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Open Source for Digital Social Innovation

Short Paper

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Abstract

Advancing the UN sustainable development goals (UN-SDGs) needs cooperation from both public and private corporations. Involving in open source initiatives is considered risky from an organisational perspective but highly promoted by governments as a way to build digital sovereignty in the European context. Open source initiatives have a greater potential to contribute to digital social innovations (DSI) and advance several UN-SDGs. However, it is not clear to practitioners and IS scholars how might corporations collaboratively pivot and sustain digital social innovations through open source initiatives. To address this practical and theoretical gap, we use a case study method and describe how few corporations associated with the French non-profit association called TOSIT (The Open Source I Trust) collaborate on projects/joint activities to achieve DSIs thereby creating a positive impact to our society. We also delineate a few essential steps for effectively pivoting an open source strategy at an organisational level. This novel guide aims to provide initial clarity to technology managers tasked with undertaking open source initiatives for DSI motives.

Keywords: Open source software, digital social innovation, sustainable development goals, TOSIT, France, governance, digital sovereignty

Introduction

Digital Social innovation (DSI) can be broken into three distinguished disciplines: innovation, sustainable development, and technology. The first refers to the new idea or product in construction, the second is the objective of these innovations in tackling the social and environmental challenges, and the third concerns hardware and software technologies used to enable these innovations (Ozman & Gossart, 2017). For instance, open data, open software, open hardware are all collaborative technologies that enable DSI, and are often seen as novel solutions to sustainable development challenges (Bria et al. 2015, 9). These principles of openness and collaboration resonate with similar notions connected to DSIs such as citizen science which engages a worldwide public in conducting scientific experiments (Hecker et al., 2018) or even, crowdsourcing, which includes external participants, usually internet-based, in trying to solve social and ecological problems (Mahmoudi & Seltzer, 2012), especially to advance SDGs. In this study, we are interested in looking at the potential mechanisms and impact of

open source initiatives on DSIs. The most adopted framework that can encourages DSI related actions from various stakeholders of the society is the 17 Sustainable Development Goals (SDG) set by the United Nations (UN) (Department of Economic and Social Affairs, 2015). Many European countries are also encouraging actions from diverse stakeholders of the society through open source software initiatives, which is estimated to contribute 65 and 95 billion euros to the European economy and build its digital sovereignty (Digital Society Lab, 2022) Thus understanding how to pivot open source software developments is practically very important for advancing UN-SDGs as well as for its potential economic value.

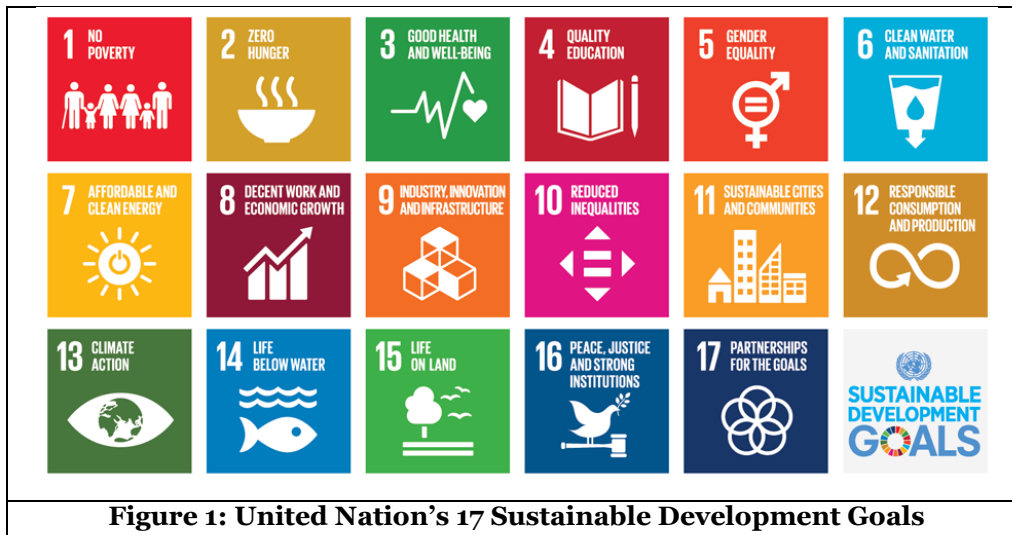


Figure 1: United Nation's 17 Sustainable Development Goals

Further, the UN has launched an urgent call for action so as to increase collaboration amongst all stakeholders in the society in order to promote the agenda of a sustainable future. They explicitly mention corporations in their 2030 agenda and state: “We call upon all businesses to apply their creativity and innovation to solving sustainable development challenges.” (United Nations, General Assembly 2015, p. 29). Given this urgency identified by the UN, corporations around the world have a huge responsibility to drive innovation to achieve these social and environmental goals. Businesses enable social innovation and are seen as “problem-solvers” for the challenges covered by the 17 Sustainable Development Goals (SDG) (Schmiedeknecht, 2019). Taking cues from prior studies that have considered open source software development as digital social innovations (Dong & Götz, 2020), in this study, we aim to answer the following research question:

RQ: How can corporations collaboratively pivot and sustain digital social innovation through open source initiatives?

We take an exploratory stance and use embedded case study design (Yin, 1994) to uncover responses to our research question by studying the sub cases within the French non-profit association TOSIT, created with a social objective to promote open source initiatives amongst corporations through collaboration and knowledge sharing.

This short paper is structured into several sections. In the first section, we offer a brief literature review on open source innovation and its link to digital social innovation and SDGs to better motivate our study. Second, we provide details about our case study method. Third, we describe our data collection and analysis. Fourth, we detail our findings. Finally, we offer a short implications and conclusion section.

Research Motivation and Background Literature

Open source software (OSS) is made by collaborations of programmers all around the world coming together as digital communities and creating digital information (Dong & Götz, 2020). Some of the most known advantages of OSS are that it can speed up innovation, sometimes faster than traditional software development (Bitzer et al., 2007). Open source software is developed in online communities, collaborating to propose innovative alternatives to expensive software (Dong & Götz (2020). This paper also emphasises the particularity of OSS as a social enabler for making programming and software

development accessible to disadvantaged users who can't afford paid software. Open Source Software is used to meet various digital needs, such as data transfer and analysis, programming and coding, marketing and design (Dong & Götz, 2020) Addressing these societal needs will help achieve several SDGs, including: Quality Education (Goal 4), Decent Work and Economic Growth (Goal 8), Industry, Innovation and Infrastructure (Goal 9) to name a few.

More and more for-profit organisations are also involving in open source software development and its provision as a means to engage in digital social innovations. Redhat, an American IBM subsidiary software company that provides OSS products in the B2B market, recently launched an open source education platform and program to give computing classes to everyone, including historically underrepresented groups, such as women and minorities (Redhat, 2022). This initiative addresses 3 main SDGs, including Quality Education (Goal 4), Gender Equality (Goal 5) and Reduced Inequalities (Goal 10), and indicates that open source can enable digital social innovation. However, undertaking such initiatives is viewed as risky by many corporate players. This is known as the paradox of open source in the corporate world (West & Gallagher, 2006). When corporates try to involve in open source and open innovation initiatives, they undertook huge fixed costs initially for the sake of innovation, however, there is also the fear that these innovations would then be replicated or used by their competitors in the market (West & Gallagher, 2006).

However, some corporate may also see this rivalry as an opportunity to create value through new partnerships to capture complementary skills. Numerous examples in the corporate ecosystem showcase these partnerships, but perhaps the loudest is the one between the biggest open source software; Linux, and the most famous company (traditional) software provider; Microsoft. Azure is a cloud computing service developed by Microsoft for public usage for managing applications using the data centres of Microsoft. Azure can provide integration with open source tools and services, including their product; Windows. Today, Linux is more used on Azure than Windows Servers (Vaughan-Nichols, 2019).

One might think that Linux, a rival firm of Microsoft, is benefiting from its software Azure and that it is bad business for Microsoft since people are now using Azure on Linux more than Windows. But Azure made it possible for Microsoft to get more exposure than ever to Linux users. Therefore, open innovation has, in fact, the potential to expand the scope for value creation (Dahlander, and Wallin, 2021). Past literature has primarily focused on understanding developer's motivations in involving in OSS initiatives (Ke & Zhang, 2010; Roberts, Hann & Slaughter, 2006). Few studies have tried to examine how corporations may best handle the paradoxical situations described above through participating in OSS from a financial perspective (West & Gallagher, 2006) or through better internal governance or leadership of OSS projects so they benefit from the stimulating innovation, creativity, and organisational growth on the one hand as well as retain control and the governance of their activities, vis-à-vis competition (Medappa & Srivastava 2019; Dong & Götz, 2020; Howison and Crowston 2014, Lindberg et al.2016). Some of these results mimic the known industry practice amongst mature player in OSS. For example, we can see that Microsoft addresses paradoxes of such a nature. Microsoft made investments in Linux development, server technology, and organisations, including the Linux Foundation and Open Source Initiative (Wikipedia, 2022) along with sponsoring many Apache foundation events (ApacheCon, 2022).

However, past research does not delve deep into how organisations, especially public organisations, pivot and sustain OSS projects as a way to collaboratively contribute to DSI from a practise-oriented perspective. This gap is also echoed by digital innovation steering public bodies such as the one in France called, CIGREF. The report that the initial strong drive to invest in open source initiatives for profit as well as social innovative motives are often curtailed due to data sovereignty issues, knowledge gap on how to best govern OSS and data at the organisational and inter organisational levels (Cigref, 2019)

As a way to fill this practical and research void related to knowledge gap regarding organizational level governance insights enumerated above, we investigate and describe how TOSIT collaborated to leverage open source as DSI actions. The idea of the paper is to showcase and investigate a few used cases governed by TOSIT in order to identify the *in-situ* role and actions of collaborative innovative agents in the context of OSS, so we are able to extract best practices and strategies for a successful governance of open source initiatives that may be carried out with DSI motives.

Method

Embedded in the qualitative research paradigm, case studies are used primarily when researchers aim at obtaining an in-depth understanding of a relatively small number of individuals, issues, or situations. They may serve a variety of purposes. Yin (1989) has defined the case study as “an empirical study that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used” (p. 23). Yin also differentiates between single, holistic case studies and multiple-case studies with embedded designs. In this study, we use an embedded case study design, which is an empirical form of inquiry appropriate for descriptive studies. We describe a few multiple coordinated actions initiated by TOSIT and by few of its members in the open source domain. The phase of data collection employed multiple sources to enable triangulation (Yin, 2013; De Toni & Pessot, 2021) lasting various months. Specifically, the sources of evidence were field notes, publicly accessible documents, internal archives and presentations of TOSIT member in public events. We then draw some generalised conclusions based on the actions taken by both TOSIT and its members as they participated in three joint projects within the consortium. This allowed us to answer our research question.

Case Context

TOSIT has been bringing large companies and French government agencies together since 2017 to collaborate in an applied context on free and open source software. Its members are many and include, in particular the five players presented below. Most of their projects indirectly promote DSIs, although they are not explicitly highlighted for the same. As part of the embedded design, we have investigated the open source initiatives and projects (3nos) undertaken by five French major banks/companies, some of which are leaders in their sector. We have selected them because all of them have developed several open source practices summarised in Table 2 and are also members of a non-profit organisations promoting open source development in France (see below).

- Crédit Agricole Group is an international banking group;
- SNCF (Société nationale des Chemins de Fer) is the French national Railway Company that operates the country's national rail traffic;
- Orange group is a network operator and digital service provider;
- EDF (Électricité de France) is a global electricity company;
- RTE is the transmission system operator of France in charge of infrastructure (high and ultra-high-voltage line).

Data Collection

Several data sources were used to explore the research questions. We use a combination of secondary sources (industry, open source association reports, corporate annual reports etc.) and other data (internal or external documents, events, field notes from different meetings and workshops attended by one author) and artefacts. We collected detailed information on each company's open source usage and strategy from these different sources, allowing us to understand the individual company's open source software strategy and the governance behind it. We also had the opportunity to examine the artefact that was used for collaboration and data product generated because of the inter-organisation collaborative initiatives under the ambit of TOSIT. Primary data through interviews were not collected for this preliminary study. These documents, mostly, included:

- The percentage of OSS used in the company compared to traditional software.
- The date the sample companies started implementing open source directives in their respective companies.
- Why the sample companies started using Open Source and the social reasons behind it.
- Why the sample companies joined the TOSIT consortium.
- The sample's directives and strategies used to handle their OSS.
- The open source best practices the sample companies wished to/were implementing.
- The information pertaining to the leaders in charge of open source within the sample.
- Information pertaining to collaborative tools usage by social actors and how they produced the OSS within each project.

Other data was collected for the said three projects that are further elaborated in the findings sections and also briefly listed in appendix 1. We used event level documents and presentations for the first initiative ecoCode. The second initiative “TDP” presented during OSXP (Open Source Experience) which is an event that brings together over 4,500 professionals to facilitate the sharing of technological trends and business opportunities pertaining to open source. Other data for the last initiative “Strategy Governance” was collected during different TOSIT meetings using field notes and documentation shared on the TOSIT SharePoint (internal content management system). All initiatives were undertaken by TOSIT members and we could gather background information on these projects’ aims, project management and governance details and how these projects were implemented and its outcomes.

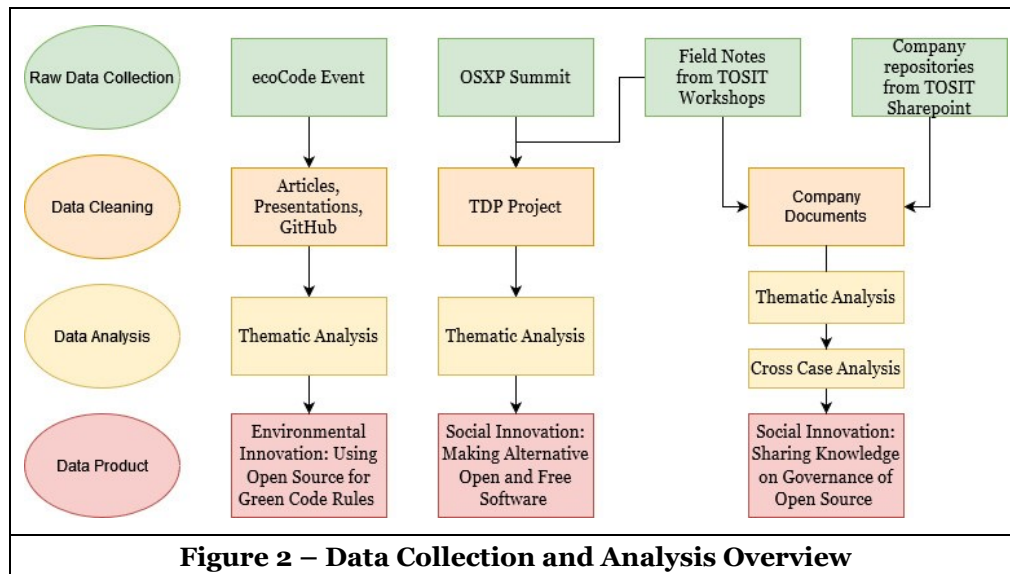
- The first initiative is ecoCode. This was a hackathon organised by TOSIT members and non-members to develop a plugin that verifies if a given code is green or not.
- The second initiative is TDP (Trunk Data Platform), which was developed by EDF (a TOSIT member) alongside the General Directorate of Public Finance (Direction Générale des Finances Publiques).
- The third activity concerns all TOSIT members who had to jointly conceive a governance strategy for open source software efforts, which can eventually be reused inside their respective companies in the future. For our study, we analysed data shared from 5 different corporation who were members of TOSIT as already mentioned above, i.e., Orange, SNCF, Crédit Agricole, RTE and EDF.

Further, TOSIT organizes different workshops as online meetings that treat a certain challenge or a problem that one or all companies faced during their usage/implementation of OSS. They also organise monthly workshops on some main subjects (e.g. social and environmental impact of open source). Different member companies participate in these workshops to make sense of the different subjects and to propose strategies and solutions together. The first author could attend these different workshops during September 2021-August 2022 and some of the data used in this study also comes from the observations and field notes taken during these meetings.

The last type of data collected was around the ecoCode Challenge event. The data for this project was collected from different presentations that were provided by members of the TOSIT who participated. One of the authors of this paper was working at CreditAgricole, which was the nodal member of TOSIT that piloted this event from idea to usage. Hence, we could collect further context information about the event through memos taken in connection with this event organisation.

Data Analysis and Findings

In the figure 2 below, we provide the various data sources and analysis methods in brief. We used thematic analysis with DSI characteristics as *a priori* theoretical lens. First, we categorized project and events within and in collaboration with TOSIT. We then classified projects and events that predominantly led to social innovations and those that predominately led to environmental innovations for both events within and in collaboration with TOSIT. We move on to offer a description of nodal projects/events in this respective higher order identified themes and summarise some governance principles based on these projects and also report on the TOSIT members initiated and participated activities. The data corpus involved information about specific projects/events (See green cells in figure 2). We could gather different kinds of data that were later used for the analysis (See yellow and orange cells in figure 2). We are in the process of continuous data analysis and can only offer descriptive insights in this paper. We further merge these insights into three sections (see red cells in figure 2) as described in the diagram below. In the following subsections, we present our overall findings through this embedded design, which are based on analyses of three key projects/events carried out by TOSIT members and these were linked to two different digital social innovative outcomes.



Environmental Innovation: Using Open Source for Green Code Rules

The ecoCode challenge is a hackathon-like project that took place at the beginning of June, 2022. It brought together some of TOSIT members and other companies (40 partners in total) including AXA France, Groupe BPCE, Wavestone, Simplon to name a few. These partners were collaborating for one single environmental aim: ‘the sustainability of (respective company’s) IT’.

Reducing the environmental digital footprints can be done using different methods. The member of this event, along with other TOSIT members, focused on the umbrella term called “ecodesign or eco conception in programming” used when undertaking Corporate Digital Responsibility (CDR) initiatives (youmatter, 2019). It was like a hackathon. During this hackathon, developers focused on recommending rules that can be implemented in a software of code quality verification. The rules will detect if the code used for a program is a green code or not. All the rules that were developed during this hackathon were added to ecoCode gitHub and “will be implemented in a SonarQube plugin” (Document 5). This code is accessible freely at <https://github.com/cnumr/ecoCode>

During this challenge, member of TOSIT and other companies could come together and free up the time from their developers and contribute to an open source and completely create a free program that can be used for education: this falls under the Quality Education SDG (Goal 4). Moreover, the result of this event was a creation of a new software program that can tell if a given code has a high carbon footprint or not: this falls under the Climate Action SDG (Goal 13). So this collaborative initiative provides an excellent example of both social and “*environmental innovation using open source undertaken by large companies in a collaborative fashion*” (Document 5), under the governance of a non-profit association, i.e., TOSIT.

Social Innovation: Making Alternative Open and Free Software

TDP (Trunk Data Platform) is an open source big data infrastructure project that facilitates and centralises access to data. TDP was developed by EDF and Direction Générale des Finances Publiques (DGFIP) and it is available for public use on GitHub. The source code source of this project is shared. Moreover, EDF and DGFIP share the knowledge they gained while making this project and the step-by-step way to create an open source program and has made it available for public use (<https://github.com/TOSIT-IO>). They shared their expertise with the TOSIT association and in other summits and conferences like OSXP Summit, which were also attended by all TOSIT members.

This shows how members of TOSIT indulge in both investment in terms of time and money despite the open source paradox that we explained earlier. Such organizations and event contribute towards openness and civic-mindedness amongst corporate innovative agents as they “*willingly share the open source software to public, including competitors*” (Document 2). This is a data analytics tool. Creating such as data analytic tools for the use of society can both be an enabler of education and a way to reduce inequalities between social classes. A free and available data analytics tool can be used by small start-

ups wanting to launch their project with minimum cost. We therefore classify this innovation to advance the Quality Education SDG (Goal 4) and the Industry, Innovation and Infrastructure SDG (Goal 9). Therefore, TDP can be considered a digital social initiative that drives innovation in the IT sector and makes knowledge accessible for everyone.

Social Innovation: Sharing Knowledge on Governance of Open Source

Knowledge sharing inside TOSIT is done through the workshops that companies can join and contribute to. Each workshop has a communication channel to facilitate the contribution of each party. Using several TOSIT collaboration tools, the company members could attempt at providing a converged response to understanding the strategic steps to best govern open source in a corporate environment in a collective fashion. Our data analysis of company repositories from the TOSIT SharePoint and the field notes we took during TOSIT workshops, revealed the emergence of the following steps to achieve a successful open source governance:

- Identify OSS of the company: Keep a catalogue of all OSS.
- Identify internal OS experts or hire them.
- Hire service providers.
- Sensitise and acculturate to open source for employees and for directors.
- Keep up with the evolution of the ecosystem by participating in events and join organisations.
- OS first strategy: Considering OSS before looking at traditional software.
- Use and contribute to OS and give back to the community.

A cross case analysis was done to compare the engagement and application of the steps amongst the five chosen corporate members of TOSIT as mentioned above to understand its relevance robustly. Here are our preliminary findings represented through their use and valence within respective company (+ symbol signifies low valence and may also include non-use of the identified step, ++ symbol signifies medium valence with limited use of the identified step, +++ symbol signifies higher valence and intentional use of the identified step) within each of the sub cases. This grid was further presented to a nodal supervisory agent within TOSIT, who validated the same.

Steps	CA	SNCF	Orange France	EDF	RTE
Identify OS Software	++	+++	+++	+++	+++
Identify internal OS experts	+	++	+++	++	++
Hire OSS managers	+	+++	++	++	++
Hire service providers on the subject	++	+++	+++	+++	+++
Sensitise to Open Source	++	+++	+++	+++	++
Keep up with the OS ecosystem	++	+++	+++	+++	++
Implement an “OS First” strategy	++	++	+++	++	++
Contribute to Open Source	+	+++	++	++++	++
Deploy OS Software	+++	+++	+++	+++	+++
Participate in OS workgroups/events	+++	+++	+++	+++	++

Table 2 – Open Source Strategy Enactment (Valence) amongst few key TOSIT members

Due to space constraints, we cannot elaborate on each step in detail. These steps can be considered as a framework that can guide future sustainable participation of corporation when they choose to integrate open source into their own IT departments, thus contributing to knowledge and capability building. This will also pave the way for corporations to give back to the community either by creating their own

OSS or sharing their knowledge through associations like TOSIT. We also confirm that, in the open source ecosystem, *“it is hard to gain expertise when a single company works alone without collaborating with other parties of the ecosystem”* (Document 4). Knowledge sharing is one of the key ways to advance on digital social innovations as a corporation. In fact, the nature of an open source by definition makes it a social and collaborative way of innovation. When looking at the significance of this knowledge sharing workshop and the subsequent open strategy governance framework that we can identify, we can link it to contribution to SDGs. Our results emerging from this initiative falls under Industry, Innovation and Infrastructure SDG (Goal 9) because it gives clear instructions concerning the governance of businesses that want to pursue open source usages in favour of social or environmental innovation. Appendix 2 (figure 3) provides a snapshot of the UN-SDGs that were advanced by TOSIT and its member companies based on the reported findings.

Implications and Conclusion

This short paper presents the preliminary findings from our case study. We investigated how large companies (public and private) who have successfully pivoted and sustained open source initiatives could also contribute to digital social innovations that benefit the entire society. In particular, we describe the naissance of two open source enabled digital social innovations (TDP and ecoCode). TDP is a free data analytic tool that is in the public domain for the use by any firm looking to derive value from data. ecoCode is another open source enabled digital social innovation arising out of the ecoCode Challenge organised by the TOSIT to collaboratively add green code rules on an open source software (SonarQube) that verifies code quality. *This is also widely available for other corporations and organization to use and exploit for environmental audit purposes* (Document 5).

Our study makes two key contributions. First, through this study, for the first time, we demonstrate how corporations can successfully pivot open source initiatives through collaborative projects even with large number of unknown collaborators, thus disregarding any fear of competition especially when such projects are driven to advance UN SDGs (4, 9, 13). We therefore showcase the importance of leveraging public-private partnerships and how might corporations collaboratively tackle the open source paradox as well as contribute to social (and environmental) digital innovations and contribute toward bridging the social inequalities (Nazrul Islam & Winkel, 2017). The findings advance research on open source that has concentrated on understanding motivation of organisations in involving in open source initiatives and project level leadership and governance issues (Wynn Jr, D. E., 2004; Medappa & Srivastava, S. C, 201; Dong & Götz, 2020). This research can also open avenue to further look at open source collaboration for sustaining digital sovereignty strategies of Europe.

Second, we indicate how companies can use collaborative governance approaches through involvement in non-profit associations such as TOSIT and strengthen their internal open source related knowledge and capability on the one hand and also *“make sustainable impact to the society”* (Document 3) and aim to tackle the grand challenges of our society. By exploring various OSS projects, we could uncover the implicit open source governance strategy used by few TOSIT members that democratise how OSS can be best leveraged by other corporations and non-profit entities. It was clear from this study that corporations using open source initiatives need to *“give back to the community by sharing their knowledge”* (Document 1) and helping to contribute to the open source ecosystem as opposed to working in silos yet undertaking open source initiatives. Such sharing would also enable the development of open source ecosystem needed to build a strong digital sovereignty strategy in Europe. Further, we identify how planned knowledge sharing workshops were employed as effective governance mechanism by TOSIT to facilitate knowledge sharing among corporations so they can continue to sustain OSS initiatives in the long run. The practice-focused approach taken in this study offers a novel guide that offers initial clarity to technology managers tasked with undertaking open source initiatives for DSI motives.

We hope to continue our investigation of this phenomenon to uncover further nuances regarding governance structures and process via inter-organisational collaborations such as those described in the projects and understand how corporations can contribute to other SDGs goals and innovated for social good. This paper reports on an applied research project led by a student, an AIS WN member, under the innovative pedagogy tool called ‘the voices of digital native’ initiated by another fellow AIS WN member. The student has received mentorship from scholars and industry tutors to create a real impact to the society. We hope this attempt to bridge the learning gap between the academia and industry through this applied research project enables us to co-construct a brighter digital future for all.

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References

- ApacheCon, 2022. Retrieved September 30, 2022, from <https://www.apachecon.com/sponsors.html#:~:text=Many%20sponsors%20consider%20Apache%20conference,of%20other%20Fortune%20500%20companies>
- Capra, E., Francalanci, C. and Slaughter, S.A. 2012. “Is software “green”? Application development environments and energy efficiency in open source applications,” *Information and Software Technology* (54:1), pp. 60–71.
- Cigref, 2018. Open Source, an Alternative to Major IT providers. Taking the plunge into open source. Retrieved October 12, 2022 from: <https://www.cigref.fr/wp/wp-content/uploads/2019/02/Cigref-2018-Open-source-alternative-to-major-IT-providers-taking-plung-into-open-source-EN.pdf>
- Department of Economic and Social Affairs. 2015. *Transforming our world: the 2030 Agenda for Sustainable Development*. SDGS.UN.ORG. Retrieved September 30, 2022, from <https://sdgs.un.org/2030agenda>
- De Toni, A. F., and Pessot, E. 2021. “Investigating organisational learning to master project complexity: An embedded case study”, *Journal of Business Research*, (129), pp. 541–554. <https://doi.org/10.1016/j.jbusres.2020.03.027>
- Digital Society Lab, 2022. Free and Open Source Software in Europe: A State of Play. Retrieved October 30, 2022 from <https://labo.societenumerique.gouv.fr/en/articles/dossier-free-and-open-source-software-in-europe-a-state-of-the-state/>
- Dong, J. Q. and Götz, S. J. 2020. “Project leaders as boundary spanners in open source software development: A resource dependence perspective”, *Information Systems Journal*, (31:5), pp. 672–694. <https://doi.org/10.1111/isj.12313>
- Haefliger, S., von Krogh, G. and Spaeth, S. 2007. “Code Reuse in Open Source Software,” *Management Science* (54:1), pp. 180–193.
- Halkias, D., and Neubert, M. 2020. “Extension of theory in leadership and management studies using the multiple-case study design,” *International Leadership Journal* (12:2), pp. 48–73.
- Hecker, S., Haklay, M., Bowser, A., Makuch, Z., Vogel, J. and Bonn, A. 2018. *Citizen Science: Innovation in Open Science, Society and Policy*. UCL Press, London. <https://doi.org/10.14324/111.9781787352339>
- Ke, W. (n.d.). *The Effects of Extrinsic Motivations and Satisfaction in Open Source Software Development*. AIS Electronic Library (AISeL). Retrieved October 25, 2022, from <https://aisel.aisnet.org/jais/vol11/iss12/5/>
- Mahmoudi, D., and Seltzer, E. 2012. “Citizen Participation, Open Innovation, and Crowdsourcing”, *Journal of Planning Literature* (28:1), pp. 3–18. <https://doi.org/10.1177/0885412212469112>
- Medappa, P. K., and Srivastava, S. C. 2019. “Does Superposition Influence the Success of FLOSS Projects? An Examination of Open-Source Software Development by Organizations and Individuals,” *Information Systems Research*, (30:3), pp. 764–786. <https://doi.org/10.1287/isre.2018.0829>
- Nazrul Islam, S. and Winkel, J. 2017. *Climate Change and Social Inequality*. Department of Economic & Social Affairs, 152 https://www.un.org/esa/desa/papers/2017/wp152_2017.pdf
- Ozman, M., and Gossart, C. 2017. *What are digital social innovations? The Conversation*. Retrieved October 21, 2022, from <https://theconversation.com/what-are-digital-social-innovations-79066>
- Redhat, 2022, *Open source in education*. (n.d.). Retrieved September 30, 2022, from <https://www.redhat.com/en/about/open-source-education/educators>

Roberts, J. A., Hann, I.-H., and Slaughter, S. A. 2006. “Understanding the motivations, participation, and performance of open source software developers: A longitudinal study of the apache projects,” *Management Science* (52:7), pp. 984–999.
<https://doi.org/10.1287/mnsc.1060.0554>

Schmiedeknecht, M. H. 2019. Social Innovation and Entrepreneurship Supporting the Sustainable Development Goals (SDGs)–Fostering Social Value Creation. *The Future of the UN Sustainable Development Goals*, pp. 211–225.
https://doi.org/10.1007/978-3-030-21154-7_10

Simons, H. 2009. *Case study research in practice*, London: Sage.

Stewart, D. and Kamins, M. 1993. “Secondary Research: Information, Sources, and Methods, Thousand Oaks”, CA: Sage Publications.

Sy Diop, K.A. and Liu, E. 2020. “Categorization of case in case study research method: new approach,” *Knowledge and Performance Management* (4:1), pp. 1-14.

United Nations, General Assembly 2015. *United Nations transforming our world: The 2030 agenda for sustainable development (A/RES/70/1)*. Retrieved from
<https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf>.

Vaughan-Nichols, S. 2019. *Microsoft developer reveals Linux is now more used on Azure than Windows Server*. Zdnet. <https://www.zdnet.com/article/microsoft-developer-reveals-linux-is-now-more-used-on-azure-than-windows-server/>

West, J. and Gallagher, S. 2006. “Challenges of open innovation: the paradox of firm investment in open-source software”, *R and D Management*, (36:3), pp. 319–331.
<https://doi.org/10.1111/j.1467-9310.2006.00436.x>

Dahlander, L. and Wallin, M. 2021. *Why Now Is the Time for “Open Innovation.”* Harvard Business Review. Retrieved from <https://hbr.org/2020/06/why-now-is-the-time-for-open-innovation#:~:text=Open%20innovation%20has%20the%20potential,potential%20in%20long-lasting%20relationships>

Wikipedia contributors 2022. *Microsoft and open source*. Wikipedia. Retrieved September 30, 2022, from https://en.wikipedia.org/wiki/Microsoft_and_open_source

youmatter. 2019. *Eco Design: Definition, Examples, Principles*. Youmatter. Retrieved September 30, 2022, from <https://youmatter.world/en/definition/definition-eco-design-examples-definition/>

Yin, R. K. 1989. *Case study research: Design and methods*. London: Sage.

Wynn Jr, D. E. 2004. *Leadership and motivation in open source projects*. Leadership, 3, 1-2004.

Appendices

Appendix-1

Document Code	Data Collected	Raw Data Origin
Document 1	Ppt file: Orange Strategy for OS	Company repositories from TOSIT
Document 2	Ppt file: TDP presentation	OSXP Summit
Document 3	Notes from workshop “Digital Responsibility”	Field Notes from TOSIT Workshop
Document 4	Notes from workshop “Support”	Field Notes from TOSIT Workshops
Document 5	PowerPoint file: ecoCode REX	ecoCode Event
Document 6	Ppt file: Open Source (SNCF)	Company repositories from TOSIT
Document 7	Ppt file: AEG ConvergenceApplicative	Company repositories from TOSIT
Document 8	Notes from workshop “Exploitation Strategy”	Field Notes from TOSIT Workshops
Table 3 – References gathered from documentation and field notes.		

Appendix-2

