



**INTERNATIONAL ACADEMIC INSTITUTE**

**IAI ACADEMIC CONFERENCE PROCEEDINGS**

**International Academic Conferences**

**13 February 2026  
Athens, Greece**

**IAI Academic Conference Proceedings****Editor:**

Hristina Ruceva Tasev, Dr. Sci, Ss. Cyril and Methodius University, Skopje, Republic of N. Macedonia

**Editorial Board:**

Milena Apostolovska-Stepanoska, Dr. Sci, Ss. Cyril and Methodius University, Skopje, Republic of N. Macedonia

Vasko Naumovski, Dr. Sci, Ss. Cyril and Methodius University, Skopje, Republic of N. Macedonia

Meic Pearse, Dr. Sci, Houghton College NY, USA

Elif Uckan Dagdemir, Dr. Sci, Anadoly University, Turkey

Mary Mares-Awe, MA, Fulbright Association, Chicago, USA

Prof. Massimo Introzzi, Bococca University – Milan, Italy

Dr. Zahida Chebchoub, UAE University, Al-Ain

Dr. Benal Dikmen, Associate Professor, T.C. İstanbul Yeni Yüzyıl University

Ass. Prof. Arthur Pantelides, American University, Bulgaria

Marija Boban, Dr. Sci, Faculty of Law, University of Split, Croatia

Gergana Radoykova, Dr. Sci Sofia University St. Kliment Ohridski, Bulgaria

Anthon Mark Jay Alguno Rivas, MA, Taguig City University, Philippines

Snezana Knezevic, Dr. Sci Faculty of Organizational Sciences, Belgrade, Serbia

Eva Pocher, Ph.D., University of Glasgow

Ass. Prof. Mariam A. Abu Alim, Yarmouk University, Jordan

Ass. Prof Aleksandra Mitrović, University in Kragujevac, Serbia

Dr. Dorjana Klosi, University of “Ismail Qemali”, Vlore, Albania

Ass. Prof. Aneta Stojanovska-Stefanova, PhD, Goce Delchev University, Republic of N. Macedonia

Stefan Milojević, PhD, Associate Professor, *Faculty of Business Economics, EDUCONS University* Belgrade, Serbia

Ionuț – Bogdan Berceanu, Senior lecturer, PhD, National University of Political Studies and Public Administration, Faculty of Public Administration, Romania

Ing. Andrea Tkáčová, PhD. Assistant Professor, Department of Finance, Technical university of Košice

**Secretary and editing:**

Filip Stojkovski

International Academic Institute

Ul. Todor Aleksandrov br.85-4

Skopje, Republic of N. Macedonia

**ISSN 2671-3179**

**TABLE OF CONTENTS****PROFILING FRAUDSTERS AND ENHANCING PROFESSIONAL SKEPTICISM AMONG AUDITORS****Stefan Milojević 4****GREEN FINANCE AS THE BASIS OF SUSTAINABLE BUSINESS****Stefan Milojević, Miloš Milošević, Stefan Krsmanović 9****REORGANIZATION PLAN IN ALBANIAN BANKRUPTCY PROCEDURES****Teuta Hoxha 15****COMPARATIVE ANALYSIS OF INTERNATIONAL ACADEMIC AWARDEES IN ENGINEERING****Anna Urbanovics, Gabriella Thomázy 22****IMPLANT TREATMENT PLANNING****Edisa Karamitri 33**

# Profiling Fraudsters and Enhancing Professional Skepticism among Auditors

Stefan Milojević, Associate Professor, CFE<sup>1</sup>

<sup>1</sup>University Educons, Faculty of Business Economics, Sremska Kamenica, Serbia, e-mail: [stefan.milojevic@educons.edu.rs](mailto:stefan.milojevic@educons.edu.rs)

ORCID ID: <https://orcid.org/0000-0001-6240-6776>

---

## Abstract

This study aims to highlight the importance of profiling clients' psychological characteristics, particularly narcissism, as a means of enhancing auditors' professional skepticism in the fraud detection process. It proposes incorporating clients' psychological profiles as an integral component of professional skepticism. The increasing sophistication of financial fraud and the growing prominence of behavioral manipulation patterns necessitate the strengthening of professional skepticism among auditors as a key mechanism for the prevention and detection of irregularities. The paper theoretically examines and synthesizes existing knowledge on behavioral profiles of fraud perpetrators and levels of professional skepticism. This topic may be of particular relevance to audit firms, regulatory bodies, and educational institutions developing audit-related programs.

**Keywords:** fraudster profiling, professional skepticism, fraud risk, audit quality

---

## 1. Introduction

Accounting fraud represents one of the most serious forms of financial irregularities, potentially generating adverse consequences for the stability of financial markets, investor confidence, and the overall economic security of organizations (Milojević, 2026). Fraud is globally recognized as a significant issue, given that it leads to substantial financial losses and erosion of trust in the economic system (Knežević et al., 2021). According to Milašinović et al. (2022, p. 21), "auditing is of great importance for business and financial decision-making," particularly considering that audit reports and audit opinions play a crucial role in ensuring transparency for investors and other users of financial statements in their decision-making processes (Brown et al., 2020; Knežević & Mitrović, 2017). Evaluations performed by auditors can reveal errors, irregularities, and fraudulent activities, thereby improving the quality and credibility of financial statements (Liu et al., 2024).

The growing incidence of fraud has led to an increased need to strengthen the role of auditors in assessing fraud risk during the audit process, as well as in detecting fraud (Darsono et al., 2023). Fraud investigation has attracted increasing attention in recent literature, particularly due to the impact of the digital environment, which has significantly transformed the nature of fraud, making it more sophisticated and difficult to detect (Milojević, 2025). Audits conducted with a fraud-oriented perspective play an important preventive role in identifying potential fraud; however, their capabilities are limited, as auditors are not responsible for planning and performing audits to detect misstatements that are not materially significant to the presentation of financial statements (Knežević et al., 2019).

ISA 240 – *The Auditor's Responsibilities Relating to Fraud in an Audit of Financial Statements* has been revised to provide clearer responsibilities, a stronger risk response, and enhanced transparency. It clarifies auditors' responsibilities, emphasizes the fraud perspective in auditors' risk assessment, provides appropriate responses to identified risks, and enhances transparency in auditors' reports for publicly traded entities.

One of the important aspects auditors must consider in the fraud detection process is professional skepticism (Brazel et al., 2010). International Standard on Auditing No. 200 (ISA 200) defines professional skepticism as "an attitude that includes a questioning mind, being alert to conditions that may indicate possible misstatement due to error or fraud, and a critical assessment of audit evidence." In other words, a low level of professional skepticism is considered one of the more prominent causes of auditors' failure to identify fraudulent activities (Kacel et al., 2017; Beasley et al., 2001). Prior auditor experience with the psychological characteristics of fraud perpetrators (particularly narcissism) may help increase the level of professional skepticism (Winardi et al., 2017).

The remainder of this paper is structured as follows. The next section examines fraudster profiling, particularly how narcissism is associated with attitudes toward fraud. This is followed by a discussion of professional skepticism in auditing. We then describe the research design and the development of our experimental materials. Subsequently, we highlight the relationship between fraudster profiling and professional skepticism. The paper concludes with final remarks, including implications for current audit practice and directions for future research.

## 2. Fraudster Profiling

The examination of the relationship between the psychological profiling of fraud perpetrators and auditors' professional skepticism in fraud detection cannot be separated from attribution theory. Attribution theory refers to the cognitive processes individuals use to infer the factors influencing the behavior of others. The theory was initiated by Fritz Heider in 1958, who argued that internal forces (personal traits) and external forces (environmental factors) jointly determine behavior (Luthans, 2011). Kelley (1973) further emphasized that attribution theory is fundamentally concerned with how individuals provide causal explanations. Internal attributions may include ability, effort, and skill, whereas external attributions may involve luck, task difficulty, and culture.

According to the KPMG study *Analysis of Global Patterns of Fraud* (2011), a global study based on the analysis of several hundred real fraud cases investigated by forensic teams across 69 countries, the profile of a typical fraudster is defined as follows:

- Most commonly male;
- Aged between 36 and 45;
- In most cases employed within the organization for more than 10 years;
- Frequently occupying a senior position;
- Working in a financial or finance-related role;
- Acting in collusion with other perpetrators;
- Committing fraud against his or her own employer.

Professional skepticism is a complex and ambiguous construct, exercised through daily audit activities and interactions between junior and senior auditors and their clients (Xu et al., 2023). This issue has attracted considerable attention among accounting researchers. A particularly sensitive area involves related-party transactions. However, it is not easy to find studies examining how the psychological profiling of fraud perpetrators may contribute to enhancing auditors' professional skepticism in fraud detection. It is argued that auditors should consider the importance of clients' psychological characteristics, alongside quantitative materiality (Jeppesen & Leder, 2016).

Profiling the psychological characteristics of fraud perpetrators (particularly narcissism) may provide auditors with potential red flags (warning signals), thereby increasing their level of professional skepticism in fraud detection. Narcissism may be identified as a fraud risk factor and should therefore be regarded by auditors as a potential red flag. Specifically, narcissism reflects behavioral tendencies associated with fraudulent conduct that auditors should take into consideration (Blickle et al., 2006).

Narcissism relates to a personality disorder characterized by a "pervasive pattern of grandiosity, fantasies of unlimited power or importance, and a need for admiration or special treatment" (Kacel et al., 2017). Campbell et al. (2010) distinguish between two types of narcissism: grandiose narcissism and vulnerable narcissism. Grandiose narcissists are often visible in the workplace; they tend to be overly confident and charismatic, possess high self-esteem, yet lack empathy and display arrogance. Vulnerable narcissists, in contrast, are characterized by hostility and a high level of psychological defensiveness, accompanied by low self-esteem, depression, and anxiety (Miller & Campbell, 2008).

Red flags represent a common and useful tool in the audit process, particularly in fraud detection, and client narcissism may constitute one such red flag (Johnson et al., 2013). Red flags are an important instrument in identifying fraudulent activities. Manifestations of narcissism may take various forms, such as displays of intellectual superiority, dominance, and general orientation toward self-enhancement (Morf & Rhodewalt, 2001).

Narcissism is perceived as a psychological factor that may influence auditors' skepticism. As a risk factor for fraudulent behavior, it is considered one of the elements that may affect the level of professional skepticism (Winardi et al., 2017). Although moderate levels of narcissism may be beneficial (Maccoby, 2003) and associated with positive personal traits such as confidence and decisiveness (de Vries Miller & Miller, 1985), more extreme forms of narcissism are linked to unethical or fraudulent behavior (Williams et al., 2010). Johnson et al. (2013) note that certain studies have associated observable measures of CEO narcissism with risky and adverse organizational outcomes. Such measures include higher levels of executive compensation, the size and prominence of the CEO's photograph in annual reports, and the frequency of first-person singular pronouns in letters to shareholders.

## 3. Professional Skepticism in Auditing

The factors influencing fraud detection include auditors' professional skepticism, competence, independence, experience, and time pressure in performing the audit. Professional skepticism is an essential quality for auditors and a key determinant of their behavior and decision-making (Sun et al., 2022). Time pressure refers to the deadline given to auditors to complete their audit responsibilities; when time is limited, particularly in complex cases, it may reduce auditors' effectiveness in detecting fraudulent activities (Agustina & Rusydi, 2021). These authors point out that ethical idealism and auditors' professional skepticism lead to a demand for more evidence in order to properly evaluate that evidence. Turner et al. (2003) highlight that management integrity is a crucial element in auditors' assessment of fraud risk.

Various global regulatory bodies have consistently demonstrated interest in professional skepticism, as reflected in their professional standards and inspection reports. For example, the American Institute of Certified Public Accountants (AICPA), through its Statements on Auditing Standards (SAS No. 1 and No. 99), and the International Auditing and Assurance Standards Board (IAASB), through ISA 200, require auditors to exercise professional skepticism throughout the entire audit engagement (Alnafisah, 2019). In the past decade, audit regulators in several countries have identified insufficient application of professional skepticism based on inspections of selected audit files, which may manifest in lower audit quality and inappropriate audit opinions (Xu et al., 2023).

The study by Klarskov Jeppesen and Leder (2016, p. 10) shows that 69% of surveyed senior Danish state-authorized auditors had experience with corporate psychopaths within their client management structures. It was observed that 70% had encountered more than one such case. That experience with corporate psychopaths was more noticeable among auditors with extensive professional experience and somewhat more prevalent among auditors from Big Four firms. Additionally, 43% of auditors who had experience with psychopathic managers stated that those individuals had also committed fraud, while in 40% of cases, this was not observed.

It is noteworthy to mention two personality scenarios characterized by high and low levels of narcissism (Winardi et al., 2017, p. 84). In the first case, involving pronounced narcissism, an individual emphasizes having worked for a large construction company, expresses strong pride in personal achievements, actively uses the pronoun “I” in communication with the auditor, highlights personal authority and problem-solving abilities, and displays strong emotional reactions to audit inquiries. In contrast, in the case of low narcissism, the individual worked for a small construction company, more frequently uses the pronoun “we” in discussions with the auditor, emphasizes the team’s ability to solve problems, and demonstrates modesty in responding to audit questions.

The findings of Ananda Rinaldy and Saputra (2024) indicate that the risk of fraud in financial statements increases due to financial pressure, ineffective monitoring, changes in directors or auditors, ego, and collusion. Dominant psychological characteristics of narcissists include authority, superiority, exhibitionism, and attention-seeking (Raskin & Terry, 1988; Bogart et al., 2004). However, some researchers argue that financial director narcissism does not necessarily lead to negative corporate outcomes; rather, narcissism may function as a motivational mechanism, as it involves belief in one’s superior abilities and a need for strong and constant affirmation from others, thereby driving individuals to achieve exceptional results (Xiang & Tian, 2020), which may be in the company’s interest.

#### **4. The Relationship Between Fraudster Profiling and Professional Skepticism**

Professional skepticism, as defined by the International Auditing and Assurance Standards Board (ISA 200), involves a questioning mind, alertness, and critical evaluation of evidence. However, skepticism is not merely a technical issue; it is also a cognitive-behavioral category. Psychological profiling (e.g., narcissism, Machiavellianism, psychopathy, the so-called Dark Triad) assists auditors in recognizing manipulative management behavior and identifying excessive self-confidence. Personality traits such as narcissism, Machiavellianism, and psychopathy, collectively known as the “Dark Triad,” have received significant attention in accounting literature (Buchanan et al., 2026, p. 27).

It is emphasized that if auditors have prior experience with such behavioral patterns, they are more likely to ask additional questions, expand testing procedures, adopt a critical approach to contradictory evidence, and refrain from uncritically relying on management representations during the audit. Integrating profiling into audit practice may include: incorporating psychological factors into risk assessment, training auditors on the Dark Triad, developing behavioral red-flag checklists, and combining quantitative materiality with qualitative indicators. This is particularly important for forensic auditors, who are playing an increasingly significant role in effective fraud risk management.

The Chief Executive Officer (CEO) and Chief Financial Officer (CFO) are the two most important executives in a firm; although they are not responsible for daily operational activities, they play a decisive role in the quality of accounting information (Xiang & Song, 2021). Malmendier et al. (2013) find that the quality of accounting information is more strongly associated with the characteristics of the CEO and CFO than with those of the entire management team. However, CFO narcissism influences audit fees through various channels and mechanisms more significantly than CEO narcissism (Xiang & Song, 2021).

This appears logical for several reasons. First, CFOs exert more direct influence over the financial reporting process than CEOs, as they are directly responsible for financial statements and make key decisions regarding accounting policies and disclosures. Second, CFOs possess a unique capacity to engage in accounting manipulation, such as restructuring transactions, applying inappropriate accounting policies, and committing fraud (Feng et al., 2011). The same study indicates that CFOs may engage in accounting manipulation under pressure from CEOs, rather than initiating such manipulation for immediate personal financial gain. Ham et al. (2017) find that executive narcissism is associated with strategic positioning, strategic choice, and staffing decisions, underscoring the importance of identifying executive narcissism.

Auditor skepticism may be viewed from multiple perspectives. Carpenter and Reimers (2013) indicate that more skeptical auditors identify a greater number of fraud risk factors, while Quadackers et al. (2014) find that they are more critical of management explanations and provide a greater number of alternative explanations.

## 5. Conclusion

Exercising due professional care entails the obligation to apply professional skepticism. In this context, fraudster profiling represents a bridge between behavioral psychology and audit methodology, as it enables the expansion of professional skepticism from a formal-procedural to a cognitive-analytical level. Profiling the psychological characteristics of fraud perpetrators, including narcissism, is increasingly perceived as an important factor for auditors, particularly given their responsibility for fraud detection. In other words, auditors should consider clients' psychological characteristics beyond the procedural aspects of auditing, as this may contribute to improving audit quality.

Fraudster profiling is undoubtedly an important activity in strengthening auditors' ability to identify risk indicators and assess the likelihood of material misstatements arising from fraud. Particular attention should be devoted to perpetrators' psychological characteristics, including elements of the Dark Triad, rationalization, opportunism, and behavioral patterns within the corporate environment. Professional skepticism entails an attitude of critical thinking, continuous awareness of the possibility of fraud, and readiness to challenge audit evidence, an approach that is increasingly important in a contemporary business environment characterized by growing fraud risks and expanding digitalization.

Therefore, auditors should not passively accept information provided by management but must analyze consistency, reliability, and alignment with other available evidence, adopting a critical stance. In the case of related-party transactions, skepticism is crucial for detecting potential irregularities.

## References

- Agustina, F., & Rusydi, M. K. (2021). Auditors' professional skepticism and fraud detection. *International Journal of Research in Business and Social Science*, 10(4), 275–287.
- Alnafisah, Y. A. (2019). *The practice of professional scepticism in auditing*. The University of Manchester (United Kingdom).
- Ananda Rinaldy, R., & Saputra, D. (2024). Financial crisis as a trigger or amplifier? The role of financial distress in moderating hexagon fraud factors on financial statement fraud. *Dinasti International Journal of Economics, Finance & Accounting*, 5(5), 4942–4952. <https://doi.org/10.38035/dijefa.v5i5.3407>
- Beasley, M. S., Carcello, J. V., & Hermanson, D. R. (2001). Top 10 audit deficiencies. *Journal of Accountancy*, 191, 63–66.
- Blickle, G., Schlegel, A., Fassbender, P., & Klein, U. (2006). Some personality correlates of business white-collar crime. *Applied Psychology*, 55(2), 220–233.
- Bogart, L. M., Benotsch, E. G., & Pavlovic, J. D. P. (2004). Feeling superior but threatened: The relation of narcissism to social comparison. *Basic and Applied Social Psychology*, 26(1), 35–44.
- Brazel, J. F., Carpenter, T. D., & Jenkins, J. G. (2010). Auditors' use of brainstorming in the consideration of fraud: Reports from the field. *The Accounting Review*, 85(4), 1273–1301.
- Brown, A., Milašinović, M., Mitrović, A., & Knežević, S. (2020). Are audit opinions related to bankruptcy forecasting of companies listed in the sector agriculture, forestry and fisheries? *Fresenius Environmental Bulletin*, 29(11), 9899–9905.
- Buchanan, J., Griffith, E., Lambert, T. A., & Perreault, S. (2025). Dark triad traits and accounting: An operating, reporting, and assurance framework. *Auditing: A Journal of Practice & Theory*, 44(2), 27–49.
- Campbell, W. K., Hoffman, B. J., Campbell, S. M., & Marchisio, G. (2010). Narcissism in organizational contexts. *Human Resource Management Review*, 20(4), 268–284. <https://doi.org/10.1016/j.hrmr.2010.10.007>
- Carpenter, T. D., & Reimers, J. L. (2013). Professional skepticism: The effects of a partner's influence and the level of fraud indicators on auditors' fraud judgments and actions. *Behavioral Research in Accounting*, 25(2), 45–69.
- Darsono, D., Chariri, A., & Januari, I. (2022). Does profiling fraudsters increase auditor's professional skepticism? In N. Eltivia et al. (Eds.), *Proceedings of the 3rd Annual Management, Business and Economics Conference (AMBEC 2021)* (pp. 60–66). Atlantis Press.
- de Vries, M. F. K., & Miller, D. (1985). Narcissism and leadership: An object relations perspective. *Human Relations*, 38(6), 583–601.
- Feng, M., Ge, W., Luo, S., & Shevlin, T. (2011). Why do CFOs become involved in material accounting manipulations? *Journal of Accounting and Economics*, 51(1–2), 21–36.
- Ham, C., Piorowski, M., Seybert, N., & Wang, S. (2025). CFO narcissism and the power of persuasion over analysts: a mixed-methods approach: C. Ham et al. *Review of Accounting Studies*, 30(3), 2419–2467.
- International Auditing and Assurance Standards Board (IAASB). (2018). *ISA 240 (Revised): The auditor's responsibilities relating to fraud in an audit of financial statements*. <https://www.iaasb.org/publications/isa-240-revised-auditor-s-responsibilities-relating-fraud-audit-financial-statements>
- Jeppesen, K. K., & Leder, C. (2016). Auditors' experience with corporate psychopaths. *Journal of Financial Crime*, 23(4), 870–881. <https://doi.org/10.1108/JFC-05-2015-0026>
- Johnson, E. N., Kuhn, J. R., Apostolou, B. A., & Hassell, J. M. (2013). Auditor perceptions of client narcissism as a fraud attitude risk factor. *Auditing: A Journal of Practice & Theory*, 32(1), 203–219.

- Kacel, E. L., Ennis, N., & Pereira, D. B. (2017). Narcissistic personality disorder in clinical health psychology practice: Case studies of comorbid psychological distress and life-limiting illness. *Behavioral Medicine*, 43(3), 156–164.
- Kelley, H. H. (1973). The processes of causal attribution. *American Psychologist*, 28(2), 107–128. <https://doi.org/10.1037/h0034225>
- Klarskov Jeppesen, K., & Leder, C. (2016). Auditors' experience with corporate psychopaths. *Journal of Financial Crime*, 23(4), 870–881.
- Knežević, S., & Mitrović, A. (2017). Analysis of the opinions in the audit reports of companies in the hospitality sector. In *Tourism International Scientific Conference Vrnjačka Banja (TISC)* (Vol. 2, No. 2, pp. 324–340).
- Knežević, S., Mitrović, A., & Cvetković, D. (2019). The role of auditing profession in detecting frauds in financial statements. *NBP – Nauka, bezbednost, policija*, 24(2), 97–109.
- Knežević, S., Živković, A., & Milojević, S. (2021). The role and importance of internal control and internal audit in preventing and identifying fraud in banks. *Bankarstvo*, 50(1), 60–89.
- KPMG. (2011). *Analysis of global patterns of fraud: Who is the typical fraudster?*
- Liu, M., Muhamad, H., Soh, W., & Hu, G. (2024). How does narcissism influence auditing? A systematic literature review. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, 14(4), 214–233. <https://doi.org/10.6007/IJARAFMS/v14-i4/23158>
- Luthans, F. (2011). *Organizational behavior: An evidence-based approach* (12th ed.). McGraw-Hill/Irwin.
- Maccoby, M. (2003). *The productive narcissist: The promise and peril of visionary leadership*. Broadway Books.
- Malmendier, U., Pezone, V., Zheng, H., 2013. Managerial Duties and Managerial Biases. *Social Science*. Electronic Publishing.
- Milašinović, M., Knežević, S., & Mitrović, A. (2022). The significance of audit and audit opinions in the contemporary environment. *Revizor*, 25(97–98), 21–31. <https://doi.org/10.56362/Rev2298021M>
- Miller, J. D., & Campbell, W. K. (2008). Comparing clinical and social-personality conceptualizations of narcissism. *Journal of Personality*, 76(3), 449–476. <https://doi.org/10.1111/j.1467-6494.2008.00492.x>
- Milojević, S. (2025). Forensic accounting in the digital environment: Trends and changes. *Megatrend Revija*, 22(2), 39–50.
- Milojević, S. (2026). Računovodstvene prevare i forenzičko računovodstvo. *Revizor*, 28(4), 109–117.
- Morf, C. C., & Rhodewalt, F. (2001). Unravelling the paradoxes of narcissism: A dynamic self-regulatory processing model. *Psychological Inquiry*, 12(4), 177–196. [https://doi.org/10.1207/S15327965PLI1204\\_1](https://doi.org/10.1207/S15327965PLI1204_1)
- Quadaackers, L., Groot, T., & Wright, A. (2014). Auditors' professional skepticism: Neutrality versus presumptive doubt. *Contemporary Accounting Research*, 31(3), 639–657.
- Raskin, R., & Terry, H. (1988). A principal-components analysis of the Narcissistic Personality Inventory. *Journal of Personality and Social Psychology*, 54(5), 890–902.
- Sun, Y., Jia, W., & Liu, S. (2022). Is auditors' professional scepticism a double-edged sword? *Accounting Forum*, 46(3), 241–263.
- Turner, J. L., Mock, T. J., & Srivastava, R. P. (2003). *An analysis of the fraud triangle*. Working paper.
- Williams, K. M., Nathanson, C., & Paulhus, D. L. (2010). Identifying and profiling scholastic cheaters. *Journal of Experimental Psychology: Applied*, 16(3), 293–307.
- Winardi, R. D., Mustikarini, A., & Permana, Y. (2017). Do auditor professional scepticism and client narcissism affect fraud risk assessment? *Indonesian Journal of Accounting Research*, 20(1), 71–98. <https://doi.org/10.33312/ijar.347>
- Xiang, R., & Song, C. (2021). CFO narcissism and audit fees: Evidence from listed companies in China. *China Journal of Accounting Research*, 14(3), 257–274.
- Xiang, R., & Tian, Q. (2020). CFO narcissism and financial restatement: Empirical evidence from Chinese listed companies. *Finance Research*, 4, 80–92.
- Xu, G., Yang, C., & Fukufuka, P. T. (2023). Professional skepticism in practice: An analysis of auditors' stories. *Auditing: A Journal of Practice & Theory*, 42(4), 157–178.

# Green Finance as the Basis of Sustainable Business

Stefan Milojević<sup>1\*</sup>, Miloš Milošević<sup>2</sup>, Stefan Krsmanović<sup>3</sup>

<sup>1</sup> Associate professor, Stefan Milojević, PhD, Educons University, Faculty of Business Economics, Sremska Kamenica, Serbia, E-mail: stefan.milojevic@educons.edu.rs, ORCID ID: <https://orcid.org/0000-0001-6240-6776>

<sup>2</sup> Assistant professor, Miloš Milošević, PhD, Academy of Business Economics, Čačak, Serbia, Email: [profmmilosevic@gmail.com](mailto:profmmilosevic@gmail.com), ORCID: <https://orcid.org/0009-0008-1910-8536>

Teaching Assistant, Stefan Krsmanović, Alfa BK University, Belgrade, Serbia, E-mail: [stefskrsmanovic97@gmail.com](mailto:stefskrsmanovic97@gmail.com)  
<https://orcid.org/0009-0007-0155-3538>

---

## Abstract

Rapid economic growth has degraded the environment in many countries. Increased consumption of energy derived from fossil fuels and other non-green sources, inadequate production processes, and improper waste management have resulted in significant environmental pollution, leading to higher public expenditures for healthcare and the remediation of natural resources.

The promotion of green agenda principles and corporate conduct represents a necessary step toward establishing sustainable production and business practices, those that do not endanger the environment and society, but instead ensure the revitalization of natural resources for future generations. Sustainable extraction of natural resources and the development of innovative technologies aimed at revitalizing or substituting natural resources have become an imperative and are receiving institutional support worldwide. Green investments are increasingly recognized as desirable and continue to grow year by year across various regions of the world.

This paper aims to highlight the importance of green finance and to present to the domestic business and academic community a pathway toward a sustainable future, while supporting Serbia's green transition through greater public awareness and visibility.

*Keywords:* Green finance, sustainable development, ESG, socially responsible investing

---

## 1. Introduction

Sustainable corporate business practices and the sustainable development of economies have come into focus for both business leaders and political authorities across various countries. The proclaimed objective of policymakers, to ensure the well-being and prosperity of the population, can only be achieved through sustainable development, as economic growth alone does not necessarily imply development. On the contrary, in the pursuit of higher growth, i.e., increased production, economies often fall into the trap of environmental degradation, which consequently leads to higher healthcare costs, remediation expenses, resource restoration costs, and similar burdens. A particular concern is environmental pollution, which affects not only human and animal health but also accelerates the depletion of natural resources and increases the risk of natural disasters resulting from rapid climate change (Afzal et al., 2022).

The main sources of environmental degradation include the combustion of fossil fuels for energy production in households and industry, toxins emitted by internal combustion engines, and industrial waste. It should be emphasized that energy consumption and greenhouse gas emissions have significantly increased over the past two decades. The development of financial markets leads to increased investment in the economy, and investments stimulate production, which in turn results in higher carbon emissions due to increased energy consumption. Accordingly, Haseb et al. (2018) conclude that financial development has a significant impact on environmental degradation. Global warming has significantly influenced changes in government policies worldwide, as authorities seek economic growth and development while ensuring environmental protection. Policymakers, as well as managers at the micro level, face difficulties in balancing economic growth with environmental requirements; however, at the global level, sustainable investments have grown exponentially.

Data on sustainable investments are published by the Global Sustainable Investment Alliance (GSIA, 2024), an international collaboration of national sustainable investment organizations that aims to promote and expand best practices in sustainable investing through international cooperation and to increase the share of sustainable investments in total professionally managed assets.

GSIA defines sustainable investing as an investment approach that considers environmental, social, and governance (ESG) factors in portfolio selection and management. Sustainable investing incorporates the following strategies, which represent a global classification standard (GSIA, 2018; 2024):

- Negative/exclusionary screening – excluding from sectoral portfolios (e.g., weapons, tobacco), companies (controversial or corrupt entities), or practices (animal testing, violations of human and labor rights) based on ESG criteria;
- Positive/best-in-class screening – investing in sectors, companies, or projects selected due to positive ESG performance relative to industry peers;

- Norms-based screening – assessing investments against minimum standards of business practice based on international norms (e.g., OECD, UN, UNICEF);
- ESG integration – the systematic and explicit incorporation of environmental, social, and governance factors into an investment manager’s financial analysis;
- Sustainability-themed investing – investments in sustainable agriculture, clean energy, green technologies, i.e., selecting investments aligned with sustainability trends;
- Impact/community investing – targeted investments aimed at addressing social, environmental, and community issues, as well as providing financial support to entities with a clear positive social and environmental orientation;
- Corporate engagement and shareholder action – using shareholder influence to shape corporate behavior and directly engaging with management regarding ESG practices.

According to GSIA (2024), responsible investments account for a significant share of professionally managed assets in every region and represent a major force in global financial markets. Table 1 presents data on investments oriented toward responsible and sustainable approaches.

Table 1: Responsible and Sustainable Investment Approach 2018–2024 (USD billion)

Region	2018	2020	2022	2024
Europe	676	2,740	10,164	14,345
United States	136	393	715	1,602
Canada	64	94	149	420
Australia and New Zealand	23	121	221	366
Japan	4	18	25	22
<b>Total</b>	<b>902</b>	<b>3,366</b>	<b>11,274</b>	<b>16,754</b>
<b>Change (%)</b>		273	235	49
<b>Total investments</b>	34.596	46.920	46.560	61.677
<b>Responsible and sustainable investments (%)</b>	3	7	24	27

Source: Morningstar Direct & Morningstar Research, September 2025.

Global Sustainable Investment Review 2024, Data Annex, Investment Insights.

## 2. Sustainable “Green” Development

Green, i.e., sustainable development, has become an imperative of economic policies across all European countries. It requires states to transform currently unsustainable, or “non-green,” companies into green, sustainable ones (Behera et al., 2024). The United Nations Industrial Development Organization (UNIDO, 2023) reports that many countries are strategically oriented toward promoting environmental protection and social greening (Li et al., 2025).

The concept of sustainable business implies the implementation of innovative strategies aimed at environmental protection, while profit is placed in a secondary position. Thus, the traditional theoretical assumption that profit is both the founding motive and the primary objective of a company as a for-profit organization is transforming. Profit is no longer the dominant objective but is subordinated to the protection of natural resources. Responding to the findings of the aforementioned researchers, Zhang et al. (2022) argue that the concept of “green finance” has not yet been precisely defined and that scholars have yet to reach a consensus regarding its definition. While Baldi and Lambertides define green finance as the financing of business operations that generate environmental benefits, other theorists (Beccetti et al., 2022) maintain that a business model can be considered green or sustainable if it is primarily oriented toward engaging in sustainable activities, effectively addressing current environmental challenges, and remaining profitable.

There is considerable divergence in defining the concept itself, which is expected with any emerging theoretical framework or orientation. Nevertheless, it can be concluded that green finance represents an approach aimed at mitigating the effects of climate change through financial investments directed toward environmental protection. Feyisetan et al. (2024) observe a significant relationship between financial investments and climate change, noting that conventional investment activities have traditionally not been dedicated to environmental protection but have instead been driven by the profit-maximization motive. What other scholars (Brooks & Schopohl, 2020) emphasize as urgent and necessary is the development of standardized metrics for assessing the environmental impact of investments, the establishment of regulatory frameworks that encourage sustainable corporate behavior, and greater transparency in reporting.

Ultimately, this leads to a redefinition of the very purpose of establishing a company. A few decades ago, the prevailing view reflected a textbook definition of the motive behind the creation of an enterprise, namely, the achievement and maximization of profit. Today, this view has been substantially modified by incorporating sustainable business practices, such that the strategic objective and purpose of a company may be defined as generating profit while prioritizing environmental protection.

### 3. Economic Development and Our Mistakes

Economic development has evolved significantly. A century ago, postcards often depicted massive factory chimneys billowing black smoke, symbols that at the time represented powerful industry and a nation's productive strength. Today, the imagery is opposed: smiling people using solar energy. Over the decades, the understanding of development has changed considerably. Even today, however, many policymakers equate growth with development, failing to understand or accept that development does not imply growth alone.

Unfortunately, our country also found itself in a difficult economic and financial situation at the beginning of the new millennium. More accurately, Serbia's economy never fully emerged from the crisis triggered by the dissolution of the former Yugoslavia. The modest steps forward that resulted in increased production and wages remain far below Serbia's GDP and per capita income levels recorded in 1989.

With globalization, production was massively relocated from countries across the world and from nearly all industries to geographically distant regions. These economic locations were able to sustain low wages, while certain industries, such as the textile industry, could not tolerate high labor costs. Simply put, for a textile company to remain competitive and survive in the market, it often has no choice but to relocate production to geographically distant locations with acceptable labor costs. These host countries readily accepted various industries; their economies grew and gradually developed. However, as they absorbed segments of global production, workers in home economies lost jobs, prompting governments to intensify economic policy measures aimed at attracting foreign direct investment.

Over the past decade, a global competition for investors has emerged, with countries competing over the scale and types of incentives offered to attract foreign capital. The Republic of Serbia has been particularly active in this regard, attracting significant foreign direct investment supported by various financial and administrative measures: business subsidies, wage subsidies for newly employed workers, reduced social contribution rates, free construction land, and the development of transport, communal, and technical infrastructure. Additionally, tax and inspection authorities have often adopted a favorable stance toward foreign investors. All of this resulted in economic growth. However, the question remains whether this growth constitutes genuine development and, qualitatively, what types of industries have entered Serbia.

Unfortunately, it can be observed that predominantly polluting and relatively polluting industries have entered Serbia. These include industries that negatively affect the environment and workers' health. Examples include tyre manufacturing, which has been characterized as environmentally harmful, as well as extractive and heavy metal industries that, due to low global market prices for finished products, reduce their costs by disabling air filtration systems. Furthermore, segments of the automotive supply industry, such as cable assembly operations, often result in severe occupational health consequences for workers.

Several researchers have examined environmental degradation resulting from financial investments. Afzal et al. (2022) find that financial development, institutional frameworks, and foreign investments determine the scope of green development. In a study conducted on a sample of 40 European countries covering the period 1990–2019, they compare financial development indicators, such as domestic credit provision, bank credit to the private sector, and foreign direct investment, with measures of environmental degradation, including energy consumption, CO<sub>2</sub> emissions, greenhouse gas emissions, and natural resource depletion. Their model also incorporates income levels, institutional quality, existing technology, education levels, population size, and urbanization. The study relies on a robust sample and a relevant time frame. The findings indicate that financial development has a negative relationship with four different measures of environmental degradation, whereas foreign direct investment and institutional quality, in certain contexts, exacerbate environmental protection challenges. In conclusion, Afzal et al. (2022) recommend that policymakers strengthen institutions and develop green finance policies to reduce long-term environmental degradation.

### 4. Green Finance in the Function of Sustainable Development

Raising awareness about the protection of natural resources, sustainable resource extraction, recycling, and employee well-being has encouraged policymakers to more clearly and formally launch various initiatives aligned with the green agenda, culminating in discussions that resulted in the adoption of the Paris Agreement. The green agenda implies the rejection of polluting industries and the conversion of existing technologies, i.e., a transition toward clean technologies. Achieving sustainable economic development, which represents a key policy objective, requires continuous promotion, integration, and institutionalization. Various researchers (Giannopoulos et al., 2022) emphasize the urgent need to transform corporate operations toward sustainable practices, particularly within the financial sector, which has led to the emergence of a broad initiative known as "green finance."

Sustainable and socially responsible investments have become increasingly popular over the past decade among both domestic and transnational investors. Their popularity has expanded as countries adopt the provisions of the Paris Agreement aimed at mitigating the negative effects of climate change. Although the primary target of sustainable business is the reduction of CO<sub>2</sub> emissions, the restoration of extracted natural resources, and adequate waste management, with a strong commitment to recycling,

other components of the ESG (Environmental, Social, Governance) concept, such as human and labor rights, investment in employees, and corporate governance practices, are also incorporated into investors' analytical frameworks.

Reliance on the ESG concept compels investors to orient themselves toward sustainable and socially responsible investments (SRIs). They tend to prioritize profitable ventures that anticipate and integrate ESG principles into their operations, even if such ventures offer lower rates of return compared to traditional investments that pay limited attention to environmental, social, and governance issues beyond what is mandated by local regulations (Krueger et al., 2024).

Investors incorporate information regarding corporate environmental practices, social factors, and governance structures into their investment decisions because such information enables better alignment of investment choices with their own preferences (Starks, 2023). The ESG concept helps investors reduce various types of risk by aligning business practices with environmental and ethical objectives while ensuring long-term financial stability and expected future returns (Gaurav et al., 2025). The same researchers observe that consistent implementation of ESG practices enhances stability, reduces regulatory risks, and attracts growing market demand. In capital markets, investors who integrate ESG principles into their securities portfolios create more resilient investment portfolios while consciously supporting socially responsible and sustainable companies (Brain & Co., 2023).

In the case of the Indian financial market analyzed by Gaurav et al. (2025), socially responsible investments increased from USD 275 million in 2020 to USD 650 million in 2021 and exceeded USD 1 billion in 2023. Furthermore, the NIFTY ESG Index outperformed the NIFTY 50 during the period 2023–2025, reflecting growing acceptance of ESG-oriented investments. Gaurav et al. (2025) anticipate the continuation of this trend through an increasing number of investors committed to socially responsible investments, which may contribute to a more socially conscious national economy and sustainable corporate practices (Ronald et al., 2024).

Green finance encompasses six environmental objectives (Kian, 2025):

- Mitigation of climate change;
- Adaptation to climate change effects;
- Sustainable use and protection of water and marine resources;
- Transition to a circular economy;
- Pollution reduction; and
- Protection and restoration of biodiversity and ecosystems.

Green financing requires directing financial surpluses toward investment projects that provide measurable environmental benefits. Related concepts include (Kian, 2025):

- Sustainable finance;
- Climate finance; and
- Low-carbon finance.

Managers and policymakers within national economies are therefore faced with the need for a deeper understanding of green finance and green financing, that is, investing in sustainable and profitable ventures guided by the principle of “sustainability before profit.” It is also evident that significant criticism has been directed at published non-financial information, particularly regarding its excessive complexity and breadth, lack of structure, and qualitative, rather than quantitative, nature. Investors expect financial material data to be incorporated into valuation models or compared with other indicators. This would significantly facilitate (pre-) investment analysis, save time, and contribute to a more efficient allocation of financial resources.

Another criticism concerns the absence of a standardized reporting format. The existence of an internationally harmonized and standardized structure for non-financial reporting, or at least clear guidelines, would greatly assist reporting entities and potential investors alike. Investors could more easily navigate relevant report sections prepared under a globally aligned reporting framework, enabling geographical comparability and faster investment decision-making, thereby enhancing overall financial market efficiency. Until such a harmonized framework emerges, companies legally obliged to disclose non-financial information may exploit this reporting vacuum by disclosing only minimal information required for formal compliance with existing legislation. Such superficial and unsystematic non-financial reporting is unacceptable, as it lacks relevance and meaningfulness.

Serbia's green transition has begun with the promotion of the platform “Green Agenda in Serbia,” which has been recognized by business representatives, bankers, and public sector officials as an effective model for mobilizing green investments, as it rapidly increased interest among companies, local governments, and public enterprises in financing green economy projects. Further efforts are needed to secure additional support to accelerate these green investments, which will remain a focus of future activities. In this regard, Serbia will intensively work on strengthening institutional capacities, developing procedures, and defining a comprehensive green financing mechanism involving the state, international financial institutions, banks, and both the private and public sectors (UNDP Serbia, 2025).

Serbia also receives support from the European Union through the initiative “EU for the Green Agenda in Serbia,” aimed at accelerating green investments that will help the national economy and small and medium-sized enterprises become more resilient to the negative effects of climate change. The European Investment Bank (EIB) for the Western Balkans notes that 10% of local

companies have already recorded losses due to natural disasters. The EIB also provides technical support to banks within the same initiative, helping transform innovative and environmentally friendly business ideas into bankable projects.

## 5. Conclusion

With the growing awareness among business leaders and the broader community regarding the importance of sustainable operations and responsible practices, further progress in the broader application of the ESG concept and non-financial reporting can be expected to yield a concrete ESG reporting format with defined metrics by reporting positions (e.g., carbon emissions, employee rights and investments, gender diversity in management, etc.). The mere existence of clear guidelines would encourage companies not yet legally required to provide non-financial (ESG) reports to voluntarily adopt ESG reporting practices and gradually prepare for future reporting periods, thereby promoting responsibility and transparency.

It can also be concluded that institutional quality reduces environmental degradation; however, institutions must act in combination with green financing mechanisms. Corporate management faces a significant challenge that reshapes traditional theoretical assumptions regarding the purpose of the enterprise. The objective of the company is shifting from pure profit maximization toward generating profit with full commitment to sustainable business practices.

## References

- Azfa, A., Rasoulinezhad, E. & Malik, Z. (2022). „Green finance and sustainable development in Europe“, *Economic research - ekonomska istraživanja*, Vol. 35, N° 1, p. 5150–5163; <https://doi.org/10.1080/1331677X.2021.2024081>
- Behera, P., Sethi, L. & Sethi, N. (2024). „Balancing India’s energy trilemma: Assessing the role of renewable energy and green technology innovation for sustainable development“, Vol. 308; <https://doi.org/10.1016/j.energy.2024.132842>
- Brain & Co. (2023). „Catalyzing sustainability and Resilience 2023 ESG Report,“ [Online]. <https://www.baincapital.com/esgandimpact/reports/Bain-Capital-ESG-Report-June2023.pdf>.
- Brooks, C., Shhopohl, L. (2020). „Green accounting and finance: Advancing Research on Environmental Disclosure, Value Impacts and Management Control Systems“, *British Accounting Review*, Forthcoming (December 2020); <http://dx.doi.org/10.2139/ssrn.3741193>
- Gaurav, A., Baishnab, K., Singh, P. K. (2025). „Intelligent ESG Portfolio Optimization: A Multi-Objective AI-Driven Framework for Sustainable Investments in the Indian Stock Market“, *Sustainable Futures* Vol. 9, 100832; DOI:10.1016/j.sfr.2025.100832.
- Giannopoulos, G., Fagernes, R.V. K., Elmarzouky, M. & Hossain, K. A. B. M. (2022) „The ESG Disclosure and the Financial Performance of Norwegian Listed Firms“, *Journal of Risk and Financial Management*, Vol. 15, Issue 6; <https://doi.org/10.3390/jrfm15060237>
- Global Sustainable Investment Alliance (GSIA, 2024). „Global Sustainable Investment Review 2024“, [www.gsi-alliance.org/wp-content/uploads/2025/11/GSIR-2024-Data-Annex.pdf](http://www.gsi-alliance.org/wp-content/uploads/2025/11/GSIR-2024-Data-Annex.pdf)
- Global Sustainable Investment Alliance (GSIA, 2024). „Global Sustainable Investment Review 2018“ [https://www.gsi-alliance.org/wp-content/uploads/2019/03/GSIR\\_Review2018.3.28.pdf](https://www.gsi-alliance.org/wp-content/uploads/2019/03/GSIR_Review2018.3.28.pdf)
- Haseeb, A., Xia, E., Danish, Baloch, M. A., & Abbas, K. (2018). „Financial development, globalization, and CO<sub>2</sub> emission in the presence of EKC: Evidence from BRICS countries“, *Environmental Science and Pollution Research*, 25(31), 31283–31296.
- Kian, L. (2025). „Green Finance: Concepts, Theories, and Implications for Sustainable Development“, *Sociale: Journal of Social and Political Sciences*, Vol. 1 N° 2, p. 199-221.
- Krueger, P., Sautner, Z., Tang, Y. D., & Zhong, R. (2024). „The Effect of Mandatory ESG Disclosure Around the World“, *Journal of Accounting Research*, Vol. 62, N° 5, p. 1795-1847; DOI: 10.1111/1475-679X.12548
- Li, F., Liu, J. & Liu, H. (2025). „Institutions empowerment for sustainability: ESG performance and enterprise green innovation - Evidence from China“, *Journal of Environmental Management*, Vol. 388 (July 2025); <https://doi.org/10.1016/j.jenvman.2025.125947>
- Morningstar Direct & Morningstar Research, September 2025. *Global Sustainable Investment Review 2024, Data Annex, Investment Insights*.
- Ronald, B. J., Joseph, S. G. M., Kumar, P., Hsu, C-Y, Mehmood, A. (2024). „Performance and risk Analysis of Sustainable Mutual funds in India: a comparative study“ *AVE Trends in intelligent social letters*, Vol. 1, N° 1, pp. 13-24; Accessed: 02.07.2026. [Online] <https://avepubs.com/uploads/articles/171881303432084.%20ATISL-12-2024.pdf>.
- Starks, L. (2023). „Presidential Address: Sustainable Finance and ESG Issues: Value Versus Values“, *Journal of Finance* 78, p. 1837-72.
- UNDP Srbija (2025). „Kako do efikasnog finansiranja zelene tranzicije u Srbiji?“, <https://www.undp.org/sr/serbia/news/kako-do-efikasnog-finansiranja-zelene-tranzicije-u-srbiji>, Accessed on 16 January 2026.

United Nations Industrial Development Organisation-UNIDO (2023). „Annual Report 2023 Progress by Innovation“, Accessed on 16 January 2026; <https://www.unido.org/annual-report-2023>

Zhang, H., Geng, C. & Wei, J. (2022). „Coordinated development between green finance and environmental performance in China: The spatial-temporal difference and driving factors“, *Journal of Cleaner Production*, 346, 131150.

# Implementation of the Reorganization Plan in Bankruptcy Proceedings Under Albanian Legislation

**Teuta Hoxha**

*Mediterranean University of Tirana*

*E-mail: hoxha\_t@yahoo.com*

---

## Abstract

This paper examines the legal regulation of the completion of a reorganization plan within bankruptcy proceedings and the role of the bankruptcy court in confirming its implementation. Particular attention is given to the procedural framework governing the declaration of the plan's fulfillment and the rights of creditors and other interested parties to challenge such a declaration. Through a doctrinal analysis of the relevant legal provisions, especially Article 121 of the bankruptcy law, the study evaluates the legal nature of the court's decision confirming the implementation of the reorganization plan and its procedural implications. The paper argues that this decision should be understood primarily as a preliminary procedural act based on the report of the supervisory administrator or the debtor, rather than a final judicial determination resulting from a full evidentiary examination. Consequently, the possibility for interested parties to file objections before the same court represents an essential safeguard for the protection of creditors' rights. The study further analyzes the conditions under which liquidation proceedings may be initiated when the plan is not implemented, emphasizing the need for a balanced and proportionate judicial approach. The paper contributes to clarifying the interpretation and practical application of the legal provisions governing the final stage of reorganization proceedings.

*Key words:* Bankruptcy law; Reorganization plan; Bankruptcy court; Creditors' rights; Liquidation proceedings.

---

## 1. Legal Force of the Reorganization Plan

The approval of the reorganization plan produces a positive effect in bankruptcy proceedings. For creditors, economic expectations regarding the recovery of their claims become clearer; for the debtor, employees, and other entities affected by bankruptcy proceedings, it creates a kind of relief or breathing space. However, this situation does not last long.

The real challenge of the procedure begins after the approval of the plan. The implementation of the reorganization plan constitutes the purpose, function, and solution to the economic aspect of the procedure, representing the real objective of the law.

From a formal perspective, the reorganization plan constitutes the legal document approved by a decision of the bankruptcy court and attached to that decision. The legal effects of the reorganization plan begin immediately after its approval by the bankruptcy court.

From a substantive perspective, the reorganization plan of a debtor in bankruptcy proceedings, approved by the creditors and the bankruptcy court, constitutes a new agreement between creditors and the debtor concerning the settlement of obligations, approved by the bankruptcy court. Like any legal agreement, its content becomes binding on the parties and has the force of law between them. However, unlike an ordinary civil law agreement, the reorganization plan also produces effects toward third parties.

The binding force of the reorganization plan constitutes its general legal effect.

Since the reorganization plan is approved by a decision of the bankruptcy court, once the decision becomes final, the content of the plan is binding on all creditors, regardless of whether they voted in favor, against, did not participate in the vote, or have legally appealed the court's decision approving the plan.

The legal force of the reorganization plan is determined by three main elements:

1. the content of the plan;
2. the specific legal provisions applicable to all types of transactions defined in the plan;

3. the provisions of the bankruptcy law.

Beyond these coordinates, the implementation of the reorganization plan, as an agreement concluded through legal procedures, is supervised by bankruptcy bodies when such supervision is provided in the plan and monitored by the bankruptcy court. This constitutes an essential difference from an ordinary legal agreement concluded according to the general rules of civil legislation.

Unlike an ordinary contract concluded in accordance with legal provisions, the reorganization plan has binding force not only for the participants in the bankruptcy proceedings who voted in favor of its approval, but also beyond this group of subjects, giving the legal force of the plan a “sui generis” nature.

Thus, co-debtors or guarantors of the debtor are usually not subjects of the procedure—they are neither creditors, parties, nor participants in the proceedings. However, the approval of a plan for the debtor’s reorganization also affects these categories, because the debtor is discharged from obligations toward co-debtors, guarantors, or other parties that assert claims against him, in the same way as he is discharged from obligations toward bankruptcy creditors.

Specifically, the debtor under reorganization is liable to creditors in the proceedings only according to the content of the plan, while creditors’ claims against third parties outside the procedure (such as guarantors or co-debtors connected to economic transactions with the debtor) remain independent and may be pursued outside the bankruptcy procedure based on the respective legal provisions governing the specific legal relationship.

For example, if a creditor is expected to realize 70% of their financial claim against the debtor according to a reorganization plan, the creditor retains the right to claim the remaining 30% from co-debtors or guarantors of the debtor. Meanwhile, the debtor—who is considered a party to the reorganization plan (although not a voter)—is discharged from the remaining 30% of the obligation.

This form of discharge from obligations represents the essence of the privileges granted to the debtor by law within bankruptcy proceedings under the reorganization option. Through procedures that guarantee the proper application of bankruptcy law, a general balance is ensured between the rights and obligations established in its provisions. This balance constitutes the economic and legal foundation of bankruptcy law.

With respect to creditors, the plan produces consequences both for those who voted in favor and those who voted against, as well as those who did not participate in the vote. Therefore, the reorganization plan has binding effect on them as if they had participated and approved it.

On the other hand, if a potential creditor has not submitted claims to the bankruptcy administrator either at the opening of the procedure or afterward, their claims generally cannot be executed during the duration of the plan if the debt arose before the decision initiating the proceedings.

Thus, the court-approved reorganization plan produces effects for all obligations and debts of the debtor prior to the declaration of bankruptcy, whose execution is suspended during the period of implementation of the plan.

If a creditor submits a claim after the approval of the reorganization plan regarding a right that arose before the beginning of the procedure, that claim is not considered part of the plan and cannot be independently executed against the debtor outside the plan as long as the plan continues to be implemented. However, the creditor retains the right to pursue fulfillment of the obligation, including execution against co-debtors or guarantors, and after the expiration of the plan’s implementation period may also address the principal debtor according to general rules.

The reorganization plan may include numerous transactions which generally require subsequent legal actions to become effective. Legal provisions ensure that no party may unilaterally withdraw from the implementation of the plan.

To guarantee that the actions provided in the plan are irreversible and cannot be abandoned unilaterally, the law provides that the consent of the parties is deemed given in the form required by law if the plan establishes, determines, or revokes rights over movable property or determines that the capital or shares of limited liability companies have been transferred.

This means that for legal actions foreseen in the plan involving the creation, modification, transfer, or renunciation of rights over such assets, the declarations of will of the parties included in the plan are considered executed in the legally required form.

For movable property, this approach does not present particular difficulties. However, regarding participation in capital, quotas, shares, or rights of a person toward the debtor affected by the plan, the discussion becomes more specific.

Law No. 9901/2008 “On Commercial Companies”, as amended, conditions the validity of the transfer of capital shares only on written form and registration in the company’s registers, without requiring a notarial act. In such cases, the plan itself is considered the act through which the consent of the parties has been expressed.

In all cases, the debtor is obliged to implement the content of the approved plan, and the supervisory administrator (if provided in the plan) must submit the necessary documentation for all transactions defined in it and complete all required formalities.

The same approach applies to obligations assumed through the plan concerning the creation, modification, transfer, or cancellation of rights over assets or the renunciation of shares in debtor companies.

For **immovable property**, the bankruptcy law does not establish the same rule. Therefore, if the plan contains clauses concerning the transfer of immovable property, the provisions of bankruptcy law together with other relevant legal provisions regulating such transfers shall apply.

## **2. Supervision of the Implementation of the Reorganization Plan**

With the announcement of the court decision approving the reorganization plan, the duties and mission of the bankruptcy administrator/supervisor generally end, except when the approved plan provides that the supervisory administrator remains in office to supervise the implementation of the plan, specifying their competencies and duties.

It is understood that the plan cannot foresee every clause for every issue that may arise during its implementation. Usually, the plan determines the basic framework for the continuation of the debtor’s activity until the obligations defined in the plan are fulfilled.

Even when detailed, issues may arise during implementation. For matters not regulated by the plan, the relevant provisions of bankruptcy law concerning the effects of the reorganization plan apply, provided they do not contradict the content of the plan.

After the approval of the plan by the court, the debtor generally regains the right to administer the bankruptcy estate and to represent it in relations with third parties in accordance with the conditions of the plan, unless the plan provides otherwise.

If restrictions on the debtor’s authority remain or new ones are introduced in the plan, they must be registered in public registers. The debtor is responsible for completing these registrations promptly, while the supervisor ensures their legal compliance.

During the implementation of the reorganization plan, the debtor continues its activity in accordance with the plan and takes all necessary measures to fulfill the obligations provided therein. The continuation of activity may generate new rights and obligations.

Obligations that arise after the approval of the plan are not subject to the automatic suspension effect provided in Article 118 of the law. Therefore, their enforcement or termination follows the general rules governing civil obligations.

The bankruptcy court generally has no jurisdiction over disputes arising from such obligations unless they originate from legal relationships defined in the plan or directly affect its implementation.

The implementation of the plan may be supervised in two ways:

1. By a plan supervisor, when the plan provides for supervision by a person appointed by the court;
2. By bankruptcy bodies, such as the creditors’ committee, the creditors’ assembly, or the bankruptcy court.

## **2.1 The Supervisor**

The supervisor of the reorganization plan is a subject of the bankruptcy procedure and must be explicitly provided for in the plan. The supervisor ensures the implementation of the plan by monitoring the debtor's compliance with the plan, bankruptcy law, and applicable legislation.

Any person who meets the criteria to be a bankruptcy administrator may be appointed as supervisor. The role and powers of the supervisor are determined in the reorganization plan and relevant legislation.

The supervisor does not replace the debtor or its governing bodies and is neither a party nor a representative of them. The supervisor does not undertake commercial or economic activities, as these belong exclusively to the debtor.

The supervisor acts independently from both the debtor and the creditors and bears responsibility similar to that of a bankruptcy administrator within the limits established by the plan and the law. However, the supervisor is not responsible for the debtor's actions.

The supervisor's duties are therefore independent from those of the debtor, and their legal responsibilities are separate.

Beyond supervision, the supervisor should also act as a guardian of the debtor, helping ensure the successful implementation of the plan and the revival of the debtor's activity.

The supervisor prepares and submits to the bankruptcy court a report on the implementation of the reorganization plan once a year, unless otherwise specified in the plan. The report is also communicated to the creditors' committee, the debtor, and any creditor requesting access.

The supervisor is responsible for the accuracy of the data presented in the report and must verify the information provided by the debtor using supporting documentation such as financial statements, contracts, and similar records.

## **2.2 Supervision by Bankruptcy Bodies**

If the plan does not provide for a supervisor, the debtor is responsible for implementing the plan and reporting to the bankruptcy court according to the plan's provisions.

In such cases, creditors monitor the implementation of obligations directly according to their respective claims, and oversight is exercised by creditor bodies or the bankruptcy court.

Normally, the creditors' committee ceases its functions once the plan is approved, but the plan may provide that the committee continues operating and specify additional duties.

In such cases, the debtor reports to the creditors' committee, which verifies the reports and acts as an advisory and preliminary oversight body before reporting to the bankruptcy court.

After submission, each creditor has the right to review the report in order to protect their economic interests in the proceedings.

## **3. Completion of the Implementation of the Reorganization Plan**

The implementation of the reorganization plan is monitored by the bodies specified in the content of the plan, which report to the bankruptcy court in accordance with the provisions set out in the plan and, in the absence of such provisions, in accordance with the applicable legal provisions.

The completion of the implementation of the reorganization plan, just like its approval, is declared by the bankruptcy court through a special decision.

It should be emphasized that bankruptcy procedures generally follow the rule that if a stage of the procedure is concluded by a court decision, then the product or consequence arising from that stage also follows the same rule, meaning that it is likewise finalized by a court decision.

The law has provided in its Article 121, titled “Completion of the Implementation of the Reorganization Plan,” as follows:

1. The supervisory administrator or the debtor informs the bankruptcy court of the completion of the implementation of the reorganization plan by submitting certificates or documents proving the full fulfillment of all the conditions agreed upon in the reorganization plan.
2. The bankruptcy court issues a decision regarding the fulfillment of the plan in accordance with its provisions. The decision of the bankruptcy court in this case shall be publicly announced.
3. Any interested party shall have 10 days from the date of the announcement to file an appeal by presenting evidence of non-fulfillment.
4. In the event of an appeal, the bankruptcy court hears the debtor and the supervisory administrator and issues a decision within five days, by which it either approves the full implementation of the plan or initiates liquidation proceedings.

From the content of this provision, it can be observed that the decision of the bankruptcy court regarding the fulfillment of the reorganization plan is reached in chambers on the basis of the report and information submitted, as the case may be, by the supervisor or by the debtor when the plan does not provide for a supervisor.

Before issuing such a decision, the bankruptcy court has the right to hear the supervisory administrator or the debtor by scheduling a hearing and to examine the documentation confirming the implementation of the plan, such as payment confirmations, bank statements, and similar documents. The above provision should be applied carefully with regard to the appeal, since it does not refer to an appeal before the court of appeal against the decision declaring the full implementation of the reorganization plan.

Analyzing the legal context of this decision and the respective phase of the bankruptcy procedure, it may be stated that the court’s decision in this case constitutes a preliminary decision, even though it is publicly announced. Through this decision, the court declares the fulfillment of the plan on the basis of the report submitted by the supervisor or the debtor.

Such a decision does not have a final character, since creditors and interested parties are informed for the first time about this legal situation—one that produces significant procedural effects—through an official formal act such as a court decision. At this stage of the procedure, such a decision essentially represents the publication of the supervisor’s or debtor’s report regarding the implementation of the reorganization plan rather than the conclusion of a judicial process resulting from the examination of evidence during judicial investigation.

From a legal standpoint, it might be considered more accurate if the decision specified in Article 121, paragraph 2 of the law was defined as a judicial decision that publishes the administrator’s or debtor’s report regarding the fulfillment of the plan. This would provide a more coherent conceptual basis for the provision in the law granting the right to challenge the decision within a ten-day period before the same court that issued and publicly announced it.

Therefore, for the purpose of a correct legal interpretation, the provision granting every interested party the right to file an appeal within ten days against the decision of the court declaring the fulfillment of the reorganization plan—before the same court that issued the decision should be understood and applied as a clear expression of the right of creditors and other affected parties to be heard and to submit evidence of non-fulfillment before the bankruptcy court.

In this case, the appeal is examined by the bankruptcy court in a judicial hearing, where the appealing party, the supervisor, and the debtor are summoned and heard. In the event that several appeals are submitted, the court may decide to procedurally consolidate them into a single proceeding, since each appeal individually may potentially affect the decision declaring the plan as fulfilled.

The law provides that, following the review of the appeal, the court shall issue a decision within five days, through which it shall decide either:

- a) to approve the full implementation of the plan
- b) to initiate liquidation proceedings.

This formulation again appears to create some confusion, since the court has already issued a decision declaring the full implementation of the plan. Nevertheless, regardless of the wording, if the claims regarding the non-fulfillment of the plan are found to be unfounded, there are no grounds to overturn the court's earlier decision.

(Alternatively, instead of the wording used in Article 121, paragraph 5 of the law, it could have been more straightforward to provide that if the court finds the appeal unfounded, it rejects it, without the need to issue another decision "approving the full implementation of the plan," a decision that the same court had already announced previously.)

If, after hearing the parties, the court finds that the plan has not been implemented in accordance with its provisions and that the preliminary decision declaring the full implementation of the plan under Article 121, paragraph 2 is therefore unfounded, the law grants the court the right to issue a decision "for the initiation of liquidation proceedings."

However, considering the progress of the procedure up to this stage—where it has been carried out through the implementation of a reorganization plan—and the importance of initiating liquidation in such circumstances, this option should be approached with a certain degree of caution by those applying the law. As formulated in Article 121, paragraph 4, the option of liquidation appears to be presented as an unavoidable alternative if the court determines that the plan has not been implemented, even minimally. However, this moment should not be interpreted as limiting the discretion of the bankruptcy court.

The bankruptcy court examines all appeals submitted by the parties affected by its preliminary decision declaring the fulfillment of obligations in accordance with the plan under Article 121, paragraph 2. If, after hearing the parties and reviewing the submitted documentation, the court finds that certain instances of non-fulfillment of the plan are not substantial, declaring the initiation of liquidation would be excessive and would lack both economic and legal justification.

In such circumstances, it is reasonable to consider that the court, exercising its active role in the procedure and applying the provisions of the Civil Procedure Code, has the right to identify the deficiencies and set deadlines for the debtor. In doing so, the court may declare the appeal admissible and return the final report submitted by the supervisory administrator or the debtor. In its decision, the court may identify the shortcomings and allow the supervisory administrator or the debtor the opportunity to remedy them or to make the necessary corrections or additions in their actions, thereby avoiding the incidental initiation of liquidation proceedings for deficiencies that may be remedied.

However, such an approach cannot be applied in every case of non-fulfillment. If, after hearing the parties, the court determines that the previous decision declaring the fulfillment of the plan lacks factual basis, or that the actions provided in the plan cannot be carried out, or that the plan itself is unenforceable, the court has the right, based on these findings, to declare the initiation of liquidation proceedings against the debtor.

Considering the way in which the provisions of the bankruptcy law are structured—where the stages of the procedure are clearly defined—the initiation of liquidation as a result of the failure or impossibility of implementing the reorganization plan should ideally be the result of a specifically initiated process, rather than an incidental one. This is particularly relevant since the law itself lists the same grounds for the initiation of liquidation as specific grounds in Part Six, Chapter One.

If the court finds the appeals filed against its preliminary decision to be unfounded, it reaffirms the preliminary decision approving the full implementation of the plan, which essentially consists in confirming the complete fulfillment of the plan according to the supervisor's report.

The court's decision in this case is published in accordance with the legal provisions governing the necessary public announcements.

Once this decision becomes final, the reorganization plan ceases to produce legal effects, and the functions of the supervisor and other bankruptcy bodies come to an end, while the jurisdiction of the bankruptcy court in the procedure it has conducted also terminates.

#### **4. Summary and Conclusion**

The completion of the implementation of a reorganization plan represents one of the most important stages in bankruptcy proceedings, as it marks the transition from judicial supervision to the restoration of the debtor's normal economic activity. The

legal framework governing this stage aims to ensure both the effective enforcement of the plan and the protection of the rights and interests of creditors and other stakeholders involved in the procedure.

The analysis of the legal provisions regulating the declaration of the fulfillment of the reorganization plan highlights certain interpretative challenges, particularly regarding the legal nature of the bankruptcy court's decision and the procedural mechanisms available for challenging it. The study demonstrates that the decision declaring the implementation of the plan should be understood primarily as a procedural act based on the report submitted by the supervisory administrator or the debtor. Consequently, the possibility for creditors and other interested parties to submit objections before the same court serves as an important safeguard to verify the accuracy and completeness of the implementation process.

Furthermore, the initiation of liquidation proceedings in cases of non-implementation of the plan should be applied with caution and proportionality. Courts should carefully evaluate the significance of any deficiencies in the implementation of the plan and consider whether they are substantial or capable of being remedied before resorting to liquidation. Such an approach contributes to maintaining the fundamental objective of bankruptcy law: balancing the protection of creditors with the preservation and recovery of economically viable businesses.

## References

- Roy Goode, *Principles of Corporate Insolvency Law*. Sweet & Maxwell.
- Kristin van Zwieten, *Goode on Principles of Corporate Insolvency Law*.
- World Bank, *Principles for Effective Insolvency and Creditor/Debtor Regimes*.
- Hoxha, T., Olldashi, E., AL-Thabhawee, G., Alkattan, H., & Abotaleb, M. (2025). The Role of the Court in the Bankruptcy Process: A Statistical and Comparative Case Study . *International Journal of Innovative Technology and Interdisciplinary Sciences*, 8(4), 1039–1081. <https://doi.org/10.15157/ijitis.2025.8.4.1039-1081>
- United Nations Commission on International Trade Law, *Legislative Guide on Insolvency Law*.
- European Parliament & Council of the European Union, *Directive (EU) 2019/1023 on Preventive Restructuring Frameworks*.
- Hoxha, T. Liquidation in Bankruptcy Law and Ordinary Liquidation, *Journal of Arts and Humanities Science*. 2025; 2(2); 88-95.
- International Monetary Fund, *Orderly and Effective Insolvency Procedures: Key Issues*.
- Hoxha, T., Olldashi, E., Almahmodi, B. H., Annuk, A., Alkattan, H., & Abotaleb, M. (2026). Data-Driven Regression Modelling of Insolvency Outcomes: Judicial Efficiency, Foreign Participation, and Recovery Trends. *International Journal of Innovative Technology and Interdisciplinary Sciences*, 9(1), 172–209. <https://doi.org/10.15157/ijitis.2026.9.1.172-209>

# Comparative Analysis of International Academic Awardees in Engineering

Anna Urbanovics<sup>1</sup>, Gabriella Thomázy<sup>2</sup>

<sup>1</sup> Department of Cybersecurity and E-Government, Faculty of Public Governance and International Studies, Ludovika University of Public Service, Hungary

<sup>2</sup> Department of International Relations and Diplomacy, Faculty of Public Governance and International Studies, Ludovika University of Public Service, Hungary;

Autonomous University of Bucaramanga (UNAB), Colombia

\*Corresponding Author: e-mail: urbanovics.anna@uni-nke.hu

---

## Abstract

International academic awards represent the highest form of recognition for research performance. They are often associated with the concept of academic excellence and can serve talent management, research strategy design and implementation, and resource allocation. The paper aims to investigate the research performance of academic awardees in the field of Engineering. The analysis involves 118 awardees of seven internationally recognized academic awards in the field of Engineering. After a comparative analysis of the seven academic awards selected for the study and the demographic background of the winning researchers, an empirical analysis is performed. The analysis is based on a data-oriented comparative methodology, measuring the researchers' publication performance and related trends. In addition to outlining the general publication performance attributes of these scientists, the study delves into their co-authorship networks. The assessment of their publication performance will be benchmarked against national performance-based research funding systems, namely the Finnish JUFO system, which categorises publication platforms into four distinct categories, which is widely accepted as measures of research excellence. The results of the empirical study are in line with phenomena of the sociology of science, including the problem of brain drain, elitism and Matilda effect. The highly prestigious international awards under review tend to be considered rather lifetime achievement awards, with awardees receiving them at a very late age. These international awards can serve as an indicator of academic excellence. The analysis covers the publication output of the awardees winning internationally recognized academic awards in the field of Engineering, the scope of the analysis is worth being extended. The dataset is based on Scopus indexed publications solely. The study offers a systematic methodology to measure academic excellence based on publication performance. Besides, these international academic awards are often involved in the methodology of international university rankings, however only a small number of universities can gain enough "Nobel" credits by academic awards. These internationally recognized awards can boost institutional competitiveness and reputation. Therefore, it is crucial that university management deal with the effects of international academic awards and incorporate the priority of winning them into the institutional research strategy. The study explores the publication performance of awardees in the field of Engineering by using a massive dataset and tested within the context of academic excellence.

*Key words:* International academic awardees; Academic excellence; Engineering; Comparative analysis; Publication performance; Co-authorship network.

---

## 1. Introduction

Today, there is much debate and attention on the topic of academic excellence; nonetheless, a single definition of the concept has not been made so far. In line with the book "The Formula" by Albert-László Barabási, academic excellence is defined as the ability of a researcher or institution to have a significant impact on a particular field of science. It stimulates other researchers to raise new questions by using new methods to contribute to common knowledge with significant and useful results. The measurement of academic excellence is multifaceted, with a range of tools available, such as publications, citations, winning research grants, academic awards, and student feedback. Recognition by the community, in this case the scientific community, is an essential component of academic excellence, and hence of success.

One of the most explicit ways to measure excellence is through academic awards. In the case of the Nobel Prize, the universally most recognised prize, we can state that winning it is synonymous with scientific success and a globally recognised reputation, which academicians and their institutions use to measure their prestige and improve their standing (e.g. the Shanghai ranking, graduate students, lecturers/researchers awarded the Nobel Prize or the Fields Medal), which in a global knowledge-based world stimulates their economic growth. At the same time, Nobel awardees are role models for future generations, helping under-represented groups such as women or members of national and ethnic minorities to enter the scientific field (Gallotti & De Domenico, 2019).

No Nobel Prize is awarded in engineering, but there are numerous other major international prizes in the field. The aim of this paper is to compare the prestigious prizes in engineering and the researchers who have won them, with a particular focus on their

publication performance. A comparative analysis of researchers who have won prestigious awards and their publication performance can help us understand the meaning of academic excellence in engineering. The study was conducted by identifying the most important engineering awards and awardees and using publicly available biographical information and publication data. After an introduction, the role of academic awards and related issues are discussed, followed by a description of the awards included in the study. This is followed by a description of the results, and furthermore, the formulation of conclusions and policy recommendations

## 2. International Academic Awards

### 2.1 The Role of Academic Awards in International Science

Increasing competition between higher education institutions has made it increasingly important to become a world-class university as a criterion (Salmi, 2009). International university rankings have become a tool for measuring the effectiveness of globalised and competitive higher education systems (Altbach, 2012), which focuses primarily on the academic performance of the researchers working there. Measuring academic impact has therefore become prevalent not only at institutional level but also at individual, researcher level. The evaluation is based on past performance, but in this context, it is also inevitable to address the future influence of institutions/organisations (Fortunato et al., 2018). Accordingly, the prediction of scientific impact has become important, in particular in terms of:

- Predicting the impact of researchers can help identify emerging talent, facilitate peer recommendations, and foster effective collaborations.
- Anticipating scientific impact is also essential for the management of researchers and research-based institutions and for the design of an effective institutional research strategy (Sasvári & Urbanovics, 2022).
- Predictions can help decision makers, inter alia in recruiting and promoting researchers, funding projects, and applying for awards (Cheang et al., 2014; Ma & Uzzi, 2018).
- Quantitative methods can help with peer review and efficient allocation of resources.
- Predicting and understanding the factors that influence academic outcomes can help scientists plan their individual research careers (Cheang et al., 2015; Dijk et al., 2014).

The scientific impact depends largely on the volume and quality of “academic capital” a researcher can accumulate over the course of his or her career. The concept of academic capital originates from Bourdieu (1988), which he formulated in his book titled “Homo Academicus”. In his book, Bourdieu analyses the academic sphere, presenting it, among other things, as a powerful medium for the building of individual careers, however, which can be stalled or even destroyed. Academic capital depends on several factors. These include origin, current livelihood, and social status, academic affiliations, number and place of publications (indexed), political involvement, and media coverage. Therefore, academic capital depends not only on individual ability and research productivity but also on general reputation. Scientific success itself is multifaceted and influenced by several factors, including interdependencies among academics, with researchers from the major Western scientific powers enjoying a privileged position. This is also highlighted by Albert-László Barabási in his book “*The Formula*” (2018), which focuses on systems of relationships and networks. The author summarises the five most important factors of academic success in the form of a law, which can be studied using network research tools and can contribute to success not only in academia, but also in sports and artistic careers.

The five laws (Barabási, 2018):

- “Performance drives success, but when performance can’t be measured, our networks drive success.
- Performance is bounded, but success is unbounded.
- Future success is dictated by previous success multiplied by the fitness of your idea or product.
- While team success requires diversity and balance, a single individual will receive credit for the group’s achievements.
- With persistence success can come at any time.”

International academic awards are one of the most important forms of academic capital. In this paper, we use the IREG Observatory definition to define this:

“The »international academic awards« as defined in this project, are those established to recognize the academic achievements of internationally renowned individuals who make outstanding contributions to the advancement of knowledge, and generally are granted to individuals without differentiation of gender, race, ethnicity, religion, language, nationality, disability or political affiliation.”

The international scientific community has created several academic awards to encourage and reward the work and achievements of researchers. The awards have several other roles in science:

- Awards are symbols of recognition and appreciation (Frey & Neckermann, 2009). They can increase the researchers' self-esteem. The bigger and more recognised the prize or the organisation that awards it, the more valuable it is in the life of the researcher.
- The awards entail social and material benefits, in some cases with direct financial rewards (Frey & Gallus, 2017).

- The awards usually recognise high-risk, high-reward research. For example, the Nobel Prize is awarded for work that is of great importance to humanity.
- The new research results that win awards attract investors and, hence, can predict the direction of future research.
- The awards inspire to achieve performances that were previously considered impossible.
- They can also become a measure of scientific credibility.
- The awards link disciplines, as a single researcher can receive recognition in several disciplines (Ma & Uzzi, 2018).
- Substantial awards are an important tool for allocating research funds on a “double-blind” basis (European Peer Review Guide, 2011).
- Finally, awards play an important role in the performance evaluation of institutions and individuals.

In terms of performance evaluation, it is important to note that the ARWU (Shanghai Ranking) methodology, one of the most closely followed methodologies internationally, also considers academic awards. In his study, Marginson (2005) notes that the success of the ARWU is due to the transparent numerical data, which, from the perspective of institutions, only consider academic achievement and productivity, thus excluding soft indicators. Academic achievement is measured essentially at the level of institutional academic productivity and individual academic excellence. The latter is measured by the number of prestigious awards won and the number of citations. The precise indicators of ARWU help the managers of institutions assess performances (Hazelkorn, 2008).

The motivational impact of academic awards:

- The importance of “first discovery”, which motivates the researcher to make the effort and commitment to become the first descriptor of academic achievement.
- Recognition of academic achievement in a particular field, winning an award can be important indicators of excellence.
- An award-winning research area adds to the attractiveness not only of the career but also of the research field.
- The added value of awarding has a clear impact on the researcher's subsequent income growth (Frey & Gallus, 2017).
- The awards encourage award-winning researchers to continue their research. At the same time, they can motivate other members of the scientific community to persevere in their work, so that they can receive similar awards in the future (Frey & Gallus, 2017).

The motivational effect of the awards is questioned by many, as it cannot be determined without certain reservations and risks. If an inappropriate person was rewarded with a prize, it may be difficult to withdraw it (Frey & Gallus, 2017). Financial compensation is linked to measurable performance and thus encourages the researcher to make an effort. Awards, on the other hand, primarily reward an achievement, a reputation. The lifetime achievement or posthumous award is an example of this, as it is clearly intended to recognise past performance (English, 2005).

## 2.2 Trends in International Academic Awards

The importance of international academic awards for academic excellence is undisputed, but general trends can also be identified. The careers of researchers can be divided into two stages (Frey & Gallus, 2017):

- from outstanding performance to recognition,
- from recognition to outstanding performance.

Research shows that, while the number of awards is increasing, the pool of researchers with scientific influence is shrinking, and they are linked through networks of acquaintances and co-authors. These networks can function similarly to other social networks, benefiting those within the network (learning, career advancement, support, etc.), with biased decisions excluding those outside the group (Ma & Uzzi, 2018; Gallotti & De Domenico, 2019).

Highly prestigious awards for outstanding academic achievement are undoubtedly the most important recognitions in the world. However, the number of subjects and awardees is limited, so significant academic achievements can go unrecognised. Relatively few academic institutions can accumulate enough so-called “Nobel credits” to confirm their place in institutional rankings. However, every year, more scientists win awards as the number of academic awards increases and covers a wider range of specialisation, but this is contrary to the phenomenon that fewer researchers are rewarded more often. This trend, in turn, highlights the issue of preferential connection and its well-known form in scientometrics, the Matthew effect (Merton, 1968). The Matthew effect in this case means that those who have successfully won an award once will capture it again, which ultimately leads to elitism (Ma & Uzzi 2018; Lu et. al., 2023).

The mechanism for awarding prizes is influenced by the researchers' network of contacts, which brings together researchers from the same institution, country, or with a focus on similar research topics (Gallotti & De Domenico, 2019). The preference for national identity during the nomination process makes it difficult for researchers from less represented countries to be awarded and increases their chances of equal treatment (Gallotti & De Domenico, 2019)

Another major issue in award-related studies is the chances of women researchers to win international academic awards. The gender gap is influenced by social and structural factors (Ahuja 2002). One such structural factor is the lack of female role models and mentors, and an example is the low proportion of women in senior management positions (Jin et al., 2021). These factors result in lower academic recognition of female researchers, with fewer chances of obtaining grants or management positions (West et al., 2013). The explanation for this phenomenon is the “Matilda effect”, as Rossiter (1993) formulated, which points to the fact

that female researchers are less recognised, and their research results are often “appropriated” by male scientists. The gender gap in career development in academia and universities is characterised by the fact that, although a higher proportion of women complete their studies, few women reach senior positions in academia and their presence is under-represented compared to men (Box-Steffensmeier et al., 2015).

When one looks at the careers of the awardees, certain trends can be observed. Generally speaking, elite research in different disciplines shows that awardees often actively work from the start and that the impact of their achievements is significant. Their outstanding research can usually be put at the beginning of their careers. Hillebrand (2002) concludes that success is more likely to be achieved if a person develops an interest in science early on, has a good education, is persistent in his or her work, and is willing to relocate, migrate within or outside the country. Regarding the relationship between creativity and age, evidence shows that the most cited publication can occur at any stage in a researcher's life (Sinatra et al., 2016; Fortunato et al., 2018), i.e., achieving a scientific breakthrough does not depend on age (Sinatra et al., 2016). However, outstanding researchers have several independent research projects going on at the same time. It is also a common tendency for awardees to experience a temporary decline in their work after the award, and then later to return to their pre-award productivity level (Mazlounian et al., 2011). This decline shows that the scientific community's focus is not on the achieved status and fame, but on the academic achievements. It is often characteristic of awardees to change their original research topic after receiving the award, which may also have an impact on the temporary decline in publication output, as it is time-consuming to study a new area and achieve a scientific breakthrough when switching to a new topic. Finally, an increase in the co-authorship rate can be observed in the post-award period, and these researchers often play a linking role in the co-authorship network (Jin et al., 2021).

### 3. Data and Method

#### 3.1 Selection of Awards and Awardees Included in the Study

Several methods were used to select the prestigious international academic awards. International awards were considered to be those awarded to individuals affiliated with institutions in more than one country over the period 2001–2021. High-profile international engineering awards were selected based on four databases. Another criterion for selection was that the awards should be listed in at least three of the M1-M4 databases.

Methodology 1 (M1): The selection was based on the publication of Meho, Lokman I. published in 2020, in which the author identified 15 high-prestige awards in engineering disciplines (Meho, 2020). After examining the 15 awards, which included the discipline, award website, and award announcement, we did not consider multidisciplinary awards. The preliminary list of 15 awards was narrowed down to only those related to the engineering discipline.

Methodology 2 (M2): We checked the awards selected in M1 in the publication titled “Mapping of Important International Academic Awards” written by Juntao Zheng & Niancai Liu (2015), who used a multi-criteria selection to identify the most important international awards by discipline. The main criteria for the selection are a) awards are given for research achievements; b) awards are given without nationality or other discrimination (gender, ethnicity, political affiliation, etc.); c) they are given by international, recognised organisations and foundations.

Methodology 3 (M3): The awards narrowed down in M1 were examined against the summarising list of Wikipedia titled “List of prizes known as the Nobel or the highest honours of a field”.

Methodology 4 (M4): The next selection was the IREG Observatory list. The IREG Observatory uses a so-called “reputation score” to distinguish prestigious international awards based on the following three criteria: a) awards for outstanding scientific contributions; b) prizes awarded without discrimination (gender, ethnicity, political affiliation, etc.); c) prizes awarded by international organisations, government organisations, prestigious foundations, scientific associations, national academies, and scientific societies (IREG). The Nobel Prize was awarded a score of 1, and the IREG list of international academic awards was drawn up from awards with a “reputation score” of 0.50 or more compared to the Nobel Prize.

Based on this, the selected awards are: 1. Benjamin Franklin Medal in Electrical Engineering, 2. Benjamin Franklin Medal in Mechanical Engineering 3. IEEE Edison Medal, 4. IEEE Medal of Honor, 5. IET Faraday Medal 6. Queen Elizabeth Prize for Engineering and 7. Timoshenko Medal

After the selection of the awards, we examined the awardees, again using a variety of methods.

Methodology 5 (M5): Based on the database of Meho, Lokman I., we determined the name, gender, and affiliations of the awardees based on the seven awards selected. A total of 118 awards were presented during the period under study, 2001–2021. Based on the database, we identified the awardees who won two or more awards during the period under review, with a total of seven individuals included in this list.

Methodology 6 (M6): Using a holistic, complex search, based on open-source information, we determined the age of the awardees, the average and median age at the time of winning the award, and the place of birth of the awardees, as this often differs from the affiliation at the time of the award-giving.

#### 3.2 Data Collection and Analysis

After defining the scope of the awards included in the study, the publication profile of the award winners was collected from the international multidisciplinary citation database, Scopus (Elsevier). The publication profile was defined based on the Scopus

author identifier (Scopus ID), and the following data was listed about the profile: number of publications, number of citations, h-index. We then exported the list of all publications related to the 118 awards (awardees) published in the last 10 years (2013–2022). The publications were then imported into the SciVal online research support platform by publication identifier (EID), making the SciVal descriptive statistics available. The publication list was used to examine publication trends over the last 10 years:

- the annual trend in the number of communications,
- the evolution of the Finnish (JUFO) and Scimago (Q-rating) rating systems,
- and research funding organisations.

We also used the evaluation system used in the Finnish performance-based research funding model as a reference for publication performance. Although it has a strong correlation with the classification by quartile of Scimago, it does not consider it as a benchmark and is more differentiated for journals. On this basis, the JUFO is interpreted in the international literature as an attempt to define international academic excellence (Saarela & Kärkkäinen, 2020). The evaluation distinguishes between four levels (Pölönen et al., 2021):

- Level 1 includes double-blind peer-reviewed publication channels with expert editorials, specialised in publishing scientific research results. Most of the publication channels will be placed at Level 1, which is the basic level.
- Levels 2 (leadership) and 3 (excellence) are awarded to the highest quality and impact scientific journals, conferences, and publishers, which are judged by experts as the best. Most of these are international publication channels, but in the humanities and social sciences, Level 2 also includes Finnish and Swedish language publishers.
- Publication channels that have been evaluated but do not meet the criteria are marked with a category 0.

The publication list was then imported into the bibliographic analysis program VOSViewer, from which the 1000 authors in the co-author network were filtered. The co-authorship network was constructed by treating authors as nodes and drawing an edge between those who had published together. For a given pair of authors, each publication contributed to the weight of the connection in a way  $1/(N-1)$ , where  $N$  was the number of authors of the publication. Thus, publications with many authors contributed less to the strength of the connections compared to articles with few authors. Importing this filtered database into the Gephi network visualization program, we examined the basic network indicators of the resulting co-author network:

- network density (the ratio of existing connections to the total number of possible connections),
- the average path length (for each possible pair of nodes that can be reached from one to the other),
- network diameter of the giant component (given by the maximum of the shortest path lengths),
- and the average clustering coefficient (the frequency with which two nodes are connected, each of which is connected to a third node).

Excel was used for data analysis, VOSViewer and Gephi for network data analysis.

### 3.3 Description of the Awards and Awardees Included in the Study

The result of the selection and the awardees are presented below, based on the M1-M6 methodology. Table 1 illustrates the awards included in the study for the period 2001–2021, with details of the number of awardees, the name of the awarding organisation, and the result obtained for M1-M4.

**1 1.** Selected awards in the field of engineering, number of awardees between 2001 and 2021. Own editing based on the following: M1: (Meho, 2020), M2: (Zheng & Niancai, 2015), M3: (Wikipedia: List of prizes known as the Nobel or the highest honours of a field), M4: (IREG Reputation score)

Number	Name of award	Number of awardees (2001–2021)	Awarding organisation	M1	M2	M3	M4
1	Benjamin Franklin Medal in Electrical Engineering	22	Franklin Institute (USA)	x	x		0.58
2	Benjamin Franklin Medal in Mechanical Engineering	9	Franklin Institute (USA)	x	x		0.50
3	IEEE Edison Medal	19	Institute of Electrical and Electronics Engineers, IEEE (USA)	x	x	x	0.58
4	IEEE Medal of Honor	16	Institute of Electrical and Electronics Engineers, IEEE (USA)	x	x	x	0.68

5	IET Faraday Medal	19	Institution of Engineering and Technology (IET)	x	x	x	
6	Queen Elizabeth Prize for Engineering	14	The Queen Elizabeth Prize for Engineering Foundation (UK)	x	x	x	0.51
7	Timoshenko Medal	19	American Society of Mechanical Engineers, ASME (USA)	x	x	x	0.59
Total		118					

The awards selected from M1 are identical to the awards defined in M2, so we confirmed the prestige awards from both databases. From awards in M1 or M2, the Benjamin Franklin Medal in Electrical Engineering and the Benjamin Franklin Medal in Mechanical Engineering are not included in the M3 database. Based on M4, one of the seven selected awards (IET Faraday Medal) is not included in the IREG list because it does not have a reputation value of 0.5 compared to the Nobel Prize. The IEEE Medal of Honor has the highest reputation score (0.68), followed by the Timoshenko Medal (0.59), with the IEEE Edison Medal and the Benjamin Franklin Medal in Electrical Engineering in third place with a score of 0.58. The Benjamin Franklin Medal in Mechanical Engineering and the Queen Elizabeth Prize for Engineering hardly made the IREG list, with scores of 0.50 and 0.51 respectively.

Of the 118 awardees, various conclusions can be drawn from the M5 and M6 presented above, particularly with regard to demographics and affiliation data. Considering the first affiliation, 78 awardees belong to the United States of America, 32 to Europe, and 8 to the Middle East/Asia. The picture is much more nuanced when considering the place of birth. The proportion of European-born researchers is almost identical to that of US-born researchers (47-45), and 22 researchers are Middle Eastern or Asian. Only 3 researchers' place of birth could not be determined. There is also a well-known phenomenon of brain drain, with many award-winning researchers, although they have US affiliations, they were not born there. Similar results have been revealed in terms of the regional distribution of the editor-in-chiefs (see, for example Csomós, 2024).

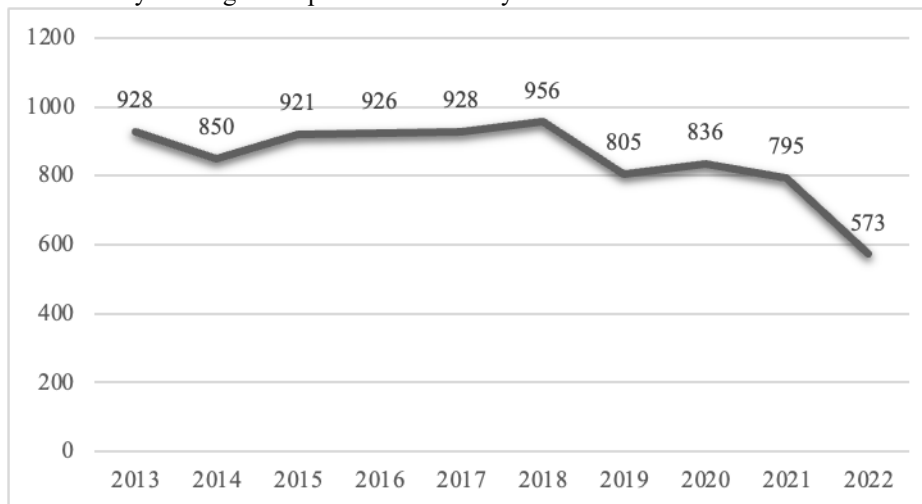
Taking the age composition into account, the mean year of birth was 1940 and the median 1939. The average age of the researchers in the year of winning the award was between 71 and 78.5 in five of the seven awards, with a similar median. The age structure of the IET Faraday Medal and Timoshenko Medal awardees was slightly lower, with a mean of 60 and 64 years and a median of 58 and 68 years. Among the seven awards, the youngest awardee was 42 years old at the time of winning the award (Queen Elizabeth Prize) and the oldest was 92 years old (IEEE Edison Medal). In terms of gender, the generality of awardees is male, with only 5 female awardees in the period under review.

As mentioned above, seven of the 118 awardees won multiple awards. Robert H. Dennard received the most awards, three awards, followed by Kees Schouhamer Immink, Bradford W. Parkinson, James J. Spilker, Michael F. Tompsett, Andrew J. Viterbi, and Yablonovitch Eli with 2-2 awards. On average, 3.37 years elapsed between winning the awards.

## 4. Results

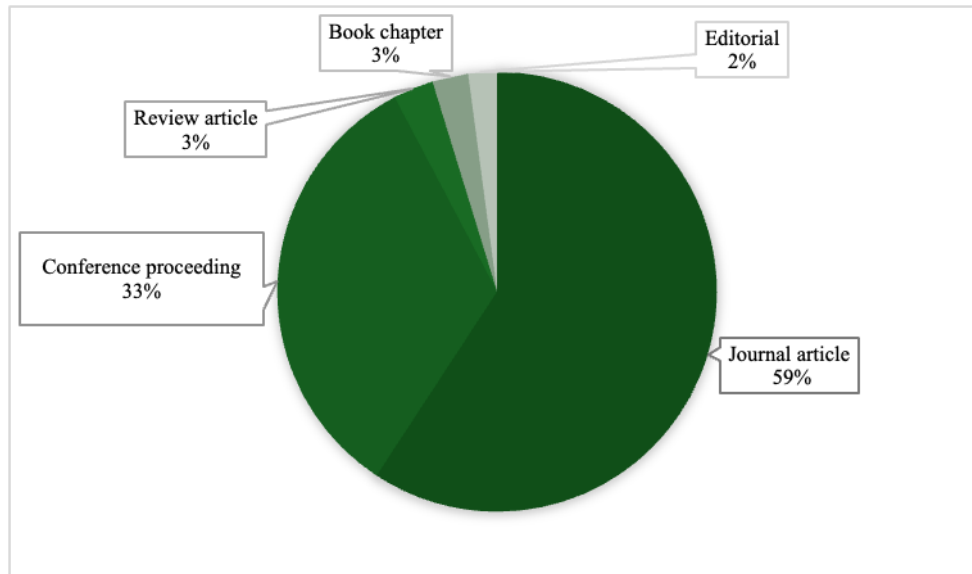
### 4.1 Publication Trends of the Award Winners

We start to present our results by looking at the publication activity of the award winners.



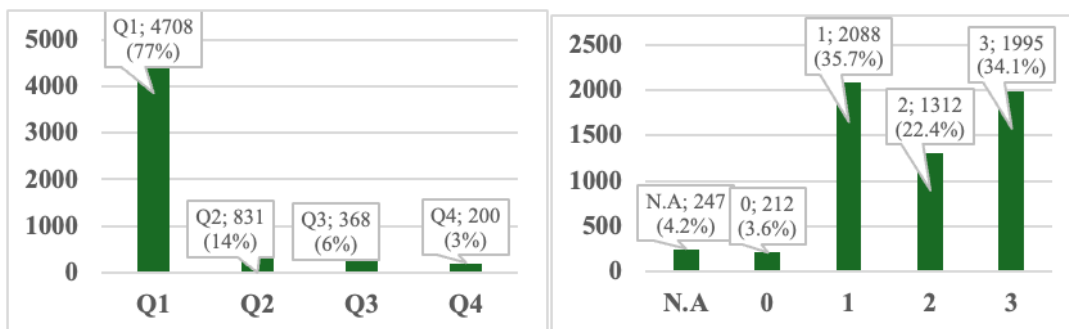
11. Evolution of the publications of the surveyed awardees over the period 2013–2022. Own editing based on Scopus data.

As can be seen in the figure, Scopus shows that between 2013 and 2022, the award winners wrote a total of 8518 publications. Their publication activity declined over the years, although there were some outstanding years. This was the characteristic of the year 2018, with 956 publications, followed by 2013 with 928 publications. In 2022, only 573 publications by award-winning authors were published.



2 2. Distribution by type of publication of the surveyed awardees between 2013 and 2022. Own editing based on Scopus data.

When examining the type of publications, we can see that the award winners match the general trend of publications by engineering scholars. At the international level, journals and conference proceedings are the most important publication platforms in the discipline, as they ensure the fastest possible peer review process (Sasvári et al., 2022). During the period under review, journal articles dominate the profile of award winners (59%), followed by conference proceedings (33%), review articles (3%), and book chapters (3%).



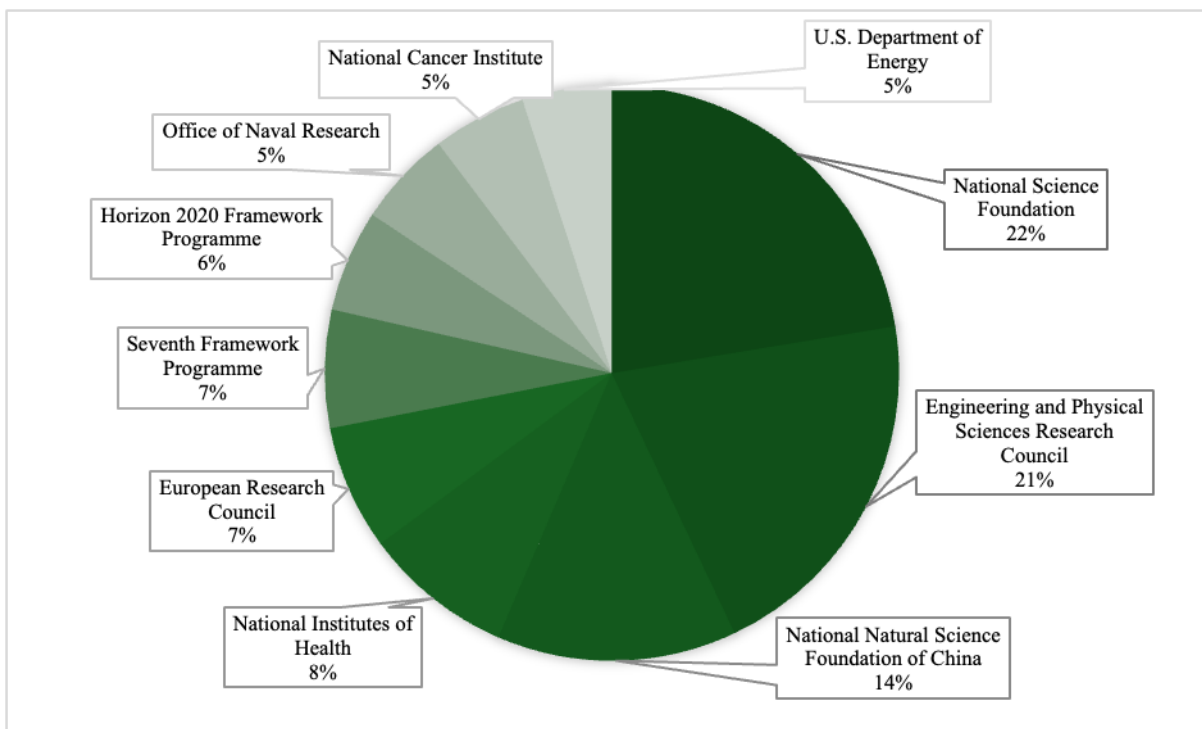
3 3. Distribution of publications of the surveyed awardees between 2013 and 2022 by Scimago quartile (left), distribution by JUFO Finnish ranking list (right). Own editing based on the data of Scopus, Scimago, and JUFO portal.

When the publication list was imported into SciVal, a total of 6107 journal articles were analysed by the system according to the Scimago quartile classification. The result is shown in the figure (Figure 3 left), where 77% (4708) of the journal publications were published in the highest Q1, 14% (831) in Q2, 6% (368) in Q3, and 3% (200) in Q4. For reference, it is also worth examining at the world, the United States of America, and the European Union in the field of engineering during the same period. These show that the average distribution for the world is: 40.4% (Q1), 21.9% (Q2), 20% (Q3), and 17.7% (Q4). The values of the European Union (EU27 excluding the United Kingdom): 47.8% (Q1), 21.8% (Q2), 17.7% (Q3), and 12.7% (Q4). In the United States of America: 52.7% (Q1), 21.3% (Q2), 16.2 (Q3), and 9.8% (Q4). So, we can see that the award winners are by far the most prominent contributors to the highest-ranked Q1 journals.

The JUFO rating (Figure 3, right) also shows a very high proportion for the highest category, 3. The publications examined show that the highest proportion of publications in the publication profile of the award-winning authors examined are from the

basic category 1 (35.7%), while category 3 is also present in a significant proportion (34.1%). Therefore, it is clear that the proportion of excellent publications is very high.

It is interesting to note that the top journals in terms of number of publications are all highly ranked journals: the IEEE Transactions on Power Electronics (366 publications; Q1; JUFO 3), the IEEE Journal of Emerging and Selected Topics in Power Electronics (118 publications; Q1; JUFO 2), the Journal of the Mechanics and Physics of Solids (114 publications; Q1; JUFO 3).

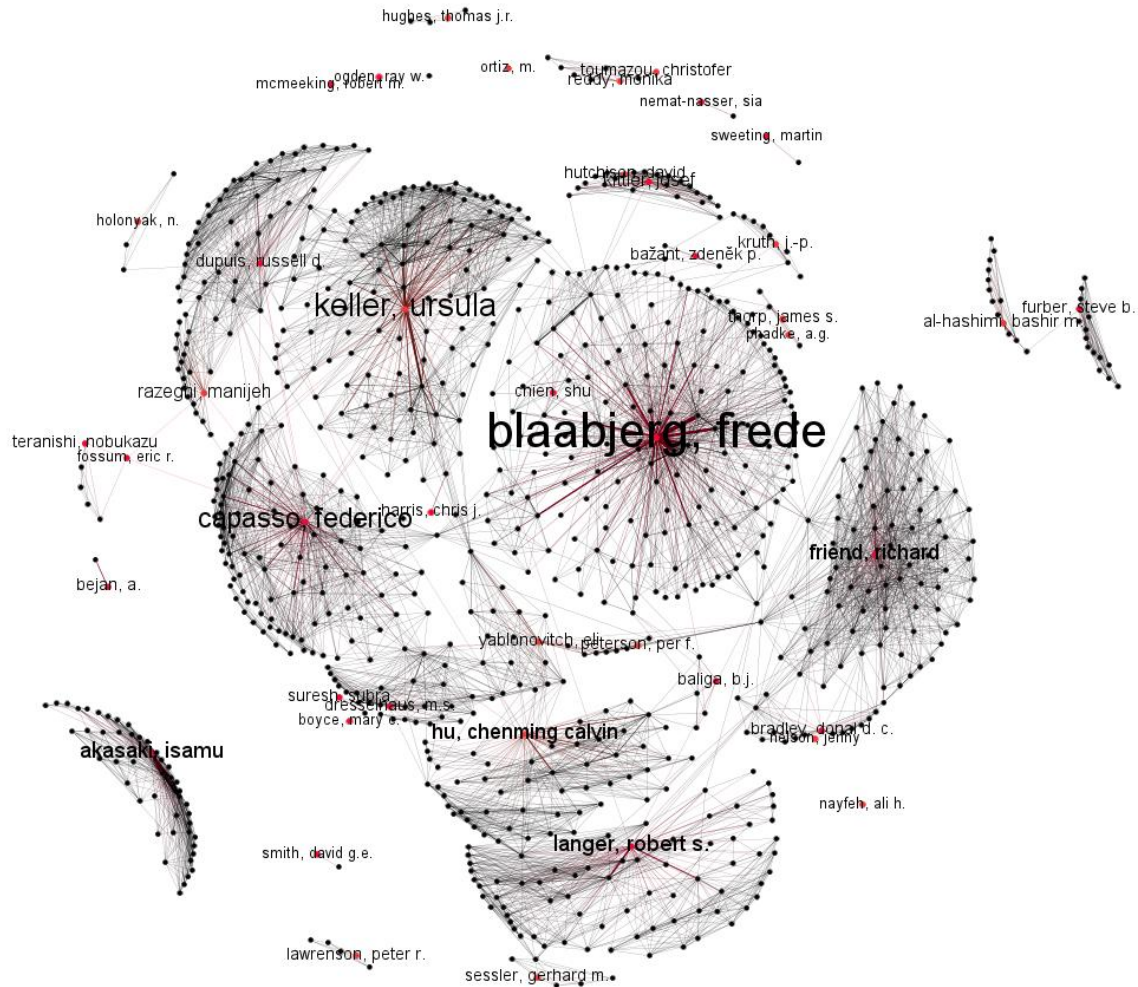


4 4. Distribution of publications by research funding organisations of the surveyed awardees between 2013 and 2022. Own editing based on Scopus data.

Research funding organisations also show a strong American dominance in terms of funding-related publication numbers, with 5 American, 3 EU, 1 Chinese and 1 British governmental organisation in the top 10 research funders. However, the British Engineering and Physical Sciences Research Council is the second after the National Science Foundation (USA). 89.5% of all publications were funded by a research funding organisation. In total, 160 such organisations are on the list. Also based on the number of publications funded, Frede Blaabjerg were on the top of the list for 3 organisations, and Richard H. Friend and Robert S. Langer for 2-2 organisations. In terms of institutions, Massachusetts Institute of Technology (MIT) and the University of Cambridge were ranked first in 3-3 cases. It is also worth noting that the top 5 institutions account for 55% of the publications in the overall publication list. Therefore, both funding and institutional contribution show a strong concentration based on the number of publications written.

#### 4.2 Co-authorship Network

Based on aggregate edge strength, the co-authorship network (Figure 5) shows the co-authorship network of the top 1000 authors. After running the necessary statistics, the co-author network is described by the following general network characteristics. The total number of nodes is 1000, and the total number of edges is 11141. The average degree number is 7.153, and the average weighted degree number is 45.166. The network diameter is 9, while the network edge density is 0.016. The number of related components is 15, while the modularity is 0.861. The average path length is 4.086 between authors.



5 5. Co-authorship network of the top 1000 authors. Own editing based on Scopus data using Gephi data visualisation software.

The network of co-authors examined includes 43 awardees. We can see that the authors are basically grouped in workshops. Among them, Frede Blaabjerg (164.0) has the highest weighted edge strength, followed by Federico Capasso (102.0) and Ursula Keller (70.0). Looking at the centrality indicators, Fede Blaabjerg also stands out (Table 2).

2 2. Centrality indicators for the central actors in the co-authorship network. Own editing based on Gephi data.

Name	Closeness centrality	Harmonic centrality	Betweenness centrality
F. Blaabjerg	0.365	0.466	94430.3
F. Capasso	0.322	0.411	64614.7
U. Keller	0.333	0.423	61861.6

## 5. Conclusions

The study examined the group of awardees in engineering discipline (2001–2021) and their publication performance over the last 10 years (2013–2022). Our results show that the findings regularly cited in the international literature on the sociology of science are also adequate for the award winners in this study. On the one hand, we could see that there is brain drain. When

considering the affiliation of the awardees, 78 American and 32 European, 8 Middle Eastern and Asian were selected, considering the origin, 47 American and 45 European, 22 Middle Eastern and Asian researchers were selected.

International university rankings also have a preference to use these internationally recognised awards in their methodology. Only a relatively small number of institutions can collect the “Nobel” credits and reputations that these awards bring. In terms of publication rankings (2013–2022), the top 5 institutions represent 55% of publications, indicating a significant concentration. However, this could be distorting for other institutions, as such an award can provide a university a huge step forward in the rankings, but it is known from the literature that only a small number of researchers (Pareto distribution) win these awards. Seven of the researchers included in the study won 2 or more awards. In general, this could lead to the issue of elitism.

On the other hand, both the Matthew and Matilda effects can be observed for female recipients, as there were only 5 women among the awardees surveyed. However, it is worth pointing out that in the analysis of the co-authorship network, one female researcher is also among the central actors (Ursula Keller), ranking third in terms of individual centrality indicators.

In terms of the age of the awardees at the time of the award, the highly prestigious international awards under review tend to be considered rather lifetime achievement awards, with awardees receiving them at a very late age. Therefore, winning the award is often of symbolic value in their own careers, with little additional motivational effect. However, the awards and achievements they represent can be an example to follow by the younger generation of researchers and can also be a motivating force. However, the conclusions about young researchers are beyond the scope of this study and will be measured in a future study.

In terms of publication performance, we can conclude that the authors who won awards have a very high proportion of articles in leading journals. This result can be identified both in the Scimago quartile ranking (77% in Q1) and in the JUFO assessment of the Finnish performance-based funding scheme (34.1% in level 3). It should be noted that the JUFO ranking also provides a more nuanced picture of academic excellence in the present study, as it differentiates more among excellent journals. Thus, in our view, it makes sense to use the Finnish scoring system in addition to the Scimago scoring system when evaluating publication performance.

## Acknowledgement

Supported by the EKOP-2025-NKE-4-II-84 University Research Scholarship Program of the Ministry for Culture and Innovation from the source of the National Research, Development and Innovation Fund.

## References

- Ahuja, M. 2002. Women in the information technology profession: A literature review, synthesis and research agenda. *European Journal of Information Systems*, Vol. 11, pp. 20–34. <https://doi.org/10.1057/palgrave/ejis/3000417>.
- Altbach, P. G. 2006. *Globalization and the university: realities in an unequal world*. In International handbook of higher education, In J. F. Forest & P. G. Altbach (Eds). Vol.18. pp.121–139. *Springer International Handbooks of Education*. Dordrecht: Springer Netherlands. [https://doi.org/10.1007/978-1-4020-4012-2\\_8](https://doi.org/10.1007/978-1-4020-4012-2_8).
- Barabási, A-L. 2018. *The formula: The universal laws of success*, Little Brown and Company, Hachette Book Group, New York.
- Benjamin Franklin Medal in Electrical Engineering. [www.fi.edu/benjamin-franklin-medals-nominations](http://www.fi.edu/benjamin-franklin-medals-nominations)
- Benjamin Franklin Medal in Mechanical Engineering. [www.fi.edu/benjamin-franklin-medals-nominations](http://www.fi.edu/benjamin-franklin-medals-nominations)
- Bourdieu, P. 1988. *Homo academicus*. Stanford: Stanford University Press.
- Box-Steffensmeier, J. M., Cunha, R. C., Varbanov, R. A., Hoh, Y. S., Knisley, M. L., and Holmes, M. A. 2015. Survival analysis of faculty retention and promotion in the social sciences by gender. *PLOSOne*, Vol. 10, No. 11, e0143093. <https://doi.org/10.1371/journal.pone.0143093>
- Cheang, B., Chu, S. K. W., Li, C., and Lim, A. 2014. OR/MS journals evaluation based on a refined pagerank method: an updated and more comprehensive review”. *Scientometrics*, Vol. 100, No. 2, pp. 339–361. <https://doi.org/10.1007/s11192-014-1272-0>.
- Cheang, B., Li, Ch., Lim, A., and Zhang, Z. 2015. Identifying patterns and structural influences in the scientific communication of business knowledge. *Scientometrics*, Vol. 103, No.1, pp. 159–189.
- Csomós, G. 2024. Mapping the geography of editors-in-chief. *Journal of Data and Information Science*, Vol. 9, No. 1, pp.1–14. <https://doi.org/10.2478/jdis-20240002>
- Dijk, D. van, Manor, O., and Carey, L. B. 2014. Publication metrics and success on the academic job market. *Current Biology: CB*, Vol. 24, No. 11, R516-517. <https://doi.org/10.1016/j.cub.2014.04.039>.
- English, J. F. 2005. *The economy of prestige: prizes, awards, and the circulation of cultural value*. Cambridge, MA: Harvard University Press.
- European Science Foundation (Eds). 2011. *European peer review guide: integrating policies and practices into coherent procedures*. Strasbourg: European Science Foundation.
- Frey, B. S., and Neckermann, S. 2009. Awards: a disregarded source of motivation. *rationality, markets and morals*. <https://ideas.repec.org/a/rmm/journal/v0y2009i11.html>
- Frey, B. S. and Gallus, J. 2017. Towards an economics of awards. *journal of economic surveys*, Vol. 31, No. 1, pp. 190–200. <https://doi.org/10.1111/joes.12127>.

- Fortunato, S., Bergstrom, C. T., Börner, K., Evans, J. A., Helbing, D., Milojević, S., Petersen, A. M., and et al. 2018. Science of science. *Science*, Vol. 359 No. 6379, pp. eaa0185. <https://doi.org/10.1126/science.aa0185>.
- Gallotti, R., and De Domenico, M. 2019. Effects of Homophily and Academic Reputation in the Nomination and Selection of Nobel laureates. *Scientific Reports*, Vol. 9, No. 1, pp. 17304. <https://doi.org/10.1038/s41598-019-53657-6>.
- Jin, Y., Yuan, S., Shao, Z., Hall, W., and Tang, J. 2021. Turing award elites revisited: patterns of productivity, collaboration, authorship and impact. *Scientometrics*, Vol. 126, No. 3, pp. 2329–2348. <https://doi.org/10.1007/s11192-020-03860-4>.
- Hazelkorn, E. 2009. Rankings and the battle for world-class excellence: institutional strategies and policy choices. *Higher Education Management and Policy*, Vol. 21, No. 1, pp. 1–22.
- Hillebrand, C. 2002. Noble century: A Biographical Analysis of Physics Laureates. *Interdisciplinary Science Reviews*, Vol. 27, pp. 87–93. <https://doi.org/10.1179/030801802225003150>.
- IEEE Edison Medal. [www.ieee.org/about/awards/medals/edison.html](http://www.ieee.org/about/awards/medals/edison.html)
- IEEE Medal of Honor. [www.ieee.org/about/awards/medals/medalofhonor.html](http://www.ieee.org/about/awards/medals/medalofhonor.html)
- IET Faraday Medal. [www.theiet.org/membership/library-archives/the-iet-archives/iet-history/awards-and-prizes-index/the-faraday-medallists/](http://www.theiet.org/membership/library-archives/the-iet-archives/iet-history/awards-and-prizes-index/the-faraday-medallists/)
- Ireg Observatory. IREG list of international academic awards 2019. <https://ireg-observatory.org/en/wp-content/uploads/2019/12/ireg-list-academic-awards.pdf>
- JUFO Publication Forum.  
[https://www.julkaisuforum.fi/en?fbclid=IwAR01T0H\\_v63AUNy9trG5zUbmOOPSfdtv5\\_1tCmY1OxbE5IaKj7YbQabDpm8](https://www.julkaisuforum.fi/en?fbclid=IwAR01T0H_v63AUNy9trG5zUbmOOPSfdtv5_1tCmY1OxbE5IaKj7YbQabDpm8)
- Lu, X. Y., Li, L., Shen, Z. S. 2023. The Nobel Prize winners will be among these candidates. *Journal of Data and Information Science*, Vol. 8, No. 4, pp. 8–9. <https://doi.org/10.2478/jdis-2023-0023>
- Ma, Y., and Uzzi, B. 2018. Scientific prize network predicts who pushes the boundaries of science. *Proceedings of the National Academy of Sciences*, Vol. 115, No. 50, pp. 12608–12615. <https://doi.org/10.1073/pnas.1800485115>
- Marginson, S. 2005. *There must be some way out of here*. Tertiary Educ. Management Conference, Keynote address, Perth, Australia.
- Mazloumian, A., Eom, Y., Helbing, D., Lozano, S., and Fortunato, S. 2011. How citation boosts promote scientific paradigm shifts and Nobel Prizes. *PLoS One*, Vol. 6, No. 5, e18975. <https://doi.org/10.1371/journal.pone.0018975>.
- Merton, R. K. 1968. *Social theory and social structure*. New York, NY.
- Meho, L. I. 2020. Highly prestigious international academic awards and their impact on university rankings. *Quantitative Science Studies*, Vol. 1, No. 2, pp. 824–848. [https://doi.org/10.1162/qss\\_a\\_00045](https://doi.org/10.1162/qss_a_00045).
- Meho, L. I. 2020. Data file. [https://scholarworks.aub.edu.lb/bitstream/handle/10938/21535/Meho\\_Award-Recipients.xlsx?sequence=5&isAllowed=y](https://scholarworks.aub.edu.lb/bitstream/handle/10938/21535/Meho_Award-Recipients.xlsx?sequence=5&isAllowed=y)
- Pölonen, J., Pylvänäinen, E., Aspara, J., Puuska, H., and Rinne, R. 2021. Publication Forum 2010-2020: Self-evaluation report of the Finnish quality classification system of peer-reviewed publication channels. Tieteellisten Seurain Valtuuskunnan Verkkojulkaisu. Tieteellisten seurain valtuuskunta, <https://doi.org/10.23847/isbn.9789525995442>.
- Queen Elizabeth Prize for Engineering. <http://qeprize.org/>
- Rossiter, M. W. 1993. The matthew matilda effect in science. *Social Studies of Science*, Vol. 23, No. 2, pp. 325–341. <https://doi.org/10.1177/030631293023002004>.
- Sinatra, R., Wang, D., Deville, P., Song, Ch., and Barabási, A-L. 2016. Quantifying the evolution of individual scientific impact. *Science*, Vol. 354, No. 6312, pp. aaf5239. <https://doi.org/10.1126/science.aaf5239>.
- Saarela, M., and Kärkkäinen, T. 2020. Can we automate expert-based journal rankings? Analysis of the Finnish Publication Indicator. *Journal of Informetrics*, Vol. 14, No. 2, 101008. <https://doi.org/10.1016/j.joi.2020.101008>
- Salmi, J. (Ed.) 2009. *The challenge of establishing world-class universities*. Washington, DC: World Bank. <https://doi.org/10.1596/978-0-8213-7865-6>
- Sasvári P., and Urbanovics, A. 2022. Subject area risk assessment of four Hungarian universities with a view to the QS university rankings by subject. *Journal of Data and Information Science*, Vol. 7, No. 4, pp. 61–80. <https://doi.org/10.2478/jdis-2022-0023>.
- Sasvari P., Bakacsi, Gy., and Urbanovics, A. 2022. Scientific career tracks and publication performance - relationships discovered in the Hungarian academic promotion system. *Heliyon*, Vol. 8, No. 3, pp. e09159. <https://doi.org/10.1016/j.heliyon.2022.e09159>.
- Timoshenko Medal. [www.asme.org/about-asme/get-involved/honors-awards/achievement-awards/timoshenko-medal](http://www.asme.org/about-asme/get-involved/honors-awards/achievement-awards/timoshenko-medal).
- Zheng, J., and Liu, N. 2015. Mapping of important international academic awards. *Scientometrics*, Vol. 104, No. 3, pp. 763–791. <https://doi.org/10.1007/s11192-015-1613-7>.
- West, J. D., Jacquet, J., King, M. M., Correll, S. J. & Bergstrom, C. T. 2013. The role of gender in scholarly authorship. *PLoS ONE*, Vol. 8, No. 7, pp. e66212. <https://doi.org/10.1371/journal.pone.0066212>.
- Wikipedia. List of prizes known as the Nobel or the highest honors of a field. [https://en.wikipedia.org/wiki/List\\_of\\_prizes\\_known\\_as\\_the\\_Nobel\\_or\\_the\\_highest\\_honors\\_of\\_a\\_field](https://en.wikipedia.org/wiki/List_of_prizes_known_as_the_Nobel_or_the_highest_honors_of_a_field)

# Treatment Planning Aspects in Fixed Implant Rehabilitations

Edisa Karamitri, DDS<sup>1</sup>, Çeljana Toti, Prof. Assist<sup>2</sup>

<sup>1</sup>Department of Orthopedic Dentistry, Faculty of Dental Medicine, Tirana, Albania

<sup>2</sup>Department of Orthodontics, Faculty of Dental Medicine, Tirana, Albania

\*Corresponding Author: e-mail: edisa.karamitri@unireald.edu.al

---

## Abstract

Osseointegrated implants provide a predictable base for the restoration of function and aesthetics in the partially and completely edentulous patient. Implant dentistry is now part of routine therapy and considered an option in every treatment plan that requires tooth replacement. Before performing the implant surgery on a patient, we as clinicians, need to answer a few decision-making questions. Some of these decisions include whether we should preserve or extract the tooth, what type of implant microstructure would enhance osseointegration, what loading protocols should be applied, is site development or surgical guide needed, what impression technique, prosthesis design or occlusion scheme should be used, and what prognostic factor will influence the intra and post-operative success of our procedures. Through the description of various clinical cases and the review of contemporary literature, this presentation will provide a systematic guide to implant treatment planning that we should consider for long-term success. Clinicians and educators will find helpful guidelines based on literature and clinical cases for each step on the decision-making process towards a successful and predictable restorative treatment.

*Key words:* dental implants, loading protocols, prosthesis design, occlusion, treatment planning.

---

## Introduction

The history of implant dentistry spans not only decades but also millennia.

The ancient cultures of the world in Egypt, China, Turkey, substituted missing dentition with stones, shells, sand ivory, among other human or animal teeth.

The establishment of metal replacements for teeth is relatively recent, in 1800's surgeons used gold, silver, lead, and platinum molded into various forms.

By early mid-20<sup>th</sup> century forms that are more familiar were developed. Dahl in 1940 created the sub periosteal implant that rested on the jaw not in the jaw. These implants frequently were met with complications, like infections and bone resorption. Leonard Linkow developed the blade fixture for areas of deficient bone. The blade design also met complications that precluded its use. The root form implant is the current standard shape. Bränemark research concluded that osseointegration was realized between bone and titanium. Endosseous implants made from Titanium or Titanium alloys have now become standard.

### *Osseointegration:*

One of the first definitions of osseointegration given by Bränemark was:

- Direct structural and functional connection between ordered living bone and the surface of a load-carrying implant.

It describes light microscope findings, later it was seen that under electron microscope a layer of glycoproteins exists in direct contact with the implant. Subsequently, several other definitions were presented. According to Zarb and Albrektsson the only acceptable definition of OI is based on a clinical examination, as a

- Process in which a clinically asymptomatic rigid fixation of alloplastic material is achieved and maintained in bone during functional loading.

This is in contrast to implants surrounded by fibrous connective tissue: fibrointegrated, which have shown a clinically discernible mobility when loaded.



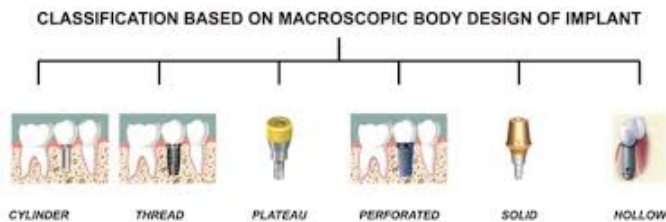
*Osseointegrated implants*



*Fibrointegrated implants*

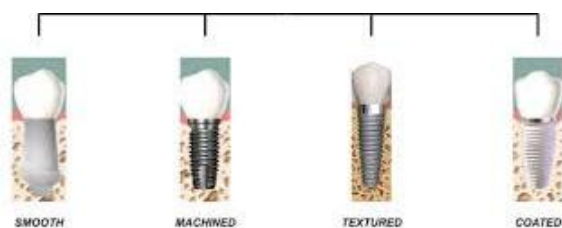
The present design of the root form implant has undergone a few modifications, macro and microscopically. The main objective of developing implant surface modifications is to promote osseointegration with faster and stronger bone formation, leading to better stability, accelerating healing, improving the clinical performance, especially in areas of poor bone quality and quantity. In addition, by accelerating healing, immediate or early load may be possible, improving the patient experience and quality of life.

*Implant surface changes:* Macroscopically, surface area augmentation often drives alterations in implant design. During the last decades, a shift from a smooth to roughened design has transpired. A threaded implant leads to more initial stability and hence greater success of osseointegration, also it facilitates self-tapping and eases placement. With this in mind, different implant systems have features that distinguish them from one another. Recently, it appears that changes in the physico-chemical properties of the titanium results in significant modulation of cell recruitment, adhesion, inflammation and bone remodeling activities in addition to regulation on bone formation response.



Surface alterations are also made microscopically. There exist varieties of different manufacturing methods to increase the surface roughness of the implant, where the most commonly used are: Machining, Sandblasting, Acid etching, Anodic oxidation, Laser modification or a combination of these. Calcium phosphates (CaP) are the most common family of bioceramics. They are considered to be bioactive and osseoconductive. This raises the percentage of bone to implant contact and accelerates wound healing (and osseointegration). Surface roughness is identified as an important parameter for implants and its capacity for being anchored in bone tissue. Further, commercially available implants have been categorized according to the roughness value ( $S_a$ ) into 4 groups (Albrektsson & Wennerberg, 2004), smooth ( $S_a < 0.5 \mu\text{m}$ ), minimally rough ( $S_a = 0.5-1.0 \mu\text{m}$ ), moderately rough ( $S_a = 1.0-2.0 \mu\text{m}$ ) and rough ( $S_a > 2.0 \mu\text{m}$ ).

The  $S_a$  value represents the mean height of peaks and pits of the surface, while another important parameter is  $S_{dr}$ , which represents the developed surface area compared to a perfect flat area. With a larger surface area, a larger contact to the bone tissue is obtained.



*Success criteria* for endosteal implants have been proposed previously by several authors. The report by Albrektsson et al is widely used today. However, it does not consider the amount of crestal bone lost during the first year. In addition, success rates suggested in this guideline describe an ideal implant quality of health for a study or clinical report, but does not address individual implants that may have a stable condition in the mouth after a brief episode of bone loss.

*Success:*

No pain or tenderness, 0 mobility, <2mm radiographic bone loss, no exudate history

*Survival:*

No pain on function, 0 mobility, 2-4 mm radiographic bone loss

*Compromised survival:*

Sensitivity on function, 0 mobility, radiographic bone loss >4mm but < 1/2 of implant length, probing depth >7 mm, and possible exudate history.

*Failure*

any of the following:

Pain on function

**Mobility**

Radiographic bone loss > ½ length of implant

Uncontrolled exudate

No longer in mouth

Osseointegrated implants provide a predictable base for the restoration of function and esthetics in the partially and completely edentulous patient. Implant dentistry is now part of routine therapy and an option in every treatment plan that requires tooth replacement. In this aspect, implant treatment planning is the most important component of any treatment modality that we perform. It is the treatment plan, not the treatment method that matters.

Without underestimating the paramount importance of the major steps on the treatment planning and diagnosis process such as: comprehensive medical, dental, social history, extra/intraoral examination of soft and hard tissues, periodontal evaluation, occlusion, radiographic and imaging examination, we will focus on a few decision making aspects of fixed implant prosthesis treatment and draw conclusions based on the available literature.

**Body of Manuscript**

Some of these Treatment Plan Considerations are:

- Implants Vs Endodontics
- Site Development
- Placement and Loading Protocols
- Impression Techniques
- Prosthesis Design
- Occlusion and Occlusal Schemes

**I. IMPLANTS OR ENDODONTICS**

One of the first treatment plan decisions is whether we should extract and place implant or perform endodontic treatment on the tooth and then restore. In essence, the use of lenient success criteria in implant studies may translate to higher success rates, while stringent criteria employed in root canal prognostic studies may lead to lower success rates. Studies show equivalent long-term survival, with guidelines suggesting that:

1. Most endodontic failures are related to non-endodontic factors, and root canal treated teeth survive better if properly restored (single crowns better than fixed partial prosthesis)
2. Failures due to endo reasons can be retreated by any type of endodontic retreatment, with orthograde retreatment preferably
3. Most implant failures are directly related to the implant itself and entail implant removal.
4. Due to higher esthetic demands in the anterior region, especially in patients with high smile line and thin mucosal biotype-greater effort should be made to save a questionable tooth to ensure preservation of the soft tissue architecture
5. Posterior teeth are replaced by implants with less restraint than in the esthetic zone, also because of higher endodontic complications and questionable endodontic prognosis in the posterior region



*Implants and endodontically treated teeth*

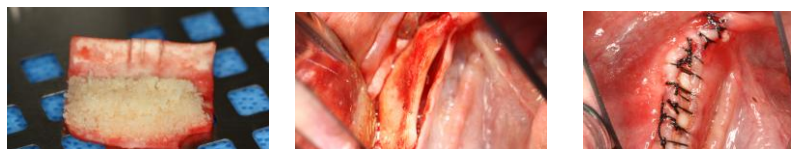
**II. HORIZONTAL AND VERTICAL BONE AUGMENTATION**

Various techniques can augment bone horizontally and vertically, but it is unclear which are the most efficient. Conclusions are based on few trials including few patients, having a short follow-up, and often being judged to be at high risk of bias, however based on the current literature:

There is moderate quality evidence which is insufficient to determine whether sinus lift procedures in bone with residual height between 4 and 9 mm are more or less successful than placing short implants (5 to 8.5 mm) in reducing prosthesis or implant failure up to one year after loading. However, there are more complications at sites treated with sinus lift procedures. Many trials

compared different sinus lift procedures and none of these indicated that one procedure reduced prosthetic or implant failures when compared to the other.

Short implants appear to be a better alternative to vertical bone grafting of resorbed mandibles.

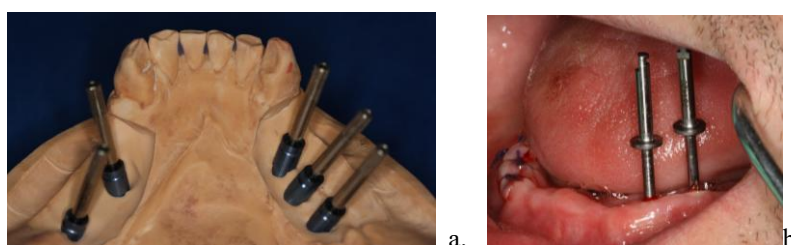


*Mandibular bone augmentation procedure with alloplastic material*

Complications, especially for vertical augmentation, are common.

Some bone substitutes could be a preferable alternative to autogenous bone.

Osteodistraction osteogenesis allows for more vertical bone augmentation than other techniques, which, on the other hand, can allow for horizontal augmentation at the same time. Titanium screws may be preferable to resorbable screws to fixate onlay bone grafts.



*Implant direction can be compromised in sites without bone augmentation (a), parallel implants placed after augmented site (b)*

### III. IMPLANT PLACEMENT AND LOADING PROTOCOLS

#### Placement

- Immediate: right after extraction
- Early placement: 6-8 weeks after extraction
- Delayed placement: 3-4 months after extraction

#### Loading

- Immediate: A dental implant is connected to a prosthesis in occlusion within 1 week following implant placement
- Early loading: A dental implant is connected to a prosthesis in occlusion between 1 week and 2 months following implant placement
- Conventional loading: Dental implants are allowed to heal for a period greater than 2 months after implant placement without connection of a prosthesis

We could also have immediate restoration without occlusal load placed on the restoration.

When selecting cases carefully and using dental implants with a rough surface, immediate loading with fixed prostheses in edentulous patients results in similar implant and prosthesis survival and failure rates as early and conventional loading. For immediate loading, most of the studies recommend a minimal insertion torque of 30 Ncm. The estimated 1-year implant survival was above 99% with all three loading protocols. Caution is necessary when interpreting these results, as many confounding factors exist that affect treatment outcomes with each of the loading protocols.

### IV. IMPRESSION TECHNIQUES

Although various implant impression techniques are used to generate a definitive cast, the body of evidence shows controversy over which technique is most accurate.

Literature shows that the splinted technique was more accurate than nonsplinted for both partially and completely edentulous patients, while the open-tray technique was more accurate than closed-tray for completely edentulous patients, but not significantly more accurate for partially edentulous patients.

Impression materials did not affect the accuracy of implant impressions.

Implant angulation greater than 20 degrees affected accuracy of impressions for both partially and completely edentulous patients. The dental literature provides insufficient data for the effect of implant connection type on accuracy and on digital impression techniques.



a. *Closed tray impression copings*



b. *Open tray impression copings*



c. *Implants analogs placed*



d. *Verification cast*

## V. PROSTHESIS DESIGN: ABUTMENTS, SPLINTING, SCREW/CEMENT

### Splinting vs. Not Splinting

Multiple nonsplinted implants can be successfully included in clinical situations to optimize esthetics and circumvent the problem of nonpassively fitting frameworks.

Studies have shown the FPD survival rate was 93.6% after 6-7 years while the corresponding value for SC was 97.5%

Clinical scenarios where splinting may be indicated:

- short implants
- augmented/grafted sites
- position of teeth in the mouth
- presence of cantilevers
- to enhance aesthetic outcome
- occlusion and parafunctional habits
- prosthesis survival (to increase prosthesis survival in cases when implant health is compromised)

Results from literature show peri-implant marginal bone loss around nonsplinted implants statistically equivalent to that observed in splinted implants.

A more recent study found other factors such as prosthesis and crown-to-implant ratio had no significant difference in marginal bone loss. Furthermore, nonsplinted implants, platform-switched abutments, abutment heights more or equal to 2 mm, and a one abutment one-time approach yielded significant reductions in marginal bone loss compared to their counterparts.

Suggested Methods to decrease biomechanical stress to the bone-implant interface

- splinting implants together with no cantilever load
- restoring in mutually protected or canine guidance occlusion
- choose an implant design to increase bone-implant contact surface area

### Screw-retained vs. Cement-retained

Despite the questionable retrievability, cement-retained implant-supported fixed restorations are a reliable and effective option especially for implant supported crowns and short span fixed partial prosthesis.

Considering factors for screw retained restorations:

- Retrievability
- Limited interocclusal space
- Transmucosal depth >3mm
- Passive fit of prosthesis

Fig.

Considering factors for cement retained restorations:

- Aesthetics
- Better occlusal surface
- Easier procedure
- Less components

Fig.

The final decision remains dependent on factors such as:

- Clinical situation
- Implant angulation
- Implant type, number, position
- Transmucosal depth
- Interocclusal space
- Occlusal scheme
- Esthetics
- Patient's choice



a. Custom implant abutments



b. Abutment placement jig



c. Abutment placement jig (occlusal view)



d. Metal substructure splinted implants cement retained prosthesis



e. *Metal substructure splinted screw retained implant supported prosthesis*

## VI. OCCLUSION



*Working and non-working contacts with canine guided occlusion scheme for implant supported posterior restorations .*



*Posterior implant crowns in occlusion*

Occlusion plays a role in functional and biological aspects of implant prosthesis. A well-controlled and maintained occlusion could reduce mechanical and biological complications, thus increasing the longevity of the prosthesis.

Dental implants present different biological and biomechanical characteristics than teeth.

There is, however, limited scientific evidence supporting cause –effect relations between occlusal factors and deleterious biologic outcomes for osseointegrated implants.

The evidence supporting specific occlusal theories is based on expert opinion and limited clinical research. General recommendations for occlusal schemes and morphology aim to reduce bending moments, non-axial load, and stress at implant-abutment interface.

Though there is no evidence that occlusal factors cause loss of osseointegration, occlusal overload may however cause mechanical complications, like veneer chip/fracture, screw loosening/fracture, or even implant fracture, therefore careful planning and ongoing maintenance is important.



*Implant supported full mouth restorations*

## Conclusion

After a comprehensive diagnosis and clear sequential steps towards the final prosthetic goal, with the patient's biology, functionality, and esthetics in mind, we can succeed even in most complicated cases.

The collaboration with our colleagues in other specialties such as Periodontics, Endodontics, Oral Surgery, and Orthodontics, thus a multidisciplinary approach, is paramount to ensure achievement of these goals.

A carefully crafted, prosthodontically driven treatment plan is the cornerstone to a successful and predictable outcome.

**References**

- Esposito et al "Interventions for replacing missing teeth: horizontal and vertical bone augmentation techniques for dental implant treatment", Cochrane Collab. 2014
- Misch et al "Implant success, survival, and failure: The international congress of oral implantologists Pisa consensus conference" ID 2008; 17:1 5-11
- Torabinejad et al "Outcomes of RCT and restorations, ISSC's, FPD's, and extraction without replacement. A systematic review." 2007
- Stoumpis C1, Kohal RJ "To splint or not to splint oral implants in the implant-supported overdenture therapy? A systematic literature review." J Oral Rehabil. 2011; Nov; 38(11):857-69
- Pjetursson, Lang "A systematic review of the survival and complication rates of fixed partial dentures (FPDs) after an observation period of at least 5 years I. Implant-supported FPDs" COIR 2004 15, 625-642
- Papaspyridakos et al "A Systematic Review of Biologic and Technical Complications with Fixed Implant Rehabilitations for Edentulous Patients" Int J Oral Maxillofac Implants 2012; 27:102-110
- Greenstein, Cavallaro "Keratinized Gingiva around Dental Implants" CCDE 2011
- Kim et al "Occlusal considerations in implant therapy: clinical guidelines with biomechanical rationale" Clin. Oral Impl. Res. 2005; 16: 26-35
- Fardal, Johannessen, J Clin Periodontol 1999
- Monje et al, J Periodontol 2014
- Papaspyridakos et al "Accuracy of implant impressions for partially and completely edentulous patients. A Systematic review" JOMI 2014, 29:4, 836-845
- Lindhe et al "Peri-implant diseases: Consensus Report of the Sixth European Workshop on Periodontology" J Clin Periodontol 2008
- Vigolo, Zaccharia "Clinical evaluation of marginal bone level change of multiple adjacent implants restored with splinted and nonsplinted restorations: a 5-year prospective study." Int J Oral Maxillofac Implants 2010 Nov-Dec; 25 (6):1189-94