Peer-review on a Decentralised Web

Thesis

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Peer-review on a decentralised web

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This dissertation is submitted for the degree of

Doctor of Philosophy

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Abstract

Peer review is an evolving process that typically validates the originality and quality of research outcomes. The process holds a vital position in academic research communities to prevent invalid and inaccurate work from being published. With all its benefits, it has been under continuous criticism for its shortcomings and inability to address the issues adequately, like preventing fraudulent and impostor reviewers from becoming a formal part of the process. Therefore, the research communities usually need help finding appropriate and suitable reviewers for their research events. To assess the suitability of a reviewer for a specific research event, the research event management team (Chairs, Organising Committee) analyses certain aspects of a researcher’s profile before inviting them to participate in the reviewing process.

This thesis investigates the aspects the research event management considers before inviting researchers for peer review. The unavailability of information about how a researcher has performed as a reviewer makes it more challenging for event management. In case such information reaches the event management, it becomes difficult to establish trust in that information. The thesis also investigates the acknowledgement and incentives researchers receive for participating in the reviewing process.

A framework based upon decentralised and distributed technologies is presented in the thesis to address these peer review issues. The framework involves using blockchain technology that enables the accumulation of the reviewing records of researchers from multiple research events. It also helps establish trust in the reviewing records and devise a mechanism to incentivise reviewers transparently.

Two research studies in the thesis involve recording and analysing researchers’ viewpoints on different peer review perspectives and practices. The results of these research
studies demonstrate the positive impact of using decentralised and distributed technologies for accumulating the reviewing records of researchers across multiple research events and incentivising reviewers.
Acknowledgements

The decision to undertake this PhD turned out to be a life-changing experience for me. The journey was loaded with the highs and lows, shine and gloom, delights of achievements and sorrows of lost paths. Fortunately, I had my support pillars from the beginning of the PhD, the most dependable during my student life. My supervisors and family. They remained unwavering to pick me up whenever and wherever I stumbled. I would not have reached this point without their consistent support. The words may not express the warmth, but I want to acknowledge their super roles in bringing a researcher out of me.

I would like to convey my sincerest gratitude to my supervisor, Professor John Domingue, for his leadership, support and encouragement. Prof. John’s visionary supervision instilled the ability to see the bigger picture on the horizon of academic research, which helped me realise the scientific outlook of my PhD. I will always be indebted to him.

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I am also sincerely thankful to my third supervisor, Dr. Tracie Farrell; her help and guidance have encouraged me to traverse the untrodden paths of qualitative research for my research studies. Dr. Farrell was also very supportive during the thesis write-up.
I thank my examiners, Prof Bart Rienties (internal) and Dr Tobias Kuhn (external), for their invaluable inputs in improving this thesis.

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To Imran Khan
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Chapter 1

Introduction

Researchers contribute to improving scientific understanding by standing on the shoulders of other researchers. Such research contributions typically follow a well-defined course of action to assess the validity, quality and originality of the research outcomes [103]. This continually evolving process is commonly known as peer review. This process aims to prevent invalid, inaccurate, unreasonable, plagiarised, fraudulent and unconvincing work. Therefore, research contributions must pass through this integral and rigorous barrier post to establish their integrity and credibility.

Most likely the first description of the peer-review process can be found in the book *Ethics of the Physician* by Ishaq bin Ali Al Rahwi (AD 854-931) of Al Raha, Syria [90]. This historical account indicates that duplicate notes of a patient’s condition were taken by the visiting physician on each visit and then sent to the local council after the patient had been cured or died, to decide whether or not the physician followed the standard operating procedures. The findings of the council could be used to sue the physicians for damages if they had maltreated the patient [90].
A German professor, Henry Oldenburg, became the acting secretary of the Royal Society when it was established in 1662. Soon, he began to receive letters from across Western Europe, suggesting the subjects for discussion in the weekly meetings of the society’s London group. Oldenburg moderated the contents of those letters, and later, he published them as records and transcripts in a monthly journal, which he named Philosophical Transactions. So, scientists’ work started to get published; thus, it was available for public scrutiny and for ascertaining the ownership of scientific work. This was the beginning of modern peer-review [29]. The modern form of the peer-review process used by journals, conferences and publishers is influenced by the review process adopted by The Royal Society of Edinburgh in 1752 when publications were inspected by a selected group of knowledgeable members [90]. Table 1.1 shows the timeline of how peer review evolved from the 18th century to the 21st century, presented by Richard Walker [98]. The British Medical Journal (BMJ) adopted peer review in the 19th century and began to reveal reviewer names to authors in the 20th century, while Nature Genetics and Nature Climate offered the double-blind review in 2013.

Contemporary practices demonstrate that research communities follow and implement the peer-reviewing process using different methods [29]. Research communities could also adjust these procedures to fit their requirements. Therefore, there is no strict and definite set of rules documented for the process.

Researchers involved in the peer-reviewing process who review scholarly articles are commonly termed as peer-reviewers. They may have diverse backgrounds, such as academia, industry or both; they may also have different undocumented reasons for partaking in the reviewing process. Their reviewing activity inherently consists of reading and evaluating an article and then submitting their opinion about whether the article should be published or not. It is pertinent to state that researchers carry
<table>
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<td>Atmospheric Chemistry and Physics introduces two-stage review process in which papers are published as &quot;discussion papers&quot; before formal review.</td>
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Table 1.1: The timeline shows notable innovations in the peer-reviewing process. The table presents how the modern-day peer review evolved from the first use of peer review by the Royal Society of Edinburgh in the 18th century to the 21st century. Richard Walker presented this table in his article "Emerging trends in peer review—a survey" in 2015 [98].
out their reviewing activities in their spare time and get little acknowledgement and incentive.

The scientific community acknowledges the importance of the peer-reviewing process [63]. It is estimated that reviewers spent at least 22 million researcher hours reviewing papers in 2013 for just 12 high impact journals [101]. Additionally, the number of researchers and the number of published articles is growing continuously at 3% per year [100]. This steady growth suggests that researchers need more frequent participation in peer review, and given the limited time, they would also need to be more selective in reading published articles. Therefore, the publication venue management team (Program Committees, Editors) would have to find and select more (and suitable) reviewers. The method of finding and selecting suitable reviewers is a critical and essential operation of peer review, and there are no strict guidelines outlined for it. Therefore, different research communities adopt multiple methods to find, invite and select suitable reviewers.

An appropriate, competent, and suitable reviewer may have several qualities acknowledged by different people in the research community. The Publication venue management team could judge a researcher on multiple criteria before inviting them for the reviewing process. For example, a researcher’s distinguished history and record as an author and a reviewer could be a compelling reason to request a researcher participates in the reviewing process [8]. A researcher with a significant number of published articles with higher h-index and a proven record of participation in prestigious publication venues may get frequent peer review invitations. The publication venue management team may struggle with discovering the reviewing history of a researcher because such information is usually spread across multiple places, including websites of the research events they took part in, conference management platforms, private emails, and CVs. Even if the publication venue management team finds such
information, it becomes challenging for them to trust this information. The publication venue management team may also find it hard to discover the previous performance of a reviewer - for example, did they submit the review before the deadline? Did they adhere to the reviewing guidelines of the publication venue?

In this thesis, we investigate the preferences and practices associated with the peer-reviewing process. We explore how senior researchers perceive and practice reviewing activity and what reforms they would like to bring. Analysing this information paved the way for further research into how data technologies could impact the overall reviewing process. We also explore how a technical infrastructure could support the accumulation of these reviewing records more transparently to help establish their integrity and enable the publication venue management team to incentivise reviewers in a trustworthy manner. The outcomes and contributions of the research conducted in the thesis are:

- Conducting a study to record, document and analyse the requirements and practices of the reviewing process.

- Analysing the preferences and requirements from researchers for technical support for the reviewing process.

- Introducing a framework that provides a technical infrastructure for accumulating the reviewing accounts of researchers from across multiple publication venues, enabling the verification of these accounts, acknowledging the reviewing efforts and incentivising reviewers for their services in a transparent and trustworthy way.

- Developing a platform based upon the framework and evaluating it. The analysis of the results reveals that the platform can help the publication venue management teams to incentivise their reviewers. It also shows that the study
participants trust the reviewing records (accumulated from across multiple publication venues) to use them on their personal and professional websites. The evaluation also shows a high likelihood of using this platform to trust the reviewing history of researchers, incentivise reviewers, and use the verifiable reviewing records on personal and institutional websites.

1.1 Problem Statement

The practice of peer-review is based on faith in its effects, rather than on facts [56]. For example, an article is perceived as credible because it was peer-reviewed regardless of the review process' issues. The peer-reviewing process continues to hold a crucial position in scientific research despite the critique on its shortcomings, including bias [61], nepotism and sexism [102]. Such issues happen regardless of intention. However, several variations in the process have emerged to address and overcome these issues, for example, the open-review process and the closed-review process [61].

The Open peer review is followed using different variations, and it does not have a standard methodology [80]. Some people refer to the term Open review as peer review where the identities of both author and reviewer are disclosed to each other while others refer to the system where reviews are also published alongside articles [80].

There are two most common types of Closed peer review, single-blind and double-blind [103]. Single-blind is the most common form of peer review among science journals, in which the identities of reviewers are not disclosed to the author [103]. Double-blind review is the most common form of peer review among social sciences and humanities journals, in which reviewers do not know the identity of authors and vice versa [103].
Different technologies and tools, including conference management tools, have also supported these types of processes (Open and Closed) in conducting peer-review. However, a few elements of the peer-reviewing process are adequately challenging enough that it keeps the Publication venue management team striving, for instance, finding and selecting a suitable reviewer for a conference. Ideally, a suitable reviewer would have their established history of reviewing research articles and producing their rigorous and comprehensive reviews. However, such history of a researcher is usually scattered in multiple places and sometimes are not well documented and recorded at all. The reviewing history of a researcher may give informed insights to the Publication venue management team that might help them select and invite suitable reviewers - for example, the number of articles reviewed by a researcher, the list of publication venues they have participated in as reviewers, the quality of reviews they have produced, and how well they carried out the reviewing job.

Researchers participate in multiple publication venues, and each publication venue may have its different peer-reviewing policies and implementations. For example, some publication venues may follow the Open reviewing process, while others may choose Closed reviewing. Data management becomes challenging because the researchers and publication venues would both need this data in such cases. Researchers may need this data for their records, for example, to display their contributions on personal and professional websites. Publication venues may need this data to display it on their websites and establish trust, transparency, and reputation. The complexity of the challenge increases when multiple entities need control and ownership of the same data, for example, the reviewing account of a researcher across ten different publication venues. The control and ownership of data under one entity is a typical example of centralisation. The Corporate Financial Institute (CFI) describes Centralisation as a process in which activities involving planning and decision making within an
organisation are concentrated to a specific leader or location \cite{10}. So, centralisation limits the data management for both publication venues and researchers when they both need the same data of the reviewing activity. From a more general viewpoint, Sir Tim Berners-Lee has also expressed his critical disappointment over the increasing centralisation of the Web \cite{37}. Recently, he has been working to reclaim the Web from corporations (centralised entities) and return it to its democratic roots (decentralised entities) \cite{37}.

Researchers have a limited set of tools available to document their reviewing history, but that might present only a one-sided picture and could avoid the perspective of the management teams of the publication venues they participated in as reviewers. Even if researchers maintain their reviewing history, an important question emerges about trusting that reviewing history. How do we establish the authenticity of this information?

While researchers usually participate in the reviewing activity throughout their academic careers, peer review offers little in the way of incentives \cite{80}. The work of reviewers is almost exclusively unpaid, and it does not get recognition and rewards \cite{80}. Publishers typically have strong motivations to find non-monetary kinds of incentives for reviewers \cite{94}. While researchers firmly believe that reviewing is inadequately acknowledged and should carry more weight in their institutions’ evaluation process, they would spend more time reviewing if their institution acknowledged the reviewing work \cite{101}. A survey study of approximately 3000 peer-reviewers by the prominent publisher Wiley revealed that feedback and acknowledgement for work as referees are valued far above either cash reimbursement or payment in kind \cite{101}. Reviewers would prefer either compensation by way of free subscriptions or the waiver of other publication charges \cite{66}. Wiley’s survey outlines that 80\% of researchers believe that there is insufficient recognition for peer review, and researchers would commit more time to
peer review if it became a formally acknowledged activity for assessments, funding opportunities, and promotion \[101\]. Another survey reported that 70\% of respondents indicated they would list their peer-reviewing credentials as formal recognition on their CV; furthermore, 27\% of respondents stated that the formal recognition of their reviewing activities would motivate them to participate more in public peer-review \[69\]. Many pieces of research conducted in the past indicated the possibility of mediocre editorial outcomes were due to the lack of incentives for reviewers, which also caused the proliferation of low-quality research \[94\]. Peer-reviewers may get anonymous recognition in the acknowledgement section of published papers, but they may get public recognition only if they sign their reviews \[94\]. However, getting an invitation to review research articles is perceived as a great honour and incentive, especially for junior researchers, that also gives them the sense of being recognised for their expertise \[94\].

This thesis focuses on addressing the issues raised above, namely:

**Unavailability of the reviewing history of researchers**

Researchers have their profiles to present their published research articles. This information may include different elements, for example, the year and venue of publication. Some platforms retrieve this information automatically once an article is published, for example, GoogleScholar \[43\], Core \[22\] and DBLP \[28\]. Some platforms may also ask researchers to feed in their information related to published articles, for example, ResearchGate \[41\]. In both cases, researchers have their profiles enriched with the information of their published research articles. Such profiles may provide significant insights into assessing how a researcher has performed as an author over time. However, there is a need for aggregating such vital information about how a researcher performed as a
reviewer. We need to investigate where to find such information and how to collect and aggregate this information.

Trust deficit in the reviewing history of researchers

A researcher may have included several publication venues in the list where they have participated as a reviewer. How do we know those accounts are genuine and not fake? We need to investigate the possible ways to establish trust in the reviewing accounts of researchers.

The information of how a reviewer has performed is crucial while finding and selecting a reviewer. We need to investigate how publication venue management teams find and select reviewers for the events. What aspects do they consider when they invite a researcher for peer review? Do they have information on how a reviewer has performed in other publication venues? If this information is available to them, how are they going to trust it? What mechanism do they follow to trust it?

Centralisation of peer review data

The peer-review data is related to both publication venues and reviewers and fairly essential for both. Researchers carry out the reviewing activity for different publication venues, and hence, its data management becomes challenging when publication venues and researchers both need ownership and control over this data. We need to investigate how we can address this issue of centralisation and data silos.

Little recognition of peer review

Researchers publish their research articles, and their work gets recognised in several ways, such as their public profiles, best paper awards, internal promotions, jobs, and grants. However, when researchers carry out the reviewing activity,
they get little recognition for it. We need to investigate the possible ways to recognise the efforts reviewers put into the reviewing activity.

**Little incentives for reviewers**

Researchers who participate in the reviewing activity are uncompensated for their services [80]. We need to investigate the possible ways to incentivise reviewers for their work and how technical infrastructure could support such mechanisms to incentivise reviewers in a transparent and trustworthy way.

### 1.2 Challenges

Researchers spend their valuable time in various research activities, and peer-reviewing is one of them. However, a list of motivations for researchers to carry out this reviewing activity is undocumented so far. Many tools and platforms are available to see how a researcher has performed as an author. However, to see how a researcher has performed as a reviewer, one may need to look up their CV, the websites of publication venues they participated in, and some conference management tools (if they allow). So, their work as reviewers is scattered across multiple places. Even if a researcher maintains their reviewing history, establishing the authenticity of these accounts becomes arduous. For instance, in the closed-review process and where reviews are not published, one may have to contact the relevant Publication venue management team to confirm if a researcher reviewed a specific number of articles for the conference. Researchers review a handful of papers every year and get very little recognition, for example, on a conference website or their CV. Despite their great deal of effort, reviewers do not get compensated for their duties.
1.2.1 Centralised Technological Infrastructure

Different technical tools have also contributed to the evolution of the peer-reviewing process. From emails and websites to standalone conference management platforms, technological infrastructure has impacted the peer-reviewing process and researchers. There are many conference management tools available, for example, EasyChair [17] and Confy+ [76]. EasyChair is a widely used and trusted conference management tool that claims to have served more than eighty-five thousand conferences [17]. However, EasyChair, a centralised entity, accumulates the reviewing history of researchers. These records are confined within the platform, so the platform precludes the public from accessing them. Even if these records are made publicly accessible, it would be difficult to verify their authenticity.

1.2.2 Trust Deficit

There is no standard procedure followed while finding and selecting a reviewer for a conference. The Publication venue management team responsible for finding and selecting reviewers typically relies upon multiple methods, for instance, inviting reviewers they already know, authors of related publications or reviewers from other events [92]. Generally, the Publication venue management team has to “take a shot in the dark” while trusting the reviewing history of a researcher. The Publication venue management team usually puts their faith in the reviewing accounts of a researcher instead of observing the facts because they do not have an established mechanism to verify the legitimacy of these accounts. For example, Dr Haug describes the retraction of 64 articles from 10 different journals by Springer. This description includes a South Korean researcher Hyung-in Moon, who admitted to having email addresses to provide peer-reviews for his own articles using those emails and fake identities. More than 250
of Hyung-in Moon’s articles were retracted because of the fake reviews, about 15% of the total number of rejections [50].

1.2.3 Compliance with GDPR

With the implementation of General Data Protection Regulation (GDPR) [44], we must make sure that we use the information about publication venues and researchers within the legal ambit of GDPR. The General Data Protection Regulation (GDPR) started to be applied directly to processing activities of personal data in the EU and UK in 2018 [44]. The GDPR brings a set of strict rules for processing personal information. According to these rules, everyone responsible for using personal data must make sure they use the information fairly, lawfully and transparently [44]. The purpose of use must be specified explicitly. The GDPR gives strong legal protection for more sensitive information, including race, ethnic background, religious beliefs, biometric and health data [44]. The GDPR also enables citizens to find out what information the government and other organisations store about them [3, 44].

1.2.4 Little acknowledgement

Researchers put in extra effort for reviewing articles; however, they get little recognition for it in the form of either their names on conference websites or if a reviewer wins an award for the best reviewer. Their efforts are not quantified scientifically, like, for example, h-index. The Hirsch’s index or h-index, introduced by Jorge Hirsch, is a research performance indicator that is designed for application at the micro-level (at the level of an individual scientist) [10]. A researcher will have the index $h$ if their $h$ number of papers have at least $h$ citations each. For instance, a researcher has the
*h-index* of 65 means that the researcher has at least 65 publications with at least 65 citations each. This *h-index* in a single number is often interpreted to reflect a researcher’s reputation, scientific contributions and achievements [10]. Quantifying researchers’ reviewing-contributions may bring a fundamental transformation in the specific procedure that involves finding and selecting suitable reviewers. Such rankings could support the Publication venue management team to evaluate potential candidates before inviting them for reviewing. Apart from its support to the peer-reviewing process, this may become a valuable number acknowledging a researcher’s reviewing-efforts, just like *h-index*. The *h-index* has also been criticised for its inconsistencies; for example, it does not necessarily suggest a researcher’s productivity, impact, quality, consistency, or career trajectory [51]. There are also trust issues related to the *h-index*; for example, it does not discriminate self-citations; a fraudulent author can deceive this bibliometric indicator [51]. We need to investigate how we can avoid such issues related to a performance indicator for reviewers. We need mechanisms to avoid self-reviewing (like self-citation) where a researcher may trick the system and review their own article.

1.2.5 Ineffective incentive models

Incentives are an essential factor in practically all disciplines. Some publication venues may incentivise their reviewers in different ways, for example, complimentary online access to the journal for a specific time [103]. Various platforms introduced models to acknowledge and incentivise reviewing-efforts, for instance, TheWinnower [104], ReviewerCredits [23] and Publons [77]. TheWinnower is an open access online scholarly publishing platform for post-publication review. Researchers submit their articles and invite researchers to review their work on the platform [104]. ReviewerCredit enables reviewers to “Claim a review”. Reviewers register their peer review activity, and ReviewCredit verifies that claim by asking for confirmation from the Journal’s
editorial office. In return, reviewers get “recognition” in the form of virtual credits that can be redeemed in the ReviewCredit platform [23]. Publons is a platform where researchers maintain their profiles as both authors and reviewers. Publons has a partnership with several journals to verify peer review claims directly on the platform [77]. However, such incentives are typically limited to a specific platform. We need to investigate the nature of the incentives publication venues could give to reviewers. The topic of incentivising reviewers has been under discussion, and critics asked whether the peer-review activity is incentivised correctly and if the peer-reviewers are being asked to evaluate the right things [45]? We need to investigate numerous questions, including the following ones. Why should researchers get incentives for the reviewing activity? Do researchers believe they should get incentives for the reviewing activity? We need to examine the possible forms of incentives they could seek if they believe in incentives for reviewers. We also need to investigate the reasons if they do not believe in incentives for reviewers. What would be the proper procedures that publication venues should follow to incentivise reviewers? What incentives do reviewers get for producing a good quality review?

1.3 Research questions and contributions

The concept of “peer-review” suggests its dependency upon peer-reviewers; therefore, finding suitable reviewers for a research event becomes the most critical need to ensure the best scrutiny of research work. The absence of data about how researchers have performed as reviewers makes the challenge greater. The thesis aims to devise a mechanism that enables the accumulation of such data reliably, along with incentivising reviewers transparently.
The issues raised in section 1.2 demand an in-depth study to investigate how researchers understand and practice the reviewing process and to what level conference management tools lend support to such practices. The study should also explore how to address the challenges of aggregating the reviewing accounts of researchers (while researchers participate in different publication venues and both entities need control and ownership of the reviewing data). The study should also investigate how to enable publication venues to recognise the reviewing activities of researchers and, finally, enable publication venues to incentivise their reviewing team. Due to the limitations of centralisation, we need to investigate other models that could address these limitations, for instance, exploring decentralised technologies. Decentralisation is a process that enables multiple (individual) actors to have control and management responsibilities contrary to a single entity in centralisation [2]. In the context of peer review, decentralised technologies may enable publication venues and researchers to have more control and management over their data, contrary to centralised conference management tools.

In section 1.1, we also discussed the challenges brought by centralisation, and the thesis explores how decentralisation could address these challenges; therefore, the fundamental research question this thesis posed is:

What impact could a technical infrastructure based upon decentralised and distributed technologies have on:

1. Accumulating the reviewing activities of researchers.
2. Recognising the efforts of reviewers.
3. Incentivising reviewers for their services.
We break down the broad research question into three research questions. We posed

*RQ1* to investigate how researchers understand and practice peer review. In *RQ2*, we investigate how decentralised and distributed technologies support providing technical infrastructure for the three issues raised in our broad research question: accumulating the reviewing accounts of researchers, recognising the efforts of reviewers, and incentivising reviewers for their job. In *RQ3*, we investigate how the technical infrastructure addresses the issues raised in *RQ1*.

*RQ1*: How do researchers in the web community perceive and practice the reviewing process (as a program committee member and chair) while:

- Accumulating the reviewing records of researchers
- Selecting suitable reviewers
- Incentivising reviewers

A review is broadly perceived as an impartial assessment of something. People in academia may perceive it with slightly different meanings; however, these views, understandings and practices in the form of evidence are not well documented. Researchers at several stages of their careers may perceive and practice the reviewing process in diverse manners. For example, a PhD student or a junior researcher is more likely to have a different understanding than a professor in the same research area. Two senior researchers may have encountered altogether different experiences in the reviewing process. Therefore, it is necessary to analyse researchers’ understandings and practices which paves the path for future research. We need to understand how peer-reviewers are selected and invited. Which tools, if any, do the Publication venue management teams use in the process to assess the competency of reviewers before asking them for participation?
Furthermore, we need to investigate what methods and tools do they use to keep such information? Do they share such data with other Publication venue management teams? How do they verify the integrity of this data? Are there any tools available to them for establishing the authenticity of such data? How do they place their trust in the available information? How would the Publication venue management team trust the reviewing history of their reviewers? Do the publication venue management teams incentivise their reviewers? What methods and tools are available to incentivise reviewers? How would the Publication venue management teams want to incentivise their reviewers?

**H1**: Publication venue management team does not have standard procedures for:

- Managing researchers’ reviewing records
- Selecting suitable reviewers
- Incentivising reviewers

**RQ2**: How could decentralised and distributed technologies support the provision of technical infrastructure to:

- Accumulate the reviewing accounts of researchers from across multiple publication venues
- Recognise reviewers’ efforts
- Incentivise reviewers

After the in-depth analysis of different tools and platforms based on centralised models, we investigate the impact of introducing decentralised and distributed technologies to
the reviewing process. We explore the possibilities of providing a technical infrastructure that could accumulate the reviewing accounts of researchers, recognise reviewers’ efforts, and incentivise reviewers for their job. We explore how to provide a technical infrastructure for both publication venues and researchers, that they would not need any centralised authority as a patron. We analyse how decentralised technologies could enable publication venues to incentivise reviewers transparently without relying upon a third-party authority. We investigate how such technical infrastructure could enable anyone to verify the reviewing history of researchers without any third-party intervention.

Scholarly tools related to peer-review, including conference management platforms, follow centralised models and keep growing their data silos, typically disconnected from other platforms and applications. Such tools typically do not allow public access to such vital information about publication venues and researchers. Even if a platform publicly exposes some of the information, an entity controlling such a platform has absolute control over data. Therefore, it becomes challenging to establish trust in the information about publication venues and reviewers.

**H2**: Introducing a technical infrastructure based upon decentralised and distributed technologies will help:

- Accumulate the reviewing accounts of researchers from across multiple publication venues
- Incentivise reviewers

**RQ3**: To what extent does the decentralised and distributed technical infrastructure address and satisfy:
• The management of researchers’ reviewing records

• The selection of suitable reviewers

• The incentivisation of reviewers

For this research question, we explore if our designed and developed technical infrastructure enables the accumulation of the reviewing accounts of researchers from across multiple publication venues and the incentivisation of reviewers. How valuable could this technical infrastructure be for both publication venues and researchers? Does this technical infrastructure reflect and answer the requirements recorded in Q1? Would the management teams and researchers want to use this technical infrastructure for their publication venues?

**H3:** The decentralised and distributed technical infrastructure fulfils the requirements of:

• The accumulation of the reviewing accounts of researchers from across multiple publication venues

• Incentivising reviewers

### 1.4 Methodology

The primary motivation for this thesis is to investigate the specific issues of peer review pertinent to:

1. Unavailability of the reviewing history of researchers.
2. Trust deficit in the reviewing accounts of researchers.

3. Centralisation of peer review data.

4. Little recognition of the reviewing activity.

5. Little incentives for reviewers.

We propose a methodology that involves different research studies to address the research questions we posed in Section 1.3. Figure 1.1 shows the three phases of our methodology.

Data Collection

Our fundamental aspiration is to learn the understandings and practices associated with the peer-reviewing process. We need to let the researchers who participated in the reviewing process for publication venues share their experiences. For example, the significance of the reviewing process they found in scientific publishing. How were they invited for peer review? How did the Publication venue management team find and select reviewers? Hence, to cover a set of such questions, we propose a study that involves asking researchers about peer review. Their first-hand experience of being involved in the reviewing process will help us understand the specific aspects of peer review - for example, how the publication venue management team finds and selects competent reviewers. Therefore, the study involves planning and conducting semi-structured interviews and then analysing the transcripts using the qualitative thematic analysis approach.

Designing the framework and developing the platform

We design a technical framework to support the provision of a technical infrastructure for accumulating the reviewing accounts of researchers from across
Figure 1.1: Three phases of the methodology, namely Data Collection (consists of a research study where we record and analyse the experiences, practices and preferences of researchers), Designing the Framework (consists of outlining a framework and develop a platform to support the accumulation of reviewing accounts of researchers and incentivisation of reviewers), and evaluating the platform (consists of another research study to analyse how the platform responds to our research questions).

multiple publication venues, recognising the reviewing efforts of researchers, and incentivising reviewers for their job, in a transparent and trustworthy way.
The framework also introduces a mechanism to establish trust in the reviewing accounts of researchers and enable the verification of the authenticity of these accounts. We also develop a platform based upon the framework.

**Evaluation of the platform**

We evaluate the platform based upon the scope of our research questions RQ2 and RQ3, and analyse how this evaluation study responds to the issues related to the accumulation of the reviewing accounts across multiple publication venues, establishing trust in these accounts, recognising the reviewing activity and incentivising reviewers. We followed the software usability testing approach that involves asking participants to carry out specific tasks and then record their views.

### 1.5 Thesis structure

This thesis is structured as follows.

**Chapter 2 - Literature Review**

This chapter describes the literature review and discusses different research studies about peer review. We also investigate different approaches adopted by conference management tools, peer-reviewing tools and other platforms. We also explore different platforms developed using centralised technologies. We discuss the limitations of centralised approaches in addressing the issues related to peer review, especially about the accumulation of the reviewing accounts of researchers from across multiple publication venues, establishing trust in the reviewing accounts, recognising the reviewing efforts and incentivisation of reviewers.
Chapter 3 - Understanding the peer-reviewing process

This chapter shares our motivation and objectives of recording researchers’ practices and experiences as the Publication venue management team members and reviewers. We state our study plan, scope, and also limitations of the experiment. We record and analyse the peer-reviewing practices and experiences of researchers.

Chapter 4 - A Decentralised technical infrastructure

We present our work of designing a framework and developing a platform based upon that framework for accumulating the reviewing accounts of researchers from across multiple publication venues, establishing trust in the reviewing accounts, recognising the reviewing efforts and incentivising reviewers. We investigate the possible impact of decentralised and distributed technologies on the peer-reviewing process.

Chapter 5 - Evaluation of the infrastructure

This chapter presents our study to evaluate our platform that provides the technical infrastructure for both publication venues and reviewers. We conduct the study by enabling researchers to use the platform and record their experiences and views. We analyse their response to discuss how this study answers our research questions RQ2 and RQ3.

Chapter 6 - Conclusion

We discuss and conclude our research work presented in the thesis and share our thoughts for future research.
Chapter 2

Literature Review

In Chapter 1 we outlined a broader perspective of issues related to the peer-reviewing process we address in this thesis. We stated our motivations for conducting this research, discussed research questions, and our approach to answering those questions. These questions are pertinent to the peer-reviewing process and different roles involved, such as authors, reviewers, editors and the Program Committees. This chapter will discuss peer review, issues found in various research works and approaches adopted to address those problems. We will cover the background of the importance of peer review, different tools and techniques used to support the process, and related research works relevant to the accumulation of the reviewing accounts of researchers from across multiple publication venues and the incentivisation of reviewers.

2.1 Peer-review

Peer review effectively allows academic societies to construct knowledge through social sharing and competition \[^{35}\]. The need and importance of peer review is increasing
with the number of journals, conferences, workshops, and publications. For example, Table 2.2 shows a list of journals in the field of computer science (including conference and proceedings) with their *h-index*, the number of papers published in the year 2020, and the number of articles published in 3 years (from 2017 to 2019) [84]. On the other hand, it is argued that the peer-reviewing process is perceived as a force that suppresses novel ideas and enforces the rules set by a “scientific aristocracy”, and not many editorial boards of scientific journals have shown awareness of peer review’s weaknesses by curbing its autocratic nature [29]. For example, a reviewer might reject an article because they were working on the same idea, or it gets rejected because of its unconventional methodology. However, scientific communities keep following the process despite its shortcomings and legitimate criticism [29].

<table>
<thead>
<tr>
<th>Title</th>
<th>h-index</th>
<th>Published in 2020</th>
<th>Published in 3 years (2017-2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE Computer Society Conference on Computer Vision and Pattern Recognition</td>
<td>406</td>
<td>1466</td>
<td>2731</td>
</tr>
<tr>
<td>Lecture Notes in Computer Science</td>
<td>400</td>
<td>21327</td>
<td>66367</td>
</tr>
<tr>
<td>Bioinformatics</td>
<td>390</td>
<td>983</td>
<td>2684</td>
</tr>
<tr>
<td>IEEE Transactions on Pattern Analysis and Machine Intelligence</td>
<td>372</td>
<td>312</td>
<td>643</td>
</tr>
<tr>
<td>IEEE Transactions on Automatic Control</td>
<td>294</td>
<td>696</td>
<td>1588</td>
</tr>
</tbody>
</table>

Table 2.2: The number of papers published in 2020 and over three years (2017-2019), sorted by the h-index. It is assumed that the number of papers submitted to publication venues would be greater than the number of papers published (because of the possible rejection of articles). This data is taken from SCImago [84].
Figure 2.1: The graph shows the increasing numbers of OpenAccess and preprints articles from 1991 to 2014 [98]. The emergence of OpenAccess articles shows constant and rapid growth in two decades. This image is taken from the article "Emerging trends in peer review—a survey" [98] by Richard Walker, published in 2015.

Figure 2.1 shows the increasing number of original research and review articles published as Open Access and preprint articles, indexed by Scopus [98].

In this chapter, we discuss the issues related to peer review. We focus on examining the literature associated with the methods and tools used for:

1. Accumulation of the reviewing accounts of researchers from across multiple publication venues

   We explore the methods to store the reviewing accounts of researchers, including the technical infrastructure, tools and platforms available for both the publication venue management team and reviewers. We discuss how Centralisation has brought the limitations. We also explore how decentralised technologies are
used to address these limitations of accumulating the reviewing accounts of researchers from across different publication venues.

2. Recognising the efforts of reviewers and for incentivising reviewers

We explore the methods used for recognising the efforts of reviewers. We examine different platforms and their technical support for incentivising reviewers. We also discuss different forms of incentives these platforms offer.

3. Finding and selecting reviewers

We explore how researchers responsible for finding and selecting reviewers for the conference carry out the search activity and how different tools support them.

We also discuss and compare centralised technologies and decentralised technologies that provide technical infrastructure for accumulating the reviewing accounts across multiple publication venues, establishing trust in these reviewing accounts, and incentivising reviewers.

2.2 Issues and criticism on the process

Diverse issues and severe criticism on the reviewing process have been reported in the scientific literature over several decades [53]. These issues include the inability to detect errors and fraud, lack of transparency, lack of reliability, the potential for bias and unethical practices, and the lack of recognition and motivation of reviewers [98]. For example, in one instance, a peer-reviewer stole and published a manuscript as his own, which took the original researcher five years from conceptualisation of the study to publication of the primary analysis [26]. Research communities have brought changes to ensure error and fraud detection and improve transparency and reliability; for example, the non-transparent nature of blind reviewing methods (single and double)
motivated adoption of open review methods. However, the process remains under discussion for its weakness to overcome such problems. For example, the same research article rejected from one publication venue could get accepted at another publication venue covering the same topic, which reveals the inconsistency of the reviewing process and the lack of its standards. After years of practice, Professor Izet Masic concludes that while peer-reviewing, the author’s country of origin plays a significant role, especially in journals with the lower Impact Factor and journals from undeveloped and small countries [63]. For example, the chances of publishing an article by an author from a developed country are more than the author from an underdeveloped country. Generally, peer review depends upon reviewers’ ethical behaviour; however, it has been suggested that such dishonest peer-reviewers and their corroborators be penalised, for example, by making the offence known in their professional circles and encouraging employers to take a strong stance against researchers who engage in these fraudulent activities [26].

Critics’ objection of bias in peer review is a threat to the process’ impartiality. Both isolated and systematic bias have been reported, including various presumptive biases, such as institutional and gender [61]. For example, female biomedical postdoctoral fellowship applicants had to be 2.5 times more productive than males to get the same competence score [102]. In another example, postdoctoral fellowship applicants with personal ties to reviewers were assessed as more competent than those not affiliated, but equally productive [102]. Researchers may have their own stories about the irrational rejection of articles. The reasons could vary from turning an article down without reviewing to deferring it under the mask of anonymity [53]. For example, a reviewer (who could also be a competitive researcher in a niche field) may create hurdles (like stopping it or causing delay) in publishing the article [52]. In another instance, a group of researchers were keeping competitors’ articles out of the top
journals while supporting the publication of inferior work [52]. For example, they rejected the articles from their competitor research labs and accepted the articles with sub-standard research outcomes. In several instances, it has been reported that the same article rejected from a journal gets accepted by another [63]. A research study reported that “Some editors, they say, are reluctant to upset favourite scientists by overturning their reviews, for fear that they will stop submitting their work to that journal” [52], which is why, for some editors and reviewers, some scientists deserve more equality (editors pay more attention to their papers) than others; and some papers do not get the scrutiny they need (favouring some researchers), while others are unreasonably rejected [52].

Suggestions

To overcome such problems, it is argued that academic communities should work on improving the process of selecting reviewers. The anecdotal instances of peer-review fraud are reported more often, and the following suggestions are recommended to ensure the sanctity of the peer-reviewing process [27].

Journal’s database

It is suggested that every publication venue should have its own database of reviewers. This database may help the publication venue management team invite reviewers, as it may inform the management team about how a researcher performed as a reviewer in previous events [27].

Verification of email IDs

In some of the publication venues, the management team requests the author(s) of an article to provide a list of reviewers they deem suitable for the article [27]. In that case, it is suggested that the publication venue management team verify
those email IDs and the relevant institutions of those reviewers. This verification
may include confirming that if the reviewer exists and belongs to an appropriate
institution [27].

**Ensure the credibility of reviewers**

It is suggested that the publication venue management team ensures the credi-
bility of reviewers before inviting them. The management team may consider
all the relevant academic information available about a researcher, for example,
their published articles, and, their webpage on their institutional website [27].

**Plagiarism check**

It is suggested that the management team analyses any occurrences of plagiarism
in the articles and reviews. The publication venue management team should
investigate if an author or a reviewer were involved in plagiarism before [27].

**A good review and a bad review**

It is suggested that the publication venue management team distinguishes
between a good review and a possible bad (or biased) review. The criteria
to judge the quality of a review should depend upon the publication venue
management team and may vary in research communities.

**Recognition for reviewer**

It is suggested that publication venues give recognition to reviewers [27]. The
form of recognition may also depend upon different research communities, such
as honouring reviewers with the best reviewer awards.

Journals, conferences and workshops typically publish their instructions for reviewers.
These instructions may vary, depending upon the research events. According to the
instructions published by The Journal of the American Medical Association (JAMA),
peer-reviewers should judge the following [29].
1. **Original content**
   Reviewers should assess the originality of the content presented in the manuscript. They should make sure the content is not plagiarised and is a genuine contribution by the authors.

2. **Validity of data**
   Reviewers should check if the data presented in the manuscript is authentic and factual. Reviewers may follow different methods to verify the integrity of the data.

3. **Reasonable conclusion**
   Reviewers should assess if the conclusions presented in the manuscripts are justified and supported by credible information (evidence). Reviewers may verify the cited articles, their results, and outcomes to evaluate if the conclusions are justified, and reasonable.

4. **Important information**
   Reviewers should check if the information presented in the manuscript is vital, appropriate, relevant to the journal, and is valuable.

5. **General medical interest**
   Reviewers should check if the article is of general medical interest and the journal's defined medical research areas.

6. **Clear writing**
   Reviewers should check if the article’s writing is clear or can be made more explicit. They should evaluate if the wordings or the writing style follow the journal’s standards.

In the following section, we investigate the first point described in Section 2.1 that how different platforms (typically centralised) supported the accumulation of the reviewing
accounts of researchers from across multiple publication venues. We also study the limitation of centralisation and how different technical infrastructures supported this accumulation of the reviewing accounts of researchers.

2.3 Conference Management Systems

Conference Management Systems (CMS) have evolved over several years now, and they have become an essential tool required by the management teams of publication venues. Some examples of these CMS are The MyReviewSystem [79], OpenConf [49], IAPR Commence [19], EasyChair [17], CyberChair [96], EDAS [34], Confious [73], ConfSys [46], ConfTool [21], ConfMaster [20] and Microsoft CMT [64]. Such Conference Management Systems aim to meet the publication venue management team’s needs by handling the entire process of conference management [60].

Conference Management Systems’ primary features involve submitting articles, assigning articles to reviewers, receiving reviews and possibly rebuttals. Such conference management systems keep data in their own data silos, usually disconnected from any other system. For example, suppose a researcher contributes to the reviewing process of three different publication venues which use three different conference management systems. In that case, a reviewer’s information, review scores and texts will be stored in three different platforms, usually disconnected from each other. Hence, the reviewing accounts of a researcher get scattered across multiple platforms, typically inaccessible to the rest of the scientific community.

These systems typically follow the centralised model where the authority and control are exercised by specific entities (usually the owners/developers of the platform).
The following section discusses centralisation and the benefits and limitations of the platforms developed using the centralised approach.

2.3.1 Centralised systems

Centralisation refers to a process in which activities involving planning and decision making within an organisation are concentrated to a specific leader or location [16]. Centralisation brings absolute control to a single or a few entities—the authority over decisions and information. An application based upon the centralised model would have its data and decision power in a single place. Therefore, there is always a risk associated with the reliability of that single entity, typically known as the single-point-of-failure.

Single-point-of-failure is described as “a potential risk posed by a flaw in the design, implementation or configuration of a circuit or system in which one fault or malfunction causes an entire system to stop operating” [7]. So, the concentration of data and resources in a single place can compromise the data and the entire system, giving it the potential to make the system vulnerable, weak, and unstable. For instance, in 2015, Amazon’s DynamoDB database malfunctioned and disrupted the services for multiple days, a typical example of single-point-of-failure [6]. In another instance, tens of thousands of Delta Air Lines passengers worldwide were affected because of a computer failure [68].

Using the lens of an end-user, some of the significant limitations centralised web applications may display are:

Data possession

Data ownership rights usually depend upon the data policies of a platform,
and in most cases, the centralised authority (the platform) holds and owns the data. In exceptional cases, the users (producer of data) may retain ownership of the data they produce in a centralised platform only if the platform allows. Generally, the users of a platform that generate data and information have little control over what happens with the data they produced. The data resides in the organisation’s data silos; therefore, generally, that organisation retains the possession, ownership and administration of data.

Data integrity
Since the data is stored beyond the users’ jurisdiction, its integrity may confront serious questions. For instance, data could be compromised, altered, hacked and manipulated. Organisations may take care of their data privacy and take security concerns seriously; however, the potential remains for accidental or malicious threats to data integrity and legitimacy.

Data lifespan
Whether to keep or delete the data solely depends upon the organisation. If the organisation shuts down or discontinues its operations, end-users may lose the data stored in data silos. Therefore, the lifespan of data entirely depends upon the organisation’s decisions.

Single-point-of-failure
The organisation’s applications, servers, command, and control systems may be vulnerable to attacks and become a single-point-of-failure target. A single successful attack on a section of the system would bring the whole system down.

Technical, legal and regulatory barriers
Usually, users produce data using an application - they may have to consider the technical and legal implications of using a platform. For example, users
have to agree to the terms and conditions for using the application, which may compromise their privacy, ownership and authority over the data they produce.

Conference management platforms like EasyChair [17], and EDAS [34] are developed using commercial models, and therefore, generally, they keep peer-reviewing information in their secured data-silos. Their commercial aspirations enable them to follow centralised techniques for saving data related to the reviewing process, which indicates that these platforms may have absolute control over data. The availability and the authenticity of a researcher’s reviewing-records can therefore solely depend upon these platforms. Consequently, a researcher may have altogether different and distinct profiles as a reviewer across different platforms. For example, a researcher who participated in the reviewing process for various publication venues a decade ago may have this information stored in a centralised conference management platform. For some reason, if that platform discontinues its services or its data is compromised, it would become challenging for the reviewer to establish their reviewing history and its authenticity. Similarly, with the restricted exposure of reviewing-accounts, and complex terms and conditions by these platforms, it becomes impracticable to utilise reviewing-accounts for personal and professional purposes, such as displaying these records on institutional and individual websites.

We discuss some of the prominent conference management tools and their workings in managing the reviewing-records of researchers.

**EasyChair**

EasyChair is one of the most active and popular conference management tools, with more than 3.2 million users and has served more than 88,000 conferences so far. EasyChair supports hosting ranging from small workshops to large conferences with thousands of submissions and participants, and they claim to
be the world’s most extensive conference management system. Their system hosts top conferences in several research areas, including the World Wide Web (WWW) and Bioinformatics [17].

Their system provides a range of services, including publishing calls for papers (CFP), abstract submission, reviewing, program generations etc. However, all such information is not open to the public; therefore, it resides in their system.

**EDAS**

EDAS is a widely used conference management system that supports article submission and the review process. For IEEE conferences, EDAS checks authors against the IEEE Prohibited Author List (PAL) and notifies publication venue management team if an author matching a name on that list submits a paper [34].

**COMFy**

COMFy is a framework that offers a unique feature that collects information from Linked Open Data sources like DBLP to check the conflict of interest between authors and assigned reviewers. For example, an indication for a possible conflict is that the reviewer and authors have co-authored article(s) before, or the domain name of the reviewer and the author’s email addresses, surnames, or organisations match [14].

**OpenConf**

OpenConf is a peer-review management system and has two editions, community and professional. The community version is free to use, and organisations can host/install it on their servers. OpenConf claims to be used worldwide at events across 90 countries [49].

**CyberChair**

CyberChair implements the paper classification mechanism to identify conflicts
between authors and reviewers. Apart from the typical features offered by a conference management tool, CyberChair used colour-schemes to indicate the state of reviews [96].

**IAPR Commence**

An open-source web-based conference management system that relies upon PHP and MySQL that remained active in early 2000 [19].

**Confious**

Confious introduced an intelligent way of identifying any potential conflict of interest in the peer-reviewing process. First, if both author and reviewer’s email addresses belong to the same institute, that would indicate a potential conflict of interest. Secondly, Confious uses a dataset from DBLP to observe if the author and reviewer have co-authored any article before. Confious uses both automatic and manual methods to assign papers to reviewers. The automatic assignment algorithm considers four parameters.

1. **Topics interest**
   
The authors mention the research topics of their articles while they submit their papers. Reviewers on-board also state their preferences for reviewing specific research areas. The algorithm checks if the research topics of an article match the interests of reviewers.

2. **Articles bidding**
   
Reviewers submit their bids to review specific papers. The assignment algorithm also analyses these bids and considers reviewers’ interest in specific research articles.

3. **Conflict of interest**
   
The algorithm analyses any conflict of interest between reviewers and authors before assigning reviewers to articles.
4. **Workload balance**

The algorithm also analyses the reviewing workload threshold and balances it by assigning a fair number of articles to all available reviewers.

Confious also enables the publication venue management team to prepare a customised review form where reviewers are asked to take extra and different questions/parameters to carry out a comprehensive review [73]. This review form may depend upon the publication venue policies; for example, a journal may ask its reviewers to assess the various aspects, including inflammatory material, out-of-scope material, and GDPR [91]. The inflammatory material may include any use of inappropriate language or potentially libellous assertions. Some articles may include information, data or material which is out of the scope of the publication venue [91]. The publication venue may also request its reviewers to examine if the article’s information, data, or material adheres to the GDPR.

**ConfSys**

This web-based conference management system also relies upon the research areas and topics listed by reviewers and authors, thus helping the publication venue management team allocate relevant reviewers to papers. The system performs basic checks, including finding institutional/organisational bias and whether the authors and reviewers were co-authors [40].

**ConfTool**

ConfTool has both commercial and non-commercial versions available. The tool enables the publication venue management team to assign reviewers both manually and automatically. The tool performs basic checks of finding conflicts of interest and allows reviewers to bid for papers they want to review [21].
ConfMaster

ConfMaster is a commercial tool for managing academic conferences and workshops that has helped organise more than a thousand academic events [20]. The tool supports the abstract submission, paper submission, reviewer assignment, and rebuttal management [20].

Microsoft CMT

The Conference Management Toolkit (CMT) is a web-based conference management tool sponsored by Microsoft Research. The tool supports the full submission lifecycle along with the bidding process. It enables the publication venue management team to find conflicts at different levels, for example, domain conflict (if the author(s) and reviewer(s) have their email on the same domain) [64].

<table>
<thead>
<tr>
<th>Platform</th>
<th>Researchers</th>
<th>Publication Venues</th>
<th>Free version</th>
<th>Automatic checks for conflict of interest</th>
<th>Automatic or semi-automatic reviewer assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>EasyChair</td>
<td>over 3.2 million</td>
<td>over 88,000</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>EDAS</td>
<td>over 100,000</td>
<td>2655</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>OpenConf</td>
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<td>over 1000</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>CyberChair</td>
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<td>N/A</td>
<td>Yes</td>
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<td>Yes</td>
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<td>IAPR Commerce</td>
<td>N/A</td>
<td>36</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Platform</td>
<td>Researchers</td>
<td>Publication Venues</td>
<td>Free version</td>
<td>Automatic checks for conflict of interest</td>
<td>Automatic or semi-automatic reviewer assignment</td>
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</tr>
<tr>
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<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ConfTool</td>
<td>N/A</td>
<td>over 1000</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ConfMaster</td>
<td>N/A</td>
<td>over 1000</td>
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<td>No</td>
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</tr>
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<td>6500</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 2.3: Comparing different conference management tools with the number of researchers and publication venues onboard shows that EasyChair is one of the leading conference management tools. N/A refers to Not Available; typically, several tools do not have their numbers publicly available while other tools are self-hosted tools. Self-hosted tools provide their code for publication venues to install on their servers.

These conference management tools typically operate in a centralised manner where reviewers’ information, reviewing credentials, and in principle, their whole reviewing activities are stored in individual data silos disconnected from each other. Presumably, the open-source self-hosted tools have the technical capacity to publish their data (open data). So, the reviewing records of researchers are primarily scattered across multiple platforms and partially barred from public access. Therefore, it becomes tedious and challenging to accumulate a researcher’s reviewing records because it is valuable and kept private, potentially reinforcing the publishers’ and journals’ influence over the academic publishing process [95].
2.3.2 Decentralised and distributed systems

In section 2.3.1, we discussed how centralised systems give their organisations a powerful position over the scientific community (that produces the content) to impose their copyright and ownership policies, which eventually generates profits [40]. To address the issues discussed earlier, researchers have explored the space of decentralised and distributed technologies.

Decentralisation can be described as a mechanism that transfers command and control and decision-making from a centralised authority to multiple entities. An application based upon decentralised infrastructure would spread its data across multiple nodes (systems) in a network. Such applications attract significant benefits in comparison with centralised applications.

Suppose there is a network of physically different computer systems. Each system has specific processing and memory capabilities and is supposed to work on a problem, perform its computational parts, and communicate with other systems over communication channels. These communication channels are used to send and receive control and data messages. Such a network is generally known as a distributed network [85]. In comparison with a centralised application, a decentralised application (deployed in a distributed network) offers distinguished benefits, including:

1. **Data independence**

   An application based upon the principles of decentralisation typically gives the users autonomy over their data usage, allowing individual entities to produce and use their data independently of any centralised entity. Usually, users have the authority to allow or restrict other applications to use their data.
2. Control independence

Similarly, an application based upon the principles of decentralisation generally gives the users autonomy over handling their data. An individual entity is autonomous in managing its data, including saving, distributing, deleting or amending it.

3. Data lifespan

Typically, every node in the network keeps the data (partial or all, depending upon data policies); therefore, it depends on a user (node) to save data as long as they want to or delete it.

4. No Single-point-of-failure

As resources, in terms of hardware systems and data, are owned by network members; therefore, it reduces the chances of network failure and single-point-of-failure. Since all members keep the same copy of data, any member of the network may provide any requested data.

Decentralised and distributed technologies experienced enormous hype with the invention of Bitcoin [67], a digital currency underpinned by a set of decentralised and distributed technologies collectively called Blockchain.

Bitcoin is a decentralised virtual currency without a central bank deployed on a distributed network. Bitcoin is built on a ledger that logs transactions. Identical copies of that ledger are stored across a network of participating computers. Bitcoin’s design empowers irreversible transactions, a prescribed course of money creation over time (by rewarding honest participants), and public transaction records [9]. Generally, central banks are responsible for managing and maintaining the bookkeeping system of currencies in a centralised system. They keep the record of money moving from one account to another, and they typically charge for such services. Since Bitcoin operates
on decentralised principles, therefore, there is no central authority for bookkeeping. Instead, the participating computers maintain Bitcoin’s bookkeeping system, and in return, they get incentives in the form of newly issued currency of Bitcoin. These incentives are the rewards for the participants who do their bookkeeping job honestly.

This bookkeeping involves recording transactions between accounts in the Bitcoin network. Every new transaction announced to the Bitcoin network is periodically grouped in a block of recent transactions. The participants in the network try to solve a computational-intensive mathematical puzzle (based upon the contents of the block) before the block could become a confirmed and accepted part of the blockchain. The first participant computer who solves this computational puzzle announces its success to the network, and if other participants accept (and confirm) this resolution, that block (of transactions) is added to Bitcoin’s ledger. When a newly solved block is published to the network, other participants verify the solution and start working on solving the next new block, which indicates that the other participants accept and agree to the solution of that computational puzzle; in other words, they all have a consensus on the solution of the puzzle. This mechanism of establishing a consensus over a block (of transactions) through solving a computational-intensive mathematical problem is known as “Proof-of-work”, which is essentially the solution to a mathematical puzzle marked on the block. The participant whose block was accepted and confirmed by the network gets an incentive in the form of Bitcoin. This mechanism of getting a reward for solving a mathematical puzzle is called “mining”. Each newly created (accepted and confirmed) block also keeps a link to the previous block so that any participant in the network can traverse from a newly created block to the genesis block, the first block.
The above example of Bitcoin shows how Blockchain technology enables a digital ledger to keep the record of digital events (transactions) in a decentralised and distributed manner, in the form of a long chain of data items linked cryptographically [86]. The notable features and promises of Blockchain technology include:

**Decentralisation**

In a centralised model, a dominant entity typically enjoys the trust of other entities in the system. That powerful entity becomes a bridge between other entities when they interact; for example, Alice usually needs a bank to send over money to Bob. However, in the decentralised model, the entities interact with each other directly without any central trust, also commonly known as peer-to-peer communication.

Blockchain implements this trustless, peer-to-peer communication. This communication involves publishing each block in the network; consequently, every network member keeps a copy of blockchain data perpetually. Therefore, they do not have a dependency upon a centralised entity for accessing data. Every network member can transact (communicate) with any other member in the network without any central authority (trust).

**Transparency**

Each network member holds an identical copy of blockchain data. For instance, Alice interacts and transacts with Bob; this transaction (or activity) is broadcasted to the whole network, and each network member updates their ledger once this transaction is confirmed on the blockchain. This activity indicates that everyone in the network observes and records all transactions published in the network, allowing transparency in the records.
**Fault tolerance**

Bitcoin’s network is spread across the globe, with thousands of participants from different continents and countries. Each participant computer is generally responsible for the network’s resilience and data integrity in such a blockchain-based network. Since each node keeps an identical copy of data, which eliminates the dependency upon any specific computer in the network; consequently, any node can serve data requests. The blockchain network removes any inconsistency in a transaction or a piece of data by reconciling it with other nodes in the network. In the above example of Bitcoin, when a participant computer solves the mathematical puzzle, it broadcasts the solution to the network. Other participant computers confirm and verify the puzzle’s solution and then move on to finding the solution to the next block’s puzzle. If a participant computer wants to alter a block verified and confirmed by other participants in the network, it needs to resolve the altered block’s puzzle and publish it to the network for consensus. To make the altered block a successful part of the blockchain, at least 51% of the network participants would have to develop a consensus over confirming and verifying the solution of the altered block’s puzzle, which becomes almost impracticable. This attempt of modifying a block and making it the accepted part of the ledger is known as the 51% attack \[67\].

For example, Alice sent 10 Bitcoins to Bob, and this transaction gets confirmed by other participants in the network. For some reason, a participant amends this transaction to 6 Bitcoins (instead of 10), recalculates the mathematical puzzle of the amended block, and after finding the solution, it announces the solution to the network. Bitcoin’s design principles do not allow other network participants to confirm such transactions (unless more than 51% of the participants agree on approving the transaction); therefore, the amended transaction is discarded.
Security

We discussed how the 51% attack resistance paints a strong picture of the blockchain network’s resilience. In the above example of bookkeeping, centralised banks take care of the security of their banks and vaults. They take extra security measures, including deploying security guards, cameras and other devices to ensure the safety of the assets in their vaults. While in decentralisation, the individual network participants take the responsibility of securing the vaults with the help of cryptography. Cryptography has a crucial part in the blockchain network, which provides two fundamental technologies [9]:

1. **public-private key cryptography**
   Anyone can create a public key and an associated private key (makes it a public-private key pair) [32]. For example, Alice creates a public-private key pair and shares the public key with her friends. Bob signs a message with that public key and sends the encrypted message to Alice. Now, since Alice is the only person with the associated private key, she decrypts the encrypted message using her private key and reads the message sent by Bob. If someone gets hold of the encrypted message, they cannot read it without the associated private key. This signing mechanism ensures that the actual (intended) recipient reads the message and not anyone else. Similarly, Alice replies to Bob with a message and signs it with her private key. Bob receives the message, decrypts it with Alice’s public key and reads it. In this way, Bob ensures that the message was sent by Alice and not by anyone else (or impostor). This signing mechanism authenticates that a message was sent by a specific sender and not by anyone else.

2. **cryptographic validation of transactions**
   The participants in the blockchain network use these mechanisms to authenticate instructions to transfer money to other participants. For example,
Alice signs (with her private key) an instruction to transfer 10 Bitcoins to Bob and publishes this to the network. The network members authenticate this instruction using Alice’s public key and confirm that the instruction came from Alice.

These cryptography technologies ensure the security of the system in a decentralised and distributed network.

**Verifiable data**

Each block has a timestamp and is connected periodically with the previous block. We discussed above that once a block becomes a part of the blockchain, it becomes impractical to amend the block after network participants confirm and validate it. Therefore, a network member can traverse from the recent block to the blockchain’s first (genesis) block and verify any transaction in those blocks. For example, Alice sent 10 Bitcoins to Bob on January 10, 2020, at 8:10 p.m. A network member can verify this transaction by accessing (traversing to) the specific block.

Figure 2.2: Blockchain’s basic data structure - a block is timestamped along with a list of transactions and the link to the previous block. Genesis block has no link to the previous block because it is the first one.

Figure 2.2 shows that the solved mathematical puzzle of each block (denoted by Hash) is unique; therefore, the next block keeps the hash of the previous block to help traverse the blockchain. Hash is a cryptographic function that generates
a fixed-length character string from the data records (transactions, in this case). Therefore, a slight change in a transaction will change the hash of a block. For example, the hash of the string “Alice sent 10 Bitcoins to Bob” is:

86F60DA4B4451315B5D29F60F63B98129295E64B6C48169A33AFBA753B7A5370

if we change the number of bitcoins from 10 to 11 in the string, the hash of “Alice sent 11 Bitcoins to Bob” will be changed to:

30129D34CB6A193C0FAA582A440B67118FB3B8F478F03CE9F02A6B2A86

Data immutability

The term immutable refers to making transactions (data) permanent, indelible and unalterable once they become a formal part of the blockchain [33]. We discussed above how cryptographic validation of transactions occurs in the Bitcoin network that confirms that the transaction came from the sender. We also discussed how network members solve the computation-intensive mathematical puzzle to make a block an accepted part of the blockchain. Once a transaction is validated by network members and becomes a part of the newly created block after solving a mathematical puzzle, it becomes immutable. In the above example, Alice had sent 10 Bitcoins to Bob on January 10, 2020, at 8:10 p.m., this transaction was added to a block, and then the block was appended to the blockchain after solving its mathematical puzzle and getting validated by network members. As the blockchain grows, several blocks get added to the blockchain after that block. These solved mathematical puzzles of each block guard the transactions inside, and therefore, it becomes impractical to amend a transaction once a block is appended to the blockchain. The chain of hashes ensures any changes would break the chain; hence, it makes the blockchain data immutable.
2.3.3 Blockchain based peer-review

As blockchain technology is gaining adoption momentum across diverse research and industries, it has been used to address challenges faced by academia. For example, blockchain technology is used to address the “reproducibility crisis”, enabling peer-reviewers to verify and validate the results generated by authors and award reputation points to research groups publishing highly reproducible results [31]. Researchers report their experiments and results in their articles. While reviewing these research articles, it becomes challenging for reviewers to reproduce the results sometimes to validate the authenticity of results, for example, in medical sciences - hence becomes a predicament for reviewers. This situation is generally known as a “reproducibility crisis”. A blockchain-based system is proposed for researchers to record their experiments and results, which becomes an authentic source for reviewers to confirm the legitimacy of results.

Blockchain technology is also proposed as a Proof of Intellectual Work and as an Intellectual Currency, attained through the features of immutability and transfer of digital assets without any third-party trust [86]. For example, Alice proposes a novel idea and Bob designs a painting. It becomes challenging to establish Alice as the original proposer of the idea and Bob as the original designer of the painting. Blockchain technology can be used to register these verifiable claims. Each claim can be identified by its author and a timestamp to indicate when it was recorded [86].

PubChain proposes a blockchain-based publication platform to store research articles and also to reward reviewers/authors in the form of PubCoin; its native cryptocurrency [99]. The incentive mechanism of PubChain relies upon the “numerical score of the paper given by the reviewer” along with additional comments on the paper. The mechanism also includes the meta-review score - a score given by the readers of a
review. In [99], the authors assume that the readers will not give high scores to a paper review with only a numerical score (without insightful comments by the reviewer). PubChain’s incentive model focuses on calculating the score given by reviewers and readers. However, it does not consider the input from the publication venue management.

An Open Review System (OPR) is developed using blockchain technologies to record the reviewing process on a private blockchain and recommend suitable reviewers based on their expertise [18]. The system focuses on implementing a typical conference management system for Open Review using blockchain technologies. The system does not propose any incentive model for reviewers or the publication event management team.

ReviewCoin (or r-coin) as a cryptocurrency is also proposed to incentivise reviewers [89] when they submit their reviews through a journal or Publons [77]. ReviewCoin is a basic idea to establish a currency exchange where reviewers are incentivised using the native r-coin instead of “real money” [89].

“DecentralizedScience” is an EU project that offers a blockchain-based system to address challenges faced by the academic reviewing process, where they claim to transfer the infrastructure and policy control from publishers to the scientific community. This system adopted the Open Access design to ensure transparency in the reviewing process. Open Access is a publishing model that focuses on making scientific knowledge freely available so that anyone can read and re-use that research [1]. The system also proposed an open reputation network of reviewers to build a reputation and reward system for reviewers [95]. This reputation system involves interaction with the public where a person can rate a review, and this transaction will be recorded on the blockchain.
This transaction will register the addresses of the sender (the one rating a review) and reviewer, along with the rating score and rated review [95].

<table>
<thead>
<tr>
<th>Platform</th>
<th>Incentive Tokens</th>
<th>Reputation System</th>
</tr>
</thead>
<tbody>
<tr>
<td>PubChain</td>
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<td>No</td>
</tr>
<tr>
<td>OPR</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>ReviewCoin</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>DecentralizedScience</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 2.4: Comparison of Blockchain-based platforms, where Incentive Tokens represents spendable cryptocurrency rewarded to reviewers, and Reputation System is a reviewers rating system.

Blockchain-based peer-reviewing systems are still in their infancy, and researchers are exploring cutting-edge technologies to address the challenges posed by the reviewing process and traditional conference management tools. Table 2.3.3 presents a comparison of different blockchain-based platforms discussed above. PubChain offers a mechanism that relies upon the numerical score of a review by its readers. ReviewCoin is merely a proposal of establishing a cryptocurrency exchange for reviewers. DecentralizedScience offers decentralisation to the reviewing process to allow more transparency in peer review.

We discussed and compared several conference management systems developed using centralised and decentralised technologies. In the following section, we analyse different platforms that record the reviewing history of researchers.
2.4 Academic reviewing credentials

In the scholarly publication, cheating and fraud may have many forms, including data falsification, creating false identities for both authors and peer-reviewers, fake submission accounts, ghost and guest authorship, and pseudonymous identities [24]. Data falsification refers to manipulating research data to give a false impression—for example, manipulating images, graphs, or removing unwanted results. To trick the reviewing process, creating fake and fraudulent identities of both authors and peer-reviewers also falls under “fraud in scholarly publishing”. For example, an author submits an article and proposes a list of potential (fake or fictitious) reviewers to review their own article. An example of fake submission accounts was reported where a researcher created a fictitious account and submitted a review “under the name of a known scientist without his/her knowledge” [87]. When a senior researcher is invited to become an author because of their influence and respect, it is typically called guest authorship. Such practices bring the hope for their paper getting accepted and possible attraction of impact once it is published [48]. Ghost authors are usually professional writers who contribute to producing an article but are not acknowledged for their contribution. For example, a pharmaceutical company hires a professional writer to draft an article, but he/she is not credited for this work [83]. Therefore, it has been argued that the peer-reviewing process needs a trust mark for every editor, author, and reviewer based on the subject matter’s expertise under consideration and their actual work as a reviewer [39]. Furthermore, it is recommended that the trust must include a method of establishing and verifying identity [39]. This identity may consist of legitimate names, institutions, published articles and the reviewing history. It has been argued that if authors want to suggest reviewers for their article, they should also provide verifiable information about reviewers [25].
Section 2.3 describes several conference management systems and how they support the peer-reviewing process. They usually focus on the articles published by a researcher and overlook their reviewing history. So essentially, they consider published articles as a criterion for inviting a researcher for reviewing and not the reviewing history of a researcher. It has been argued that the reviewing activity of a researcher is independent of the publishing performance of the researcher [72]. We discussed above how blockchain-based platforms address the issue of establishing trust in the reviewing process.

The following section lists some prominent platforms that record the reviewing history of researchers.

1. **Publons**

   Publons (founded in 2013, with over 2M researchers now) is a free online social media platform for researchers to record and showcase their reviewing records publicly [88]. Publons ranks its users based on the number of papers they have peer-reviewed [88]. Journals registered on Publons verify these reviewing records [72]. Registered users may also have to send/forward an email to Publons to confirm the legitimacy of a submitted review [77].

2. **PubPeer**

   It is a social platform that allows its users to comment on articles (research papers). The platform is more like an open space for the public to comment on any research article on PubPeer, and it focuses on building a profile for articles rather than its users who comment [78].

3. **OpenReview.net**

   The platform enables journals, conferences and workshops to implement their
policy of the Open Peer Review process. Both authors and reviewers interact with each other through reviews and their rebuttals [70].

In the following section, we investigate the second point described in Section 2.1 of how publication venues use different platforms to recognise the reviewing activity of researchers and methods adopted to incentivise reviewers.

2.5 Recognition of peer review activity and incentives for reviewers

We discussed about the lack of appropriate recognition and incentivisation for reviewers in Section 1.1. It is generally considered that practically all research assessment organisations, institutions, funding agencies, and publishers acknowledge peer review poorly [94]. Instead, it is perceived as expected or typical behaviour for all researchers to contribute in any role to peer review [94]. An intriguing analogy of accountants performing financial auditing and getting a significant financial incentive, typically in the form of money, is compared with what reviewers do while conducting technical reviews of research articles and not getting any such incentives [99]. Often researchers manage to carry out peer-reviewing in their spare time, raising questions like why should peer-reviewing be free? Moreover, are researchers worth less than accountants [99]? 

Table 2.6 shows the survey analysis where respondents had to select one option from several initiatives that would make them more likely to accept reviewing invitations. It is suggested that there is a need to find effective ways to recognise and reward
<table>
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<th>Reward and recognition initiative</th>
<th>Votes (%)</th>
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</tr>
<tr>
<td>Acknowledgement in the journal</td>
<td>6</td>
</tr>
<tr>
<td>Acknowledgement on the journal’s website</td>
<td>5</td>
</tr>
<tr>
<td>A personal thank you note from the editor</td>
<td>5</td>
</tr>
<tr>
<td>Name being published alongside the paper as one of the reviewers</td>
<td>3</td>
</tr>
<tr>
<td>Signed report being published with the paper</td>
<td>1</td>
</tr>
<tr>
<td>Accreditation</td>
<td></td>
</tr>
<tr>
<td>A certificate from the journal to acknowledge review effort</td>
<td>7</td>
</tr>
<tr>
<td>Credit automatically awarded on a 3rd party site</td>
<td>3</td>
</tr>
<tr>
<td>CME Accreditation/CPD points</td>
<td>2</td>
</tr>
<tr>
<td>Rewards</td>
<td></td>
</tr>
<tr>
<td>Personal access to journal content</td>
<td>6</td>
</tr>
<tr>
<td>Discount/waiver on Open Access fees</td>
<td>4</td>
</tr>
<tr>
<td>Access to papers which I have reviewed, if accepted and published</td>
<td>4</td>
</tr>
<tr>
<td>Discount/waiver on colour or other publication charges</td>
<td>4</td>
</tr>
<tr>
<td>Cash payment by the journal</td>
<td>3</td>
</tr>
<tr>
<td>Reviewer web badges that you could include on your LinkedIn site/online resume, etc.</td>
<td>3</td>
</tr>
<tr>
<td>Book discount</td>
<td>3</td>
</tr>
<tr>
<td>Payment in-kind by the journal</td>
<td>2</td>
</tr>
<tr>
<td>Payment or credits by independent/portable peer review services</td>
<td>1</td>
</tr>
<tr>
<td>Performance-based rewards</td>
<td></td>
</tr>
<tr>
<td>Reviewer of the year awards from the journal</td>
<td>5</td>
</tr>
<tr>
<td>&quot;Top reviewer&quot; badges that you could include on your LinkedIn site/online resume, etc.</td>
<td>4</td>
</tr>
<tr>
<td>Feedback</td>
<td></td>
</tr>
<tr>
<td>Feedback from the journal on the usefulness/quality of your review</td>
<td>8</td>
</tr>
<tr>
<td>Information from the journal on the decision outcome of the paper</td>
<td>8</td>
</tr>
<tr>
<td>that you reviewed</td>
<td></td>
</tr>
<tr>
<td>Visibility of other reviewers comments/reviewer reports</td>
<td>6</td>
</tr>
<tr>
<td>Metrics related to your review history</td>
<td>3</td>
</tr>
<tr>
<td>Post-publication metrics related to the articles you have reviewed</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 2.6: The list of rewards and recognition initiatives that would make researchers accept invitations to peer review. This table is taken from the research article “Rewarding reviewers – sense or sensibility? A Wiley study explain” by Verity Warne [101].

reviewers for maintaining their motivation for participating in the reviewing process [101].
In the following section, we investigate the third aspect, a crucial phase involved in peer review, described in Section 2.1 of how publication venues find and select reviewers for the reviewing activity. We also examine how different methods, techniques and tools are used to support finding reviewers.

### 2.6 Finding and selecting reviewers

Many researchers recognise peer-review as an integral part of their profession because they consider it a social duty or a quid pro quo service [94, 66]. It is challenging for the publication venue management to find researchers and invite them to participate in the reviewing process as it involves critical deliberations and considerations. Publication venue management may follow several methods to identify potential reviewers. For example, it is generally assumed that a reviewer’s interest can be identified based on their previous publications available on the Web [75]. Similarly, a paper’s topics could be extracted from its title and abstract, and the reviewers’ expertise from the titles of their publications available on the Web [38]. This activity could be carried out by following both manual and automated methods to identify potential reviewers [60].

**Manual methods**

Publication venue management tries to identify and classify suitable reviewers when an article is submitted to the publication venue. Some publication venues allow reviewers to bid for papers they would want to review because they are considered reliable as only the reviewer knows better if they are competent to evaluate a specific article or not [60]. However, there is a risk of antagonistic bids in order to give articles a poor score deliberately. Sometimes, publication venue management also gets recommendations from the authors of an article [5].
The bibliography of a research article is a rich resource for discovering experts in a specific research area, but it becomes difficult with increasing numbers of publications appearing rapidly. Therefore, with this human limitation, many authors that could potentially be good reviewers may not be requested [5]. However, it is suggested that reviewers should be selected for their expertise and trustworthiness rather than credentials (academic degrees) [39].

Researchers are requested to express their topics of interest, papers, competencies and previous reviewing experience. Therefore, existing systems use three different methods of explicitly describing papers and reviewers’ competencies [60]:

1. **Bidding/rating papers**

   Typically, publication venue management allows reviewers to express their interest in reviewing specific papers, enabling them to bid for the papers they want to review. This exercise is carried out to gather reviewers’ interests that help assign suitable reviewers to an article.

2. **Predefined topics**

   Typically, publication venue management enables authors to mention their research article’s topics explicitly. The publication venue management also requests its reviewers to mention their topics of interest. The combination of both datasets becomes a valuable resource for the publication venue management that helps assign reviewers to the articles accordingly.

3. **Combination of both**

   Sometimes, publication venue management follows both strategies (bidding and topics) to get the most appropriate reviewers available for an article.

Inviting reviewers depends solely upon the publication venue management team; therefore, they use multiple methods to find reviewers they deem relevant for their event. The publication venue management may use different online tools
to explore researchers’ publications, for example, GoogleScholar\[43\], DBLP\[28\] and CORE \[22\]. Nonetheless, the publication venue management typically has to rely upon the reviewing history submitted by researchers, for instance, their websites and CVs.

**Automated methods**

Intelligent platforms automatically extract the required descriptive information from reviewers’ previous publications on online libraries like DBLP \[28\], GoogleScholar \[43\] and CORE \[22\]. For example, EDAS \[34\] and CyberChair \[96\] use the algorithms for automatic assignment of reviewers that process papers based on the bids they get, starting with the paper with the least number of bids. If a paper does not get the required number of reviewers, the algorithms continue with topic matching \[60\]. The reviewer assignment algorithms of MyReview \[79\] and EasyChair \[17\] consider bids only. If a paper does not get a single bid, the algorithms determine reviewers implicitly through topic matching.

Intelligent recommender systems rely upon the authors of publications they find over different platforms. These platforms keep mining new research articles and authors and provide rich recommendations to the publication venue management team, for example, CORE \[22\]. However, these platforms do not provide any information about a researcher as a reviewer.

Natural Language Processing (NLP) techniques are also used to design and develop intelligent components for scientific Conference Management Systems that are able to automatically \[38\]:

1. **Identify paper topics**

   Such systems identify the research topics of a paper by analysing the title and abstract of the paper.
2. **Identify reviewers expertise**

   Such systems identify the expertise of a reviewer through analysing the titles of their research publications available on the web.

3. **Assign reviewers to papers**

   Based upon the analysis discussed above, such systems assign suitable reviewers to papers.

   These NLP techniques also ignore how these researchers might have performed as reviewers. Therefore, the question “Is a good author also a good reviewer?” is worth investigating.

Despite following these two generic methods of finding and selecting reviewers that rely upon the papers authored by reviewers, the reviewing history of a researcher remains an essential missing piece of the puzzle because the publication venue management usually does not have access to the reviewing records of researchers. Nonetheless, these methods are typically applied while assigning reviewers to articles, and they do not necessarily indicate the reason for inviting specific reviewers to the conference. The question of how and on what criteria the publication venue management requests and invites reviewers without their established reviewing accounts remains unexplored.

**What makes researchers accept reviewing invitations?**

Over 170,000 researchers were approached for a survey in July 2015 to explore peer-reviewing experience, attitude towards recognition and reward for reviewers, and the survey received 2982 usable responses. Apart from the results showed in Table 2.8, it was concluded that the participants strongly believed that reviewing is insufficiently acknowledged and should carry more weight in the evaluation process of institutions
<table>
<thead>
<tr>
<th>Factors affecting influence</th>
<th>Accepting invite (Mean ranking)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prestige and reputation of the journal</td>
<td>1.5</td>
</tr>
<tr>
<td>Personal relationship/networking opportunity with the requesting editor</td>
<td>3.0</td>
</tr>
<tr>
<td>Reviewer acknowledgement in the journal</td>
<td>3.4</td>
</tr>
<tr>
<td>Feedback provided by the journal post-review</td>
<td>3.6</td>
</tr>
<tr>
<td>Reviewer benefits/rewards offered by the journal</td>
<td>3.7</td>
</tr>
<tr>
<td>CME/CPD credit/accreditation awarded for review activity</td>
<td>4.8</td>
</tr>
<tr>
<td>Reviewer credit awarded on 3rd party website</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Table 2.8: Factors influencing decisions to accept reviewing invitations (1 being the highest level of influence) - a survey of over 170,000 researchers was conducted by Wiley (a publishing company) with 2982 usable responses. This table is taken from the article *Rewarding reviewers – sense or sensibility? A Wiley study explained* [101]. The results (as shown in Table 2.8) suggest that the prestige and reputation of the publication venue is the top factor influencing the decision to accept a review invitation. The opportunities to develop personal relationships and network with the Editor are ranked as the second reason that influences the decision to accept a review invitation.

### 2.7 Discussion

The literature review was conducted sequentially, starting from learning about the peer-reviewing process and the issues related to peer review. We highlighted the significant issues, including accumulating the reviewing records of researchers, finding and selecting peer-reviewers, and incentivising researchers for their reviewing activities. Then, we investigated how different researchers have addressed these issues and which technologies and methodologies are adopted to assist publication venue management.
We learnt that most of the available tools were following centralised models, and there were a few instances of using decentralised technologies to address peer-review issues.

Despite several issues and reported incidents, peer review remains a pivotal point in the scholarly publication process. Several researchers have suggested adjustments and improvements to the process and introduced different technical platforms to address issues. Most of these tools operate as commercial entities; therefore, they have implemented policies to safeguard their commercial (and monetary) interests. Storing the peer-reviewing data and information is a stronghold of these platforms, which regrettably does not favour academia and, more importantly, reviewers. The centralisation of data and information, particularly in disconnected data silos, is a significant impediment to exploring different ways of addressing issues related to the peer-reviewing process. The reviewing records of researchers are limited to the platforms they interact with, and thus, it becomes challenging to accumulate them and establish the authenticity of these reviewing credentials. To counter this centralised approach, several researchers have adopted a decentralised approach, Blockchain, though in its infancy.

Interestingly, reviewers are typically selected because of the articles/research papers they have authored so far. This approach does indicate a significant reason that a researcher with an established and published authorship record would be a suitable candidate for reviewing an article that falls within the same research area of their authored research articles. However, this reason does not suggest that an author would necessarily be a good reviewer too. Nevertheless, it is still current practice to invite researchers based on their established authorship record for reviewing; it appears to be an implicit assumption that writing research articles implies the ability to review them too. This practice may also suggest that the publication venue management teams may not have a comprehensive reviewing history of researchers/reviewers.
These reviewing records are typically spread across websites and various conference management platforms. So, a researcher may, in theory, have to present a list of URLs to establish their reviewing credentials. Do such platforms pose a hurdle in accumulating reviewing records? Would these platforms agree to connect to other platforms and share data? Would they waive their business interests or continue to grow their data silos in isolation? Such middle grounds may offer complementary technologies to assist academics in accumulating their reviewing records and continue using Conference Management Tools.

There is an ongoing debate on incentivising reviewers, and many incentive models are introduced and practised. It is argued that acknowledging the reviewing activity is an essential and fundamental factor that academia should not ignore. This acknowledgement should reflect on a broader picture, including grants and internal promotions. Since this acknowledgement is based upon the data and information related to the reviewing history of a researcher, it becomes challenging to ascertain the authenticity of such information. Before we encounter the problem of verifying reviewing records of researchers, there is an unavailability of these reviewing records in the first place. In case if some researchers have maintained their reviewing records across multiple publication venues, these reviewing records are scattered across the websites of those research events. So, there is a need to devise a mechanism to accumulate these reviewing records.

Furthermore, there is a need to find novel ways to address the issues pertinent to verifying these records and save time. If someone wants to verify a researcher’s reviewing records, they might have to contact the publication venue management team of each event the researcher had participated in; a tremendous hassle and time-consuming effort to verify reviewing records of a researcher.
Summary

In this chapter, we discussed the significance and issues of the peer-review process. We investigated three issues related to peer review.

1. Accumulation of the reviewing accounts of researchers from across multiple publication venues
   We discussed how different conference management systems are serving as the central agents in the reviewing process. These systems also have policies to safeguard their interests, so they typically follow and implement a centralised model to control the reviewing data. This approach has resulted in data silos of these platforms growing in isolation and are usually disconnected from other platforms. We discussed how decentralised approaches have started to address the issues and concerns of these platforms, though in their infancy. We also investigated how Blockchain technology is being used to address these issues of peer-review. We discussed how blockchain technology plays a vital role in establishing trust in data.

2. Recognising the efforts of reviewers and incentivising reviewers
   We discussed the significance of incentives for reviewers and how different models are adopted to acknowledge and incentivise the reviewing activities of researchers.

3. Finding and selecting reviewers
   We also discussed how publication venue management teams find and select reviewers and what factors influence researchers to accept reviewing invitations.
Chapter 3

Understanding the peer-reviewing process

In Chapter 1 we briefly discussed the plan for this thesis, which includes recording viewpoints and practices involved in peer review. We discussed in Section 1.3 that we would investigate three aspects of the academic reviewing process.

a) Accumulation of the reviewing accounts of researchers from across multiple publication venues

b) Recognising the efforts of reviewers and incentivising reviewers

c) Finding and selecting reviewers

This chapter presents our first study to understand and report researchers’ viewpoints on the issues mentioned above. The study participants are the researchers who participated actively in different publication venue management teams (for example, Editors, Associate Editors, Program Committee Chairs, Reviewers).
3.1 Introduction

Researchers may have different perceptions of the scholarly reviewing process practised by journals, conferences, and workshops. They may have different understandings of the efforts required to produce a review. They may also have different interpretations of the quality of a review. Researchers may have different reviewing-process experiences because they might have assisted diverse research events in various roles. They may also have different reasons for participating in the reviewing process.

It is a common perception that researchers do not get incentives for their reviewing activities, and there is an ongoing debate on incentivising peer-reviewers [58]. Possible incentives may vary from being monetary or non-monetary, or a combination of both [58]. Interestingly, the financial aspect seems to be ignored entirely by academia. For example, in 2018, there were about 33,100 English language journals actively involved in publishing over 3 million peer-reviewed articles per year [57]. As the process of publishing a scientific research article typically consists of paying for publishing (and also reading) an article, the revenue generated from the journals (Scientific, Technical and Medical journals in the English language) publishing increased from $8 billion in 2008 [100] to $10 billion in 2017 [57]. However, the reviewers involved in carrying out the exhaustive peer-review task did not receive a slice of the pie as a reward in terms of monetary appreciation, nor did the authors, editors and other members of the management. We need to investigate how to enable journals, conferences and workshops to incentivise peer-reviewers with monetary compensations. Similarly, forms of non-monetary incentive for researchers may vary from citing the reviewing activity in their CV and the websites of research events they participate in as reviewers to a reputation score earned as a reviewer. We need to explore possible forms of incentive (both monetary and non-monetary) for reviewers.
Finding and selecting a suitable reviewer for a research event is a time-consuming and hectic task. It may be a “shot in the dark” when an unknown researcher is requested to participate in the reviewing process for a publication venue because the only resources available to trust that researcher’s credentials are their CV and any information (if) found on different platforms and websites. A question arises as to how to verify researchers’ reviewing accounts and claims. Therefore, there is a risk of jeopardising the whole reviewing process if a poor reviewer is selected. Such an incident, in extreme cases, may have profound consequences that can cause irreparable damage to the reputation of the publication venue and its management. For example, a reviewer who produces a review with illogical methods, inappropriate language and a condescending tone may harm the reputation of that publication venue. We need to explore how to establish trust in the reviewing credentials of researchers independent of any silos, websites and platforms. We also need to investigate how important it is for peer review and if any practices are followed to establish trust in the reviewing credentials of researchers before inviting them to review for a research event.

To record and document such views and practices, we need to let the minds of researchers speak of their experiences and comprehensions. This research study investigates how the reviewing process is practised and what researchers aspire to have and follow. Therefore, we opted to conduct a study consisting of interviewing senior researchers who participated in the reviewing activity of publication venues. We invited senior researchers to participate in the study because of their experience and participation in various publication venues. PhD students and junior researchers may not have that level of experience. We recorded and analysed their views, judgements and practices and then drew our conclusions which paved the path for our further work. This study investigates and answers our first research question $RQ1$, defined in Section 1.3.
RQ1: How do researchers perceive and practice the reviewing process?

3.1.1 Motivation

The study’s main objective is to learn how the reviewing process is being practised. We want to record the participants' views about any possible (or ideal) improvements in the reviewing process. To gain maximum out of the participants' experience, we set a broad study scope to let researchers talk about anything regarding peer review.

3.2 Research Questions

We focus on investigating these three broad research questions.

1. What is a review? How does the web community perceive it? What elements of information are used to gauge the efforts a reviewer has put into producing a review?

   Generally, the guidelines for reviewers are published on the websites of publication venues, or they are communicated to the reviewers through email. Senior researchers typically participate in the reviewing process of different research events, and they may have an outline of a review. We need to investigate what they think of a review, its structure, requirements, and necessary constituents. We need to examine the principles they consider while evaluating the level of effort a reviewer has put into producing a review. We need to document and analyse how they merit a review’s quality. We need to analyse their understanding of the quality of a review.
2. How does a reviewer maintain their reviewing records? How can those reviewing records be trusted? How would the accumulation of their reviewing records in a trusted and transparent manner impact the overall process of peer-reviewing?

There are different tools and platforms available that maintain the authorship records of researchers, for example, GoogleScholar[43], CORE[22] and dblp[28]. These tools typically accumulate the research articles of researchers published across different publication venues. However, the reviewing activity of researchers is not recorded and accumulated like the activity of article writing. In such cases, we need to investigate how researchers maintain their reviewing accounts. We need to analyse how a publication venue management finds and selects suitable reviewers for their event and how they trust the reviewing accounts of researchers. We need to investigate the possible impact of establishing trust in the reviewing accounts of researchers and improving transparency in the reviewing process.

3. What are the incentives for reviewers currently in place? What impact would incentivisation have on the reviewing process? What are the possible monetary and non-monetary incentives for reviewers?

We need to document and analyse researchers’ viewpoints about incentivising reviewers. We need to record and investigate different mechanisms (if any) adopted to incentivise reviewers. We need to identify and analyse the possible forms of incentives for reviewers.

3.3 Research Study

We limited the scope of our research to three broad areas related to peer review, as mentioned in Section 1.3. Hence, our first step is to document, understand
and investigate the viewpoints of researchers. Investigating the research questions mentioned above requires conducting a comprehensive study that involves recording and analysing the views of senior researchers who have participated in the reviewing process for different publication venues. We present the following plan and methodology for conducting this study.

3.3.1 Methodology

There are several ways to acquire researchers’ views and observations, for example, using surveys, asking them in emails or through interviews. Since we needed a rich descriptive understanding of the problem area from a diverse cohort of participants, we planned to adopt a qualitative research method of conducting interviews with researchers for this study. Social scientists and anthropologists introduced qualitative research methods \cite{30} to study human behaviour \cite{93}, and conducting interviews is a commonly practised procedure for such data collection \cite{54}. These interviews can be carried out by following different methods, for example, individual interviews (one to one interviews) and group interviews (also known as focus groups) \cite{54}. To get rich and valuable information from individual experiences, we opted for conducting individual interviews instead of group interviews.

There are several different forms of interviews, but four main types of individual interview are \cite{13, 4}:

1. **Structured**

   Structured interviews are conducted to obtain information on a tightly focused topic. Usually, the participants are given multiple choices for their answers; for
example, “How do you find your school environment? Is it excellent, good or poor?”

2. **Unstructured**

Unstructured interviews are opposite to structured interviews, where the interviewer asks open-ended questions and starts a natural conversation with the participants. For example, “Which sports facilities do children have in this country?”, and “How does the government help to improve these facilities?” This type of interview may end up with a considerable amount of data on diverse topics.

3. **Semi-structured**

Semi-structured interviews are a mix of the above two types of interviews where the set of pre-planned and open-ended questions are asked, and the participants elaborate and explain their viewpoints. For example, “What benefits do you think of electric vehicles? Would you buy one soon?”

4. **Depth**

Depth interviews are conducted to cover one to two issues, but in greater detail, \[L3\]. For example, “How has the pandemic impacted your job? What do you think of its impact on your future employment?”

We planned the research study to have a focused limited scope to investigate specific issues of peer-review. We also wanted to allow participants to explain their experiences and preferences in a conversational tone. Therefore, we decided to conduct semi-structured (one-to-one) interviews of researchers, which allow participants to share their views about open-ended questions related to the specific issues of peer-review.

The alternative method was to use questionnaires; however, we intended to get rich information from the participants so that they could conversationally share their
experiences, explain incidents in detail, and relate the study questions to their personal experiences. To further our research, we plan to use questionnaires to extend the scope of our research studies, including other aspects discovered in this study, and attract more participants from different research communities.

We planned to conduct these one-to-one interviews either face-to-face or via online meeting tools (Skype, Zoom). For that, we prepared a set of questions and presented them in the form of a questionnaire to all participants well before we conducted the interviews. We also gave them the study information sheets and took their consent before conducting interviews. We also requested that participants visit this research project’s website\(^1\) to help them further understand the research idea. We used a voice recording device for recording the interviews after taking consent from the participants. We transcribed these audio recordings and used these documents for the qualitative analysis. It is essential to mention that we sought ethical approval from The Open University Human Research Ethics Committee (OU-HREC)\(^2\).

### 3.3.2 Scope of the study

We limited the scope of this research study to the participants involved in three conferences, The International Semantic Web Conference (ISWC)\(^3\), The Extended Semantic Web Conference (ESWC)\(^4\) and The Web Conference (WWW)\(^5\). We selected these conferences because many researchers and reviewers participated in more than one of these conferences. For example, a researcher participating in ISWC might have also engaged in ESWC, or vice-versa. Therefore, we limited the scope of this study

\(^1\)https://peermiles-project.kmi.open.ac.uk/
\(^2\)Reference: HREC/3389/JAN
\(^3\)http://swsa.semanticweb.org/
\(^4\)https://eswc-conferences.org/
\(^5\)https://www.iw3c2.org/conferences/
to a specific research community. Another reason for having a limited number of participants in the study is the PhD’s time limit. We had to comply with our academic ethics committee to ensure our research study follows well-defined principles and rules of conducting a qualitative research study. Then, we had to conduct these interviews as per the availability of an empty time slot in a participant’s busy schedule.

It is imperative to mention that researchers from other research communities, and even from other fields in the computer sciences, may have different viewpoints, experiences and preferences about peer review.

To address the research questions discussed in section 3.2, we also set the ambit of our topics for this study as:

1. **Efforts involved in reviewing**
   We planned to investigate the efforts involved in reviewing research articles. For example, which efforts does a reviewer put into producing a review? How does a review text reflect the level of effort a reviewer has put into it? How does the publication venue management team evaluate a review and its reviewer?

2. **Accumulation of the reviewing accounts**
   We planned to investigate the mechanism and tools involved in accumulating the reviewing accounts of researchers from across multiple publication venues. For example, what methods do researchers adopt to accumulate their reviewing records from across different publication venues? Which tools are available for accumulating the reviewing records of researchers?

3. **Public recognition of reviewing efforts**
   We planned to investigate the tools and methods involved in recognising the reviewing efforts of researchers. For example, how does academia acknowledge
their reviewing services? What are the forms of recognition available (and in practice) for reviewers? How do the research institutes acknowledge the reviewing activity of their researchers?

4. **Finding and selecting reviewers**

We planned to investigate the tools and methods involved in finding and selecting suitable reviewers for a publication venue. For example, how does the publication venue management search, select and invite a potential reviewer? Which factors does it consider before selecting reviewers? How does it find new reviewers?

5. **Establishing trust in the reviewing accounts**

We planned to investigate the tools and methods involved in establishing trust in the reviewing accounts of researchers from across different publication venues. For example, how does the publication venue management trust a researcher’s reviewing accounts before inviting them?

6. **Incentivisation**

We planned to investigate the tools and methods involved in incentivising reviewers for their services. For example, what forms of incentives for reviewers are available? Do reviewers prefer to have incentives for their reviewing activity? If yes, how would they want to be incentivised? If no, why would they not want any incentives?

These topics helped us preparing a set of questions for the participants.

### 3.3.3 Recruitment of participants

As the study was limited to three conferences, the potential participants for this study are the researchers who participated in at least one of the three conferences
as members of the publication venue management team. We invited forty-four (44) potential participants; fourteen (14) agreed to participate. We conducted the semi-structured interviews with all fourteen (14) researchers involved in three conferences mentioned above, and we appreciate and thank everyone we approached, whether they participated or not.

**Sampling strategy and limitations**

The forty-four researchers we contacted for the study had participated in research event proceedings in different capacities, including the Program Committee Chairs. They had experience managing a research event and conducting peer-reviewing activities, including finding and selecting suitable reviewers. Consequently, our sampling strategy covered all three aspects of our study that the potential participants had experienced. These aspects were a) participation in the peer-reviewing process, b) finding, and selecting suitable reviewers, and incentives for reviewers. We had constraints in conducting the study, including the response from the potential participants and their availability for the study. Fourteen out of forty-four decided to partake in the study.

### 3.3.4 Questionnaire

We prepared a questionnaire related to the study, which is also hosted on the project’s website. It consists of twelve questions and is designed to take about thirty to forty minutes an interview.

1. Researchers put their efforts in reviewing articles for different workshops, conferences and journals. Such efforts are seldom recognised and ac-
knowned. What information do you get as a PC-Chair at the moment, which tells you about the efforts a reviewer has put in?

This question intends to explore a range of efforts by reviewers, which the publication venue management examine after receiving review texts. How does the publication venue management get to know which reviewer has put in the effort to produce a review? What information, data, and level of access to that information does the management have to judge these efforts?

2. In your opinion, what elements of information should make up the effort in reviewing and what elements of information are missing at the moment?

This question intends to get a researcher’s viewpoint about which elements of information are essential to establish whether a reviewer has put in their efforts or not. Out of those elements, which details are available and which features are missing?

3. Reviewing is carried out by following different processes, for example, Open and Closed. In the Open reviewing process, the identities of authors and reviewers are not concealed from each other. The Closed review process is usually followed in two ways, i.e., single-blind and double-blind. In single-blind, the identity of a reviewer is anonymised while in double-blind, the identities of both author and reviewer are concealed from each other. In your opinion, how would variations in the process affect the efforts involved in reviewing?

Journals, conferences and workshops adopt different variations in the peer-reviewing process. This question aims to determine if these variations have any impact on reviewers’ efforts. Do reviewers produce the same quality of a review, whether it is Closed-reviewing or Open-reviewing?
4. Researchers’ efforts usually do not get public recognition. If they were recognised in the form of public profiles with appreciations and reputations, how would it impact academia?

Researchers have their public profiles as authors on various scholarly platforms that typically show their publications and citations. However, this question intends to find the impact of having similar profiles of researchers as reviewers to expose the number of reviews a researcher has carried out and how many times a researcher has participated in research events in diverse roles, such as that of Program Committee Chair and Demo Chair. The idea will even help consider the venues that the researcher has participated in and the number of papers they have reviewed so far.

5. Researchers’ efforts of reviewing articles for different workshops and conferences are not accumulated at a single place. How would the accumulation of reviewing efforts across multiple research events (i.e., conferences and workshops) impact academia?

Researchers participate in various research journals, conferences, and workshops in different roles, such as Track Chair, Poster Chair and Reviewer. Publication venues publish such information on their website. So, if a researcher participates in, for example, seven distinct conferences and workshops over a year, this information will be scattered across seven different websites. This question intends to explore the possible impact of accumulating all this information. In which ways would it help journals, conferences and workshops? How would it help researchers (reviewers)?

6. As a PC-Chair of an event, you have a responsibility to find and select appropriate researchers for reviewing articles for the event. What mechanism do you follow to find and select suitable reviewers?
The publication venue management adopts multiple methods to find and select reviewers for an event. This question aims to explore those methods. How do those methods help, and how would the publication venue management want to improve those methods?

7. **What information is available to you to trust reviewers’ information and their reviewing record? What information is missing?**

While finding and selecting a reviewer, the publication venue management has access to relevant information about a researcher (reviewer). This question intends to explore what information is available to the publication venue management. Is that information trustworthy? What mechanisms does the publication venue management follow to trust this information? Does that information have any missing parts?

8. **As a PC-Chair, what mechanism would you follow to trust reviewers’ information and their reviewing record?**

This question intends to explore the (ideal) ways the publication venue management would want to follow to trust researchers’ reviewing records. For example, how would they want to make sure the information they get is authentic? How would they want to ensure that such information is not fake or tampered with?

9. **If the verified information of reviewers and their record is provided to you, how would it impact you as a PC-Chair?**

Since it requires an enormous amount of time and effort to reach out to every single journal, conference and workshop a researcher has participated in finding out the authenticity of reviewing records presented to the publication venue management, this question aims to find out the impact of providing verified (verifiable) reviewing-records to the publication venue management. How would it impact their finding and selection methods?
10. **Reviewers spend a considerable amount of time out of their busy schedules to carry out reviewing for different research events. However, their efforts are not incentivised. Would you, as a PC-Chair, like to incentivise reviewers? If yes, how? If no, why?**

This question intends to find out possible ways of incentivising reviewers. These incentives could be of both types, monetary and non-monetary. Should reviewers be incentivised? If yes, what could be the possible form of these incentives? If not, why not? Which methods, if any, does the publication venue management adopt to incentivise their reviewers? If reviewers are not incentivised, what are the reasons for not getting adequate incentives for their services?

11. **What would be the possible impact of incentivising reviewers for their reviewing efforts across multiple research events?**

If a researcher reviews for X number of publication venues per year, what impact could incentivisation have on them? Would it motivate researchers to participate more in the reviewing process? If yes, what impact would it have on researchers? Would it increase reviewers’ participation in the reviewing process? Would it increase the burden on reviewers? What overall impact would it have on the reviewing process? What factors are involved in this if it does not motivate researchers to participate in the reviewing process? Can bad reviewers exploit the incentive mechanisms? What impact would it have on the process if reviewers get monetary incentives? Should the monetary aspect be involved in such incentivisation? If yes, why, and if no, why not? What impact would it have on the process if reviewers get non-monetary incentives?

12. **If peer-reviewers are enabled to exchange their incentives across multiple research events, what possible impact can it have on academia?**

Incentives earned through participating in the reviewing process are typically
redeemable at the same publication venue or platform. This question intends to find if these incentives are made interchangeable, how would it impact the publication venues that reviewers participate in? For example, would it attract researchers from other communities? Would it allow cross-communities collaboration between researchers (reviewers)?

3.3.5 Data collection

The conversations were recorded in audio format and then transcribed later. We took consent and made it clear that we will not use this data beyond the scope of this study and the agreed ambit. The original audio files and transcripts are saved in a secured server of our institution. We intend to store the audio files until September 2021, and the transcripts will be held until December 2025, as specified in the information sheet.

3.4 Results

We carried out thematic analysis [11] of the interview transcripts and produced a document of thematic codes. Both the document of codes and its visualisation can be accessed online [7].

“Thematic analysis” is a qualitative research method that helps identify, analyse, organise, describe and report themes found within a data set [12]. A theme, in this context, is “an idea or concept that captures and summarises the core point of a coherent and meaningful pattern in the data” [12]. We opted for this research method

[7] https://peermiles-project.kmi.open.ac.uk/study1
because of its usefulness for analysing the viewpoints of different research participants, highlighting similarities and differences and producing unexpected insights [15].

**Thematic codes**

This section lists the themes, sub-themes, and brief descriptions of the most discussed issues. Since we specified a set of topics for this study, they became one of the most discussed concepts and ideas. We followed the inductive reasoning method for identifying the thematic codes. For example, introducing monetary incentives will encourage junior researchers in the web community to participate more in academic reviewing activities. Hence, the study shows that most participants will be encouraged to participate more in the peer-reviewing activity, regardless of their seniority in academia. It is worth mentioning again that the following are the views and understandings of the study participants. Figure 3.1 reflects the analysis based upon the views of fourteen participants; they discussed during the interviews. The following analysis discusses the themes and topics discussed during the interviews. We have also mentioned the number of participants who discussed specific themes and topics; for example, eleven participants considered that reviewers’ profiles could be a form of incentive. The rest of the three participants did not discuss this specific topic.

### 3.4.1 Incentivisation

Fourteen participants expressed their views, understandings and observations about incentives for reviewers. The following sub-themes report the interpretations of the ideas discussed by the participants.
1. **Reviewers profiles**

Eleven participants considered that reviewers’ profiles could be a form of incentive. Incentivisation could be one of the main motivations for researchers to build their profiles as reviewers. There are many platforms that aggregate research publications of researchers to showcase their profiles. Such profiles may show the number of published research articles and their citations. However, their...
reviewing activity is mostly not reported like their activity of publishing articles. Therefore, incentivising the reviewing process may motivate researchers to produce an increased number of higher quality reviews if they know their reviewing credentials would also get published like their research articles. Their
reviewing profiles may have the impact of establishing a reviewer as an active and engaging researcher. A participant said “I think it’s important to incentivise reviewers, and I would do it by using a publicly recognisable system that collects reviewing contributions, that people can refer to it in order to prove what they have done, but also to show their contribution as they do with articles and papers.”

2. **Overall positive impact**

Nine participants believed that incentivising reviewers would have a positive impact on the academic publishing process. Any form of incentive may attract more researchers to participate in the reviewing process and produce higher quality reviews. Incentivising reviewers may stimulate researchers’ participation as reviewers, which is a healthy sign of improving research. For example, one of the participants said: “I think that, definitely, researchers would be more willing to take on reviewing responsibilities, knowing that they would get credit for it, knowing that there’s something in it for them, that they can later on in their career point back to. So, they can point back to their reviewing credits profile or whatever and then whoever is looking at can say, *Oh, yes, this person has done a pretty good job at volunteering to review.*” Five other participants did not generalise the impact of incentives; they specified the types of impact; for example, incentives will help produce higher quality reviews.

3. **Redemption value**

Six participants believed that such incentives should be redeemable for something useful for researchers. One of the most discussed forms of incentive is getting a discount on the conference registration fee. If such incentives are made redeemable, it may attract more participation. Researchers would tend to
participate in a conference which they had never attended before, in any capacity. The other eight participants did not discuss redeeming reviewing incentives.

4. **Higher quality reviews**

Six participants considered that incentivising reviewers might help produce higher quality reviews. Different incentives for reviewers may motivate them to produce better quality reviews. Some publication venues acknowledge their reviewers’ contributions by honouring them with best reviewer awards. The publication venue management typically publishes these rewards on their website. Such information may also get published by the reviewer’s institution. Therefore, incentivising reviewers may become a vital motivational factor in producing higher-quality reviews, which is a healthy indication of advancing research. One participant did not believe it would help improve the quality; they said: “About the quality, No, I don’t think it will increase the quality”.

5. **Reputation based invitations**

Five participants discussed that reviewers would get invitations based upon their reputation score, and they count it as an incentive. For example, if researchers actively participate in the reviewing process, they are more likely to receive more reviewing invitations. Such an abundance of reviewing requests may have negative and positive impacts, as too many reviewing requests could burden a researcher. However, such invitations could also enable a reviewer to explore a wide range of diverse research communities spread across journals, conferences and workshops. Established reviewing profiles would be helpful for the publication venue management filter and invite reviewers based on their reputation. The other nine participants did not discuss if incentives (like reputation scores) would bring more reviewing invitations.
6. **Meticulous curation**

Five participants argued that research communities should carefully design and curate incentive models for reviewers. An incentive model should ensure transparency, trust, and clarity and avoid gamification or exploitation of the system. Transparency in the reviewing process is necessary to enable authors, reviewers, and publication venue management to justify and maintain their viewpoints. Therefore, a transparent incentive model will help establish trust and clarity in the research outcomes. The incentive model should prevent bad reviewers from exploiting or gamifying the system. For example, it should discourage a reviewer who only participates in the reviewing process to get incentives and increase the number of reviews but produces poor reviews, does not meet the deadline and does not consider the review-quality parameters set by the publication venue.

7. **Existing incentives**

Four participants believed that there are already different incentive models in place for reviewers. For example, public recognition, as the publication venue management publishes their names on the website. Researchers may also write about their reviewing activities in their CV. Such activities may include their participation in different roles and even mention wins in the best reviewer awards.

8. **Motivation**

Two participants shared that reviewers should get incentives because they do not necessarily attend the event. Offering them some incentives may motivate them to participate in the event, allowing more exposure to the research community.

9. **Indifferent and unconcerned**

Two participants argued that researchers have been carrying out the reviewing activity for a long time now without any tangible incentives. Researchers are
already burdened with their job activities; therefore, incentivisation will not attract them.

10. **Penalisation**

Two participants argued that some researchers do not pay proper attention to the reviewing process; therefore, they usually end up producing low-quality reviews. Hence, research communities should decide on some penalties for such reviewers. For example, the publication venue management restricts them from future participation. Research communities may also establish a typical list of reviewers who deliberately hinder the reviewing process and do not perform well consistently. Research communities may also establish a mechanism to report a bad reviewer to their institution, for instance.

11. **No incentives**

Two participants responded that researchers who participate in the reviewing process do not get any incentives. Reviewers spend time reviewing research articles out of their busy schedules, but publication venues do not provide any incentives for reviewers, which is demotivational for them. The lack of incentives could be a compelling reason for reviewers not to take it earnestly.

12. **Flexible deadline**

One participant shared that researchers are busy with their usual research responsibilities. The publication venue management should give them a flexible timeline/deadline for submitting their reviews. Giving more time for reviewing could be a valuable incentive for reviewers.

13. **Proxy-reviewing**

One participant believed that senior researchers delegate their reviewing articles to junior researchers at times. Incentivisation of the reviewing process may help avoid proxy reviewing. Senior researchers should not delegate articles to junior
researchers for review to preserve and guard their hard-earned credibility and the quality of their reviews. Moreover, junior researchers would want to review articles they could get acknowledged for rather than their seniors.

14. **Punctuality**
One participant argued that late submission of reviews is one of the most persistent issues the publication venue management faces. Researchers may have genuine reasons and hindrances in place that would explain their late review submissions. However, the researchers who usually linger over submitting their reviews may submit in time if they get attractive incentives.

15. **Will not help**
One participant expressed that researchers already have their sense of moral responsibility to give it back to their research communities by participating in peer-review. Hence, they are not looking for any incentives for reviewing articles. Therefore, the incentivisation of the reviewing process will not offer any help in improving the process.

16. **Monetary**
Seven participants expressed their views, perceptions and opinions about financial incentives for reviewers. Such monetary incentives may include offering cash prizes, discounts on conference fees and some academic/non-academic subscriptions. For example, researchers have to pay for publishing their research articles. The publication venue management could offer them some discount if they participate in the reviewing process of the event. Monetary compensation may have various forms, for example, paying for access to an educational web platform that offers premium services and paid courses. Reviewers may also get fiat currency as monetary compensation.
(a) **Positive impact**

Four participants believed that monetary incentives for reviewers would have a positive impact as it may encourage researchers to participate more in the reviewing activity and might also encourage them to produce higher-quality reviews. The greater the financial incentives, the greater the involvement will be in the reviewing activity.

(b) **Negative impact**

Three participants argued that monetary incentives for reviewers would harm the reviewing process because it may enable bad reviewers to exploit the system. They may attempt to participate more in the reviewing process to gain more financial incentives and ignore the quality of the review they produce.

17. **Non-Monetary**

Five participants expressed their views and observations about non-financial incentives for reviewers. Such incentives may include recognition, reviewing scores, trusted and verifiable profile as a reviewer. Recognising the efforts researchers put into reviewing is a form of non-monetary incentive, for example, conferring on them the best reviewer awards, publishing their names and services on the publication venue website, and acknowledging their reviewing job while evaluating them for internal promotions. Translating their reviewing services into a score is another form of non-monetary incentive, for example, rating a review from one to ten (1 to 10). Creating public profiles of reviewers which display their reviewing activity is also a form of non-monetary incentive. Publication venue management can verify these profiles (and any associated reviewing records) if someone requests the management for verification.
(a) **Positive impact**

Three participants discussed that non-monetary incentives would have a positive impact on the reviewing process. Recognition for their reviewing activity will motivate researchers to participate more in the reviewing process.

<table>
<thead>
<tr>
<th>Incentivisation</th>
<th>Frequency</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Participants</td>
<td>References</td>
</tr>
<tr>
<td>Reviewers profiles</td>
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<td>16</td>
</tr>
<tr>
<td>Overall positive impact</td>
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<td>16</td>
</tr>
<tr>
<td>Redemption value</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Better quality reviews</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Reputation based invitations</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Meticulous curation</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Existing incentive</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Motivation</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Indifferent and unconcerned</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Penetration</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>No incentives</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Flexible deadline</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Proxy-reviewing</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Punctuality</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Will not help</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Monetary</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Non-Monetary</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 3.1: According to the study participants, incentivising reviewers would positively impact academia, and reviewers’ profiles were the most discussed form of incentive.

18. **Exchange of Incentives**

Thirteen participants expressed their views and observations about the various possibilities of exchanging reviewing incentives across different publication venues. The following sub-themes briefly report the interpretations of their ideas. It is worth mentioning that these perspectives may have contradictions because researchers may disagree with the viewpoints of fellow researchers in a research community.
Figure 3.3: The figure shows the visualisation of the sub-theme of Exchange of incentives. Thirteen participants discussed this topic.

(a) **Positive impact**

Twelve participants believed that exchanging incentives across multiple research events, journals, conferences, workshops, and other publication venues would positively impact the reviewing process. Different publication venues may allow researchers the possibility to redeem their incentives earned from other publication venues. For example, a reviewer received
X units of incentives from a conference-A. Another publication venue, conference-B, may offer to allow redemption of these incentives (earned from conference-A). The mechanisms involved in exchanging these incentives may depend upon individual publication venues. Nonetheless, it will increase cross-publication-venues interaction between researchers. Also, the utilisation of spendable incentives across different publication events will impact academia distinctly.

(b) Diverse research communities
The exchange of incentives allows researchers to utilise their incentives earned from Conference-A at Conference-B. Nine participants argued that this exchange of incentives between different research events would enable researchers from diverse research communities to interact. This interaction may foster research understandings across various domains. The exchange of incentives will allow researchers to disseminate their research findings to new, unexplored and unfamiliar research communities. Such interactions may also help find opportunities to collaborate in future research endeavours, for example, bidding for research projects.

(c) Higher quality reviews
As the exchange of incentives will enable researchers to explore diverse research communities, researchers may want to build up their profiles as reviewers, which display multiple participations across research events and venues. Therefore, three researchers believed that researchers would tend to produce higher quality reviews to establish their reviewing experience in various research topics, conferences and fora.

(d) Negative impact
Three participants feared that there might be actors that try to exploit the system for personal gains. This exchange of incentives would enable
such actors to exploit the system through different gamification practices. Therefore, this exchange of incentives across various research events would harm the reviewing process and academia.

(e) **Reviewing-score based invitations**

One participant discussed that researchers who participate in the reviewing process of several publication venues would have their reputation score as well. This reputation score may include the number of research events they have been involved in and the number of articles they have reviewed. This reputation score will be a reliable and decisive indicator for inviting a researcher as a reviewer. However, research communities need to propose a method to calculate this score.

(f) **Higher quality research**

One participant believed that the exchange of incentives would also encourage researchers to submit their articles to diverse research events and publication venues, which will foster the research findings, and eventually improve the overall research quality. The exchange of incentives would enable more interaction between researchers and publication events. The increased interaction may help produce more research articles and more peer review activity, therefore, more competition. Reviewers from diverse research communities may offer different and unique viewpoints about a research article that help authors investigating unexplored research areas, therefore, a possibility of producing higher-quality research.

(g) **No impact**

One participant shared that the exchange of incentives will not draw the attention of reviewers; therefore, it will not impact the quality of reviews.
### Exchange of Incentives

<table>
<thead>
<tr>
<th>Exchange of Incentives</th>
<th>Frequency</th>
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<tbody>
<tr>
<td></td>
<td>Participants</td>
</tr>
<tr>
<td>Positive impact</td>
<td>12</td>
</tr>
<tr>
<td>Diverse research communities</td>
<td>9</td>
</tr>
<tr>
<td>Better quality reviews</td>
<td>3</td>
</tr>
<tr>
<td>Negative impact</td>
<td>3</td>
</tr>
<tr>
<td>Reviewing-score based invitations</td>
<td>1</td>
</tr>
<tr>
<td>Better quality research</td>
<td>1</td>
</tr>
<tr>
<td>No impact</td>
<td>1</td>
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</tbody>
</table>

Table 3.2: According to the study participants, enabling research communities to exchange incentives between researchers and publication venues (journals, conferences and workshops) positively impacts academia and will help researchers explore diverse research communities.

#### 3.4.2 Current Practices: Trust in reviewing records

We investigated how the publication venue management establishes trust in researchers’ reviewing credentials before inviting them to review for their event and which particular mechanisms and tools they use to believe in the reviewing records of researchers. Fourteen participants shared their experiences.

1. **Reputation**

Nine participants argued that spending years within a research community influences researchers to identify and comprehend many other researchers and their skills. This is how a researcher is perceived based on their research expertise and capabilities. So, this reputation of researchers becomes a significant reason to invite them for reviewing. Publication venue management invites highly reputable researchers for the reviewing process.

2. **No Mechanism**

Nine participants shared that there is no practical mechanism in place to establish trust in the reviewing records of researchers. The publication venue management is left with no option but to believe in researchers CVs and websites.
Figure 3.4: The figure shows the visualisation of the theme of Current Practices involved in establishing trust in the reviewing records of researchers. Fourteen participants discussed this topic.

3. Reviewers CV

Seven participants argued that researchers cite their reviewing activities in their CVs. This information may include the number of publication venues they have participated in and the number of research articles they reviewed. The publication venue management may find a researcher’s CV online, and trust the
information mentioned in the CV. A participant said “I think we tend to trust people’s word unless there is a clear hint that, for example, you may see, kind of, an imbalance between the places where the person publishes and the places where she or he claims to be a reviewer, and then you may say, ‘Maybe there is something you need to track’.”

4. **Feedback**

Five participants believed that the publication venue management gets feedback on reviewers from previous managing bodies. For example, a senior researcher managing a publication venue in 2020 is requested to provide feedback on reviewers from the event. This feedback would help senior researchers who are managing the event in 2021. Although a meagre bit of information, the publication venue management trusts this information about reviewers of previous editions, which helps them invite reviewers again. However, there is a possibility of receiving contradictory feedback from the publication venue management about the same researcher; for example, a management team member may rate a reviewer high while another member may rate the same reviewer low.

5. **Venues**

Four participants explained that a researcher’s CV typically mentions the publication venue names (journals/conferences/workshops) in which they have participated as a reviewer. The publication venue management tends to acknowledge whether a researcher has reviewed for a famous, well-reputed, and prestigious journal/conference/workshop. The publication venue management may also check this information on those events’ websites, and hence, would trust this information about a reviewer.

6. **Known researcher**

Three participants argued that the publication venue management would trust a
researcher’s reviewing credentials simply because they already know them. The publication venue management may know a researcher because of professional associations, common research institutes, collaborative research fields and co-authoring activity. One of the participants said, “So, the trust is purely based on personal contacts.” Therefore, since the publication venue management knows a researcher very well, they would believe the reviewing accounts of that researcher.

7. **Reviewing Platforms - Easychair**

EasyChair [17] - a widely used conference management platform, keeps the record of reviews and reviewers. Three participants explained that if the publication venue management uses EasyChair to manage their research event, it will solicit great help from EasyChair to establish the integrity of a researcher’s reviewing records. EasyChair allows reviewer database management, where a publication venue management can also download the list of reviewers. The publication venue management trusts such information provided by conference management tools.

8. **Comparison**

One participant shared that during the reviewing process, the publication venue management compares the reviews produced by three or more reviewers. This comparison helps them in ascertaining the reviewing ability of a researcher. This technique does not add to establish trust in the reviewing records but does indicate a reviewer’s comprehension level.

9. **Blacklist**

One participant believed that researchers involved in managing a publication venue maintain a personal blacklist of reviewers who do not perform well. Their performance criteria may vary from producing a quality review to their time to submit a review or rebuttal. The publication venue management does not invite
the researchers included in their blacklist to participate in the reviewing activity of its event.

10. **Reviewing score**

One participant shared that the publication venue management trusts the number of reviews a researcher has produced. However, the source of this number could only be in the CV of a researcher. A significant number of reviews would indicate that the researcher is an established reviewer.

<table>
<thead>
<tr>
<th>Current Practices: Trust in reviewing-record</th>
<th>Frequency</th>
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<tbody>
<tr>
<td></td>
<td>Participants</td>
<td>References</td>
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<tr>
<td>Reputation</td>
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<td>No Mechanism</td>
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<td>Reviewers CV</td>
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<tr>
<td>Feedback</td>
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<tr>
<td>Venues</td>
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<tr>
<td>Already know people</td>
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</tr>
<tr>
<td>Reviewing Platforms - Easychair</td>
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<td>4</td>
</tr>
<tr>
<td>Comparison</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Blacklist</td>
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<td>1</td>
</tr>
<tr>
<td>Reviewing Score</td>
<td>1</td>
<td>1</td>
</tr>
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Table 3.3: According to the participants’ viewpoint, there is no specific mechanism in place for the publication venue management to establish trust in the reviewing records of researchers. However, the publication venue management relies upon researchers’ overall reputation, apart from what they mentioned in their CVs.

3.4.3 **Preferences for trust**

Twelve participants shared their preferences and choices to help establish trust in reviewers’ available information, credentials, and the overall reviewing process.

1. **Reviewing contributions system**

Eleven participants argued that there should be a system available to accumulate
Figure 3.5: Twelve participants shared their preferences about establishing trust in the reviewing records of reviewers.

the reviewing efforts of researchers—a system in place to assert the provenance of a researcher’s reviewing efforts. The system should contain information on the number of reviews a researcher has carried out, the venues they have participated in as a reviewer or any other role, and their feedback.

2. Reputation

Eight participants discussed that there are many popular platforms available
which inform researchers’ contributions as authors, for example, GoogleScholar [43], ResearchGate [41], dblp [28]. There is a possibility that a researcher could be an outstanding author but a mediocre reviewer. Therefore, a researcher’s reputation as an author is not enough to establish them as a trusted and reputed reviewer. There should be a mechanism to gauge the reputation of a researcher as a reviewer. This reputation may help determine the level of trust a reviewer has in the eyes of research communities they have participated in or want to participate in. To this end, research communities in academia need to set a standard formula for assessing a researcher’s aptitude as a reviewer.

3. **Earned reviewing rewards**

Seven participants believed that there should be a system that shows a list of rewards earned by a reviewer. The system should also list the different roles a researcher has performed in the reviewing process, such as an Editor, Program Committee Chair, Demo Chair and Meta-reviewer. Such a list of awards will reflect the trustworthiness of a reviewer.

4. **Reviews count**

Seven participants considered that the number of reviews a researcher has produced will help in trusting a reviewer. This number will indicate how actively a researcher has been involved in the reviewing process.

5. **Feedback from community**

Five participants discussed that the feedback from the research community about a reviewer will help in establishing trust in a reviewer. A researcher participates in different publication venues as a reviewer, and hence their reputation builds up over time. This reputation reflected in the form of textual feedback from the research community will help build trust in a researcher’s reviewing credentials.
6. **Feedback from the publication venue management**

   Five participants argued that the publication venue management may share deep insights about the conduct of a reviewer. The feedback from the management team of research events a reviewer has participated in will help establish trust in a reviewer. For example, the editor of a journal provides a reviewer’s feedback, which helps establish trust in the reviewing capabilities of a researcher.

7. **Impact of reviews**

   Five participants expressed that the publication venue management should maintain a list of high impact reviews and reviewers. For example, a high impact review may influence the authors to amend and improve their research article. Similarly, a publicly available review may attract public appreciation and help other researchers derive different research ideas. Therefore, a mechanism to calculate the impact of reviews a reviewer has produced so far will give insights into the reviewer’s comprehension and analysing skills. Such a tool would be helpful while establishing trust in reviewers.

8. **Feedback from authors**

   A researcher participates in different research events as a reviewer and produces reviews of several articles. Four participants believed that the feedback from the authors of these articles will help to establish trust in a reviewer. For example, the authors may highly appreciate the analysis of a reviewer, or they may reject it altogether. The feedback from the authors may help the publication venue management analyse the reviewing capabilities of a researcher if both the feedback and reviews are available.

9. **Affiliated institution**

   Three participants discussed that the career of a researcher may spread across multiple research institutions, universities and industries. A researcher is typ-
ically believed to have a distinguished reputation if they belong to and have worked for prestigious institutions. Such reputation may indicate their extraordinary abilities to author and review research articles. This information also helps in trusting the reviewing credentials of a researcher because they have worked in esteemed organisations.

10. **Profile as an author/researcher**

Three participants expressed that the number of research articles published by a researcher and their impact, their h-index will help establish trust. A wide range of online platforms is available for researchers to build their profiles, such as GoogleScholar [43] and ResearchGate [41], which may help find and filter out leading and distinguished authors. There seems to be an inherent assumption that a good author would be a good reviewer, so their profiles as authors would help establish trust in their reviewing history.

11. **Venues they have reviewed for**

A researcher participates in different publication venues as a reviewer. Three participants believed that such venues may also indicate the reviewing skills of a researcher. For example, a researcher who engages in renowned and prestigious conferences as a reviewer would be more trustworthy than a researcher who has participated in some newly established workshops.

3.4.4 **Accumulation of reviewing records**

Fourteen participants shared their views about the possible impact of the accumulation of reviewing accounts from across multiple publication venues.
Table 3.4: Twelve participants shared their viewpoints about establishing trust in the reviewing records of researchers.

1. **Overall positive impact**

   Eleven participants believed the accumulation of researchers’ reviewing records from across multiple publication venues would positively impact academia. This accumulation would yield numerous benefits for both researchers and journals/conferences/workshops, such as the valuable information about a researcher participating in different publication venues would help analyse a researcher’s reputation as a reviewer.

2. **Promotions and grants**

   Eight participants shared the view that the accumulated reviewing records of a researcher should be considered for internal and external promotions and grants.

3. **Higher quality reviews**

   When researchers know they will have their public profiles as reviewers, it may stimulate them to produce higher quality reviews. Four participants believed that public scrutiny of their contributions might push them to formulate comprehensive reviews.
Figure 3.6: Fourteen participants shared their views about the accumulation of the reviewing records of researchers from across multiple publication venues. Seven participants discussed the impact of reviewers having public profiles.

4. Public profiles

Seven participants discussed the impact of public profiles of reviewers. The accumulation of reviewing efforts across various publication venues will give insights into a researcher’s academic activities over time. Their public profiles with a list of venues, the number of articles reviewed and the managerial roles they have performed in research events shall establish researchers credibility as reviewers. Public profiles of reviewers may impact the following:

(a) **Academic career**

Three participants expressed that the accumulation of reviewing records will
help researchers in establishing their academic careers at the early stages. Such a record will help them in their job interviews, bids for funding and internal promotions. For example, the accumulated records of a reviewer may establish the researcher’s credibility and allow more opportunities to network with different research communities. This increased interaction may bring more possibilities to author research papers and contribute to receiving research funding.

(b) **Reviewers History**

Two participants shared that the accumulation of reviewing records will help in identifying the chronological account of researchers as reviewers. Such records will show where (publication venues) and when a researcher was actively reviewing and if there was a period when they did not participate in the reviewing process.

(c) **Reputation based invitations**

Three participants considered that the public profiles of reviewers would attract more reviewing invitations based upon the reputation score of their reviews. For example, a good reviewer with several reviews and positive feedback is likely to get frequent invitations to review.

5. **Finding reviewers**

Nine participants believed that the accumulation of reviewing records will help find and select suitable reviewers. The reviewer’s history may show a list of publication venues and the number of reviewed articles. Therefore, it will help the publication venue management to analyse and select suitable reviewers for their event. A participant said “That would make it easier to see the track record of potential reviewers, would help programme chairs to expand their committees without too much effort.”
6. **Standard metric**

Seven participants argued that the accumulation of the reviewing records of researchers will help model a reviewer-level metric to measure the quality, productivity and impact a researcher has made as a reviewer, for example, a mechanism devised to analyse and rate a reviewer based upon multiple factors, including the number of articles they reviewed over a specific period and their reviews’ rating scores. Research communities should plan and develop such mechanisms to rate the reviewing contributions of researchers.

7. **Diverse research communities**

Six participants expressed that the accumulation of researchers’ reviewing records would produce a data set, encouraging and motivating them to explore diverse and unexplored research communities they were not involved in before.

<table>
<thead>
<tr>
<th>Accumulation of reviewing-records</th>
<th>Frequency</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Participants</td>
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<td>Promotions and grants</td>
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<tr>
<td>Public Profiles</td>
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<td>Better quality reviews</td>
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<td>Standard metric</td>
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</tr>
<tr>
<td>Diverse research communities</td>
<td>6</td>
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</table>

Table 3.5: Fourteen participants shared that the accumulation of reviewing records of researchers would impact academia. Currently, the reviewing records of researchers are spread across different websites, conference management tools and emails, and thus the accumulation of these records would help create researchers’ profiles as reviewers.
3.4.5 Current Practices: Selection of the publication venue management team

Fourteen participants shared the current practices while selecting a management team and reviewers for the publication venues.

![Diagram showing selection processes]

Figure 3.7: Fourteen participants shared the current practices while selecting a management team and reviewers for the publication venues. The figure shows that the participants typically invited the reviewers they already know and the reviewers from previous editions.

1. Known researchers

Thirteen participants shared their experience that senior researchers already knew fellow researchers in their research area, so they invited them to review for the publication venues they manage.
2. **Reviewers of previous editions**

   Eleven participants expressed that senior and active researchers usually have the reviewers lists of previous editions of the publication venue; therefore, they select and invite reviewers from those lists.

3. **Reviewers of other events**

   Five participants believed that the publication venue management explores websites of similar research events to find the reviewers lists.

4. **GoogleScholar**

   GoogleScholar becomes a helpful tool while looking for reviewers. Four participants expressed that the publication venue management explores recently published articles in a specific research area, and then they find and invite authors of those articles for the reviewing activity. For example, a participant said “In a couple of conferences that I’ve programme chaired, I’ve even checked the Google Scholar page of the people that I did not recognise at all to see how senior they are, how relevant they are to the topic, but also have they published, what’s their research interests, that tends to be useful information that I normally use”.

5. **Reviewers list**

   Four participants shared that researchers maintain a reviewer list that they find suitable for specific research areas. That list becomes helpful when a researcher is responsible for finding and inviting reviewers for a publication venue.

6. **Authors of papers in previous editions**

   A list of authors who participated in previous editions of an event is maintained and becomes helpful while inviting people for the reviewing activity. Two participants believed that those authors get the preference over the possible invitation of new reviewers.
7. PhD Students

Two participants understood that the publication venue management looks for PhD students researching similar areas by exploring institutional websites, research-related platforms, and personal/professional acquaintances.

8. Uninvited researchers

Two participants shared that the publication venue management looks for those researchers who have never participated in their events before. This quest could involve exploring platforms, asking colleagues (Snowball Sampling) for recommendations, and advertising through email lists and websites. Snowball Sampling is a qualitative research method used to invite unknown (new) participants by the existing participants of the study (through networking or referral). The existing participants of the study are typically requested to recommend other contacts who meet the research criteria [74].

9. Blacklist

One participant argued that the publication venue management maintains its blacklists of poor reviewers and avoids inviting these reviewers for future events. Such blacklists are held at the individual level by researchers and the publication venue level. These blacklists are generally informal and private and may depend upon researchers to share their lists with fellow researchers.

10. Volunteers

One participant expressed that some publications venues are open for voluntary reviewers’ participation. For example, the significant number of research articles submitted to a conference that becomes challenging for the reviewing team may enable the publication venue management to allow voluntary participation. Publication venue management could also devise the Open Review strategy to allow anyone to comment on a research article.
### Current Practices: Selection of management team

<table>
<thead>
<tr>
<th>Known researchers</th>
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</thead>
<tbody>
<tr>
<td>Reviewers of previous editions</td>
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<td>13</td>
</tr>
<tr>
<td>Reviewers of other events</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>GoogleScholar</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Reviewers list</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Authors of papers in previous editions</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PhD Students</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Uninvited researchers</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Blacklist</td>
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<td>1</td>
</tr>
<tr>
<td>Volunteers</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3.6: Fourteen participants shared about current practices involved in selecting reviewers. According to them, publication venues (journals, conferences, workshops) typically maintain their history of previous editions, and therefore, they retain reviewers lists which aid in inviting reviewers.

### 3.4.6 Impact of verified information

Fourteen participants shared their views about the impact of possibly verified (and verifiable) information of researchers’ reviewing credentials. This information may include the number of articles reviewed by a researcher for specific journals, conferences and workshops.

1. **Overall positive impact**

   Eleven out of fourteen participants believed that the verified and verifiable information of reviewers would positively impact academia. It will benefit the publication venue management in establishing trust in researchers’ reviewing credentials, thus eliminating trust issues.

2. **Selection of reviewers**

   Ten participants believed that verified (and verifiable) information would help the publication venue management select reviewers for its event. Such information would help the management choose reviewers without any doubts and suspicions.
Figure 3.8: Fourteen participants shared their views about the possible impact of verified information about reviewers. Eleven participants considered that it would positively impact academia, while one feared that it would burden good reviewers because they would get more reviewing invites.

in the reviewing accounts of researchers. A participant said “Well, definitely it would help to make sure that highly unreliable reviewers, you know, I would not invite them or I would treat them with care.”

3. **Popularity based filtering**

Seven participants considered that reviewers’ verifiable information would help filter out reviewers with poor performance or low reputation. Hence, the publication venue management would have better options while choosing reviewers for its event.
4. **Appropriate assignment**

Six participants believed that reviewers’ verified information would support the publication venue management in assigning articles to more suitable and relevant reviewers. Such verifiable reviewing records would inform the management about the number of papers reviewed by a researcher for different journals, conferences and workshops, and thus ultimately, the sum of a researcher’s expertise.

5. **Diverse research communities**

Two participants shared that verified reviewing records of a researcher would give insights into diverse research domains and communities. Such information would help the publication venue management understand researchers’ profiles, reviewing credentials, rewards, and the venues they have reviewed.

6. **Burden on reviewers**

One participant worried that if the publication venue management gets the verified information of reviewers, it will tend to invite those researchers with good reviewing numbers and reputations. Hence, it will put more burden on qualified and competent reviewers.

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<thead>
<tr>
<th>Impact of verified information</th>
<th>Frequency</th>
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<td></td>
<td>Participants</td>
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<td>Overall positive impact</td>
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<tr>
<td>Selection of PC</td>
<td>10</td>
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<tr>
<td>Popularity based filtering</td>
<td>7</td>
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<tr>
<td>Appropriate assignment</td>
<td>6</td>
</tr>
<tr>
<td>Diverse research communities</td>
<td>2</td>
</tr>
<tr>
<td>Burden on reviewers</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3.7: According to the participants of the study, verified (and verifiable) reviewing records of researchers would positively impact academia, significantly the process of finding and selecting peer-reviewers.
3.4.7 Quality of a review

Seven participants shared their viewpoints on the quality of a review. These perspectives constitute how a review should look and what elements of information a review should include.

![Diagram showing various factors of review quality]

Figure 3.9: Seven participants discussed the quality of a review. According to the participants, nine factors are important while evaluating the quality of a review.

1. Completeness

Five participants opined that a review should present a comprehensive portrayal of an article, including its strong and weak points. A review must address the issues raised in the article, the presence or absence of novelty, and suggest improvements for the paper. The degree of completeness of a review is an
essential element involved in constituting a review's quality. A review’s quality is
directly proportional to the perception of the review’s completeness: the greater
the comprehensiveness, the higher the perceived quality.

2. **Constructive criticism**

Four participants asserted that a review’s quality should be reflected by the
level of criticism it extends to an article. A reviewer should express criticism
constructively by citing literature and related work.

3. **Detailed**

Four participants opined that the extent of details a review as stated should
be considered while weighing a review’s quality. These details may vary from
expressing different aspects and facets of the research reported in an article to
suggestions and ideas given by a reviewer. A good quality review would showcase
the detailed understanding of the reviewer. For example, a participant said “How
detailed it is in terms of recommendation, do they make comments about the
various aspects of the paper, so the presentation, the technical work, the related
work, the results, or is it just like a brief opinion line that they provide. I would
also consider how polite, let’s say, their review is, so sometimes reviewers get a
bit carried away with their review, and if they really hate the paper you could
see that in the language they use, of course that’s never a good thing, it’s always
good to be a bit more encouraging, if there was something definitely wrong with
the paper, did they provide some suggestions of how it could be improved, if
some related work missing do they give links to those, so that’s basically, all of
these are indicators of quality.”

4. **Recommendations**

Four participants stated that a higher quality review would include recommen-
dations to improve an article under review. The difference between a suggestion
and a recommendation in this context is that a suggestion is an idea proposed by a reviewer, while a recommendation is a list of required measures to improve the article.

5. **Suggestions for improvement**

Three participants stated that a quality review should include suggestions for improvements. For example, a reviewer may suggest that the authors draw a table to compare the features of different social media applications.

6. **Length of a review**

Three participants shared that a review’s length is essential while determining a review’s quality.

7. **Tone**

The tone of a review would be an essential factor while assessing its quality. Three participants discussed that a review’s tone should not be too harsh nor too appeasing. A higher-quality review must maintain etiquette and respect towards authors even if the reviewer criticises or rejects the article, for example. A review must not include offensive, sarcastic or derogatory remarks.

8. **Justification**

Two participants stressed that a reviewer should justify the score they give to an article. Their produced text should reflect this justification in the form of constructive criticism, rationale, recommendations and suggestions written in a well-mannered and ethical way. This explanation should reflect the degree of justification while measuring a review’s quality.

9. **Authors feedback**

One participant discussed that authors’ feedback of a review should be considered while measuring a review’s quality.
Table 3.8: The study participants have different and broad perspectives about the quality of a review. Diverse researcher communities may have different viewpoints on the attributes that define the quality of a review.

### 3.4.8 Reviewing efforts

Twelve participants shared their experiences of being involved in the publication venue management about the elements of information they get that informs them of the extent of effort a reviewer has put into reviewing.

1. No information

Ten participants shared that there is no mechanism in place at the moment to assess the level of effort a reviewer has put into reviewing. As the publication venue management team, they get no information to evaluate the effort of a reviewer. For instance, a participant said “I don’t think there’s any support for that”.

2. Length of a review

Eight participants stated that the textual length of a review could be a factor that might help evaluate the efforts applied in producing the review.

3. Punctuality

Three participants shared that the publication venue management team would
Figure 3.10: Ten out of twelve participants shared that they did not get any information that could inform them about the reviewer’s efforts. Eight participants believed they could assess the level of effort by analysing the length of a review.

consider the punctuality factor while assessing a reviewer’s efforts. The management team may consider how soon after getting the paper, a reviewer has produced a review. For example, a reviewer submitting their review soon after getting the paper would indicate that the review was produced in haste. On the contrary, it may also point to the efficiency and competence of a reviewer. Submitting a review after its deadline may indicate that the reviewer has not taken it earnestly. So, the time taken in producing a review may help the management team evaluate their reviewers.
4. Comprehension

Two participants shared their experiences that meta reviewers or senior members in the management team typically have the responsibility of evaluating review texts to determine the comprehension level of reviewers. Meta reviewers in the management team are the reviewers who analyse the reviews produced by reviewers. Senior members in the publication venue management team are experienced researchers who may have conducted research, authored articles, participated in different research events, and been in senior positions in their fields. They should evaluate whether a reviewer was able to understand the research article under review.

5. Reviews count

One participant shared that the number of reviews a reviewer has produced in a publication venue may inform the level of effort that has been put into reviewing. A greater number of reviews by a reviewer would indicate that higher levels of effort being put into reviewing.

<table>
<thead>
<tr>
<th>Reviewing Efforts</th>
<th>Frequency</th>
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<tbody>
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<td></td>
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<td></td>
</tr>
<tr>
<td>No information</td>
<td>10</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Length of a review</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Punctuality</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Comprehension</td>
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<td>2</td>
<td></td>
</tr>
<tr>
<td>Reviews count</td>
<td>1</td>
<td>1</td>
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Table 3.9: According to the participants’ viewpoints, no specific information is available to the publication venue management that helps measure the efforts a reviewer has put in, apart from the length of a review.
3.4.9 Preferences for evaluating efforts

Eight participants shared their views about the elements of information they prefer, which would inform the extent of effort a reviewer has put into reviewing an article.

Figure 3.11: Eight participants shared their preferences for evaluating the efforts of a review in producing a review.

1. **Time spent**

Five participants stated that a mechanism should estimate the level and amount of effort a reviewer has put into reviewing by analysing the time spent producing a review. For example, the publication venue management may ask reviewers to mention the time they took to produce a review. That time can be further segmented, such as reading the paper, exploring related literature, simulating
the experiment, and producing the results (if available). The amount of time spent by a reviewer should indicate the level of effort a reviewer has put in.

2. **Comprehensive**

Four participants said that the level of comprehensiveness should inform the efforts of a reviewer. A comprehensive review may suggest the range of aspects a reviewer has discussed, such as the number of suggestions and improvements mentioned and the justification of the given score with reason and rationale should be enough to indicate the level of the reviewer’s efforts.

3. **Constructive**

Four participants shared their opinion that a constructive review should present the degree of effort a reviewer has put in. Researchers may have a different interpretation of the term “constructive review”; however, a constructive review typically suggests improvements and points out the weak parts of an article.

4. **Rigorous review**

Four participants stated that a review’s rigour level should present the reviewer’s efforts to evaluate an article. In this context, the term rigour suggests evidence-based criticism, references to papers and established techniques, completeness in terms of analysis, and recommendations presented in a review.

5. **Informed decision**

Three participants discussed that a review that presents a clear, concise and justified decision (either accepted or rejected) would indicate the extent of effort a reviewer has put into reviewing. An informed decision would cite different reasons, bases and rationales to justify itself, which would suggest that the reviewer has carried out a high-quality review.
6. Knowledgeable

Three participants stated that a review should present the knowledge and expertise of the reviewer on the topics discussed in an article. For example, a review suggesting other methods and techniques, citing different research papers and recommending improvements may indicate that the reviewer is an expert, knowledgeable and competent to produce a high-quality review. This factor will help the publication venue management team evaluate the efforts a reviewer has put into reviewing.

7. Length of a review

Two participants mentioned that the length of a review would indicate the extent of effort a reviewer has put into producing a review. A long review-text would affirm that its reviewer has put in energy in reviewing.

<table>
<thead>
<tr>
<th>Preferences for evaluating efforts</th>
<th>Frequency</th>
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<tr>
<td></td>
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<td>Time spent</td>
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<td>Rigorous review</td>
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<tr>
<td>Informed decision</td>
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<tr>
<td>Knowledgeable</td>
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</tr>
<tr>
<td>Length of a review</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3.10: The study participants shared their preferences for evaluating the efforts put by reviewers to produce a review.

3.4.10 Public recognition

Nine participants shared their views about the possible ways in which researchers are getting public recognition for their reviewing activities.
Figure 3.12: Nine participants shared their views about the public recognition reviewers get. Six participants believed that mentioning the reviewing activity in the CV is a form of recognition for peer review.

1. **Resume/CV**

   Six participants considered that researchers get public recognition of their reviewing activities when they mention it on their CV. Researchers could list the number of journals, conferences and workshops they have participated in within different roles.

2. **Community Service**

   Five participants shared that researchers believe peer-reviewing is their moral responsibility to give something back to the research community, which is why public recognition for peer-review does not seem important to some researchers.
3. **Best reviewer award**

Four participants believed that researchers get public recognition for their peer-reviewing activities if they win the best reviewer award in a research event. For example, based on the quality and quantity of the reviews, the publication venue management may select reviewers as the winner of the “best reviewer award” and publish this information on their website.

4. **Websites of events**

Four participants explained that the websites of journals, conferences and workshops typically mention the names of their management team, including reviewers. So, this is a form of public recognition for researchers for their reviewing activities.

5. **No recognition**

Two participants believed that there is no recognition for researchers involved in the peer-reviewing process. They also assumed that sometimes, senior researchers delegate some articles to junior researchers for review.

6. **More senior - less valued**

One participant shared that senior researchers do not get much value from reviews regarding public recognition. They have already excelled in their research domains and have established their credibility amongst the research community.

3.4.11 **Standard review format**

Seven participants shared that there should be a standard format of a review and clear instructions for reviewers, planned and realised by the research community.
Table 3.11: According to the participants, researchers’ reviewing-contributions mentioned on their CV are considered as recognition. The participants believed that usually, researchers carry out the reviewing activity because they believe it is their moral duty and community service.

Figure 3.13: Seven participants considered that research communities should develop a standard review format to improve the reviewing process.

1. Research community dependent

Four participants stated that a standard review format should be designed and
implemented by research communities. Since there are different research areas and their communities, each research community should develop its own standard review format to assist reviewers and the publication venue management.

2. **Meticulous analysis**

Four participants shared that a standard review format should include a specific section for the summary of an article, reflecting the reviewer’s understanding. This summary should address the critical information reported by an article.

3. **Research novelty**

Three participants shared that a standard review format should include a specific segment where reviewers report any novelty they find in an article. In this context, novelty may refer to new methods, techniques and observations, leading to new knowledge discovery.

4. **Structured analysis**

Three participants stated that a standard review format would be helpful for peer review. Uniformity of the review structure should facilitate both reviewers and the publication venue management. For example, a reviewer would know the specific sections and issues they have to address, while it would help the venue management assess the quality of the review in a structured way. Hence, a standard review format should be designed to regulate both reviewers and the publication venue management.

5. **Research quality**

Two participants proposed that a standard review format should include a specific section to report an article’s research quality. The quality of a review may depend upon how different research communities and publication venues define it.
6. **Clear readability**

One participant stated that clarity in a review is essential; therefore, a standard review format should be designed so that anyone can read and understand it unambiguously.

7. **Multiple-choice questions**

One participant stated that a standard review format should include multiple-choice questions for reviewers. Such questions would help both reviewers and meta-reviewers assess an article and justify their decision.

8. **Potentially controversial**

One participant feared that a standard review format might become controversial for the public or other research communities. The disagreement of researchers over the interpretations and structural design of the review format may make it controversial. Therefore, different publication venues may have different review formats.

<table>
<thead>
<tr>
<th>Standard review format</th>
<th>Frequency</th>
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<td>Research novelty</td>
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<td>Research quality</td>
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<td>Clear readability</td>
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</tr>
<tr>
<td>Potentially controversial</td>
<td>1</td>
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</table>

Table 3.12: According to the participants, research communities should design and develop a standard review format to help the publication venue management and reviewers.
3.4.12 Open review

Eleven participants shared their views, experiences, and practices about the positive and negative aspects of the Open Review process.

Figure 3.14: Eleven participants discussed the Open Review process and shared its positive and negative aspects. Seven participants believed it produces high-quality reviews, while five participants worried about the reluctance of reviewers.
1. **Negative aspects**

Following are the negative aspects of the Open Review process, according to the participants.

(a) **Reluctant reviewers**

Five participants believed that if authors and reviewers know each other (i.e., their identities are revealed to each other) in the Open review process, it becomes complicated and challenging for reviewers to express themselves independently. Reviewers may know authors personally or have professional terms; therefore, writing a negative or critical review for their article becomes tricky. Otherwise, in the case of a closed-review process, reviewers would not feel such pressure. In many cases, when the author or a researcher is a renowned person, it may cause discomfort for reviewers to write a critical or unrelenting review of their article.

(b) **Less reviewers**

One participant feared that due to the openness in the process, fewer reviewers would want to participate in the reviewing process, and most would avoid it.

2. **Positive aspects**

Following are the positive aspects of the Open Review process, according to the participants.

(a) **Public accountability**

Three participants favoured the public accountability aspects of the open reviewing process. Reviewers can be held responsible for the reviews they have produced. The public and other researchers may criticise and scrutinise reviews and reviewers. Hence, reviewers can be made accountable for their reviews, according to the participants.
(b) **Higher quality of reviews**

Seven participants shared their experience that the open reviewing process is more likely to produce higher quality reviews because of openness and transparency. Therefore, reviewers would contribute to writing constructive reviews of articles. A participant said “I’m pretty sure that open reviews would have a higher degree of effort and quality in the reviewing process.”

(c) **Generous review scores**

One participant shared that reviewers tend to become generous while giving review scores because of the reviewing process’s openness. Reviewers would avoid criticism on their reviews; therefore, they would try to become more considerate in evaluating articles.

(d) **Review-text available**

One participant stated that the availability of review-text publicly has a positive impact on the overall reviewing process. The availability of review text allows other researchers to comment, criticise and provide suggestions and recommendations, which is a positive sign of advancing research.

<table>
<thead>
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<td>References</td>
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<tr>
<td>- Reluctant reviewers</td>
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<td>6</td>
<td></td>
</tr>
<tr>
<td>- Less reviewers</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>+ Public Accountability</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>+ Better quality of reviews</td>
<td>7</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>+ Generous review scores</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>+ Review-text available</td>
<td>1</td>
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</tbody>
</table>

Table 3.13: According to the participants, the open-reviewing process ensures a higher quality of reviews, and it may also cause discomfort for some reviewers.
3.4.13 Blind review process

Six participants discussed the blind reviewing process, which is generally practised in two ways, single-blind and double-blind. The single-blind process reveals the authors’ identities to reviewers, while the double-blind process conceals the identities of both authors and reviewers from each other.

Figure 3.15: Six participants discussed the Blind review process and shared their experiences.

1. Double blind

The participants shared their views about the double-blind reviewing process.
(a) **Fair**

Two participants believed that the double-blind process provides fairness to the reviewing process because reviewers do not know about the article’s authors. Therefore, in the absence of bias, reviewers would write fair and unbiased reviews.

(b) **Freedom of expression**

Four participants believed that the double-blind reviewing process provides reviewers with freedom of expression, which explains why reviewers appear more confident and impartial while writing such reviews.

2. **Single blind**

The participants shared their views about the single-blind reviewing process.

(a) **Prone to bias**

Two participants believed that the single-blind reviewing process might create an environment where reviews could be the subject of bias. For example, since reviewers know about the authors of an article, while authors do not know about reviewers, this one-sided concealment may allow reviewers to exploit the system and produce biased reviews. Such a bias may have different reasons, for example, competitive researchers or institutions, professional jealousy or the theft of research ideas. For instance, a participant said: “*But if it’s a single blind, I suppose there is some chance of bias, because you might know the person who is writing that paper.*”
Blind review | Frequency
---|---
Double blind: Fair | 2 | 2
Double blind: Freedom of expression | 4 | 4
Single blind: Prone to bias | 2 | 2

Table 3.14: According to the study participants, the double-blind reviewing process allows more freedom of expression, and hence reviewers could produce unbiased and impartial reviews.

3.4.14 Affiliation bias

Four participants feared that affiliation bias could occur in the reviewing process. For example, if an article is written by a renowned senior researcher (professor) or an author who belongs to a prestigious institution, a reviewer may write a less critical review, give a generous review score, and accept the paper. Similarly, if an article is written by an unknown (or lesser-known) researcher or if the author belongs to a lesser-known institution, a reviewer may produce a harsh and critical review, give a lower review score, and reject the paper.

<table>
<thead>
<tr>
<th>Affiliation bias</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bias</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 3.15: The study participants shared their views about bias in peer review

3.4.15 Existing platforms

Three participants discussed the limitations of existing conference management platforms, for example, EasyChair and Publons. EasyChair does not allow its data to be accessed publicly, while Publons is still in its infancy with few journals on board. Therefore, existing platforms are essentially building up their data silos.
Table 3.16: The study participants shared their views about existing conference management platforms and their limitations.

### 3.4.16 Accountability

Two participants suggested that meta-reviewers and other members of the publication venue management should make reviewers accountable for their reviews and ask them to justify their reviews, scores and decisions. The participants shared that such accountability will impact the reviewing process and eventually would advance research. The publication venue management should question reviewers for the decision they take about an article. The proposition of making reviewers aware of answering for their reviews would improve the quality of reviews.

<table>
<thead>
<tr>
<th>Accountability</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Participants</td>
</tr>
<tr>
<td>Accountability</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3.17: The study participants shared their views about accountability in peer review.

### 3.5 Discussion

We interviewed fourteen researchers, and the analysis of these interviews revealed informed aspects of peer review. We discussed these insights by dividing them into two general sections; a) current practices and b) suggestions on improving these practices. These address the first general research question RQ1 (3.1) that we had posed, and further research questions mentioned in section 3.2. We further discuss and analyse the results in light of the topics we set in the scope of this study (Section 3.3.2).
1. **Efforts involved in reviewing**

   There is no mechanism in place to assess the levels of effort put into reviewing an article. The publication venue management does not have accurate tools to determine the amount and extent of measures a reviewer has adopted to comprehend an article and how genuine and valid their reviews are. Therefore, researchers have different perceptions and understandings of the efforts put into producing a review.

2. **Accumulation of the reviewing accounts**

   Researchers do not have their reviewing records accumulated in a single place or have their promulgated profiles as reviewers. Typically, such records are found on the websites of research events they have participated in, or their CVs mention their reviewing activities. Researchers believed that the accumulation of the reviewing records of researchers is a positive measure to take. Researchers’ reviewing records in a single place will benefit them in multiple ways. For example, apart from their profiles as authors, their reviewing profile would also help while applying for promotions and research grants.

3. **Public recognition of reviewing efforts**

   There is no standard review format in practice at the moment. Research communities should design a standard review format that helps reviewers produce a review and supports the publication venue management to evaluate the review. Research communities should also devise a mechanism to evaluate the quality of a review. Introducing and following a standard (structured) review format may also help evaluate the quality of a review. Such information that includes the number of reviews a researcher has carried out, and the quality of these reviews may help develop reviewers’ profiles.
4. **Finding and selecting reviewers**

Finding and selecting appropriate reviewers for a publication venue is a tedious job. The publication venue management typically invites researchers for reviewing it already knows or the reviewers from previous editions. However, with the help of verified information of reviewers, the venue management can select suitable reviewers for their research event and assign appropriate reviewers to research articles.

5. **Establishing trust in the reviewing records**

There is no specific mechanism to establish trust in the reviewing records of researchers. However, currently, researchers trust the reviewing records of other researchers based upon a few factors, including the researcher’s reputation, their CV, and if they already know a reviewer. Researchers would prefer to have a system that could show their reviewing contributions. As the number of researchers and research articles is continuously growing, there is an urgent need to develop a mechanism that establishes trust and ascertains the authenticity of researchers’ reviewing records.

6. **Incentivisation**

Researchers carry out their reviewing activities because of their in-built moral responsibility for the research community. Researchers typically do not get incentives for their reviewing activity, and they believe that the incentivisation of reviewers would positively impact academia. Such incentives would motivate researchers to participate more frequently in the reviewing process and encourage reviewers to produce high-quality reviews. However, research communities should design and develop transparent models for incentivising reviewers. These incentives may have both monetary and non-monetary forms. The exchange of incentives across multiple publication venues would also positively impact
academia. Such an exchange would enable researchers to explore diverse research communities and write high-quality reviews.

3.5.1 Common narratives

The participants were in favour of introducing novel mechanisms to incentivise peer reviewers. Such incentives should carry some monetary value that they can redeem. The participants felt a lack of trust in the reviewing history of researchers, and they had no choice but to accept whatever records were presented to them. The participants had a consensus over introducing a basic definition of the quality of a review. Similarly, they opined that a standard review format would help identify the quality of a review.

3.5.2 Distinct narratives

A distinct narrative about incentivisation was that since the researchers carry out the reviewing activity to give back to the community and advance scientific knowledge; therefore, such an acknowledgement (within a community) is enough, and no other incentives are needed. Furthermore, if monetary incentives are introduced, they will bring more problems to the peer-review process, and some researchers may try to trick the system into gaining maximum benefits. Another different narrative was to penalise immoral reviewers who show no respect for the process or their commitments and consistently produce low-quality reviews.
3.6 Summary

In this chapter, we investigated different aspects of peer review by recording and analysing experienced researchers’ practices and views to answer our first research question (3.1), RQ1: 'How do researchers perceive and practice the reviewing process?'. We investigated how researchers are following current practices, whether they would prefer any improvements in those practices, and what those might be. We learned how the researchers involved in managing a publication venue find and select reviewers, which methods and tools they use, and what elements hinder the process.

We learned that researchers’ reviewing records are scattered across multiple platforms and websites. They are not accumulated in a single place, so researchers do not have profiles as reviewers. However, there is no mechanism to establish the validity and authenticity of these reviewing records, even if they are found in the CVs of researchers and websites of publication venues. We also learned that researchers would want to have their profiles as reviewers and a system to ascertain trust and authenticity in the reviewing records.

We learned that researchers have different understandings of incentives for reviewers. For some researchers, reviewers do not get any incentive, while, for some researchers, reviewers get public recognition in the form of best reviewers awards and their names on event websites. Nonetheless, participants believed that researchers should get incentives for their reviewing activities. Research communities should decide the type of incentives which could be in a monetary form or a non-monetary form. Furthermore, exchanging such incentives between different journals, conferences, and workshops would be expected to positively impact academia and enable researchers to explore diverse research communities.
Chapter 4

PERKS - A framework for acknowledgement, incentivisation and accumulation of peer-review

In Chapter 2, we presented an overview of how different models and platforms addressed the issues related to peer review. We analysed researchers’ different viewpoints, experiences, and preferences about peer-review in the study we presented in Chapter 3. This chapter presents PERKS, a framework based upon decentralised technologies to address the issues raised in the study. PERKS is an acronym of PEer Review acKnowledgement and reward System.

4.1 Introduction

We discussed the fact in Chapter 2 that the platforms, typically based upon centralised models, could not effectively address the accumulation of reviewing records from across
multiple publication venues. The study participants (reported in Chapter 3) also shared their views that the reviewing records of researchers are spread across multiple platforms, and there is no mechanism in place that aggregates them.

According to the study participants (reported in Chapter 3), there is no formal mechanism in place to trust the reviewing credentials of researchers. However, in Chapter 2, we discussed uses of blockchain technology to make these records immutable, ignoring the role of the publication venue management. This approach can also be deceived; for example, anyone can create a fake reviewing record and publish it on the blockchain. Furthermore, other fake identities can be used to ascertain the authenticity of such records.

Chapter 2 also discussed the available incentives for reviewers and different platforms used to incentivise reviewers. In Chapter 3, the study participants also shared their views about the lack of incentives for reviewers.

The analysis of peer-review presented in Chapter 2 and the analysis of the study we conducted (reported in Chapter 3) suggested the creation of a model or framework to address the problems. We reiterate these issues as:

- A mechanism to accumulate the reviewing records of researchers from across multiple publication venues
- Establish trust in the reviewing records
- Support and improve the process of finding and selecting reviewers
- Public recognition of the reviewing efforts of researchers
- Incentivise reviewers with spendable incentives in a transparent way
We hypothesise that decentralised and distributed technologies can help meet the needs and preferences expressed by study participants. We propose a framework based upon decentralised and distributed technologies to address the above issues. Thus, we define a broad set of goals of the proposed framework.

4.1.1 Goals of the framework

The framework should enable researchers to have their reviewing records accumulated and acknowledged without the intervention of commercial entities. These reviewing contributions should not be confined within a centralised system but allow for exploration without reliance upon a centralised system. The framework should allow anyone to verify the authenticity of the reviewing records independently, without the need for a 3rd party system. It should take a simple mouse click to establish the reviewing records of a researcher, rather than having to look for the publication venue management on events’ websites and then contacting the management of each research event for which the researcher had participated in as a reviewer. The framework should also ensure transparency while enabling the publication venue management to incentivise their reviewing team. The framework should also ensure that the incentives are spendable.

By achieving these goals, we aim to partially address the question defined in Chapter 1 as:

Q2: How could decentralised and distributed technologies support the provision of technical infrastructure to accumulate the reviewing accounts of researchers from across multiple publication venues, recognise reviewers’ efforts, and incentivise reviewers for their job?
4.2 Design principles

We identify the following design principles to develop such a framework that accomplishes the above goals.

4.2.1 Ability to aggregate

In Chapter 2, we discussed different conference management systems (based on the centralised model), along with their advantages and shortcomings. The notable shortcomings of such systems include the limitation of data into isolated silos. We also learned (through the study we conducted in Chapter 3) that the reviewing records of researchers are spread across multiple platforms and websites. Therefore, the framework should enable the aggregation of reviewing records of researchers from across multiple publication venues.

4.2.2 Ability to establish trust

In Chapter 2 we discussed several instances where researchers deceived and cheated the reviewing process to carry out reviews in their favour. In chapter 3 the study participants also expressed that there are no mechanisms in place to verify the authenticity of the reviewing records of researchers. Therefore, the framework we propose should enable anyone to verify the veracity of the reviewing records of researchers so that anyone can trust these reviewing records without contacting the publication venue management teams.
4.2.3 Ability to ensure transparency

In Chapter 2, we discussed how the platforms based upon centralised models do not offer much transparency because of their built-in features of retaining control and data. The framework we propose should bring more transparency to the overall mechanisms of recording researchers’ reviewing accounts and incentivising reviewers.

4.2.4 Ability to provide incentive mechanism

In Chapter 2, we discussed several instances where researchers considered that reviewers should be incentivised for their services. The study participants (in Chapter 3) also shared their views about incentivising reviewers. The framework we propose should provide a technical infrastructure to help publication venue management incentivise their reviewers. The process of incentivising reviewers should be transparent and trustworthy. Also, the incentives the framework offers should be spendable.

4.3 Technical background

This section covers the technical aspects of the framework, including the associated tools and technologies. The framework uses blockchain technology to achieve the goals, enabling the accumulation of reviewing records from multiple research events and publication venues. Different stakeholders of the system can interact with each other without any intervention from a third party. Blockchain technology also enables the recorded data to be immutable, which means no one can tamper with the data, not even the one who registered it on the blockchain. Therefore, the usage of blockchain technology will ensure the credibility and veracity of the reviewing records of researchers.
in a transparent way. Blockchain technology also enables the provision of spendable cryptocurrencies without a central reserve bank, which the framework enables journals, conferences and workshops to incentivise their reviewers with spendable coins.

To achieve these functionalities, we used the following features of blockchain technology.

**Smart Contract**

A "smart contract" is simply a program that runs on the Ethereum blockchain [36]. This is the code written in Solidity language, responsible for reading and writing data on the Ethereum blockchain. While developing an ethereum based blockchain application, writing and deploying smart contracts ensure the automation and execution of the code. Such code execution may include typical deposit and withdrawal transactions, registering a student, updating a patient’s vaccine record, and issuing a ticket. A smart contract may perform all such activities when a specific condition written in the code is met without a third party’s interference. The usage of smart contracts improves efficiency, accuracy and transparency in code execution. As the smart contracts are deployed on the blockchain, no one can change or alter their code.

**ERC20 Token**

A token can represent virtually anything in Ethereum, for example, reputation points, the skills of a character in a game, financial assets, and fiat currency [36]. An **ERC20** token is a smart contract that keeps track of fungible tokens, which means an ERC20 token is precisely the same as any other ERC20 token issued under the same contract [36]. The ability of an asset to be easily interchanged with another asset for the same value is typically known as Fungibility. For example, gold is a fungible asset; a gram of gold in a country would have the same value as one gram of gold anywhere in the world. Similarly, in the case of
Bitcoin, the value of a bitcoin owned by X would be the exact value of a bitcoin held by Y. Therefore, if an organisation (journal, conference or workshop) issues a thousand ERC20 tokens, every token has the same type and value; all tokens will always be equal. A conference rewards its two reviewers, Alice and Bob, with its ERC20 tokens. The value of a token rewarded to Alice will always be the same as that of a token rewarded to Bob.

**IPFS**

InterPlanetary File System (IPFS) is a protocol used to store and share data in a distributed file system over a peer-to-peer network [55]. The IPFS looks for the content rather than the location of a resource. For example, a friend recommends reading a specific research article with its Digital Object Identifier (DOI). With the centralised web, we may have to visit GoogleScholar, find that article, and access it from where it was stored, for instance, an online library of a university. The location of that article may look like:

https://library.open.ac.uk/research/biomedical/paper2394.pdf

With the decentralised web, cryptography plays a vital role in generating the unique cryptographic hash (a fixed-length string of characters), for example:

QmXoypizjW3WknFiJnKlwHCnL72vedxjQkDDP1mXWo6uco

Using IPFS, we access the recommended research article (file) by using its unique hash. IPFS will ask for that cryptographic hash in the peer-to-peer network and brings us the file. Accessing a file in the decentralised web is different from the centralised web. The centralised web typically works with location-based URLs, while the decentralised web works with content-based URLs. For example, we stored the data on the IPFS; it generated the cryptographic hash of the data as:
- and the data can be accessed by visiting:

https://blockchain.kmi.open.ac.uk/ipfs/QmXoypizjW3WknFiJnKLwHCnL

4.4 User journey

This section describes a user’s interaction with the framework. A user may interact with the system as a member of the publication venue management or as a researcher.

The following figure 4.4 shows that when a user clicks the Conference button, it shows the option to log in to the system using the Solid interface.

![Conference button and login option]

Figure 4.1: The user finds the conference login button on the header.

The following figure 4.4 shows a pop-up window after clicking the login button, the default way of login into the Solid infrastructure.

So, after a successful login, the menu shows the options of Dashboard and logout, as shown in Figure 4.4. Clicking on the Dashboard will take the user to the dashboard section where the user could either add a new research event or view the previous events.
Figure 4.2: A pop-up window appears to use the credentials of Solid account. A user may create a new account of Solid as well.

It needs the year and the URL of a research event to create a research event in the system. A conference may have more than one event in a year. The listing of events shows the year of an event, and the number of roles already added, for example, fifteen roles added to a conference event held in the year 2020.

Now, a role must be selected from the dropdown menu, along with the inputs of paper reviewed by a researcher, their ORCID, and the number of tokens rewarded.

The newly added record is displayed under the role table, showing the ORCID, name, articles reviewed, and the number of tokens rewarded.
A researcher may use the login button that will allow the researcher to use their ORCID credentials to log into the system.

The system redirects the user to the ORCID page and returns to the platform after a successful login.

A researcher may view their timeline that shows the number of reviewed articles and the number of reward tokens earned in specific research events in particular roles.
Figure 4.4: The dashboard for a conference has two sections. One is for creating a new research event, for example, the event of a conference held in 2020. The dashboard also displays a list of research events of the conference.

Figure 4.5: The dashboard of an event has two sections. One is for adding a role, for example, Poster Chair and Demo Chair. The user will have to enter the number of papers reviewed by the reviewer, the ORCID of the reviewer and the number of ERC20 tokens rewarded to the reviewer.
Figure 4.6: After a role is added, the dashboard displays the list of reviewers, the number of papers reviewed and the number of ERC20 tokens earned as rewards.

<table>
<thead>
<tr>
<th>ORCID</th>
<th>NAME</th>
<th>ARTICLES REVIEWED</th>
<th>REWARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000-0000-0000-0000</td>
<td>Alice</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Figure 4.7: By clicking on the Researcher button, a user may login with their ORCID.
Figure 4.8: The web browser takes the user to ORCID’s login page.
Figure 4.9: The timeline of a reviewer shows certain elements of information, for example, the year of the conference events they participated in, the role they participated as in the conference, the number of papers they reviewed and the number of tokens they earned. By clicking the Ethereum icon, a new web page opens and displays a reviewing record in JSON format.
4.5 Architecture

Based on the above design principles, we define the architecture of our proposed framework. The framework enables publication venue management to input the reviewing records of researchers. These records are stored in the system and become immutable when they are registered on the blockchain. The framework also enables journals, conferences and workshops to issue their own digital currency and use it to incentivise their reviewing team. In this way, the framework could initiate developing an ecosystem of digital currencies issued by academic research events. However, the value of such digital coins would depend upon various economic factors, which publication venue management may decide later. The framework lays down a fundamental technical infrastructure consisting of three major components to accomplish the above goals.

Figure 4.10: The Framework consists of three major components, Verification component, Control and Data Storage component and User Interface component.

1. **Verification component**

The verification component is directly connected with the backend component. It receives requests from the backend component to write or read data from the blockchain. The verification component uses an Ethereum-based blockchain [105]; therefore, it deploys *Smart Contracts* written in the *Solidity* language. The defined smart contracts contain the business logic (coding) pertinent to
the peer-reviewing conferences and researchers. The component also contains
the ERC20 smart contract to represent the digital currency of a publication
venue. The component involves using IPFS that stores the reviewing records of
researchers.

![Verification Component](image)

**Verification Component**

Smart Contracts

The component deploys smart contracts for two primary purposes. One
is to manage the data related to publication venues, their events and
researchers participating in them. The other is to enable publication venue
management to issue its digital (blockchain-based) currency for researchers.

ERC20 Token

The verification component deploys ERC20 tokens for each publication
venue, which it could issue to its reviewers as an incentive. Each publication
venue registered in the system would have its discrete ERC20 token.

IPFS

The verification component uses IPFS to store and access the reviewing
records of researchers. Each reviewing record has a specific URL that contains the record in JSON format. Researchers could use these URLs of their reviewing records to establish the authenticity of their peer-reviewing participation. Data from IPFS can be accessed using the URL of blockchain, for example:

```javascript
const ipfs_url = 'https://blockchain.kmi.open.ac.uk/ipfs/randomhash';
```

2. Controller and data storage

The controller and data storage component is a bridge between the verification component and the user interface. It receives requests from the user interface, processes them, communicates with the verification component and returns the response to the user interface. This component also involves a sub-component for storing the data we cannot store on the blockchain due to GDPR. The controller component involves a web server that offers APIs.

Login Options

The controller component uses the identity management systems of Solid and ORCID. The framework uses Solid’s identity management to enable publication venue management to log in and ORCID’s identify management to enable researchers to log in. Thus, the framework does not keep/store its users’ login credentials (keys/passwords) a step towards decentralisation.

3. User interface

The user interface component enables researchers and publication venue management to interact with the system. The component allows researchers and publication venue management to log into the system, view the list of researchers and publication venues onboard. The component allows publication venue management to add the reviewing records of researchers.
Figure 4.12: The Controller and Data Storage component consisting of a web server and database. The web server enables researchers to login using their ORCID, and publication venue management to login using their Solid ID.

4.5.1 Implementation

Permissioned Blockchain

The platform can be deployed on any Ethereum-based blockchain; however, we deployed the verification component on a permissioned and private blockchain, maintained by a limited number of consortium members.
Solid

Solid is a decentralised platform for Social applications based on Linked Data. Solid uses Semantic Web technologies for data management independent of user applications, giving users autonomy and authority over their data. Solid enables users to store their data in an online storage space personal online datastore Pod. These Pods are data storage spaces provided by Solid servers. Users can deploy these (self-hosted) servers or create their pods on publicly available Solid servers they trust. Solid implements W3C standard WebID as decentralised identity management [82]. A Solid WebID may look like:

https://peermiles.solid.open.ac.uk/

ORCID

To resolve the researcher name ambiguity, the Open Researcher & Contributor ID (ORCID) introduced a registry of persistent unique identifiers for researchers [47]. The identifier is independent of the organisations and institutions a researcher may belong to; therefore, the framework uses ORCID to enable researchers to login into the platform. The platform does not store the login credentials (passwords/keys) of a researcher. A researcher’s profile can be accessed using their 16-character ORCID, for example:

https://peermiles.kmi.open.ac.uk/researchers/0000-0000-0000-0000
**Smart Contracts**

The controller component uses the OpenZeppelin [71] library for secure smart contract development. This library provides the basis for implementing Ethereum-based tokens and smart contracts through the reusability of Solidity components to build a customised and complex system.

This platform enables the publication management to register the reviewing record of a researcher and the specific event of the publication venue they had participated in; Therefore, the platform also registers the events of each publication venue. For example, a conference may have several events that were conducted in 2018, 2019 and 2020. Each event would have a separate list of reviewing teams. However, reviewers would get the same ERC20 token of that conference. The code in Listing 3 registers a conference event. The platform would record each conference event on the blockchain, and thus each reviewing record would include the blockchain address of the publication venue event.

The publication venue management has to input the name of the publication venue, the symbol for the ERC20 token, and the number of the initial supply of these tokens. This smart contract also imports the base smart contract from the OpenZeppelin [71] library. The ERC20 tokens of a publication venue would carry the same value for all its events; for example, an ERC20 token issued by Conference-A to Researcher-A would be the same value as the token issued to Researcher-B. However, ERC20 tokens of two conferences may have different values, depending upon several factors, the economic rewards offered by conferences, and the ecosystem of conferences in this platform.

We used a specific URL to access any reviewing record from IPFS, for example:
pragma solidity ^0.6.2;
import '@openzeppelin/contracts/access/Ownable.sol';
contract Conference is Ownable {
    string public webId;
    address public peermilesToken;

    constructor(string memory _conferenceWebId) public {
        webId = _conferenceWebId;
    }

    function getConferenceData() public view returns (string memory _conferenceWebId, address _peermilesToken){
        _conferenceWebId = webId;
        _peermilesToken = peermilesToken;
    }

    function addPeerMilesToken(address _peermilesToken) public onlyOwner {
        peermilesToken = _peermilesToken;
    }

    function getPeerMilesToken() public view returns (address _peermilesToken) {
        _peermilesToken = peermilesToken;
    }
}

Listing 1: The code is written in Solidity language that registers a publication venue along with its Solid webId and ERC20 token address on the blockchain.

https://blockchain.kmi.open.ac.uk/ipfs/

bafkreifzvliqkJ3dt7modc2p5wp5rqpkcr3xp5x2uamg7hki4ur3m7rva

This URL shows a reviewing record in JSON format as shown in Listing 5.

Each reviewing record would have its discrete IPFS URL. Researchers can use these URLs as proof of their participation in an event in a specific role. For example, Listing 5 shows that a researcher participated in a conference event in the year 2019 as Demos Chair, reviewed five articles and earned five reward tokens of that conference. Now,
pragma solidity ^0.6.2;

import "@openzeppelin/contracts/access/Ownable.sol";

contract Researcher is Ownable {
    string public orcid;

    constructor(string memory _orcid) public {
        orcid = _orcid;
    }

    function changeOrcid(string memory _orcid) public onlyOwner {
        orcid = _orcid;
    }
}

Listing 2: Smart contract for Researcher - The code in Listing 2 registers a researcher with their ORCID on the blockchain.

This URL would stay on the blockchain forever, and anyone can verify this reviewing record by just visiting the specific URL.

We have chosen JSON format to represent a reviewing record by accessing a URL because of its usability. The JavaScript Object Notation (JSON) represents data in a self-describing way, which humans also easily understand. Modern web applications also use JSON for their data representation. Therefore, if a researcher or conference desires to use (or display) the data from IPFS URLs, it would be easy to integrate these reviewing records with their websites.

Server

The controller and storage component deploys an ExpressJS based server. The server handles the incoming requests and outgoing responses. The server also uses the static files generated for the user interface component.
pragma solidity ^0.6.2;
import "@openzeppelin/contracts/access/Ownable.sol";

contract ConferenceEvent is Ownable {
    address public conferenceAddress;
    mapping(address => uint256) listOfRewards;
    constructor(address _conferenceAddress) public {
        conferenceAddress = _conferenceAddress;
    }
    function getConferenceEventData() public view returns (address _conferenceAddress) {
        _conferenceAddress = conferenceAddress;
    }
    function rewardTokens(address _person, uint256 _rewardTokens) public onlyOwner {
        listOfRewards[_person] = _rewardTokens;
    }
    function getRewardToken(address _person) public view returns (uint256 _rewardTokens) {
        _rewardTokens = listOfRewards[_person];
    }
}

Listing 3: Smart contract for Conference Event: The code manages a publication venue event on the blockchain. The code is responsible for rewarding ERC20 tokens to researchers.
pragma solidity ^0.6.2;

import "@openzeppelin/contracts/access/Ownable.sol";
import "@openzeppelin/contracts/token/ERC20/ERC20.sol";

contract PeerMiles is ERC20 {
    constructor(
        string memory _name,
        string memory _symbol,
        uint256 initialSupply
    ) public ERC20(_name, _symbol) {
        _mint(msg.sender, initialSupply);
    }
}

Listing 4: Smart contract for ERC20 Token: The code registers the ERC20 token for a conference.

RESTful API

The ExpressJS-based server also deploys RESTful APIs used as the points to interact with the platform. These APIs are used to carry out different Create Read Update Delete (CRUD) operations, including:

1. CREATE and Login Conference
   This API call checks whether the requested webId is registered in the system and registers it if the webId is not found. The User Interface component sends a request to the Control and Data Storage component, where the server fulfils the request and sends the response after executing a query to check if the webId is already registered.

2. CREATE and Researcher
   This API call checks whether the requested ORCID of a researcher is registered in the system and registers it if the ORCID is not found. After the management
"conference": {
    "webId": "https://peermiles.solid.open.ac.uk",
    "name": "Demo Conference",
    "abbr": "MDC",
    "url": "https://demo-conf.org",
    "address": "0x295FDa669B7bfb67e3799CD880e42E58d31bD60B",
    "peermiles": "0xa2e5b8A6a5B00F26446dd58c805782C89C91B3F3"
},
"conferenceEvent": {
    "year": 2019,
    "url": "https://2019.demo-conf.org",
    "address": "0xC19cf2D61D054a3aCCB20c640b80C30a4546D14"
},
"role": "Demos Chair",
"researcher": {
    "name": "",
    "address": "0x34be1DFFc7eE9d70D5d93D5E1D90dD270F6cD916",
    "orcid": "0000-0000-0000-0000"
},
"articlesReviewed": "5",
"reward": "5"
}

Listing 5: Reviewing record retrieved from IPFS in the form of JSON
adds a researcher’s record, the ORCID of that researcher is sent to the Control and Storage component, which executes a query to check if that ORCID is registered. The control component generates a blockchain account for that ORCID if that researcher was not registered before and saves this data in both database and blockchain.

3. **READ all conferences**

This API call returns the data of all the conferences registered in the system. The user interface component requests the control component to fetch all the registered publication venues with the system. The control component executes a query to fetch all the publication venues registered in the system and responds to the user interface component.

4. **READ one conference**

This API call returns the data of a conference of a specific webId. The user interface component requests the control component to fetch the registered publication venue with webId. The control component executes a query to fetch the information about the publication venue registered in the system and responds to the user interface component.

5. **CREATE Conference Event**

This API call registers a conference event in the system. The user interface component requests the control component to register an event of a publication venue. The control component executes a query to register the publication venue event registered in the system and responds to the user interface component.

6. **READ all conference events**

This API call returns the data of all the events of a conference. The user interface component requests the control component to fetch all events of a publication venue. The control component executes a query to fetch the information about
the publication venue events registered in the system and responds to the user interface component.

7. **READ one conference event**

This API call returns the data of one event of a conference. The user interface component requests the control component to fetch a specific event of a publication venue. The control component executes a query to fetch the information about the specific publication venue event registered in the system and responds to the user interface component.

8. **Reward a researcher**

This API call registers a reviewing record of a researcher for a specific conference event. The user interface component sends the data to the control component. The control component executes a query to register that information both in the database and blockchain. This data contains the number of papers a reviewer has reviewed and the number of ERC20 tokens they have received.

9. **READ rewards of all researchers**

This API call returns the data of all researchers and their rewards. This API call is used for the researchers’ web page that shows all researchers registered with the system. The control component responds to the request by sending all data about researchers.

10. **READ rewards of one researcher**

This API call returns the data of a single researcher and their rewards. The user interface component requests the control component and sends the ORCID of that researcher along with the request. The control component executes the query to fetch information of that researcher and responds to the user interface component.
The controller and storage component uses JSON as a data transporter for these API calls responses.

**Database**

The controller component includes a database (MongoDB) to keep the relevant data off the blockchain and store only limited data. Apart from the scalability and processing capability of blockchain technologies, we also have to consider the General Data Protection Regulation (GDPR) limitations; therefore, we must avoid putting personal (or sensitive) data onto the blockchain. The controller component uses Mongoose, an Object Data Modeling (ODM) library for MongoDB and Nodejs, to manage the objects in code and represent those objects in MongoDB. “An Object Data Model is based on object-oriented programming, associating methods with objects that benefit from class hierarchies”. Therefore, we devised data models for the platform that maintain abstraction from complex queries.

The `webId` represents the Solid ID (essentially a URI), `name` keeps the name of a publication venue while `abbr` represents the abbreviation for the publication name. The abbreviation is also unique because it will also be the symbol for the conference’s ERC20 token. The data object of a publication venue would also store an array of references to its events. The property `url` is self-explanatory to store the website address of a publication venue. The field `account` stores the blockchain account address and its password in case these credentials are to be handed over to the publication venue management in future so that they can interact with the blockchain independently. The field `contractAddress` stores the blockchain address of the publication venue Smart Contract while `peermilesAddress` saves the blockchain address of the ERC20 Token address of the publication venue.
const mongoose = require("mongoose");
const uniqueValidator = require("mongoose-unique-validator");
const ConferenceSchema = new mongoose.Schema(
    {
        webId: {
            type: String,
        },
        name: {
            type: String,
        },
        abbr: {
            type: String,
            unique: true,
            index: { unique: true, collation: { locale: "en", strength: 2 } },
            trim: true,
            uniqueCaseInsensitive: true,
        },
        seriesEvents: [ {
            type: mongoose.Schema.Types.ObjectId,
            ref: "ConferenceEvent",},{}],
        url: {
            type: String,
        },
        account: {
            address: { type: String },
            password: { type: String },
        },
        contractAddress: {
            type: String,
        },
        peermilesAddress: {
            type: String,
        },
        registered: {
            type: Boolean,
        },
        registrationDate: {
            type: Date,
            default: Date.now,
        },
    },
    { versionKey: false }
);
ConferenceSchema.plugin(uniqueValidator);
const Conference =
    mongoose.models.Conference || mongoose.model("Conference", ConferenceSchema);
module.exports = Conference;

Listing 6: Data model for Conference - The code represents the data model for a publication venue in the platform.
Each publication venue event holds the reference to its publication venue and the year it took place. An array of roles defines a list of objects to keep a record of researchers and their roles in the conference event.
Listing 9: Data model for Reward

Listing 8 shows the data model for a researcher. The field orcid stores the ORCID ID of a researcher. The data model also keeps the blockchain account and the smart contract addresses of a researcher.

Listing 9 shows the data model for rewarding a researcher. The data model refers to the objects from other data models, including Conference, ConferenceEvent, Roles and Researcher. The data model of Roles represents all the roles a researcher could be in the reviewing process, for example, Demos Chair, Industry Chair, and Panel Chair. The field articlesReviewed represents the number of articles reviewed by a researcher, while the field reward represents the number of tokens a researcher gets. The field ipfs keeps the IPFS URL for a particular reviewing record.
Figure 4.13: The list of researchers registered with the platform by either they logged in with their ORCID, or added by the publication venue management team.

### 4.5.2 User interface

The user interface component of the framework depends upon the APIs exposed by the controller component. We have used frameworks and libraries for developing the user interface. We have used Vue.js [97], an open-source framework for building user interfaces.

The user interface displays the registered conferences and researchers, as shown in Figure 4.13. The table of researchers shows the ORCID of each researcher registered in the system.

Each researcher has their profile (timeline) to show the number of publication venue events they participated in, the number of articles they reviewed and the number of rewards (ERC20 tokens) they earned, as shown in Figure 4.14. In addition, each
Figure 4.14: The profile page shows the timeline of a researcher with the number of research events they have participated in as a reviewer, the number of papers they reviewed and the number of ERC20 tokens they were rewarded.

Each reviewing record has an Ethereum icon to represent the IPFS URL for each reward, helpful in verifying the reviewing history of a researcher.

A reviewing record of a researcher accessible through an IPFS URL is represented as JSON, as shown in Figure 4.15.

The user interface also enlists the number of publication venues registered in the system, as shown in Figure 4.16. A publication venue’s profile shows the number of events registered in the system. An event’s profile shows the list of roles and
Figure 4.15: A new web page opens after clicking the Ethereum icon of a reviewing record, that shows the specific reviewing record in JSON format.

researchers, the number of articles they reviewed, and the number of reward tokens they earned. This profile also exposes the IPFS URL for each record.

Process Flow

Figure 4.17 describes the process flow for conference management to login into the system and then record the reviewing contributions of researchers. The system accepts Solid ID for conferences. On successful login with Solid ID, the system checks if the Solid ID is already registered for any publication venue or not. If that Solid ID is registered, the system takes them to a web page to create a new publication venue
Figure 4.16: The list of conferences registered with the platform, along with their abbreviations, websites and Solid IDs.

<table>
<thead>
<tr>
<th>Name</th>
<th>Abbr.</th>
<th>Website</th>
<th>SOLID</th>
</tr>
</thead>
<tbody>
<tr>
<td>My Demo Conference</td>
<td>MDC</td>
<td>Website</td>
<td><a href="https://peermlies.solid.open.ac.uk">https://peermlies.solid.open.ac.uk</a></td>
</tr>
<tr>
<td>Demo Conference</td>
<td>DC1</td>
<td>Website</td>
<td><a href="https://democonf.solid.open.ac.uk">https://democonf.solid.open.ac.uk</a></td>
</tr>
<tr>
<td>Demo Workshop</td>
<td>DW1</td>
<td>Website</td>
<td><a href="https://demoworkshop.solid.open.ac.uk">https://demoworkshop.solid.open.ac.uk</a></td>
</tr>
<tr>
<td>SolidCom</td>
<td>SCM</td>
<td>Website</td>
<td><a href="https://peermlies.solidcommunity.net">https://peermlies.solidcommunity.net</a></td>
</tr>
</tbody>
</table>

Figure 4.18 shows the process flow for a researcher to login into the system and make use of their data. Researchers can only use ORCID for login. On successful login, the system checks if that ORCID is registered with the system. If it is not registered, the system generates a blockchain account for that ORCID. The researcher is then able to view their profile and records on the blockchain.
Figure 4.17: The process flow diagram for a conference user that starts with login with their Solid ID, and enables the user to create a research event, and add new reviewing records of researchers.

4.5.3 Performance metric

The platform has three major parts; one is deployed upon an ethereum-based blockchain, and the other two reside on a web server. There has been continuous and incremental improvement in the Ethereum protocols that have impacted the performance of a blockchain; for example, reducing the time taken to confirm a block
4.6 Discussion

In this chapter, we introduced a model based upon decentralised technologies. Introducing decentralisation brings fundamental changes to the existing methods involved in recording the reviewing accounts of researchers. We discuss these significant changes and their impact in light of the goals we set for this framework in Section 4.1.1.

1. Accumulation of reviewing records

The framework enables the publication venue management to create the reviewing...
records of researchers. Following this mechanism helps ascertain the fact that the publication venue management confirms these records. A researcher’s profile may include the reviewing records created by multiple publication venue management teams. So, a researcher’s profile may show a list of publication venues, their events, their roles in the reviewing process, the number of papers they reviewed and the number of incentive tokens they were rewarded.

2. Verifiable reviewing records

The framework uses blockchain technology and IPFS to manage the reviewing records, and hence this information is stored permanently. Each reviewing record has a specific URL, and the framework enables anyone to verify the reviewing records of researchers through accessing these URLs. The publication venue management teams and researchers both can use these URLs on their websites. For example, a conference may include these URLs along with the names of their reviewing team members, and researchers may include these URLs on their institutional and personal web pages. These are the lifelong reviewing records of researchers, and the framework enables anyone to verify their authenticity at any time.

3. Transparency

The framework introduces more transparency while documenting the reviewing records, as it only allows conference management to add a record, and researchers may only view those records. Researchers cannot add or amend any record; hence, it enables conference management to bear all responsibility of creating the reviewing records and awarding ERC20 tokens. The fact that the reviewing history of a researcher is immutable would ensure transparency and strengthen further trust in the reviewing process. For example, when the publication venue
management creates a reviewing record, it is recorded on the blockchain, and thus, this information is lifelong and publicly available for everyone.

4. Incentives for reviewers
The framework enables publication venue management to incentivise their reviewing team using blockchain-based cryptocurrencies. These incentives have the potential to offer monetary value; therefore, the ecosystem of multiple publication venues using this framework would enable research communities to explore ways of making use of these spendable currencies. However, the value of these currencies would depend upon the economic models adopted by the ecosystem of publication venues. The non-monetary incentives are researchers’ profile as reviewers, their lifelong and immutable reviewing history independent of any platform. Such incentives would become a form of recognition for their efforts and services to advance research. For example, researchers could present these records for internal promotions, grants and further employment prospects.

5. Finding and selecting reviewers
The framework enables the accumulation of reviewers and their lifelong and verifiable reviewing history. There is a potential of having a pool of such reviewers if a significant number of publication venues use the framework, therefore, significantly impacting the process involving finding and selecting peer-reviewers for publication venues. The framework would offer the publication venue management the reviewing history of researchers instead of their authored publications while selecting a reviewer.

4.6.1 Contributions

We enlist the following technical contributions of this chapter.
1. We adopted decentralised and distributed technologies to address the issues of peer review.

2. We designed a framework that enables the publication venue management to record the reviewing activity on the blockchain.

3. The framework reduces the dependency upon centralised platforms and increases transparency in the overall reviewing process.

4. The framework introduces spendable incentives for reviewers.
4.7 Summary

In this chapter, we introduced a framework to address the major issues reported in Chapter 2 and identified Chapter 3.

The framework we presented has three main components: the verification component, the controller and storage component, and the user interface component. The verification component involves deploying the Smart Contracts on an Ethereum blockchain. These Smart Contracts are responsible for storing critical information of the publication venues and researchers, along with the incentives. These incentives are ERC-20 based tokens (each publication venue has its discrete crypto token).

The controller and storage component is responsible for communicating with both the verification and user interface components. The user interface shows the lists of publication venues, their events and researchers. The user interface enables researchers and conference management to log in using ORCID and Solid, respectively. The user interface also enables the publication venue management to create its events and add the reviewing records of researchers. In addition, the user interface displays the reviewing profiles of researchers. Each reviewing record also contains an IPFS URL that leads to a reviewing record’s JSON-based representation.

We then discussed the impact of our framework on the peer-reviewing process and how it answers our research question defined in Section 1.3.
Chapter 5

Evaluation of the framework

We conducted a study (reported in Chapter 3) that involved interviewing senior researchers. In Chapter 4, we presented a design of our framework to address the issues reported in the study earlier. This chapter presents the evaluation of the framework.

5.1 Introduction

In this chapter, we evaluate the aspects of peer review identified in Chapter 4 as being explicitly addressed by our framework.

1. The accumulation of the reviewing records from across multiple research events

We aim to evaluate the framework regarding the impact the accumulation of the reviewing records of researchers will have, for example, the ability to use these records on the professional and personal websites of researchers.
2. **The impact of verifiable reviewing records**

The framework enables making the reviewing records tamper-free and immutable. These reviewing accounts are permanently recorded once they get registered on the blockchain. We plan to evaluate the framework regarding the impact of the immutability of reviewing records, such as establishing trust in these records. For example, how would it impact the publication venue management team when they know the reviewing records of researchers (potential reviewers) are genuine, tampered-free and lifelong.

3. **The role of transparency in accumulating the reviewing records, and incentivising reviewers**

The framework allows researchers’ reviewing accounts to be recorded transparently. The data is recorded on the blockchain and is publicly accessible. We aim to evaluate the framework regarding transparency in the reviewing records and incentives for reviewers. For example, in the presence of these publicly accessible immutable reviewing records, would there be a need to contact the publication venue management to ascertain the veracity of the reviewing records of researchers?

4. **The impact of introducing blockchain-based incentives for reviewers**

The framework enables the publication venue management to incentivise their reviewing team with a new phenomenon, cryptocurrencies. We plan to evaluate the framework regarding the incentive mechanism, for example, enabling the publication venue management to send incentive tokens to reviewers and its impact on peer review?

5. **Overall usability of the platform**

We plan to evaluate the overall usability of the framework in terms of:
(a) The accumulation of the reviewing records from across multiple publication venues

(b) Establishing trust in the reviewing records

(c) The impact of transparency in recording the reviewing records of researchers

(d) Using these records on professional and personal websites

(e) Incentivising reviewers with blockchain based cryptocurrencies

Our plan to evaluate the framework would address the research questions RQ2 and RQ3 (defined in Chapter 1).

**RQ2**: How could decentralised and distributed technologies support the provision of technical infrastructure to accumulate the reviewing accounts of researchers from across multiple publication venues, recognise reviewers’ efforts, and incentivise reviewers for their job?

**RQ3**: To what extent does the technical infrastructure described above address and satisfy the concerns raised in the research question RQ1?

### 5.2 Evaluation plan

We reported the development of a platform based upon the framework in Appendix 4. We aim to know the researchers’ viewpoints on using the platform; therefore, we planned to evaluate it by assessing its usability, such as its value for reviewers and publication venue management.

In such a scenario, we opted for descriptive evaluation techniques to evaluate the platform. The descriptive evaluation techniques are used to describe the state and the issues of the software in an objective way [42] - for example, recording and assessing
the activities of a user while working with the software. The descriptive evaluation techniques can be subdivided into several approaches, including [42]:

1. **Behaviour-based evaluation**

   Such techniques are used to observe the users, such as how they use specific software features, what issues they face, and what features they dislike. Using such techniques help analyse users’ behaviour while interacting with software features, for example, analysing the features users use more frequently. These techniques may include different procedures adopted to observe the software users, such as “thinking aloud” technique that allows users to express themselves verbally while using the system.

2. **Opinion based evaluation**

   Such techniques are used to obtain the users’ views about a software’s features and issues, for example, interviewing users and conducting surveys. These techniques help collect specific information about software features and user experience to analyse the impact of these features’ impact and how different users may perceive and practice it. For example, software introduces a feature that enables users to make video calls to their peers. The opinion-based evaluation techniques can be used to ask users specific questions about the software, for example, does the software crash when users share their screen during the video call? Users may express their preferences and suggest changes to improve specific features of the software during the experiment.

3. **Usability testing**

   Software usability testing techniques may involve analysing both the behaviour and opinion of the users. Such techniques are a combination of both behaviour and opinion based evaluation techniques. The participants are typically requested to perform specific tasks and then record their viewpoints on different aspects...
related to these tasks. The researcher or facilitator (the one conducting the software evaluation) observes and records the participants’ behaviour (using different techniques, for example, screen recording of the interaction of the participants with the software) and their feedback.

We planned to evaluate the framework to find out its usefulness for academia instead of measuring the capabilities and performance of the technical infrastructure underpinning the platform. Therefore, we adopted a technique of usability testing that involved requesting the users to perform specific tasks on the platform and then conducted a targeted survey. We also interpreted and analysed the results we received from the survey.

5.2.1 Methodology

The platform is deployed on a server within KMi’s research infrastructure (having a public-facing URL) while the verification component communicates to the private blockchain deployed in our university. We define our methodology in terms of explicitly defined scope, the process involved in inviting and recruiting participants, and then recording their opinions after they used the platform.

5.2.2 Scope of the study

The outcomes of the study that we conducted in Chapter 3 suggested a set of improvements in the peer-review process overall. We focused on evaluating the platform considering the aspects mentioned in Section 5.1. These aspects are:

a) The accumulation of reviewing records
b) Verifiable reviewing records

c) Transparency

d) Incentives for reviewers

e) Overall usability of the platform

5.2.3 Identifying, inviting and recruiting participants

We successfully recruited 7 participants for the study; 6 out of them were previous participants (in the first study).

We understand there could be different reasons for researchers not being willing to participate in this. We were carrying out our evaluation study in exceptionally challenging times since the COVID-19 pandemic had been ongoing for more than a year now. The distress of the virus itself, combined with the lockdown, was bound to impact the decisions of the researchers that we called upon to participate.

5.2.4 Evaluation tasks

We informed our participants about the general information regarding the research study through the participant information sheet. We requested them to access the platform using a specific URL [https://peermiles.kmi.open.ac.uk/]. We created two Solid accounts and shared their credentials with the participants (if they do not have Solid accounts or do not want to use their Solid accounts with the platform). We shared two Solid accounts with the participants to have data from at least two publication venues. For example, to show a researcher has participated in more than one publication venue in different roles and received rewards for their participation.
To elicit their views about the aspects mentioned in Section 5.1, we requested them to use the platform and carry out the following tasks. These tasks included interacting with the platform, logging into the system, submitting researchers’ reviewing records, and incentivising reviewers with blockchain-based currencies.

1. **Login using Solid and ORCID**

   The task involved requesting participants to log into the platform using two Solid and ORCID accounts because they both represent different entities. A Solid account represents publication venue management, while an ORCID account represents a researcher.

   ![Login using Solid and ORCID](image)

   Figure 5.1: By clicking on the Researcher and Conference buttons, a user may login with their ORCID and Solid.

2. **Creating conference event**

   The task involved requesting participants to create a conference event by the year and the URL of the event. For example, Conference-X had an event in 2019, and it has a URL as https://2019.conference-x.com.

3. **Adding a reviewing record**

   The task involved requesting that participants add a reviewing record. The participant has to input the following four parameters.
4. **View verified information**

The task involved requesting that participants view the information of the publication venues, their events, and the immutable reviewing records of researchers. Participants were requested to click on an Ethereum icon (placed before each reviewing record) to display the information of a reviewing record.
5.2.5 Targeted Survey

As mentioned in Section 5.2, we adopted an evaluation technique that involved asking participants to perform specific tasks and then requesting them to take a survey to register their viewpoints. We used the technique of conducting a targeted survey to quantify the participants’ viewpoints about specific features of the platform instead
of a simple yes/no question. Therefore, we used the Likert rating scale [59] for the survey. “The Likert rating scale is used to measure attitudes and opinions with a greater degree of nuance than a simple yes/no question” [65]. The survey questions enable participants to choose from a series of answers, ranging from one extreme view to another, for example, the question “How likely would you recommend our X parcel delivery service?” has a five-point Likert scale from “very likely” to “highly unlikely” [65].

We presented our participants with the URL:

https://forms.gle/XjKPPszwW3ZRkNRg9

for the survey. The survey has “Informed Consent” for the participants, which they have to accept before their views get recorded for the study. We requested participants to input their names (not to be published in results). The survey has ten questions in total. Five questions use the Likert scale of 1 to 5, wherein one is for Strongly Disagree, and five is for Strongly Agree. We used this scale to determine participants’ conclusive views. Four questions used the Likert scale from 1 to 10, wherein one is for Very Unlikely, and ten is for Very Likely. We used this scale to discover more granular feedback of a statement acknowledged by participants. Using the Likert scale from 1 to 10 will help us identify the domains where the framework needs improvements. The survey’s last question has a text field where participants recorded their views and opinions in textual form.
5.3 Survey Results

The Likert-scale survey produced quantitative data, as shown in Table 5.2 and Table 5.4. We analysed the limited sample size using descriptive statistics techniques. Descriptive statistics techniques are typically used to organise, present and analyse numerical data. For example, we have reported the mean value of the results of each question to understand the average score (response) by the participants. We have also reported the mode value of the results of each question to find the response that occurred most frequently.

The survey has the following questions and their answers. We have also reported the mean and mode values of the results. The mean value (notified by $\bar{X}$) indicates the average number of the results, while the mode value (notified by Mo) indicates the number of repetitions in the results. The questions in Table 5.2 used a Likert scale of 1 to 5 while the questions in Table 5.4 used a Likert scale of 1 to 10.
1. The login options (ORCID and Solid) of this platform for linking up a researcher with their ORCID and a conference with their Solid pods work as expected.

| 5 | 5 | 4 | 2 | 4 | 1 | 4 | $\bar{X}$: 3.57 | Mo: 4 |

2. As a PC-Chair, you are able to send incentive tokens to reviewers with this platform.

| 5 | 4 | 4 | 1 | 3 | 3 | 5 | $\bar{X}$: 3.57 | Mo: 5,4,3 |

3. As a Researcher, you are able to receive incentive tokens with this platform.

| 5 | 4 | 4 | 4 | 3 | 3 | 4 | $\bar{X}$: 3.85 | Mo: 4 |

4. As a PC-Chair, you can trust these immutable and verifiable reviewing accounts of a reviewer without contacting the concerned conference.

| 4 | 4 | 3 | 2 | 3 | 5 | 5 | $\bar{X}$: 3.71 | Mo: 3,4,5 |

5. As a Researcher, you can use these immutable and verifiable accumulated reviewing-records on your institutional and personal website.

| 4 | 4 | 3 | 4 | 4 | 5 | 5 | $\bar{X}$: 4.14 | Mo: 4 |

Table 5.2: These questions used a linear scale of 1 to 5 wherein one is for Strongly Disagree, and five is for Strongly Agree, and the results also show the mean and mode values.
6. How likely would you want to use this platform as a PC-Chair to trust the verifiable accumulated reviewing records of a researcher?

| 7 | 7 | 6 | 7 | 8 | 6 | 10 | $\bar{X}$: 7.28 | $Mo$: 7 |

7. How likely would you want to use this platform as a PC-Chair to incentivise reviewers if monetary value is added to these incentive tokens?

| 7 | 7 | 8 | 8 | 2 | 7 | 10 | $\bar{X}$: 7 | $Mo$: 7 |

8. How likely would you use these immutable and verifiable reviewing records on your institutional and personal websites?

| 7 | 4 | 5 | 8 | 8 | 8 | 10 | $\bar{X}$: 7.1 | $Mo$: 8 |

9. How likely would you recommend this platform to other researchers and program committees?

| 7 | 7 | 7 | 7 | 7 | 8 | 10 | $\bar{X}$: 7.57 | $Mo$: 7 |

Table 5.4: These questions used a linear scale of 1 to 10 wherein one is for Very Unlikely, and ten is for Very Likely, and the results also show the mean and mode values.
The last question of the survey was “What changes/impact would this platform have on the peer-reviewing process?” The following were the responses.

- “Possibly incentivize reviewers in their work”

- “It would provide a form of reward to reviewers, whose role is currently insufficiently appreciated.”

- “If the intended verifiability and trust is delivered then it can certainly help recognize the effort of reviewers. One thing I think that is missing is the record of the quality of reviews.”

- “increase of trust in peer-reviewing”

- “It may incentivize reviews by having a transparent record of service done across different events. It may also help PC chairs to more easily find good PC members.”

- “The platform has good potential, but I could not fully try it. I could log in as Researcher with my ORCID but not as conference or workshop via SOLID. Happy to retry this as soon as the login is fixed.”

- “This is a great work. I look forward to use it and give credit to my researchers. I believe the added value is to have a place where we to get our ‘symbolic credit’ and get to verify our activity for the community.”

5.4 Analysis and Discussion

In this chapter, we discussed our evaluation plan for the framework we proposed in Chapter 4. In Section 5.1, we planned to evaluate the framework considering the
following perspectives. We discuss how the results reported in this chapter help address the following aspects.

1. **Accumulation of reviewing records**

Researchers’ reviewing profile builds up as they participate in the reviewing process for journals, conferences and workshops. The framework enables researchers to showcase their reviewing profile with their accumulated records created by the publication venue management. The results of the third question in Table 5.2 show that a majority of the participants were able to view their profiles as reviewers. A reviewer’s profile contains a list of records in chronological order. Each record shows the name of the publication venue, the year that event took place, the researcher’s role, the number of articles reviewed by the researcher, and the number of incentive tokens they received for participating in the reviewing process.

2. **Verifiable reviewing records**

As the framework enables the reviewing records to become immutable, the results of the fourth question in Table 5.2 show that a majority of the participants believed they could trust these reviewing records of a researcher without contacting the corresponding conference management. Introducing a feature to establish such a level of trust in the reviewing history of researchers would help the publication venue management in different ways; for example, inviting unknown researchers would become less risky for the publication venue management. This feature would also help eliminate impostors and reviewers with their fraudulent reviewing history. The level of trust in the immutable reviewing records directly indicates the level of trust in the framework. Further, it fulfils one of the framework’s goals: to make the reviewing records such that everyone can trust their authenticity without suspicion.
The sixth question in Table 5.4 asked for the likelihood of using the platform as the publication venue management to trust the reviewing records of a researcher. The results of the sixth question in Table 5.4 show the participants' confidence in the platform that they would use this platform as the publication venue management to trust the reviewing history of researchers because the reviewing records are permanent and verifiable.

3. Transparency
The framework enables researchers to use their ORCID account; therefore, they would not need to create and maintain another account on our platform. Their reviewing contributions get linked to their unique digital identifier, ORCID. The platform also enables conference management to log in using their Solid account; hence, they are not required to create a new account. The platform does not store login credentials (passwords) for either Solid and ORCID. The results of the first question in Table 5.2 show the login options worked for a majority of participants.

4. Incentives
The framework enables the publication venue management to create a reviewing record on the platform. This reviewing record incorporates four inputs, including the ORCID of a researcher, their role in the conference (for example, Demo Chair, Reviewer), the number of articles they reviewed, and ERC20 tokens they were awarded. The results of the second question in Table 5.2 reflect that a majority of the participants were able to create a reviewing record and also reward the reviewers with incentive tokens (cryptocurrencies).

5. Overall usability of the platform
The following discussion may also involve the above four aspects; therefore, the
following interpretations address the overall usability of the platform, including the perspectives mentioned above.

The framework enables researchers to retrieve and display their reviewing history on their professional and personal websites. As the reviewing records leave their permanent traces on the blockchain, a visitor can verify a reviewing record using a URL that brings a reviewing record (in JSON form) from the blockchain. The platform provides a unique URL for each reviewing record, fetching data from the blockchain (IPFS). The results of the 5th question in Table 5.2 show that this feature acts accurately and can enable researchers to use their reviewing history on their professional and personal web pages. This feature of using permanent and verifiable reviewing records on professional and personal websites would have various benefits. For example, this would establish trust in the reviewing history of researchers, help verify these records with a single mouse-click, and acknowledge the reviewers’ services in the form of their profiles as reviewers.

The framework enables conference management to incentivise their reviewing team for their services using ERC20 tokens. The results of the 7th question in Table 5.4 show that six out of seven participants believed they would want to use the platform to incentivise reviewers if monetary value is added to the incentive tokens in future. One of the seven participants believed they would not use the platform for incentivising reviewers. We discovered (in Chapter 3) that researchers have divided opinions about the idea of using monetary value to incentivise reviewers. Some researchers believe reviewers should carry out their reviewing activities as their obligation to academia and not get monetary incentives in return. While some researchers believe reviewers do a tremendous job of reviewing for journals, conferences and workshops, and they do not get paid (in financial terms), therefore, there should be a way to compensate them with monetary value. So, the results of this question show that a majority of
the participants would want to use this platform to incentivise reviewers (given the monetary value is added).

The framework allows the use of the reviewing history of researchers outside the platform (i.e., on professional and personal web pages), and the results in the 5th question in Table 5.2 show that the feature works fine. The 8th question in the survey is slightly different from the 5th one because we asked the 8th question to measure the likelihood of using these records outside the platform. The results of the 8th question in Table 5.4 show the high likelihood of using the reviewing records, while two participants have chosen a middle ground.

The results of the 9th question in Table 5.4 show that it is likely that the participants would recommend this platform to other researchers and the publication venue management. The results show confidence in the philosophy and the list of features that this platform provides.

The 10th question records participants’ views about the platform’s possible impact on the peer-reviewing process. According to the participants’ viewpoints, the duties performed by researchers in different roles in the reviewing process are rarely acknowledged and appreciated. The platform would help incentivise and acknowledge reviewers for their participation in the academic reviewing process. The platform provides a subtle mechanism to verify the reviewing history of researchers. The platform would help academia in many ways, including increasing the trust in the academic peer-reviewing process, recognising the rarely-acknowledged reviewing efforts by researchers, and finding suitable reviewers for research events. One of the participants suggested that a reviewing record should also include the quality of a review.
5.4.1 Conclusion

We listed two research questions in Section 5.1 to investigate how decentralised and distributed technologies could be the basis for a technical infrastructure to accumulate the reviewing records of researchers across multiple research events and to incentivise reviewers for their unacknowledged services to peer-review. We introduced a framework and developed a platform based upon the framework mentioned in Chapter 4. In this chapter, we evaluated the platform in the light of research questions we posed in Section 5.1. We analysed the results of the targeted survey and concluded that the platform serves the intended purpose of compiling the reviewing contributions of researchers across multiple research events. The platform makes these records immutable and allows anyone to verify their authenticity without contacting the concerned publication venue management. However, it is suggested that a reviewing record should also include the quality of a review. The platform also enables the publication venue management to reward its reviewers with blockchain-based cryptocurrencies.

The findings of RQ1 are reported in Chapter 3, where we designed and conducted structured interviews of senior researchers to inquire about peer review. We discuss how the findings of this research study address the concerns raised in Chapter 3.

We discussed in Chapter 3 the participants’ opinions that the collection of the reviewing records of researchers from across multiple research events would have a positive impact on academia. The accumulation would enable the build-up of reviewers’ public profiles. The publication venue management could explore these profiles to find suitable reviewers. These profiles could also be used to assess researchers while considering internal promotions and awarding grants. The results in this chapter show that the PeerMiles platform enables researchers to have public profiles. These public profiles show the reviewing records of researchers in chronological order as a timeline.
We mentioned in Chapter 3 that the second most discussed topic was about the elements researchers would want to consider to establish greater trust in peer-review. Participants aspired to have a system that shows the reviewing contributions of researchers, their reputation as reviewers, the number of reviews they have done, a list of venues where they have participated as reviewers, the possible impact of their reviews and the feedback given by the publication venue management and research community. The PeerMiles platform aims to address these aspects and help establish trust in peer review. This chapter reports and interprets the results and hence analyses that the participants recognise the PeerMiles platform that helps establish trust in the reviewing contributions of researchers. Once recorded in the system, the immutability of the reviewing records ensures the authenticity of these records, and therefore, anyone can infer that these reviewing records are genuine, tamper-free and recorded by the publication venue management itself. This feature reduces the need for contacting the publication venue management to verify the legitimacy of a reviewing record because of the degree of trust that it brings.

We analysed and reported in Chapter 3 that incentivising reviewers for their services remained the most discussed topic during the interviews. The participants discussed both monetary and non-monetary forms of incentives for reviewers. They also expressed their views about the possible exchange of incentives across journals, conferences and workshops. This exchange of incentives can connect different research communities and enable researchers to explore and participate in research events unknown to them before. So, the PeerMiles platform enables conferences to incentivise their reviewers and provides the technical infrastructure to exchange incentives between conferences. The ERC20 token (cryptocurrency) of an individual conference can be recognised and accepted at another conference. The ERC20 token of each publication venue will have its symbol; for example, The Web Conference may have “TWC” as its ERC20
token symbol. These ERC20 tokens will hold value and can be sent and received by researchers. As the economic and monetary aspects of cryptocurrencies are not in this thesis’s ambit, we leave it to future work when the PeerMiles community grows and develops an ecosystem of journals, conferences, and workshops. The individual publication venues may then decide upon their exchange rate with other venues.

5.4.2 Contributions

We discussed several approaches and tools to manage peer-review data in Chapter 2 which typically rely upon centralised technologies. We learnt that by using decentralised and distributed technologies, the reviewing records of researchers from across multiple publication venues could be accumulated in a transparent and trustworthy way. Using blockchain technology to establish lifelong authenticity in the reviewing records of researchers may also address peer review issues, for example, avoiding impostors or fraudulent reviewers. These lifelong records may also become a form of recognition for the unacknowledged job peer-reviewers do. Furthermore, blockchain technology can also be used to incentivise researchers. Such incentives may attract more adoption if monetary value is added to them.
5.5 Summary

This chapter reports a research study conducted to evaluate the framework we designed in Chapter 4 and addresses the research questions posed in Chapter 1. We discovered that decentralised and distributed technologies could be used to address the issues of peer review we learnt in Chapter 3. These issues include enabling the accumulation of reviewing records from across multiple publication venues, establishing trust in those reviewing accounts of researchers and enabling publication venue management to incentivise their reviewing team.

We learnt that decentralised and distributed technologies help accumulate the reviewing accounts of researchers and create public reviewers’ profiles. These public profiles with lifelong and immutable reviewing records are a form of recognition and help academics get acknowledged for the work they were unacknowledged earlier. These public profiles may also help the publication venue management in a greater perspective of finding suitable reviewers for research events. We learnt in Chapter 3 that, according to the participants, they followed different ways to find and select reviewers; however, most of them were ineffective because the publication venue management did not have access to the information about how researchers performed as reviewers. The publication venue management typically has to rely upon the list of publications a researcher has authored, which implicitly presumes that a qualified author is a competent reviewer. Thus, we learnt that decentralised and distributed technologies simultaneously served to address both issues, i.e., accumulating the reviewing accounts of researchers from across multiple research events, creating public profiles of reviewers, and establishing trust in those reviewing accounts to avoid fraudulent impostors reviewers.
We also learnt that blockchain technology could enable the publication venue management to incentivise their reviewing team transparently and justly. Some researchers aspire to have such incentives carry monetary value too.

We learnt that the use of decentralised and distributed technology could bring inherent transparency and trust. For example, the information of the reviewing accounts belongs to both reviewers and publication venue management, and decentralised and distributed technologies enable both of them to use this information independent of any centralised authority. Furthermore, the activities recorded on the blockchain are typically public and transparent, enabling anyone to observe and verify the authenticity of recorded information.
Chapter 6

Conclusions and Future Work

Peer review has been under discussion and criticism for a long time because of its decisive role in publishing research articles, and it may continue as long as it maintains its significant position in advancing academic research. Furthermore, different research activities and outcomes will also continue to address and impact many aspects of the reviewing process, such as introducing different processes to meet their requirements, publishing review texts and enabling public discourse. Publication venues may have reasons for adopting specific methods, and they may contradict other venues’ practices.

This thesis discussed some of the core issues of peer review. One of the critical issues this thesis investigated is the researchers’ efforts to review articles. We explored how researchers perceive these efforts, how these efforts translate into reviewing records, and how these reviewing records are collected and stored. We investigated how researchers and publication venue management trust these reviewing records. We also explored another vital issue of incentivising reviewers. Hence, the broad research objectives of this thesis were:
1. To explore the strategies for managing the reviewing records of researchers.

2. To investigate how researchers and research event management trust these reviewing records.

3. To investigate how reviewers are incentivised for their services.

4. To investigate how a technical infrastructure (based upon decentralised and distributed technologies) could impact reviewing records and incentivise reviewers.

These objectives lead us to investigate three broad research questions, defined in Section 1.3 as:

1. **RQ1: How do researchers perceive and practice the reviewing process?**

   For this research question, we designed a research study (reported in Chapter 3). We devised a methodology that enabled researchers to share their experiences and feedback to help improve specific areas of peer review. We investigated how researchers perceive peer-review, which impediments they encounter and how they take various approaches to address these issues. We also explored how researchers could aspire to see advancements in the reviewing process. To this end, we conducted semi-structured interviews with senior researchers who had participated in the reviewing process for journals, conferences and workshops in different roles. We analysed their following viewpoints.

   a) **What is a review?**

      We investigated how researchers observe the elements that constitute a review. How would the management of different publication venues perceive it? How do they know the level of effort a reviewer has put into producing a review? Which elements of information are required to assess these efforts?
Which elements of information are available to them, and which elements are missing? What methods and tools are used to keep a record of how reviewers have performed? How do researchers maintain their reviewing records? How does a publication venue management maintain these records of their reviewers?

b) Trust in the reviewing records
We investigated the importance of trust in the reviewing records of researchers. For example, how important is it for a researcher that everyone trusts their reviewing records? How important is it for the publication venue management to have trusted and authentic reviewing records of researchers? How does a publication venue management find and select reviewers? How can a venue management team trust their reviewing records? Are their reviewing records available to the publication venue management?

c) Acknowledgement of reviewing activity
Researchers participate in the reviewing activities of different publication venues. Do they get acknowledged for their reviewing job? Does academia recognise their reviewing activity? We investigated the viewpoints of researchers about recognition and acknowledgement of their reviewing activities. What are the different forms of recognition they get? How do different research communities acknowledge their reviewing team? What changes should they bring in to acknowledge the reviewing activities effectively?

d) Incentives
We investigated the aspects involved in incentivising reviewers. What are the main forms of incentives, according to researchers? How do publication venue management incentivise their reviewing team? What methods should research communities follow to incentivise reviewers? How would it impact academia if such incentives carry a monetary value?
e) Feedback to bring improvements

We also solicited feedback from researchers about any improvements they would aspire to bring to the issues mentioned above.

We compiled and analysed the results of this study in light of the expressed views of the participants about the issues mentioned above. We discovered the following.

a) No mechanism to evaluate the efforts of reviewers

We discovered the absence of a mechanism that evaluates the reviewer’s efforts to produce a review. We also discovered that according to researchers, they do not have enough information that could help them evaluate the level of effort of a reviewer. However, researchers involved in managing a publication venue may evaluate the level of effort using a few elements, including the length of a review, the comprehension level of a review, and how soon a reviewer submitted their review after they were allocated the article. We also discovered that researchers managing a publication venue may prefer to evaluate a review based on the following information elements.

i. The amount of time a reviewer has spent in producing a review.

ii. The degree of comprehensiveness of a review.

iii. The amount of constructive criticism and knowledge a review offers.

iv. The length of a review text.

b) Reviewing records are spread across multiple places

We analysed that the information about the reviewers and their reviewing activities is spread across several places. For example, the publication venue management maintains such records on conference management tools they use and websites of the publication venue. Furthermore, researchers may mention their reviewing activity on their CV and personal and professional
websites. Both publication venue management and researchers acknowledge the unavailability of an established mechanism that could help them identify the reviewing activities of researchers.

c) **Impact of accumulating reviewing records**

We analysed that the accumulation of the reviewing records of researchers from across multiple research events will positively impact academia. Such researcher records will help create public profiles displaying the reviewing history, impacting their academic careers, promotions and potential research grants. The accumulation of the reviewing accounts across multiple research events would also help the publication venue management find and select suitable reviewers with their established reviewing history.

d) **No mechanism to find and select reviewers**

We discovered the absence of a specific mechanism for the publication venue management to find and select reviewers for their research event. They usually invite researchers they already know or the reviewers who have participated in previous editions. While inviting unknown researchers to participate in the reviewing process, the publication venue management typically considers the list of their authored publications, assuming that a good author would be a good reviewer.

e) **Recognition and acknowledgement**

We analysed that reviewers usually do not get acknowledgement for their work apart from their names on the websites of research events. They consider peer-review as their moral commitment to further research and give it back to the research community.

f) **No mechanism to trust the reviewing records**

We discovered that there is no specific mechanism to establish trust in the reviewing accounts of researchers. Venue management teams typically do
not have any means to assess researchers’ capabilities to review the research work of others. The management struggles with both finding and trusting the reviewing records of researchers.

g) Impact of verified information

We concluded that the availability of the verified reviewing records of researchers will positively impact peer-review. The verified information will help the publication venue management find and select suitable reviewers and assign appropriate reviewers to research articles.

h) Incentives for reviewers

We analysed that introducing different incentives for reviewers will positively impact the reviewing process. Monetary and non-monetary incentives may increase the motivation to participate in peer-review and to produce higher quality reviews. The exchange of incentives between publication venues will help researchers explore diverse research communities.

i) Quality of a review

We analysed the absence of a standard model to assess the quality of a review. The understanding and interpretation of the quality of a review vary in research communities. Researchers have different viewpoints of the elements that should make up the quality of a review. Therefore, research communities should establish an outline to define the elements and criteria to evaluate the quality of a review.

2. RQ2: How could decentralised and distributed technologies support the provision of technical infrastructure to accumulate the reviewing accounts of researchers from across multiple publication venues, recognise reviewers’ efforts, and incentivise reviewers for their job?

The analysis of the results of RQ1 helped us identify areas to address, and we
proposed a framework. We also identified the design principles for the framework that included the ability to aggregate the reviewing records of researchers from across multiple publication venues, the ability to establish trust in these reviewing records and the ability to enable the publication management to incentivise reviewers transparently. Following these design principles, the framework outlines the technical infrastructure based upon decentralised and distributed technologies. The technical infrastructure includes three major components of the framework: Verification, Control and Data Storage, and User Interface. The verification component uses a blockchain and IPFS to make data immutable, transparent and lifelong. The usage of blockchain has been effective in addressing the issues identified in RQ1. The correlation of its effectiveness with the defined design principles is following.

a) **The accumulation of reviewing records**

We learnt that using the decentralised and distributed technologies for accumulating the reviewing records of researchers from across multiple publication venues address the shortcomings of centralised platforms available for peer review; for example, both researchers and publication venues may access and use their data for multiple purposes. Publication venues may use this data to analyse the performance of researchers involved in peer review. Researchers may use their data on their professional and personal web pages. The usage of decentralised technologies enables publication venues to use data of multiple researchers and to use data of multiple publication venues.

b) **Establishing trust**

We found that the decentralised and distributed technologies can help determine the veracity of the reviewing records of researchers. The immutability of the reviewing records ensures data integrity; therefore, anyone can trust
the credibility of this data. The fact that the reviewing data is lifelong, tamper-free and permanent brings the underlying evidence that the data came from the publication venue management, reducing the need to contact the management to ascertain data integrity.

c) Incentives

We discovered that the decentralised and distributed technologies enable publication venue management to incentivise their reviewers in monetary and non-monetary forms. The monetary aspect depends upon the monetary value each publication venue management gives to its cryptocurrency enabled by the framework. The non-monetary aspect includes the public profiles of researchers and reviewers and the ability to use their profiles (with their verifiable and immutable data) on their personal and professional web pages, leading to the public acknowledgement of the hard work of reviewers.

d) Transparency

Using decentralised and distributed technologies to register researchers’ reviewing records and incentivise reviewers in a transparent way address the opacity by centralised platforms used for peer-review. The framework enables data to be open and publicly accessible; therefore, open for scrutiny and verifiability at any point in time.

3. RQ3: To what extent does the technical infrastructure described above address and satisfy the concerns raised in the research question RQ1?

In Chapter 5, we evaluated the PeerMiles platform to address our research questions RQ2 and RQ3. We devised our evaluation method asking researchers to utilise the platform, followed by a short survey to record their opinions. From
this, we analysed and concluded that according to the input given by researchers (in the form of survey results), the PeerMiles platform provides the essential infrastructure to:

a) Accumulate the reviewing records of researchers from across multiple conferences

b) Establish trust in these records

c) Enable the verification of these records without the intervention of a third party (or contacting the venue management)

d) Enable venue management to incentivise their reviewing team with a spendable reward

6.1 Limitations

The research work reported in this thesis consists of two research studies, and one introduces a framework and its implementation. There was a considerable limitation in pursuing senior researchers to participate in the research studies. A few researchers did not respond to our request to participate, and a few were busy and could not find spare timeslots in their schedules. The severity of this limitation was increased when we approached researchers for the second research study to evaluate the platform. The PhD timeline was also limited; we have added a few directions and tasks in the future work. Because of the limitations we had while conducting the research studies, we plan to evaluate the next version of our tool using other methodologies, such as the think-aloud protocol.
6.2 Future work

This course of exploring and investigating peer review enabled us to identify different directions for further research. These directions may have their challenges and limitations; however, they offer a range of potential prospects for future research related to peer review. We discuss these possibilities in the following sections.

6.2.1 Recording of the reviewing credentials

In this thesis, we introduced an idea to record the reviewing records of researchers in a decentralised manner. A reviewing record consisted of these elements:

1. The name of the conference
2. The year the conference was held
3. The number of articles reviewed
4. The role a researcher participated as
5. The number of incentive tokens (ERC20) earned as reward

This record consisted of essential information elements. However, there is potential for further research on formulating and formalising reviewing records. Researchers may want other aspects of information to be included in a record—for example, the text of a review, the feedback from editors and the text of rebuttal from authors. Furthermore, a reviewing record may also vary with various peer review processes (for example, open and closed).
In our first research study (Chapter 3), we analysed that the participants discussed the quality of a review, and we observed that it does not have a precise standard definition. Therefore, introducing a widely accepted standard definition of the quality of a review would be a challenging research area.

### 6.2.2 Incentives

This thesis introduced a technical infrastructure that supports incentivising reviewers in a decentralised and transparent way. We used blockchain-based tokens to represent the currency for a conference. The exploration of the economic perspectives of such currencies is another challenge. For example, what impact would it bring to peer review? How could it be exploited? What would be the possible use-cases for using such currencies? How would a conference decide the monetary value of their currency? Would researchers be ready to accept and use them? Investigating these challenging aspects with an economic and financial lens would yield more and detailed insights.

### 6.2.3 Exchange of incentives

This research enables conferences to have their own crypto-currencies (blockchain-based ERC20 tokens). As the ecosystem grows and if more conferences were to start using a crypto-currency incentive model such as PeerMiles platform, a challenge of interoperability would arise in terms of using crypto-currencies. That suggests enabling Conference-A to accept the currency of Conference-B. A challenging research aspect would be determining a mechanism to allow a researcher to exchange crypto-currencies between multiple conferences. This exchange could also bring the economic factor that decides the value (price) of a crypto-currency against another currency. For example,
a researcher can exchange one token of one conference with two tokens of a second venue.

6.2.4 Comparative analysis of author and reviewer profiles of a researcher

We proposed a framework and developed a platform that enables researchers to have their own profiles as reviewers. These profiles list their reviewing records. As discussed in Chapter 2, multiple platforms build researchers’ profiles based on their authored articles. There is a potential challenge of analysing a researcher’s profile (as an author and reviewer). The investigation may analyse how a researcher performed as an author and reviewer over a certain period but what would be the criteria to analyse their performance? Which factors should be considered for this analysis? Therefore, there is a potential challenge in investigating researcher profiles for merit in different tasks. Another compelling challenge will be to investigate if a good author is a good reviewer and vice versa?

6.2.5 Use of Decentralised Personal Data Stores

Our framework enables the publication venue management to use identity management provided by Solid. However, the framework does not explore the space of using the storage facility provided by Solid. It would be challenging to use its storage (Solid pod) and store data in individual data pods of publication venues, as Solid also incorporates Access Control List (ACL - to allow or disallow any other user/application from accessing their data storage). We also intend to explore utilising decentralised personal data stores for individual researchers.
6.2.6 Towards complete decentralisation

Our framework, PERKS, is one of the many steps towards the complete decentralisation of the mechanism of managing the reviewing data of researchers. The framework enables users to use their ORCID and Solid accounts, and in future, Soild pods (individual storage spaces) can also be used to store researchers’ data. This feature will empower researchers and venue management teams with more control over their data. Our framework involves a component that keeps the data off-chain (in a database); it would be challenging to replace it with other decentralised storage solutions without compromising the high-level functioning of the framework. Blockchain is a new phenomenon that brings operational challenges to its novice users. The framework uses blockchain accounts, but it conceals them from its users to avoid additional complexity. It would be challenging to enable users to use their blockchain accounts directly with the framework and save them from the technical complexities.

Summary

In our journey of investigating peer review, we marked several aspects that research communities need to address; for example, we discovered in Chapter 3 that there is no mechanism established to know how a reviewer has performed. Furthermore, there is no standard review format that helps reviewers produce impactful reviews and helps the management analyse the performance of their reviewing team. Researchers who actively participate in the reviewing process are rarely acknowledged for their services to their fellow researchers and research communities. Reviewers should get acknowledged and incentivised for their hard work.
Research communities believe in the peer-reviewing process despite its shortcomings, which is why peer review is practised worldwide. However, with the improving and evolving policies, research communities should also leverage state of the art technologies to address the lacunae and deficiencies.
Bibliography


