	2,64	2,36	1,83	C23	<b>5,00</b>	<b>4,51</b>	<b>4,41</b>
C10	2,44	1,79	1,39	C24	<b>4,56</b>	<b>4,07</b>	<b>3,99</b>
C11	<b>4,47</b>	<b>3,99</b>	<b>3,55</b>	C25	<b>3,98</b>	2,54	<b>2,85</b>
C12	<b>4,61</b>	<b>4,61</b>	<b>4,58</b>	C26	<b>4,47</b>	2,62	2,49
C13	<b>4,51</b>	<b>4,42</b>	<b>3,59</b>	C27	<b>3,99</b>	<b>3,44</b>	<b>3,49</b>
C14	<b>5,00</b>	<b>3,98</b>	<b>4,04</b>	C28	<b>3,91</b>	3,02	<b>2,98</b>
$\alpha$	<b>Importance</b>		<b>Application</b>		<b>Intended application</b>		
	3,84		3,20		2,78		

The results are presented graphically using scatter plots, in which the mean lines ( $\alpha$ ) are highlighted to facilitate evaluation and analysis. This representation is illustrated in Figures 2 and 3.



**Figure 2.** Scatter plot  
Importance vs. Application.



**Figure 3.** Scatter plot  
Importance x Intention of application.

Evaluating the quadrants 2 and 4, company is allocating or plans to allocate resources in areas or topics that are not considered important for the company's context. However, the organization should consider them as evaluating criteria for managing its supply chain, given the importance of pillar E, recognized in other studies and focused on by academia [42]. In addition, although they evaluate the C25, C26, and C28 criteria as important for the organization, they need to be applied more. However, criteria C25 and C28 are intended to apply above  $\alpha$ , unlike C26 - Transparency in management, the only criterion of significant importance with low application and the intention of application with a longer term.

The most relevant criteria in this analysis are those located in the first quadrant (above the cut-off value of the Application/Application Claim axis and to the right of the cut-off value of the Importance axis), as they indicate that the company is applying or plans to apply resources to the criteria it considers important. In addition, the first quadrant contains key criteria, which must be used as parameters for the others, employing them to comprehend the method of selecting criteria for their effective application, understanding the rationale behind their importance, and exploring replicable strategies for other criteria.

The second quadrant reveals an inconsistency in the company's strategy: the C1 criteria - Pollution and Waste and C2 - Use of Resources are the only criteria with low importance and significant application (above the value of  $\alpha$ ); criterion C2, although indicated with little importance by the respondents, has a high intention of application. However, a more thorough analysis by companies regarding the criteria falling within this quadrant is pertinent. The company should investigate as it may be adopting such criteria under market pressure. If this holds true, it is essential to understand why the market deems them important: do they generate financial benefits or enhance operational efficiency? If the company adopts these criteria solely due to external pressure, it is necessary to evaluate whether it genuinely benefits from this practice. Another possibility is the application of these criteria in response to customer demands. In this case, it is also crucial to understand the reason for the demand: is it due to legal issues, company values, or tangible benefits? Finally, there is the possibility of the company applying such criteria without a critical analysis of their relevance, by convention or protocol. However, the regulation around the topics influenced by the popularity of the environmental pillar in the global context can influence companies in applying these criteria. Criteria falling within this quadrant should serve as a red flag for companies, prompting them to conduct further research and deeper analyses to understand why they are adopting practices they do not truly consider important.

In the third quadrant are located the criteria that need to be more important or applied, that is, criteria that are not eligible for supply chain management and consistent with the company's context. The company has finite resources, and each criterion involves multiple key performance indicators (KPIs). Moreover, it's not enough to simply apply these criteria; they also require control, monitoring, and evaluation. Implementing all these criteria both internally and throughout the supply chain would be an extremely costly operational burden for the company to manage.

In the fourth quadrant, we find criteria that are considered highly important but have little application. Thus, it is necessary to compare them with key criteria to identify strategies that can promote the applicability of these criteria. To do this, a guideline like the guideline of the Sustainable Development Goals (SDGs) should be applied, as it offers an internationally recognized protocol to promote sustainability in countries. By following the proposed methodology, companies can allocate resources more precisely, focusing on important criteria that are not yet being applied, thus avoiding waste of

resources on less relevant or already implemented criteria. This guideline or protocol consists of 5 stages, as follows: 1st stage: understanding the criterion, considering that each criterion involves various KPIs, it is crucial that the company evaluates their relevance within the specific business context. 2nd stage: defining priorities based on KPIs relevant to the company. 3rd stage: establishing clear goals for the implementation of KPIs and the criteria. 4th stage: applying the criteria defined in the previous stages, putting the defined plan into practice, and collecting data related to the incorporation of the criteria into their operations. 5th stage: conducting subsequent evaluation to verify the effectiveness of integration and examine whether the applied criteria continue to be relevant to the company. This process of continuous evaluation closes the cycle, allowing for adjustments and improvements as necessary.

Considering this, it is important to highlight that the relevance of transparency in ESG management, especially in supply chain management, can result in significant improvements in financial performance and the trajectory towards sustainable development. However, it is crucial to recognize that the implementation of these practices involves several factors and is a complex process, making it challenging to achieve results in the short term. The importance of this topic in sustainable transformation is that the company is in the initial phase of applying ESG in internal processes, and transparency within and in its supply chain greatly impacts the organization's performance [43].

After this detailed analysis, the survey results indicate the company's focus is on corporate social sustainability. A different result is observed in two similar applications but in different contexts. In these specific and different scenarios, the prioritization points to the environmental pillar, followed by the social pillar and, finally, the governance pillar [13; 44; 45]. This suggests that, in different contexts, the prioritized pillars may also vary, evidencing the sensitivity of ESG pillars' prioritization to each scenario's specific characteristics. However, the organization's result is consistent with the initial phase of ESG implementation that it is in, given the importance of the social and governance pillars in sustainable transformation and in aligning sustainability with suppliers. This result is consistent with the context of ESG promotion, where to improve the organization's ESG reputation [46], purchasing companies outsource the processes that impact its ESG assessment; this can be avoided by implementing a decision process with different metrics for internal processes and supply chain management, promoting ESG promotion and reflecting on the operational and financial performance of the entire supply chain [42; 47]. Thus, it is important to consider the results of the ranking method and generate an action plan consistent with what is relevant to the company, both for internal application and to evaluate new suppliers, in addition to establishing criteria for already consolidated partners and promoting a more sustainable supply chain.

The process proposed in this study involves conducting a survey with the company to understand the importance of ESG (Environmental, Social and Governance) criteria,



followed by the application of the Fuzzy Delphi method to reduce subjectivity, performing a quadrant analysis, employing concepts such as those used to identify the relative importance of the criteria. In this analysis, the first quadrant is reserved for key criteria, the second for criteria that need further analysis, the third for criteria to be discarded, and the fourth for criteria to be applied according to a guideline based on the SDG guideline. When replicated by other stakeholders, this process can result in greater efficiency and effectiveness in promoting ESG principles.

## **4 Conclusion**

In this study, the objective was to identify the ESG criteria and themes present in the literature and to conduct research for sustainable supply chain management customized to the context of each organization. The weights assigned to different themes and pillars were calculated using the Fuzzy Delphi method. This approach aims to provide a solid foundation for future research by establishing a robust and informed framework for subsequent analysis and developments in the ESG context. After applying the research and analyzing the results of the calculations using the Fuzzy Delphi method, it became evident that the company in focus demonstrates a greater appreciation for the Social pillar of ESG, with C14 (S-pillar) and C23 (G-pillar) being the most important criteria for the organization and C12 (S-pillar) being the most applied criterion in the company. The limitations of this study include its restricted application to a specific context, which may result in difficulties of generalization and validation in broader scenarios. The future research outlined in this study aims to deepen the knowledge of corporate sustainability, using the results of this current study as a basis for the evolution of the modelling of a supplier management framework with multicriteria methods. In addition, these enhancements are intended to be applied to the classification of sustainable suppliers associated with the company.

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## **References**

1. EBA. EBA report on management and supervision of ESG risks for credit institutions and investment firms. 2021. <https://www.efront.com/en/alternative-investment-software/efront-insight-sustainability?> Accessed January 29, 2024.

2. United Nations-supported Principles for Responsible Investment. (n.d.). What is responsible investment? PRI. <https://www.unpri.org/introductory-guides-to-responsible-investment/what-is-responsible-investment/4780.article>. Accessed January 29, 2024.
3. Feng J, Goodell JW, Shen D. ESG rating and stock price crash risk: Evidence from China. *Finance Res Lett*. 2021;102476. doi:10.1016/j.frl.2021.102476
4. Blank H, Sgambati G, Truelson Z. Best Practices in ESG Investing. *J Invest*. 2016; 25(2):103-112. doi:10.3905/joi.2016.25.2.103
5. Coleman L, Maheswaran K, Pinder S. Narratives in managers' corporate finance decisions. *Account Amp Finance*. 2010; 50(3):605-633. doi:10.1111/j.1467-629x.2010.00343.x
6. Escrig-Olmedo E, Rivera-Lirio JM, Muñoz-Torres MJ, Fernández-Izquierdo MÁ. Integrating multiple ESG investors' preferences into sustainable investment: A Fuzzy multicriteria methodological approach. *J Clean Prod*. 2017;162:1334-1345. doi:10.1016/j.jclepro.2017.06.143.
7. Kim, S.; Li, Z. Understanding the Impact of ESG Practices in Corporate Finance. *Sustainability* 2021, 13, 3746. <https://doi.org/10.3390/su13073746>.
8. Ting, I.W.K.; Azizan, N.A.; Bhaskaran, R.K.; Sukumaran, S.K. Corporate Social Performance and Firm Performance: Comparative Study among Developed and Emerging Market Firms. *Sustainability* 2020, 12, 26. <https://doi.org/10.3390/su12010026>.
9. Park, S.R.; Jang, J.Y. The Impact of ESG Management on Investment Decision: Institutional Investors' Perceptions of Country-Specific ESG Criteria. *Int. J. Financial Stud*. 2021, 9, 48. <https://doi.org/10.3390/ijfs9030048>.
10. Ishizaka, A.; Lokman, B.; Tasiou, M.A Stochastic Multi-criteria divisive hierarchical clustering algorithm, *Omega*, Volume 103, 2021, 102370, ISSN 0305-0483, <https://doi.org/10.1016/j.omega.2020.102370>.
11. Aras, G.; Hacioglu Kazak, E. Enhancing Firm Value through the Lens of ESG Materiality: Evidence from the Banking Sector in OECD Countries. *Sustainability* 2022, 14, 15302. <https://doi.org/10.3390/su142215302>.
12. Bhattacharya A.; Bhattacharya S. Integrating ESG Pillars for Business Model Innovation in the Biopharmaceutical Industry. *Australasian Accounting, Business and Finance Journal* 2023. <https://doi.org/10.14453/aabfj.v17i1.12>.
13. Meng X, Shaikh GM. Evaluating Environmental, Social, and Governance Criteria and Green Finance Investment Strategies Using Fuzzy *AHP and Fuzzy WASPAS*. *Sustainability*. 2023; 15(8):6786. doi:10.3390/SU15086786.
14. Morgante F.C.; Gholamzadehmir M.; Sdino L.; Rosasco P. How to invest in the "Market of Sustainability": Evaluating the impacts of a Real Estate investment across ESG criteria [Investire nel "Mercato sostenibile": Valutare gli impatti di un investimento immobiliare attraverso i criteri ESG]. *Valori and Valutazioni* 2023, 33, 65-84. <https://doi.org/10.48264/VVSIEV-20233306>.
15. Back, J. A., Tedesco, L. P., Molz, R. F., & Nara, E. O. B. (2016, November). An embedded system approach for energy monitoring and analysis in industrial processes. *Energy*, 115, 811–819. <https://doi.org/10.1016/j.energy.2016.09.045>
16. Correa, E., Nara, E., Junior, O., Strobel, R., Paulista Cotian, Luis. (2023). Systematic review of the literature on risk and benefit in bariatric surgery. *Magazine Sodebras*. 18. 133-141. <https://doi.org/10.29367/issn.1809-3957.18.2023.211.133>.
17. Carvalho PS, Siluk JC, Schaefer JL, Pinheiro JR, Schneider PS. Proposal for a new layer for energy cloud management: The regulatory layer. *Int J Energy Res*. 2021; 45(7):9780-9799. doi:10.1002/er.6507
18. Schaefer JL, Siluk JC, de Carvalho PS. Critical success factors for the implementation and management of energy cloud environments. *Int J Energy Res*. 2022. doi:10.1002/er.8094
19. Carvalho PS, Siluk JC, Schaefer JL. Mapping of regulatory actors and processes related to cloud-based energy management environments using the Apriori algorithm. *Sustain Cities Soc*. 2022; 80:103762. doi:10.1016/j.scs.2022.103762

20. Benitez Nara, E. O., Schaefer, J. L., de Moraes, J., Carvalho Tedesco, L. P., Furtado, J. C., & Baierle, I. C. (2019). Obtención de documentos de investigación sobre la competitividad de las pequeñas y medianas empresas: un enfoque basado en las redes de autores. *Revista Española De Documentación Científica*, 42(2), e230. <https://doi.org/10.3989/redc.2019.2.1602>
21. Baierle IC, Siluk JC, Gerhardt VJ, Michelin CD, Junior AL, Nara EO. Worldwide Innovation and Technology Environments: Research and Future Trends Involving Open Innovation. *J Open Innov.* 2021; 7(4):229. doi:10.3390/joitmc7040229
22. Tardio, P.R., Schaefer, J.L., Nara, E.O.B., Gonçalves, M.C., Dias, I.C.P., Benitez, G.B. and Castro e Silva, A.d. (2023), "The link between lean manufacturing and Industry 4.0 for product development process: a systemic approach", *Journal of Manufacturing Technology Management*, Vol. 34 No. 8, pp. 1404-1424. <https://doi.org/10.1108/JMTM-03-2023-0118>
23. Exploring materiality - 40. Sustainability Accounting Standards Board. SASB. <https://sasb.org/standards/materiality-map/>. Accessed on November 31 2023.
24. ESG Ratings Methodology. Powering better investment decisions - MSCI. <https://www.msci.com/esg-and-climate-methodologies>. Accessed on November 31 2023.
25. S&P Global Corporate Sustainability Assessment. Accessed January 31, 2024. [https://portal.s1.spglobal.com/survey/documents/CSA\\_Handbook.pdf](https://portal.s1.spglobal.com/survey/documents/CSA_Handbook.pdf). Accessed on November 31 2023.
26. World Economic Forum. 2020. Measuring Stakeholder Capitalism Towards Common Metrics and Consistent Reporting of Sustainable Value Creation. Available online: <https://www.weforum.org/reports/measuring-stakeholder-capitalism-towards-common-metrics-and-consistent-reporting-of-sustainable-value-creation>. Accessed on November 31 2023.
27. Refinitiv. Financial Markets Infrastructure and Data. LSEG. [https://www.lseg.com/content/dam/data-analytics/en\\_us/documents/methodology/lseg-esg-scores-methodology.pdf](https://www.lseg.com/content/dam/data-analytics/en_us/documents/methodology/lseg-esg-scores-methodology.pdf). Accessed on November 31 2023
28. Sinproquim. ABNT PR2030 ESG Presentation - May 2023. [https://sinproquim.org.br/wp-content/uploads/2023/05/APRESENTACAO-ABNT-PR2030-ESG\\_Maio23.pdf](https://sinproquim.org.br/wp-content/uploads/2023/05/APRESENTACAO-ABNT-PR2030-ESG_Maio23.pdf). Accessed on November 31 2023.
29. Stefano, N. M., N. Casaroto Filho, and M. C. D. Freitas. "Proposta de um instrumento de pesquisa para avaliar a gestão de periódicos científicos: utilizando o método Fuzzy Delphi." *Iberoamerican Journal of Project Management (IJoPM)* 5.2 (2014): 39-69.
30. Huang, M.-F.; Peng, L.-P. Extração de Fatores de Avaliação de Resiliência Social em Áreas de Proteção de Recursos Hídricos Utilizando o Método Fuzzy Delphi. *Sustentabilidade* 2023, 15, 13764. <https://doi.org/10.3390/su151813764>.
31. Abdul-Hamid, A.Q.; Ali, M.H.; Tseng, M.L.; Lan, S.; Kumar, M. Impeding challenges on industry 4.0 in circular economy: Palm oil industry in Malaysia. *Computers & Operations Research*, Volume 123, 2020, 105052. ISSN 0305-0548. <https://doi.org/10.1016/j.cor.2020.105052>.
32. Kou, G.; Ergu, D.; Shi, Y. An integrated expert system for fast disaster assessment. *Computers & Operations Research*. Volume 42, 2014, Pages 95-107. ISSN 0305-0548. <https://doi.org/10.1016/j.cor.2012.10.003>.
33. Tsai, F.M.; Bui, T.T.; Tseng, M.L.; Lim, M.K.; Hu; J. Municipal solid waste management in a circular economy: A data-driven bibliometric analysis. *Journal of Cleaner Production*. Volume 275, 2020, 124132, ISSN 0959-6526. <https://doi.org/10.1016/j.jclepro.2020.124132>.
34. Stefano, N. M., N. Casaroto Filho, and M. C. D. Freitas. Proposal of a research instrument to evaluate the management of scientific journals: using the Fuzzy Delphi method. *Iberoamerican Journal of Project Management (IJoPM)* 5.2 (2014): 39-69.
35. Danacı M, Yıldırım U. Comprehensive analysis of lifeboat accidents using the Fuzzy Delphi method. *Ocean Eng.* 2023;278:114371. doi:10.1016/j.oceaneng.2023.114371
36. Nguyen PH, Nguyen LA, Pham HA, Pham MA. Breaking ground in ESG assessment: Integrated DEA and MCDM framework with spherical Fuzzy sets for Vietnam's wire and cable sector. *J Open Innov.* 2023; 9(3):100136. doi:10.1016/j.joitmc.2023.100136

37. Park SR, Jang JY. The Impact of ESG Management on Investment Decision: Institutional Investors' Perceptions of Country-Specific ESG Criteria. *Int J Financial Stud.* 2021; 9(3):48. doi:10.3390/ijfs9030048
38. Jensen MC, Meckling WH. Theory of the firm: Managerial behavior, agency costs and ownership structure. *J Financial Econ.* 1976; 3(4):305-360. doi:10.1016/0304-405X(76)90026-X
39. Raza H, Khan MA, Mazliham MS, Alam MM, Aman N, Abbas K. Applying artificial intelligence techniques for predicting the environment, social, and governance (ESG) pillar score based on balance sheet and income statement data: A case of non-financial companies of USA, UK, and Germany. *Front Environ Sci.* 2022;10. doi:10.3389/fenvs.2022.975487
40. Bernile G, Bhagwat V, Yonker S. Board diversity, firm risk, and corporate policies. *J Financial Econ.* 2018; 127(3):588-612. doi:10.1016/j.jfineco.2017.12
41. Nekhili M, Boukadhaba A, Nagati H, Chtioui T. ESG performance and market value: the moderating role of employee board representation. *Int J Hum Resour Manag.* 2019:1-27. doi:10.1080/09585192.2019.1629989
42. Truant, E.; Borlatto, E.; Crocco, E.; Sahore, N. Environmental, social and governance issues in supply chains. A systematic review for strategic performance. *Journal of Cleaner Production*, Volume 434. 2024. 140024, ISSN 0959-6526. <https://doi.org/10.1016/j.jclepro.2023.140024>.
43. Zeng H, Li RYM and Zeng L (2022) Assessment of green supply chain performance based on ESG and financial indicators. *Front. Environment. Science.* 10:982828. doi: 10.3389/fenvs.2022.982828
44. Matemane R, Moloi T, Adelowotan M. Appraising Executive Compensation ESG-Based Indicators Using Analytical Hierarchical Process and Delphi Techniques. *J Risk Financial Manag.* 2022; 15(10):469. doi:10.3390/jrfm15100469
45. Li Y, Zhang Y, Solangi YA. Assessing ESG Factors and Policies of Green Finance Investment Decisions for Sustainable Development in China Using the Fuzzy *AHP and Fuzzy DEMATEL*. *Sustainability.* 2023; 15(21):15214. doi:10.3390/SU15211521
46. Lheureux, Yasemin. "Predictive insights: leveraging Twitter sentiments and machine learning for environmental, social and governance controversy prediction." *Journal of Computational Social Science.* 2023; 1-22. doi.org/10.1007/s42001-023-00228-5
47. Ahmed, M.U. and Shafiq, A. (2022), "Toward sustainable supply chains: impact of buyer's legitimacy, power and aligned focus on supplier sustainability performance", *International Journal of Operations & Production Management*, Vol. 42 No. 3, pp. 280-303. <https://doi-org.ez433.periodicos.capes.gov.br/10.1108/IJOPM-08-2021-0540>

# Publishing Agreement

## for Contributions in Edited Works

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This Publishing Agreement (this “**Agreement**”) has been approved by and entered into between:

**[Names + Addresses of all co-authors of the chapter, including the corresponding author (where possible with ORCID)]**

(the “**Author**”)

whereas, in the event that the Author is more than one person, **[Name of the Corresponding Author]** serves as corresponding author

(the “**Corresponding Author**”)

on the one part and

Springer Nature Switzerland AG  
Gewerbstrasse 11, 6330 Cham, Switzerland

(the “**Publisher**”)

on the other part;

together hereinafter referred to as the “**Parties**”.

The Publisher intends to publish the Author’s contribution in a collected work provisionally titled:

**Industrial Engineering and Operations Management -XXX IJCIEOM, Salvador, Brazil, June 26–28, 2024**

(the “**Work**”)

edited by: **João Carlos Gonçalves dos Reis, Francisco Gaudêncio Mendonça Freires, Milton Vieira Junior, Rafael Garcia Barbastefano, Ângelo Márcio Oliveira Sant’Anna**

(the “**Editor**”)

The Publisher intends to publish the Work under the imprint Springer .

The Work may be published in the book series **Springer Proceedings in Mathematics & Statistics**.

## 1. Contracting Authors

When the Author is more than one person then, unless otherwise indicated in this Agreement or agreed in writing by the Publisher:

(a) the expression “**Author**” as used in this Agreement will apply collectively for all such persons (each a “**co-author**”);

(b) the Corresponding Author hereby warrants and represents that all co-authors of the contribution

have expressly agreed that the Corresponding Author has full right, power and authority to sign this Agreement on their behalf, that the Corresponding Author is entitled to act on their behalf, and that they shall be bound by the Corresponding Author, with respect to all matters, responsibilities, notices and communications related to this Agreement; the Corresponding Author shall obtain authorisations and make them available to the Publisher on request; and  
(c) each co-author is jointly and severally responsible for the Author's obligations under this Agreement which apply to each co-author individually and to the co-authors collectively and the Publisher shall not be bound by any separate agreement or legal relationship as between the co-authors.

## 2. Subject of the Agreement

2.1 The Author will prepare a contribution provisionally titled:

**[Title of the Contribution]**

The expression "**Contribution**" as used in this Agreement means the contribution as identified above, and includes without limitation all related material delivered to the Publisher by or on behalf of the Author whatever its media and form (including text, graphical elements, tables, videos and/or links) in all versions and editions in whole or in part.

2.2 The Contribution may contain links (e.g. frames or in-line links) to media enhancements (e.g. additional documents, tables, diagrams, charts, graphics, illustrations, animations, pictures, videos and/or software) or to social or functional enhancements, complementing the Contribution, which are provided on the Author's own website or on a third party website or repository (e.g. maintained by an institution) subject always to the Author providing to the Editor, at the latest at the delivery date of the manuscript for the Contribution, an accurate description of each media enhancement and its respective website or repository, including its/their owner, nature and the URL. The Publisher is entitled to reject the inclusion of, or suspend, or delete links to all or any individual media enhancements.

2.3 In the event that an index is deemed necessary, the Author shall assist the Editor in its preparation (e.g. by suggesting index terms), if requested by the Editor.

## 3. Rights Granted

3.1 The Author hereby grants to the Publisher the perpetual, sole and exclusive, worldwide, transferable, sub-licensable and unlimited right to publish, produce, copy, distribute, communicate, display publicly, sell, rent and/or otherwise make available the Contribution in any language, in any versions or editions in any and all forms and/or media of expression (including without limitation in connection with any and all end-user devices), whether now known or developed in the future, in each case with the right to grant further time-limited or permanent rights. The above rights are granted in relation to the Contribution as a whole or any part and with or in relation to any other works.

Without limitation, the above grant includes: (a) the right to edit, alter, adapt, adjust and prepare derivative works; (b) all advertising and marketing rights including without limitation in relation to social media; (c) rights for any training, educational and/or instructional purposes; and (d) the right to add and/or remove links or combinations with other media/works.

The Author hereby grants to the Publisher the right to create, use and/or license and/or sub-license content data or metadata of any kind in relation to the Contribution or parts thereof (including abstracts and summaries) without restriction.

The Publisher also has the right to commission completion of the Contribution in accordance with the Clause "**Author's Responsibilities – Delivery and Acceptance of the Manuscript**" and of an updated version of the Contribution for new editions of the Work in accordance with the Clause "**New Editions**".

3.2 The copyright in the Contribution shall be vested in the name of the **Author**. The Author has asserted their right(s) to be identified as the originator of the Contribution in all editions and versions, published in all forms and media. The Author agrees that all editing, alterations or amendments to the Contribution made by or on behalf of the Publisher or its licensees for the purpose of fulfilling this Agreement or as otherwise allowed by the above rights shall not require the approval of the Author and will not infringe the Author's "moral rights" (or any equivalent rights). This includes changes made in the course of dealing with retractions or other legal issues.

#### **4. Self-Archiving and Reuse**

- 4.1 **Self-Archiving:** The Publisher permits the Author to archive the Contribution in accordance with the Publisher's guidelines, the current version of which is set out in the **Appendix "Author's Self-Archiving Guidelines"**.
- 4.2 **Reuse:** The Publisher permits the Author to copy, distribute or otherwise reuse the Contribution, without the requirement to seek specific prior written permission from the Publisher, in accordance with the Publisher's guidelines, the current version of which is set out in the **Appendix "Author's Reuse Rights"**.

#### **5. The Publisher's Responsibilities**

- 5.1 Subject always to the other provisions of this Clause below, the Publisher will undertake the production, publication and distribution of the Contribution and the Work in print and/or electronic form at its own expense and risk within a reasonable time after acceptance of the Work unless the Publisher is prevented from or delayed in doing so due to any circumstances beyond its reasonable control. The Publisher shall have the entire control of such production, publication and distribution determined in its sole discretion in relation to any and all editions and versions of the Contribution and the Work, including in respect of all the following matters:
- (a) distribution channels, including determination of markets;
  - (b) determination of the range and functions of electronic formats and/or the number of print copies produced;
  - (c) publication and distribution of the Contribution, the Work, or parts thereof as individual content elements, in accordance with market demand or other factors;
  - (d) determination of layout and style as well as the standards for production;
  - (e) setting or altering the list price, and allowing for deviations from the list price (if permitted under applicable jurisdiction);
  - (f) promotion and marketing as the Publisher considers most appropriate.
- 5.2 All rights, title and interest, including all intellectual property or related rights in the typography, design and/or look-and-feel of the Contribution shall remain the exclusive property of and are reserved to the Publisher. All illustrations and any other material or tangible or intangible property prepared at the expense of the Publisher including any marketing materials remain, as between the Parties, the exclusive property of the Publisher. The provisions of this subclause shall continue to apply notwithstanding any termination of, and/or any reversion of rights in the Contribution to the Author, under this Agreement.
- 5.3 Without prejudice to the Publisher's termination and other rights hereunder including under the Clause "**The Author's Responsibilities**", it is agreed and acknowledged by the Parties that nothing in this Agreement shall constitute an undertaking on the part of the Publisher to publish the Contribution unless and until: (i) any and all issues in relation to the Work (including all necessary revisions, consents and permissions) raised by the Publisher have been resolved to the Publisher's satisfaction, and (ii) the Publisher has given written notice of acceptance in writing of the final manuscript of the entire Work to the Editor. If following (i) and (ii) above the Publisher has not published the Contribution in any form within a reasonable period and the Author has given written notice to the Publisher requiring it to publish within a further reasonable period and the Publisher has failed to publish in any form, then the Author may terminate this Agreement by one month's written notice to the Publisher and all rights granted by the Author to the Publisher under this Agreement shall revert to the Author (subject to the provisions regarding any third party rights under any subsisting licence or sub-licence in accordance with the Clause "**Termination**").
- The Author may also give such written notice requiring publication on the same terms as above if the Publisher has published the Contribution but subsequently ceases publishing the Contribution in all forms so that it is no longer available.
- This shall be the Author's sole right and remedy in relation to such non-publication and is subject always to the Author's continuing obligations hereunder including the Clause "**Warranty**".

#### **6. The Author's Responsibilities**

- 6.1 ***Delivery and Acceptance of the Manuscript***

- 6.1.1 The Author shall deliver the Contribution to the Editor (or, if requested by the Publisher, to the Publisher) on or before 08-Jan-2025 (the "**Delivery Date**") electronically in the Publisher's standard requested format or in such other form as may be agreed in writing with the Publisher. The Author shall retain a duplicate copy of the Contribution. The Contribution shall be in a form acceptable to the Publisher (acting reasonably) and in line with the instructions contained in the Publisher's guidelines as provided to the Author by the Publisher. The Author shall provide at the same time, or earlier if the Publisher reasonably requests, any editorial, publicity or other information (and in such form or format) reasonably required by the Publisher. The Publisher may exercise such additional quality control of the manuscript as it may decide at its sole discretion including through the use of plagiarism checking systems and/or peer review by internal or external reviewers of its choice. If the Publisher decides at its sole discretion that the final manuscript does not conform in quality, content, structure, level or form to the stated requirements of the Publisher, the Publisher shall be entitled to terminate this Agreement in accordance with the provisions of this Clause.
- 6.1.2 The Author must inform the Publisher at the latest on the Delivery Date if the sequence of the naming of any co-authors entering into this Agreement shall be changed. If there are any changes in the authorship (e.g. a co-author joining or leaving), then the Publisher must be notified by the Author in writing immediately and the Parties will amend this Agreement accordingly. The Publisher shall have no obligation to consider publication under this Agreement in the absence of such agreed amendment.
- 6.1.3 If the Author fails to deliver the Contribution in accordance with the provisions of this Clause above by the Delivery Date (or within any extension period given by the Publisher at its sole discretion) or if the Author (or any co-author) dies or becomes incapacitated or otherwise incapable of performing the Author's obligations under this Agreement, the Publisher shall be entitled to either:
- (a) elect to continue to perform this Agreement in accordance with its terms and the Publisher may commission an appropriate and competent person (who, in the case of co-authors having entered into this Agreement, may be a co-author) to complete the Contribution; or
  - (b) terminate this Agreement with immediate effect by written notice to the Author or the Author's successors, in which case all rights granted by the Author to the Publisher under this Agreement shall revert to the Author/Author's successors (subject to the provisions of the Clause "**Termination**").
- 6.1.4 The Author agrees, at the request of the Publisher, to execute all documents and do all things reasonably required by the Publisher in order to confer to the Publisher all rights intended to be granted under this Agreement.
- 6.1.5 The Author warrants that the Contribution is original except for any excerpts from other works including pre-published illustrations, tables, animations, text quotations, photographs, diagrams, graphs or maps, and whether reproduced from print or electronic or other sources ("**Third Party Material**") and that any such Third Party Material is in the public domain (or otherwise unprotected by copyright/other rights) or has been included with written permission from or on behalf of the rightsholder (and if requested in a form prescribed or approved by the Publisher) at the Author's expense unless otherwise agreed in writing, or is otherwise used in accordance with applicable law. On request from the Publisher, the Author shall in writing indicate the precise sources of these excerpts and their location in the manuscript. The Author shall also retain the written permissions and make them available to the Publisher on request.

## 6.2 **Approval for Publishing**

- 6.2.1 The Author shall proofread the page proofs for the Contribution provided by or on behalf of the Publisher, including checking the illustrations as well as any media, social or functional enhancements and give approval for publishing, if and when requested by the Publisher. The Author's approval for publishing is deemed to have been given if the Author does not respond within a reasonable period of time (as determined by the Publisher) after receiving the proofs nor contacts the Publisher within three days after receipt of the last of three reminders sent by the Publisher via email. The Publisher shall not be required to send a second set of corrected proofs unless specifically requested by the Author in writing but in any event no further



amendments may be made or requested by the Author.

In the event of co-authors having entered into this Agreement the Publisher shall send the page proofs to the Corresponding Author only and all persons entering into this Agreement as Author agree that the Corresponding Author shall correct and approve the page proofs on their behalf.

- 6.2.2 If the Author makes changes other than correcting typographical errors, the Author shall bear all the Publisher's costs of such alterations to proofs including without limitation to alterations to pictorial illustrations. The Publisher shall have the right to charge and invoice these costs plus value added or similar taxes (if applicable) through its affiliated company Springer Nature Customer Service Center GmbH or Springer Nature Customer Service Center LLC, respectively, to the Author, payable within 14 days of receipt of the invoice.

### 6.3 **Cooperation**

Without prejudice to the warranties and representations given by the Author in this Agreement, the Author shall cooperate fully with the Editor and the Publisher in relation to any legal action that might arise from the publication or intended publication of the Contribution and the Author shall give the Publisher access at reasonable times to any relevant accounts, documents and records within the power or control of the Author.

## 7. **Warranty**

- 7.1 The Author warrants and represents that:

- (a) the Author has full right, power and authority to enter into and perform its obligations under this Agreement; and
- (b) the Author is the sole legal owner of (and/or has been fully authorised by any additional rights owner to grant) the rights licensed in the Clause "**Rights Granted**" and use of the Contribution shall in no way whatever infringe or violate any intellectual property or related rights (including any copyright, database right, moral right or trademark right) or any other right or interest of any third party subject only to the provisions in the Clause "**The Author's Responsibilities**" regarding Third Party Material (as defined above); and
- (c) the Contribution shall not contain anything that may cause religious or racial hatred or encourage terrorism or unlawful acts or be defamatory (or contain malicious falsehoods), or be otherwise actionable, including, but not limited to, any action related to any injury resulting from the use of any practice or formula disclosed in the Contribution and all of the purported facts contained in the Contribution are according to the current body of research and understanding true and accurate; and
- (d) there is no obligation of confidentiality owed in respect of any contents of the Contribution to any third party and the Contribution shall not contain anything which infringes or violates any trade secret, right of privacy or publicity or any other personal or human right or the processing or publication of which could breach applicable data protection law and that informed consent to publish has been obtained for all research or other featured participants; and
- (e) the Contribution has not been previously licensed, published or exploited and use of the Contribution shall not infringe or violate any contract, express or implied, to which the Author, or any co-author, who had entered into this Agreement, is a party and any academic institution, employer or other body in which work recorded in the Contribution was created or carried out has authorised and approved such work and its publication.

- 7.2 The Author warrants and represents that the Author, and each co-author who has entered into this Agreement, shall at all times comply in full with:

- (a) all applicable anti-bribery and corruption laws; and
- (b) all applicable data protection and electronic privacy and marketing laws and regulations; and
- (c) the Publisher's ethic rules as laid down in the Book Authors' Code of Conduct currently available online at <https://www.springernature.com/gp/authors/book-authors-code-of-conduct>, as may be updated by the Publisher from time to time (provided that in the event of material changes the Publisher shall notify the Author by email) (the "**Applicable Laws**").

If the Author is in material breach of any of the Applicable Laws or otherwise in material breach of accepted ethical standards in research and scholarship, or becomes the subject of any comprehensive or selective sanctions issued in any applicable jurisdiction (e.g. being subject to the OFAC sanctions list) or if, in the opinion of the Publisher, at any time any act, allegation or conduct of or about the Author

prejudices the production or successful exploitation of the Contribution and the Work or brings the name and/or reputation of the Publisher or the Work into disrepute, or is likely to do so, then the Publisher may terminate this Agreement in accordance with the Clause "**Termination**".

- 7.3 The Publisher reserves the right to amend and/or require the Author to amend the Contribution at any time to remove any actual or potential breach of the above warranties and representations or otherwise unlawful part(s) which the Publisher or its internal or external legal advisers identify at any time. Any such amendment or removal shall not affect the warranties and representations given by the Author in this Agreement.

## **8. Author's Discount Electronic Access**

- 8.1 The Author, or each co-author, is entitled to purchase for their personal use the Work and other books published by the Publisher at a discount of 40% off the list price, for as long as there is a contractual arrangement between the Author and the Publisher and subject to any applicable book price law or regulation. The copies must be ordered from the affiliated entity of the Publisher (Springer Nature Customer Service Center GmbH or Springer Nature Customer Service Center LLC, respectively). Resale of such copies is not permitted.
- 8.2 The Publisher shall provide the electronic final published version of the Work to the Author, provided that the Author has included their e-mail address in the manuscript of the Contribution.

## **9. Consideration**

- 9.1 The Parties agree that the Publisher's agreement to its contractual obligations in this Agreement in respect of its efforts in considering publishing and promoting the Contribution and the Work is good and valuable consideration for the rights granted and obligations undertaken by the Author under this Agreement, the receipt, validity and sufficiency of which is hereby acknowledged by the Author. The Parties expressly agree that no royalty, remuneration, licence fee, costs or other moneys whatsoever shall be payable to the Author.
- 9.2 The Publisher and the Author each have the right to authorise collective management organisations ("**CMOs**") of their choice to manage some of their rights. Reprographic and other collectively managed rights in the Contribution ("**Collective Rights**") have been or may be licensed on a non-exclusive basis by each of the Publisher and the Author to their respective CMOs to administer the Collective Rights under their reprographic and other collective licensing schemes ("**Collective Licences**"). Notwithstanding the other provisions of this Clause, the Publisher and the Author shall each receive and retain their share of revenue from use of the Contribution under Collective Licences from, and in accordance with, the distribution terms of their respective CMOs. To the fullest extent permitted by law, any such revenue is the sole property of the Publisher and the Author respectively and, if applicable, the registration and taxation of that revenue is the sole responsibility of the respective recipient party. The Publisher and the Author shall cooperate as necessary in the event of any change to the licensing arrangements set out in this Clause.

## **10. New Editions**

- 10.1 The Publisher has the sole right to determine whether to publish any subsequent edition of the Work containing an updated version of the Contribution, but only after reasonable consultation with the Author. Once notified by the Publisher that an update of the Contribution is deemed necessary, the Author agrees to deliver an updated manuscript in accordance with the terms of the Clause "**The Author's Responsibilities**" and the other relevant provisions of this Agreement, together with the material for any new illustrations and any other supporting content including media enhancements, within a reasonable period of time (as determined by the Publisher) after such notification. Substantial changes in the nature or size of the Contribution require the written approval of the Publisher at its sole discretion. The terms of this Agreement shall apply to any new edition of the Work that is published under this "**New Editions**" Clause.
- 10.2 If the Author, for whatever reason, is unwilling, unable or fails (including as a result of death or incapacity) to submit an updated manuscript that meets the terms of this Agreement within the above stated period, then the Publisher is entitled to revise, update and publish the content of the existing edition or to designate one or more individuals (which, where co-authors have entered into this

Agreement, may be one or more of the co-authors) to prepare this and any future editions provided that the new editions shall not contain anything that is a derogatory use of the Author's work that demonstrably damages the Author's academic reputation. In such case, the Author shall not participate in preparing any subsequent editions. The Author agrees that the Publisher shall be entitled but not obliged to continue to use the name of the Author on any new editions of the Work together with the names of the person or persons who contributed to the new editions. Should the Author or the Author's successors object to such continuing use then they must notify the Publisher in writing when first contacted by the Publisher in connection with any new edition.

## **11. Termination**

- 11.1 In addition to the specific rights of termination set out in the Clause "**The Publisher's Responsibilities**" and the Clause "**The Author's Responsibilities**", either Party shall be entitled to terminate this Agreement forthwith by notice in writing to the other Party if the other Party commits a material breach of the terms of the Agreement which cannot be remedied or, if such breach can be remedied, fails to remedy such breach within 45 days of being given written notice to do so.
- 11.2 Termination of this Agreement, howsoever caused, shall not affect:
- (a) any subsisting rights of any third party under any licence or sub-licence validly granted by the Publisher prior to termination and the Publisher shall be entitled to retain its share of any sum payable by any third party under any such licence or sub-licence;
  - (b) except where stated otherwise in this Agreement, any claim which either Party may have against the other for damages or otherwise in respect of any rights or liabilities arising prior to the date of termination;
  - (c) the Publisher's right to continue to sell any copies of the Work which are in its power, possession or control as at the date of expiry or termination of this Agreement for a period of six months on a non-exclusive basis.

## **12. General Provisions**

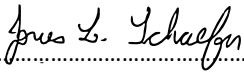
- 12.1 This Agreement, and the documents referred to within it, constitute the entire agreement between the Parties with respect to the subject matter hereof and supersede any previous agreements, warranties, representations, undertakings or understandings. Each Party acknowledges that it is not relying on, and shall have no remedies in respect of, any undertakings, representations, warranties, promises or assurances that are not set forth in this Agreement. Nothing in this Agreement shall exclude any liability for or remedy in respect of fraud, including fraudulent misrepresentation. This Agreement may be modified or amended only by agreement of the Parties in writing. For the purposes of modifying or amending this Agreement, "in writing" requires either a written document signed by both the Parties or an electronic confirmation by both the Parties with DocuSign or a similar e-signature solution. Any notice of termination and/or reversion and, where applicable, any preceding notices (including any requesting remediable action under the Clause "**Termination**") must be provided in writing and delivered by post, courier or personal delivery addressed to the physical address of the relevant Party as set out at the beginning of this Agreement or any replacement address notified to the other Party for this purpose. All such notices shall become effective upon receipt by the other Party. Receipt is deemed to have taken place five working days after the respective notice was sent by post or left at the address by courier or personal delivery. If the Publisher is the terminating Party the notice need only be provided to the address of the Corresponding Author. If the Author is the terminating Party a copy of the notice must also be sent to the Publisher's Legal Department located at Heidelberger Platz 3, 14197 Berlin, Germany.
- 12.2 Nothing contained in this Agreement shall constitute or shall be construed as constituting a partnership, joint venture or contract of employment between the Publisher and the Author. No Party may assign this Agreement to third parties but the Publisher may assign this Agreement or the rights received hereunder to its affiliated companies. In this Agreement, any words following the terms "include", "including", "in particular", "for example", "e.g." or any similar expression shall be construed as illustrative and shall not limit the sense of the words preceding those terms.
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The Corresponding Author signs this Agreement on behalf of any and all co-authors.

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.....  
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