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From Fees to Free: Comparing APC-Based and Diamond Open Access Journals in Engineering

Luís Eduardo Pilatti , Luiz Alberto Pilatti *, Gustavo Dambiski Gomes de Carvalho and Luis Mauricio Martins de Resende

Postgraduate Program in Production Engineering, Ponta Grossa Campus, Federal University of Technology—Paraná (UTFPR), Ponta Grossa 84016-210, Brazil; lepilatti@yahoo.com.br (L.E.P.); gustavocarvalho@utfpr.edu.br (G.D.G.d.C.); lmresende@utfpr.edu.br (L.M.M.d.R.)
* Correspondence: lapilatti@utfpr.edu.br; Tel.: +55-42-99103-3179

Abstract: This study analyzes the impact of different Open Access (OA) publication models in engineering, comparing journals that charge Article Processing Charges (APCs) with those operating under the Diamond OA model. A total of 757 engineering OA journals, comprising 504 APC-based and 253 Diamond OA journals, were examined using bibliometric data from 2020 to 2023. The analysis focused on four key metrics: CiteScore, total citations, number of published articles, and the percentage of cited articles. The results indicate that APC-based journals dominate the upper quartiles (Q1 and Q2) regarding absolute citation counts, primarily driven by high-volume mega-journals such as IEEE Access. However, Diamond OA journals exhibit a higher proportion of cited articles (88.8% compared to 83.4% in APC-based journals) within the top 10% category. Despite their benefits in providing cost-free dissemination, Diamond OA journals account for only 8.4% of the 3012 active engineering journals indexed in Scopus, highlighting sustainability and visibility challenges. The findings suggest that, while APC-based journals achieve higher absolute citation counts, editorial reputation and visibility strategies significantly influence citation performance. This study contributes to the ongoing discussion on the financial sustainability and equity of OA publishing in engineering.

Keywords: open access; article processing charges; diamond open access; engineering

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1. Introduction

The Open Access (OA) movement began in the early 21st century, gaining momentum with the Budapest Open Access Initiative (BOAI) in 2002, which defined OA as the free and unrestricted availability of scientific knowledge (BOAI, 2002). In 2003, the Bethesda (Brown et al., 2003) and Berlin (Max-Planck-Gesellschaft, 2003) Declarations further consolidated the pillars of the "BBB" movement (Budapest, Bethesda, and Berlin), emphasizing that removing financial and legal barriers to scholarly publications would generate global benefits for scientific progress. These foundational efforts established the framework for what is now known as OA, shaping policies and practices adopted worldwide (Suber, 2012).

Different OA publication approaches have emerged within this evolving landscape, each reflecting a distinct financial or operational model. One is Gold Open Access, in which authors (or their institutions) typically pay Article Processing Charges (APCs) so that published research is immediately available to readers (Borrego, 2023). This may include hybrid options—where only some articles in a subscription-based journal are Open Access—and "transformative" arrangements like Subscribe to Open (S2O), which converts subscription-based content to OA once specific targets are met. Another approach is Green Open Access, in which authors deposit peer-reviewed versions of their work (often postprints) in institutional or disciplinary repositories, typically at no additional cost, even if the final version in the journal remains behind a paywall (Swan, 2015). Hence, Green OA is not limited to preprints; it can also cover revised manuscripts and published PDFs, depending on the publisher's policy.

Diamond Open Access represents another pathway, requiring no charges for authors or readers; instead, it relies on institutional subsidies, grants, or scholarly societies (Ancion et al., 2022; Rooryck et al., 2024). In other words, the editorial and publication processes are funded through mechanisms that do not involve APCs, allowing both submission and access to remain free. Although our operational definition of Diamond OA focuses on this no-fee aspect, some advocates apply more restrictive criteria—such as requiring community-led governance of the journal—to be considered fully "Diamond." Despite their inherent advantages in promoting inclusive research dissemination, Diamond OA journals face significant challenges in sustaining workflows, visibility, and editorial rigor without direct APC revenue.

It is essential to clarify that while 'Diamond OA' and 'no-fee OA' are closely related concepts, they are not entirely synonymous. Diamond OA specifically refers to journals that impose no fees on authors or readers and are typically sustained through structured funding mechanisms, such as institutional support or public subsidies. In contrast, 'no-fee OA' is a broader term encompassing any Open Access journal that does not charge publication fees, regardless of its funding structure or governance model. Thus, while all Diamond OA journals are no-fee OA by definition, not all no-fee OA journals meet the more specific criteria associated with Diamond OA, such as community-led editorial processes or adherence to specific quality standards (Rooryck et al., 2024).

In engineering, a domain essential for technological and economic development often linked to large-scale applied research (Laakso & Björk, 2012), the adoption of OA has been somewhat heterogeneous. Many established, high-impact publications run by professional societies (e.g., IEEE) adhere to Gold or hybrid models, often requiring substantial APCs (Wang, 2024). By contrast, Diamond OA journals remain less prevalent, especially compared to some fields in the Humanities or Social Sciences (Borrego, 2023). Nonetheless, recent initiatives such as the Diamond OA Standard (DOAS) seek to strengthen the sustainability and competitiveness of no-fee journals, establishing clear guidelines for funding, editorial governance, research integrity, and impact (Ancion et al., 2022; Rooryck et al., 2024).

The debate around APCs and the feasibility of Diamond OA transcends financial considerations, encompassing equity and ethical dimensions. Critics argue that fee-based models can reinforce global inequalities by limiting the ability of less-funded researchers to publish in high-visibility outlets (Haug, 2019; May, 2020). On the other hand, publishers and editors of mega-journals often justify APCs by citing expenses related to large-scale editorial operations and global dissemination efforts (Frank et al., 2023). In engineering, where research outputs can have significant commercial, infrastructural, and societal implications, overcoming cost barriers is particularly important for ensuring that innovations reach—and are developed by—diverse global communities (McCabe & Mueller-Langer, 2024).

Despite the growing literature on OA's overall citation advantages, few studies differentiate fee-based (APC) journals from Diamond OA journals, specifically within engineering—an area marked by high publication volumes, patent relevance, and strong ties to industry (Huang et al., 2024; Langham-Putrow et al., 2021). Hence, this study compares journals in both models—focusing on metrics such as CiteScore, total citations, number of published articles, and the proportion of cited articles—to determine whether charging fees alone correlates with higher impact or whether other factors, such as editorial history and reputational capital, shape visibility. By highlighting these distinctions, this work contributes to ongoing debates on equity in scholarly communication, the financial sustainability of Diamond OA, and pathways to bolster engineering research worldwide.

2. Method

2.1. Overall Approach

This research adopted an exploratory and documentary design, encompassing four main steps: (i) collecting and curating data on OA engineering journals, (ii) determining whether each journal charged an APC or operated under a Diamond model, (iii) extracting bibliometric metrics (CiteScore, citations, articles published, and percentage of cited articles) from 2020 to 2023, and (iv) applying non-parametric statistical tests for group comparisons and correlation analyses.

2.2. Data Collection and Sample Definition

Data were gathered in late November 2024, primarily from the Scopus database, selected for its broad coverage of engineering journals published by recognized professional societies and commercial publishers. The Scopus query filtered journals classified under "Engineering" (code 22, which includes 18 sub-areas), marked as "Open Access", and assigned to at least one quartile (Q1–Q4). Journals with "N/A" quartile status or that were inactive were excluded.

This initial process identified 803 journals, of which 46 were removed for not meeting the defined criteria (e.g., "N/A" quartile). Consequently, 757 active OA engineering journals remained, encompassing sub-areas such as electrical, mechanical, civil, chemical, and computer engineering.

Next, the financing model of each journal was assessed to determine whether it charged APCs or operated under a Diamond model (no fees for authors). As the primary source, data were first extracted from the Directory of Open Access Journals (DOAJ). When the DOAJ lacked information on a particular journal's fee structure, we checked OpenAlex. When data were missing or conflicting, we consulted the journal's official website (e.g., instructions for authors or FAQs) to confirm whether fees were charged. Consequently, each of the 757 journals was conclusively categorized as APC-based (G1) or Diamond (G2), ensuring no publication remained unclassified. This procedure yielded 504 APC-charging journals (about 66.58%) and 253 Diamond journals (about 33.42%).

A supplementary check compared these 757 journals against 3012 active engineering journals in Scopus, revealing that only about 25% are OA with a defined quartile. Additionally, 8.4% of these 3012 engineering journals operate under a Diamond OA model with an assigned quartile, highlighting the relatively limited share of Diamond journals in the field.

2.3. Variables and Analysis Period

This study adopts a conceptual framework linking each measured construct to a corresponding bibliometric indicator. Specifically, we interpret *prestige* through the 2023 CiteScore metric, impact (or academic attention) through the total number of citations from 2020 to 2023, editorial volume through the number of articles published in the same period, and visibility through the percentage of articles that received at least one citation. This approach clarifies what is measured and why each indicator is employed when comparing APC-based and Diamond OA journals in engineering.

Four key indicators were evaluated from 2020 to 2023:

1. The 2023 CiteScore is a Scopus metric that calculates the ratio between the total number of citations received by publications from the previous four years and the total number of published items. This metric enables classification into quartiles (Q1–Q4) and helps identify each category's top 10% of journals.

2. The total number of citations from 2020 to 2023 represents the cumulative citations received by the journal's articles, reviews, and conference papers.
3. The number of articles published between 2020 and 2023 refers to the total count of articles and reviews indexed by Scopus over the same timeframe, reflecting the journal's editorial volume.
4. The percentage of cited articles indicates the proportion of articles published between 2020 and 2023 that received at least one citation, serving as a relative measure of the journal's visibility.

Quartile stratification (Q1–Q4) and a top 10% filter were employed to capture broad distribution trends and higher-prestige segments.

2.4. Statistical Procedures

Preliminary assessments included the Ryan–Joiner test (Ryan & Joiner, 1976) to gauge normality and Levene's (1960) or Bartlett's (1937) tests to examine the homogeneity of variance. These checks revealed non-normal distributions and unequal variances in the data, justifying non-parametric approaches (Conover, 1999; Hollander et al., 2013). Specifically, the Wilcoxon rank-sum test was applied to compare median values (e.g., CiteScore, total citations, article counts, and percentage of cited articles) between APC-based (G1) and Diamond (G2) journals, both in each quartile and within the top 10% category. Spearman's rank correlation (ρ) was employed to assess monotonic associations (e.g., between CiteScore and total citations), as it does not assume normally distributed variables. All statistical tests were performed at a significance level of $p < 0.05$.

2.5. Study Limitations

Several potential biases should be considered. First, although comprehensive, the Scopus database may not index some journals, potentially underestimating the presence of Diamond OA titles. Second, DOAJ and OpenAlex records may be outdated or incomplete, necessitating manual checks but leaving a possibility of unreported fees in exceptional cases. Third, this investigation focuses on quantitative indicators, not addressing peer-review quality or societal impact. Lastly, the 2020–2023 interval overlaps with the COVID-19 pandemic, which may have affected submission and citation patterns in specific engineering subfields. Despite these constraints, the dataset and methods employed provide a solid foundation for comparing APC-based and Diamond OA journals in engineering.

3. Results

3.1. Distribution by Quartile and Top 10%

Table 1 presents the distribution of the 757 OA engineering journals (G1: APC-charging vs. G2: Diamond) across quartiles (Q1–Q4) and the top 10%. G1 dominates the top quartiles (Q1 and Q2), representing 80.30% and 74.79%, respectively. In Q3, G1's share is 52.22%, nearly matched by G2 (47.78%), while G2 prevails in Q4 (70.89% vs. 29.11%). Notably, 20 Diamond journals appear in the top 10% category (15.87%), indicating that although less frequent, the Diamond model can still attain high prestige.

Table 1. Distribution of engineering OA journals (APC vs. Diamond) by quartile and top 10%.

Quartile	Journals	G1 (APC)	G2 (Diamond)
Q1	264	212 (80.30%)	52 (19.70%)
Q2	234	175 (74.79%)	59 (25.21%)
Q3	180	94 (52.22%)	86 (47.78%)
Q4	79	23 (29.11%)	56 (70.89%)
Top 10%	126	106 (84.13%)	20 (15.87%)

3.2. Citescore and Citations (2020–2023)

Table 2 summarizes the mean and median CiteScore and citation counts (2020–2023) for G1 and G2 within each quartile, including Wilcoxon p-values. Although there is no significant difference in CiteScore for Q1, G1 significantly exceeds G2 in citation counts ($p < 0.05$). In Q2 and Q3, G1 demonstrates higher CiteScore and citation values than G2 ($p < 0.05$). No significant differences emerged in Q4.

Table 2. Comparison (CiteScore, Citations) for G1 vs. G2 by quartile.

Quartile	Metric	G1 (Mean, Median)	G2 (Mean, Median)	*p*-Value (Wilcoxon)
Q1	CiteScore	9.10 (7.75)	8.17 (7.10)	>0.05
Q1	Citations	11,389 (2090)	1577 (1154)	<0.05 (G1 > G2)
Q2	CiteScore	3.84 (3.90)	2.79 (3.00)	<0.05 (G1 > G2)
Q2	Citations	2389 (682)	462 (297)	<0.05 (G1 > G2)
Q3	CiteScore	1.96 (2.00)	1.50 (1.50)	<0.05 (G1 > G2)
Q3	Citations	481 (287)	340 (176)	<0.05 (G1 > G2)
Q4	CiteScore	0.67 (0.70)	0.59 (0.70)	>0.05
Q4	Citations	111 (68)	83 (48)	>0.05

3.3. Percent of Cited Articles and Top 10%

Regarding the percentage of cited articles, Diamond titles (G2) in the top 10% display a higher average (~88.8%) compared to G1 (~83.4%), a statistically significant difference ($p < 0.05$). Notably, in Q1, G1 journals still show a slight advantage in the mean percentage of cited articles (78.5% vs. 75.9%), albeit with considerable variability. This indicates that even though APC-based mega-journals often accrue large citation totals, Diamond journals can attain comparable—or, in specific segments such as the top 10%, even superior—ratios of articles receiving at least one citation.

To offer a detailed snapshot, Table 3 presents the average percentage of cited articles for G1 and G2 journals across the four quartiles (Q1–Q4). While G1 consistently reports higher absolute citation counts (see Section 3.2), the data suggests that G2 can sustain a comparable or higher fraction of cited papers in specific tiers. Such a pattern implies that despite often publishing fewer articles, Diamond journals may sustain robust readership and influence, as evidenced by their cited-article percentages.

Table 3. Average percentage of cited articles in APC-based (G1) vs. Diamond (G2) journals, by quartile (2020–2023).

Quartile	G1 (Mean %)	G2 (Mean %)	*p*-Value (Wilcoxon)
Q1	78.5	75.9	<0.05 (G1 > G2)
Q2	82.0	84.3	<0.05 (G2 > G1)
Q3	68.2	71.6	<0.05 (G2 > G1)
Q4	55.9	58.1	>0.05 (n.s.)
Top 10	83.4	88.8	<0.05 (G2 > G1)

Notes: 1. "Mean %" refers to the average proportion of each journal's articles (published 2020–2023) that received at least one citation in the same period. 2. "Top 10%" follows Scopus's categorization for the highest CiteScore ranking within each engineering sub-area. 3. p-Values were obtained via Wilcoxon Rank-Sum comparisons of median cited-article percentages in G1 vs. G2 per quartile. 4. "n.s." indicates a non-significant difference.

Overall, G1 tends to publish in higher-impact outlets (particularly Q1 mega-journals), boosting absolute citation tallies. However, G2 demonstrates a capacity for strong relative impact: specific Diamond journals match or exceed G1 in the share of cited articles—most notably in Q2 and the top 10%—underscoring that no-fee publishing can thrive in engagement and reach.

3.4. Citescore–Citation Correlation (Spearman)

Table 4 provides Spearman's ρ for the relationship between CiteScore and total citations in each quartile. For Q1, G1 and G2 exhibit moderate-to-strong correlations (ρ = 0.54 and 0.63, respectively). In Q2, G1's correlation is strong (ρ = 0.78), whereas G2's is moderate (ρ = 0.57). In Q3, G1's correlation drops to weak-moderate (ρ = 0.29), while G2 maintains a moderate correlation (ρ = 0.49). Both groups show moderate correlations in Q4.

Table 4. Spearman's p (CiteScore vs. Citations) by quartile.

Quartile	Group	ρ (Spearman)	*p*-Value	Interpretation
Q1	G1	0.54	0.0001	Moderate
Q1	G2	0.63	0.0000	Moderate-strong
Q2	G1	0.78	0.0000	Strong
Q2	G2	0.57	0.0021	Moderate
Q3	G1	0.29	0.0425	Weak-moderate
Q3	G2	0.49	0.0000	Moderate
Q4	G1	0.58	0.0038	Moderate
Q4	G2	0.49	0.0001	Moderate

3.5. Articles Published and Mega-Journals

A further dimension of impact lies in publication volume. G1 generally reports higher article counts across the quartiles—especially in Q1, where the average exceeds ~1400 articles published between 2020 and 2023. A leading example is IEEE Access, a Q1 mega-journal that published nearly 50,000 articles over the examined interval, accruing more than 480,000 citations (see Section 4.2). This extraordinarily high output raises the overall G1 average. In contrast, G2 journals often operate on more minor scales but tend to display more uniform editorial outputs.

To illustrate these contrasts, Table 5 compares G1's and G2's Q1 "mega-journals" (those exceeding ~1000–1200 articles per year on average) with other Q1 titles. While G1 mega-journals dominate volume, Diamond outlets in Q1 still maintain competitive percentages of cited articles. No Diamond "mega-journal" was identified in Q1, matching the high publication volumes in specific APC-based titles.

Table 5. Number and percentage of articles publishes and cited in Q1 mega-journals vs. other Q1 journals (2020–2023).

Journal Category	Avg. Articles Published (2020–2023)	% Cited Articles (Mean)	Notes
Q1 Mega-Journals (G1)	49,687	88.5	e.g., includes IEEE Access, with >49,000 articles alone
Other Q1 (G1)	~1400	78.5	Often more specialized, lower-volume outlets
Q1 Diamond Mega-Journals	N/A	N/A	No Diamond mega-journal identified meeting similar high-volume thresholds
Other Q1 (G2)	~400	75.9	Smaller scale, frequently society-led, with a strong editorial focus

Notes: 1. "Mega-journal" status here is loosely assigned to G1 titles publishing >1000 articles/year on average. 2. "Avg. Articles Published" covers total articles indexed by Scopus from 2020 to 2023. 3. "%Cited Articles (Mean)" is the average proportion of those articles receiving at least one citation.

As summarized in Table 5, G1's mega-journals illustrate the stark disparity in article volume between certain APC-based outlets and most Diamond journals. Although large-scale APC-based venues can amplify article visibility—partly by their sheer output—Diamond journals, while generally publishing fewer articles, still sustain credible citation ratios. These dynamics highlight how editorial reputation, visibility strategies, and high publication volumes (particularly in mega-journals) heavily shape engineering citation landscapes.

4. Discussion

The data indicates differences between APC-based (G1) and Diamond (G2) engineering journals. Observed patterns concern fee-based publication, the role of mega-journals, and ethical considerations surrounding equitable access.

4.1. APC and Correlation vs. Causation

A principal contention involves whether charging APCs inherently confers more citations or a higher CiteScore (Langham-Putrow et al., 2021; Mounier & Rooryck, 2023). Although G1 typically occupies the upper quartiles and records higher absolute citation averages, caution is warranted in equating fees with guaranteed impact. Many top-tier journals adopted APCs only after building substantial reputational capital; prestige often precedes fee-based publication (Borrego, 2023; Max-Planck-Gesellschaft, 2003). Meanwhile, outliers in G2—particularly within the top 10% of journals—show that a no-fee model does not preclude strong visibility (Ancion et al., 2022; De Filippo & Mañana-Rodríguez, 2020).

4.2. Mega-Journals and Citation Concentration

The existence of prominent, high-volume journals under influential societies (e.g., IEEE) explains the pronounced gap in average citation totals between G1 and G2, especially in Q1 and Q2. As noted in Table 2, G1's average citations in Q1 are much higher (~11,389 vs. ~1577), reflecting the output of a few mega-journals publishing thousands of articles annually (May, 2020; Miranda & Garcia-Carpintero, 2019). While this approach can broaden dissemination for specific authors, it also raises concerns about the accessibility of such outlets for researchers who cannot afford potentially high APCs (Huang et al., 2024; Mounier & Rooryck, 2023).

4.3. Sustainability of Diamond Open Access

Diamond OA accounts for ~33.42% of OA journals in engineering, yet it remains a minority (about 8.4% of the 3012 active engineering journals). Notably, the data reveal that some Diamond journals can match or surpass the relative impact of APC-based journals (see Section 3.3). These results align with earlier findings that a robust editorial infrastructure and substantial financial backing help no-fee journals achieve competitive performance (Laakso & Björk, 2012; Wang, 2024). Diamond OA often relies on grants, institutional support, or societal funds (De Filippo & Mañana-Rodríguez, 2020; May, 2020). Additional analyses have highlighted that such multi-stakeholder support—involving libraries, consortia, and scholarly networks—can help Diamond journals maintain editorial rigor while remaining fee-free (Fecher & Wagner, 2016).

4.4. Ethical Challenges and Equity in Engineering

As engineering research is closely tied to patents, commercialization, and large-scale infrastructure projects, limiting publication opportunities due to financial constraints can hinder innovation in less-resourced regions (Rooryck et al., 2024; Wang, 2024). APCs often exceed USD 2000 in well-established journals—and, in some cases, surpass USD 3000 in high-impact or mega-journals (Borrego, 2023; Rodrigues et al., 2022)—which may exacerbate global inequalities (Langham-Putrow et al., 2021; Max-Planck-Gesellschaft, 2003). For instance, IEEE Access currently charges an APC of USD 2075 and has published nearly 50,000 articles during the analyzed period (IEEE, 2024). Other prominent engineering journals set prices that can approach or exceed USD 3000, especially if they offer rapid review services or wide dissemination (Borrego, 2023).

On the other hand, Diamond journals do not impose direct financial barriers but face challenges in building reputation and visibility, particularly in a discipline where high-impact publications often require substantial editorial resources (De Filippo & Mañana-Rodríguez, 2020; Frank et al., 2023). Effective interventions include public funding programs for the Diamond model or transparent APC waiver policies (Frank et al., 2023; McCabe & Mueller-Langer, 2024). However, achieving accurate equity in engineering publications may require broader structural changes. Without consistent support from institutions or public policies, Diamond journals remain a minority (Section 3), leaving authors from less-resourced regions more dependent on APC-based routes or facing barriers to publishing in recognized, high-impact journals (Huang et al., 2024; May, 2020).

4.5. Implications for Researchers in Developing Countries

The data (Tables 1 and 2) illustrate a structural challenge: G1's higher citation averages entice authors seeking broader visibility, yet APCs may be prohibitive for those lacking funding (May, 2020). Although many Diamond outlets appear in Q3–Q4 and garner fewer citations, high-impact Diamond journals in the top quartile exist, indicating that authors concerned about costs can still find reputable, fee-free venues (Haug, 2019; Huang et al., 2024). Strengthening editorial standards and raising awareness of Diamond OA options could help mitigate inequities and spur new research directions (Ancion et al., 2022; Miranda & Garcia-Carpintero, 2019).

4.6. Comparisons with Other Disciplines

The role of funding agencies in supporting or offsetting APCs varies across disciplines. In biomedical research, it is common for funding bodies to include specific resources for covering APCs, acknowledging the high volume and relevance of publications in this area (De Filippo & Mañana-Rodríguez, 2020). This practice reflects the recognition that rapid and open dissemination of biomedical findings can have immediate societal impacts. However, such financial support is not uniformly distributed across all scientific domains. In fields like engineering, authors may encounter limited funding opportunities for APCs, potentially restricting access to high-impact journals (Rooryck et al., 2024).

The term "offsetting" refers to financial mechanisms where agencies provide full or partial reimbursement for APCs, reducing the direct financial burden on researchers. This is more prevalent in biomedical sciences, where the urgency for open dissemination aligns with global health priorities. In contrast, researchers in other fields often rely on institutional funds or personal resources, which can contribute to disparities in publication opportunities (Frank et al., 2023).

Regarding journal classification, PLoS ONE is often mistakenly categorized solely as a biomedical mega-journal due to its substantial output in health sciences. However, it is, by definition, a multidisciplinary publication encompassing diverse research fields beyond biomedicine (PLoS ONE, 2024). This distinction is important for contextualizing comparative analyses of APC funding and publishing trends across scientific disciplines.

4.7. Future Challenges and Perspectives

The results (Tables 1 and 2) show continued growth in OA across engineering, though skewed toward G1 in the upper quartiles. Of 3012 active engineering journals, only 757 (about 25%) are OA with quartile data, and Diamond titles make up just 8.4% of that total. Policies mandating OA for publicly funded research will likely increase interest in diverse OA business models (BOAI, 2002; Max-Planck-Gesellschaft, 2003). However, Diamond OA requires stable funding frameworks to remain viable (Borrego, 2023; May, 2020). Meanwhile, the ascendance of mega-journals and major commercial publishers may intensify regional disparities unless robust waiver or tiered fee structures are implemented (Rodrigues et al., 2022).

4.8. The Ongoing Shift Away from Impact Factor (IF)

The global academic community is increasingly re-evaluating the Impact Factor (IF) as a primary metric for research assessment (Wilsdon et al., 2015; DORA, 2013). Critics argue that IF, originally designed to evaluate journal influence, has been misapplied as a proxy for article or author quality, leading to distorted research practices and publication incentives (Hicks et al., 2015). Recent initiatives, including the Declaration on Research Assessment (DORA) and national policies in various countries, advocate for a broader set of metrics that emphasize research quality, societal relevance, and open dissemination (DORA, 2013; Hicks et al., 2015).

Although the present study utilized CiteScore as a comparative metric due to its broader coverage and relevance for engineering disciplines, it is essential to acknowledge the ongoing shift towards more holistic assessment frameworks. Future investigations could explore whether the decline in IF reliance will influence researchers' choices regarding journal selection, particularly in the context of OA publishing models. This evolution may encourage greater engagement with Diamond OA journals, whose visibility is not always captured by traditional citation metrics but may reflect substantial societal contributions and niche academic relevance (Wilsdon et al., 2015).

4.9. Authors' Provenance and Journal Selection

Another consideration is the provenance of authors who select APC-based versus Diamond OA journals. Studies suggest that researchers from high-income countries are more likely to publish in fee-based journals due to broader access to institutional or funding resources (Rodrigues et al., 2022; Rooryck et al., 2024). Conversely, scholars from low- and middle-income regions may prefer Diamond OA due to the absence of financial barriers (Oliveira et al., 2023). This dynamic introduces global inequalities in access to high-impact outlets, reinforcing the importance of supporting Diamond OA initiatives to democratize academic dissemination.

Although detailed data on authors' geographic distribution were beyond this study's scope, the findings underscore the need for future research examining how authors' provenance influences publication strategies. Such insights could inform policies promoting equitable access to scholarly communication, ensuring that researchers from diverse backgrounds can publish in reputable, high-visibility journals regardless of financial constraints (May, 2020; Frank et al., 2023).

4.10. COVID-19 Influence on Citation Patterns

The period analyzed (2020–2023) coincides with the global COVID-19 pandemic, significantly impacting research dynamics and dissemination trends across various scientific fields. Specific subfields, particularly biomedical engineering, may have experienced shifts in citation patterns due to heightened research activity related to pandemic-driven innovations, such as the development of medical devices and diagnostic technologies (Borrego, 2023; Wang, 2024). For instance, rapid-response research and the urgency for accessible knowledge could have accelerated citation rates for studies addressing pandemic-related challenges. Conversely, other engineering domains less directly connected to COVID-19 may have faced disruptions in research output, publication rates, or citation cycles due to institutional closures and resource limitations (Huang et al., 2024). Although this study did not conduct a granular analysis by subfield, future investigations could explore these dynamics in depth to understand how global crises influence citation trajectories in engineering disciplines. Recognizing these variations is essential for accurately interpreting bibliometric trends during extraordinary periods (Laakso & Björk, 2012; Rooryck et al., 2024).

4.11. Sustainability Strategies and Pathways for Diamond OA Journals

Sustainability remains a central challenge for Diamond OA journals, which operate without the financial cushion of APC revenues. While the "balanced system" proposed in this study emphasizes the need for equitable access and sustainable operations, translating this concept into practice requires concrete strategies.

One potential pathway is government–university–society co-funding models, where public institutions, academic consortia, and professional societies collaboratively support journal operations. Such models have proven successful in certain regions, ensuring that editorial processes, peer review, and dissemination are maintained without direct costs to authors (Rooryck et al., 2024; Frank et al., 2023). Governmental policies promoting open science can play a pivotal role by allocating dedicated funds to sustain Diamond OA journals, particularly in disciplines like engineering, where operational costs can be significant (Borrego, 2023).

Additionally, implementing tiered APC systems in hybrid or transformative journals can balance financial sustainability with inclusiveness. Under such schemes, APCs could be scaled based on the institutional affiliation, geographic region, or funding capacity of the author, ensuring that researchers from less-resourced institutions or countries are not excluded from publishing opportunities (Frank et al., 2023; Ancion et al., 2022).

Further, transparent waiver policies and subsidies can offer relief to authors from low-income countries, aligning with global equity objectives (Huang et al., 2024). These policies would ensure that financial limitations are not barriers to disseminating research, particularly in engineering fields critical to societal advancement.

Finally, encouraging community-led governance of Diamond OA journals can enhance sustainability by fostering shared responsibility among stakeholders, including editors, reviewers, and sponsoring organizations (De Filippo & Mañana-Rodríguez, 2020). Community engagement enhances legitimacy and promotes collaborative efforts to secure funding, streamline editorial processes, and expand the journal's reach.

In sum, achieving a balanced and sustainable system for Diamond OA in engineering requires a multi-faceted approach, combining financial innovation, policy support, and collaborative governance structures. Future research should explore these mechanisms further to identify scalable and context-specific solutions for sustaining Open Access publishing.

4.12. Ethical Considerations and Future Outlook

Engineering endeavors shape critical domains such as infrastructure, automation, and energy (Miranda & Garcia-Carpintero, 2019). Restrictive paywalls or high APCs may impede international collaboration and limit breakthrough access, especially in emerging economies (Oliveira et al., 2023; Suber, 2012). This study's findings (especially in Tables 1 and 2) show that Diamond journals, although fewer in number, can excel in relative citation metrics and facilitate broader participation. Policy initiatives—from consortia-based funding to Open Access advocacy—are needed to ensure OA in engineering fulfills its promise of inclusivity (Frank et al., 2023; Rooryck et al., 2024). While fee-based journals dominate sheer citation counts, well-supported Diamond outlets demonstrate strong performance when backed by institutional partnerships and editorial rigor. The challenge ahead is reconciling financial sustainability, open dissemination, and high-quality peer review to keep engineering research equitable and impactful.

5. Conclusions

This study evaluated 757 OA engineering journals—504 fee-based (APC) and 253 Diamond—to compare CiteScore, citation totals, publication volume, and cited-article percentages over 2020–2023. Although APC-based titles generally reported higher absolute citation metrics, mainly influenced by mega-journals like IEEE Access, these results do not unequivocally validate that paying fees alone guarantees visibility. Instead, a few high-volume journals inflate the average, indicating that reputation and editorial tradition may be more decisive than APC status. Furthermore, specific Diamond OA journals stand out in relative impact measures, notably in the top 10%, presenting higher percentages of cited articles (~88.8% vs. ~83.4% for APC). Nevertheless, Diamond journals remain relatively scarce, corresponding to about 8.4% of the 3012 active engineering journals in Scopus. Expanding Diamond OA thus hinges on stable financial mechanisms and broader institutional support to ensure viability and visibility. Ultimately, both models are relevant for disseminating engineering research, but a more balanced system—combining the global reach of mega-journals with the inclusivity of fee-free publishing—will better serve the goals of innovation, equity, and sustainable development.

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References

Ancion, Z., Borrell-Damián, L., Mounier, P., Rooryck, J., & Saenen, B. (2022). *Action plan for diamond open access*. Zenodo. [CrossRef]

Bartlett, M. S. (1937). Properties of sufficiency and statistical tests. *Proceedings of the Royal Society of London. Series A, Mathematical and Physical Sciences*, *160*(901), 268–282. [CrossRef]

BOAI (Budapest Open Access Initiative). (2002). *Open society foundations*. Available online: https://www.influencewatch.org/organization/budapest-open-access-initiative/ (accessed on 14 December 2024).

Borrego, A. (2023). Article processing charges for open access journal publishing: A review. *Learned Publishing*, *36*, 359–378. [CrossRef]

Brown, P. O., Cabell, D., Chakravarti, A., Cohen, B., Delamothe, T., Eisen, M., Grivell, L., Guédon, J.-C., Hawley, R. S., Johnson, R. K., Kirschner, M. W., Lipman, D., Lutzker, A. P., Marincola, E., Roberts, R. J., Rubin, G. M., Schloegl, R., Siegel, V., So, A. D., . . . ,&, Watson, L. (2003). *Bethesda statement on open access publishing*. Howard Hughes Medical Institute. Available online: https://dash.harvard.edu/handle/1/4725199 (accessed on 14 December 2024).

Conover, W. J. (1999). *Practical nonparametric statistics* (3rd ed.). John Wiley & Sons.

De Filippo, D., & Mañana-Rodríguez, J. (2020). Open access initiatives in European universities: Analysis of their implementation and the visibility of publications in the YERUN network. *Scientometrics*, *125*, 2667–2694. [CrossRef]

DORA. (2013). *San Francisco declaration on research assessment*. Available online: https://sfdora.org/ (accessed on 14 December 2024).

Fecher, B., & Wagner, G. G. (2016). Open Access, innovation, and research infrastructure. *Publications*, *4*(2), 17. [CrossRef]

Frank, J., Foster, R., & Pagliari, C. (2023). Open access publishing—Noble intention, flawed reality. *Social Science & Medicine*, *317*, 115592. [CrossRef]

Haug, C. J. (2019). No free lunch—What price is Plan S for scientific publishing? *The New England Journal of Medicine*, *380*(12), 1181–1185. [CrossRef] [PubMed]

Hicks, D., Wouters, P., Waltman, L., de Rijcke, S., & Rafols, I. (2015). Bibliometrics: The Leiden Manifesto for research metrics. *Nature*, *520*(7548), 429–431. [CrossRef] [PubMed]

Hollander, M., Wolfe, D. A., & Chicken, E. (2013). *Nonparametric statistical methods* (3rd ed.). John Wiley & Sons.

Huang, C.-K., Neylon, C., Montgomery, L., Hosking, R., Diprose, J. P., Handcock, R. N., & Wilson, K. (2024). Open access research outputs receive more diverse citations. *Scientometrics*, *129*(3), 825–845. [CrossRef]

IEEE. (2024). *Information for authors—Article processing charges*. Available online: https://ieeeaccess.ieee.org/ (accessed on 14 December 2024).

Laakso, M., & Björk, B. C. (2012). Anatomy of open access publishing: A study of longitudinal development and internal structure. *BMC Medicine*, *10*, 124. [CrossRef]

Langham-Putrow, A., Bakker, C., & Riegelman, A. (2021). Is the open access citation advantage real? A systematic review of the citation of open access and subscription-based articles. *PLoS ONE*, *16*(6), e0253129. [CrossRef]

Levene, H. (1960). *Contributions to probability and statistics: Essays in honor of harold hotelling* (I. Olkin, S. G. Ghurye, W. Hoeffding, W. G. Madow, & H. B. Mann, Eds.; pp. 278–292). Stanford University Press.

Max-Planck-Gesellschaft. (2003). *Berlin declaration on open access to knowledge in the sciences and humanities*. Available online: http://openaccess.mpg.de/286432/Berlin-Declaration (accessed on 14 December 2024).

May, C. (2020). Academic publishing and open access: Costs, benefits, and options for publishing research. *Politics*, *40*(1), 120–135. [CrossRef]

McCabe, M. J., & Mueller-Langer, F. (2024). Open access is shaping scientific communication: Funders and publishers should roll out policies in ways to support their evaluation. *Science*, *385*(6714), 1170–1172. [CrossRef] [PubMed]

Miranda, R., & Garcia-Carpintero, E. (2019). Comparison of the share of documents and citations from different quartile journals in 25 research areas. *Scientometrics*, *121*(2), 479–501. [CrossRef]

Mounier, P., & Rooryck, J. (2023, December 23). *Towards a federated global community of Diamond Open Access. The Diamond Papers*. Available online: https://thd.hypotheses.org/296 (accessed on 31 July 2024).

Oliveira, A. L., Pilatti, L. A., Pilatti, L. E., & Rasoto, V. I. (2023). Pagamento de taxas (exorbitantes) em periódicos científicos internacionais de grande visibilidade. *Boletim de Conjuntura (BOCA)*, *14*(40), 332–351.

PLOS ONE. (2024). *About PLOS ONE*. Available online: https://journals.plos.org/plosone/s/about (accessed on 25 March 2025).

Rodrigues, M. L., Savino, W., & Goldenberg, S. (2022). Article-processing charges as a barrier for science in low-to-medium income regions. *Memórias do Instituto Oswaldo Cruz*, *117*, e220064. [CrossRef] [PubMed]

Rooryck, J., Rico Castro, P., & de Pablo Llorente, V. (2024). Quality as a public good: The Diamond Open Access Standard (DOAS) and its role in the Global Diamond Open Access Alliance. In *Septentrio conference series*. Septentrio Academic Publishing. Available online: https://new.eludamos.org/index.php/SCS/article/view/7770 (accessed on 14 December 2024).

Ryan, T. A., & Joiner, B. L. (1976). *Standard probability plots and tests for normality*. Minitab.

Suber, P. (2012). *Open access*. MIT Press.

Swan, A. (2015). *Open access and the humanities: Contexts, controversies and the future*. Cambridge University Press.

Wang, M. P. (2024). Research on open access journals based on article processing charges. *Open Access Library Journal*, *11*, e11916. [CrossRef]

Wilsdon, J., Allen, L., Belfiore, E., Campbell, P., Curry, S., Hill, S., Jones, R., Kain, R., Kerridge, S. R., Thelwall, M., Tinkler, J., Viney, I., Wouters, P., Hill, J., & Johnson, B. (2015). *The metric tide: Report of the independent review of the role of metrics in research assessment and management*. HEFCE. [CrossRef]