

Value-driven industry transformation: Leveraging open-source to establish new standards

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Abstract. Traditional industries face growing pressure to digitally transform. In particular, established organizations must adopt new mindsets and act to remain competitive. To counter the challenges posed by monopolies and new entrants in a diverse and fiercely competitive landscape like Logistics, the Open Logistics Foundation (OLF) plays a pivotal role. It aims at fostering the development of logistics-specific open-source-software (OSS) to establish new digital services setting industry standards and ensuring enhanced connectivity and compatibility. The OLF represents an expanding core-community of dedicated logistics organizations. This core-community collaboratively identifies, selects, and develops relevant OSS for upcoming value-serving digital services and solutions. What sets this approach apart is its departure from the traditional solution-oriented open-source model. Instead of concluding with an OSS community, it starts with a dedicated core-community aiming at setting new widely adopted standards. However, even with this standard-driven approach, designing the right solution can be as challenging as finding a unicorn. To enhance the likelihood of success, this paper designed and evaluated the Minimum Viable core-Community driven Open-Source method (MV-COS). The MV-COS offers a comprehensive and standardized support allowing to holistically craft the vision, stakeholder-specific value propositions, and the corresponding implementation strategy of OSS projects. It prioritizes the early design and assessment of its likelihood to attract and align a critical mass of users which is the fundamental requirement for establishing new de-facto standards. The MV-COS enables to fail fast and iterate early, avoiding the unnecessary expenditure of resources.

1 Introduction

In today's rapidly digitalizing landscape, established industries and organizations face the double-edged sword of digitalization [1, 2]. On the one hand, it multiplies the potential for up-and-coming start-ups to break into traditional sectors with unparalleled ease [3, 4]. On the other hand, it poses an existential threat to incumbents, challenging the viability of their long-standing business models [5, 6].

Thus, industry transformation in the era of Industry 4.0 is not a question of 'if', but 'when'. For example, digital platforms drive this transformation, facilitating broad integration across supply chains [7]. They have catalyzed disruptions enabling newcomers like Uber

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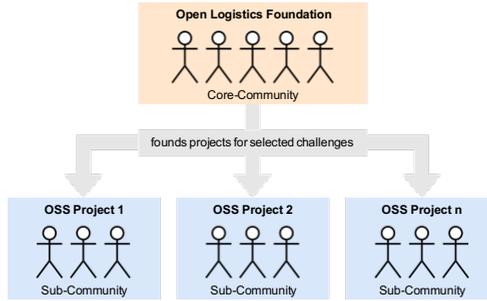


Figure 1. Structure of the Open Logistics Foundation

to challenge traditional industries, particularly in commodity markets favoring low prices and convenience [8, 9]. This precarious position, for many established organizations, necessitates not just rapid adaptation, but a radical reshaping of their strategy [10].

This dynamic is also shown in the European logistics sector - a heterogeneous industry comprising up to a million organizations marked by intense price competition and minimal collaboration [4, 11]. With disparate levels of digital maturity across its spectrum, the industry provides limited avenues for differentiation [12]. The emerging digital landscape, however, introduces the threat of digital monopolies that could disrupt the existing equilibrium [4, 13]. To prevent this it requires robust competition and new levels of collaboration.

This paper addresses this ongoing transformation and its challenges. Central to our proposition is the power of digital standardization to establish greater compatibility and connectivity [14]. While established standards are like “unicorns” - rare, perfect solutions that arrive at the opportune moment - relying on serendipity is a luxury the industry cannot afford. Instead, it necessitates a more proactive approach: the deliberate cultivation of new digital services setting industry standards to empower and connect established organizations.

In this context, the Open Logistics Foundation (OLF), an independent association within the logistics industry already consisting of 28 member organizations representing today’s core-community, introduces an innovative approach. Moving away from in-house developments and proprietary software solutions it aims at establishing a committed core-community of logistics organizations aiming at collaboratively selecting, developing, offering and adopting logistics-specific open-source-software (OSS) to set the basis for new industry-wide digital services (see Figure 1). OSS “is software with its source code available that may be used, copied, and distributed with or without modifications, and that may be offered either with or without a fee” [15, p. 1463]. It emerges as a suitable approach, renowned for its accessibility and adaptability.

The OLF is a pioneer striving to transform a traditional industry through the collaborative development of OSS-driven commodity services. This approach promotes compatibility, reduces costs, and streamlines efforts [16]. Logistics organizations supporting this vision can join OLF as members. The resulting core-community establishes guidelines for member onboarding, governance, development standards, software quality, and approved OSS licenses. Together, they identify, assess, and select the most valuable commodity services. For each sought-after commodity service, an OSS project is initiated, which gets shaped by keen OLF members operating as a sub-community (see Figure 1).

This is a unique and pioneering approach as “(t)ypically, an open-source project starts with a single programmer solving a small problem (e.g., a malfunctioning system affecting his own work) that later turns out to be significant, and then makes the solution available to

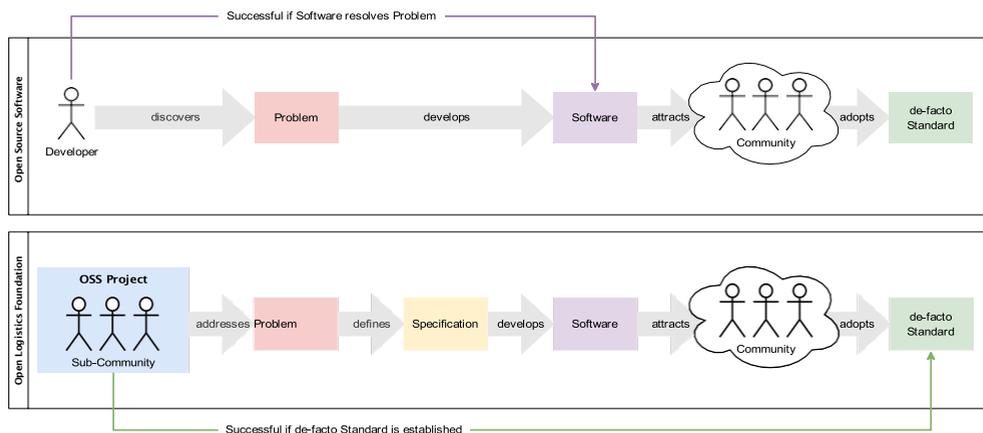


Figure 2. Traditional OSS approach vs. the OLF’s OSS approach.

others” [15, p. 1464]. The OLF reverses this traditional OSS project trajectory by applying a structured top-down strategy. In contrast to commencing with a solution addressing a pressing challenge which might become popular and potentially attracts a community, it advocates to kickstart with a robust core-community of logistics stakeholders designing the specifications for the de-facto standard and collaboratively engaging in developing it. In other words, the process is initiated with a committed core-community, as opposed to ending with one [17]. However, the greatest difference lies in the measurement of success. While OSS projects following the traditional approach are *successful if software resolves problem*, OSS projects in the context of OLF are just *successful if de-facto standard is established* (see Figure2).

Thus, *effectively* implementing OLF’s reversed strategy calls for the thoughtful design of a core-community and its sub-community led OSS projects. OLF should tackle a growing range of relevant logistics challenges, *offering* solutions that drive change by setting new industry benchmarks. Given the logistics industry’s heterogeneous nature setting new standards is a particularly ambitious and challenging endeavor. Thus, the sub-communities must address the selected challenges comprehensively, ensuring they appeal to a *sufficiently* large group of stakeholders. This is the prerequisite for creating solutions tailored to industry needs, setting the stage for a successful industry transformation. To achieve that demands careful planning and execution. We assume that a strategic method supporting the stepwise and multi-stakeholder design of de-facto standards is essential leading to our research question:

“How to design value-driven OSS projects to significantly increase the odds of establishing new industry standards to steer the industry transformation?”

Our research aims to provide a comprehensive roadmap for the digital evolution of the logistics sector, harmonizing the collective efforts with the democratizing essence of OSS. To support the individual sub-communities in designing *effective* OSS project strategies, we introduce the Minimum Viable core-Community Open-Source method (MV-COS). It emphasizes the importance of including the envisioned users and their specifications, ensuring the final software product not only meets but exceeds set requirements, gaining the critical mass of users essential for establishing a standard. Furthermore, it sets out to integrate and align the initiators, contributors, and users of the OSS projects.

The structure of the paper: The paper begins with an introduction, followed by the related work in Section 2. Section 3 explains the methodology, while Section 4 introduces the OLF use case, the MV-COS, and the corresponding workshop study. The MV-COS gets evaluated in Section 5. Section 6 discusses the findings, and finally, the conclusion, limitations, and future work are presented in Section 7.

2 Related Work

This section covers two areas of related work. First, diving into standards to get a better understanding of the OLF's objective for the Logistics sector. Second, open-source as it is the technology and environment of choice for collaboration and distribution by the OLF.

2.1 Established (Software) Standards

According to Merriam-Webster's dictionary, a standard is "something established by authority, custom, or general consent as a model or example" [18]. Today's heavily intertwined economy is not conceivable without proper standards since standards enable seamless collaboration by relying on clearly defined interfaces and specifications. This holds true for traditional sectors, like logistics, to innovative business models emerging from the internet. Following, we provide three examples for (software) standards which had a major impact on the success in their respective sector.

ISO-Containers are standardized stackable shipping containers used in international logistics easing the transportation of cargo via truck, train, and ships. The ISO standard 668 by the International Maritime Organization in 1968 defines their specification and dimensions. Part of this specification is not only the construction form or size, but their identification markings, which enables tracking each container worldwide. Today, ISO-Containers are also used outside of the logistics sector, e.g., for tiny houses and pop-up stores [19].

Job Definition Format (JDF) is an open file format for the exchange of data in the application domain of the printing industry. It is based on the Extensible Markup Language [20] and maintained by the International Cooperation for the Integration of Processes in Prepress, Press, and Postpress with over one hundred members [20]. The first concept of JDF was published in 2000 by Adobe, Agfa, Heidelberger Druckmaschinen AG, and MANRoland. It unifies existing formats, e.g., Portable Job Ticket Format and Print Production Format, under one format [21] with the goal of establishing an industrial standard. Using JDF as the default format helps to remove inefficiencies when passing data along the chain of manufacturing steps [21] and allows vendor-independent workflow automation.

Hypertext Transfer Protocol (HTTP) is one of the principal protocols of the World Wide Web [22] and defines the communication between web browsers and web servers. The groundwork of HTTP was laid by Tim Berners-Lee at the European Organization for Nuclear Research in the late 1980s. The first official specification of HTTP was released in 1991 as version 0.9 [23]. 30 years later, HTTP has become a de-facto standard for exchange of data between network devices (e.g., in IoT-devices) and surpassed its use-case originating in the Web. In 1994 the World Wide Web Consortium (W3C) was founded to manage and steer the further development of HTTP and related technologies.

These three examples illustrate the variety of origin stories for new standards:

- From ISO-Containers, specified by ISO norms in the late 1960s and still the backbone of modern logistic, to
- JDF, a unification of existing solutions to an established standard by corporations in industrial printing, and

- HTTP, simplifying the exchange of information between researchers which became one of the most important computer protocols curated by the W3C.

The OLF's goal is to establish a family of software standards for the logistics sector, similar to the JDF in the printing sector. Following the example of HTTP (virtual) and ISO-Containers (physical), those standards were essential to achieve the seamless exchange of information and goods in a global and inter-organization setting.

2.2 The Open-Source Lever

“Openness” has a major impact on information systems leading to the exploration of new research streams, such as open source or open innovation [24, 25]. OSS is the earliest example that connects the concept of openness with IT by sharing source code among diverse entities [24–26]. The concept fosters transparency and collaboration allowing users to review, use, modify, and distribute their source code [15]. Thus, OSS enables a multitude of strategic potentials. For example, adopting OSS can fuel value creation through network effects as the producers and adopters increase the value of the software [16, 27]. Furthermore, organizations can harness innovative ideas from the OSS community [28, 29]. In each case, the OSS community is the key to enable strategic potentials [16]. Therefore, “community over code” is a common mantra in OSS communities as it ensures the success of an OSS project [30].

AlMarzouq et al. [16] describes three different approaches that an organization can use to get involved with OSS: The software-centered approach (user), the community-centered approach (contributor), and the license-centered approach (initiator). The software-centered approach focuses on the passive use of OSS without actively participating in the broader OSS community. Taking the user role allows organizations to leverage OSS, customize it according to their specific needs, and enhance internal processes and software efficiency. The community-centered approach goes beyond adopting OSS and describes a strategy in which organizations take the role of a contributor in the OSS community [16]. In contrast to the software-centered approach, the organization participates in the project's development processes and contributes internal software code [31]. The license-centered approach describes organizations that act as initiator of an OSS project by providing OSS or creating an OSS community to develop a new solution. This approach is attractive to experienced organizations aiming at strategically utilizing OSS, e.g., to improve their competitive position [16]. Since the OLF aims to set new de facto standards, it chooses the license-centric approach, but at the same time must ensure that the other two approaches are also covered in order to attract sufficient contributors and users.

3 Method

Creating OSS projects aimed at setting new standards requires large, interdisciplinary teams and calls for strategic alignment among all stakeholders. Canvases, as proposed in this paper, can streamline these complex projects. They break down the intricate design process into manageable building blocks, simplifying communication and reducing overall complexity [32]. This encourages and eases brainstorming and the collaboration among the participants.

Figure 3 shows the design of the Minimum Viable core-Community driven Open-Source method (MV-COS). It consists of three hierarchy levels and five canvas-types forming a holistic approach. However, already single levels or canvases support the users. The method of this paper follows Hevner's three-cycle view [33]: Covering conceptual literature, the team's OSS expertise, project notes, and practitioner feedback connecting the relevance, design, and rigor cycles.

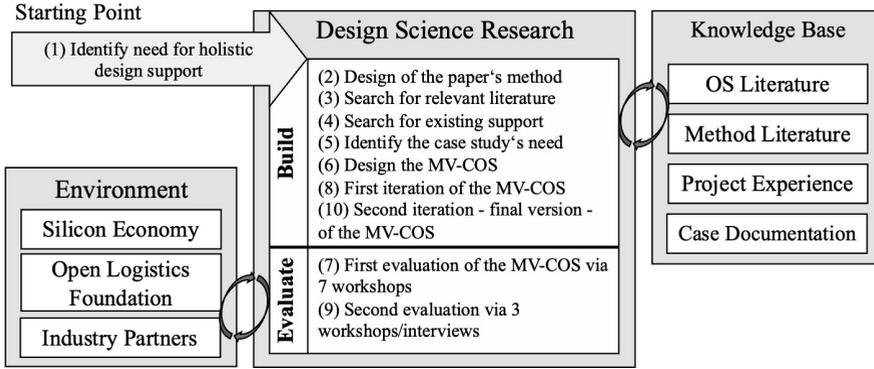


Figure 3. Paper's method following Hevner's Three Cycle View

Our case study pinpoints the need for a specialized yet holistic approach that can tackle the intricate task of designing a dedicated OSS project to set new industry standards (relevance – step 1). To address this need, we design the method of the paper (design – step 2), combining literature review with use case insights and our project experience. This approach creates a knowledge base of the OSS community (design) for industry transformation (rigor – step 3 & 4).

Our aim is to craft a holistic method stepwise supporting the design of the vision, value, and implementation aspects of an OSS project while tailoring the support to the unique roles of the initiator, contributor, and users (design – step 5). The MV-COS is versatile and adaptable to specific case settings. Therefore, we match case study requirements with dedicated ‘building blocks’ resulting in the first version of the MV-COS (step 6).

We evaluate MV-COS in two rounds of workshops with higher managers of Logistics organizations which are part of OLF's core-community (relevance – steps 7 & 9). Workshops are a commonly accepted tool for assessing artifacts, as they provide qualitative feedback from participants [34, 35]. The first round of workshops consisted of seven workshops (step 7) and the second of three (step 9). All workshops were conducted as interactive online sessions adopting and evaluating the MV-COS. The workshop's standardized structure supported the correct adoption of the MV-COS. This is important to evaluate and validate its lever.

Based on the gathered feedback of the first seven workshops we iterated the MV-COS, especially focusing on level 3 - implementation (design - step 8). Section 4.2 presents the final version of the MV-COS which was evaluated and iterated based on the feedback of the three additional workshops (design - step 10; see Figure 4).

4 Minimum Viable core-Community driven Open-Source method

This Section briefly introduces OLF as case study before introducing the MV-COS and its three hierarchy levels. After the introduction of the MV-COS section 4.3 describes the workshop setting adopted to apply, test and evaluate the MV-COS with OLF-members.

4.1 The Case Study – The Open Logistics Foundation (OLF)

OLF is a non-profit operating foundation aiming at revolutionizing logistics [36]. Established in 2021, it promotes cross-industry standardization via collaboratively developing and

adopting logistics-specific open-source software and hardware. The foundation manages an open and neutral GitLab instance¹ where all developed components are freely available via repositories. This is envisioned to boost competitiveness, enabling new business models and collaboration [37, 38].

OLF's unique core-community approach fosters the collaborative creation of standards, tools, and services, which can be used commercially by any organization. This OSS approach aims at accelerating digitalization in logistics, allowing easy, low-risk access to new technologies and fosters the creation of tailored solutions. Further, it channels resources into the most value-adding components maximizing the OSS lever.

Independently funded through member fees by its support association, OLF e.V. operates under European law. It guarantees neutrality in software development and free access to everything developed by the core-community. OLF invites Logistics organizations to join their collaborative efforts, driving OSS projects to address specific logistics issues and core business areas. Adopting the license-centered approach, OLF created a permissive OSS license.

4.2 The Design of the MV-COS

The process of planning and designing OSS projects is a complex endeavor. Typically, the community of an OSS project comprises three roles: the initiator, the contributors, and eventually, the users. However, success is not automatic. Unlike merely developing a great solution for its own purpose, the OLF sets out to establish new standards (see Section 2.1) which requires to attract a critical mass of users. Thus, the OSS projects must be attractive and beneficial to a wide range of stakeholders. This task is complex as it involves designing OSS projects from the perspectives of all three roles across three stages: (1) the overall vision, (2) the value proposition specific to each stakeholder/role and their corresponding requirements, and (3) an implementation strategy aligning all goals and preconditions.

Thus, this pioneering approach demands the identification of appealing and relevant challenges that not only boost community growth but also attract a critical mass of users to set new standards. Equally important is the identification of suitable partners who can both initiate and contribute to the community. Together, they design and develop solutions that serve the community's needs. Navigating this complex process requires significant time and a shared understanding that directs effective communication among all involved stakeholders.

In response to these complexities, we introduce MV-COS, which is composed of hierarchical and interconnected canvases (see Figure 4). It aims at a comprehensive step by step yet minimalistic design allowing for a streamlined focus on the most essential aspects to achieve minimum viability. It reveals the complexity and makes it tangible and understandable. The MV-COS starts with a shared vision (why), moves to individual benefits and values (what), and culminates in a shared implementation strategy (how).

The MV-COS provides a forum for open discussion facilitating the negotiation of solutions that accommodate everyone involved. What distinguishes this approach is its ability to highlight all critical decisions that must be made collaboratively. It helps the community initiators to concentrate on the most essential aspects, such as a convincing value proposition, and quickly spotting any diverging needs or misunderstandings during the subsequent phases. This strategy promotes a "fail fast and adapt early" mindset, allowing for quick iterations and problem-solving. Thus, if preconditions are contradictory, or the effort outweighs the benefits, these challenges can be addressed promptly.

Once a robust design is finalized, it guarantees alignment among all partners, facilitating a smooth initiation of implementation. This collaborative method of designing OSS projects

¹<https://git.openlogisticsfoundation.org>

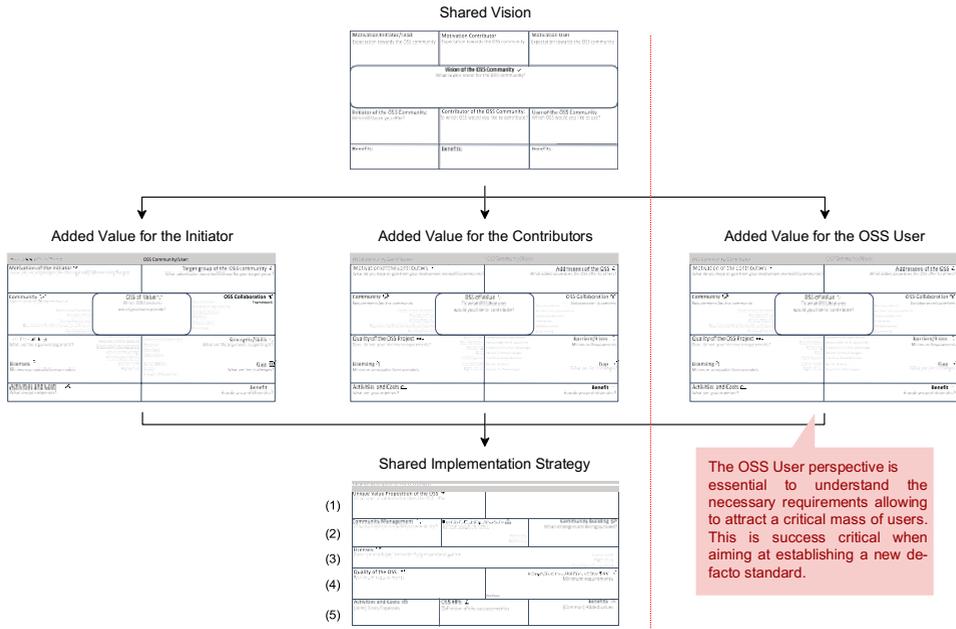


Figure 4. The Minimum Viable core-Community driven Open-Source method (MV-COS)²

not only simplifies the process but also ensures that all stakeholders’ unique needs and conditions are considered, thereby nurturing an engaged community.

Now we describe the MV-COS and its three hierarchy levels (see Figure 4):

Shared Vision: At this level the vision of the OSS project gets defined, considering the motivations of the initiator, contributors, and targeted users. All are asked to outline what they can *offer* and the benefits they envision. This allows for an immediate assessment of the cost-benefit ratio for all involved roles and stakeholders.

Value Design: Here, three slightly customized versions are designed tailored to the differences of the three roles. While the initiator needs to ensure that the other roles are motivated and benefit from the value, they must also comprehend the targeted users to create a *sufficiently* large community. This combined understanding leads to the definition and requirements of the OSS project’s value, collaboration, barriers, strengths, skills, licenses, gaps, costs, and benefits. In contrast, the contributors focus more on their requirements, especially in terms of the quality required by the OSS project. Despite users not having direct influence at this stage, it is crucial to gain a realistic understanding of their needs, the approach to integrating OSS, minimum quality requirements, and criteria for joining the community since the adoption by a critical mass of users is a prerequisite for establishing standards.

Shared Implementation Strategy: This stage aggregates all information from the previous stages in five steps (see Figure 5):

1. *Value Proposition:* Describes what the project aims to achieve by outlining the unique value proposition of the OSS and summarizing the user’s requirements.

²Find the source files of the MV-COS canvases here:
https://osf.io/4v3zm/?view_only=86780b41ac9e4ff5b766582b351bfd34

| Detailed description of the OSS project | | |
|---|---|---|
| (1) | Unique Value Proposition of the OSS [⚡] What special added value does the OSS offer? | User Requirements What requirements do users have for the OSS? |
| (2) | Community Management [👥] What is the structure of the community? | Decision-making structure ^{⚙️} ^{***} Who has which rights? Democracy Meritocracy |
| (3) | Licenses [📄] Description of the license incl. rights and obligations | Community Building ^{🏗️} What strategies are being pursued? License model Rights of use Country-specific regulations |
| (4) | Quality of the OSS ^{***} Minimum requirements | Integration Possibilities of the OSS [🔌] Minimum requirements Interfaces |
| (5) | Activities and Costs [💰] | OSS KPIs Definition of the success metrics |
| | | Benefits [📈] (Common) Added values |

Figure 5. Shared Implementation Strategy Canvas (see overview in Figure 4)

2. *Governance Structure:* Discusses the requirements for community management, decision-making structures, and community building, emphasizing the importance of devising strategies suitable for the context.
3. *Legal:* Addresses the licensing of the OSS project impacting the appeal of the OSS project. All partners need to understand usage rights and country-specific regulations.
4. *Technological Requirements:* Covers the minimum feature and quality requirements for the OSS, and the ease and openness of its integration, e.g., APIs.
5. *Value Capture:* Evaluates the cost-benefit ratio. Only if the OSS project leans towards the benefits/value side, the OSS project should be approached.

The Shared Implementation Strategy Canvas is a strategic tool designed to integrate and assess information from the two preceding hierarchical levels. Its structure, comprising five steps and associated blocks, serves as a comprehensive aggregator of prior information and decisions. This layout facilitates immediate identification of consensus and discrepancies among stakeholders, showcasing areas of alignment and divergence at a glance.

Enabling rapid identification of decision areas lacking consensus is the canvas’ primary objective. This feature promotes early iterations, driving stakeholders into discussions and negotiations to reach a unified agreement. The iterative process continues until consensus is achieved or, in the case of failure, stakeholders gain a clear understanding of the disagreement’s nature. This understanding may lead to exploring broader options, such as engaging additional partners or adopting alternative approaches.

To reveal potential conflicts as early as possible during the design phase of the collaboration is the objective of the third and final hierarchy level of the MV-COS. This proactive approach aims to prevent stagnation or failure of the selected OSS projects during implementation or post-completion. By ensuring the transparent and collective design from the start, the canvas clarifies expectations and responsibilities, fostering a tangible and collaborative implementation process.

An important aspect of the Shared Implementation Strategy Canvas is its feedback mechanism. Decisions and compromises made at this third level necessitate revising the second level's information and decisions. This bottom-up correction aligns the stakeholders' unique value designs with the agreed-upon compromises, ensuring that these adjustments still support the envisioned strategies and business models.

For the canvas to be *effective*, all three hierarchy levels and their interlinked canvases must integrate into a cohesive and fitting representation. If this integration fails, the project risks failure. Moreover, involving potential future users in the discussion is crucial. Their participation ensures that the OSS project caters not just to the core community but also appeals to a broader user base, essential to for achieving widespread adoption.

It is noteworthy that each canvas within the framework can function independently as a decision-making tool. This flexibility allows individual stakeholders to adopt a specific canvas and/or hierarchy level for internal brainstorming or preliminary discussions across organizations. However, to truly leverage the MV-COS it should be fully and collectively adopted with the essential stakeholders. This comprehensive adoption fosters a holistic approach, maximizing the tool's *effectiveness* in facilitating collaboration and decision-making.

4.3 Application

After designing the MV-COS based on literature review findings and our project experiences, we iteratively tested and evaluated it across ten workshops. The initial seven workshops emphasized the practical relevance of the shared vision and value design canvases. We engaged participants from all three roles: initiator, contributor, and user. We subsequently consolidated and assessed the results. Each workshop lasted 90 minutes and was conducted digitally using Microsoft Teams. They adhered to a consistent format that included a brief introduction, a step-by-step guide through the three interconnected canvas levels, an analysis of OSS-specific barriers and recommendations, and a segment for the participant's feedback.

At this stage of the research the focus was on testing the applicability and usability of the MV-COS. To truly focus on these objectives the workshops were conducted with one participant each to observe their adoption of the MV-COS and get deeper insights into the results (filled out canvases) and the participants' final feedback.

Initially, participants completed the *Shared Vision Canvas*, detailing their organization's specific vision relative to their role in the OSS project. They were also prompted to articulate the motivations of the other two roles, either the initiator, contributor, or user, fostering a comprehensive understanding. This approach facilitated a first assessment of the cost-benefit ratio of all roles and stakeholders.

Then we assessed the three *Value Design Canvases*, each tailored specifically to one of three roles, revealing the stakeholders' diverse intentions and conditions in the OSS project. Today, OSS initiatives are comparatively under-researched in the logistics industry explaining why we expanded the workshop to address OSS barriers and recommendations.

All insights were used to refine the *Strategy Implementation Strategy Canvas*. It was evaluated and validated in a second round of workshops which mirrored the format of the first round. These three workshops were conducted with three OSS strategy experts.

5 Evaluation

This section summarizes the evaluation and feedback accumulated over all ten workshops. Participants emphasized the importance of a shared vision to align *efforts* and onboard all stakeholders successfully. They found the vision canvas to be particularly valuable, serving

as a tool to uncover stakeholder motivations and define a collective vision. This, in turn, facilitated resource allocation and collaboration. Participants stressed the need to establish a shared understanding of the OSS concept among all stakeholders to counter the limited OSS knowledge within the logistics industry.

While working on the first OLF OSS project the workshop participants recalled that several critical aspects arose in an unstructured manner, leading to repetitive discussions. Here, they highlighted the utility of the value canvas, providing a clear and standardized structure which is especially useful in the early stages of designing OSS projects. Clarifying the target audience of the OSS solution - including users not represented in the early design stages of OSS projects - was deemed crucial, particularly in traditional industries with highly heterogeneous yet essential user groups. This clarity was perceived as essential for building OSS communities of a critical size, a primary goal of the value canvas.

The strategy implementation canvas was considered vital for defining stakeholder requirements in advance ensuring holistic problem-solving. While user requirements were based on the previously filled out value canvases, some participants noted the challenge of defining technical requirements. However, the consensus was that the canvas was helpful, with each block being essential at different stages of the project.

In contrast to the software industry, participants stated that logistics actors often lack experience in OSS projects. Therefore, various aspects, including legal, social, and economic considerations, must be addressed before starting an OSS project to overcome barriers such as licensing. Participants stressed the need for best practice guidelines, interdisciplinary collaboration, and accessible offerings to lower entry barriers.

In the observed use case, the first OSS project lacked a structured approach, relying on the knowledge of experienced participants. The participants noted that an approach like the MV-COS would have been helpful as it would have eased transparency and shared understanding among all involved and targeted stakeholders. In addition, the MV-COS has the potential to also increase structure, standardization and thus improve reproducibility.

Suggested areas for improvement include a greater focus on technical aspects, tailored to the project's development phase. Here, further refinements on the essential building blocks are an interesting avenue for further research. Thus, the study highlighted the critical role of vision, user value, and role-based considerations in OSS projects and underlined the applicability and usefulness of this holistic approach allowing and easing stakeholder alignment.

In summary, the participants found the MV-COS very useful. It yielded important insights for the development and implementation of OSS projects aiming at setting new de-facto standards. Participants emphasized that their ambitious goal requires a clear and structured vision to align stakeholders from the start. Here, it is essential to create value for users to foster community growth and address the diverse core requirements of the essential stakeholders. Further, it is vital to recognize the varied roles within OSS communities and ensure early awareness of the user base.

6 Discussion

The transformation of industries, particularly through a digital lens, presents countless challenges, intensified when attempting to copy the approach of the OLF as a pioneering model. The primary challenges stem from:

Complexity of the Endeavor: Industry transformation is not merely about introducing a new technology or system. It is about redefining the foundation on which industries are built, reshaping long standing practices, and reimagining business norms.

Heterogeneity of Stakeholders: A single industry encompasses a broad spectrum of mind-sets, expertise levels, and stakeholders. Aligning them towards a unified vision is challenging. Every stakeholder brings a unique set of competencies and requirements. Managing this diversity can be frustrating.

End-users vs. Software Engineers: One significant deviation from traditional OSS approaches lies in the target audience. Traditionally, OSS caters to software engineers easing their developmental tasks. In contrast, industry transformation via OSS targets “end-users” like logistics experts, drivers, etc. The tools and solutions developed should, therefore, be user-centric, addressing especially real-world challenges rather than just coding intricacies.

Redefining Business with OSS: It is essential to recognize that this is not just about creating software; it is about crafting solutions that have a direct impact on business processes. OSS in this context becomes a pipeline for new collaborative services, innovative solutions, and a change in the traditional modus operandi.

When we pivot to the subject of establishing OSS communities, the focus is often dual-faceted. On one side, there is the traditional approach, where communities form to address their immediate challenges, hoping that their solutions gain traction. On the other, there is the purpose-driven approach, where communities form explicitly to design standards for broader industry compatibility.

The latter approach gets supported by MV-COS guiding the OSS project design, offering several advantages:

Addressing Real-world Challenges: The primary objective remains addressing specific industry challenges. This user-centric approach ensures that those on the ground - e.g., the stakeholders of the logistics industry like logistics experts, drivers, and other end-users - benefit directly from the solutions developed.

Stakeholder Expectation Management: Capturing the anticipations of all stakeholders ensures that solutions are developed with a holistic understanding of user needs, ensuring that the final tools are functional and practical.

Requirement Pre-definition: The MV-COS supports the early identification of stakeholder requirements, streamlining the development process and ensuring that the resulting solutions are aligned with industry needs.

Interdisciplinary Collaboration: Encouraging collaboration among stakeholders from various disciplines fosters a holistic approach to solution development. It ensures that solutions are not just technically sound but also viable.

In response to our research question (see Sec. 1), the transformation of industries, particularly using the OLF’s pioneering approach, presents unique challenges that necessitate a rethinking of traditional OSS paradigms. Emphasizing end-users, achieving stakeholder alignment, and fostering interdisciplinary collaboration to significantly increase the odds of establishing new industry standards. Here, the adoption of the multi-canvas MV-COS to design value-driven OSS projects is critical for success. The MV-COS provides a dedicated and standardized structure for designing value-driven OSS projects, seamlessly integrating the visions, goals, and conditions of all involved stakeholders. By ensuring stakeholder alignment and onboarding from the start, it simplifies collaboration and notably enhances the overall value of the OSS project.

7 Conclusion & Future Work

The OLF approach is unique in its innovative and pioneering strategy to achieve the long due digital transformation of the logistics industry. It fosters the close collaboration in the selection and development of logistics-specific OSS. Unlike traditional OSS projects that typically

start with individual programmers solving specific problems, the OLF reverses this trajectory by applying a structured top-down strategy. This approach is distinct in its commitment to start with a committed core-community of logistics stakeholders, design solutions that address pressing industry challenges comprehensively, and promote the collaborative development of logistics-specific OSS. It sets the stage for the successful industry transformation and aligns with the unique needs of the logistics sector. This study made valuable contributions to both the academic and practical understanding of the holistic design of OSS projects. It emphasizes the need for stakeholder alignment when following a standard-driven rather than traditional OSS approach (see Figure 2).

Regarding **scientific contributions**, our research systematically described, recorded, and analyzed OSS projects and derived a holistic approach towards designing OSS projects when introducing and adopting the MV-COS (see Figure 4). The MV-COS asks to design OSS projects from vision, stakeholder-value to its holistic implementation. It underlines the importance of interdisciplinary collaboration to ensure that the OSS project delivers functionalities/features of value for new digital logistics services and solutions. This contrasts with today's mostly software- and development-driven focus on OSS and OSS application.

With respect to **practical contributions** the study provides a blueprint for the successful design and deployment of OSS projects with a focus on standards and user requirements. It highlights the potential of OSS as a lever for digital services and emphasizes its role as an alignment tool to foster collaboration among diverse stakeholders.

A key **limitation** is that the study's workshop participants came from an environment already familiar with OSS, potentially skewing the findings toward a more positive view of OSS adoption. Additionally, the study primarily focused on IT-heavy interview partners, which may not fully capture the broader challenges of introducing the OSS-based digital services into practice requiring the acceptance and adoption by non-technical stakeholders.

Furthermore, the absence of recorded barriers before the decision to "go open source" leaves questions unanswered regarding why some organizations do not readily embrace OSS solutions. The technical implementation aspect, downplayed in some of the workshops, remains a potential barrier that warrants further investigation.

Future work will evaluate the proposed approach in concrete multi-stakeholder contexts to assess its impact on shared understanding and collaboration in OSS projects and larger initiatives. This evaluation should delve into the initial barriers to successful implementation and a systematic analysis of potential benefits. Additionally, more detailed implementation strategies and recommendations for action should be developed. Finally, the testing and application of this approach in various contexts, including the early stages of new OSS projects, will enable comparisons before and after implementation. This will enhance our understanding of the value of MV-COS in industrial settings. To further bridge the gap between theory and practice in OSS deployment establishing this more holistic picture is essential.

Once the MV-COS has been applied, tested and evaluated in other contexts, we aim at analyzing its generalizability. If it is generalizable, we plan to develop a designated software solution to provide users with a new level of support, guidance and guaranteed alignment. This covers e.g., support based on integrated rules such as 'to proceed fill in this building block' or 'having entered something in block X, please add/re-check block Y'. In previous research, we have already developed similar applications via domain-specific languages adopting the graphical notations of domain experts (e.g., turning established documentation languages for visualizing deployment workflows into fully-fledged programming languages [39]). Our experience shows that this eases interdisciplinary collaboration throughout the requirements engineering, development and implementation phases [40], while lowering the entry barrier for non-experts [41]. In addition, we have found that canvases are excellent visual interfaces to

be integrated via graphical, domain-specific languages. Accordingly, we consider the match between the MV-COS and a domain-specific language driven application to be promising.

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