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PROCESS MODELING IN HUMANITARIAN SETTINGS: A CASE STUDY AND LESSONS LEARNED

Research paper

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Abstract

In spite of significant prior work, few scholars have addressed the unique problems of business process modelling in humanitarian settings. We surface and explore these challenges by treating the ‘guest intake process’ at homeless shelters as an exemplar. In most cities, the homeless shelters are a part of the ecosystem of care that includes hospitals, training agencies, housing agencies and others to support homeless individuals. The exemplar we have chosen represents the first line of defence for the homeless guests: the Intake practice at a homeless shelter, a process that remains fairly knowledge-intensive. Our work follows a collaborative research approach, working with the largest homeless shelter in the region. We conduct observations and interviews at the shelter to construct process models with the Petri Net formalism, followed by analytical experimentation. Lessons learned from the work are compared against prior research in modelling of knowledge-intensive processes. We find that process modelling in humanitarian settings such as homelessness remains fraught with problems. We identify new directions, where prior work in knowledge-intensive processes may require extensions in response to the unique nature of work in humanitarian settings. The paper elaborates these findings, illustrates with authentic examples, and outlines possibilities for future research and implications for practice.

Keywords: Knowledge-intensive Processes, Homeless Shelter, Guest Intake Process, Conceptual Model.

1 Introduction

Researchers in information and communication technologies (ICT) have paid scant attention to societal problems in humanitarian domains (Limburg et al. 2017; Zhang et al. 2010). The recent recognition of the field of digital humanities, as it reaches beyond its origins in information sciences (Clement & Carter, 2017), is encouraging scholars to take on these challenges – to explore how ICT solutions may be designed, deployed and evaluated in these contexts. Within this umbrella of concerns (Vanhoutte, 2013), several problems have been noted, including the nature of data gathering, privacy concerns, and others that require ICT solutions (Majchrzak et al. 2016). In this paper, we address a microcosm of these concerns brought together within the societal problem of homelessness; by exploring the Guest intake practice at a homeless shelter as an exemplar.

Homelessness is a significant societal concern because of its sheer scale (Dittmeier et al. 2018). Homelessness takes a toll on the individual, and presents difficult challenges for the society (McLaughlin & Rank, 2018). Prior scholarship points to a number of problems, societal, policy-related, and technological, including: health and crime costs (McLaughlin & Rank, 2018), data integration (Culhane, 2016), funding for housing (Ellickson, 1990) and many others (Byrne et al. 2013). In spite of such attention (Henry et al., 2018), homelessness has remained difficult to eradicate. A part of the problem can be traced to the fragmented ecosystem responsible for caring for the homeless (Glendening & Shinn, 2017; Turner & Krecsy, 2019). The fragmentation leads to decision-making driven by local constraints, data gathering dictated by peculiar requirements (Jones, 2015), and obstacles to data sharing across agencies (Culhane, 2008; Ellickson, 1990) – all leading to sub-optimal responses to homelessness.

In this ecosystem (often described as the ‘continuum of care’ (Grunberg & Eagle, 1990; Shinn et al. 2001; Wong et al. 2006), homeless shelters represent a significant entry point. Guest intake at the shelter can be described as a *practice* that requires humane considerations, as well as a *process* that includes a set of phases and activities with different roles responsible for each phase or activity (Davenport, 2015). This combination of practice and process can be traced to the knowledge-intensive nature of the work done by the staff at the homeless shelter during guest intake. It emphasizes the need for structure (warranted by data collection and reporting needed for policies and external funders) and the need for situated decision making and knowledge-intensive work (required to care for individual and nuanced requirements for the guests).

The *goal* of this work is to explore conceptual modeling of such processes, relying on the guest intake practice at a homeless shelter as an exemplar. The work is difficult because of the need for domain-specific understanding of the concerns. Our work is, therefore, done in collaboration with a homeless shelter (in the Northeast United States), and includes: primary data collection and conceptual modeling, visits to the homeless shelter to appreciate the nature of work, discussions with stakeholders to refine the modeling decisions, and pairing with data analytics (see Purao et al. 2019). We develop successive versions of the conceptual, relying on site-based informants and observational and interview data to reach a stable version, before conducting analytical experimentation. This is followed by comparisons against prior research about knowledge-intensive processes to surface unique problems and opportunities in humanitarian settings.

The key *contribution* of our work is two-fold. We find that traditional approaches to conceptual modeling of processes in humanitarian settings (e.g. Petri Nets, see Van der Aalst & Stahl, 2011) does allow capturing of key constructs. . However, as anticipated, it cannot address the nuances for the work practice that includes high knowledge-intensive components. A comparison against prior research in knowledge-intensive processes suggests possibilities that may address some of the concerns. However, some problems remain, that present new research opportunities. Our analysis suggests four such opportunities. These include: discretionary tasks, task groups, incorporating knowledge intensity, and case management. *Prima facie*, these appear to have possible solutions in prior research. However, as the paper illustrates, each of these directions presents some unique challenges in humanitarian settings. They present new directions and possibilities for extension of prior work. We demonstrate these with examples from our work at the homeless shelter. Based on these, we point to both, possibilities for future research and implications for practice, including the potential use of more contemporary approaches such as case management, and incorporating these within the conceptual modeling practice.

The paper proceeds as follows. Section 2 provides background about homelessness, and summarizes prior work related to knowledge-intensive processes, and case management. In section 3, we describe the research setting and the research approach. Section 4 shows the process model for guest intake with a foundational process modeling formalism along with analytical experimentation. In section 5, we identify and illustrate the challenges and opportunities for improving process modeling in such contexts, drawing on lessons from prior work. We conclude in section 6 with future research and practical implications.

2 Background and Prior Work

2.1 The Homelessness Problem

The term ‘homeless’ describes “a person who lacks a fixed, regular, and an adequate nighttime residence” (Henry et al., 2018). Being homeless is not a condition, it is something you experience. The HEARTH Act of 2009 (HUD, 2015) describes the homeless as unsheltered persons occupying a “place not designed for ... sleeping accommodation for human beings.” Importance of the problem can be traced to The UN Universal Declaration of Human Rights (Article 25), which states: “Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care.” In the US, the AHAR report (Henry et al., 2018) finds that on a single night in 2018, more than half a million people were experiencing homelessness.

Homelessness is a multifaceted issue that requires a range of agencies (shelters, hospitals, correctional facilities) to respond to the many concerns of the homeless community (Roche, 2004). A complex ecosystem of agencies (described as the Continuum of Care or CoC (Poole & Zugazaga, 2003) is tasked with addressing different facets of the problem, including short and long-term housing, funding, training programs, healthcare, and several others. The most common entry point to the CoC is a homeless shelter, where individuals or families facing homelessness present themselves (Figure 1).

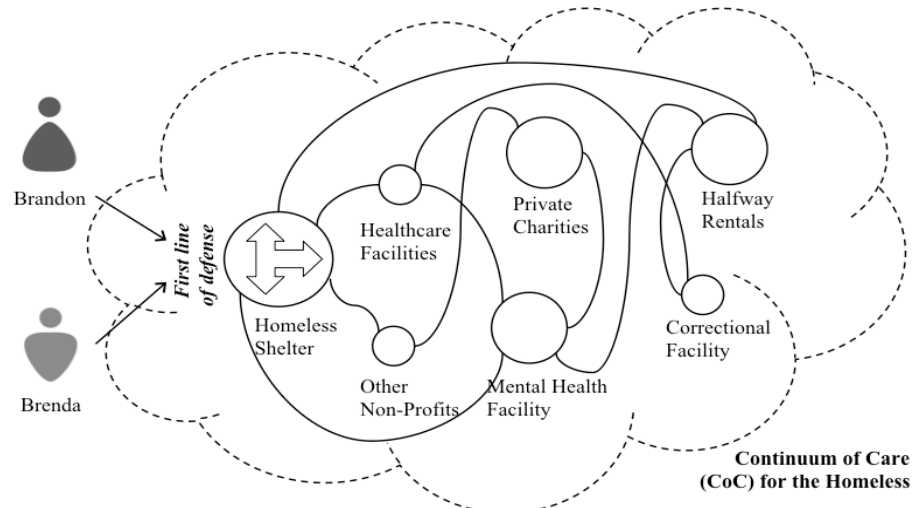


Figure 1. The Ecosystem (Continuum of Care, CoC) for the Homeless Community

Guest intake at the homeless shelter incorporates a set of practices, norms and steps that are used by the shelter staff to organize their efforts to respond to the homeless guests who present themselves at the shelter, including offering specific help, making available different programs, suggesting a course of action, providing a bed for stay, and even diverting the guests from the shelter. Figure 2 shows an example scenario.

A guest intake scenario. Jordan, a 60-year male presents himself at men's shelter. He has been here before. He is African American, has a disability, reports substance abuse, and does not indicate being a veteran (important to identify programs that may help). The shelter staff explores options and constraints such as capacities at different locations. They assess whether he presents a risk of sliding into long-term homelessness. Based on this triage, they decide whether to let Jordan stay in the shelter or direct him to a different program. After some exploration, the staff assigns Jordan a bed for the night, and a caseworker who can start exploring the availability of permanent housing, and possible jobs that Jordan may be able to hold.

Figure 2. The Guest Intake Scenario: An Example

The example shows both structured and un-structured elements, identifies important considerations, points to the knowledge-intensive nature of work, and the importance of tracking each case beyond specific tasks. Much work during the guest intake does not have the benefit of a process perspective. Instead, it relies on practices learned over time, data capture driven by reporting requirements (Mosley, 2012), and analytics with this data (Purao et al., 2019). Our collaboration revealed that the guest intake practice may benefit from going beyond the usual descriptions such as 'this is how we do it' (Brunner, 2019) to improve operations, and provide more appropriate services to the guests.

2.2 Knowledge-Intensive Processes and Case Management

A starting point for our work was the idea of knowledge-intensive processes (KiP), relatively new research direction, where definitions and characteristics co-exist (Boissier, Rychkova, & Le Grand, 2019). Examples of KiP characteristics include: the need for human collaboration, a high degree of uncertainty, and need for

creativity and improvisation, among others. The general problem has been defined as “process management for knowledge work” (Davenport, 2015). It acknowledges the basic idea that “treat[ing] something as a process by imposing a structure on it” has been difficult in domains that require knowledge-intensive work because it is often viewed as “a bureaucratic, procedural annoyance” [ibid]. More recent work (Di Ciccio et al. 2015; Vaculín et al., 2011) describes KiPs as processes whose conduct is dependent on knowledge workers performing interconnected knowledge-intensive decision-making tasks that are knowledge, information and data centric and require substantial flexibility at design- and run-time. As Di Ciccio et al. (2015) and Boissier et al. (2019) point out, much work related to KiP still remains open to debate. Table 1 points to several characteristics that are part of this slowly emerging consensus (Di Ciccio et al. 2015).

Characteristic	Description
Knowledge-driven	The status and availability of data and knowledge objects drive human decision making and directly influence the flow of process actions and events.
Collaboration-oriented	Process creation and execution occurs in a collaborative multi-user environment, where human-centered and process-related knowledge is co-created, shared and transferred by and among process participants with different roles.
Unpredictable	The exact activity, event and knowledge flow depends on situation- and context-specific elements that may not be known a priori, and which may change during process execution, and may vary over different process cases.
Emergent	The actual course of actions gradually emerges during process execution and is determined step by step, when more information is available.
Goal-oriented	The process evolves through a series of intermediate goals or milestones to be achieved.
Event-driven	Process progression is affected by the occurrence of different kinds of events that influence knowledge workers’ decision making.
Constraint- and rule-driven	Process participants may be influenced by or may have to comply with constraints and rules that drive actions performance and decision making.
Non-repeatable	The process instance undertaken to deal with a specific case or situation is hardly repeatable, i.e., different executions of the process vary from one another.

Table 1. Characteristics of KiP: Knowledge-Intensive Processes (See Di Ciccio et al., 2015)

Inherent in the ideas related to KiP is an emphasis on the “case,” i.e., a specific instance, such as a citizen requiring some service, a patient requiring medical attention, or a homeless guest in need of help. This presents an inherent tension because the emphasis shifts to individual cases from a standard control flow between tasks (Marin, 2016). Marin et al. (2015) summarize the evolution of scholarly perspectives related to this emphasis on cases as a move from case-handling (see Van der Aalst & Stahl, 2011), to a more active stance towards managing cases, to a more recent emphasis on production case management (with case templates created during the design phase, and used by knowledge workers to deal with different instances) (Motahari-Nezhad & Swenson, 2013). Table 2 shows a brief summary of the work.

Conceptualization	Description
Case Handling	Using the case as the central concept; Activities are less rigid; The process is driven by not only the process flow, but also based on data (Van der Aalst, Weske, & Grünbauer, 2005).
Case Management	Retaining the control flow between task; Decomposing a task into work content and activities; The work content provides the flexibility (Kaan, Reijers, & van der Molen, 2006)
Dynamic Case Management	Collaborative, dynamic, information intensive processes driven by events; Use of a case folder that contains information to manage the case (Le Clair & Moore, 2009)

Adaptive Case Management	Creation of a case template outlining a preferred sequence of tasks by the knowledge worker when dealing with a case (Swenson, 2010)
Production Case Management	Creation of a case template during design; Use of the template by knowledge workers when dealing with instances (Motahari-Nezhad & Swenson, 2013)

Table 2. Evolution of Work Related to Emphasizing Cases (Marin & Hauder, 2015)

We note that in spite of the significant progress in understanding the requirements for KiP and case management, the scholarly consensus remains: finding the appropriate mix of design-time and run-time support for KiP continues to be challenging (Marin et al. 2016).

3 Research Approach

Armed with this knowledge, and driven by our research goal, we collaborated with one of the largest homeless shelters in the Northeast US. Figure 3 outlines the collaborative research approach.

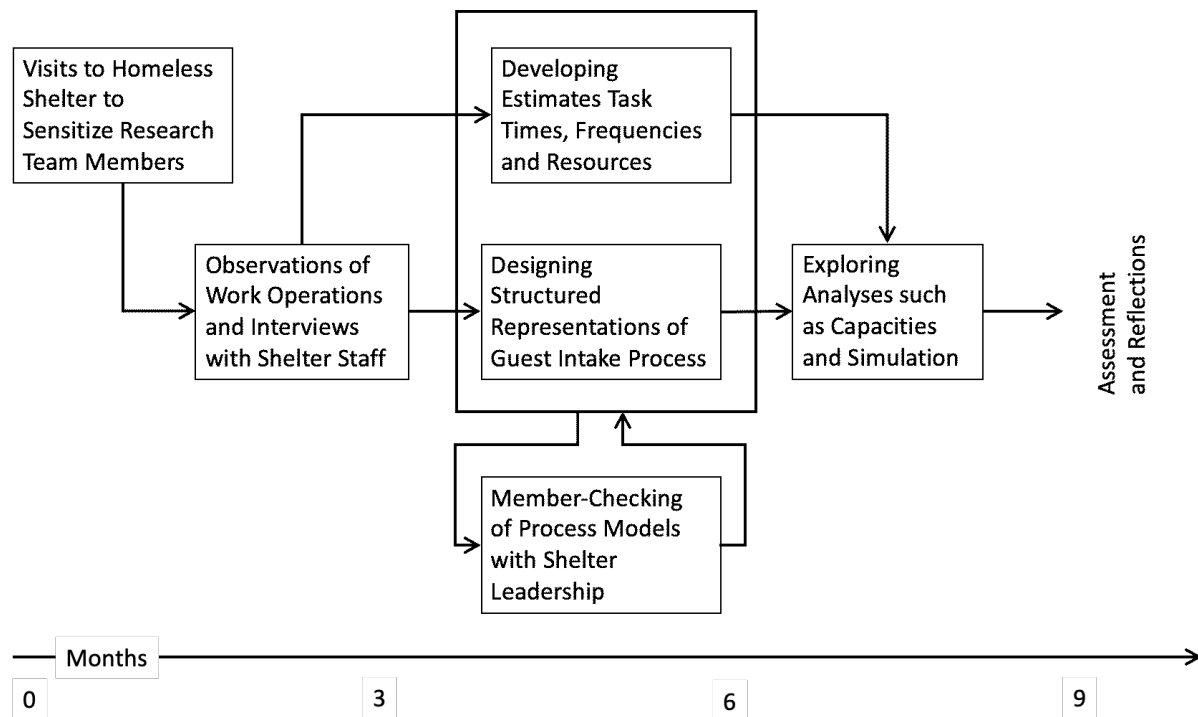


Figure 3. Research Approach

First, members of the research team visited the shelter to sensitize the research team to the context. During these visits, the team heard from the managers, visited several parts of the shelter including the communal eating area, common rooms with TV, and sleeping arrangements including single and tiered beds. Second, members of the research team visited the shelter to learn about the guest intake process based, observed different portions of the guest intake process including initial entry, triage interaction with the guest to assess and discuss alternatives, and eventual resolution, captured field notes, and learned about the process from the shelter staff. Next, the research team developed a first approximation of a conceptual model for the guest intake process, following the Petri Net formalism, including initial estimates of times and volumes. The model was tested and refined for accuracy (including syntax) and reasonableness of estimates and assumptions over multiple cycles of discussions with member checking carried out with multiple stakeholders including the individuals responsible for program evaluation, strategic initiatives and the lead triage manager at the data collection site. Finally, we carried out analytical experimentation including capacity planning and simulation, and comparisons against prior work to identify possibilities for

incorporating knowledge-intensive work in the conceptual models. These dual outcomes, iterative approach and reciprocal shaping allowed us to describe our work as following the action design research approach (Sein et al. 2011) with an engaged scholarship perspective (Van de Ven, 2007).

4 Modeling the Guest Intake Process

To construct a conceptual model of the Guest Intake process, we relied on the Petri Net formalism (Van der Aalst & Stahl, 2011). Although others modeling techniques exist, several (e.g. BPMN) can be mapped to the Petri Net formalism (Dijkman et al. 2008; Ou-Yang & Lin, 2008), which produces a conceptual model as a set of coordinated tasks undertaken to fulfill a specific goal (Van der Aalst & Stahl, 2011).

The constructs in a workflow-net constructed with Petri Nets include tasks, places, and arcs. A workflow-net $N = (T, P, A)$, where T is the set of tasks, P is the set of places and A is the set of arcs, and two special places, $p1$ and $p2$, where $\bullet p1$ (pre-set) = null and $p2 \bullet$ (post-set) = null. Cases are denoted by tokens that traverse different paths through the net. Firing rules capture net behavior to dictate how tokens move from one place to the next.

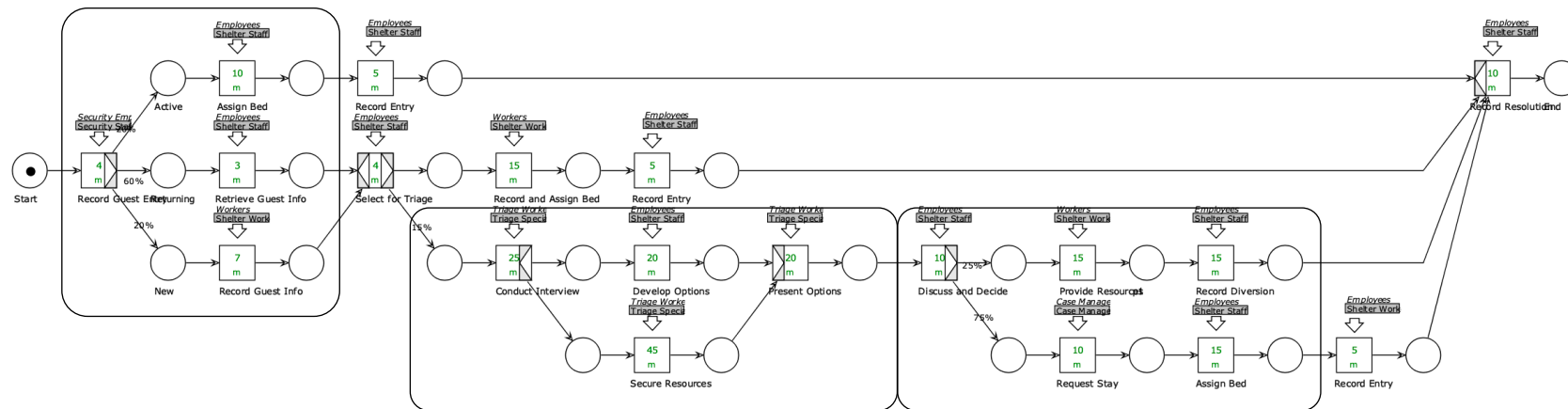
The process-oriented view emphasizes clear specification of tasks, assigning responsibilities to roles, and making resources necessary for task completion available for each role. We note that following the research method, our efforts to construct the conceptual model involved visits to the homeless shelter, primary data collection, and multiple iterations, following by a final round of member-checking. The homeless shelter we worked with provides services to approximately 2,000 homeless men and women daily in the four shelters they run. Across the four shelters, on most days, they run ‘at capacity,’ in that most beds are occupied. In other words, the daily arrival rates at these shelters often match the bed capacity available. Our work involves close collaboration with one of the shelters, which caters to single men. This shelter offers 670 beds for nightly stays.

As our modeling effort went through multiple iterations and we developed a deeper understanding of the work practice involved with the guest intake tasks, the terminology we used evolved, and the structure of the tasks became more apparent. The description we provide below represents a stable version that resulted from multiple versions and discussions with the stakeholders.

We view the guest intake process as three blocks of activities (see Figure 4). The first block acknowledges three alternative paths: active guests (at the shelter for the day), returning guests (stayed at the shelter before), and new guests (seeking shelter for the first time). The second block shows triage efforts for guests (returning and new) such as finding alternatives (e.g. returning to family), finding resources (e.g. solving transient problems), and other temporary housing solutions. This block most closely resembles the collaborative, knowledge-intensive mode of work, and hides much of the specific work. Here, the triage specialist coordinates with case workers and shelter staff, draws upon external knowledge sources to develop options, secures resources, and discusses these with the guest. The tasks carried out during this block of activity tend to be unpredictable, and dictated by the context. As an example, the triage staff may find out that for a new guest, the cause of homelessness is traced to a small unpaid utility bill. The triage staff may locate funding that will provide help to make past due payments, resolving the threat of homelessness. In other cases, the problems may be more severe. The third block of activity includes discussion of alternatives with the guest. The guest may accept an option, in which case the shelter staff will procure resources to help the guest leave the shelter. If not, the shelter staff will assign internal resources and locate a bed for the guest for the night. Figure 4 shows the process model with notes overlaid for explanation.

To provide our partners initial outcomes that would be deemed valuable for understanding and improving the process, we performed capacity estimation and simulation to answer questions such as staffing needed to respond to guest arrival rates, and to understand bottlenecks and delays. Table 3 summarizes the inputs used and results obtained.

A Conceptual Model of the Guest Intake Process was constructed using the Petri Net Modelling formalism, which emphasizes the essential nature of a process as an ordering of tasks, punctuated by resting places necessary to account for multiple performers. Other standards such as Business Process Modelling Notation (BPMN) will result in a similar outcome with some more elaboration of documents and events.



Arriving Guests

Active
Returning
New

Triaged Guests

~15% Triaged
(for potential diversion)
~85% Continue

Guests Diverted

~25% Accept Alternatives and Leave
~75% Stay with the Shelter
Not triaged Stay with the Shelter

Figure 4. Conceptual Model of the Guest Intake Process

Parameters	Values
Shelter Capacity	670 Beds, i.e. $670 \times 365 = 244,550$ Bed-nights
Guests Served	Example, from July 2018-June 2019: 4,471 unique guests
Triage Days	Staffing data, 60%, i.e. $365 \times 60\% \approx 219$ days
Daily Arrivals	Historical data, ~ 670 arrivals per day, Shelter opens 3pm
Types of Guests	New $\sim 20\%$; Active or Returning $\sim 80\%$
Staffing	Significant variations, based on time of day and time of year
Process performance	Delays during peak times, wait times in excess of 60 minutes
Bottlenecks	Tasks in the Triage Activity Block

Table 3. Parameters and Results from Analytical Experimentation¹

This experimentation revealed that the guest intake process had significant variations (one stakeholder noted, “there is no typical day at the shelter” (Brunner 2019), and shared that the staff roles often crossed the task focus). Triage specialists, responsible for developing options and securing resources invested significant efforts for each individual; navigation consultants (aka case managers) examined select cases to explore housing or other supportive services; the shelter staff simply filled in as needed. This ‘implicit’ member-checking resulted in a faithful representation of the guest intake process; which we analyzed to surface key characteristics of the work. Table 4 summarizes these reflections.

Characteristic	Description	Examples (drawn from scenarios)
Emphasis on the Case	A decision made / task performed entirely driven by the case	The shelter may simply provide bus fare to a guest to reach their relatives in the city
Lack of knowledge	A decision made with incomplete knowledge to avoid to a tragedy	Information not available due to reluctance or disability but the shelter will still help
External knowledge	A task may require (unavailable) knowledge about external source	A triage specialist may not know availability at a housing agency in time
Limited resources	A performed to continue the process in spite of resource limits	The shelter staff may face funding limits on a program that may prevent help offered
Limited visibility	Limited visibility about the outcomes achieved for a case	The movements of a guest after they leave the shelter are not known to the staff
Limited prediction	An actor may have limited ability to predict the trajectory of a case	The staff may find it difficult to guess how a case would proceed
Long duration	A case may persist well beyond the nominal process boundaries	A guest may return to different agencies over long time periods

Table 4. Characteristics of Work Identified from the Guest Intake Process

These characteristics pointed to potential mapping against those for the knowledge-intensive processes. As the research process continued, we continued collaboration with the stakeholders to identify challenges and opportunities for conceptual modeling of KiP in humanitarian settings.

5 Challenges and Opportunities

The challenges and corresponding opportunities reflect the conflict between the ideals that underlie traditional process modeling, and the nature of work required in humanitarian settings, e.g. to respond to the situated concerns of guests who present themselves at the homeless shelter. Such complexity and

¹ Numbers represent the outcomes of discussions with the stakeholders followed by member-checking.

situatedness is also seen in other domains such elder care, child welfare services and others. Table 5 shows this analysis, with authentic examples [adapted] from the domain we investigated.

Knowledge-Intensive Processes (see Table 1)	Work in Humanitarian Settings (see Table 4)	Comments (with examples from Caring for the Homeless)
Knowledge-driven	Lack of Knowledge External Knowledge Limited Visibility	The mapping points to the difficulties of having access to all the relevant information needed at the point of rendering services to the homeless
Collaboration-oriented	External Knowledge	Representative of how the shelter staff needs to draw on information from external partners
Unpredictable	Limited Prediction	The predicted journey for the homeless guest cannot be predicted by the shelter staff
Emergent	Emphasis on the Case	The decisions that the shelter staff must make are emergent given the incomplete knowledge
Goal-oriented	Emphasis on the Case	The overall goals of minimizing the incidence and recidivism drive this concern
Event-driven	(see comment)	This characteristic <i>may</i> be mapped against the long-duration nature of care for the homeless
Constraint- and rule-driven	Limited Resources	This characteristics for KiP reflect the need to respect funding constraints on programs
Non-repeatable	Emphasis on the Case	Possibility of using Case Templates designed at design time for use during execution
(see comment)	Long Duration	<i>May</i> be mapped against the event-driven characteristic of knowledge-intensive processes

Table 5. Mapping the Characteristics of KiP against Work in Humanitarian Settings

Based on this mapping, we identify key challenges for conceptual modeling of and support for knowledge-intensive processes in humanitarian settings. We describe the first challenge as **discretionary tasks**: the need to carry out or ignore tasks based on context. For example, if Jay (see Figure 2 earlier) presents at the shelter, the shelter staff may ignore other attributes, and instead, move quickly to explore options such as permanent supportive housing or identification of bed space in acceptable substance abuse programs. In more extreme cases (e.g. because this shelter does not have a sobriety rule), a larger number of tasks may be ignored. Consider an example from a different domain. In a child welfare services setting, a case worker may need to make certain decisions quickly for a child even in the absence of complete history or family whereabouts to respond to immediate concerns, ignoring some tasks.

We describe the second challenge as **task groups**: the need for flexibility. For example, when John, a veteran, presents at the shelter, the shelter staff may carry out tasks such as develop options and secure resources not only in parallel (as shown in the process model, see Figure 4), but also collaboratively to share what they are learning about resources available in different funding programs targeted at this population and develop options that may be considered based on John's history. Some programs and resources may not be in their control (e.g. government policies that impact funding restrictions in other organizations in the CoC). Similar examples can be considered for other domains such as elder care, where a home health aide may work with family members to develop care options.

We describe the third challenge as **knowledge intensity**: possibilities for knowledge extraction from and knowledge use for different tasks. For example, when Jeff, a 45-year old, white male, who suffers from health problems, presents at the shelter, the shelter staff may not know whether he has been in a healthcare facility before returning to the shelter (unless Jeff agrees to share this information). As a result, they may not be fully aware of his health status, and more importantly, whether he has returned to his habit of substance abuse. They may make an effort to extract this information, and use any decision models, or rely on experience to guesstimate Jeff's trajectory. Interestingly, the stability of the knowledge they extract may be quite low (Brunner, 2019). The data we analyzed (see Purao et al., 2019) showed that even information that is expected to be stable (e.g. birthday) is often modified by the client.

The term knowledge intensity, therefore, points not only to lack of data but also severely compromised data (that can make eligibility for different services difficult to assess). Similar examples in other domains may include, classifying individuals as “troubled” children by the child welfare services.

We describe the fourth challenge as *case management*: the tension between a task-based view with roles and responsibilities for each task, and a case-based view that requires a recognition of the individual, a concern that can be critical in humanitarian domains. For example, Jose, a 55-year old, Hispanic male who has been in and out of the shelter, presents at the shelter, the shelter staff may focus on his case as someone with significant recidivism to develop options that may help with this tendency. The decision would require knowledge extraction and knowledge use that is described as part of the previous challenge so the shelter staff can find a way to manage Jose’s case better. A similar example may be seen in the context of elder care, to manage long-term chronic conditions, which requires treating each individual as a unique case. Table 6 summarizes the challenges for KiP in humanitarian settings.

Challenge	Description
Discretionary Tasks	Unlike traditional processes, some tasks may be ignored or may not be completed because of (a) <i>incomplete knowledge</i> , (b) <i>reliance on external knowledge sources</i> . Process execution would continue in spite of wilful non-completion of these tasks.
Task Groups	Unlike traditional processes, task sequence can be flexible due to (a) <i>incomplete knowledge</i> , (b) <i>reliance on external knowledge sources</i> , and (c) <i>limited resources</i> . Process execution will need to reflect this collaboration across tasks and roles.
Knowledge Intensity	Unlike traditional processes, some tasks need (a) <i>knowledge extraction</i> to minimize (b) <i>limited visibility</i> ; and making tasks (c) <i>knowledge-driven</i> to overcome (a) <i>limited prediction</i> . Process execution will need this knowledge-intensity.
Case Management	Unlike traditional processes, process and case perspectives will need to be balanced because of (a) <i>limited visibility</i> and (b) <i>limited prediction</i> . Process execution will require attention to both.

Table 6. Challenges for Knowledge-Intensive Processes in Humanitarian Settings

6 Discussion and Concluding Remarks

In this paper, we have explored the challenges associated with modeling knowledge-intensive processes in humanitarian contexts. Examples of such domains include elder care, child welfare services, homelessness and others. Our work focused on the domain of caring for the homeless, and continues to progress in close collaboration with one of the largest homeless shelters in Northeast US. Our efforts were aimed at developing a conceptual model of the guest intake process at this homeless shelter, treating it as an exemplar of knowledge-intensive processes in humanitarian settings. Our effort provide, to the best of our knowledge, a first effort to examine conceptual modeling of such processes.

The key contributions of this work are, therefore, a conceptual model for the Guest Intake process at the homeless shelter (with analytical experimentation), and comparisons against contemporary research about modeling of knowledge-intensive processes. We find four key challenges for the conceptual modeling of knowledge-intensive processes in humanitarian settings: (a) acknowledging the discretionary nature of some tasks in a process, (b) treating a set of tasks as a group with variable sequence and knowledge sharing across the roles that perform these tasks, (c) incorporating knowledge intensity, both as knowledge extraction and knowledge use to improve process execution, and (d) balancing against case management demands against efficient task performance. Our path to these findings has been to first identify key characteristics of knowledge-intensive processes and examine how they are manifested in the Guest Intake process, followed by comparisons against contemporary work in knowledge-intensive processes. Future work can address the applicability of our findings to other settings to understand the similarities and difference. The findings also suggest possibilities for incorporating such ideas in modeling. One example, recently introduced to the conceptual modeling community is CMMN (case management modeling and notation) (Marin, 2016). It suggests possibilities

for advanced case management, and possibilities for partial structuring, higher degrees of freedom for process flow, and discretionary items (OMG, 2019). Such solutions may be more suited to the contexts we have examined beyond the ideas of adaptive processes (Marin & Hauder, 2015). Whether such modeling can facilitate the design of support mechanisms that different roles can use remains open to further investigation. It is important to point out that there are some fundamental differences that we have not explored. These include the impact of extrinsic motivation often being more significant for employees in for-profit organizations (Gilbert & Powell, 2010; Lee & Wilkins, 2011). These ideas also surfaced as part of the triage work, e.g., as high level of compassion for the clients who presented at the shelter, which impacted the iterations for task completion, decisions for each task, and what was considered effective. We will need to exhibit this sensitivity to ensure that any process changes are not viewed as dehumanizing. Exploring these with continued collaboration with our partners remains on our future research agenda.

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