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Towards a Better Peer Review System:

Challenges, Innovations, and Blockchain Solutions

A research report produced by Agnostica, Ltd

https://agnostica.global

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November, 2025

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Executive Summary

This report presents a comprehensive analysis of **academic peer review challenges and potential improvements.** Twelve professors from U.S. research universities participated in semi-structured interviews between late 2024 and early 2025. Participants ranged from second-year assistant professors with only a few publications and limited reviewing experience, to full (tenured) professors with extensive leadership (Dean, Assistant Dean for research, etc.) and editorial board (Executive Editor, Editorial Board Member for multiple journals, etc.) experience. All had served as reviewers or editors, and most had firsthand experience navigating promotion and tenure processes (both being granted tenure, and later, serving on promotion and tenure committees). These professors ranged from eight interviews with editors, reviewers, and researchers – including extensive conversations with leading researchers, editors and deans: Dr. Oscar and Dr. Gale. Key findings and proposals include:

- **Major Challenges:** The current peer review system faces a **reviewer recruitment crisis**, misaligned incentives, variable quality control, opacity, and heavy editorial workloads. A small minority of academics perform a majority of reviews, leading to burnout and delays. Review labor is largely **unrewarded and undervalued**, creating a disincentive to participate. The process is often criticized as *slow, biased, and opaque*, with editors struggling to find qualified reviewers and authors frustrated by mysterious decisions.

- **Proposed Improvements:** Interviewees identified several avenues for reform. These include establishing better **incentive structures and recognition** (e.g. requiring authors to review, granting formal credit in hiring/promotion), providing **training and mentoring** to improve review quality, leveraging **automation and AI tools** to assist editors (for reviewer matching, plagiarism or AI-content detection), and experimenting with **new peer review models** (such as open peer review or post-publication review) to increase transparency and efficiency. Crucially, any new approach must balance speed with rigor – *"speed is not important if the review is bad"*, as Dr. Oscar put it.

- **Blockchain Feasibility:** Blockchain technology offers promising – but not plug-and-play – solutions to some of these issues. A decentralized platform could implement **verifiable reviewer identities and reputation**, **transparent and tamper-proof review logs**, and **tokenized incentives** (e.g. reviewer rewards held in escrow and released upon timely completion). Interview input and industry use cases (e.g. ResearchHub, Orvium) suggest blockchain can enhance trust, accountability, and reward mechanisms in peer review. However, adoption hurdles are significant: integration with existing publishing workflows, cultural resistance, and ensuring confidentiality will be as challenging as the technology itself. Any blockchain-based system must be carefully designed with academia's norms in mind to avoid unintended consequences.

In the following sections, we delve into these themes in detail – first examining the pain points of the status quo, then exploring practical improvements, and finally assessing how blockchain could play a role in a future peer review ecosystem. Quotes from Dr. Oscar and Dr. Gale are highlighted to illustrate expert perspectives, while other interviewees' insights are incorporated anonymously. The goal is to blend policy-level analysis with real-world anecdotes to illuminate both the urgency of reform and the nuanced trade-offs any solution must navigate.

Challenges in Current Peer Review Practices

Peer review remains the "gold standard" for validating research, yet those on the front lines describe a system increasingly under strain. Across the interviews, a clear consensus emerged that the traditional

peer review model is **“on its last breath”**, as Dr. Gale Dr. Gale quipped, even if no obvious successor has taken its place. This section synthesizes the major challenges identified by editors and researchers, which collectively underscore why rethinking peer review is both difficult and necessary.

Reviewer Recruitment & Workload Crisis

One of the most frequently cited challenges is the **difficulty of finding willing and qualified reviewers**. Dr. Gale confessed she is *“perplexed by the mass refusal to review”* that has taken hold in recent years. In her experience as a journal editor, what used to be considered a prestigious duty has turned into a thankless chore that many academics now avoid. “Everybody wants their paper reviewed, but nobody wants to review anybody else’s paper,” she observed wryly. This imbalance is borne out by industry data: *only ~20% of researchers perform 70–95% of the reviews*, meaning a small, overtaxed minority shoulders most of the burden, with roughly 80% of professors outsourcing their shared governance to others. Several interviewees noted that the COVID-19 pandemic greatly exacerbated this trend – with increased personal and teaching demands, *“peer review was the first ballast to be jettisoned”*, as one researcher put it, leaving editors scrambling for willing referees.

The **editorial workload** associated with peer review has ballooned as a result. Dr. Gale recounted how she often had to **invite 10 people to get 3 to agree** to review, an effort-intensive process that can delay decisions and degrade quality. *“By the time you’re at number 10, that person might be tangential in expertise…You’re starting to get desperate, and that’s not gonna give you the best reviews,”* she said, noting that having to settle for less-qualified reviewers becomes inevitable. This Catch-22 fuels a vicious cycle: as more papers are handled by overburdened or out-of-field reviewers, the average quality of reviews drops, which in turn frustrates authors and editors alike.

Several **structural factors** underlie the reviewer shortage. Academia’s incentive system is heavily tilted toward *producing* articles, not reviewing them – a misalignment discussed below. Moreover, the growth in research output (with submissions rising each year) has simply outpaced the growth of the reviewer pool. One editor noted that in emerging research hotspots (e.g. China), scholars publish far more papers than they review, creating a global imbalance. Junior researchers may also feel unprepared or unauthorized to review, leaving the duty to a shrinking cadre of senior experts. Without intervention, many fear the **peer review workload is reaching unsustainable levels**, where delays lengthen and the system’s credibility erodes due to reviewer fatigue.

Poor Incentives and Lack of Recognition for Reviewers

Virtually all interviewees agreed that the academic reward structure fails to adequately recognize peer review contributions. *“It’s totally undervalued… you are never given much credit for doing any kind of service, and yet you’re expected to do a lot of it,”* Dr. Gale remarked about university promotion criteria. Serving on editorial boards or reviewing manuscripts is seldom counted formally in hiring, tenure, or grant decisions. As a result, researchers understandably prioritize activities that *are* counted (publishing, grant-writing, teaching) over the invisible labor of reviewing. Dr. Oscar summarized the problem bluntly: reviewing is “**not really properly valued in general**” in academia.

Over the years, journals and publishers have attempted to **incentivize reviewers** with token gestures. These include thank-you **certificates**, **acknowledgment letters**, small **honoraria or discounts**, and awards for exemplary reviewers. Dr. Oscar described how some publishers issue formal certificates of appreciation (Springer even auto-generates them for each completed review) and others like MDPI offer voucher discounts on article processing charges (on the order of ~$100 off APCs per review). In Indonesia, he noted, local journals often send appointment letters recognizing one’s reviewer service – meaningful domestically but not internationally. Dr. Oscar himself received a “good reviewer” award from Springer for timely, high-quality feedback. While appreciated, these measures are limited in impact. *“They are not*

enough," he admitted, because the fundamental culture is *"used to not paying reviewers"* or rewarding them in substantive ways. The norm of volunteer peer review remains deeply entrenched.

Indeed, opinions diverge on whether **monetary incentives** are desirable at all. Some interviewees – especially editors like Dr. Gale – expressed strong caution about paying reviewers. *"If you start paying people, I guarantee you you'll be gaming the system,"* she warned. Her concern is that **pay-per-review** would attract the wrong motivations: *"I don't want to submit a paper to some guy who does 20 reviews on a Friday just to make money. How carefully is he going to read my paper?"*. In this view, a flat payment could encourage speed over quality – reviewers rushing through reports to maximize income, or even outsourcing the work to students or AI. Dr. Oscar echoed some of these concerns, noting that any simplistic pay scheme could be gamed. For example, *if reviewers were paid by the word, unscrupulous ones would "ask ChatGPT to make it longer"* just to inflate the word count. He observed that academics have a "resistance to money-oriented" peer review in general, fearing it might erode the altruistic, community-driven ethos of the enterprise.

Yet, the **status quo of zero reward** is clearly problematic. Many interviewees advocated for a middle ground: **strengthening non-monetary incentives and recognition**. Several concrete ideas emerged:

- **Require contributions from authors:** To address the asymmetry Dr. Gale described, some suggest a *"pay it forward"* model. *"If you submit to a journal, you have to commit to doing two reviews,"* she proposed as a policy. This would directly link publishing and reviewing in a reciprocal obligation. A few journals have toyed with such policies or informal expectations, but it's not yet widespread.

- **Embed reviewing in career metrics:** Dr. Oscar argues that if universities and funders *"officially recognized [reviewing] by institutions"* – for instance, by counting verified review contributions in annual evaluations or Key Performance Indicators – researchers would feel a greater incentive. One can imagine an academic CV listing not just publications but also number of reviews completed, possibly with a performance rating, which promotion committees could value as service to the field. This however would represent a large cultural shift in universities.

- **Public or community recognition:** Several noted the rise of platforms like **Publons** (now integrated with Web of Science) that record and showcase reviewers' work. Publons allows a researcher to maintain a profile of reviews done (without revealing manuscript details). *"It's a list of all the reviews they've done"* which can serve as a reputation indicator. However, currently one can only see one's *own* record on Publons, not others', and it remains a self-curated metric. This is handled similarly with ORCID as well. Interviewees suggested making such records more **open and transparent** – for example, a **public ledger of review contributions** (discussed more under blockchain) – to confer community prestige on active reviewers. Many journals already publish annual reviewer thank-you lists; extending that to quantifiable, verifiable credit could help shift norms.

- **Institutional rewards:** Short of direct payment, universities could offer perks for heavy reviewers – e.g. a teaching release for performing a certain number of reviews, or small research grants/travel funds for those recognized by journals. A few publishers also give out **"Reviewer of the Year" awards** with prizes. These initiatives remain patchy, but they indicate growing acknowledgement that without better incentives, the peer review system cannot remain viable.

In summary, a major challenge is that the **incentive structure is fundamentally misaligned**: as one interviewee put it, *"We're all under publish-or-perish pressure, so of course people focus on writing their next paper rather than reviewing someone else's"*. Rebalancing this will require **cultural changes** (e.g.

valuing peer review as scholarship) in tandem with policy changes (requirements or rewards for reviewing). The interviews suggest that academics are open to change here – many *want* to see reviewing treated as a first-class contribution – but the path must avoid perverse incentives that could undermine quality.

Quality Control and Consistency of Reviews

Even when reviewers are secured, a persistent issue is the **variable quality of peer reviews**. *"All the problems around it are humans. Humans are fallible,"* Dr. Gale mused, highlighting that some reviewers do excellent, constructive work while others submit perfunctory or biased critiques. Ensuring consistent, high-quality reviews is an ongoing struggle for editors. Several specific quality concerns were raised:

- **Inadequate or unconstructive reviews:** Both senior editors shared anecdotes of receiving reviews that were not only unhelpful but in some cases *unprofessional*. *"I've had people say very nasty things in reviews that are really quite shocking,"* Dr. Gale said, recalling comments that she felt should never have been passed to authors. These include snide remarks or ad hominem criticism that offer little scientific value. Part of the problem is that **reviewers operate in isolation** – unless an editor intervenes, there's little accountability for a poorly done review or a rude tone. The opaqueness of the process (discussed in the next subsection) means authors often have no recourse against a bad review aside from hoping the editor will disregard it.

- **Biases and conflicts of interest:** Humans are subject to conscious or unconscious biases. Reviewers may be biased against competing research groups or certain methodologies. Dr. Gale noted *"reviewers can be biased – you can have jealousy, discrimination, exclusionary practices"* that creep in. There is also the risk of **conflicts of interest** if reviewers are direct competitors. Journals try to mitigate this with anonymous review and COI policies, but it's not foolproof. A few interviewees mentioned that increased diversity among reviewers and perhaps **blinded or charmed review models** (where identities are hidden or revealed at the right time) could help, but these solutions are imperfect.

- **Inexperience of reviewers:** A subtler issue raised by Dr. Oscar is that **junior or untrained reviewers sometimes deliver poor feedback**, or even have expectations misaligned with real-world publishing, simply out of lack of experience. In his words, first-timers might write critiques that are *"impossible to fulfill"* or even include *"fake things"* in their review reports. For example, a novice reviewer might ask an author to perform an experiment that is completely outside the scope of the paper, or cite literature inappropriately. These reviews can derail the process, confusing authors or leading to unfair rejections. Both Dr. Oscar and Dr. Gale stressed the need for *mentoring and guidance* to bring new reviewers up to standard. *"Editors have to play a role in that,"* Dr. Gale argued, describing how she has at times coached reviewers: *"I'm going to send this back to you, and you're taking out this part here [because it's not appropriate]. Then send it back to me."*. However, not all editors invest such time – and not all reviewers receive feedback on their performance.

- **Predatory and AI-generated reviews:** An alarming development noted by Dr. Oscar involves **predatory journals and the use of AI to generate reviews**. In our interviews, he described how some illegitimate or low-quality journals boast extremely rapid peer review, which is often a red flag. *"They have high payment and rapid, often AI-generated review processes,"* he said of these predatory outlets. In one case, a student he knew received an obviously computer-generated peer review containing irrelevant feedback, demonstrating the potential for abuse when automation is misapplied. Such practices severely undermine quality control, as they give the appearance of peer review without the substance. Even in legitimate venues, editors now worry about reviewers possibly using tools like ChatGPT to write their critiques without disclosure. This raises questions

about accuracy and integrity – a human signing off on an AI-written report might miss subtle errors or context. Ensuring quality thus now includes verifying the authenticity of reviews and their content.

To tackle these issues, interviewees suggested a mix of **policy and technology responses**. Many called for **better reviewer training** – for example, formal workshops or modules on "how to peer review" for graduate students and new faculty. Some journals and universities have begun offering such training, recognizing that reviewing is a skill that can be taught. Senior mentors can also help by inviting junior colleagues to co-review papers (with permission), thereby modeling good practices. On the technology front, editors envision tools that could assist in quality control: for instance, **algorithms to flag unusually short reviews or overly negative sentiment**, helping editors spot possibly inadequate reports. One editor mentioned the idea of a **reviewer rating system**, where editors rate the helpfulness of each review and over time reviewers build a score (some journals like *Elsevier's* have an internal reviewer score already). If transparently shared, this could incentivize reviewers to be more diligent, although it might also discourage reviewers from taking on tough papers for fear of a bad score.

Dr. Oscar, with his computer science background, proposed an innovative approach: using **federated learning to evaluate review quality** without exposing the review text. In concept, each publisher's system could locally analyze a review (for length, complexity, perhaps an editor's rating) and then send only an aggregate metric to a central reputation system. This would preserve confidentiality while still allowing a network to accumulate data on review quality and timeliness across platforms. Such technical solutions are still nascent, but they show promise in **standardizing quality control** in a scalable way.

Finally, greater **transparency (discussed next)** can itself improve quality. If reviewers know their work might be made public (even anonymously), they may put in more effort or at least mind their tone. *"Maybe people would be more responsible,"* Dr. Gale said of the prospect of publishing peer reviews. In sum, maintaining high peer review standards remains a human challenge at core – but thoughtful training, feedback mechanisms, and supportive technology can mitigate the inconsistencies that currently frustrate authors and editors.

Transparency and Trust in the Process

Traditional peer review has often been described as a "black box." For authors, and even for readers of published papers, much of what happens during review is invisible. This opacity can breed mistrust: authors wonder if their work got a fair hearing, or why a decision was made, while the broader community has no record of the vetting a paper received. **Increasing transparency** was a recurring theme in our interviews, but it comes with trade-offs.

On one hand, openness is seen as a way to **hold reviewers and editors accountable**. Dr. Gale is not opposed to the idea of *publishing peer review reports anonymously*, after decisions are made. *"I don't really mind [that idea] because maybe people would be more responsible,"* she noted. If the content of reviews were visible to the community (with reviewer identities redacted), it could shine light on the quality and fairness of the evaluations. Cases of unprofessional or off-base reviews, as she described, would be apparent for all to see – which might discourage such behavior. Some journals have already adopted this approach: for example, **open peer review** models (used by eLife, F1000Research, *Nature Communications,* etc.) publish the review reports alongside the article, sometimes even with the reviewer names if they agree. Interviewees familiar with these models felt that **transparency generally improves civility and constructiveness**. As Dr. Gale put it, *"people would quickly see that [telling an author 'why didn't you do it my way?'] is a pretty stupid way to do a review"* if those comments were publicly accessible.

Greater transparency can also educate the community. Early-career researchers can learn how reviews are written by reading actual examples. It demystifies the process – instead of wondering why a manuscript

was rejected, one could read the reasons (assuming reviews are published or at least shared with all authors). Some interviewees suggested **sharing anonymized past reviews internally** as a resource for new reviewers to emulate (several journals do publish "best review" excerpts or guidelines distilled from real reviews).

However, **transparency has its downsides**, and interviewees cautioned about those as well:

- **Retaliation or pressure:** If reviewer identities are revealed (even informally), there's a risk of blowback, especially for junior reviewers who criticize senior authors. Even making review texts public, some feared, could lead to authors trying to guess or find out who reviewed them and then holding grudges. This is why most open review implementations keep reviewer names hidden unless voluntarily disclosed.

- **Bias introduction:** Dr. Oscar noted that a fully open reputation system (where one's reviewing history is public) could inadvertently *"harm the junior scholars, because they do not have [a large review record]"*. In a transparent world, editors or algorithms might favor veteran reviewers with long track records, sidelining capable younger researchers who haven't had time to build a reputation. This is a real concern: transparency must be balanced with inclusivity. Dr. Oscar's stance was that it's acceptable to favor experience to an extent – *"more experienced people"* should be higher in the queue for assignments – but he also believes in giving newcomers opportunities to prove themselves. Any reputation display should be designed so that it doesn't permanently lock out newcomers (for example, by weighting recent activity more, as he suggests).

- **"Trolls" and noise:** An open peer review process (such as allowing public comments on preprints or journals) can invite unqualified or bad-faith inputs. *"If you put it out open, you have trolls and idiots jumping in,"* warned Dr. Gale bluntly. Broadly opening reviews to anyone (a kind of crowd review) might solve some problems but create others. Maintaining quality in an open forum is challenging – moderation would be required to filter out nonsense or harassment. This is analogous to the moderation issues on public platforms; scholarly discourse could be disrupted by a few loud, unqualified voices if not managed.

Despite these concerns, there was an overall sense that **smart increases in transparency are worth trying**. Several interviewees endorsed **publishing peer review histories** in some form. One suggestion was that journals could post a *summary of the peer review process* for each article: how many rounds of review, general nature of feedback, etc., without naming names – to give readers confidence that rigorous vetting occurred. Others advocated for journals to allow authors to share their decision letters and reviews (some authors already do this on personal websites or preprint servers).

Interestingly, Dr. Gale tied the issue of transparency to the broader crisis of **misinformation and public trust in science**. In an era of rampant science denial, she expressed caution about completely abandoning traditional peer review, for fear that it might **undermine public trust** further. Transparency could be a double-edged sword: on one hand, showing the public how review improves papers might enhance credibility; on the other, airing all the scientific disagreements and criticisms openly could be weaponized by science skeptics. For now, she leans toward **incremental changes** rather than radical openness: *"I feel like this is not the right time to give up on the traditional model entirely… I'm totally for trying new models and seeing what they can do, but putting the nail in the coffin of the traditional model seems dangerous to me [right now],"* she said.

To conclude, the trustworthiness of peer review hinges on an optimal balance of **transparency and confidentiality**. The traditional model skews toward secrecy (anonymous reviews, confidential deliberations). Future models may push the pendulum toward openness, leveraging transparency to drive

accountability and trust. Our interviewees envision a system where authors and the community have more visibility into how decisions are made, yet reviewers are protected enough to be honest, and junior reviewers are not shut out. Achieving this balance is a delicate social engineering challenge that any new platform – blockchain-based or otherwise – must carefully navigate.

Editorial Burden and Systemic Inefficiencies

Finally, our interviewees highlighted some practical pain points that affect editors and the overall efficiency of peer review. Many current processes are **archaic or siloed**, adding undue burden:

- **Fragmented submission systems:** Editors who handle multiple journals noted that each publisher often uses a different platform (e.g., ScholarOne/Manuscript Central, Editorial Manager, OJS, etc.), and these systems do not interoperate. *"Each big publisher has its own platform… they do not use Manuscript Central universally,"* Dr. Oscar observed, calling this fragmentation *"problematic"*. A reviewer might have profiles in a dozen systems, and an editor can't see their full reviewing history in one place. This also causes the duplicate identity issue Dr. Oscar described – e.g., the same person with two emails might appear as separate reviewers in Web of Science's database. Merging these identities manually is tedious if not impossible. Such inefficiencies waste editors' time and obscure useful information about reviewer expertise and workload.

- **Limited reviewer search tools:** While systems like ScholarOne offer an automated "reviewer locator," these tools are often limited to indexing certain databases (chiefly Web of Science for ScholarOne). Dr. Oscar pointed out that this misses many qualified experts – for instance, those not indexed in WoS, or practitioners outside academia. Editors end up relying on personal networks or Google searches to find reviewers, which is time-consuming. A more integrated, intelligent search drawing from multiple sources (WoS, Scopus, Google Scholar, ORCID, university directories, etc.) would greatly ease the burden.

- **Manual clerical tasks:** Editors still do a lot of clerical work – checking references, ensuring submissions meet formatting guidelines, sending reminders to reviewers, etc. Dr. Gale lamented the loss of copy editors (in the publication process) which now leaves even typo-catching to authors and reviewers. There is room for **automation** to assist here: for example, tools that automatically verify references or check for common reporting issues in a manuscript could save reviewers from doing it.

- **Slow turnaround and communication:** Authors often complain (and editors agree) that the peer review cycle is slow. Part of this is due to reviewer recruitment delays and multiple rounds of revision. Interviewees suggested **better tracking and communication** could help – e.g., systems that show authors where their paper is in the pipeline (awaiting reviewer assignment, under review, etc.), which some modern platforms do. Also, practices like transferring reviews between journals (cascade review) can prevent re-reviewing the same paper multiple times at different journals, thus reducing redundant work – but this requires coordination among publishers.

Addressing these systemic issues doesn't grab headlines, but it's essential for any **comprehensive improvement**. Some proposals from interviewees included:

- **Unified reviewer profiles:** Implement a universal identifier (like ORCID) for reviewers across platforms to aggregate their contributions and avoid duplications. This could be facilitated by blockchain (each reviewer having a decentralized ID), as discussed later.

- **AI-assisted editor tools:** Develop AI that can recommend reviewers based on a manuscript's content (natural language processing to find topic matches) and a reviewer's past work. Also, AI that can flag potential conflicts of interest or detect if a submitted paper is very similar to others (plagiarism or duplicate submission detection) can lighten editors' screening work.

- **Workflow integrations:** If a new platform (like the one this project team is exploring) is built, it should aim to **integrate with existing editorial systems** rather than expect everyone to adopt a brand new system overnight. Plugins or APIs that allow data sharing (for example, feeding review metadata to a blockchain while editors continue using their familiar interface) would smooth adoption. Dr. Oscar mentioned the need to *"persuade each publisher one by one"* for any new system, hinting that offering easy integration (instead of a rip-and-replace) is key to overcoming resistance.

- **Focus on meaningful metrics:** Editors are often evaluated by metrics like turnaround time, which can incentivize rushing. Dr. Oscar urges that **quality metrics** take precedence over speed. A pilot system might measure success in terms of review constructiveness (perhaps via post-review ratings or re-review rates) rather than just how fast decisions are made. This ties back into incentive alignment: rewarding quality will encourage all participants to take the process seriously, even if it takes a bit longer.

In summary, the current peer review system's challenges are multifaceted – cultural, structural, and technical. From overburdened reviewers to lack of rewards, from variable quality to lack of transparency and clunky workflows, these pain points paint a picture of a system in need of innovation but also cautious stewardship. As Dr. Gale aptly analogized, *"peer review is the worst system except for all the others"* – it's deeply flawed, yet any replacement must be careful not to throw out the baby with the bathwater. **Improving peer review will require simultaneous progress on many fronts**, as the next section explores, combining policy changes, community efforts, and technology.

Practical Proposals for Improving Peer Review

What can be done to fix peer review? Our interviewees offered a range of solutions – some incremental, some radical – to address the challenges outlined above. Broadly, their suggestions fall into a few thematic areas: **incentivizing and recognizing reviewers; training and expanding the reviewer pool; harnessing technology to streamline processes; and experimenting with alternative peer review models**. In this section, we synthesize these proposals. At the outset, it's worth echoing a sentiment expressed by Dr. Gale: *"If it were simple to fix peer review, it would've been done a long time ago"*. Every intervention has trade-offs, but together these ideas sketch a roadmap toward a more efficient, fair, and sustainable system.

Strengthening Incentives and Recognition for Reviewers

Perhaps the clearest theme was the need to **realign incentives** so that reviewing is no longer a thankless task. There was broad support for measures that **compel or entice more academics to participate in peer review**, without undermining the volunteer spirit that good reviewing relies on.

Mandatory Reviewing Commitments: One straightforward approach, raised by multiple interviewees, is to tie reviewing to publishing through **mandatory commitments**. For example, journals (or funding agencies) could require that for every paper submitted, the authors must have performed a certain number of reviews in the recent past. Dr. Gale's proposal that each submission be accompanied by an agreement to review two other papers is one model. Some conferences already use similar policies (e.g. an author

must volunteer to review submissions if they are submitting). This would immediately broaden the reviewer pool and distribute work more evenly. There are challenges – authors might perform token reviews just to fulfill the requirement, and ensuring quality would be crucial – but it enforces the principle of reciprocity. In a decentralized platform context, one could imagine smart contracts enforcing this: e.g. an author can't post a new manuscript for review until they have earned two "review credits" by reviewing others.

Academic Credit and Career Incentives: As discussed in the challenges section, a powerful lever is to **give formal academic credit for peer review**. Interviewees suggested that institutions could include review activity in annual performance reviews or tenure dossiers. One concrete idea was to create a **"review score" or index** for researchers (similar to an h-index but for reviewing) that could be reported. Dr. Oscar mentioned that if the academic community "imposed" that review work counts, institutions would adapt and "make KPIs" around it. For example, a university could set a guideline that faculty are expected to perform, say, three reviews per year and could acknowledge that in service contributions. Another suggestion was **awards and recognition at the institutional level**: e.g. a university could have an annual award for outstanding peer reviewers in each department. Normalizing these practices would slowly shift culture: as one interviewee noted, *"people respond to what affects their career – make reviewing matter for promotions and you'll see more of it."*

Reviewer Reputation Systems: Several conversations touched on creating a robust **reputation system for reviewers**. This could provide positive reinforcement (public recognition for good reviewers) and also help editors select reliable referees. The current rudimentary version is Publons/Web of Science, which logs reviews but isn't widely used as a selection tool. A more sophisticated reputation system might incorporate **quality metrics** (e.g. editor ratings of review usefulness, timeliness of completion) rather than just quantity of reviews. Interviewees envisioned that such a system could be made **transparent (with permission)** to signal who the community's top reviewers are. Dr. Oscar is enthusiastic about this, especially if implemented via blockchain for tamper-proof verifiability. However, he and others stressed it must be **fairly designed** so as not to discourage new reviewers. One idea is a *normalized score* that weighs recent activity, ensuring that an emeritus professor who reviewed hundreds of papers decades ago doesn't automatically outrank a mid-career researcher actively reviewing now. The reputation system could also include **badges or levels** (e.g. "Expert Reviewer – Level 2") to gamify participation in a positive way.

Non-Monetary Rewards and Perks: In lieu of direct payment (which, as noted, is controversial), there are other rewards that could motivate reviewers:

- **Discounts and vouchers:** Expanding programs like MDPI's discount vouchers for APCs could appeal to those who publish in those journals. A decentralized platform might reward reviewers with tokens that can be used to offset publication fees or conference fees.

- **Continuing Education credits or Certificates:** In some professions, performing certain volunteer tasks yields continuing education units or certificates that can be used in annual evaluations. Journals could offer certified letters praising a reviewer's contributions, which faculty could use in evaluation dossiers.

- **Priority in one's own submissions:** A tantalizing idea is giving frequent reviewers some priority when they submit their own papers – for example, guaranteeing a faster review or allowing an extra round of revision. This would need careful implementation to avoid bias, but it essentially says: help others and you get a smoother ride when you're an author.

- **Networking and Visibility:** Top reviewers could be invited to join editorial boards or program committees, which raises their professional profile. Some interviewees noted that being on a journal's board, while time-consuming, is considered prestigious and signals expertise. Thus, using

review performance as a pipeline to editorial roles can be a motivator.

Interviewees acknowledged that none of these incentives alone will magically fix the problem. But collectively, they can **foster a culture where reviewing is expected and respected**. The goal is to transform peer review from an "optional altruistic chore" into a normal part of a researcher's job description – without losing the sense of scholarly duty that ensures reviewers actually care about doing it well.

Expanding and Training the Reviewer Pool

Given the reviewer shortage, another obvious strategy is to **increase the supply of capable reviewers**. This means both tapping new sources of reviewers and improving the skills of existing and nascent reviewers.

Engaging Early-Career Researchers: Many interviews highlighted that *graduate students and postdocs* are an underutilized resource for peer review. Often, PIs will receive an invitation and delegate it to a student (with the editor's approval) as a training exercise. Making this more systematic could help. Journals could more often allow co-reviewing (some journals do this presently), where a junior person's review is submitted alongside a senior mentor's oversight. Or conferences could explicitly include senior PhD students in their reviewer pools for student papers. One interviewee suggested creating a **mentored reviewer program**: newcomers sign up to review under the guidance of a veteran who gives feedback on their review before it's officially submitted. This not only grows the pool but builds competency.

Reviewer Training Programs: In Dr. Gale's view, there's *"no better education than reviewing"* for learning how to write good papers. However, reviewers themselves may need education. Several interviewees advocated for formal training modules. Professional societies or libraries could offer workshops on how to review (covering ethics, how to structure feedback, etc.). There are already some online courses and resources on peer review (e.g. Publons Academy). Making such training a standard part of graduate curricula or orientation for new faculty would raise baseline competency. Editors like Dr. Gale also practice on-the-job training by giving feedback to reviewers (especially when a review was inappropriate), but not all editors have bandwidth for that. Therefore, institutionalizing training (perhaps via short certifications) could ensure new reviewers don't go in blind. As a bonus, those who complete training could earn a certificate or badge, feeding into the **reputation system** mentioned earlier.

Broadening the Pool Beyond Academia: A few interviewees mused about looking outside the usual circles for qualified reviewers. For example, industry researchers or retired academics could be invited more often – they are less under publish-or-perish constraints and might have more time. For applied fields, practitioners can offer valuable perspectives. The challenge is identifying and reaching these people, which ties back to improving search tools. A decentralized approach (like putting out open calls for reviewers on certain topics) might draw in fresh expertise, though it raises quality control concerns (screening volunteers for actual expertise is needed). Still, the idea is to **break the dependence on the same small set of reviewers** by recruiting more diversely.

Reducing Barriers to Reviewing: Part of expanding the pool is making it as easy as possible to say "yes" to a review request. Interviewees noted a few barriers: clunky systems requiring multiple logins, lack of access to the full paper if a university library doesn't subscribe, etc. Ensuring that when someone is asked to review, they can easily access the manuscript and relevant files (perhaps via a secure, one-click link) would remove minor annoyances that sometimes deter busy people. Additionally, clarifying expectations (e.g. providing an estimated time commitment or a checklist) can help potential reviewers plan. One researcher said he often declines because he's unsure how much work a given review might be; if editors provided more info upfront ("this is a short theoretical paper, ~20 pages, we need the review in 3 weeks"), it would aid decision-making.

Recognizing and Improving Poor Reviewers: Expanding the pool isn't just about new people – it's also about *improving the output of existing reviewers*, especially those who may be well-intentioned but deliver mediocre reviews. Interviewees suggested that editors should not hesitate to **give feedback or even block chronically bad reviewers**. If someone repeatedly submits superficial or overly harsh reviews, editors can stop inviting them or convey expectations. In a future platform with a reputation system, poorly rated reviews would naturally curtail one's invitations. Conversely, giving second chances – e.g. if an editor sees potential in a new reviewer's flawed review, they might coach them for next time – can convert a so-so reviewer into a good one. The overarching idea is that reviewing skill can be cultivated, and doing so grows the effective pool of quality reviewers.

Leveraging Technology and Automation

The interviews made it clear that **technology is not a silver bullet**, but smart tools can significantly enhance the peer review process. Two areas stood out: **automation to reduce administrative burdens** and **AI/machine learning to assist in analysis and matching**.

Automated Workflows: Simple automation can save a lot of time. For example, automatic reminder emails to late reviewers, or templates that generate first draft decision letters based on reviewer comments (some editorial systems do this). A more advanced idea is an **AI-driven "virtual assistant" editor** that can handle tasks like checking if a submission meets basic formatting and ethical requirements (e.g. detects if a clinical trial registration is missing, or if references are incomplete) – essentially a pre-review audit. Dr. Oscar mentioned that some platforms (especially in larger publishers) already provide recommendations for reviewers by analyzing the manuscript's references and abstract. Extending this, one could envision an AI that not only suggests names but also provides a confidence score for each suggestion based on expertise similarity.

Reviewer Discovery Tools: Improving the reviewer search functionality is a top priority. The ideal system would allow an editor to input a manuscript (or its key metadata) and query a **large, aggregated database of potential reviewers**. This database would transcend any single publisher – possibly an open network that indexes researchers, their publications, past reviewing history (if available), and areas of expertise. This is a space where a **decentralized platform** could shine by pooling reviewer data across journals. If privacy and data ownership issues can be resolved, such a tool could dramatically cut down the time editors spend hunting for the right reviewers. Dr. Oscar's suggestion to tap into *"broader networks – conference databases, Google Scholar profiles, subject-specific communities"* points in this direction. Some prototype services (like Reviewer Finder by Web of Science, or journal-independent reviewer databases) are emerging, but a unified solution is still lacking.

AI in Manuscript Screening: Interviewees also discussed using AI to assist in evaluating submissions. For instance, natural language processing could help identify papers that are likely low-quality or even AI-generated before sending them to reviewers. Dr. Oscar, as an editor, has learned to spot certain red flags of **AI-generated manuscripts** – *"too beautiful" language with *"hyperbolic"* phrasing but internally inconsistent content. An algorithm trained on known AI-written vs. human-written papers might help flag these for extra scrutiny (though AI detectors are far from foolproof). Similarly, plagiarism detection software is already standard in many journals to catch unoriginal content. These tools indirectly aid peer review by filtering out problematic papers so that reviewers spend time on genuine submissions.

AI-Assisted Reviewing: A provocative topic is whether AI could help write or summarize reviews. None of our interviewees advocated replacing human judgment, but some saw potential in AI-generated *support*. For example, an AI could **summarize a manuscript's key points and known weaknesses** (if trained on similar papers), giving busy reviewers a starting point or a consistency check. It could also compare a manuscript against its references to see if key prior works were cited, or generate a list of questions that a reviewer might consider. There are already tools like Scite.ai that analyze citation contexts, which a

reviewer could use to gauge how a work's claims stand. However, everyone agreed that **AI should augment, not replace, human peer review**, at least until it's far more advanced (and even then, oversight is critical). As Dr. Oscar's anecdote about AI-written reviews shows, unguided AI involvement can be counterproductive. The goal should be to **use AI to handle routine tasks** and surface insights, freeing human reviewers and editors to focus on substantive evaluation.

Federated and Secure Systems: Implementing these tech solutions at scale raises issues of data sharing and confidentiality. Interviewees like Dr. Oscar were acutely aware that publishers are hesitant to give external systems full access to their databases. Hence, the idea of **federated learning or plugin-based architecture** is appealing. Each journal or publisher could run a local module that analyzes data (e.g. calculates a reviewer's performance metrics, or a manuscript's similarity score) and only shares anonymized results to a network. This would maintain the privacy of manuscripts and reviews while still contributing to a global intelligence that benefits everyone. A blockchain could act as the backbone for these exchanges, recording the hashed outcomes without revealing content. For example, a plugin in a journal's system could post to the blockchain: "Manuscript X received a review of Y quality rating on date Z by reviewer ID #123" without exposing the text of the review. This is complex to implement but would elegantly circumvent many integration hurdles. It's essentially the concept of *"bringing the algorithm to the data, not data to the algorithm"* – each repository keeps sensitive data locally but contributes to a decentralized metric or record.

In conclusion, technology can be a force multiplier for peer review improvement. The interviews emphasized targeting tech where it matters: speeding up drudgery, enhancing search and matching, and underpinning new systems of credit and trust (via blockchain, discussed next). Still, a note of realism: as one editor put it, *"Peer review is fundamentally a human process – software can help, but it can't solve biases or make people care."* Thus, tech must go hand in hand with the cultural and incentive shifts outlined earlier.

Exploring Alternative Peer Review Models

Beyond tweaking the existing system, our interviewees also reflected on **alternative models** of peer review that have been tested or proposed. These range from open peer review to completely new publication paradigms. While there is some excitement about innovation, there is also caution – echoing Winston Churchill's famous line (paraphrased by Dr. Gale) that *the traditional model is the worst form…except for all the others tried*.

Open and Transparent Peer Review: We've already touched on publishing review reports openly. Some models also **open up the identity of reviewers** (signed reviews). A few journals (like *Frontiers* and some BMC journals) publish reviews with the reviewer's name. Interviewees were split on this: some believe signing reviews can improve accountability and give credit, while others worry it suppresses honest criticism (reviewers may soft-pedal critiques if their name is attached, especially when reviewing a famous author). A compromise that several favored is **publishing the reports but not the names** – providing transparency of content without forcing disclosure of identity. This retains anonymity's protection while achieving accountability for the content of reviews. Another variant is **collaborative review**: e.g., *eLife* recently adopted a model where after initial reviews, the reviewers and editor confer and issue a consolidated decision letter. This avoids contradictory reviewer feedback and treats peer review more as a consultation than isolated evaluations. Our interviewees with editorial experience appreciated this idea, though noting it takes a strong editor to mediate.

Post-Publication and Crowd-sourced Review: A more radical shift is to decouple peer review from the act of publication. For instance, *preprint servers* allow authors to get feedback from the community (some even have formal commenting systems). Platforms like PubPeer enable comments on published papers by anyone. The advantage is continuous review and **"many eyes"** on the science, potentially catching issues

that two or three assigned reviewers might miss. One researcher we interviewed lauded the speed of such community-driven review: *“Open access (preprint) is much faster”*, he noted, and indeed papers can receive critiques within days of posting. However, the challenge lies in **quality control and noise filtering** – distinguishing expert critique from uninformed opinions or malicious actors (the “trolls” concern Dr. Gale raised). Some platforms attempt moderation or identity verification to ensure commenters are qualified. The **blockchain** concept intersects here: using **decentralized identity** to verify credentials of reviewers in a public forum could allow open commenting while still weighting input by proven expertise. We will expand on that in the blockchain section.

Journal-less Publishing and Peer Review: A few interviewees mentioned the concept of **overlay journals or no traditional journals at all**. In this vision, researchers could publish their articles to a public repository (like arXiv or similar) and peer review is organized in overlay or after the fact. For example, the journal might be a curator that picks papers from the repository and attaches peer review reports to them (the journal stamp). This model can reduce costs and speed, but it requires a trusted way to manage and record peer review. Projects like **Peerage of Science** and **Review Commons** have explored portable peer review: a single set of reviews that an author can take to multiple journals. Our interviewees were intrigued by such models for efficiency, though noted they haven’t yet unseated the traditional journal system broadly.

Decentralized Peer Review Platforms: Some of the more forward-thinking ideas came from those aware of blockchain and Web3 developments. They envisioned a **decentralized platform** where peer review is not controlled by any one publisher but by the community. Such a platform might operate as a **DAO (Decentralized Autonomous Organization)** of scientists, as one interviewee suggested, where reviewers are stakeholders. There could be token incentives, reputation scores, and community voting on acceptance of papers. We discussed examples like **ResearchHub**, which is trying to create a Reddit-like forum for papers with built-in cryptocurrency (RSC) to reward contributions. Another example is **Pluto** and **Eureka** – blockchain-based ecosystems where reviewers earn tokens and smart contracts manage the review workflow. These are early experiments (explored more below, and in this project team’s in-depth report on the current market landscape of decentralized peer review and publication platforms, cited in appendix), but they illustrate an alternative where the *process* of peer review is separated from traditional journals and made more open, transparent, and community-governed.

Caution and Hybrid Approaches: Despite interest in new models, our interviewees consistently urged caution. Dr. Gale, for example, expressed nervousness about throwing out the old system entirely, especially in the current climate of science skepticism. The consensus seemed to be: **experiment, but in parallel to the existing system**, and be ready to address new problems that arise. As she said, *“every time you fix one problem, you create a few new ones”*. Therefore, a likely future is a **hybrid one**: traditional peer review may coexist with new approaches, and best practices from each will inform improvements in the other. For instance, if open review proves successful in certain fields, more traditional journals may adopt elements of it (like publishing anonymous reviews). If token incentives work on a blockchain platform to boost participation, publishers might integrate that idea in a conventional setting.

In summary, there is no shortage of ideas for reinventing peer review. Our interviewees provided a sobering context to these ideas – acknowledging that none is a panacea. But there is also a sense of urgency: the traditional model, *“trucking along”* as it is, might eventually “come off the rails” if nothing changes. Incremental changes (like those earlier in this section) will help, but more transformative models could address root causes of dysfunction. The key will be to *pilot these innovations in controlled ways*, gather evidence (as one interviewee noted, we need more research on peer review itself), and scale up what works.

The next section delves deeper into one particularly promising avenue that was the focus of our Catalyst project interviews: **blockchain-based solutions**. We will examine how blockchain could underpin many of

the improvements discussed – from reputation systems to token incentives and transparent records – and what challenges lie in applying this technology to academic peer review.

The Feasibility of Blockchain in Peer Review and Publishing

Could blockchain technology help fix peer review? This question was central to our project and interviews. Blockchain, with its promise of decentralization, transparency, and tamper-proof record-keeping, appears well-matched to some of peer review's knottiest problems (trust, credit, and data integrity). Over the past few years, several initiatives have indeed tried to marry blockchain with scholarly publishing. Our discussions with Dr. Oscar, in particular, dug into the practical and technical aspects of implementing a blockchain-based peer review platform on Cardano (the context of our Catalyst funding). This section synthesizes those insights alongside industry research and emerging use cases, painting a picture of what a *"Peer Review 2.0"* on blockchain might look like – and what hurdles must be overcome for it to succeed.

Decentralized Identity and Verifiable Reviewer Credentials

A foundational concept is giving each reviewer a **secure, verifiable identity on the blockchain**. Instead of being just an email in an editor's spreadsheet, a reviewer could have a **decentralized identifier (DID)** linked to their professional credentials (ORCID, university affiliations, publication history). This would allow for a few important features:

- **Unified Reviewer Profile:** As mentioned earlier, duplicate or fragmented reviewer records would be resolved. A single digital identity can be used across all journals and platforms. When this reviewer provides a review, that contribution can be logged to their identity.

- **Verifiable Credentials:** Reviews or certificates of reviewing can be issued as cryptographic tokens or records to that identity. For example, after completing a review, a token could be minted to the reviewer's address representing the accomplishment (perhaps with metadata like journal name, year, maybe a rating). Because it's on blockchain, *"it cannot be forged,"* as Dr. Oscar noted – one couldn't claim fake reviews. This tackles the issue he raised where basic PDF certificates *"can be forged"* or exaggerated on a CV. Instead, there's an immutable ledger of one's review contributions.

- **Reputation Score:** With identities and credentials in place, a reputation or score can be algorithmically computed for each reviewer by the system. Dr. Oscar was enthusiastic about designing *"sophisticated metrics"* for this. For instance, the algorithm might consider the number of reviews, the venues (reviews for prestigious journals might weigh more), the quality as judged by editors, and the timeliness. By publishing this on-chain, editors and authors could consult a reviewer's reputation before trusting them. This adds a layer of accountability and trust that currently is missing in ad-hoc reviewer selection.

Cardano offers infrastructure for DIDs (e.g. Atala PRISM) that could be used to implement such identities. The interviews touched on using Cardano's blockchain to store reviewer "credentials and reputation scoring". An important nuance is ensuring the reputation system is **fair to newcomers**, a concern Dr. Oscar raised multiple times. One way is to use *relative or recent activity* as he suggested, so the scoring isn't just a cumulative total that old-timers dominate. Another approach is a tiered system where new reviewers can climb ranks quickly if they perform well, rather than being stuck beneath a glass ceiling of points.

By anchoring reviewer identity and reputation on a blockchain, we effectively create a **decentralized reviewer community** that isn't owned by any single publisher. This could enable mobility and openness – for example, a new journal could boot up and immediately query the blockchain for potential reviewers with

certain reputation levels, without needing to build its database from scratch. Reviewers likewise carry their "peer review resume" with them, which might incentivize them to maintain it diligently.

Transparent and Immutable Review Records

Another touted benefit of blockchain is its **immutability** – once data is written, it's virtually impossible to alter or fake. In peer review, this property can be harnessed to improve **transparency and trust in the review process**:

- **Time-stamping and Provenance:** Each step of peer review (submission, reviewer assignment, review submission, decision) can be cryptographically time-stamped on-chain. Projects like **BeerReview** have used Ethereum to ensure every manuscript is time-stamped at submission and review events recorded. This means there's an indelible audit trail, reducing opportunities for malfeasance (e.g., an editor back-dating a review or an author claiming their paper was mishandled – the timestamps provide an objective record).

- **Tamper-evident Review Content:** While storing full review texts on-chain might be infeasible (and raises confidentiality issues), one can store a **hash of the review text**. This creates a digital fingerprint of the content. If later there's any dispute, one can verify that the review published or communicated to the author is exactly the one that was submitted (no secret edits). It can also allow journals to **publish reviews openly** in a trustworthy way – because readers can see a hash on the blockchain matching the review, proving it wasn't altered post-hoc. Orvium, a blockchain-based publishing platform, uses blockchain timestamps for *"proof-of-existence"* of manuscripts and review records. Authors retain copyright in Orvium's model, but the peer review timeline is transparent and verifiable, which *"gains credibility through tamper-proof processes"*.

- **Open Access to Reviews:** A decentralized network could optionally make review reports public (with or without identities) by linking them to published articles on-chain. For example, a smart contract representing an article could contain pointers to the hashes of its reviews and possibly the content if not sensitive. This could realize Dr. Gale's notion of *"putting them someplace on the web so you could look 'em up"* – essentially a global database of review reports. Of course, for this to work, cultural norms would need to accept such openness, and one might limit it to reviews of published papers (not rejected ones, unless authors consent).

Data integrity is the key here. Blockchain's value is in guaranteeing that once a review or decision is recorded, it wasn't tampered with by an unscrupulous actor (say, a predatory journal claiming "peer reviewed" without actually doing it – a blockchain log would expose the lack of legitimate review events). It could also help resolve disputes: if an author claims their paper was unfairly handled, an independent body could check the blockchain log to see if, for instance, the editor made a decision without the requisite number of reviews, or if a review was submitted very quickly (suggesting low effort). This level of oversight is currently not possible because review data is locked in siloed systems.

One must note, as Dr. Oscar did, that **confidentiality** is a constraint. Therefore, most blockchain implementations opt to store metadata and hashes, not raw content. This strikes a balance: *transparency of process* without exposing the private content of reviews (unless desired). The interviews also surfaced the idea of **selective transparency** – e.g., making data available in aggregate or after a time delay. A journal might commit its review records to blockchain but keep them encrypted for a period (accessible only to authorized parties), and perhaps decrypt and open them after a paper is published or a certain time has passed. This could be an interesting compromise: ensure integrity now, release transparency later.

Tokenized Incentives and Reviewer Bounties

One of the most innovative (and debated) aspects of using blockchain is the ability to create **cryptocurrency or token incentives** to reward peer review. Cryptographic tokens can be easily distributed, traded, and programmed with conditions (smart contracts). Our interviewees and prior research suggest several models:

- **Reviewer Tokens for Completed Reviews:** Reviewers could earn a fixed amount of a native token for each verified review they complete. This is essentially paying reviewers, but in tokens rather than fiat, which some argue might be more acceptable if the tokens confer benefits within the scholarly ecosystem. For example, **ResearchHub** rewards reviewers with its RSC token (roughly equivalent to $150 value per review). The idea is to tangibly reward effort and time. Dr. Oscar was cautious about monetary incentives but not wholly against them if done carefully. If tokens have real-world value, the same concerns about gaming apply – reviewers might chase tokens rather than focus on quality. However, smart contracts can introduce conditions: e.g. the token is released only if the review is submitted on time and passes an editor's quality check. This leads to the concept of **escrow bounties**.

- **Escrow and Smart Contract Bounties:** A system could escrow a reward (tokens or even stablecoins) for a review task. When a manuscript is submitted, the "bounty" is posted – say 100 tokens – that will go to whoever claims and completes the review satisfactorily. Reviewers could even compete or bid for bounties if one imagines a marketplace (though that might encourage speed > quality). The escrow is unlocked by predefined conditions coded in a smart contract: for instance, two other parties (editor and maybe a second reviewer) have to sign off that the review was acceptable, then payment flows. This ensures **accountability** – you only get paid if you do a decent job. Dr. Oscar liked the idea of conditional rewards but warned money can prompt gaming such as reviewers focusing on what gets the bounty rather than genuine interest. So designing the conditions (perhaps requiring a quality rating above X) is critical.

- **Tokenized Reputation / Governance Rights:** Another use of tokens could be *non-monetary value tokens* – essentially points that give influence in the network. For example, active reviewers might earn governance tokens that allow them to vote on platform decisions (like a DAO governance model for the peer review platform). This turns reviewers into stakeholders. It could also be symbolic rewards like **NFT badges** for milestones (one project, ROSA, even floated NFT ownership of reviews as a concept, tying into reputation). These approaches aim to create a community feeling and extrinsic motivation without directly paying in currency.

- **Covering Costs and Sustainability:** Tokens could also solve some financial issues in publishing – for instance, using cryptocurrency for micropayments to reviewers globally without bank transfer hurdles (addressing a point raised in an Editor's Cafe comment about cross-border payments). They could also be used to fund the platform (through tokenomics) or to compensate authors or curators in new ways. For example, a token economy might reward not just reviewers but also readers who post successful replications or comments, thus broadening what "peer review" means to a more ongoing, community-wide process.

Interviewees saw potential in tokens but emphasized **guardrails**. Dr. Gale's fears of people churning out 20 reviews for money resonate as a warning. Dr. Oscar provided a practical example of metric gaming (word count inflation via AI). Therefore, any token incentive scheme should:

- Tie rewards to quality signals (e.g., editor approval, author satisfaction ratings).

- Possibly limit how many tokens one person can earn in a period to prevent excessive reviewing.

- Be transparent so that if someone is gaming the system, it's visible and can be corrected (this is where the immutable record helps – one could analyze on-chain data to detect unusual patterns).

One exciting possibility raised was that **blockchain tokens could engage a broader community** beyond the usual academic circle. For instance, citizen scientists or retired experts might be enticed to contribute reviews or comments if there's a token reward. This intersects with the "crowd review" idea but with a way to weight contributions by those who prove knowledgeable (their tokens/reputation speak for them).

In summary, blockchain enables creating an **incentive economy** around peer review, which is novel. If designed right, it could alleviate the volunteer fatigue by literally rewarding the labor that's currently expected for free. However, to maintain integrity, these incentives must be coupled with strong quality control mechanisms – essentially automating the "carrot and stick" approach: *carrots* for timely, good reviews, *sticks* (or no carrots) for shoddy ones. Traditional systems have lacked carrots; blockchain gives us a toolkit to introduce them, but we must ensure the carrots don't attract only the donkeys, so to speak.

Integration with Existing Publishing Platforms

Even the best blockchain solution will fail if it isn't adopted by the community. Our interviews underscored the importance of **integrating with, rather than supplanting, existing workflows**:

- **Publisher Buy-In:** As Dr. Oscar noted, big publishers have established systems and can be resistant to change. To get their buy-in, a blockchain system might need to demonstrate value in a pilot and perhaps integrate gradually. For instance, a publisher could start by using the blockchain just to log review metadata for transparency, without changing how their editors and reviewers actually interact day-to-day. Over time, more features could be adopted. One strategy is to target journals or publishers that are already reform-minded (some smaller publishers or open access platforms might be more eager to try new technologies).

- **User Experience:** The solution must be easy for editors, reviewers, and authors. This likely means **building interfaces or plugins** that connect to common editorial systems (like OJS, ScholarOne). If an editor can push a button in ScholarOne that says "Record review on blockchain" and doesn't have to log into a separate system, they might use it. Dr. Oscar suggested a plugin approach – essentially what we described with local analysis feeding the chain. For reviewers and authors, using the system (like claiming tokens or viewing reputation) should be as simple as logging in with ORCID or an institutional account; the blockchain part can be under the hood.

- **Interoperability:** The blockchain solution should aim to be **publisher-agnostic and interoperable**. This might mean adhering to emerging standards in scholarly communication (for example, data models for peer review events that some initiatives are working on). It will help if multiple blockchain or decentralized initiatives collaborate or at least ensure their systems can talk to each other. The worst case would be fragmented silos on the blockchain – defeating the purpose.

- **Pilot Programs and Metrics:** A suggestion from interviews was to run pilot trials to gather data. For example, select a willing journal (perhaps one edited by innovators like Dr. Oscar himself) and run its peer review through the new platform in parallel. Measure outcomes like review time, reviewer satisfaction, and any difference in quality. Dr. Oscar emphasized measuring **review quality and time-to-completion** as key success metrics for any pilot. If a blockchain system can show

improvements there, it will make a stronger case to publishers and the community.

Cardano-specific integration: Since our project is on Cardano, a word on its relevance: Cardano is known for a strong focus on formal development and governance, which could appeal to academic stakeholders who want a robust solution (as opposed to some earlier blockchain experiments that were more hype-driven). Cardano's smart contracts (Plutus) and identity solutions could be leveraged to implement the features discussed. Moreover, aligning with Cardano might bring in the Cardano community as early adopters (e.g., using Catalyst funding as a springboard, perhaps some journals in blockchain research or by Cardano-affiliated academics could pilot the system).

Hurdles: We should acknowledge some integration hurdles raised:

- **Scalability:** Peer review generates a lot of events; a public blockchain must handle these without high fees or slow speeds. Cardano's scalability (e.g. Hydra) might mitigate this, but it's a consideration. Alternatively, a hybrid approach (off-chain storage, on-chain hashes) can keep the load light.

- **Legal and Privacy Issues:** Storing academic data (especially if it includes personal data) on a blockchain can raise GDPR or privacy concerns. Using hashes and DIDs can minimize personal data on-chain, but any integration with publishers would involve careful data agreements. Recent developments on the Cardano partner chain Midnight offer some intriguing possibilities here.

- **Community Trust:** Ironically, while blockchain is supposed to enhance trust, persuading academics to trust a *blockchain system* could be a challenge. Some might be skeptical or not technically inclined. Hence, part of integration is also **community education** – showcasing success stories, publishing white papers or results that demonstrate how the blockchain approach preserves academic rigor and privacy.

Case Studies and Emerging Use Cases

The vision of blockchain in peer review isn't just theoretical. Our research (and some interviewee inputs) highlighted several **real-world projects and experiments** that inform feasibility:

- **MetaReview / Blockchain Peer Review Pilot:** In 2018-2019, there were pilots where publishers like Springer Nature tested logging peer review events on a blockchain (called "MetaReview"). The outcomes showed it's technically doable to record peer review steps immutably, but integration and community uptake were hurdles.

- **Orvium:** A well-known startup in this space, Orvium aimed to create a full stack open science platform on blockchain They designed features like versioned manuscripts, open peer review with optional anonymity, and a token (ORV) to reward reviewers and authors. Orvium's model emphasized transparency: once a paper and its reviews are on the platform, everything is visible, and authors keep copyright. While Orvium's adoption has been limited so far, it serves as a blueprint of what a *blockchain journal* could look like.

- **ResearchHub and Others:** As mentioned, ResearchHub is already distributing crypto for reviews. It's not a formal journal but a community where users share papers and critique them for tokens. This is more akin to a social network for science, but it demonstrates that some researchers are willing to engage in exchange for tokens. Another, **Pluto**, tries to maintain blinded review for fairness while still issuing tokens to reviewers to build reputation. **Eureka** uses smart contracts to

weigh review quality (ensuring tokens reward rigor over quick acceptance). **PubChain** combines decentralized storage (IPFS) of papers with blockchain-based review rewards to create a completely open access, community-driven journal model.

- **Emerging Platforms (ROSA, DAP):**Two notable projects in development: ROSA, which introduces NFT-based review ownership and community governance via a DAO, and DAP, which works on a different distributed ledger (HashNET) to create scholarly wallets and a "virtual editor" AI assistant. These experimental ideas push the envelope – e.g., NFT reviews could allow reviewers to own and trade their reviews (perhaps if a review is highly valued, it becomes a sort of credential NFT).

- **The Chronicle coverage:** A 2018 *Chronicle of Higher Education* piece titled "Will Blockchain Revolutionize Scholarly Publishing?" captured early optimism and noted that Orvium's model would make peer review **fully open (no anonymity)**. It highlighted that *"peer review will no longer be anonymous under the blockchain-based model"*, which some see as a benefit for accountability but others as problematic for candidness. This underscores the social choices baked into any implementation.

From these case studies, we glean that blockchain can indeed implement the features we theorize – it's technically feasible to reward reviews with tokens, track everything transparently, etc. The bigger question is **which features actually solve the pain points and will be embraced by researchers**. For example, ResearchHub's success suggests rewards can attract participation, but it's still a niche community; the mainstream academic world hasn't jumped in. Orvium's partial fizzle suggests that just building the platform isn't enough – you need network effects (authors submitting, reviewers signing up) to make it worthwhile.

Our interview with Dr. Oscar, who is both tech-savvy and steeped in academic editing, provides a balanced perspective: he is *"enthusiastic"* about blockchain's potential but *"candid"* about adoption hurdles and the need to prove value gradually. He drew a parallel to ORCID: initially optional and ignored by many, now finally widely adopted after years of community push. Blockchain-based peer review might follow a similar trajectory – skepticism and slow uptake until at some tipping point it becomes normalized.

One intriguing comment from a professor (outside our core interviewees, but in a forum) was: *"Integrating blockchain could enhance transparency, traceability, and trust… interested to see how such innovations complement existing models"*. This captures the general sentiment: even those not deeply into crypto see the potential benefits conceptually. The task ahead is to turn that conceptual promise into concrete, user-friendly tools that the academic community feels confident using.

Challenges and Future Outlook

While the advantages of blockchain in peer review are compelling, our analysis would be incomplete without addressing the key **challenges and limitations** that came up:

- **Scalability and Cost:** Public blockchains can have issues with transaction throughput and fees. If every review event is a transaction, costs could mount (though Cardano's fees are relatively low, and layer-2 solutions can help). A poorly designed system might also bloat the blockchain with data. Solutions include using off-chain storage (IPFS, etc.) for bulky data and only writing hashes, batching transactions, or using a consortium chain for academia if needed.

- **Cultural Resistance:** Many academics are still unfamiliar with or wary of blockchain. Some perceive it as hype or unrelated to their work. Outreach and education will be needed to demonstrate that the technology can be a means to *academic* ends (fairness, efficiency), rather than being seen as tech evangelism. Early successes will need to be publicized through academic

channels (conferences on peer review, editor societies, etc.) to build trust.

- **Governance and Who Runs It:** A decentralized system raises the question – who operates and governs it? Perhaps a coalition of universities or a non-profit scholarly body could oversee it initially. Eventually, if it's truly decentralized, governance tokens or a foundation may manage updates and policies. Ensuring the system isn't captured by any one interest (e.g., a single publisher or a token investor group) will be important for credibility. The ethos should align with academia's: open, community-driven, and ideally non-profit or sustainable-cost.

- **Transition and Interoperability:** For those heavily embedded in current systems, switching costs are high. One likely scenario is a *gradual hybrid model*: journals might use the blockchain backend while front-end processes remain familiar. Or certain fields (perhaps computer science, which is often early in open science adoption) might pilot the system first. We may also see different approaches converge – for example, if several blockchains are used by different groups, eventually standards might allow them to interconnect or merge for simplicity.

- **Legal/Privacy**: As noted, GDPR and data privacy laws require careful handling. Reviewers would likely need to consent to having their contribution logged on a blockchain (even if pseudonymous). Authors might need to consent to certain data sharing too. Strong encryption and possibly permissioned aspects might be needed for sensitive info. These are not insurmountable but require design input from legal experts.

Blockchain is not a magic fix for peer review, but it offers a *toolset* to implement many of the improvements long desired: fair rewards, global participation, proof of integrity, and openness. Our interviews and research suggest that, if nothing else, blockchain projects are forcing a re-examination of the status quo. They introduce competition of ideas in a space that hasn't seen much innovation in decades.

In a hopeful vision, one professor commented that *"blockchain may well be the cornerstone of this transformation"* toward restored trust, fairness, and inclusivity in peer review. Even if that is optimistic, it's telling that stakeholders are imagining peer review in such new terms. Over the next few years, we expect to see more pilots, more data, and perhaps the first mainstream adoption of blockchain in an aspect of publishing (maybe logging peer review for a major conference, or a consortium of libraries supporting a tokenized review platform for open access journals).

Our Catalyst project aims to be at the forefront of this movement on the Cardano blockchain, leveraging the thoughtful insights from experts like Dr. Oscar and Dr. Gale to ensure that technology is applied in service of academic values. In the conclusion, we summarize the key takeaways and outline next steps for turning these insights into action.

Conclusion

The peer review system, a linchpin of scholarly communication, is undeniably strained. **Recruiting reviewers has become harder**, **incentives are misaligned**, and **trust in the process is wavering** due to opaqueness and inconsistent quality. Our interviews with journal editors and researchers provided a frank diagnosis of these issues, but also a blueprint for change. There is no single fix – instead, a combination of cultural shifts, policy adjustments, and technological innovations must work in concert.

On the human side, **reimagining incentives** stands out as critical: academia must find ways to credit and reward the essential labor of peer review, integrating it into the currency of career advancement. As Dr. Gale Dr. Gale emphasized, simply expecting every scholar to review out of altruism while institutions only

reward publications is a recipe for burnout and disengagement. Whether through requiring review service in exchange for submissions or formally recognizing review work in evaluations, the message was clear – *the system must give back to those who give their time*. In parallel, **investing in the reviewer community** via training, mentorship, and expanding participation (bringing in fresh researchers and diverse voices) will help rebuild the foundation of expertise that quality peer review rests upon.

On the process side, **transparency and accountability** emerged as double-edged but necessary pursuits. Thoughtful increases in transparency – like publishing anonymous review reports or maintaining immutable audit trails – could shine light into the "black box" of peer review and rebuild trust in editorial decisions. This must be balanced with protecting academic freedom to critique without fear, and protecting less experienced reviewers as they grow. Editors will play a key role here: as gatekeepers and mentors, they can enforce standards (sending back poor reviews, banning toxic behavior) and implement new practices (e.g. open reviews, transferable reviews between journals) that set a healthier tone.

Technology, especially **blockchain**, offers powerful tools to support these human and process solutions. As we've detailed, a blockchain-based peer review platform could *institutionalize many of the proposed improvements*: it can provide **verifiable credit** for reviewers (finally giving credit where it's due), enable **tokenized incentives** with safeguards, ensure **tamper-proof transparency** of review histories, and connect the currently siloed world of peer review into a **global network**. Importantly, it can do so in a decentralized way, aligning with the academic ideal of a community-governed knowledge ecosystem rather than one controlled by a few corporate entities.

Yet, we temper this optimism with the lessons of history and the realities of implementation. Peer review has persisted in its current form in part because every alternative comes with its own challenges. As Dr. Gale wisely noted, *"every time you fix one problem, you create another"*. Thus, the approach must be iterative and evidence-based. Pilot projects (like this project) will need to test assumptions, measure outcomes, and be ready to adjust. For instance, if token incentives inadvertently encourage superficial reviews, the model must be tweaked (or scrapped) to prioritize quality – perhaps by weighting reputation over raw counts, or coupling rewards with editor endorsements.

The feasibility of a blockchain solution will ultimately be judged not by the elegance of the code, but by the **uptake and satisfaction of its users**: editors who find it eases their workload and improves review quality, reviewers who feel more recognized and rewarded, and authors who experience fairer, faster, and more informative peer review. Achieving this will require close collaboration between technologists and the academic community. The interviews with Dr. Oscar and others underscore the importance of involving stakeholders in the design – incorporating features like ORCID integration, ease of use within existing workflows, and metrics that academics respect (quality and timeliness, not vanity scores). It also requires transparency from the developers: just as we seek transparency in peer review, the design and governance of a blockchain platform should be openly discussed, with community feedback guiding its evolution.

In closing, the challenges of peer review are substantial, but the will for improvement is strong. What's encouraging now is that we see *glimmers of better options*: a mix of policy innovation (like new incentive structures) and technological innovation (like decentralized systems). These are not silver bullets, but together they form a promising arsenal. As the academic world continues to grapple with the demands of the 21st century – from the deluge of publications to the need for greater trust in science – retooling the peer review process is both our greatest challenge and our greatest opportunity.

This report marks a milestone in our journey. We have synthesized voices from the front lines of peer review and examined cutting-edge proposals. The next milestone will be translating these insights into a working prototype on the Cardano blockchain, guided by the principles and caveats highlighted herein. With careful implementation and community engagement, we aim to demonstrate that a *better peer review system is possible* – one that honors and incentivizes the critical work of reviewers, upholds rigorous

standards, and leverages modern technology to uphold the timeless values of scholarly communication. The road ahead will require patience and iteration, but the destination – a more transparent, efficient, and equitable peer review ecosystem – is well worth striving for.