Towards Goal-Oriented Recommender- and DataSpace-Driven Volunteering

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Voluntary engagement is an indispensable cornerstone of Critical Infrastructures (CI) such as civil protection, disaster, crisis and rescue management as well as health and social services. Sustainability of the voluntary sector, however, is massively endangered by profound changes in demography, social structure, and volunteer motives in the sense of individualization and pluralization of society. This paper tackles these key challenges by giving an overview on our digital platform for goal-oriented volunteering across and independently of different non-profit organizations. This platform is intended to be a first step towards synergistically aligning the goals and competencies of volunteers with the activity requirements of CI by proposing first ideals on using recommender and dataspace technologies.

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1 Introduction

Voluntary engagement is a vital pillar of Critical Infrastructures (CI), including civil protection, disaster management, and health services, making it essential for society. Globally, over 10% of people volunteer, rising to 23% in the EU and 46% in Austria. Austrian volunteers contribute 14.7 million hours weekly, with 5.8 million hours dedicated to CI (BMSGPK, 2022; UN, 2022). However, sustainability of the voluntary sector for CI is under threat from (i) *demographic changes* resulting in growing volunteering demands, and (ii) significant *motivational and social change* (UN, 2022). Personal benefits and skill acquisition now play a larger role, leading to greater *diversification* and necessitating alignment with CI activity requirements (Simsa, et al., 2019). Volunteers demand for flexibility leads to fragmentation, emphasizing the need for goal-oriented, competence-based bundling of formal and informal (i.e., independent of Non-Profit Organization (NPO)) volunteering (UN, 2022).

IT support for volunteering has focused on managing engagement through NPOs, neglecting volunteers' personal goals beyond these organizations. Aligning IT tools with personal goal-setting can enhance performance, engagement, and well-being (Locke et al., 2019). This gap is critical, as effective IT support is essential as effective IT support benefits both NPOs and volunteers (UN, 2022). Thus, our research project *»CIvolunteer« (CI Powered by Volunteers, cf. Figure 1)* envisions »cross-NPO engagement by personal goals«. This paper, first, contributes an in-depth discussion of the deficiences and challenges of the state-of-the-art of (i) *goalification,* particularly from the perspective of *operationalization* of goals, as well as (ii) *bundling of volunteering*, from an *IT support perspective*, in Section 2. Based thereupon, second, the conceptual framework of our *goalification platform for volunteering* — "goalification" being a play on the term "gamification" (Docherty, 2018) — is presented in Section 3 together with first ideas towards *Large Language Model (LLM)-based recommender functionality*. Thirdly, in Section 4 *dataspace functionality* for volunteer bundling is discussed. Finally, our contributions are summarized in Section 5.

2 State-of-the Art – Goalification and Volunteer Bundling

The selection of related work aligns with our goal of providing a *goalification platform for volunteering*, leveraging *recommender* and *dataspace* technologies. Accordingly, the discussion is divided into (1) *goalification* and its *operationalization*, and (2) *IT support for volunteering, including engagement bundling* (see Figure 1).

Figure 1: Overview of »CIvolunteer«
Source: Own

2.1 Goalification & Operationalization

Goal setting helps individuals achieve objectives, improving performance, engagement, and well-being (Locke et al., 2019). Research either targets specific aspects of goal setting, (e.g., Ekhtiar et al., 2023; Cham et al., 2019) or explores related fields like personal informatics (Li et al., 2010), persuasive systems (Oinas et al., 2009), behavior change techniques (BCT) (Corker et al., 2023), habit formation (Stawarz et al., 2015) or Self-Determination Theory (SDT) (Villalobos et al., 2020).

Deficiencies and Challenges. From an *application-oriented point of view*, the benefits of goal setting have been adopted by a plethora of *goalification apps*, which have emerged for many facets of life, not only in the work context but especially for personal use increasing well-being (Locke et al., 2019). However, as highlighted in our survey (Pröll et al., 2024), these apps neither address the voluntary sector nor support the complete *goalification lifecycle,* from planning goals to acting thereupon and finally analyzing their outcome (Holding et al., 2023). Besides, the *operationalization* of goals into executable activities is rarely, and at best quite rudimentary supported by goalification apps and remains underexplored in goal-setting research (Epstein et al., 2020, Niess et al., 2018). This lack originates not least in the fact that goal setting empowers users to bring in their individual point of view by setting goals on basis

of *personal motives* and *psychological needs,* often leading to quite *abstract (aka. qualitative) goals* (e.g., setting the goal to increase one's well-being by the end of the year), thus ultimately challenging its *operationalization* (Niess et al., 2018) (cf. Section 3).

2.1 Volunteering IT Support & Volunteer Bundling

Volunteering IT support (Pröll et al., 2016, 2017, 2020a, 2020b) is dominated by *commercial, NPO-centric Volunteer Management Systems (VMS)* as shown in our evaluation of 18 VMS using over 100 evaluation criteria (Pröll et al., 2016). These VMS *manage volunteers*, *organizational structures* various *phases the volunteering process* including scheduling, execution, rewards, and assessments, features for communication, coordination, and customization (Pröll et al., 2016). In the informal sector Volunteer Web Portals primarily facilitate simple activity placements to connect volunteers with regional opportunities (Pröll et al., 2016).

Deficiencies and Challenges. Most of these systems are, however, (i) *walled volunteering "data silos"*, i.e., preventing a human-centric and NPO-overarching exploitation of volunteering data (e.g., activities accomplished by a particular volunteer or competencies acquired) (Pröll et al., 2016) and (ii) they *lack* any mechanisms for *personal goal setting*, *activity recommendation*, *progress monitoring* and *reflection* beyond simple activity and competence documentation, e.g., *digital volunteer passports* (Pröll et al., 2020a, 2020b). In order to strengthen the volunteer sector, however, bundling of volunteer engagement is of fundamental importance. This requires in turn to base upon the numerous existing VMS being already employed since decades by NPO's in various domains, ranging from civil protection, disaster, crisis and rescue management to health and social services, food supply and harvesting. Not least because of this broad variety of domains, the underlying data of these VMS is characterized by (i) various kinds of *heterogeneity*, from syntactic to structural and semantic, (ii) and different forms of *persistency mechanisms*, from simple file-based mechanisms to different CMS and DBMS, thus challenging data sharing and exchange being crucial for bundling of volunteer engagement (cf. Section 4).

3 LLM Powered Goalification App at a Glance

Based on our conceptual goalification framework proposed in (Pröll et al., 2024a, 2024b) and the state-of-the art discussed in Section 2, we realized a first prototype of our »CIvolunteer« goalification app, providing basic goalification functionalities

and an initial version for LLM-based recommendations for operationalizing goals (cf. Figure 2, including exemplary frontend mockups of our prototype).

3.1 Goalification Framework as Conceptual Basis

Methodology. Our conceptual goalification framework systematizes and integrates the required functionality for a goalification platform. We base our approach on goal theory (Locke et al., 2019) and draw from design space conceptualizations in fields like personal informatics (Li et al., 2010), persuasive systems (Oinas et al., 2009),

BCT (Corker et al., 2023), habit formation (Stawarz et al., 2015) and SDT (Villalobos et al., 2020) to form a kind of overarching framework. At its core is a *process-oriented perspective* covering the entire goalification lifecycle (Holding et al., 2023). Feasibility is justified by a mapping of this perspective and its functionality to eight existing design space conceptualizations (Proell et al., 2024a).

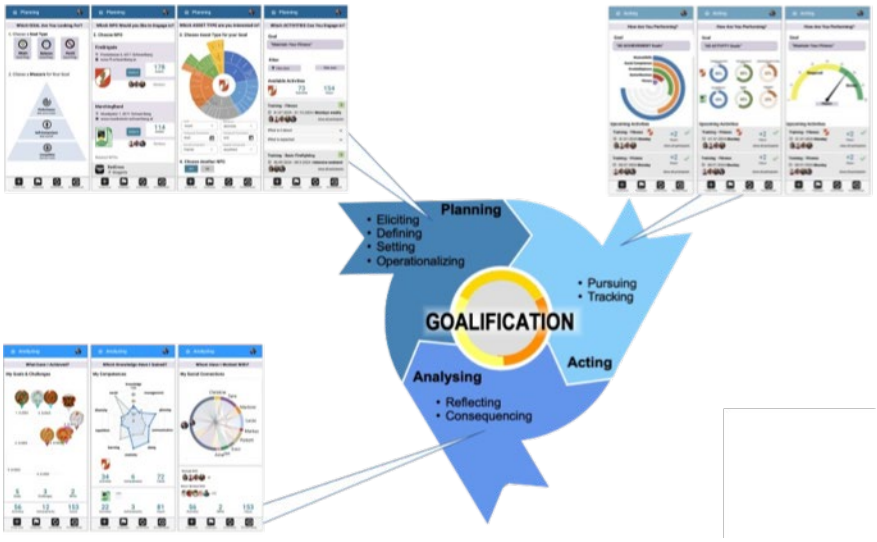

Figure 2: Conceptual Goalification Framework and Frontend Mockups
Source: Own

Goalification Process. Following the design space conceptualizations of Li et al. (2010) and Ohlin et al. (2015) and the goalification lifecycle (Holding et al., 2023), our process perspective includes three key phases for comprehensive goalification

support: (i) *planning*, in terms of eliciting, defining, setting, and operationalizing quantitative and qualitative goals (ii) *acting*, consisting of pursuing and tracking goals, and (iii) *analysing*, covering reflecting goals and consequencing thereof, aligning with action research principles (Heckhausen, 2007). Each phase offers distinct, complementary functionality and mind-sets. This approach not only mirrors real-world app usage but also provides flexibility for diverse volunteering domains and motives through its spiral cycles, arbitrary start points, and nested structure.

3.2 Goal Operationalization by LLM-based Recommendations

Operationalizing goals is vital in the planning phase but is rarely supported by goalification apps, partly due to the challenge of abstract qualitative goals (Niess et al., 2018). This section presents first ideas for supporting goal operationalization through *LLM-based recommendations* (Pröll et al., 2024c).

Traditional Recommender Technologies Inadequate. Current *recommender systems* use *collaborative filtering* (similar users have similar preferences), *content-based filtering* (users prefer items with features like those they've liked before) or a *combination* of both (Ricci et al., 2022). These methods often assume *stable preferences,* which may not align with the *evolving nature of personal goals* (Niess, et al., 2018). Instead, volunteering recommendations should prioritize helping users achieve their goals effectively, e.g., prioritizing opportunities that supports multiple goals over those that address only one (Papadimitriou, 2018).

LLMs as Silver Bullet? LLM-based recommenders offer a promising solution by operationalizing both *quantitative goals* (e.g., for the goal to intensify volunteering neighborhood assistance, all related opportunities seem reasonable) and more complex qualitative goals (e.g., enhancing social competence through volunteering) (Niess, et al., 2018, Pröll et al., 2024c). Leveraging natural language understanding, LLMs can better capture user preferences, item descriptions, and context, improving recommendation accuracy (Hua et al., 2023; Liu et al., 2023; Lin et al., 2024; Wang et al., 2024). This makes then the most promising approach for goal-oriented volunteering.

LLM-based Goal Operationalization Approach. As a first step we explored how *LLMs* can serve as *annotators* to provide labeled ground truth data of *personal goals* (both *quantitative and qualitative*) and *volunteering opportunities* (both *regional and supra-regional*). We compared existing approaches and proposed their adoption to the peculiarities of our domain (Pröll et al., 2024c), see Figure 3.

Second, to assess the impact of different label-based models, we proposed using *transfer learning* (Wang et al., 2016) with customized cross-encoder models (Reimers et al., 2019) to *fine-tune models*. We then evaluated the *feasibility* of various labeling approaches and the resulting models using appropriate metrics and statistical tests.

Our findings indicate that fine-tuned models based on LLM-generated labels achieve high precision. By using a self-trained model, we eliminate the need for costly external queries, improving efficiency and scalability. Currently, the recommendation mechanism relies on simple goal-to-activity matching, but future work will integrate user profiles for more dynamic recommendations that consider goals, activities, and individual preferences. We are also developing an extension that uses reinforcement learning to adapt recommendations to evolving user preferences, enhancing personalization and long-term utility.

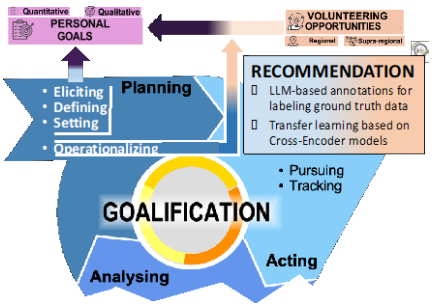

Figure 3: LLM-based Goal Operationalization by Recommendation
Source: Own

4 Volunteer Bundling using Dataspaces

Besides aligning personal goals of volunteers with activity requirements of NPOs through recommendations, bundling of volunteering across different NPOs is crucial, especially in crisis situations. In the following, we discuss (i) applying the

dataspace paradigm to the volunteering sector (cf. Fig. 4), highlighting its *key characteristics* and a *potential usage scenario* for *volunteer engagement bundling*, through three basic principles as well as (ii) considerations for their implementation.

4.1 Goal Operationalization by LLM-based Recommendations

Introduced by Franklin et al. (2005), dataspaces provide an abstraction layer for data and service management, addressing the data-centric nature of modern society (Abadi et al., 2022). Dataspaces follow the *"FAIR philiosophy"*, ensuring findability, accessibility, interoperability, and reuse of data and services, leveraging *semantic technologies* (Hauf et al., 2024). The dataspace paradigm is well-suited to tackling the challenges outlined in Section 2.2, by enabling (i) inter-NPO data and service sharing, (ii) in diverse formats, (iii) controlled by data producers, (iv) accessible through various VMS, and (v) support for different applicationslike our goalification platform. While existing dataspace proposals focus on domains like agriculture, energy, and healthcare (Bacco et al., 2024), none yet target the volunteering sector, and only few base their work on real-world data/services (Giess et al., 2025).

Three basic Principles of a Volunteering Dataspace. Based on this rationale, the essence of dataspaces and their application to our volunteering use case in terms of a novel *"volunteering dataspace"* is summarized by three core principles (cf. Figure 4).

(1) Volunteering Data Co-Existence & Pay-As-You-Go Integration Levels. Our volunteering dataspace will use a *federated, co-existence approach* for heterogeneous data, preserving data at its source (Franklin et al., 2005), including volunteering data from various VMS across different NPOs. B*asic functionality,* like on-demand queries, should be provided regardless of data heterogeneity or integration. Data integration should follow an agile "pay-as-you-go" strategy (Franklin et al., 2005), leading to a progressively evolving volunteering dataspace. Unlike traditional *schema first* approaches in relational DBMS, our dataspace will adopt a *data first, (integrated) schema later or never* policy similar to NoSQL systems (Abadi et al., 2022). This is essential as the dataspace is *domain-agnostic* and does not rely on a fixed unifying schema for volunteering data. Volunteering data will be integrated only *gradually, whether* and *when necessary,* with *low upfront* and *maintenance costs* as the big assets, requiring, however, to be balanced with potentially *restricted base functionality* (Wang et al., 2016).

Relationships between resources will be inferred automatically, e.g., through user feedback or as new VMS data sources are added (Bacco et al., 2024).

(2) Data Querying Service Levels. Due to limited data integration and loosely coupled VMS data sources, *querying* our volunteering dataspace will v*ary in service levels*, wiht best-effort or approximate answers based on the integration level (Bacco et al., 2024). The dataspace will rely on a *brokering hub* (cf. Figure 4) to share its VMS resources, including details like source, name, location, size, creation date, and owning NPO. The resulting catalogue of products (*data* and *services*) (Giess et al., 2025) will be a key functionality of our volunteering dataspace.

(3) Data and Service Sovereignty. From a policy perspective, our volunteering dataspace should be a *distributed system* governed by a framework that enables *secure*, *trustworthy* data and service sharing while maintaining *sovereignty* (Bacco et al., 2024) without central authority control. Participants – whether NPOs or volunteers – should have control over who, how, when, and at what price their data and services are used, ensuring the data producer retains control (Wang et al., 2016). Finally, volunteering data of NPOs should be managed completely independent of the according VMS that produce or consume this data, thus being in line with the W3C Verifiable Credentials Data Model (W3C, 2024).

4.1 Goal Operationalization by LLM-based Recommendations

Figure 4: Dataspace-based Bundling of Volunteering
Source: Own

»BrokeringHub« as Initial Step. As an initial step towards establishing a novel dataspace for volunteering, we propose a so-called *»BrokeringHub«*, where *lightweight adapter plug-ins* allow NPOs and volunteers themselves to contribute proven competencies, open activities and achieved goals, while allowing sponsors to offer, e.g., incentives. The challenge is to create an *open and scalable platform* via connection services such as *Zapier* and *IFTTT* (Cosar, 2021) instead of "yet another data silo/island solution". Building on this, purely syntactic data exchange should be "lifted" to a semantic level by *semantic integration as needed,* building an adequate basis for coordination and cooperation by applying standards such as *Linked Open Data* and *ontologies* (Hauf et al., 2024).

Engagement Asset Ontology for Structural Pay-as-you-go Integration. A common core ontology formalizing volunteering concepts and relationships in-between has been proposed in our previous work (Pröll et al., 2020a), providing the fundament for *structural pay-as-you-go* integration. Based on the metaphor *»I am what I do«*, a basis for deriving the common core concepts of volunteer engagement has been found in the area of *linguistic research*, notably in the prominent work of Vendler about the aspectual classification of verbs (Vendler, 1957), as well as by considering well-known upper ontologies like SUMO (Niles and Pease, 2001) or DOLCE (Gangemi et al., 2002). The core of generic concepts of our ontology expresses the fact, that `Engagement` in `Activities` running through certain `States` may lead to `Accomplishments` and various `Achievements`, justified by some `Evidence`. Although this so-called *engagement asset ontology* (Pröll et al., 2020a), focuses on volunteering, special attention has been paid to provide a core of generic concepts being applicable to a much broader range of application areas. This is achieved on the one hand by enabling *white-box reuse*, i.e., subtyping to extend the pre-defined type taxonomies, thereby coping with peculiarities of assets issued by, e.g., different NPOs. On the other hand, *black-box reuse* is supported through explicit extension points, allowing to enhance and configure the ontology by specifying, e.g., further properties (Pröll et al., 2020b).

LLMs for Behavioral Pay-as-you-go Integration. In order to populate this ontology, a central challenge is the semantic integration of competencies acquired in different NPOs, using appropriate semantic matching technologies as basis for *behavioral pay-as-you-go integration*. Competencies are usually described in textual form by different rules that have to be fulfilled in the respective NPO, e.g., completion of

certain courses. Modern LLMs provide possibilities for the analysis of semantic equality, which can serve as a basis for semantic matching, thus being one important challenge for our future research.

5 Conclusion

This paper provided a first step towards »cross-NPO engagement by personal goals«. Based on an in-depth discussion of the state-of-the-art in goalification and volunteering IT support, a goalfication platform for volunteering has been presented, followed by first ideas in using LLM-based redommender for goal operationalization and dataspaces for engagement bundling. Future work is mainly focused on improving LLM-based recommender and in using LLMs also as a core mechanism for behavioral pay-as-you-go integration in our volunteering dataspace, allowing the semantic matching between volunteering data (e.g., activities, achievments or competencies) of different NPOs.

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