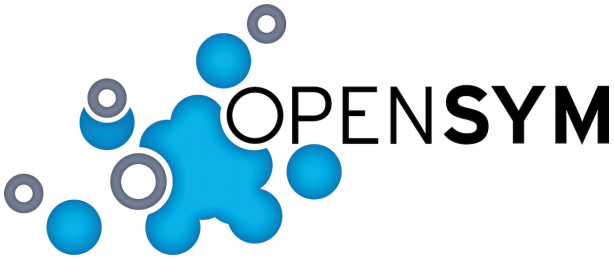
Companion Volume to the Proceedings of the 17th International Symposium on Open Collaboration



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Foreword

Welcome to the companion to the proceedings of OpenSym 2021, the 17th International Symposium on Open Collaboration! The companion comprises two main categories of contribution to the conference:

- Abstracts from the doctoral symposium
- Extended abstracts from experience reports

We thank the speakers for their contribution to the success of OpenSym!

We would like to thank the experts that will participate in the Doctoral Consortium: Lorraine Morgan (NUI Galway, Ireland), Chintan Amrit (University of Amsterdam, The Netherlands) and Matthijs den Besten (Montpellier Business School, France)

We would also like to thank our financial sponsors, the Universidad Rey Juan Carlos, our ACM in-cooperation partners SIGWEB and SIGSOFT, and the supporter of OpenSym, The John Ernest Foundation. Without their support and sponsorship, OpenSym 2021 would not have been possible!

We hope that you will enjoy the work presented here and that it provides you with a glimpse of the diversity and energy of the actual event!

For the OpenSym 2021 conference committee

Gregorio Robles
General Chair, OpenSym 2021

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Dislodging Domesticity and Rigidity: A Platform Approach to Open Innovation in Asset Management

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This study explores how complementors in a platform orientation enhances the creation of openness and how complementor services and module features interact at interfirm level to create balance between openness and obtaining control benefits in a platform. This platform openness helps develop new blueprints for co-creation in traditionally domesticated markets. The research contribution focuses on emphasizing how institutional rigidity can impact strategic flexibility and how opening a platform to third parties can enhance the diversity of complementors for innovation.

CCS Concepts: • **General and reference → General literature**.

Additional Key Words and Phrases: Value Co-creation, Value networks, Platforms, Openness, Institutionalized markets

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1 INTRODUCTION

Despite widespread enthusiasm, the practice of collaborative networks has not spread similarly in all industrial sectors. It appears to remain hard to implement or often unsuccessful in certain *domesticated* markets [1], in which collaboration is significantly hindered by structural inertia. Long-term arrangements between buyers and sellers, called *domesticated* markets or more recently, *institutionalized* markets, previously has been seen to lessen competition and creates barriers for new sellers [28]. Markets are *domesticated* when the perfect competition mechanisms of *traditional* marketing [5] are offset by longstanding arrangements and relationships. Exchanges are internalized within captive ties between network actors, to reduce uncertainty, transaction costs or for the synergy of combining complementary operations [31]. Opening a platform can enhance the diversity and innovativeness of complementors [10]. At the same time it can become increasingly difficult to orchestrate as the network expands [34], because, as the number of suppliers increases, they typically become more diverse [3].

This study aims to investigate conceptually and empirically how platform openness can be managed by the lead actor and focal firm through complementor selection and module features set within an institutionalized market. It aims to start with understanding how complementors in the platform orientation enhance the creation of openness and how complementor services and module features interact at interfirm level to create balance between openness and obtaining control benefits in a platform. This platform openness helps develop new blueprints for co-creation in traditionally domesticated markets.

It draws together research from the information systems, business and marketing management literature and analyses the best approaches and recommendations for organizations that aim to leverage value co-creation and platform strategy to drive innovation. This research applies an exploratory multiple case study design, and through an inductive approach it aims to build on platform theory in value co-creation networks within the context of a value network. An exploratory

case study is adopted as it defines questions and hypothesis of a resulting study. It presents data that explains how events occurred and reflects a cause-and-effect relationship [36]. Analysing the platform cases will enable multiple scenarios and provide a base for robust insights to be utilized for application.

2 CONTEXT

The topic of value co-creation in B2B (business to business) has attracted significant interest in current management and marketing research. Complementors join a partners ecosystem to create and capture value [37]. However, tension between value creation can arise when a complementor enters a relationship with a partner who benefits from the network effect [37]. While the complementor and partner create value collectively, their relationship also strengthens the network effect which increase the partner's ability to suitable value.

This informs the focus on complementor selection, specific product offerings, modular features, and value networks.

Boudreau [2] outlines that two digital platform types exist: 1. Operating system, includes a set of tools and standards that is the foundation for the third-party or partners engagement method and 2. Marketplace, where various categories of users transact amongst each other or with the platform provider directly. The platform types are not clearly defined, and the lines are blurred, and this supports the need to determine which outcomes drive effectiveness in network collaborations [23]. This in turn looks at the selection of the stakeholders involved in the collaboration to drive efficiencies. Information technology services platforms are facilitating the development of co-creation in value networks. In network effects the understanding of the value creation and value distribution becomes important [26].

In the platform model, value is co-created by the interaction of a variety of stakeholders, not just between two, which is a dyadic interaction [33]. Research by Normann and Ramírez disputed the linear creation of value by suggesting that value is created through a network and introduced the model of a value network [24]. Gyrd-Jones and Kornum [13] outline the notion of a stakeholder ecosystem, in which value is co-created by the network of stakeholders, interacting in a connected, complex manner of which each stakeholder holds their own identity. Each stakeholder gives and receives so value is "uniquely experienced and determined by the beneficiary" as outlined by Greer et al. [12]. Value perceptions are expected to differ between partners [21], aligning these dynamics of value and interaction between stakeholders is explored in the research. New insights for example, by Haberly et al. [14] outlines the digital platform economy, conceptualized as a "collection of technology-enabled hub and spokes business models", wherein a platform-providing scenario, the lead firm co-ordinates the activities of platform users, inferring that there is an initiator of value.

Network effects are determined by the partnership of the actors, beneficiaries or creators, and the producers and consumers as part of the multi-stakeholder network become less active value co-creators and that value co-creation is not dyadic but collaborative. Greer et al. argue that the value is "determined by the beneficiary" [12].

The platform model and platform openness is analysed, adopting an architectural perspective of platforms which will allow for a key focus on how platform openness and control can be balanced. This research complements marketing management literature and information systems literature, aims to propose new blueprints in traditionally domesticated markets, with a focus on openness as part of platform strategy. Domesticated markets are still relatively unchartered territory, and contribution of this paper is on emphasizing how institutional rigidity can impact strategic flexibility and how opening a platform to third parties can enhance the diversity of complementors for network innovation.

3 AIMS AND OBJECTIVES

This research explores value co-creation and platform theory and examines the value network structure of organizations and their services, to adopt a platform strategy and create new blueprints for co-creation. Opening a platform to

third parties can enhance the diversity of complementors and how their innovations contribute to the platform [10]. This study aims to respond to the problem of breaking down rigidity and domesticity in institutionalized industries. The multiple case study aims to investigate platforms in a value network. These cases aim to further understand the architectural perspective of the platform and suggests that openness can be balanced through careful competitor selection and product and service offerings through module features and interfirm interaction and co-ordination.

In B2B, value co-creation is less natural and more structured. In the B2B space value networks are created to have multiple stakeholders co-create through collaboration. B2B much like corporate co-creation spaces look at competitive advantage and in B2C spaces it focuses more on the customer need [26]. Which in the two-sided network effect, could support the fact that multi-stakeholders' collaboration is not organic but rather structured through an active firm level and a complementor level [26]. With beneficiaries and creators, this theoretical view is supported by a study that outlines that a considerable share of value is developed and provided by users before the service provider commercially introduced them into the markets [25].

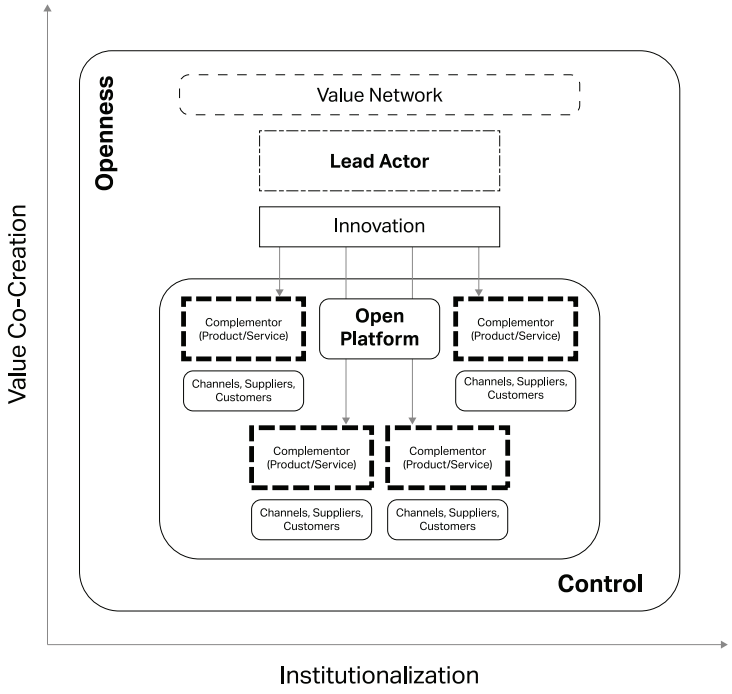

Fig. 1. Research Model

Thus, following the core practices from the B2C and other industries, the aim is then to develop and engage a diverse ecosystem of channels, suppliers, partners which build solutions that aim to attract customers to the platform. The process of value co-creation by these ecosystem complementors plays a key role in the value networks (See Fig. 1). The customer has a need, the representatives in the ecosystem all provide services that integrate in a platform that answer to the need and this is designed to create customer value, through co-creation.

The platform orientation looks in-depth into the industry cases, we investigate co-creation of value, that includes a variety of stakeholders in a two-sided network effect within the asset management context. These stakeholders extend

across partners, producers, consumers, distributors etc. enabling value at the same time in a platform orientation. This study aims to better understand collaboration and the process involved in the value network and aims to contribute to networks and platform literature by explaining how value is leveraged in the network collaboration within an institutionalized B2B asset management industry.

4 THEORETICAL BACKGROUND

4.1 Co-creation and Value Networks

Jaakkola & Hakanen [18] and Perks et al. [27] outline value in networks which acknowledges that all business enterprises are simultaneously value creators, both suppliers and customers. Ford states that value co-creation processes inevitably involve several diverse stakeholders and outlines that network orchestration mechanisms develop value platforms and are defined as dynamic configurations of tangible and intangible resources that act as foundations for creating activities, such as complementors [8].

Digital platforms are an omnipresent phenomenon that challenges incumbents by changing how we consume and provide digital products and services. Whereas traditional firms create value within the boundaries of a company or a supply chain, digital platforms utilize an ecosystem of autonomous agents to co-create value [17].

4.2 Institutionalism and Innovation

Hargrave and Van de Ven outline institutional innovation that impacts strategic flexibility [15]. Domesticity, institutional and structural factors impact open innovation, and examines the structure of organizations through the lens of rationalized myths, accepted for the organization to gain or maintain legitimacy in the institutional environment. Van Bockhaven et al. outlines that innovation is brought about by a collective and intentionally frame breaking character and highlights that this is particularly prevalent in contexts marked by ex ante rigidity, and highlights that in such contexts change is constrained by institutional barriers [32].

4.3 Networks and Network Effects

Frankenberger et al. [9] outline network effects as a phenomenon whereby increased numbers of people or participants improve the value of a good or service. Industrial networks are thus regarded as complex networks of connected exchange relationships between industrial actors, while innovation networks, sees end-user value which is created mainly at the network level and that network configurations substantially affect it [4]. Perks et.al have recognized the importance of digital platforms in orchestrating solution networks and outline that in existing networks that are relatively stable, emphasis is placed on the exploitation of each actor's specialized knowledge [27].

4.4 Ecosystems and Platform Strategy

Gawer & Cusumano focus on platform architecture and platform openness [11]. A digital platform consists of different subsystems where their openness acts as an architectural feature, influencing a solution provider's control over its solution networks. Opening a platform to third parties can enhance the diversity of complementors and how their innovations contribute to the platform [10].

Two distinct areas of transparency and accessibility exist, such as continuum versus dichotomy which can be closed and open [35]. Also, the interdependence between platform and agents in an ecosystem can have both economic and structural components [20]. Economic components describe the type of complementary capabilities of products or

services provided by complementors, while the structure is the set-up. Jacobides et al. focus on unique and super-modular complementarities to outline the relationship between a platform and actors in an ecosystem [19].

In analysing the theoretical background to the study, it draws on three major areas discussed in the literature on (1) value co-creation (2) platform model and (3) complementors. These three areas are elaborated on in the literature review later in this study and outlines their intersections within an institutionalized setting. The study focuses on the core theoretical basis of the platform model aligned to the importance of taking complementors into account, which can influence platform openness and interfirm co-ordination.

4.5 Research Question

To address the gaps in the literature highlighted above and which will be discussed further in the literature section, the overall research problem addressed in this research paper can be stated as follows: How can platform openness help develop new blueprints for co-creation in traditionally domesticated markets?

This study aims to respond to the problem and to understand how institutional rigidity can impact strategic flexibility and how opening a platform to third parties which can enhance the diversity of complementors for network innovation.

In order to respond to this aim, the following two research questions are to be examined:

RQ1 How complementor services and platform features enable openness in value networks?
RQ2 How platform openness in value networks help dislodge rigidity?

5 METHODOLOGY

The study utilizes a qualitative research method. It outlines a multiple case design; an exploratory case study is adopted as it defines questions and hypothesis of a resulting study. It presents data that explains how events occurred and reflects a cause-and-effect relationship [36]. Analysing the platform cases will enable multiple scenarios and provide a base for robust insights to be utilized for application.

5.1 Research Design

The research design helps capture the complexities and deeper insights involved. The multiple case study covers four B2B technology platform cases, to best outline the value network. The cases illustrate how openness in the platform can allow for complementors to co-create value, with multiple stakeholders contributing their services to create value across the digital technology platform and industry focused environment. The cross-case analysis allows for robust conclusions on value co-creation practices by contrasting and replicating findings from individual cases [36].

As outlined by Eisenhardt [6] and also Yin [36], in order to increase the possibility of gaining variability in the results and to expand the external generalizability of the findings, selecting networks that represent different industries, comprise companies of different sizes, and differ in terms of the length of co-operation, would support this. The networks also differ in the type of services, thus following the cross-market focus of services including: “document reporting and compliance”, “design and delivery of fund portals”, “fund distribution operations through blockchain” and "fund distribution services", which enable the comparison between platform services in the network to gain insights into the special features involved in the platform model.

B2C platform research is more common (such as Uber, Facebook, etc.) than B2B and especially cloud-based experience platforms, which are not yet settled [16]. Thus, there is a clear link to the need for contemporary event research of emerging B2B platforms and complimentary third party services, which can be the answer to dislodging rigidity in

domestic markets, which the multiple case study design will aim to explore. The multiple case design will look at empirical, real-life cases. This is supported by Siggelkow's point that the value co-creation practices of B2B platforms are grounded in a real situation described by case studies [29], thus it is the most suitable design for exploring the situation.

5.2 Data Collection and Analysis

Data collection will include semi-structured interviews. The selection of interviewees is based on a predefined list of criteria, such that they had to have participated in the value co-creation process, participated in the building of the B2B platform model and have decision-rights in the process. It follows purposive sampling, interviewees had to possess top management positions, relevant technical knowledge and busines knowledge and know the companies value chain business process and their characteristics well.

Additional documents (such as company presentations), social media, websites and member checks will be followed, as it allows for triangulation of data. Along with the selection of knowledgeable experts motivated to provide accurate statements by promising to treat their data and personal information confidential which aims to reduce any bias as primary information sources due to their position and association with outholding as well as under or overreporting about events.

This research-in-progress is embedded in an overall method of a multiple case research agenda: (1) literature review, (2) in-depth case studies, and (3) prescriptive knowledge. The paper at hand identifies modes and mechanisms of balancing control and openness in a platform model.

This study aims to gain insights into openness within a platform, set within the asset management industry. Through the method of multiple case research, focused on empirical structures, the research outlines the focal firm as the enabler of change through the selection of complementors into the platform model and how this allows for module features to then open up and at the same time balance control benefits within the network.

A qualitative research format is chosen because the topic of open platform strategy in institutionalized markets are scarcely explored and a qualitative research design allows the exploration of new relationships among key dimensions [22]. Unlike in experiments, the contextual conditions are not delineated and, or controlled, but part of the investigation.

Typical for case study research is non-random sampling; there is no sample that represents a larger population. Contrary to quantitative logic, the case is chosen, because the case is of interest [30], or it is chosen for theoretical reasons [7].

Case studies allow a lot of detail to be collected that would not normally be easily obtained by other research designs. Case studies tend to be conducted on rare cases where large samples of similar participants are not available. Within a case study, empirical and scientific experiments can be conducted [36].

6 INTENDED FINDINGS, CONTRIBUTION AND IMPLICATIONS

The study aims to understand how complementors in the platform orientation enhance the co-creation of value in the network and how it helps develop new blueprints for co-creation in traditionally domesticated markets, providing more openness.

6.1 Findings and Contribution

The research findings are aimed at answering (RQ1) How complementor services and platform features enable openness in value networks? (RQ2) How platform openness in value networks help dislodge rigidity?

These findings will provide recommendations for organizations that aim to leverage value co-creation and collaboration in networks and explore effective strategies and mechanisms in a value network for innovation. The key contribution focuses on co-creation in domesticated markets which are still relatively unchartered territory. The contribution focuses on emphasizing how institutional rigidity can impact strategic flexibility and how opening a platform to third parties can enhance the diversity of complementors for innovation. To explore conceptually and empirically how platform openness can be managed by the lead actor with the focus firms through complementor selection and module features. The study aims to start with understanding how complementors in the platform orientation enhance the creation of openness, and also analyse how complementor services and module features interact at interfirm level to create balance between openness and obtaining control benefits. It aims to explore how openness to third parties can enhance the diversity in platforms and helps develop new blueprints for co-creation in traditionally domesticated markets.

The explorative nature of the approach and methodology aims to highlight key aspects, challenges, and outcomes in this area of focus and aims to outline best practice in the experience of value co-creation and openness in platform strategy.

6.2 Theoretical and Practical Implications

The theoretical implications aim to relate to research on value co-creation, platform strategy and complementor capabilities. Through this it aims to analyse how complementor services and module features interact at interfirm level to create balance between openness and obtaining control benefits. These theoretically supported constructs are then applied in real, live settings. The case examples will help in understanding how to approach collaboration as part of the B2B platform orientation as well as how best to leverage value co-creation in a platform strategy. Furthermore, it will outline how to enable innovation as part of the value network to drive openness and diverse capabilities within a platform model, all set in an institutionalized industry. Practitioners will understand the benefits of co-creating in a platform model as part of a value network and gain deeper insights into module features to attain control benefits within a platform model strategy.

7 CHALLENGES AND LIMITATIONS

The research aims to focus on a narrow empirical perspective of four platforms within one value network, to understand the value co-creation process and the collaboration of actors involved in the platform orientation, with the focal firm as the lead actor. Case study research strategy sets limitations on the degree to which the findings can be generalized beyond the studied context. Thus, analytical generalization, where the results are likely to apply the platform orientation for value co-creation and align a similar character where the insights are transferrable and can be applied across other contexts [36]. By selecting the two-sided networks effect setting, that varies in the nature of actors, activities and resources, the study is able to seek variation that could reveal a broader view of the studied phenomenon and expand the generalizability of the findings [6, 36]. Further limitations involve the specific industry focused areas as outlined in previous chapters. Thus, future research would benefit further from investigation of these linkages and explore also other value creation in other industries, services, and solution networks. Challenges of collaborative value creation can

be addressed through this research by providing a holistic understanding of the network set-up and the processes of the platform orientation to leverage value from it, looking at outcomes, and the variety of actors in the co-creation process thereby offering implications for theory and practice. Although we have chosen a deep dive into one institutionalized setting, future studies could look into a broader scope of an institutionalized setting to corroborate our findings. The study does not analyse open innovation as well as neo-institutionalization theories and principles which could be utilized for future studies.

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Investigating Western Bias in Wikipedia Articles about Terrorist Incidents

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Wikipedia is one of the most popular sites on the web and an essential knowledge source for millions of web users. As this online encyclopedia significantly shapes our image of the world, its neutrality is of utmost importance. However, past studies demonstrated that Wikipedia is frequently unbalanced or biased in various subject areas. In this work, we analyze one potential bias on Wikipedia, the so-called western bias, by examining Wikipedia articles about terrorist incidents. To that end, we investigate pageviews of 2029 articles in the first month after events happened. While our findings do not apply to all events in general, we do find that terrorist incidents happening in the "western world" receive more attention on Wikipedia than those from non-western regions.

CCS Concepts: • **Human-centered computing** → **Empirical studies in collaborative and social computing**; **Wikis**.

Additional Key Words and Phrases: Wikipedia, western bias, North-South divide, terrorist incidents, data science

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1 INTRODUCTION

With more than 56 million articles created by millions of contributors since its inception in 2001, Wikipedia is nowadays the most famous online encyclopedia. People use Wikipedia for a variety of reasons, whether it be as a starting point for research, for learning about topics of interest for school or work, or for fact checking [10]. Through this, the encyclopedia is accessed millions of times every day from all over the world, with the most popular English language version being visited around 10 billion times every month.[1]

Despite its success, Wikipedia is often criticized. For example, although one of the central basic principles of the website is neutrality, many people accuse it of being unbalanced [4, 5]. Recently, researchers also uncovered inequalities [9, 15] and biases on Wikipedia [1, 7, 12]. In this work, we address a particular kind of bias: *Western bias*, which describes the tendency of western states or regions to regard western behavior patterns as usual, natural, or more important, rendering non-western views as inferior [6]. Past work highlighted such inequalities in other media and concluded that events or locations from some regions of the world receive less attention than others [3, 13].

Depending on the line of research, there are different concepts for dividing the world into western and non-western regions. For our work, we choose the socio-economic division into *Global North* and *Global South*, henceforth referring to western (developed) regions as the *North* and non-western (developing) regions as the *South* [2]. We consider this classification instead of a strict geographical division and investigate whether articles belonging to different regions receive uneven amounts of attention, possibly due to large communities of readers and editors mostly stemming

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[1] Wikimedia Statistics: https://stats.wikimedia.org/#/all-wikipedia-projects and https://stats.wikimedia.org/#/en.wikipedia.org

from the North.[2] These users' interests and media diet shape Wikipedia content quite significantly, possibly omitting perspectives and knowledge other demographic groups could contribute.

In our analysis, we focus on articles about terrorist incidents from 2018 to 2020, which generally attract a lot of attention. We divide these articles according to the economic region the incidents happened in—the South or the North. Through this, we aim to answer the following research question: *Do Wikipedia articles about terrorist incidents in the Global South receive less attention than articles about similar incidents in the Global North?*

Overall, we analyze pageviews of 2029 Wikipedia articles (228 terror, 1229 sports, and 572 election articles), showing that articles about terrorist incidents in the South generally receive less attention than those from the North, seemingly confirming Wikipedia's alleged western bias. However, we also find that this does not apply to other events covered on Wikipedia. For example, elections or sports events show diverging results, with articles covering the South generating as much or even more traction than their northern counterparts. Altogether, our findings further the understanding of western bias on Wikipedia, the mitigation of which would advance neutrality and knowledge equity on Wikipedia.

2 MATERIALS AND METHODS

Approach. To measure the attention an article receives, we collect pageviews within the first four weeks after an event took place. We parse the dates and location from the corresponding Wikipedia article's info box. To compare articles about terrorist activities in the South and North, we apply Mann-Whitney U tests to test for differences in distributions of pageviews and edits. Additionally, we compare results for articles about terrorist incidents to those about other events to check whether such differences are observable regardless of the topic. We use sports events and elections for this purpose, as these can be reliably linked to a location and date. Additionally to pageviews, we also analyze the number of page revisions, as frequent edits could also indicate greater interest in an event. Lastly, we fit a linear regression to assess the effect of the region on the pageviews of terror articles, while also considering the number of deaths.

Dataset. We retrieve article data about terrorist incidents from 2018 to 2020 from lists on Wikipedia [14]. In addition to these lists, we retrieve all articles belonging to the Wikipedia categories *Terrorist_incidents_in_<continent>_in_<year>* to our dataset via *Petscan*.[3] Next, we download revision, user, and page history data from MediaWiki history dumps and retrieve the pageviews of the individual articles using the Wikimedia REST API.[4] Afterward, we assign the respective economic region to each article [8]. Besides the categories containing terrorist incidents, we repeat this process for sports and election categories (*<year>_in_<continent>_sport* and *<year>_elections_in_<continent>*, respectively).

3 RESULTS AND DISCUSSION

Figure 1 (left) shows that the number of pageviews of terrorist incidents from the South is lower than those of articles from the North. We statistically confirm the observed difference between the two groups (Mann-Whitney U, $p < 0.001$). We further test for a difference in the number of edits and conclude that there are significantly fewer edits on articles about terrorist activities from the South ($p < 0.001$). The distribution of pageviews depending on the continent on which the incident took place also reflects this north-south divide (omitted from paper for brevity). Correspondingly, the continental regions that mainly belong to the North (Europe, North America, Oceania) get slightly more pageviews than those from the South (Africa, Asia, South America). Altogether, we conclude that the North's terrorist activities receive more attention than the South's. One possible reason our data shows higher pageviews for the North might be that the western media is mainly concerned with this region, while the South is more of a secondary consideration.

[2] Wikipedia demographics: https://en.wikipedia.org/wiki/Wikipedia:Wikipedians#Demographics
[3] Petscan: https://petscan.wmflabs.org
[4] MediaWiki history dumps: https://dumps.wikimedia.org/other/mediawiki_history/readme.html, Wikimedia REST API: https://wikimedia.org/api/rest_v1

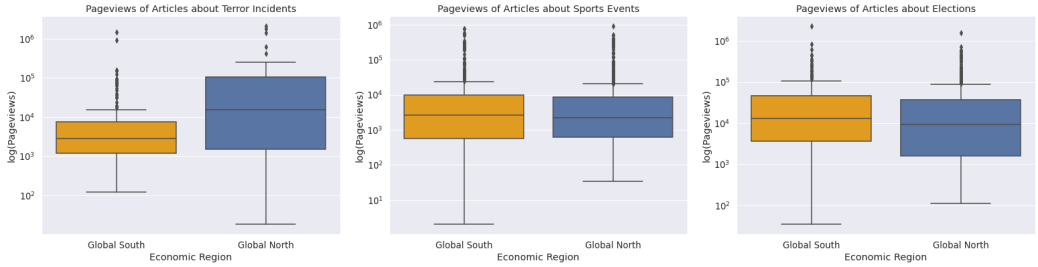

Fig. 1. **Distribution of pageviews of different event types depending on the economic region.** On the left, the events' type is terrorist incidents. In the middle, the pageviews are from articles about sports events and on the right from elections.

This bias might be mirrored by the English Wikipedia, due to its predominantly western user demographic. Moreover, people from the South might use other information channels than Wikipedia to follow such events.

To control for the event type, we also analyze sports and elections. On the one hand, sports events that have taken place in the South do not receive fewer pageviews than those in the North (Mann-Whitney U, $p = 0.374$). However, a comparison of the edits suggests that articles from this category in the South change more often ($p < 0.001$). On the other hand, contrary to our previous findings, articles about elections that took place in the South are getting more attention than those in the North ($p < 0.01$), although the analysis of the distribution of the edits shows no significant differences in the two regions ($p = 0.097$). According to the democracy index published by *The Economist* [11] there are still countries in the South, particularly in Africa, which are not democratic or are currently transitioning into a democracy. This could possibly lead to democratic elections from this region drawing more attention. We leave the exploration to which specific factors (e.g., region or editor characteristics) explain these inequalities for future research.

Finally, we fit a linear regression to determine whether the attention, i.e., pageviews (V), is affected by the economic region (R) while controlling for the number of inflicted deaths (D). To account for outliers, we use log scale for pageviews and deaths. Region is a binary variable coded as 0 for North and 1 for South. To capture the region-specific attention gain a surplus of deaths might bring, we also include the interaction between economic region and deaths. We model the regression as following: $V = \beta_0 + \beta_1 D + \beta_2 R + \beta_3 DR + \epsilon$. The fitted regression (adjusted $R^2 = 0.315$) suggests that deaths is a significant predictor of the attention an article receives ($\beta_1 = 1.811$, $p < 0.001$). Most notably, no significant difference between the North and South exists for when there are no or only few deaths ($\beta_2 = -0.771$, $p = 0.18$). However, the coefficient of the interaction term signals that with an increase in reported deaths, articles in the South receive significantly less attention than those in the North ($\beta_3 = -1.277$, $p < 0.001$). Hence, although our model finds no fundamental regional difference in attention for a terror incident happening, incidents in the North generate far more pageviews as soon as casualties increase—suggesting a bias in terms of coverage of incidents in non-Western countries. We also fit this regression using edits as the dependent variable and find no significant differences to pageview results.

4 CONCLUSION

In this experience report, we demonstrate our approach of showing that Wikipedia articles about tragic events such as terrorist incidents happening in the Global South receive less attention than those in the Global North, manifesting a western bias. However, we also reveal that this does not hold for all other events, such as sports events or elections. Therefore, we cannot confirm the existence of western bias for all articles about events. We further conclude that there are possibly other factors influencing the attention of individual articles and plan to address this in future research.

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The Implementation of an Open Hardware and Open Source Software Internet of Things Demonstrator: An experience report

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The Internet of Things (IoT) is an area of rapid development and growth. The use of open hardware (OH) and open source software (OSS) in combination can provide opportunities for businesses and other organisations to develop innovative IoT solutions that build on existing implementations, thereby reducing both time to market and the overhead of innovation in terms of time and money. Additional benefits of using OH and OSS accrue in long-term maintenance, and in longer-term innovation cycles. This paper outlines the experience of ongoing work to implement a small IoT sensor network for an industry audience using OH devices, and OSS, including implementations of open communication standards.

CCS Concepts: • **Hardware** → *Sensor devices and platforms*; *Wireless devices*; • **Computer systems organization** → *Sensor networks*.

Additional Key Words and Phrases: Open Hardware; Open Source Software; Internet of Things

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1 INTRODUCTION AND AIMS

In this paper we describe work in progress to implement a small system to demonstrate the practicality of building an IoT sensor network using exclusively open hardware (OH) components and open source software (OSS). The demonstration will be sited in ASSAR[1], an industry innovation arena in Skövde in Sweden, and the knowledge and experience acquired during implementation shared with partners in an industrial research project. *Open hardware* (OH), sometimes referred to as *open source hardware*, describes hardware which shares qualities with open source software (OSS) in that *designs* can be licensed, distributed, studied, and freely modified by others [8, 13]. OH is found in both industry [11, 14] and scientific computing [3, 6, 9, 10], as well as education and hobby computing in popular platforms such as Arduino [2].

OH provides the opportunity to use and further develop existing designs freely, thereby reducing the cost of innovation. In the longer term, it is possible to recreate OH devices, just as it is possible to recreate and maintain OSS, in order to support long-term maintenance of systems. Accordingly, the use of OH can provide collaborative mechanisms for hardware innovation that might be applicable to smaller businesses and organisations [4, 9, 13].

The project is intended to demonstrate:

(1) Interoperability between different open hardware IoT platforms using open source software; and
(2) The practicality of constructing IoT sensor networks using open hardware and open source software components.

[1] https://assarinnovation.se/en/

2 IMPLEMENTATION AND ARCHITECTURE

The sensor network is being implemented as a geographically dispersed system. Most of the microprocessors will be in ASSAR and additional sensors will be located in offices (used by the first author) around 1km and 50km from ASSAR. The microcontroller (MCU) and microprocessor boards used in the demonstration are all certified as OH by the Open Source Hardware Association (OSHWA) (see Table 1). The sensor components of the demonstration are linked by software hosted in the cloud that relays data from the dispersed machines. Sensors communicate with a Beaglebone Black microprocessor using the Open Mobile Alliance (OMA) Lightweight Machine to Machine (LwM2M) protocol [7] which uses the constrained application protocol (CoAP) [12] as a transport. The Beaglebone Black hosts an instance of the Eclipse Leshan LwM2M server and aggregates data from the sensor boards for display.

Table 1. Microprocessor and microcontroller boards used in the demonstration

Manufacturer	Board	Processor	Operating System	OSHWA UID
AdaFruit	Grand Central	ARM M4 (ATSAMD51)	(*tbd*)	US000247
AdaFruit	Feather Digi-Key	STM32F405	Zephyr	US000299
BeagleBone	BeagleBone Black	ARM A8	Debian Linux	US000236
Olimex	OLinuXino-1Ge 16GW	ARM A64	Ubuntu Linux	BG000042
Olimex	ESP32-EVB	ESP32	FreeRTOS	BG000011
SparkFun	Red Thing-V Plus	SiFive FE310 (RISC-V)	Zephyr	US000746
SparkFun	RED-V RedBoard	SiFive FE310 (RISC-V)	Zephyr	US000745

The sensors deployed in the network are sources of data used to demonstrate data transmission over the network. Consequently the sensor devices have a deliberately simple design and use sensor components commonly available through electronics retailers. Two fundamental designs were created: one to gather environmental data used to demonstrate interoperability through data acquisition and aggregation, and a second to support the display of the demonstration.

A sensor unit built using the Olimex ESP32 board is part of the main display. The circuitry including the sensors is implemented on a 'breadboard' so that the circuit structure and components are displayed clearly for visitors to the demonstration. The ESP32 board runs an instance of the Eclipse Wakaama [5] client and uses some custom software to read data from the sensors using the FreeRTOS [1] operating system. The second design is implemented using off-the-shelf components soldered to expansion boards for both 'featherwing' and conventional Arduino form factors. The former for the AdaFruit Feather DigiKey and the latter for the AdaFruit Grand Central. The two RISC-V boards also have the same form factors. Prototypes of the sensor board implementations were developed using Arduino Uno MCUs and the Arduino IDE. The Arduino tooling is easy to work with and Arduino libraries for electronic components are often ported to other development environments. Consequently, the prototype hardware is known to work, and software written in C and developed for a prototype board running on an Arduino can be ported to another system simplifying the software development process.

Two additional sensor devices are implemented using the RISC-V MCUs and used deployed to detect movement near the exhibit using a combination of passive infra red (PIR) and ultrasound sensors. Motion is used to wake a monitor attached to the OLinuXino microprocessor to provide information about the demonstration and to attract the attention of potential visitors.

All software being developed for the demonstration will be released under version 3 or later of the GNU Public Licence and all hardware designs released using the strongly reciprocal version of the CERN open hardware licence (CERN-OHL-S-2.0)[2]. The documentation of the hardware components created and the demonstration are published using a Creative Commons licence (CC-BY-SA 4.0) [3].

3 CHALLENGES

Software licensing proved to be a challenge at the outset of the project. Hardware manufacturers and others provide software packages as examples of device usage, or libraries, or in the form of firmware that can be used operate their products. Often, Open Source Initiative (OSI) approved[4] permissive licences are used, but in some cases the code is stated to be in the Public Domain. In the European Union, and other legal jurisdictions, where there is no legal means to support a Public Domain declaration, the software is not considered to be open source. Accordingly, some hardware components were not used as additional software development would be required. Older source code is most affected. In the last few years, software authors have introduced optional use of the Creative Commons Public Domain Dedication[5] (CC0) with Public Domain code. However, this change has not always been applied retrospectively.

Another challenge is the overhead of using the tooling for the MCUs. While the MCUs appear to be largely similar at one level of abstraction — i.e. an MCU is a processor with a number of General Purpose I/O pins that can be programmed — the libraries and tools are often different, and also at differing levels of maturity. Tooling and libraries can also be adapted by manufacturers. For example, the libraries bundled with the ESP-IDF for the ESP32 chips have been adapted by Olimex to support their products, including the evaluation board used in the demonstration. Differences between the two library versions are often subtle, and published support material and code examples may be misleading or unhelpful as a consequence.

4 CONCLUSIONS

We have outlined the experience of ongoing work to implement a demonstration of an IoT sensor network using open hardware (OH) and open source software (OSS). A deliberate choice was made to use a variety of MCUs in the demonstration, requiring the use of multiple development environments. In practice, system implementers should try reduce complexity of systems by using as few different types of MCU, thus limiting the number of platforms targeted by the software development process, and thereby the range of tools developers need to learn to use.

In addition to sharing the knowledge gained with industrial partners, future work is planned in two main areas. The first is to introduce public key infrastructure to support identification and authorisation for the sensor network. The second is to refine the sensor board designs so that they can be manufactured to demonstrate to smaller organisations and businesses the practicality of developing and manufacturing open hardware for their own applications and products.

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[2] https://opensource.org/CERN-OHL-S
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[5] https://creativecommons.org/publicdomain/zero/1.0/

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Impact of the COVID-19 pandemic for North-South Research Collaboration: An Experience Report

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This experience report summarises the findings from an online survey dataset consists of 102 respondents from 33 countries from the global North and South. Using an independent non-parametric *t*-test, we found a significant difference in the way both sides used certain technologies and platforms to collaborate with their colleagues, as well as the factors affecting their ability to work from home during the pandemic.

CCS Concepts: • **Human-centered computing** → Collaborative and social computing.

Additional Key Words and Phrases: COVID-19 pandemic, Global North-South, New Normal, Clusters of Excellence, Collaborative research projects, Qualitative and Quantitative survey, Lockdown, Social distancing

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INTRODUCTION

The main characteristic of North-South research collaboration [6] is that researchers are often geographically dispersed. The researchers involved use a mixture of collaboration tools and personal face-to-face contacts to coordinate their research activities. Under normal circumstances, they can travel and meet in small groups to discuss their research in a workshop, seminar or conference. Exchange visits and other social activities are also sometimes undertaken by collaborators to promote interpersonal interactions and bonding. Researchers can also use emails, video conferencing, or social media platforms to "talk" to their colleagues when the need arises. However, since the WHO declared the outbreak of COVID-19 on 30 January 2020 to be a public health emergency of international concern, many "normal" [9] research collaboration activities have almost become impossible. What followed the declaration was the dawn of the "New Normal" era that continues to bring unprecedented socio-economic [7] and scientific [13] challenges for society in general and North-South research collaborations as we knew it.

At the Africa Multiple Cluster of Excellence, University of Bayreuth[1] (Germany), we are involved in several interdisciplinary projects, aimed at reconfiguring African Studies [10], with partners from the global North (e.g. Europe) and global South (e.g. Africa). Like many other collaborative projects Freeth and Vilsmaier [3], Heymann et al. [5], Porter and Birdi [8], we are also heavily impacted by the COVID-19 pandemic. Our motivation for this research is to understand how to sustain our current and future research collaboration by learning from best practices adopted by researchers to help them cope with the pandemic. The COVID-19 pandemic makes it almost impossible to have face to face contact with study subjects [2] because of social distancing [1, 12], travel and lockdown restrictions. Thus, a possible approach we are taking to understand the complex nature of North-South research collaboration is to use an online survey in

[1] https://www.africamultiple.uni-bayreuth.de/en/index.html

which we ask the people involved a series of questions. The survey was active for 3.5 months (January 15 - April 30, 2021). During this period, we collected 1320 responses (100 full + 1220 partial responses). The full-responses dataset used in this analysis consists of 102 respondents from 33 countries. Apart from helping us overcome the challenges associated with conducting empirical research during a pandemic, this approach might help us understand the opportunities and challenges posed by the COVID-19 pandemic for North-South research collaborators and the strategies and technologies they employed to address those challenges. For this shortened version of the original paper, we only present and discuss some of the findings.

- ***What communication and coordination technologies are North-South researcher collaborators using to help them collaborate with their partners during the COVID-19 pandemic?*** To answer this question, we analyse the technologies, platforms, and research data storage and sharing services North-South research collaborators are using.
  In the survey, participants indicated that their use of Zoom, WhatsApp, Microsoft Teams, Cisco Webex, and Skype has significantly ($p < 0.05$, 2-tailed) increased during the COVID-19 pandemic. Other technologies not included in the survey also registered an increase in use during the pandemic. However, there is significance difference in the way North-South research collaborators use WhatsApp ($p < 0.01$), Skype ($p < 0.01$), and Google Meet ($p < 0.05$). Even though the use of Zoom has increased 100% during the pandemic for all the people surveyed, some researchers reported "Zoom fatigue' and the problems they encountered during online meetings. For example, one global South collaborator commented, *"…I can work peacefully at home...meetings in Zoom... are possible-but it is difficult to discuss all the nuances of the research project"*. We cannot infer fatigue from our data, but the group studied had 44.76 online meetings using a computer, Laptop or Tablet (N = 90, Std. Dev. = 32.38) and 14.2 online meetings using telephone or mobile (N = 90, Std. Dev. = 17.36). Meaning not a single working day goes by without a Zoom meeting. However, we found out that, during the same period, researchers in the global North had twice as many online meetings using telephone or mobile as their counterparts in the global South.
  During these online meetings, users encountered numerous challenges. For instance, 19% of the people surveyed reported low bandwidth and insufficient internet connection problems. In addition, audio and video quality problems were reported by 18% and 16% of the respondents, respectively. There are no significant differences in these challenges between the global South and North groups. When asked to indicate the platforms they are using to collaborate with their colleague, most of the respondents chose other collaboration platforms not represented in the survey. However, ResearchGate, Google Scholar, Facebook and LinkedIn are also popular platforms among respondents. The cloud storage services for sharing research data is dominated by Google Drive (global South mean = 0.7647 (n=34), std = 0.4306 and global North mean = 0.5303 (n = 66), std = 0.5029) and there is a significant difference ($p < 0.05$) in the use of this drive by research collaborators in the North and South. DropBox is the second preferred cloud storage for sharing research data (global South mean = 0.4412 (n = 34), std = 0.5040 and global North mean = 0.5758 (n = 66), std = 0.4980). Other cloud storage services surveyed are also commonly used by the collaborators.
- ***How is working from home helping or hindering a researcher's ability to collaborate with partners during the COVID-19 pandemic?***
  Many people are slowly getting used to working from home during the pandemic [4, 9, 11, 13]. 85% of the people surveyed answered the "Are you working from home?" question in the affirmative. 10% are working from home but sometimes go to their offices to work on their research projects. In a general opinion column, we could not

find consensus amongst the researchers when asked whether they would like to continue working from home after the lockdown ("Yes" = 34%, "No" = 31%, "Undecided" = 29%), but the majority of them (94%) said that they are looking forward to the end of the lockdown. The average number of countries visited by the respondents was 1.11 (Std. Dev. = 0.89), and the maximum number of countries visited by one individual from the global North was 4. Furthermore, more than two-thirds (67.2%) of the respondents from the global South felt more productive when working from home during the pandemic than their Northern counterparts.

When asked to rank the factors affecting their ability to work from home, participants from both the global North and South reported that the most significant effect (of the lockdown) is the lack of direct face-to-face contact with colleagues. Researchers also have difficulty in contacting research partners and scheduling meetings when working from home. When asked to rank what distracts them most when working from home, most people reported that children are the most distracting. Distractions from phone calls and messaging and other forms of distractions not captured in the survey also rank high amongst the respondents. Furthermore, our data revealed that respondents from the North are less distracted by neighbours (mean = 8.5536 (n = 56), std = 2.5220, $p < 0.01$) and TV and Radio (mean = 8.3818 (n = 55), std = 2.7588, $p < 0.01$) than their counterparts in the South. Specifically, except for the participants from 4 countries in the global South (South Africa, Nigeria, China, Costa Rica), all other participants who gave rank 10 (less distracting) to distractions from neighbours are from the global North. A stark contrast was observed on how the lack of electricity ($p < 0.01$), internet connection ($p < 0.01$) and the cost of mobile data ($p = 0.000251^{**}$) is affecting researchers from the global South to engage in research collaboration while working from home. Another notable highlight of this study is the cancellation or suspension of local and international events (e.g. meetings, workshops, conferences, fieldwork) because of travel restrictions. The highlight is lucidly captured in the comments made by some of the survey respondents. For example, one respondent from the South commented that if it were not for the pandemic, his team would have completed the fieldwork they scheduled for September 2020. Another respondent from the North felt sad that the workshop he organised with South African and European partners did not take place because of the lockdown.

In conclusion, this experience report highlights the complex nature of research collaboration and how the COVID-19 pandemic is changing many aspects of research collaboration. We have introduced the technologies and platforms North-South research collaborators are using during the pandemic. We have also discussed how working from home is impacting their research collaboration. We posit that this report can potentially act as a best-practice guideline for Clusters of Excellence and universities interested in sustaining research collaboration during COVID-19.

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