7-8-2023

Governing Actor Networks in an Emerging Crowdsourcing Ecosystem

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Completed Research Paper

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Abstract

Organisations harness the wisdom of community to solve problems or create new knowledge. Multiple organisations, diverse communities and multiple platforms are forming ecosystems to co-create value. We observe that Libraries, Archives, Galleries and Museums are forming collaborative crowdsourcing ecosystems to curate knowledge and create knowledge that ecosystem-wide stakeholders can use. However, despite the collaborative nature of crowdsourcing, various tensions arise among actors that hinder effective outcomes. Through a qualitative case study, we identify crowdsourcing actor networks and explore their tensions that hinder effective outcomes. We propose a strategic governance approach to foster crowdsourcing-based collaboration in a complex and dynamic ecosystem to create and capture value. This study presents a shift in the traditional schema of structured hierarchical governance of crowdsourcing projects to unstructured non-hierarchical governance of a multi-actor crowdsourcing ecosystem. The value propositions of crowdsourcing ecosystem actors networks are value co-creation, resource sharing, collective ownership, and mutual dependency.

Keywords: crowdsourcing ecosystem, actor networks, strategic governance, knowledge curation, knowledge creation, value co-creation

Introduction

Cultural heritage information is the pride of any community and nation. The sources of cultural heritage information are stored in various artefacts scattered around the world in Galleries, Libraries, Archives and Museums (GLAM), educational institutions and private collections. These widespread pieces of information are required to be identified, organised and digitally available to create cultural heritage knowledge. However, GLAM organisations have limited resources to capture and curate cultural heritage sources. The major challenge GLAM organisations and individuals face is managing the collection and correlation of these pieces of information to create knowledge or help content creators create new knowledge. Therefore, they have started open collaborations with sister GLAM organisations, other not-for-profit entities, and with the community via crowdsourcing. Through crowdsourcing, knowledge curation is possible by filling information gaps, correcting wrong information and mapping the related information sources. It would be ideal when knowledge creators know about the right pieces of information. We recognized this newly formed crowdsourcing-based collaboration as a crowdsourcing ecosystem consisting of multiple organisations, platforms and multiple crowd communities that complete assigned tasks, but also extend the knowledge creation process by curating information at multiple outlets. Collectively, this process helps enrich the sources of information and helps create new knowledge.

However, problems can arise as these actors have different motivations, levels of collaboration, different internal and external processes, and capture value differently. The presence of multiple actors raises governance challenges for the crowdsourcing ecosystem and can affect outcomes. Therefore, it is essential to identify and address these challenges to ensure a self-sustaining crowdsourcing ecosystem capable of knowledge curation and creation. To ensure that a crowdsourcing ecosystem can be sustained and continue to add value, we suggest it is crucial to understand *How to govern actor networks in an emerging crowdsourcing ecosystem?* With good governance, an appropriate flow of information and collective understanding will enhance the collaborative planning and decision-making by actor networks allowing practitioners to manage the crowdsourcing ecosystem and meet stakeholder expectations effectively (Muthukannan et al., 2020).

We explore the existing crowdsourcing literature and found a few studies on the governance of standalone crowdsourcing projects including the crowd contributions and task management. However, there is a gap in the explanation of crowdsourcing theory from cross-organisational perspectives, its inferences, processes and impacts (Estellés-Arolas & González-Ladrón-De-Guevara, 2012; Estellés-Arolas, Navarro-Giner, & González-Ladrón-de-Guevara, 2015; Garrigos-Simon et al., 2015; Geiger et al., 2012, 2011; Schenk & Guittard, 2011; Zhao & Zhu, 2012b). Another gap in the IS research on crowdsourcing and digital ecosystems is the lack focus on the not-for-profit sector (Alam & Campbell, 2013; Alam & Campbell, 2012; Ellis, 2014; Holley, 2010; Roiu, 2012) as most of the crowdsourcing research has been on the business sector. These empirical gaps motivated this research. To understand the crowdsourcing ecosystem governance mechanisms, we first conducted a stakeholder analysis and identified the types, roles and characteristics of actor networks of a crowdsourcing ecosystem. Second, we explore the tensions between these actor networks that cause governance challenges. And finally, we proposed a governance framework for actor networks for a sustainable crowdsourcing ecosystem.

This paper is organised as follows. Following the introduction, we discuss the contextual background by explaining knowledge curation and creation expectations and challenges in the GLAM sector and the emergence of a crowdsourcing ecosystem. The second section discusses our theoretical framework, focusing on the ecosystem governance challenges and opportunities from digital and platform ecosystem perspectives. Then we discuss a crowdsourcing project's governance mechanisms and how it differs from a crowdsourcing ecosystem. In the third section, we discuss the case of crowdsourcing at the AWMM and our research methods. It is followed by findings and discussion about the revelation of crowdsourcing-based collaboration governance practices. Finally, we conclude our work by outlining our contributions and future research opportunities.

Transformational Crowdsourcing Practices

GLAM sector crowdsourcing

The Galleries, Libraries, Archives and Museums (GLAM) sector comprises public or semi-public knowledge and cultural heritage organisations that collect, organise, preserve, and disseminate knowledge and cultural assets of historical, national, and cultural value. The GLAM organisations' prime objective is to curate information to support the creation of historical, cultural, and literary knowledge. To achieve this objective, GLAM organisations spend millions of dollars collecting, preserving, curating, and exhibiting artefacts worth trillions of dollars. However, the information resources are dispersed across the globe in public and private collections. GLAM organisations cannot access all the required information due to various limitations, i.e., financial resources, declining humanities experts, cultural permissions, national policies, and insufficient human resources. To cope with this challenge, in recent years, the GLAM sector has initiated open collaboration with other organisations and community engagement via crowdsourcing practices.

The GLAM sector harnesses crowdsourcing for a) mapping the dispersed information resources; b) curating by completing information, correcting mistakes, and adding new resources; c) improving the speed and quantity of data processing; d) adding contextual quality to content by engaging local communities, and e) building knowledge-based global communities (Alam & Campbell, 2017; Deupi & Eckman, 2016). These organisations are leveraging the 'cognitive surplus' of their user base (Oomen & Aroyo, 2011) through crowdsourcing for tasks, such as translation, corrections, identification, transliteration, etc. (Alam & Campbell, 2013; Alam & Campbell, 2012; Ellis, 2014; Holley, 2010; Roiu, 2012). In this process, the GLAM

organisations and partnering bodies curate knowledge to create knowledge. Some notable GLAM crowdsourcing projects include the Smithsonian Transcription Center's crowdsourcing projects; *'TROVE'* by the National Library of Australia; *Beyond Words* by the National Library of Congress (USA), and *Digitalkoot* by the National Library of Finland.

Crowdsourcing ecosystem

Crowdsourcing practices are considerably growing in quantity and scope for both for-profit and not-for-profit and can be considered on the verge of changing how value creation and organisational coordination occur in organisations (Assis Neto & Santos, 2018; Blohm et al., 2018). We observe a transition in crowdsourcing practices from traditional liaison to collaborative crowdsourcing. In the traditional crowdsourcing setting, there are three actors: crowdsourcer (organisation or individual), crowdsource (crowd) and crowdsourcing intermediary (platform). We term this type of crowdsourcing as a *standalone crowdsourcing project* (figure 1). Existing crowdsourcing research is focused on crowd engagement, task management or platform governance for this type of project (Blohm et al., 2018; Kohler, 2018).

Figure 1. Transition of Crowdsourcing Practice

With the expansion of crowdsourcing practices, a paradigm shift is emerging as multiple stakeholders are forming a cross-organisational collaboration to expand the horizon of value creation. We term this type of practice as a *crowdsourcing ecosystem*. In the crowdsourcing ecosystem, various organisations, platforms and crowd communities collaborate to share their resources and skills to co-create value and consequently share crowd-created value to create knowledge. Many GLAM organisations are either creating cross-organisational crowdsourcing networks (e.g. multiple crowdsourcing projects by the Smithsonian Transcription Center) or joining existing crowdsourcing networks to share crowd work and extend value creation (e.g. the GLAM and Wikimedia initiative, also known as GLAM-Wiki), hence initiating crowdsourcing ecosystems. To our knowledge, there is no extant research on the crowdsourcing ecosystem. Hence, this paradigm shift calls for a new exploration of crowdsourcing practices. These new collaborations also bring challenges for the GLAM sector, including the nature of responsibilities, quality control and bias in user-created content, regulatory issues related to content exchange and ownership, authenticity, and incorporation of crowdsourced content into the knowledge lifecycle (Oomen & Aroyo, 2011). To benefit from collaborative crowdsourcing, it is important to identify the actor networks and their relations in a crowdsourcing ecosystem and govern these collaborations.

Theoretical Background

This section provides the theoretical background about the governance mechanisms of crowdsourcing activities. We used actor-network theory to illustrate the relationships of actants (a term used to capture the role of both human and nonhuman actors) within crowdsourcing-based collaborative networks and how they are created and sustained. There is no existing literature on the governance of the crowdsourcing ecosystems; therefore, we looked at the digital ecosystems governance and crowdsourcing platform governance literature streams to understand the actor-network governance challenges, opportunities and mechanisms.

In recent years, significant scholarship has been on the emergence, value co-creation and governance of different types of ecosystems in the IS field. These ecosystems are either digital or assisted by digital platforms. Some ecosystems discussed in the IS literature includes general business-focused ecosystems, service-focused ecosystems, platform-focused ecosystems and agility-focused ecosystems (Nischak et al., 2017); intra-organisational ecosystem, entrepreneurial ecosystem and product ecosystem (Wang, 2021) and digital ecosystems (Jacobides et al., 2018). The crowdsourcing ecosystem concept combines platform ecosystems and digital ecosystems (Hein et al., 2020); therefore, we focused on the explorations of digital platform ecosystem literature to understand its governance challenges. Jacobides (2019) and Jacobides, Cennamo and Gawer (2018) define *digital ecosystems as a technology-enabled community of individual,*

organisational, and networked entities contributing to a focal value proposition. These partnering firms in an ecosystem collaborate due to their complementarities, competition or coopetition.

A digital ecosystem as an open, adaptive, self-organising, not fully hierarchical controlled meta-organisation of multiple actors requires close coordination of the actors' activities by social-technical structures, such as governance mechanisms (Gulati et al., 2012; Jacobides et al., 2018). Digital ecosystem governance entails the management of complex, dynamic power relationships (Ofe & Sandberg, 2022). Therefore it is about decision rights, control and ownership (Tiwana et al., 2010), sharing responsibilities, accountability, inter-organisational configuration, distributed ownership of the resources, systems, and processes (Grant & Tan, 2013); value-sharing (Hein et al., 2020) as platforms ecosystems are not managed hierarchically by any single authority (Jacobides et al., 2018) but by various co-existing stakeholders. The research on dyadic governance suggests that partnering firms in an ecosystem can co-create additional value if they adopt the right governance practices (Sarker et al., 2012; Tiwana et al., 2010), and the selection of these governance mechanisms requires an understanding of the actor networks of a digital ecosystem.

Actor networks of digital ecosystems

The digital ecosystems involve multiple actor networks, including organisations, communities, government organisations, regulators, private sector entities, individuals and platforms that are digitally connected and enabled by modularity. The complex nature of digital ecosystem actor networks and their relationship make it difficult to govern the value co-creation process (Grant & Tan, 2013). Often, indirect, complex, and non-linear relationships among the actor networks affect the outcomes (Tsujimoto et al., 2018) and sustainability (Fedorenko et al., 2017) of a digital ecosystem. Understanding the inter-relationships between these has remained rather scarce (Grant & Tan, 2013; Ketonen-Oksi & Valkokari, 2019). We looked at the Actor-Network Theory (ANT) to understand 'heterogeneous actors' and analysis of the interaction, linkages, and influences between these actors (Almila, 2016) and the use of technology-oriented communications and infrastructure standards (Walsham, 1997) of the crowdsourcing ecosystem. ANT also helps unfold the translations, relationships, alignments and governance of heterogeneous actor networks (Montenegro & Bulgacov, 2014; Walsham, 1997). Networks require interaction, movement, and processes, i.e., the active participation of actors involved, decision-making (Montenegro & Bulgacov, 2014), role definitions and understanding of the actors' actions. It also involves how regulatory and political actors affect formal and informal rules and how actor networks cope and survive with these rules (Kjær, 2011). The existing crowdsourcing research used ANT for actor engagement, task guidance, user orientation, platform designs, and competition evaluations. In this study, we used ANT to govern actors in a cross-organisational crowdsourcing ecosystem.

Crowdsourcing governance

In recent years, a few studies have explored the governance of crowdsourcing platforms for quality assurance and successful outcomes (Zhen et al., 2021). These studies look at crowdsourcing as a one-off undertaking (Nevo & Kotlarsky, 2020) or have taken a micro-perspective to conceptualize tasks management (Zhen et al., 2021), crowd motivation (Alam & Campbell, 2017), platform management (Blohm et al., 2018; Gol et al., 2019; Malhotra & Majchrzak, 2014) and organisational motivations (Gol et al., 2019) from an organisation or platform perspective. However, the crowdsourcing practices are relatively mature, with long-term and interconnected initiatives taking place (Nevo & Kotlarsky, 2020). Yet, still, this progress has not been addressed in the current IS research.

One concern is governing activities in collaborative crowdsourcing for effective outcomes. The governance of the crowdsourcing initiatives aimed to keep control in multiple dimensions: crowdsourcing decision factors – task characteristics, people, management, and infrastructures (Qutab et al., 2023; Thuan et al., 2018); over their contents (Askay, 2017; Jain, 2010); on the crowd contributions (Allahbakhsh et al., 2013; Daniel et al., 2018; Gould et al., 2016; Hansen et al., 2013; Weld, 2015); on the outcomes; and administrative control including cost and internal staff (Li et al., 2017; Majchrzak & Malhotra, 2016). Loss of control causes delayed or failed projects (Fedorenko et al., 2017) and can jeopardise crowdsourcing practices' adoption, scalability and sustainability. Governance is defined as *the actions and policies employed to effectively manage the crowd and steer them toward the desired solution* (Pedersen et al., 2013, p-582). Although governance of crowdsourcing projects is described as significant for successful outcomes but stands as a challenge in practice and as a gap in empirical research (Blohm et al., 2018; Geiger

et al., 2011; Jain, 2010; Pedersen et al., 2013; Zogaj et al., 2015) even for the standalone crowdsourcing projects. One of the reasons for losing control over crowdsourcing practice is its ever-evolving nature, crowd diversity, dynamic process and variety of tasks. Therefore, governance is an essential aspect of successful crowdsourcing initiative but due to unconventional nature of crowdsourcing it is becomes difficult for the organisations to manage and share control, responsibilities and ownership among stakeholders. Moreover, the nature of a crowdsourcing ecosystem further the complexity of governance mechanisms.

Research Design

Case description

Auckland War Memorial Museum (AWMM), the first museum of New Zealand (NZ), was established in 1856. There are three major subject categories of AWMM's collections. 1) Documentary heritage, including pictures, manuscripts, archives, papers and plans, serials and newspapers. 2) Natural sciences collections include Botany, Entomology, Geology, Palaeontology, Land vertebrates, and Marine biology artefacts. 3) Human History and Applied Arts collections, including Archaeology, Taonga Māori, Pacific, World Ethnology and Social and War History. In 2015, the vision of AWMM was revisited by the administration to cope with the emerging attention competitor like theme parks and the digital entertainment industry. AWMM is set to explore digital transformation, expanding collaboration with peer organisations and engaging audiences for co-production through crowdsourcing (Clare, 2016, p. 6). This transition initiated the crowdsourcing journey of AWMM (table 2) with their first experimental initiative, *Online Cenotaph*, aimed to engage the local crowd to curate information about the WWI and WWII personnel from archival materials like personal diaries, letters, government records, photo collections. The timelines of two crowdsourcing projects, Online Cenotaph and Measuring the ANZAC (Australian and New Zealand Army Corps), correlated with the centennial commemoration of WWI and hence gained the global attention of crowds and organisations.

Data collection and analysis

We adopted a revelatory (Sarker et al., 2012) single case study approach (Eisenhardt, 1989) that allows exploring interesting phenomena through an in-depth analysis of unusual, exemplary, novel cases (Eisenhardt & Graebner, 2007). To explore the transition in the crowdsourcing practices, we selected the AWMM, and its national and international crowdsourcing-based collaborating organisations. To understand the trajectory of crowdsourcing practices, processes, learnings, pitfalls, and successes, we captured longitudinal data covering a period of 15 months from 2019 to 2022 in two phases. AWMM had four concurrent crowdsourcing projects in 2019. We continued observing the evolution of crowdsourcing practices in the next eight months at AWMM as it grew to nine independent and interconnected projects with other GLAM sector organisations and other not-for-profit entities (table 2). In the first phase, we interviewed AWMM's crowdsourcing and partnership managers, who directed us to crowdsourcing partners from multiple organisations, crowdsourcing platforms and prime crowd contributors. We collected data through semi-structured interviews with 19 individuals, each lasting 60-75 min (table 1).

In addition to interviews, we collected archival data: marketing materials – blog entries, online forums, recorded conference talks, and published articles to understand the crowdsourcing projects' lifespan, roles of stakeholders, interconnectivity patterns and progress. With this data, we could identify the emergence of the crowdsourcing ecosystem, its actor networks, and their roles (figure 2). In the second phase, we re-interview 11 interviewees to reaffirm our findings and further explore the crowdsourcing ecosystem's governance mechanisms. All the interviews were recorded and professionally transcribed. Subsequently, the transcripts were assessed using the NVivo 12 software and by conducting two coding cycles (Saldaña, 2009). The perspectives of multi-actor collaboration governance guided our data analysis at the emergence stage of digital and platform ecosystems. This perspective guided us on coding, paraphrasing, and a higher abstraction of emerging themes to find answers to our research question (Klein & Myers, 1999; Langley, 1999; Walsham, 2006). We used ANT to identify the actors and describe their roles (Figure 1), the interactions and tensions between the actor networks (Table 3) and analysis governance mechanisms sustain the crowdsourcing ecosystem (Table 4). Informed by the ANT, we were able to gain insights into the

complex interplay between actors, formation of networks their relationships, and the factors that shape the crowdsourcing ecosystem's dynamics.

Sources	Description	Objectives
Interviews	30 interviews with project managers and organisers from AWMM, collaborating organisations, and crowd representatives.	To unfold the actors, tensions and governance mechanism for effective crowdsourcing outcomes.
Observations	Observation of nine crowdsourcing projects online activity and progress.	To understand the evolution of the crowdsourcing practices.
Archival data	150 files of archival data, recorded talks and presentations, marketing materials – blog entries, published articles and reports in both hard copy and soft copy from various sources.	
Table 1. Data Sources		

Formation of networks

This recognition led AWMM to expand crowdsourcing-based collaborations. It also impacted the scope and value prepositions of these collaborations. There are two core value propositions of AWMM's crowdsourcing ecosystem – 1). knowledge curation, and 2). knowledge creation. Knowledge curation and knowledge creation are interconnected processes essential for developing cultural and heritage knowledge. Knowledge curation involves collecting, organising, and managing information to make it accessible and usable. In contrast, knowledge creation involves generating new knowledge by adding to existing knowledge or creating new knowledge. Knowledge creation is impossible without curated knowledge, which often includes looking back at missing or wrong pieces of information. Some of AWMM's crowdsourcing projects intend to curate knowledge by bringing multiple stakeholders and crowd communities together to fill the information gaps. For example, in the Online Cenotaph, Cenotaph Memorials and Bionomia Project (Table 2), crowd was invited to curate knowledge by identifying, transcribing, tagging, matching, and making edits. The Wikimedia collaboration project was initiated by two Wikimedian-in-Residence (WiR) at the AWMM. They conducted a wide range of activities, including identifying and preparing data for Wikimedia foundation platforms (Wikicommons, Wikidata, Wikipedia), training AWMM staff, arranging collaborative crowdsourcing activities, i.e. edit-a-thon (target-oriented sessions for editing Wikipedia pages), monthly meetups and hosting Wiki-GLAM conference by AWMM in 2021 (Dickison, 2020). These activities helped AWMM to form a network of collaborating organisations, editors, and expert volunteers in New Zealand and globally. Collectively, they curated knowledge about WWI and WWII fallen heroes and veterans, flora and fauna of New Zealand, and the cultural heritage history of indigenous communities of Māori and Pacific origin. The curated information is used to create knowledge by AWMM staff, researchers affiliated with AWMM, international higher education institutions, government agencies, other GLAM organisations and volunteer content creators at open-access knowledge platforms like Wikipedia. The value propositions attached to AWMM's CS projects indicate the significance of forming interdepend networks to share resources and co-create.

Findings

In the finding section, we identified and explained the crowdsourcing ecosystem actors (figure 2), discussed the actor-network tensions (table 3) and then outlined a governance framework for the crowdsourcing ecosystem (table 4).

Actor Networks of Crowdsourcing Ecosystem

The traditional crowdsourcing project consists of three actors - crowdsourcer (organisation or individual), crowdsource (crowd) and crowdsourcing intermediary (platform). But a crowdsourcing ecosystem has

multiple actors, including various organisations, groups and individuals who collaborate to co-create value. The actors of an ecosystem have different attributions and behavioural principles and connect through various relationships: visible and/or invisible resource flows, contracts, trust, and vision sharing (Tsujimoto et al., 2018). An insufficient understanding of actors and their relations constrains the capacity of an ecosystem (Jacobides et al., 2018). Therefore, it is essential to consider who these actors are and what roles they play in an ecosystem. Our research on the GLAM sector crowdsourcing ecosystem helped us identify seven actor networks (figure 2) content owners, capital providers, platform providers, regulators, content aggregators, content creators, and content consumers.

Value propositions	Crowdsourcing projects, timeline and status	Crowdsourcing tasks	Description of activities
Knowledge curation	Online Cenotaph (Since 2015) – *ongoing*	Identification, transcription, explanation	AWMM initiated the first crowdsourcing activity by using an internal platform and attracting the local crowd.
Knowledge curation leading to knowledge creation	Measuring the ANZAC (Since 2015) – *ongoing*	Transcription	An international team of researchers acquired data from AWMM and used Zooniverse (platform) and community to enrich ANZAC military data for historical, health and genealogical research.
Knowledge curation leading to knowledge creation	Wikimedian-in-Residence (WiR) (2017, 2018) – completed	Preparing data, wiki edits	Identifying and preparing data for Wikimedia foundation platforms, training staff, arranging crowd activities
Knowledge curation and knowledge creation	Cenotaph Memorials (2020) – *completed*	Identification, transcription, explanation	AWMM used Zooniverse (an external platform) used (platform)and community connection to
Knowledge curation and knowledge creation	Online Cenotaph and Archives New Zealand collaboration (2020) – *completed*	Identification, transcription, explanation	AWMM continues expanding their crowdsourcing activity by using an internal platform and inviting expert crowds for target-oriented projects.
Knowledge curation leading to knowledge creation	Wikimedia common's image tagging (since 2020) – *ongoing*	Image tagging	Uploading images to wiki commons, creating and correcting the metadata for provenance and quality content for Wikipedia articles.
Knowledge curation	Bionomia Project (Since 2020) – *ongoing*	Data matching	Collaboration with Global Biodiversity Information Facility (GBIF) to provide biodata about New Zealand to the international community.
Knowledge curation leading to knowledge creation	ISA tool (2021) – *ongoing*	Image tagging	Collaboration with Investigation Study Assay (ISA) to provide a detailed description of the Life Sciences experimental metadata so that the resulting data and discoveries are reproducible and reusable.
Knowledge curation leading to knowledge creation	From the Page (since 2022) – ongoing	Transcription	AWMM uploads resources to be transcribed by the global crowd communities, and this is to be used for Biodiversity Heritage Library
Table 2. Crowdsourcing projects timeline, descriptions and core values at AWMM			

Content owners are organisations, individuals or communities that own the content or intellectual rights over content. IS scholarship deliberate particular focus on content owners and dubbed them as lead actors who set ecosystem-level goals (Jacobides et al., 2018). The content owners initiate a crowdsourcing project or crowdsourcing base collaboration with other actors. They prepare data to share on the crowdsourcing platform and with content aggregators. Content owners sometimes directly engage with the crowd to manage crowdsourcing activities and sometimes indirectly contribute to co-occurring crowdsourcing projects.

Content Owners	Capital Providers	Platform Providers	Regulators	Content Aggregator	Content Creators	Content Consumers
Roles: Crowdsourcing call, information sharing, data preparation, capturing value	**Roles:** Investors	**Roles:** Mediators or intermediaries	**Roles:** Regulators	**Roles:** Information and resource exchange	**Roles:** Knowledge curation, knowledge creation	**Roles:** Knowledge curation, knowledge creation, capturing value
Description: Orgnistaions or individuals who own the contents and engage crowd to work on these contents.	**Description:** Investors, funders and venture capitalists supporting the crowdsourcing activities.	**Description:** Crowdsourcing platforms, social media platforms or organisational websites	**Description:** Actors who provide regulation-related advices and services.	**Description:** Organisations that help distribution of contents among other contributors.	**Description:** Users, who create and add contents in response of an open call for crowdsourcing.	**Description:** Users who use the digital content on primary, secondary and tertiary sources.
Examples: AWMM, Archive New Zealand, NZ Defence Forces, National Library of New Zealand and Auckland Council	**Examples:** Government agencies, AWMM, Wikimedia Foundation (Wikipedia & History), Lotteries Grants Board (cenotaph & BHL)	**Examples:** AWMM website, Zooniverse, Wikimedia, Wikicommons, Wikidata, ISA Tool, Bionomia Project	**Examples:** Intellectual Property Organisation (IPO); Copyright Act; Creative Commons, Open GLAM	**Examples:** The Internet Archives, DigitalNZ, Pinterest, Europeana, Digital Pacific, Wikidata, Sketchfab, Wikicommons, Flicker, Biodiversity Heritage Library (BHL), Global Biodiversity Information Facility (GBIF)	**Examples:** General public, citizen scientist, War veterans' families, Wikipedian-in-residence, wikipedians, researchers, museum volunteers, visitor hosts, AWMM staff	**Examples:** General public, citizen scientist, War veterans' families, Wikidata, History teachers, Sketchfab researchers, museum volunteers, visitor hosts, AWMM staff, NZ War Graves Trust, Ancestry, FamNet

Figure 2. Roles and descriptions of the actors in AWMM's crowdsourcing ecosystem

The second type of actors is capital providers who fund the activities of crowdsourcing. The third actors are platform or platform providers acting as crowdsource mediators. The platform plays a vital role in crowdsourcing as the structure of a platform impact the nature of crowdsourcing and outcomes and facilitates the governance of actor networks (Jacobides et al., 2018). The fourth types of actors are government-linked associations to regulate the crowdsourcing collaboration and value exchange. The fifth type of actors in the crowdsourcing ecosystem is content aggregators, who receive data from content owners and distribute it to crowdsourcing platforms, other organisations, or crowds for crowdsourcing purposes. The sixth type of actor is the content creator crowd that does crowdsourcing tasks. These creators can be internal or external crowd members. The last type of actors is content consumers who consume crowdsourced value and regenerate new value. There is a thin line between content creators and consumers because creators often decompose the information to create content on another platform. In the case of AWMM's crowdsourcing ecosystem, some elite content creators curate knowledge at one crowdsourcing platform (i.e. Wikidata, Wikimedia, ISA tool, etc.) and create knowledge at another platform (i.e. Wikipedia, iNaturalist etc.). These actors together create a flow of value creation process for knowledge curation and knowledge creation that is impossible to achieve from a standalone crowdsourcing project (Adner, 2006).

Tensions of Actor Networks

Various tensions may arise among the actor networks of an ecosystem. One of the main tensions in GLAM crowdsourcing is the loss of control over their contents (Askay, 2017; Jain, 2010) and the crowd contributions (Allahbakhsh et al., 2013; Bonabeau, 2009; Daniel et al., 2018; Fleurbaay & Eveleigh, 2012; Gould et al., 2016; Hansen et al., 2013; Weld, 2015). Existing IS literature on ecosystem research indicates a few prominent tensions among the actors. Warehem et al. (2014) identified three salient tensions that characterise the digital ecosystem: standard-variety, control-autonomy, and collective-individual. Schreieck et al. (2022) discussed that companies face four IT governance tensions: rigidity, alteration, mistrust, and competition in innovation ecosystems. Huber et al. (2017) discussed the merits of standardization, ecosystem-wide rules and values to handle tensions.

The GLAM sector collaborates for knowledge curation and knowledge creation, yet various tensions arise related to control and underlying processes of resource exchange. Our respondent identifies some limitations and constraints that cause tensions among actors and impact expected outcomes. These tensions are mistrust, goals misalignment, resource constraints, content ownership, standardization and communication and coordination and quality control (table 3).

Tensions	Descriptions	Related quotes
Mistrust	The content owning organisations find it challenging to share their unique resources with others due to misuse and misinterpretation of resources.	"We have to go through cultural permissions to share content on a third-party platform. We started to sort it out but had to drop it as we could not get required permissions. The last thing we need is creating a cultural conflict". *(Crowdsourcing manager)*
Goals misalignment	Differences in the actor-network goals or priorities can create tensions and disagreement on allocating resources or pursuing specific outcomes from collaboration.	"Not all GLAM organisations understand the spirit of open GLAM and open access. I mean, they understand it by definition but are unwilling to open their collections. Sometimes it is due to organisational policies and cultural and ethnic issues. We have worked hard to win their trust, and we did it by showing the impact of open sharing". *(GLAM-Wiki manager)*
Resource constraints	The resource constraints limit the participating organisations. These constraints may include funding, human resources, expertise, and digital transformation.	"Some GLAM organisations are willing to participate but require technical and financial support. We supported some organisations with technical knowledge like training, digitization, Wikimedian-in-Residence (WiR), guidelines to prepare data for Wikicommons and Wikidata and sometimes also provide funds". *(GLAM-Wiki manager)*
Content Ownership	To preserve the provenance of the contents shared with other ecosystem participants and to share the ownership of co-created value.	"[...] you understand that sharing our contents on an external platform will lower online traffic to our website. We need to show we are receiving attention to holdings". *(Crowdsourcing manager)*
Standardization and interoperability	The inability to understand and apply the same IT rules creates standardization tension.	"[...] among the GLAM organisations, libraries have better-standardised metadata, but museums and archives have different metadata schemes. I mean, if they create metadata on our platforms, it can help but imagine how many resources will be required?" *(GLAM-Wiki manager)* "[...] dealing with an organisation who perceived the creative commons cc by rules differently than our understanding is a challenge" *(GLAM-Wiki manager)*
Communication and coordination	Inactive and ambiguous communication can create coordination tension in the actor networks.	"The crowdsourcing partnerships started with personal communication between managers. We need dedicated staff to keep it going". *(Collaboration manager)*
Quality control	Differences in expectations around the quality of outcomes can create tensions within actor networks.	"We wanted to see the quality of crowdsourced content, and when we receive it, we need to fix it before adding it to our collection". *(Crowdsourcing manager)*
Table 3. Tensions in the GLAM sector crowdsourcing ecosystem		

The first tension is *mistrust,* where the GLAM organisations are constrained by fear of losing control over their unique contents. Losing control is associated with misuse and misinterpretation of resources,

especially in cultural permissions, contextual knowledge and isolated information from the collection. There was a crowdsourcing project initiated in 2019 by AWMM and GLAM-Wiki. But, it was suspended due to the challenges of acquiring cultural permissions of indigenous collections from Māori and Pacific communities. The second tension is *goals misalignment* of different priorities leading to disagreement on the allocation of resources, pursuing specific outcomes or urgency of project completion by ecosystem actors. This disagreement also affects the volunteer crowd engagement as they may lose interest in the project.

The third tension is *resource constraints* faced by different crowdsourcing ecosystem actors. All the actors do not have the same resources, expertise, human resources and IT infrastructure, i.e. digital transformation. The fourth tension is associated with *content ownership*. After sharing resources to open access platforms, GLAM organisations lose control over their contents, usage, and provenance information after sharing resources to open access platforms. Although, in some cases, the provenance is maintained at the first level of sharing. For example, AWMM shared images at Wikimedia or Flickr with ownership information, but when someone reshares these images on other platforms, they may lose provenance-related metadata. Another example is that individuals reshare open access data on external platforms and pay less attention to correcting metadata, impacting provenance, quality control and acknowledgement to content owners. Another aspect of content ownership relates to the crowdsourced value's proprietorship. The new crowdsourced content may be created without informing content owing organisation, and it becomes impossible to trace extended knowledge creation.

The fifth tension is the lack of *standardisation* of rules and IT processes. The participating actors need to understand the rules of exchange, ownership and distribution to ensure fair use of information. The IT standardization includes metadata schemas, digitisation standards, and IT processes to ensure interoperability. The sixth tension is about poor *coordination and communication*. The actor networks must maintain active and meaningful communication to sustain coordination. The last tension is *quality control*. Another challenge and fear our respondents mentioned is quality control over the crowdsourced content. The meaning of quality may vary for the different actors, so incorporating new crowdsourced contents into existing data becomes challenging and creates tension for the participants. Some of these tensions faced by crowdsourcing ecosystem actors are related to organisational culture, and some are related to a lack of IT infrastructure and resources. By identifying these tensions, we can propose a governance framework for actor networks of the crowdsourcing ecosystem.

Governance framework

Despite the perceived benefits of crowdsourcing, it brings significant challenges to control and sustainability. The tension between co-created value and governance is interlinked (Huber et al., 2017) in an ecosystem. Existing crowdsourcing literature provides some guidelines for standalone crowdsourcing projects. Pedersen et al. (2013) developed a conceptual model for crowdsourcing from the problem perspective, consisting of six components: problem, people, process, technology, governance and outcomes. Love & Hirschheim (2017) constructed a process model for crowdsourcing grounded in an input and output format with four main organisational components: people, tasks, technology and structure. Blohm et al. (2018) identified 21 governance mechanisms from a task perspective under six categories for crowdsourcing. These include task definition, task allocation, quality assurance, incentives, qualification and regulation. Jain (2010) investigated the governance mechanism in crowdsourcing initiatives under the light of governance challenges: effective incentive mechanisms; managing submissions; loss of control; quality of the ideas, and creating trust. She proposed a framework of governance mechanism consisting of five dimensions: leadership, structure, social and relational. Alam & Campbell (2013) studied crowdsourcing IT governance from an organisational perspective and discussed structure, process and relational mechanisms among crowd and organisation. Although governance of crowdsourcing projects is described as significant for successful outcomes but stands as a challenge in practice and as a gap in empirical research (Blohm et al., 2018; Geiger et al., 2011; Jain, 2010; Pedersen et al., 2013; Zogaj et al., 2015). Our study explores a novel perspective of crowdsourcing ecosystem governance that is not discussed in existing crowdsourcing literature. Contemplating the existing literature and research findings from AWMM's crowdsourcing practices, we identified the governance roles of actors in crowdsourcing ecosystem (table 4) as stakeholder management, project management, crowd management, regulations and quality assurance.

The first governance mechanisms are about *stakeholder management* in a crowdsourcing ecosystem. The respondents believed that collaborators need to be clear about their underlaying vision for collaboration and should unify their goals before starting the collaboration. Unified values and goals lead to agreement on roles in an ecosystem. Actors either define their roles (actor networks of content owners, platform, capital, and regulators) or are being made aware of their roles (content creators, content aggregators and content consumers). Hence, they can take responsibility for different activities and regularly evaluate their contributions and gains from collaboration.

Governance \ Actors	Content owners	Platform providers	Content creators	Content consumers	Content aggregator	Regulators	Capital providers
Stakeholder Management							
Unifying vision and goals	●	●			●		●
Agreeing to roles	●	●	●	●	●	●	●
Defining values and standards	●	●	±	±	●	±	●
Resource exchange	●	●	●	±	●	●	●
Interoperability	●	●			●	±	
Coordination	●	●	●	●	●	±	
Evaluation	●	●			●	●	●
Project Management							
Decision-making	●	●	±	±	●	●	●
Cost management	●	●					●
Job design: Content creation workflows	●	●			●		
Communication	●	●	●	●	●	●	●
Create due processes	●	●			●	●	
Platform management	●	●			●		
Content optimization	●	●	●	●	●	●	
Data management	●	●			●	●	
Crowd Management							
Induction	●	●			●	●	
Training and mentoring	●	●				●	
Retention	●	●			●	●	
Regulations							
Open sharing	●	●			●	●	±
Cultural permissions	●	●			●	●	±
Fair use of information	●	●	●	●	●	●	±
Intellectual property	●	●	±	±	●	●	●
Ethical implications	●	●	●	●	●	●	±
Quality Control							
Quality standards and guidelines	●	●	●	●	●	●	
Transparency	●	●			●	●	●
Self-moderation	●	●	●	●	●	●	●
Monitoring	●	●			●	●	±
Table 4. Governance mechanisms for the crowdsourcing ecosystem actors							

●*direct impact,* ±*partial or in-direct impact*

The second set of governance mechanisms are related to *project management* which consists of activities and tensions related to managing a crowdsourcing project within a crowdsourcing ecosystem. The project lead organisations need to make decision-making to create due processes of crowdsourcing task planning, task allocation, communication channels and frequency, coordination roles and cost management. The platform-related management includes data management and content optimization for crowdsourcing.
The third set of governance mechanisms are related to *crowd management* to leverage the crowd's wisdom for value-cocreation. There are two types of crowds: internal (organisational staff) and external (Stieger et

al., 2012; Zuchowski et al., 2016). Internal crowds - staff development is crucial for becoming lead actors in an ecosystem for successfully completing a crowdsourcing project and sustaining multi-actor collaboration. AWMM's GLAM-Wiki partnership was started with Wikimedian-in-Residence (WiR) program (table 1). Two residents spent eight months assisting AWMM's staff in planning and managing projects on different Wiki platforms during 2018 and 2019. The external crowd consists of diverse (skill sets, cultural backgrounds, work habits and objectives) and dispersed workforce; therefore, skill development is rather challenging. In the GLAM sector crowdsourcing ecosystem context, the external crowd is a mix of experts and amateur non-contracted volunteers that is difficult to attract and retain. Our respondents suggested a set of mechanisms for crowd management, e.g., detailed and precise information about the goals of the crowdsourcing project, achievable project timeline, clear expectations from the crowd, and easy training tutorials. They also suggested that active communication with the crowd is key to retaining their contributions; therefore, consistent feedback, acknowledgements, symbolic rewards and sharing of the project's success is recommended. Content creator interviewees praised active communication by the project coordinator, which kept them motivated and encouraged them to continue their participation.

The fourth governance mechanism is related to *regulation*. Managing multi-actor networks and building mutual trust between organisations and crowd requires clear identification of terms and conditions, rights, and limitations. Regulations help organisations and crowds to understand their roles, rights and responsibilities in crowdsourcing activity (Love & Hirschheim, 2017). The volunteer crowd is not contracted and not protected by employment regulations. Therefore, a fair and balanced approach to managing intellectual property is important (De Beer et al., 2017; Karachiwalla & Pinkow, 2021). In the GLAM sector crowdsourcing ecosystem context, various legal tensions arise (table 3) concerning the nature of open information exchange, cultural permissions, copyrights and provenance. AWMM' adopted an *'open by default'* policy and offers common licensing 'Creative Commons 4.0 license' (Dickison, 2020) to provide open access to their contents. However, using these resources is subject to acknowledging content ownership and fair use of information, e.g. for research, study, personal and educational use only. AWMM holds various cultural objects under cultural permissions and has certain conditions on reuse independent o of copyright considerations (Dickison, 2020). Another aspect of the regulations relates to intellectual property on the crowd-created content in a crowdsourcing ecosystem. The collaborating organisations and platforms must co-own the new content, which should be discussed upfront. The last aspect of regulation is related to ethical implications. Wikimedia Foundation, Zooniverse and AWMM devised detailed information about the netiquettes and online conduct for the crowd contributors and the consequences of incompliance.

The fifth governance mechanism is related to *quality assurance*. Quality control encompasses various aspects depending on the type of crowdsourcing tasks (simple or complex), crowd type (amateur or expert) and the subject of the content. The GLAM sector is significantly sensitive to the quality of crowdsourced content due to cultural and historical knowledge implications. Wrong or weak crowd contributions can cause information disorder [anonymous]. The respondents suggested mechanisms to ensure quality assurance: creating and communicating quality standards and guidelines, transparency, monitoring and self-regulation. Clear guidelines and standards for accepting crowdsourced content help monitor the project, and communicating these outcomes increase transparency. Our respondents also reinforce the importance of the self-moderation nature of crowdsourcing. For example, the community corrected the mistakes made by individuals on Wikipedia and Online Cenotaph. They also suggested smaller crowds may have higher bias and chances of information disorder, while the self-moderation is possible in the presence of a large, diverse and active crowd.

Discussion

Forming a crowdsourcing ecosystem in galleries, archives, museums, and libraries (GLAM) sector is important to sustain cultural and historical knowledge curation and creation in the competitive age of AI created contents and growing information disorder (Qutab et al., 2019; Wardle & Derakhshan, 2017).The GLAM organisations face various challenges hindering knowledge curation. To cope with these challenges, the GLAM sector started using crowdsourcing as one of the potential solutions. We observe a transition in existing crowdsourcing practices where one organisation use a digital platform and crowd to solve problems into the emergence of a multi-actor crowdsourcing ecosystem for value co-creation. This ecosystem maximises GLAM sector opportunities to curate and create knowledge by resource sharing and co-surviving

but has a complex and dynamic nature. Our study is an effort to initiate a discussion on the governance of a crowdsourcing ecosystem to gain expected outcomes.

The crowdsourcing ecosystem combines digital and platform ecosystems, where a central platform or an organisation achieve some degree of autonomy to governance the processes. However, the crowdsourcing ecosystem is more complex and dynamic than a single-platform ecosystem (De Reuver et al., 2018; Selander et al., 2013; Tan et al., 2020; Tiwana, 2015). In a crowdsourcing ecosystem, all participating actors co-share responsibilities and are expected to exchange crowdsourced value. Therefore, the known contingencies of the digital ecosystem and platform ecosystem governance mechanisms are valuable but require considerable expansion to fit the nature of a crowdsourcing ecosystem. We tried to address this challenge and initiate a discussion on this new form of crowdsourcing by asking how to govern actor networks in an emerging crowdsourcing ecosystem. We identified and explained the actor networks of a crowdsourcing ecosystem, explored their tensions and proposed a governance framework to cope with these tensions for a sustainable ecosystem. The seven actor networks of a crowdsourcing ecosystem are driven by mutual dependency on knowledge curation and knowledge creation but are hindered by various tensions. These tensions include mistrust, goals misalignment, resource constraints, content ownership, standardization and communication and coordination and quality control. To address these tensions, crowdsourcing ecosystem actors require to work on their networks through strategic governance. We proposed a governance framework comprising five sub-categories to manage actor network relations and crowdsourcing project management to ensure value curation. The stakeholder relations are driven by mutual agreement on active coordination by resource sharing and open access, and they need to devise strategic governance processes, standards and regulations. Through this framework, organisations can make strategic decisions by envisioning future collaborations. The strategic governance refers to the principles, frameworks, and processes that guide decision-making, coordination, and management of the crowdsourcing ecosystem. We proposed a set of governance mechanisms including shared vision and goals, sharing responsibilities through mutual understanding and project management strategies and regulations and evaluation. Another important empirical contribution of this study is differentiating the traditional schema of structured hierarchical governance in standalone crowdsourcing projects from the unstructured non-hierarchical governance of a multi-actor ecosystem. The dynamics of decision-making, authority, coordination, and adaptability are different for crowdsourcing ecosystem and require further exploration.

Our study also implies that crowdsourcing ecosystem governance is based on an open, adaptive, self-organising, non-hierarchical relation of actor networks. Actors gradually grow their trust in each other by unifying their vision and resources to co-create value propositions. However, various tensions that required a collaborative governance model hindered forming and sustaining of trust in collaboration. This collaborative governance model consists of two folds of mechanisms, one for actor networks and one for crowdsourcing activities.

Implications

This study contributes to both the crowdsourcing theory and practice. Crowdsourcing is an emerging phenomenon with widespread applications, yet it faces challenges of lacking comprehensive process models. This study expands the empirical research by developing an integrated strategic framework for the crowdsourcing ecosystem. It extends the existing crowdsourcing and digital ecosystems research by identifying an emerging crowdsourcing ecosystem and its underlying governance processes. The crowdsourcing ecosystem governance is far more complex than the governance of a standalone crowdsourcing project and, therefore, requires a new discussion in the IS literature.

The results of this study are presumed to be beneficial for the stakeholders, i.e. strategic planners, leaders, project managers, marketers, crowdsourcing platform developers etc., involved in cultural and heritage knowledge curation and creation. An ecosystem perspectives can help foster a more robust and sustainable approach to crowdsourcing governance, benefiting both practitioners and the overall ecosystem dynamics. The GLAM managers can better understand the nature of collaboration and relations of actor networks from the examples of the AWMM crowdsourcing ecosystem. They can make informed decisions to join an existing crowdsourcing ecosystem or to form a new one. Moreover, they can minimise their tensions and achieve expected outcomes. A sustainable crowdsourcing ecosystem can assist in knowledge curation and knowledge creation goals of the GLAM sector.

Although this particular research focuses on the Galleries, Libraries, Archives and Museums (GLAM) and Academic institutions and Records, the not-for-profit sector is much broader. Academic institutions and health and social services organisations are also part of the not-for-profit sector and are collaboratively forming digital or service ecosystems. We hope that the outcomes of this research will have practical implications for these sectors.

Limitations and future research

There are a few notable limitations of this study that we will explore in future research. The first limitation is that in this study we focus on only identification and explanation of the actor networks of the crowdsourcing ecosystem. The future research may include the analysis of these networks and their relationships to better understand the governance mechanisms. The second limitation is that we focused on the formation of the actor networks but does not include the factors that contribute to the formation of these networks. The multi-actor network governance is a dynamic process shaped by institutional forces, human agency and digital transformation (Grant & Tan, 2013). Various other factors, e.g. organisational types, nature and characteristics of crowdsourcing tasks, types and levels of the crowd expertise, systems and routines, can influence the dynamics of the governing crowdsourcing ecosystem. Future research could explore the differences between actor network tensions and governance mechanisms at a crowdsourcing ecosystem's formation and sustaining stages. It would be interesting to explore how these mechanisms can affect value creation, capturing and exchange in a crowdsourcing ecosystem. Another limitation is related to methodological approach. We conducted this single case study in the not-for-profit sector and in a specific setting of the GLAM sector. There is a scope for exploring the differences in crowdsourcing ecosystem implications between the not-for-profit and for-profit sectors.

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