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Design Principles for a Community Informatics–Driven Data Integration Platform: A Conceptual Architecture for the Trefoil Guild Melaka

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ABSTRACT

Community-based organisations increasingly rely on digital systems to support membership coordination, activity tracking, and capability-building programs. However, small volunteer-led associations often lack platforms that reflect their community values, participatory practices, and user-centered needs. This paper proposes a conceptual data-integration architecture for the Trefoil Guild Melaka, guided by contemporary perspectives in Community Informatics, Participatory Information Systems, and User-Centered Design. Adopting a conceptual modeling approach rather than empirical evaluation, the paper synthesises socio-technical frameworks to outline an integrated platform comprising membership, activity-tracking, and capability-building modules. The contribution is both theoretical and methodological, demonstrating how socio-technical principles can inform platform design for grassroots organisations and support digital inclusion, collective agency,

and participatory engagement. The discussion also highlights implications for digital empowerment strategies, participatory system development, and future implementation pathways, emphasizing how carefully conceptualised architectures can provide community-driven organisations with sustainable trajectories for digital transformation.

Keywords: Community Informatics, Participatory Information Systems, User-Centered Design, Conceptual Architecture, Grassroots Organisations, Digital Empowerment.

INTRODUCTION

Community organisations such as the Trefoil Guild Melaka play an essential role in sustaining social cohesion, intergenerational learning, and volunteer-led participation. These organisations provide safe spaces for community engagement, personal development, and collective action, particularly among women and older adults. However, despite their importance, many grassroots associations continue to rely on manual or fragmented documentation practices for membership information, event reporting, and capability-building initiatives. Such fragmentation often results in inconsistencies, administrative burden, and the loss of organisational memory—issues that are increasingly recognised as symptoms of "digital marginalisation" within small voluntary groups [1].

Digital systems designed for non-profits are often adapted from enterprise software, which assumes hierarchical governance and standardised workflows that do not correspond to the fluid, relational, and participatory nature of community-based organisations [2]. These mismatches underscore the need for conceptual architectures grounded in community-responsive design principles and informed by socio-technical theory that attends to human values, local practices, and shared decision-making. While larger organisations may adopt commercial digital platforms, smaller associations require systems that are both technically accessible and culturally aligned with how their communities function [3].

In response to this need, the present study develops a conceptual data-integration architecture for the Trefoil Guild Melaka. The Trefoil Guild represents a unique context: it is intergenerational, volunteer-driven, and structured around activities that blend social interaction, community service, and lifelong learning [4]. These characteristics make the organisation an ideal case for exploring how digital platforms can support not only administrative efficiency but also the social and developmental dimensions of community life.
The architecture proposed in this paper is guided by three theoretical lenses: Community Informatics, which emphasises digital inclusion and community capacity-building [5, 6]; Participatory Information Systems, which foreground collaborative design, shared ownership, and system adaptability [7, 8]; and User-Centered Design, which ensures that system features reflect user contexts, needs, and usability expectations [9, 10]. These perspectives provide complementary insights for developing a platform that is not only functional but also socially meaningful, culturally resonant, and responsive to the Trefoil Guild's evolving practices.

By integrating these frameworks, this paper proposes a conceptual architecture organised around membership management, activity tracking, and capability-building modules. Rather than presenting empirical testing or implementation, the study offers a theoretical and methodological contribution. It demonstrates how socio-technical insights can inform system

design for grassroots organisations, ensuring that digital transformation is pursued responsibly and in alignment with community participation, inclusivity, and empowerment. The subsequent sections elaborate the theoretical foundations, methodological approach, and conceptual architecture, leading to a discussion of the implications and future participatory pathways of the proposed model.

THEORETICAL FOUNDATIONS

The conceptual architecture proposed in this study is informed by three complementary theoretical perspectives: Community Informatics (CI), Participatory Information Systems (PIS), and User-Centered Design (UCD). These frameworks provide a socio-technical foundation that aligns technology design with the values, practices, and aspirations of grassroots organisations such as the Trefoil Guild Melaka. By integrating these perspectives, the paper positions digital platform development not merely as a technical activity but as a community process grounded in empowerment, participation, and meaningful user experience.

Community Informatics

Community Informatics (CI) provides a socio-technical perspective focused on how information and communication technologies can strengthen community capacity, agency, and local decision-making. Recent CI scholarship emphasises that the value of ICTs emerges not from technical capability alone but from the degree to which technologies are embedded within community practices, norms, and shared goals [5]. CI advocates for systems that promote participation, digital inclusion, and community-defined outcomes, particularly in small associations that may lack formal technological infrastructure.

In the context of voluntary women's organisations, CI principles highlight the importance of designing systems that enhance local autonomy and intergenerational engagement while supporting organisational sustainability [6]. This is particularly relevant for the Trefoil Guild Melaka, whose membership structure and activities rely heavily on interpersonal relationships, trust, and mutual support. A CI-driven architecture must therefore reflect low barriers to adoption, intuitive data flows, and meaningful control by community stakeholders rather than external administrators.

From a design perspective, CI provides three guiding implications:

- Technology must support existing community practices, not replace them.
- Digital inclusion and accessibility must be foundational, especially in intergenerational groups.
- System governance should empower local actors, ensuring transparency and community ownership of data.

These principles position CI as the primary lens for conceptualizing the platform's purpose and socio-organisational alignment.

Participatory Information Systems

Participatory Information Systems (PIS) extend the logic of CI by outlining how users should be involved not only in using technology but also in shaping its creation, evolution, and governance. Contemporary participatory design literature underscores the importance of co-

design, shared decision-making, and dialogic engagement, especially in community settings where diversity of perspectives is central to collective identity [7, 8].

For grassroots associations, participatory approaches enable members to articulate system needs that may not surface through conventional requirements engineering [11]. This is crucial in the Trefoil Guild Melaka, where different age groups, leadership roles, and activity committees may hold varied expectations of digital support. Participatory frameworks encourage a system architecture that is adaptable and co-evolving, accommodating emergent needs as community practices shift over time.

Key participatory principles relevant to the platform's architecture include:

- Co-production of requirements, where system modules reflect collaboratively expressed needs rather than top-down specifications.
- Reflexive system evolution, enabling the platform to adapt as new types of activities or reporting emerge.
- Transparency in data processes, allowing members to understand how information is collected, shared, and used.

By integrating PIS principles, the proposed architecture supports not only functional data integration but also participatory governance—ensuring that technology remains a facilitator of collective agency rather than a prescriptive tool imposed from outside.

User-Centered Design

User-Centered Design (UCD) provides the practical and methodological grounding for translating socio-technical principles into usable system interactions. Recent UCD frameworks emphasise the importance of understanding user goals, contexts, and constraints, particularly in non-profit and community environments where technological literacy and device access vary widely [9, 10].

For the Trefoil Guild Melaka, UCD aligns with the organisational commitment to inclusivity and lifelong participation. Members may have different levels of familiarity with digital systems; thus, the platform must prioritise intuitive navigation, clear data entry workflows, and minimal cognitive load [12]. UCD also stresses the importance of designing around "practices" rather than "tasks"—a crucial distinction in community spaces where activities often blend social, administrative, and experiential dimensions.

Applied to the platform architecture, UCD contributes three essential considerations:

- Interface simplicity, ensuring that all modules—membership, activity tracking, and capability-building—remain easy to access and use.
- Workflow coherence, aligning data processes with real organisational routines such as event reporting or membership renewal.
- Adaptability to diverse devices and user abilities, supporting elderly members and users with varying digital comfort levels.

UCD thus serves as the mechanism through which CI and participation-oriented principles become concretely manifested in system elements.

Integrating the Frameworks

Although each theoretical lens offers unique contributions, their integration forms a cohesive foundation for the conceptual architecture. CI provides the why, grounding the system in community empowerment; PIS provides the how, emphasizing collaborative structuring of modules and workflows; UCD provides the what, translating socio-technical intentions into accessible design.

Together, the three frameworks support an architecture that is:

- Community-responsive (CI)
- Co-created and adaptable (PIS)
- Usable and inclusive across generations (UCD)

This integrated foundation guides the subsequent conceptualisation of system modules, data flows, and design principles presented in later sections.

METHODOLOGICAL APPROACH

The methodological approach underpinning this study is conceptual and theory-driven, reflecting the early stage of digital adoption within the Trefoil Guild Melaka and the practical constraints faced by many grassroots organisations. Conceptual system design is widely recognised as a legitimate scholarly contribution in information systems and community informatics because it establishes the theoretical and structural foundations upon which future participatory and technical development can be built [5, 6]. This approach prioritises clarity, coherence, and socio-technical alignment before any commitment to implementation – see Figure 1.

The methodology began with an extensive review of existing literature on Community Informatics, Participatory Information Systems, and User-Centered Design. These bodies of scholarship informed the identification of core concepts such as empowerment, digital inclusion, co-creation, transparency, user experience, and workflow alignment. Rather than treating these concepts as abstract ideals, the study systematically examined how they could translate into practical architectural features for a platform intended for a voluntary, intergenerational organisation.

A second step in the methodology involved conceptual requirements mapping, a technique that extrapolates probable user needs, organisational workflows, and data categories based on documented practices and comparable contexts. This approach has been recommended by participatory design scholars as a preparatory strategy for communities that are not yet ready for formal co-design or usability testing [8]. For the Trefoil Guild Melaka, where leadership responsibilities shift and administrative capacity varies, conceptual requirements mapping allowed the architecture to be grounded in plausible workflows—membership recordkeeping, event documentation, badge progression, and lifelong learning—without imposing rigid or premature technical assumptions [13].

The final methodological step derived a set of design principles that mediate between theory and architecture. These principles—detailed later in Section 5—provided conceptual criteria for evaluating and shaping the platform's modules, data flows, governance features, and

interface considerations. Through these steps, the methodology delivered a coherent conceptual architecture that reflects the Trefoil Guild's values and operational realities, while establishing a foundation for future participatory refinement once the organisation is ready for more direct involvement in the design process.

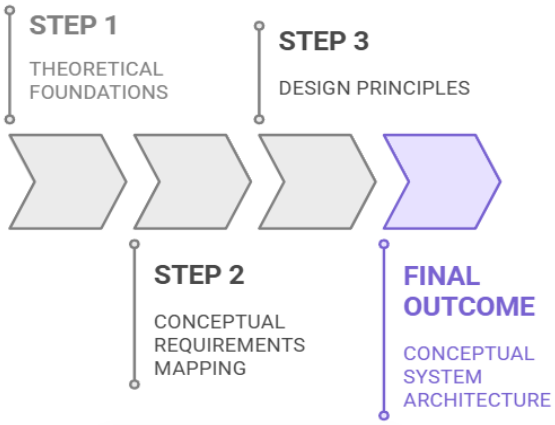

Figure 1: Methodological Approach in 3-Steps

The goal of this methodological approach is not to produce a finished system blueprint, but to articulate a theoretically grounded starting point that can guide inclusive and contextually appropriate digital transformation [14]. By combining theoretical rigor with practical sensitivity, conceptual system design provides a useful framework for organisations like the Trefoil Guild Melaka seeking to strengthen their digital infrastructure in a way that reinforces, rather than disrupts, their established community culture.

CONCEPTUAL ARCHITECTURE OF THE PLATFORM

The conceptual architecture proposed for the Trefoil Guild Melaka is designed to integrate membership information, activity documentation, and capability-building data into a unified socio-technical environment that reflects community values, participatory traditions, and user-centered practices. Rather than specifying technology stacks or detailed software engineering requirements, the architecture provides a high-level conceptual model illustrating how key system components interact to support organisational functions. At the highest level, the platform consists of three major modules—Membership Information, Activity Tracking, and Capability-Building—all connected through an integrated data layer governed by transparent and community-oriented oversight. Each module supports a different core function of the Trefoil Guild, yet all three reinforce one another through shared data flows and relational documentation. To visualise the architecture, Figure 2 positions the modules within a layered structure that reflects governance, data integration, functionality, and user interaction.

The Membership Information Module consolidates demographic profiles, membership categories, leadership roles, and participation histories, addressing the common issue of scattered or informally stored data in voluntary associations. Such consolidation strengthens organisational memory, enhances administrative reliability, and supports participatory governance through configurable categories and localised data control. This approach reflects CI principles focused on digital inclusion and capacity building, ensuring that membership data remains both structured and flexible enough to accommodate community-driven practices.

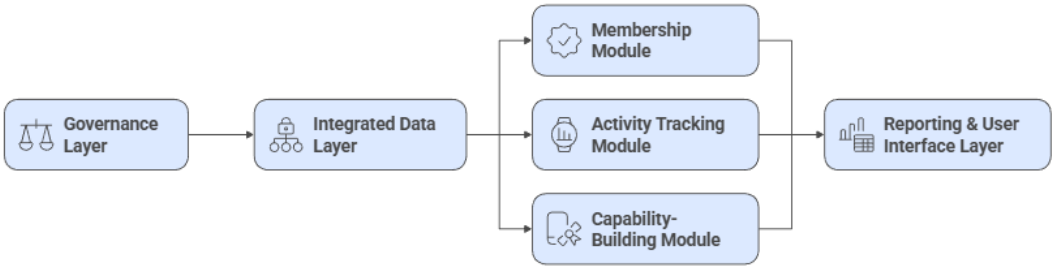

Figure 2: High Level Conceptual Architecture

Complementing this, the Activity Tracking Module documents core organisational events—including meetings, community service programs, trainings, and intergenerational engagements—that collectively constitute the Trefoil Guild's social and cultural foundation. Beyond improving administrative efficiency, activity records contribute to the collective narrative and identity of the Trefoil Guild, echoing insights on digital community engagement and storytelling [2]. By enabling adaptable event categories and reporting fields, the module embeds participatory design values and ensures that event documentation aligns with real-world organisational rhythms and meanings.

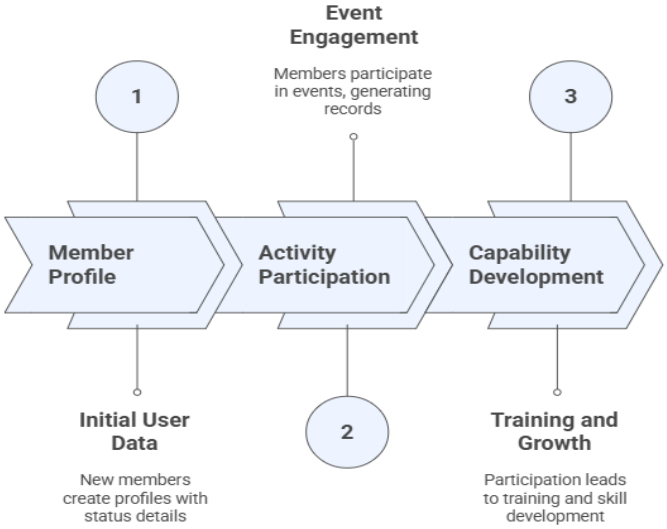

Figure 2: Data Flow Between Modules

Finally, the Capability-Building Module supports the Trefoil Guild's commitment to lifelong learning by capturing training involvement, skill development, and progression pathways, offering a longitudinal perspective on both individual and collective growth. Drawing on contemporary HCI scholarship that highlights the importance of systems accommodating human development over time [9], this module integrates seamlessly with the other components through intentional data flows – see Figure 3. For example, attendance recorded in an activity not only updates membership profiles but also feeds into capability-building records. These interconnected data pathways reduce redundancy and support workflow alignment—an essential UCD principle ensuring that digital systems complement rather than disrupt existing community practices [10]. Overall, the architecture balances structure with adaptability, enabling governance and reporting while remaining responsive to the Trefoil Guild's evolving culture and activities.

DESIGN PRINCIPLES

The design principles underlying the conceptual architecture for the Trefoil Guild Melaka emerge from the integration of Community Informatics, Participatory Information Systems, and User-Centered Design. These principles do not stand alone; rather, they function as a bridge between theory and practice, guiding how system features are shaped and interpreted within the community's context. They also ensure that the platform reflects the Trefoil Guild's values and that its structures and workflows remain sensitive to the organisation's culture, intergenerational dynamics, and participatory ethos.

The first principle, inclusivity, arises from CI's emphasis on equitable digital participation. Community settings often involve diverse user groups, including older members who may be less digitally confident. Inclusivity therefore extends beyond simple accessibility to encompass interface clarity, intuitive workflows, and minimal technical barriers [6, 15]. For the Trefoil Guild, an inclusive system ensures that technology enhances, rather than disrupts, participation. The second principle, co-creation, is derived from PIS assumptions that systems should be shaped collaboratively by those who use them [16]. Even though this study does not report empirical co-design activities, the conceptual architecture anticipates future collaboration by allowing editable fields, flexible categorisations, and adaptable data structures. The authors [7] argue that such anticipatory design forms a critical foundation for later participatory refinement. Transparency, the third principle, reinforces participatory governance by ensuring that users understand data flows, permissions, and system rules. Transparency strengthens trust, which is central to community-led groups, and fosters an environment where users feel confident in how the platform represents them and their work [8]. Complementing these values is workflow alignment, a core tenet of UCD. For grassroots organisations, the success of a digital platform depends heavily on how well the system aligns with pre-existing routines. When workflows are intuitive and familiar, users experience less cognitive strain and are more likely to sustain engagement [10]. This principle guided the logical sequence of system interactions developed in the conceptual architecture, ensuring that tasks such as creating events or updating attendance mirror the Trefoil Guild's established administrative processes. The final principle, flexibility, integrates insights from all three frameworks. Community organisations evolve, often rapidly, in response to leadership changes, new programs, or emerging needs. A flexible architecture adapts to these shifts, allowing for updates to categories, training modules, reporting formats, or activity structures without disrupting the system as a whole [17]. These principles and their theoretical roots are summarised in Table 1, which serves as a visual synthesis of the connection between theory, design, and system function.

Table 1: Design Principles and Theoretical Origin.

Design Principle	CI Contribution	PIS Contribution	UCD Contribution
Inclusivity	Digital inclusion	Shared visibility	Accessible UI
Co-creation	Community autonomy	Decision-sharing	Adaptable content
Transparency	Trust, openness	Clear governance	Understandable flows
Workflow Alignment	Supports community rhythms	Flexible routines	Minimises cognitive load
Flexibility	Adapts to change	Evolves with users	Adjustable interactions

DISCUSSION

The conceptual architecture presented in this study makes several contributions to the literature on community informatics, participatory design, and digital support for grassroots organisations. First, it illustrates how socio-technical theories can inform the early development of digital systems for community groups that are at risk of digital marginalisation. Many small voluntary associations, including those focused on women's development and intergenerational engagement, face challenges in identifying or adopting technologies that reflect their culture, practices, and operational constraints [1]. By grounding the architecture in CI principles, the study demonstrates how digital systems can strengthen community memory, support shared identity, and promote digital inclusion.

Second, the integration of PIS principles provides a pathway for future participatory refinement. Although the present study is conceptual, it embeds flexibility and adaptability directly into the architecture. This approach ensures that technology design remains an iterative and relational process—one that evolves through engagement with members rather than imposing predefined structures on the community [7]. Such an approach positions the Trefoil Guild not as passive technology adopters but as active co-creators of their digital future. Third, the incorporation of UCD ensures that user experience remains a central consideration, reducing the risk of technological burden and abandonment. Research consistently shows that digital literacy variation and usability challenges can impede adoption, particularly in intergenerational groups [9]. The conceptual architecture's emphasis on simple workflows, intuitive interfaces, and minimised cognitive load addresses these concerns and enhances the likelihood of sustainable utilisation.

The discussion also recognises the limitations of a conceptual study. Without direct community engagement or prototyping, certain assumptions about workflows or user needs may require adjustment once empirical work begins. Participatory workshops, usability testing, and iterative development cycles would be essential for validating and refining the architecture. Nonetheless, conceptual modeling remains a crucial step in ensuring that grassroots organisations approach digital transformation with clarity, purpose, and theoretical grounding [2]. In terms of broader significance, the conceptual architecture offers a replicable model for other community groups seeking to build data integration platforms aligned with local values. As digitalisation becomes increasingly pervasive, there is a risk that small organisations accept systems that inadvertently reinforce exclusion or administrative strain [18]. By demonstrating how socio-technical theory can inform platform conceptualisation, this study contributes to a more equitable and context-sensitive trajectory for community digital development.

CONCLUSION

This paper presented a conceptual, theory-informed architecture for a data integration platform tailored to the unique context of the Trefoil Guild Melaka. Drawing on Community Informatics, Participatory Information Systems, and User-Centered Design, the architecture reflects values of empowerment, co-creation, inclusivity, and usability that are essential to grassroots organisations. The three interrelated modules—membership, activity tracking, and capability-building—demonstrate how technological structures can support administrative functions while enhancing relational, developmental, and participatory aspects of community life. Although conceptual in nature, the study establishes a strong foundation for future participatory design activities. It provides an initial structure that the Trefoil Guild can refine

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collaboratively, ensuring that future prototypes or implementations reflect the lived realities of members. As community organisations navigate digital transformation, conceptual frameworks such as this one play an important role in guiding thoughtful, sustainable, and socially grounded system development.

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