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Beyond article processing charges: An efficiency-integrity-sustainability framework for open access publishing

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Abstract

Open access (OA) publishing has significantly increased access to scientific knowledge, but its main funding models encounter increasing financial, operational, and equity challenges. The long term sustainability is threatened by the increase in article processing charges (APCs), Very weak diamond OA models, increasing market concentration, and predatory publishing incentives. In this paper, an Efficiency-Integrity-Sustainability (EIS) framework is proposed for evaluating and improving the open access publishing systems. The framework incorporates measurable indicators of operational efficiency, research integrity, and financial sustainability, while underlining the importance of predictive analytics, editorial intelligence, and data-driven decision-making. This paper showcases how AI-powered workflow management, transparent pricing, flexible APC models, and diversified revenue streams can improve publishing performance without compromising on quality or equity. A stakeholder roadmap is provided for publishers, libraries, universities, funders, and researchers to enable implementation of the EIS model. The paper argues that the future of OA relies not only on funding overhauls but also on the strategic use of data analytics and operational intelligence to build a publishing ecosystem that is efficient, trustworthy, equitable and resilient.

Keywords: Open Access Publishing; Article Processing Charges (APCs); Artificial Intelligence in Scholarly Publishing; Efficiency-Integrity-Sustainability (EIS) Framework; Predictive Analytics; Research Integrity

1. Introduction

Open access (OA) has democratized the scientific literature, although its commercial models are under great distress. 2022 U.S. research policy mandated rapid open access by 2025 [1], hence increasing demand. Meanwhile, author fees are exploding worldwide: a report of six prominent OA publishers revealed that the amount of money being spent on annual article processing charges (APCs) increased from $910.3 million in 2019 to $2.538 billion in 2023, contributing to more than $9 billion (USD) from 2019 to 2023[2]. Traditional sources of income for academic societies, including subscription and publication revenues, are declining, threatening funding for conferences, scholarships, and outreach initiatives. An official with the society warned that requiring open access could endanger nearly $8 billion a year in revenue generated by the society that "enhances the productivity and future of research[3][4].

Meanwhile, the number of publications is exploding - Clarivate shows a 48 percent increase in WoS-indexed research, from 1.71 million in 2015 to 2.53 million in 2024[5] - overtaxing editorial systems. In this context, high APCs exclude underfunded writers, and economically motivated "low-fee" models encourage substandard editing practices, promoting predatory journals and undermining confidence[6][7].

These patterns indicate not a failure of OA goals, but of OA economic strategies. In earlier work we proposed the use of an Efficiency-Integrity-Sustainability (EIS) framework[2] to evaluate OA systems. "Efficiency" means getting the most

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quality production per dollar and staff hour. “Integrity” means rigorous, transparent peer review and pricing. “Sustainability” means dependable, diverse financing and equitable access. We argue that the implementation of EIS and a solution to the dilemma may be achieved through the integration of predictive analytics and editorial intelligence into the operations of publication.

2. Flaws of Current OA Models

- **APC Conundrum:** Charging authors' flat APCs has proved regressive. Top journals (e.g., Science Advances) charge fees of $5,450 per paper[8]. This may be accessible for writers at wealthier universities, but it disproportionately disadvantages researchers in lower-income countries[6]. Waivers assist (for example, Hinari Group A/B writers currently pay $0 at Science Advances[9]), but the basic paradigm scales poorly: as production expands, stringent flat fees exclude many authors and create imbalances.
- **Diamond OA’s Fragility:** Diamond journals charge neither readers nor writers, depending on institutional subsidies and volunteer labor. They are championed for equality, but suffer serious sustainability issues. As one research shows, many diamond journals run on modest budgets (typically <€10k/year) and over 25% are losing money[10]. In reality, these publications deal with editing backlogs, outmoded equipment, and closure risk. The closing of Work Organisation, Labour & Globalisation in 2025 is a case in point: after lowering fees, it “pivoted [to diamond OA] but without sustainable funding, the model collapsed under the weight of uncompensated work” [11]. In essence, diamond OA demands large infrastructure and long-term financing commitments (server hosting, digital archiving, editing manpower) that few small publishers or institutions can manage indefinitely[11].
- **Transformative Agreements & Concentration:** Read-and-publish (transformative) arrangements package subscription and OA costs for major institutions. While driving OA acceptance, they benefit well-funded colleges and entrench large publishers. tiny social publishers generally cannot negotiate similar arrangements; several experts fear that transformational partnerships would “subsum[e]” tiny publishers, as they sell their autonomy for inclusion in giant publishers’ packages[12]. This fosters consolidation: a few major houses take most money, while specialized society journals lose writers and subscription revenues.
- **Predatory Incentives:** High-volume gold-OA models might impair quality. Cutting corners on peer review or relying on unpaid editors are ways publishers may make a profit at low APCs. This has led to a boom in predatory journals where publications are published for payments without much scrutiny. Such tactics directly impair scientific integrity and public trust[7].

Overall, these weaknesses reveal that comparing models by cost alone ignores key concerns of equality, integrity, and robustness. We need a comprehensive framework - EIS - to assess and guide improved models.

3. The EIS Framework

The Efficiency-Integrity-Sustainability (EIS) paradigm decomposes publication performance into essential dimensions[2]. Each dimension is associated with observable indicators (see Table 1 below). For example:

Table 1 Dimensions and Indicators

Dimensions	Indicators
Efficiency	KPIs include Cost per Trusted Article, Average Editing Turnaround, Degree of Automation in Operations
Integrity	Transparency in Pricing (disaggregated APC Charges), Rigorous Peer Review (following COPE Ethics), AI Methods for Detecting Fraud/Manipulation
Sustainability	Diversification of Revenue (APCs, Grants, Memberships), Equity of Author Access (e.g., discount policies for LMICs), and resilience of infrastructure (archiving, adaptability to policy changes) [2][13].

Monitoring these metrics allows stakeholders to spot issues (e.g., skyrocketing cost per article, or unclear fees) and address them first.

4. Data-based enablers of EIS

We argue that the implementation of predictive analytics, machine learning supervision and, editorial intelligence tools in publishing may operationalise EIS goals:

- **Efficiency of Predictive Analysis:** Publishers can use data science to estimate submission quantities by field, season and area. This allows for proactive recruitment of personnel and reviewers before bottlenecks occur, simplifying procedures and reducing delays. Likewise, AI can assist in routine checks (e.g., format compliance, reference validation, similarity screening) to facilitate editorial work. AI-driven screening systems (e.g., automatic scope checks or plagiarism scans) can perform initial triage, allowing editors to focus on substantive review[14]. Dynamic APC pricing (by tying costs to real editing work or authors' financial ability) might also lead to improved efficiency over time. For example, society Z might estimate demand and allocate more articles to a low-APC "diamond" route or read-and-publish deal, striking a balance in workload. Data-driven planning eliminates waste in all cases: Rather than a zero-sum scramble to make more, analytics smooth out resource use, lowering the cost of each trusted piece without sacrificing speed.

Table 2 Efficiency tools

Tool/Mechanism	Function (Efficiency)	Evidence (Outcome/Metric)
Predictive analytics	Provided to pre-allocate staff	Easier workload, fewer bottlenecks
Routine checks AI/ML	Automated format/scope/plagiarism triage	More precise desk-reject, quicker initial screening
Editorial ML oversight	Auto-suggest reviewers or editors by topic	Less time spent on assignments Higher match rate
Dynamic APC pricing (cost/ability-based)	Adjust fees in real time (e.g. low-APC channels for high demand)	Balanced route submissions, stable costs
Journal system (platform with flexible workflow)	Facilitates journal transfers, effective communication	Less delay in re-submission cycle

- **Integrity via Editorial Intelligence:** Machine learning techniques could actively promote integrity. AI can identify problems upon submission: detectors for image duplication and stylometry for ghostwritten text, and algorithms for citation network analysis for hidden citation rings. Importantly, these systems must also be transparent and auditable to reduce bias[15]. The EIS framework also calls for price transparency. Emerging initiatives (e.g., Plan S) now require publishers to provide detailed breakdowns of APC costs[13]. When writers know exactly what services (peer review management, copyediting, hosting, etc.) their payments buy, that builds confidence and exposes "black box" unscrupulous tactics. Early adopters (e.g., the Plan S Price Transparency

Framework adopted by Frontiers, PLOS, Springer Nature etc.) [16][13] are evidence of this principle. Thus, public APC calculators and audits reach the EIS integrity goals via accountability for each expense.

Table 3 Integrity tools

Tool/Mechanism	Function (Integrity)	Evidence (Outcome/Metric)
Image Forgery Detection	Detect duplicate or AI-generated figures	Fewer retractions, fewer problems with images
Citation-network analytics	Flag unusual citation patterns(rings)	Normalized citations, cartels identified
Stylometry analytics	Detect ghost-writing or text recycling	Less authorship or retraction disputes
Plagiarism checkers	Identify copied text	More original submissions Fraud detected
APC tool for Cost-transparency	Breakdown of the publishing costs	More author trust, responsibility

4.1. Sustainability via Diversified, Data-Driven Models

Sustainability is about multiple, dependable streams of income. Analytics enables better business models:

- **Tiered APCs:** Publishers could have sliding-scale fees based on real-time data on authors' institution, funding and country. Authors at under-funded universities automatically pay less or no APCs at all, well-funded authors pay more. Currently, a number of publishers waive costs for authors from Hinari countries[9]. A dynamic approach would do away with ad hoc exemptions, adjusting fees in real time to balance equity and income.
- **Better Transformative Deals:** Data on true manufacturing costs could aid negotiations. If a publisher can prove that automation is reducing its cost per piece, libraries may demand lower fees under read-and-publish contracts. Batch-level analytics (by consortium or journal) enable consortia to adjust agreements to actual production and cost patterns, putting an end to continuous overpayment for the "big deal."
- **Subscribe-to-Open (S2O) Models AI forecasting is crucial here:** Predictive subscriber-retention algorithms could estimate how many institutions it would take to flip a journal OA. Analytics can identify the existing customers who are most likely to renew and focus efforts on that level. If S2O is to be viable, publishers and libraries can work together to reduce the uncertainty of S2O (knowing in advance how many libraries will support the flip). All in all, data-informed pricing and models lead to adaptive and inclusive financing that explicitly considers authors' limits, in line with the Sustainability indicator of fair access.

Table 4 Sustainability tools

Tool/Mechanism	**Function (Sustainability)**	**Evidence (Outcome/Metric)**
Tiered/sliding APC pricing	Author's country/funding, scale fees	Authorship equity, diversified income
Transformative deals informed by data	Use cost analytics to negotiate R&P contracts fairly	Better cost-sharing, controlled spends
Subscriber churn prediction	Library support prediction for S2O flips	Greater chance of OA transition
Dynamic access-based pricing Pay authors back (model)	Charge readers per access	Authors recoup expenses
Batch level analytics	Track journal/consortium usage to inform agreements	Cost per article aligned to output

Together these technologies transform the EIS framework from a diagnostic rubric into an operational plan. Journals become high-tech, data-driven services, optimizing continuously for little waste and high trust.

5. Stakeholder Roadmap for a Data-Driven EIS Model

- **Commercial and Society Publishers:** To get a head start, publishers need to embrace data-driven EIS practices, embedding predictive analytics, editorial intelligence, and AI-enabled workflow management across their publishing operations. With editorial AI, commercial publishers can decouple volume from quality, optimize reviewer allocation, predict submission trends, and implement tiered APCs that reflect real editorial effort. Publishing transparent APC cost breakdowns, as encouraged by Plan S, increases integrity and builds trust among stakeholders. Predictive models can also help secure long-term institutional agreements by offering dependable forecasts of submission and open-access production volumes , which can stabilize revenue streams and lead to improved capacity planning . Society publishers are often less well resourced with analytical tools and can participate via shared infrastructures, consortia or publishing platforms offering forecasting tools, reviewer recommendation systems and editorial performance dashboards. A data-driven mix of publishing models, including diamond OA for core society journals and transformative agreements for others, can help to preserve scholarly missions while responding to shifting market conditions. Automated integrity reporting metrics on desk rejections, review times and COPE compliance, for example; can further prove editorial quality and differentiate society journals from predatory alternatives.
- Research Ecosystem Stakeholders (Libraries, Universities, Funders & LMIC **Researchers):** Libraries, universities, funders and researchers all have a crucial part to play in supporting a sustainable, EIS-oriented

publishing ecosystem. Libraries and universities can use EIS indicators in their evaluation of publishing agreements, with an eye to efficiency, transparency and integrity, not just journal prestige. Data on publication costs, turnaround times and quality of service can help in negotiations, help to ensure fair policies on APC reimbursement and provide the rationale for investing in community-owned publishing infrastructure. Research funders can support these efforts by requiring the publications they support to meet minimum EIS standards, including transparent pricing, rigorous peer review practices, and proof of cost-effectiveness [13]. Funding agencies might also want to fund the development of open-source editorial AI and analytics tools, lowering the barriers for smaller publishers and strengthening the overall scholarly communication infrastructure. Systems that are data driven can reduce financial and informational barriers for researchers in low and middle income countries (LMICs). Automated APC waivers or discounts linked to institutional and national economic indicators could lead to better equitable access to publishing opportunities[6]. Also, algorithmically generated lists of reliable journals and capacity building programs based on analytics can help researchers to avoid predatory journals and increase engagement in the global scholarly communication. Taken together, these efforts contribute to a more equitable and sustainable research ecosystem in which the ability to publish is driven by the quality of the research and not the ability to pay.

5.1. The EIS Productivity Paradigm

Efficiency, Integrity, and Sustainability (EIS) in Scholarly Publishing

Efficiency in publishing is about the maximum scholarly output (papers processed or published) for a given input (time, labour, money). In practice, journals monitor speed and cost-effectiveness of the workflow. For example, the Royal Society notes “time taken from receipt to publication” as an important measure of editorial efficiency [17]. Editors frequently have targets (such as a target number of days to first decision) and monitor average turn-around times. Similarly, experts on journal management recommend the systematic monitoring of editorial performance metrics to identify bottlenecks and improve workflow efficiency [18]. The efficiency indicators are:

- Time to decision: median days from submission to first editorial decision.
- Time to publication: median days from submission to final publication [17].
- Cost per article. Total editorial/publishing cost/number of articles (e.g. APC cost)
- Throughput: number of articles handled per editor or per year (e.g. submissions processed, acceptance rate) [18].
- Process bottlenecks: e.g. fraction of desk rejections (signalling fast triage) or reviewer turnaround times [18].

Integrity means that the scholarly record is trustworthy, and that published research is accurate, ethical, transparent, and reproducible. It contains ethical standards, rigorous peer review and safeguards against misconduct. Bolland et al. have pointed out that robust review processes and protection from fabrication, falsification, plagiarism and undisclosed bias are key to reliable scientific literature [19]. Publishers are increasingly developing dedicated research integrity teams and using automated screening tools to detect ethical issues before publication [20].

Signs of integrity are:

- Retractions/corrections: low rates of retraction or correction indicate a lower number of serious errors or cases of misconduct [19,20].
- Ethical compliance: percentage of journals having ethics policies (e.g. membership of COPE), mandatory disclosure of conflict of interest and funding sources [19].
- Quality checks: tools used to identify plagiarism, image manipulation, paper mills, ghostwriting and other misconduct pre- or post-peer review [20].
- Transparency: open peer review, published histories of review and clear reporting of editorial policies. But initiatives such as Plan S also call for transparency in APCs and that their charges match the services provided.
- Public trust metrics: reader surveys, external audits, or independent evaluations of editorial and peer-review processes [19].

Sustainability means the long-term viability, resilience, and fairness of scholarly publishing models. A sustainable publishing ecosystem needs stable and diversified funding, fair opportunities for authors and wide access to research outputs. Recent stakeholder surveys identify affordability, openness, transparency and benefit to the community as central elements of sustainable publishing [21]. Sustainability indicators include:

- Open access (OA) share: proportion of publications published OA, notably via diamond or platinum OA models that do not charge author fees [21].
- Cost/affordability: average article processing price and availability of exemptions or reductions, notably for researchers from low- and middle-income countries [21].
- Revenue diversity: mix of APCs, subscriptions, society funding, institutional support, grants, transformative agreements.
- Financial transparency: publication of budgets, APC calculations or cost breakdowns, as recommended by open access initiatives.
- Longer time horizons: formal sustainability plans, endowments or participation in multi-year read-and-publish and subscribe-to-open deals.
- Mission Alignment: Support for journals owned by society, led by scholars or community-based journals that reinvest revenue back into the research community [21].

Each can be measured and reported. Journals often report median decision and publication times as a proxy for efficiency [17,18], retraction and correction statistics as a proxy for integrity [19,20], and disclose APC policies, waiver programs, and funding structures as a proxy for sustainability [21]. These indicators allow publishers, libraries, funders, and researchers to evaluate and compare performance across the three interconnected dimensions of Efficiency, Integrity, and Sustainability (EIS) in scholarly publishing.

6. Conclusion

The OA funding crisis is the inevitable outcome of legacy models in tension with global scale. Article fees and big deals are not the enemy per se. Their unsustainability is inherent in obsolete operational models. The EIS framework has helped diagnose these problems; now we must act on this. Parts of this vision are already enabled by predictive analytics and AI: automated triage tools, APC calculators, and pilot programs for tiered pricing today[13][14]. Scaling these innovations through publisher investment, library consortia and funder mandates can build an OA ecosystem which is cost-effective, trustworthy and equitable. Policymakers should incentivize EIS compliance (e.g., via funding shared AI tools and requiring transparency), so predatory, volume-driven models are crowded out. Instead of whining about high fees, the global research community needs to demand hard metrics of efficiency, integrity and sustainability. Only a coordinated, data-driven approach like this can deliver the promise of open access for authors, readers and society alike.

- Knowledge Gaps and Limitations

The proposed EIS framework indicates the promise of AI-enabled publishing systems, predictive analytics and editorial intelligence, but a few limitations should be acknowledged. First, the application of AI-based tools for manuscript review could create algorithmic bias that could influence editorial decisions and discriminate against some authors or topics. Second, the advanced analytics and automation systems may require significant financial investment, which may be difficult for smaller journal and society publishers to afford. Third, privacy and data governance issues are critical to data collection and processing for publication, and should be dealt with through appropriate safeguards. Fourth, over-reliance on automated systems can result in less human oversight and new threats to the integrity of research. Poor algorithms may also have a counterproductive effect on authors from underrepresented regions or institutions, thus undermining the goals of equity. Future research should empirically evaluate these risks and develop governance frameworks for the responsible, transparent and inclusive deployment of AI and analytics in scholarly publishing.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflicts of interest regarding the publication of this paper.

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