Keeping People First in the Smart Cities Enterprise

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Abstract. Abraham Lincoln in his Gettysburg Address spoke of "government of the people, by the people and for the people." The INCOSE Smart Cities Initiative (SCI) is proceeding along these lines to support municipal governments in considering people first for smart city efforts. This Initiative will support municipalities and public agencies in adopting Smart Cities technologies by applying systems engineering principles and tools. This Initiative will support holistic development of Smart Cities infrastructure and Concepts, Applications, Technology and Services (CATS) through an open framework. Their initial set of models and metrics focused on the people and communities to determine how a smart city can improve life for its residents. Towards that end, a modeling initiative using the Unified Architecture Framework (UAF) was created to put the human at the center of the socio-technical system. The model looks at a city as an enterprise to examine the organizations, people, and communities using the human factors set of views. As a city of any size is a complex system of systems, the initial model is focused on Homeless/Unhoused People, how they interact with other organizations and people in the community. Only once this is understood should architects and planners explore technical solutions and how to improve outcomes for both them and the city. This paper will briefly discuss the SCI and its goals, and then show how MBSE can help planners understand the problem before looking for solutions.

Introduction

H.L. Mencken once said, "There is always a well-known solution to every human problem — neat, plausible, and wrong." (Mencken, 1917) This describes the approach many are tempted to take regarding the many complex problems facing us today. These include climate change, energy conservation, and housing insecurity. People look for simple solutions without considering the big picture, understanding emergent properties, how things change over time, and interactions with connecting systems. Engineers often do the same. Software engineers start coding before understanding the requirements, mechanical engineers start with CAD models, and electronics engineers look for IT solutions. Even systems engineers can be tempted to look at technology as a solution to all problems. However, when introducing Model-based Systems Engineering (MBSE) into an organization one must consider people first, then process, and lastly tools. The goal for this modeling project was to restrict the initial model to people and organizations. By restricting the modeling effort to just the people, it forced the modelers to concentrate on trying to understand the human interaction at play

before jumping to a technological solution. This is also aligned with the Initiative's perspective viewing a city as human centric. An enterprise is defined as "A human undertaking or venture that has explicit and clearly defined mission, goals, and objectives to offer products or service, or to achieve a desired project outcome or business outcome". (ISO 15704, 2019). So, cities, by definition, are enterprises as they were created for people by people.

The Smart Cities Initiative

The INCOSE Smart Cities Initiative will draw upon the experience and knowledge of INCOSE members to support communities in developing their Smart Cities Concepts, Applications, Technology and Services (CATS) by leveraging systems engineering tools and principles. Smart Cities CATS are being planned and developed across the world to apply information and communication technology (ICT) within traditional urban networks and services, making them more flexible, efficient, and sustainable. The efficiency of operations such as transportation, energy, water supply, building infrastructure management, and waste management are improved within the community for the benefit of its residents, making smart cities greener, safer, faster, and friendlier. Benefits include real-time resource allocation, improved resource use, reduced waste, and enhanced public safety. Since the Smart City concept comprises Smart Infrastructure, Smart Transportation, Smart Energy, Smart Healthcare, and Smart Technology, the Systems Engineering knowledge, experience, and skillset of INCOSE members is strategically positioned to support our global communities as they embark on supporting the multi-faceted Smart Cities CATS. (INCOSE, 2022)

The goal of this initiative is to create a model of a smart city that illustrates resources municipalities can use to create a framework for their Smart Cities CATS enabling interconnectivity, reuse, and consistency. It is intended that adopting a Smart Cities technologies open framework will assist these stakeholders with the integration of infrastructure and its related smart technology. As the Initiative developed a definition of a smart city and selected Max Neef's Nine Fundamental Human needs (Neef, 1989) as the center of our focus, it became clear that modeling efforts would also need to support a human-centered perspective. Combining the need for a holistic model with the human-centered focus and increasing public discourse about housing insecurity, the Initiative selected housing insecurity as a starting point. This use case requires the model to visualize the human condition and how the human is related to the environment. (Note: unless it is part of a quote, the paper will use the terms unhoused, housing insecurity, unhoused people/persons, and people experiencing homelessness as these are the terms currently in use.)

As a validation of the needs the Initiative is seeking to address, the Colorado Smart Cities Alliance Connected Colorado (C²) Challenge identified four primary challenges they were striving to address: housing stability, community resilience, safe streets, and civic engagement. All these issues are directly linked to the needs of the humans in the cities. An approach that focuses on the human as the center of the city system and organizes solutions around the needs of the humans is preferable. (CSCA, 2023)

The issues facing today's cities, housing insecurity included, are wicked problems. Per Rittle and Webber (1973), who defined wicked problems, "planners are liable for the consequences of the solutions they generate; the effects can matter a great deal to the people who are touched by those actions." (Rittle, Webber, 1973) We, as systems engineers, are not the subject matter experts on these issues, but our unique perspective can bring together existing resources to frame these wicked problems in new ways. Perhaps, we can help municipal planners and others to understand the potential effects of their actions. In this paper, we relied on published information regarding housing insecurity to inform the modeling. We are not providing a solution, but rather a method for modeling humans that can be expanded and replicated to provide perspective, insight, and understanding that drive new solutions that can be used by smart cities.

The Housing Insecurity "Problem"

In March 2020, The United Nations identified housing insecurity as a "serious violation of human dignity" and defined it as a global problem. The root causes of housing insecurity are starting to be studied and more broadly understood. Meanwhile, countries, states, and municipalities around the world are grappling with the issue. In some areas, the housing insecurity is a result of prolonged conflict and subsequent migration. In others, housing insecurity rates are spurred by the cost and availability of regional housing. Many cities are specifically seeking "smart cities" solutions to address of housing insecurity.

"The United Nations Centre for Human Settlements has proposed that individuals are considered "houseless" if they are sleeping rough, which means in the street, in public places or in other places not meant for human habitation, or in shelters provided by welfare or other institutions." (UIA, 2021) The Encyclopedia of World Problems and Human Potential defines that housing insecurity "is also the absence or attenuation of the affiliative bonds that link settled persons to a network of interconnected social structures, typified by the absence of any form of permanent accommodation. … It is much more than just losing a roof over your head; it becomes part of a much wider process of marginalization, which involves not just housing or financial inadequacy but an inability to participate in and avail of the quality of life and opportunities enjoyed by the rest of society." (UIA, 2021) This statement indicates the complexity and human-centeredness of the issue. There are many other definitions of housing insecurity available. Others are provided by the U.S. Department of Housing and Urban Development (HUD, 2009).

There are also numerous statistics on housing insecurity. Again, for simplicity we picked a single example. (NAEH, 2022) "In January 2020, there were 580,466 people experiencing homelessness on our streets and in shelters in America. Most were individuals (70 percent), and the rest were people in families with children. They lived in every state and territory, and they include people from every gender, racial, and ethnic group. However, some groups are far more likely than others to become unhoused. Historically, policymakers and practitioners at every level of government have focused special attention on specific populations and subpopulations. For example, decision-makers are often concerned about children and young people due to their developmental needs and the potential life-long consequences of hardships early in life. People in families with children make up 30 percent of the unhoused population. Unaccompanied youth (under age 25) account for six percent of the larger group." The NAEH website referenced above contains multiple pages of statistics regarding housing insecurity, which we are excluding due to space.

Effects of Housing Insecurity. Housing insecurity takes a toll on communities where this is prevalent. In 2012, the US Secretary of Housing and Urban Development Shaun Donovan estimated that the government spends about $40,000 per unhoused person per year. Recently, "Los Angeles County Board of Supervisors approved a $532.6-million spending plan that significantly expands permanent and interim housing solutions and increases funding for local cities." This funding is being provided by a 2017 sales tax within the county. These costs impact everyone. Additionally, encampments of the unhoused can have a visual impact on tourists, shoppers, or other economic generation activities. As they should be, research and publication efforts are focused on understanding housing insecurity and its causes and effects on the unhoused person. (Ponio, 2021)

Effects of Being Unhoused. Housing insecurity takes a greater toll on the un-housed person. The distinction between homeless and houselessness defined by the UIA Encyclopedia indicates the nuances of the human condition associated with being houseless. "The risk of becoming homeless/houseless is increased by a lack of access to helping resources, whether finances, the support of friends and family, or public or voluntary support services." (UIA, 2021) The consequences of housing insecurity include chronic illness, addictions, recurrent jail time, victimization, crime, loss of self-esteem, reduced life expectancy, and loss of ability and will to care for oneself. For children, the

impacts of housing insecurity are profound, including "health problems, hunger, poor nutrition, developmental delays, anxiety, depression, behavioral problems, and educational underachievement," according to Rafferty & Shinn (1991). Visualizing these challenges and complexity is something that systems engineering, specifically model-based systems engineering (MBSE), can help with.

The Unified Architecture Framework (UAF)

Architecture frameworks are used to understand enterprises and systems of systems and how they change over time. The Unified Architecture Framework (UAF) is used to define the overall goals, strategies, capabilities, interactions, standards, operational and systems architecture, systems patterns and so forth (OMG, 2022). It is focused on the scope, needs, strategy, expectations, stakeholders, and long-term plans of an enterprise. The roots of the UAF come from the defense industry, but it is equally applicable to commercial enterprises. The UAF was ratified by the Object Management Group (OMG). (OMG, 2022) Several papers have been written on the UAF and its support of SoS modeling including (Hause, Dandashi 2015) and (Hause 2014). It is built on SysML, so has built-in traceability to system development in SysML. The full details of SysML and UAF are not included here for space reasons. (OMG, 2022)

Viewpoints

Specific viewpoint descriptions are consistent with UAF modeling practice. Viewpoints are described below.

Architecture Management (Am) – Identifies the metadata and views required to develop a suitable architecture that is fit for its purpose.

Strategic (St) – Capability management process. Describes the capability taxonomy, composition, dependencies, and evolution.

Operational (Op) – Illustrates the Logical Architecture of the enterprise. Describes the requirements, operational behavior, structure, and exchanges required to support (exhibit) capabilities. Defines all operational elements in an implementation/solution independent manner. These views are not included in the paper due to space but are normally included.

Services (Sv) – The Service-Orientated View (SOV) is a description of services needed to directly support the operational domain as described in the Operational View.

Personnel (Ps) – Defines and explores organizational resource types. Shows the taxonomy of types of organizational resources as well as connections, interaction, and growth over time.

Resources (Rs) – Captures a solution architecture consisting of resources, e.g., organizational, software, artifacts, capability configurations, and natural resources that implement the operational requirements. Further design of a resource is typically detailed in SysML or UML.

Security (Sc) – Security assets and security enclaves. Defines the hierarchy of security assets and asset owners, security constraints (policy, laws, and guidance) and details where they are located (security enclaves).

Projects (Pj) – Describes projects and project milestones, how those projects deliver capabilities, the organizations contributing to the projects and dependencies between projects.

Standards (Sd) - The set of rules governing the arrangement, interaction, and interdependence of solution parts or elements. This includes non-technical standards such as operational doctrine, industry process standards, etc.

Actual Resources (Ar) – The analysis, e.g., evaluation of different alternatives, what-if, trade-offs, V&V on the architecture. Illustrates the expected or achieved actual resource configurations.

Aspects

The aspects largely correspond to the SysML/UML views defined in their standards. For example, the taxonomy view is a block definition diagram, and the processes views are activity diagrams. Others such as the roadmap diagrams are custom diagrams as they represent timelines or other reports. They are further described in each section.

The Smart Cities Model

Autoville has been experiencing an increasing number of unhoused people. They reside in city parks, under bridges, in makeshift encampments, and on the city streets. This has caused increased crime, increased police interactions, overloaded courts, resident complaints, and decreased tourism. Sadly, an increasing number of unhoused people have been dying from violence, overdose, alcohol poisoning, and exposure. The city administration has decided to study the situation and provide services to improve the situation. These include housing, treatment, counseling, and education rather than increased law enforcement or ignoring the problem.

Of course, it must be mentioned that although this paper describes a model of a human enterprise, it does not consider people could be modeled as homogenous entities, systems, or automatons. Every person is unique, with unique characteristics, hopes, dreams, lives, and issues. Creation of the model is not meant to dehumanize people or to distill them down to a set of equations, rather it is meant to help to understand them as a means of providing viable solutions to the issues facing them and the cities in which they live.

High Level Conceptual Model

To understand the enterprise at the highest level and in the simplest form, the high-level taxonomy diagram is used. The purpose of the diagram is to describe the main enterprise concepts in a manner that is easy to understand to ensure a common understanding. Figure 1 describes the main concepts and their relationships. The Unhoused Person is at the center of the diagram. The other concept elements show their relationships with the Unhoused Person. Unhoused people have interactions with multiple organizations and systems in Autoville. This helps to understand the positive and negative effects that unhoused people have on city elements, and vice versa. Understanding this will help to frame solutions and understand the problem.
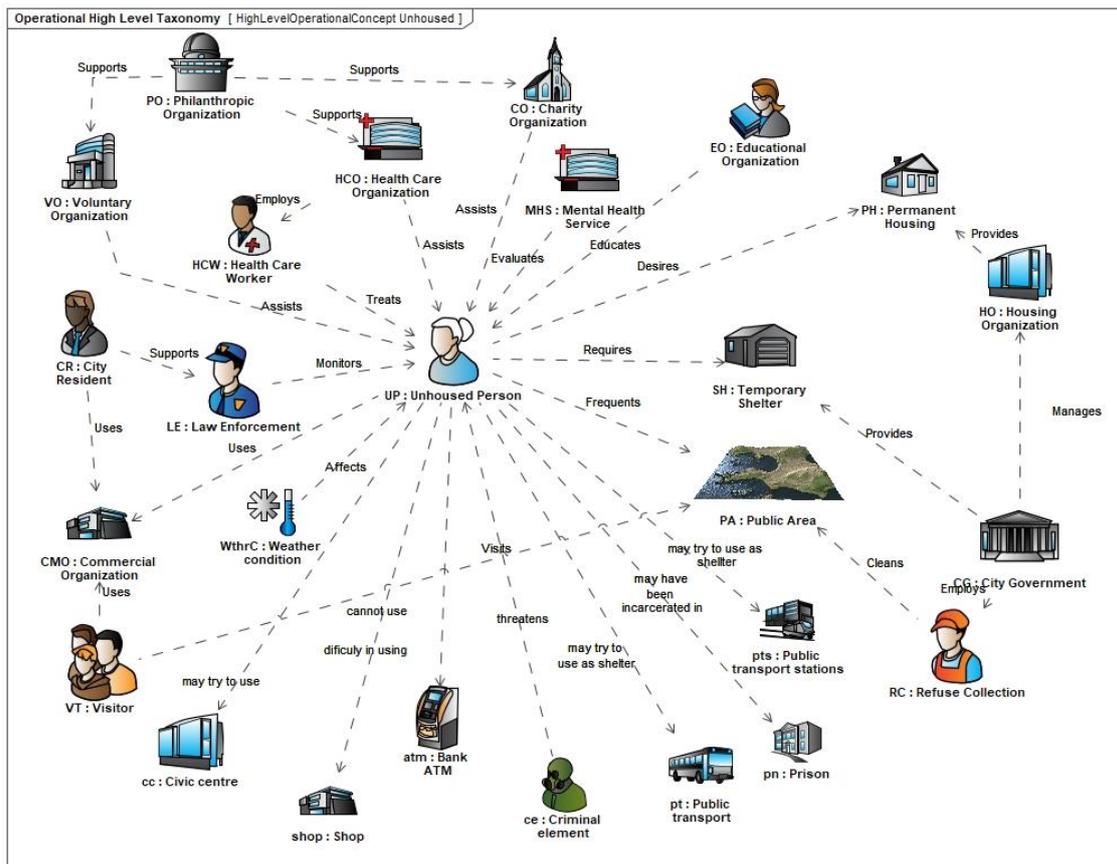

Figure 1. Autoville Unhoused Person Concept Diagram

Enterprise Goals and Phases

An enterprise goal is an endpoint, accomplishment or target an organization wants to achieve in the short term or long term. Goals can take many different forms and be aspirational or motivational, such as driving an organization toward a certain objective like improved customer service. They can also have very specific objectives, such as reaching a particular revenue target, net income, profit margin, profit goal or other financial milestone. These are shown in Figure 2.
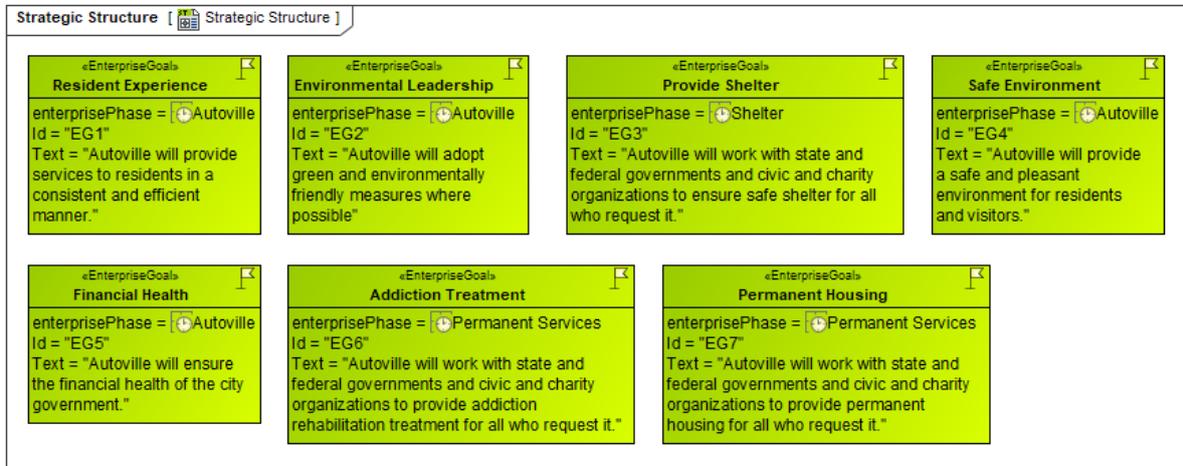

Figure 2. Initial Project Goals

The goals provided illustrate potential human centered goals that a municipality may have. Setting goals defines what Autoville wants to achieve. These can be phased over time and linked to other elements in the architecture. The goals defined are related to issues dealing with both the unhoused people and their interactions with the city. Each goal includes a text description elaborating the intent of the goal. Goals differ from requirements in that they are "will" statements rather than "Shall" statements, thus defining intent. The goals are phased as shown in Figure 3.
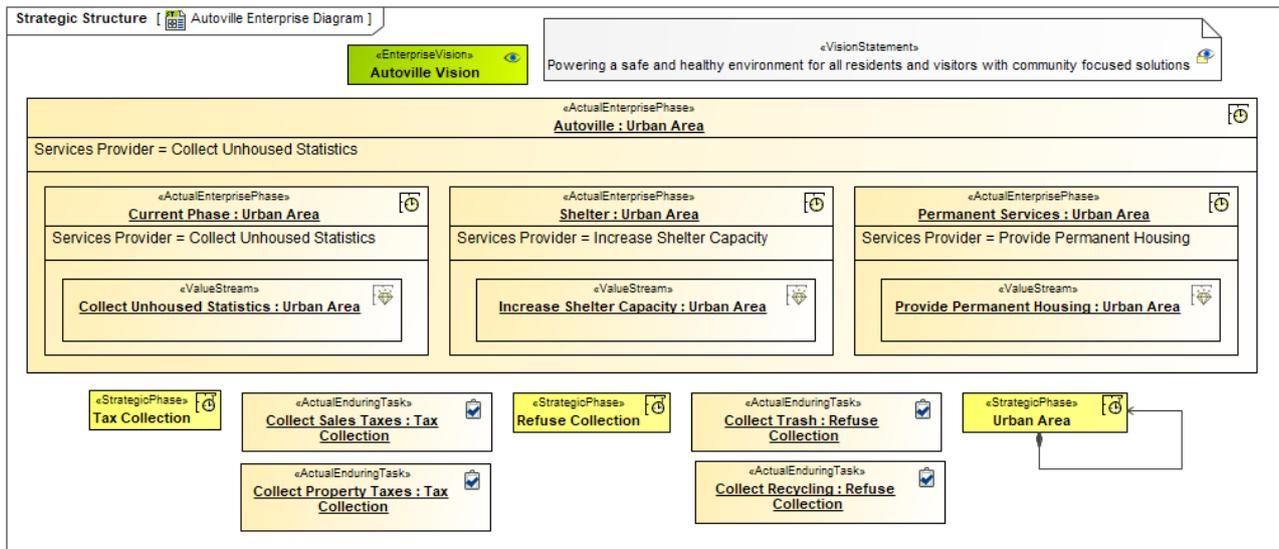

Figure 3. Autoville Three Phase Project

An enterprise phase describes a temporal or structural part of an enterprise. A temporal part allows you to define how an enterprise will change over time, linked to the goals and capabilities that will be achieved in each phase. Structural parts divide the enterprise into specific areas of concern. The enterprise in Figure 3 is divided up into three phases. The goal of the current phase is to collect statistics and study the problem. Phase 2 will increase shelter capacity and phase 3 will provide

addiction treatment, provide permanent housing, and increase employment training. Capabilities and the resources that support them will be linked to the different phases. Enduring tasks that keep the city operating are also shown. The ongoing goals of the enterprise as a whole are also shown such as resident experience, environmental leadership and safe environment.

Capability Modeling

A Capability is "The ability to achieve a desired effect under specified standards and conditions through combinations of means and ways to perform a set of tasks." (OMG, 2022) Stating a capability rather than a system or a requirement "shall" statements changes the mentality from "what solution do I need" to "what do I want to achieve." This is in keeping with best practice for both systems engineers and architects. The Autoville capabilities are shown in Figure 4.
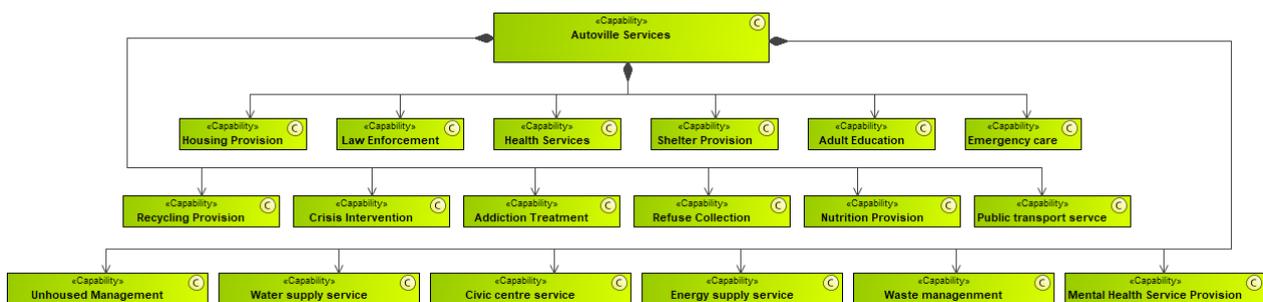

Figure 4. Autoville Capabilities

Autoville services describe the overall capabilities available within the city. These are provided by the government, volunteer organizations, religious organizations, healthcare organizations, businesses, and industry. For example, Health Services could be provided by a federal, state, city or private hospital, city or private clinic, care home, voluntary organization, etc. It can also include online services as well.

Human Factor/Personnel Views

The personnel views provide a means of looking at multiple aspects of people and organizations, their life cycles, competencies, abilities, activities and behaviors, measurable properties etc., and form the bulk of this paper. These provide a means of capturing the human factors and integration with specialist tools. The mapping to the implementing resources is done in the resources and personnel views as shown in Figure 7. In this case, we have limited the resources to human resources. The personnel views begin with the unhoused persons who are the focus of the model (and issue). By iterating their characteristics in this way, their motivations, stimuli, and other factors become visible and reinforce the complexity of each situation. There is not just one type of unhoused person. As discussed earlier, people become unhoused for many reasons and will remain unhoused or find their home for many reasons as well. Once again, there has been a considerable amount of research into types of unhoused people and so we picked one. (Comic Relief, 2022) Below is an extract from their website of the four types of unhouse people face in the United States and elsewhere.

Transitional Unhoused is "a state of housing insecurity that's a result of a major life change or catastrophic event". These life changes might be job loss, a health condition, divorce, domestic abuse, a substance use disorder, or personal or family crisis, among many others, resulting in people being in unhoused situations for less than a year.

Episodic Unhoused is experienced when people are currently unhoused or have experienced at least three periods of housing insecurity within the last 12 months. Like transitional unhoused, many of those facing episodic housing insecurity are younger or dealing with a disabling condition. These

conditions could be substance use disorder, mental illness, and other mental and/or physical health conditions. In some cases, some episodically unhoused people have seasonal or minimum wage income jobs. The episodic unhoused can eventually become chronic unhoused without adequate resources and support.

Chronic Unhoused is defined as "an unaccompanied unhoused individual with a disabling condition" who has been unhoused for more than one year. It's more common for people experiencing chronic housing insecurity to also deal with a certain disability, mental health condition, addiction, and other debilitating conditions that restrict their ability to escape housing insecurity. According to the National Alliance to End Homelessness, chronically unhoused people tend to be older and make up about 17% of the unhoused population.

Hidden Unhoused persons live with others temporarily without a permanent home and are often most unnoticed. Since they lack access to housing support resources and cannot be identified, they are 'hidden' from national statistics on homelessness. People who experience hidden homelessness, often turn to friends, family, and neighbors for a shelter or a place of refuge. Statistics about them are scarce as they don't typically access services. Unhoused Person types are shown in Figure 5.
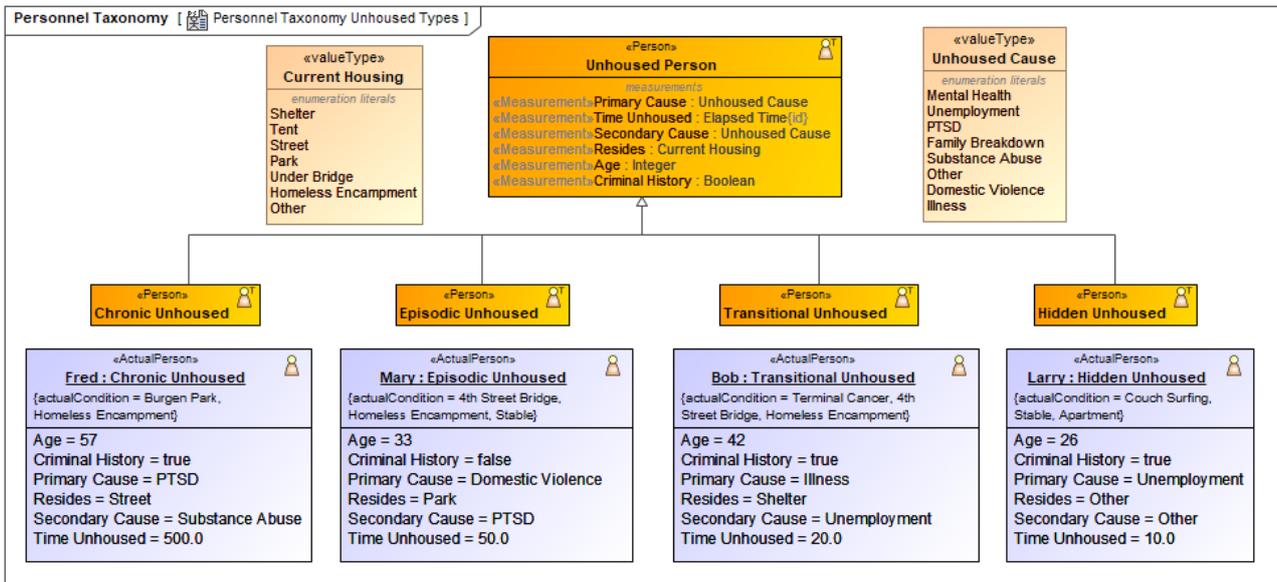

Figure 5. Types of Unhoused People and Their Attributes

The four types are shown using inheritance. The unhoused person's attributes of primary Cause, Time Unhoused, Secondary cause, Resides, Age and Criminal History are inherited by the four types. There are instances created for each of these illustrating example unhoused people and their specific attributes. There are millions of unhoused people, so these 4 are used to illustrate examples of the concepts. Of course, each unique individual has multiple attributes and their own personal history recounting the events that brought them to their current situation.

Event Modeling

Both positive and negative events occur in the life of an unhoused person. These events can either exacerbate the problem or provide a path toward a positive solution. Identifying and analyzing some of these issues is critical insight to identify where along the event cycle a change can best support a positive solution rather than a negative outcome. It is the interaction of the unhoused person with the supporting environment that is essential to influence the consequences of these events. These are shown in Figure 6 and will be referenced by the state diagram in Figure 11.
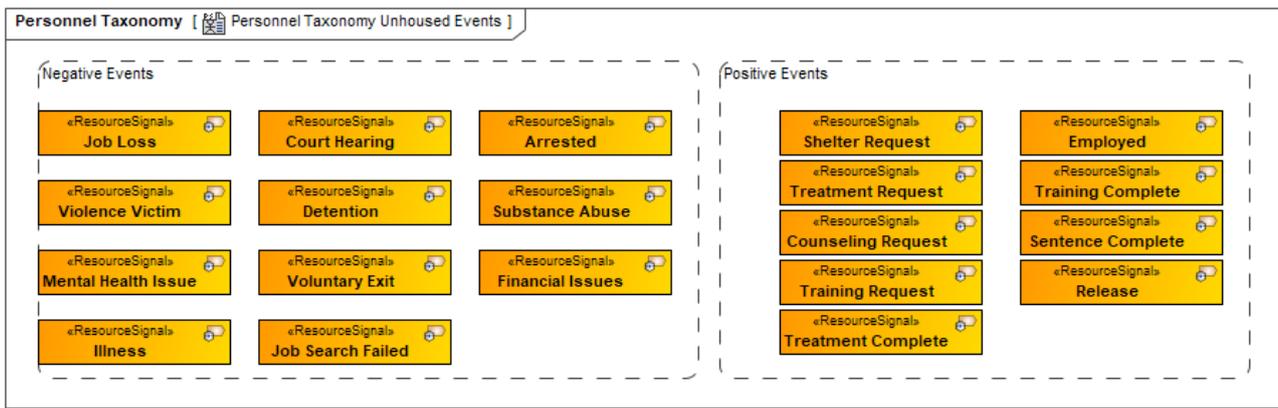
Figure 6 Events in an Unhoused Person's Life

Implementation of the Capabilities

Within a municipality, capabilities can be provided from within the city structure or outside agencies. Figure 7 shows the organizations and people implementing the capabilities.
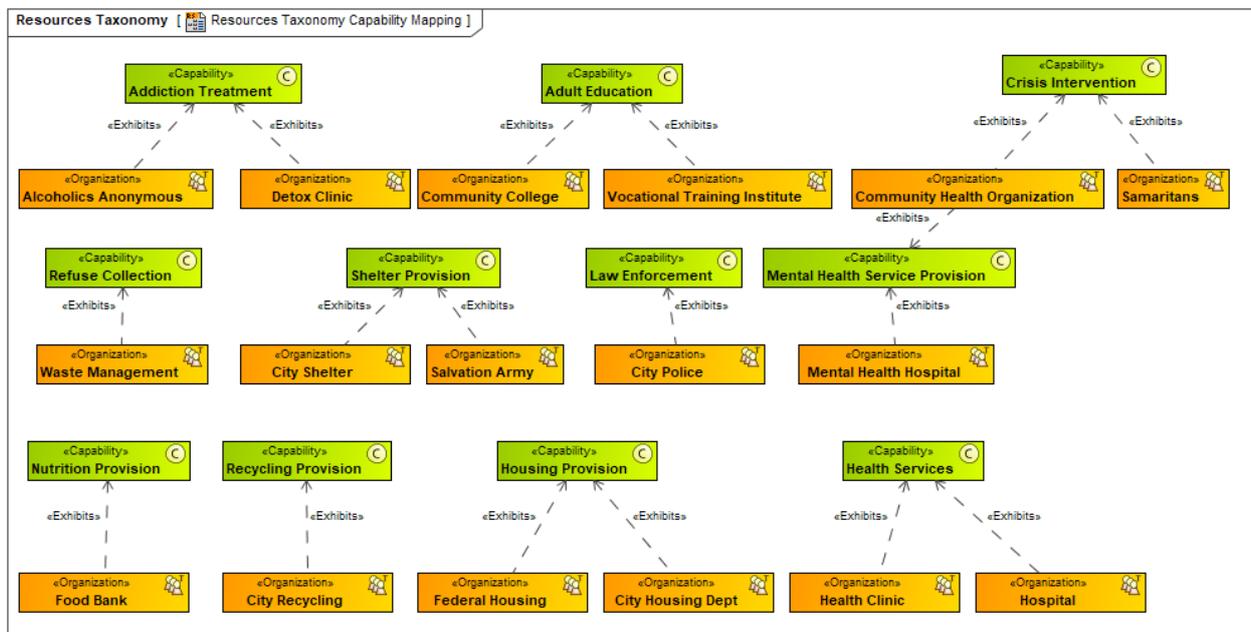

Figure 7. Organizations Providing these Capabilities

As a sample, the organizations listed are a subset of the implementing resources. In fact, it is merely a subset of the types of implementing resources. Instances of types of resources can also be shown as they are for people in Figure 5 earlier in this paper. Instances are rarely used in SysML but are an integral part of UAF as they provide a means to define template/types of resources with measurement definitions and provide specific values for the physical resources that exist that are of that type. For example, Health Clinic attributes could include the number of staff of each type, number of clinicians available at any time, available beds, examination rooms, etc. Instances created for the existing Autoville clinics could be defined to determine the total capacity for treatment in the event of a crisis. Of course, the intention is NOT that the UAF model would become the system that Autoville would use to manage healthcare. Instead, it is a means for city planners and managers to look across a range of different capabilities and cross cutting areas that would not be available if one simply looked at an aspect of city services. This greater context is what the UAF provides.

Missing the Obvious

Housing insecurity can be a condition that is ignored at times, and solutions seem evasive because the situation is hard to visualize in context. Holt (2009) presented a paper entitled "Gorillas in Our Midst" highlighting the challenge of humans missing the big picture. This was based on an experiment and subsequent book called the Invisible Gorilla. (Chabris, Simons, 2011) The experiment is described on their webpage http://www.theinvisiblegorilla.com/gorilla_experiment.html .

"Imagine you are asked to watch a short video (above) in which six people-three in white shirts and three in black shirts-pass basketballs around. While you watch, you must keep a silent count of the number of passes made by the people in white shirts. At some point, a gorilla strolls into the middle of the action, faces the camera and thumps its chest, and then leaves, spending nine seconds on screen. Would you see the gorilla? Almost everyone has the intuition that the answer is "yes, of course I would." How could something so obvious go completely unnoticed? But when we did this experiment at Harvard University several years ago, we found that half of the people who watched the video and counted the passes missed the gorilla. It was as though the gorilla was invisible. This experiment reveals two things: that we are missing a lot of what goes on around us, and that we have no idea that we are missing so much. And it got us thinking that many other intuitive beliefs that we have about our own minds might be just as wrong."

In his INCOSE paper and presentation, Holt draws parallels between the experiment and the importance of enterprise architecture drawing the following conclusions. "The world is forever changing. There is a need to: identify change, manage change, and predict future change. It is essential that all aspects of business are aligned and harmonized. The ability to focus on views is essential." The ability to bring these views together to see the big picture is imperative. For addressing housing insecurity, it is also imperative. Healthcare organizations who play a role in care of unhoused persons are further elaborated in Figure 8.
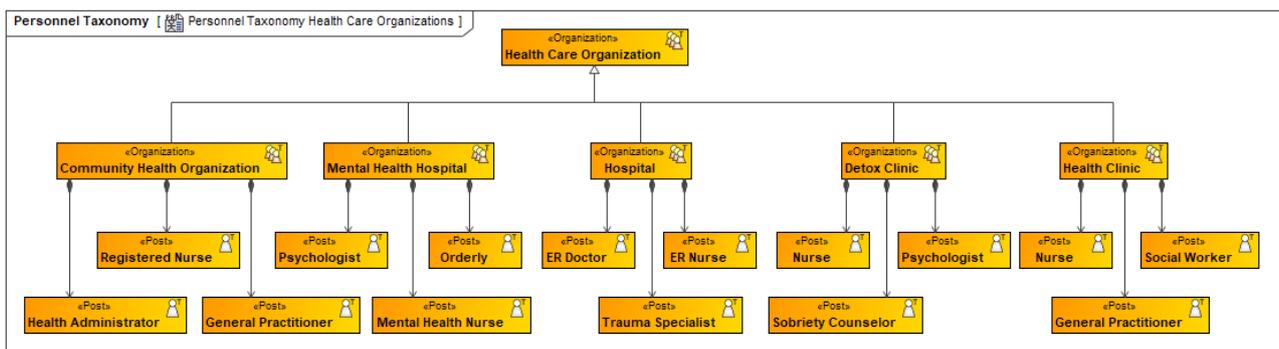

Figure 8. Healthcare Organizations and Staffing

The context of the unhoused person continues to become more complex. Health Care Organizations are both public and private, which means that a city doesn't have control or even influence over the services provided by private organizations. This can lead to bigger silos than may exist within a single organization. Yet, all the organizations together are charged with a duty of care to the community. Health care also offers specialized services, some of which are helpful for a given unhoused situation and others not. However, because of the public and privately provided services, the redundancy of services or lack of a needed service is probable. Even this view alone could be helpful to understand what services should be added or reduced for a particular environment. In addition to the health care services, there are many governments (Figure 9) and voluntary organizations (Figure 10) who interact with the unhoused.
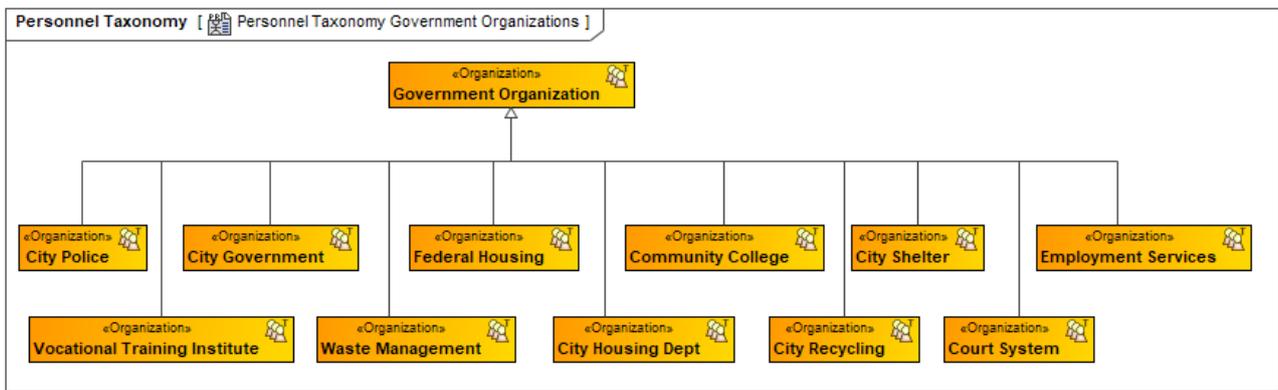
Figure 9. Government Organizations Interacting with the Unhoused

Identifying those resources and reviewing for redundancy and missing resources can be informative to understanding the context and how to support solutions.
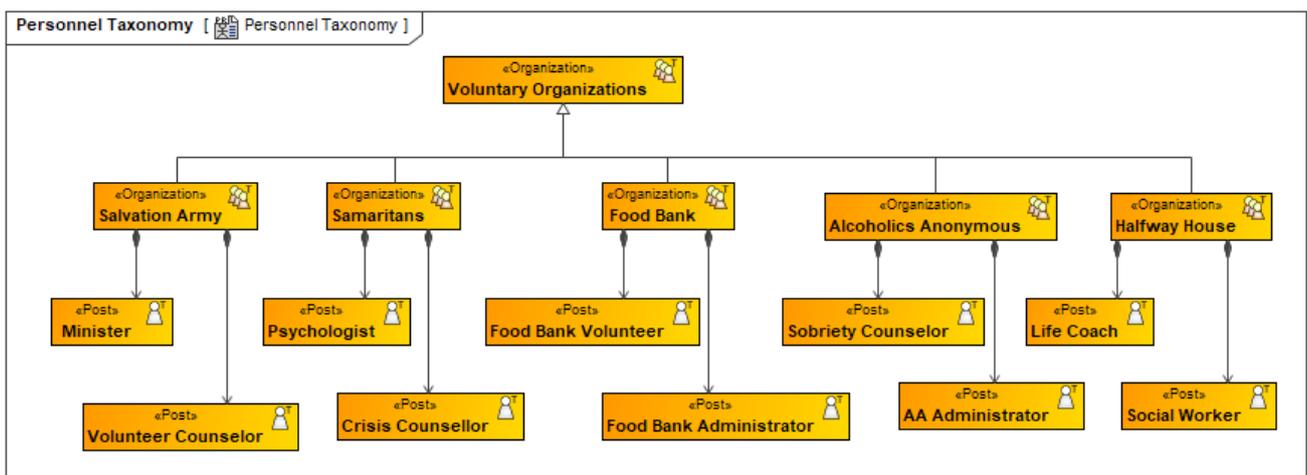

Figure 10. Voluntary Organizations

Vicious and Virtuous Cycles of Unhoused Persons

Using the previously documented potential events in an unhoused person's life (Figure 6), a view of the states in the unhoused person's life can be created. Outlining the positive and negative events illustrates the vicious and virtuous cycles of the chronic unhoused person. A vicious cycle is in one in which a negative event causes a further event with the status spiraling downwards. This series of recurrent housing insecurity and failed recovery attempts are frequently reported and documented. However, it is not often paired with the virtuous cycles where an unhoused person becomes permanently housed and achieves stability. By showing the cycles within the same paths (Figure 11), experts can determine where to intervene to improve the final outcome. This can move the person from the vicious to virtuous cycle.

It is also possible to examine the events and transitions to determine if there are any errors in process or procedures. For example, it appears that the only way that someone can receive mental health treatment is to first become incarcerated. While this may not make any logical sense, procedures established over time often do not. Documenting them can be useful to find problems in how things can be improved. In addition to the intervention of people, systems and procedures could also be identified that may be of assistance. For example, when an unhoused person becomes incarcerated, the appropriate government and volunteer departments could be informed to intervene and assist. By examining each negative and positive transition, it could be determined how to mitigate the negative events and amplify and assist the positive ones. To assist in the visualization, the positive transitions and states are colored green, and the negative transitions and states are colored red. This helps to

highlight the overwhelming negative events in an unhoused person's life. This could also form the basis of a failure mode approach (FMEA): What are the failure modes? What are the effects of failure? How can we detect a failure and how can it be mitigated? The goal of this of course is prevent the vicious cycle towards becoming unhoused and motivate the virtuous cycle. This model is by no means complete and the exact states and transitions would need to be customized for each locality. Some states and transitions were omitted for space and clarity.

Finally, it is at this stage that managers, experts, social workers, decision makers, and technologist can start to determine where specific technologies can be of help. As we mentioned at the beginning of the paper, people first, then process, then tools and technology. An automated wrong solution just gives you the wrong results faster. This ties directly to the theme of the INCOSE EMEA conference of engineering in a sustainable world. Engineering requires understanding, as without understanding the solution will not match the needs of the stakeholders. As is evident from the created model, stakeholders are wide and varied, each with their own unique set of needs. Understanding these needs will reduce false starts and create better solutions for sustainable cities and environments, reduce poverty and promote decent work and economic growth.
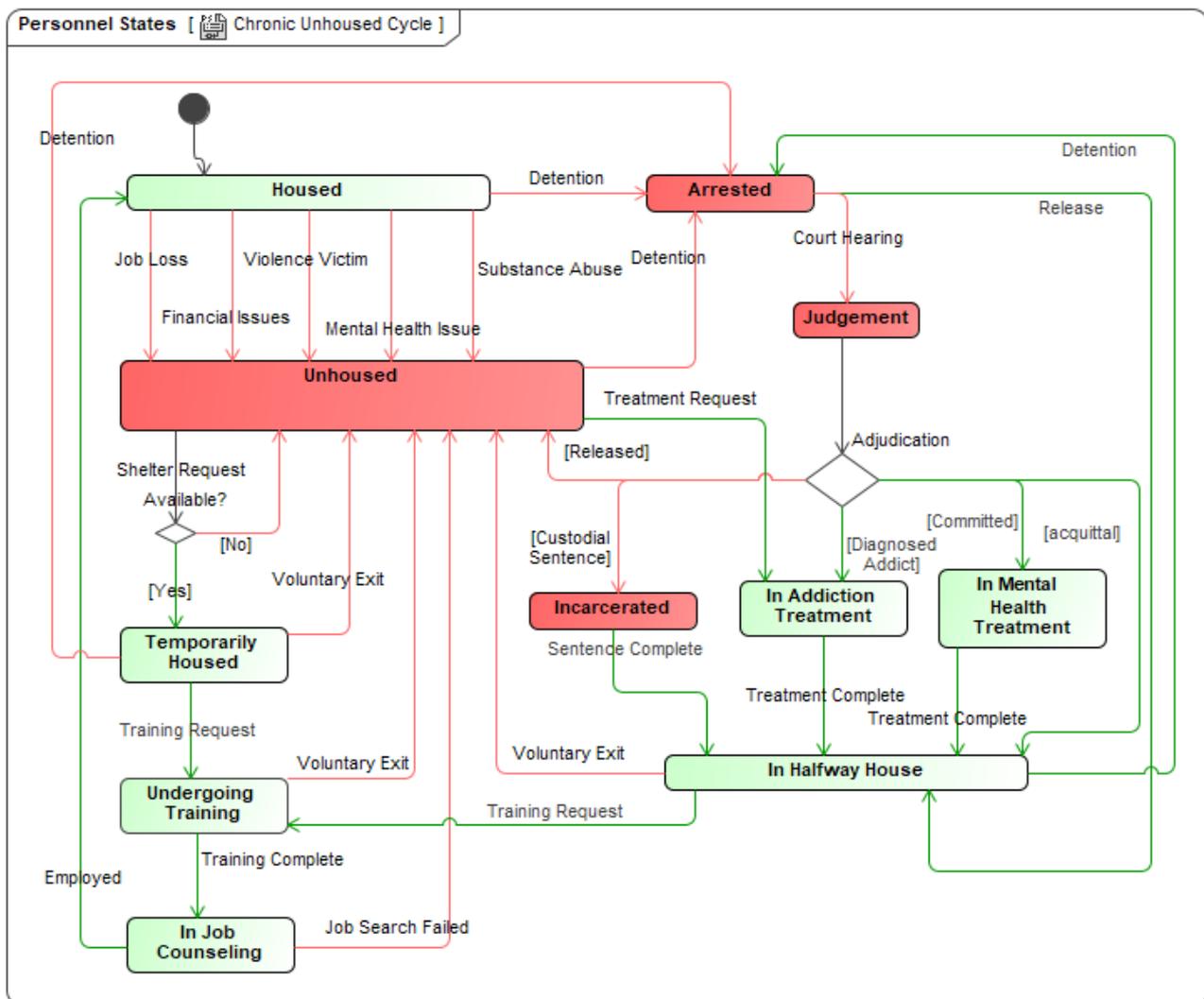

Figure 11. Chronic Unhoused Cycle

While the personnel states perspective can help identify where and when to intervene, a more concrete model has been created for the unhoused person's interactions with Autoville Organizations. (Figure 12.) This diagram shows a subset of the interactions that an unhoused person has with the organizations in Autoville. This array of interactions would be overwhelming for anyone, especially

someone experiencing housing insecurity, possibly with medical or mental difficulties. This diagram helps to illustrate that a dedicated capability needs to be created to address housing insecurity and to provide targeting and expert assistance. Currently, housing insecurity is everyone's and no one's problem, meaning that no one is sufficiently addressing it. Using the model to represent the context, new perspectives can be gained and potential points of influence for change are identified.
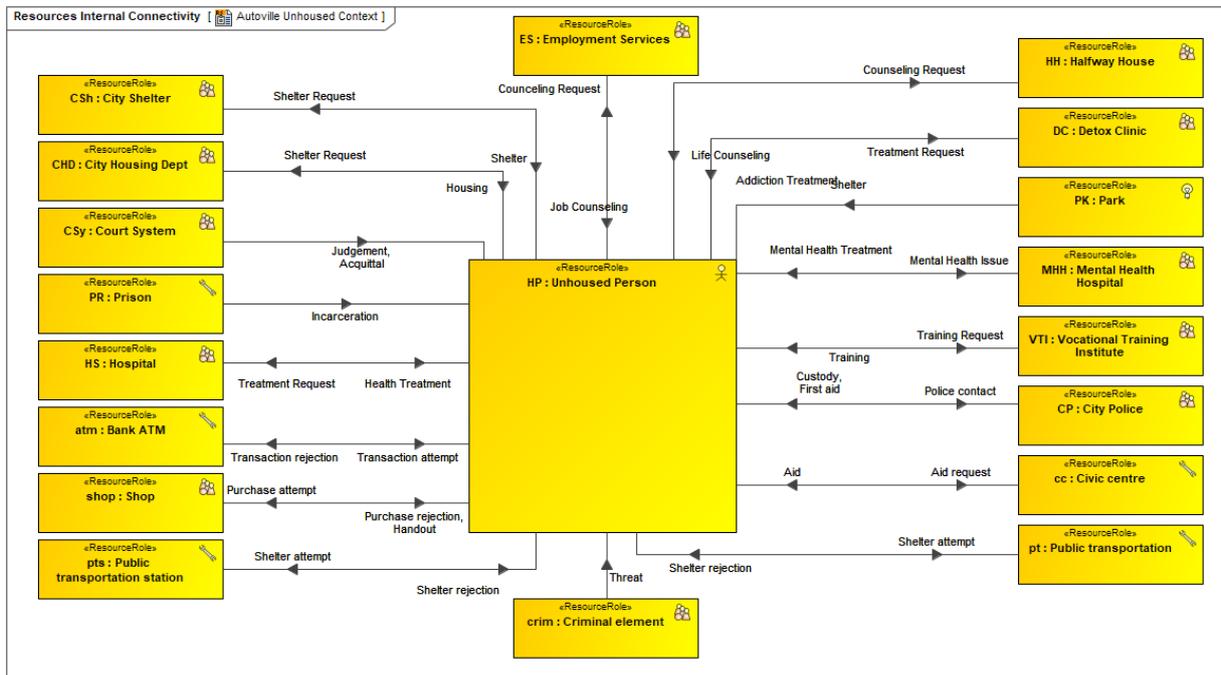

Figure 12. An Unhoused Person's Interactions with Autoville Organizations

If a position were created to coordinate resources for unhoused people, a new capability could be provided within the city. This could streamline access for the unhoused person, coordinate resources, seek to fill missing services, and leverage the array of public and private organizations who provide services to unhoused people. Figure 13. illustrates how this role would interact within context.
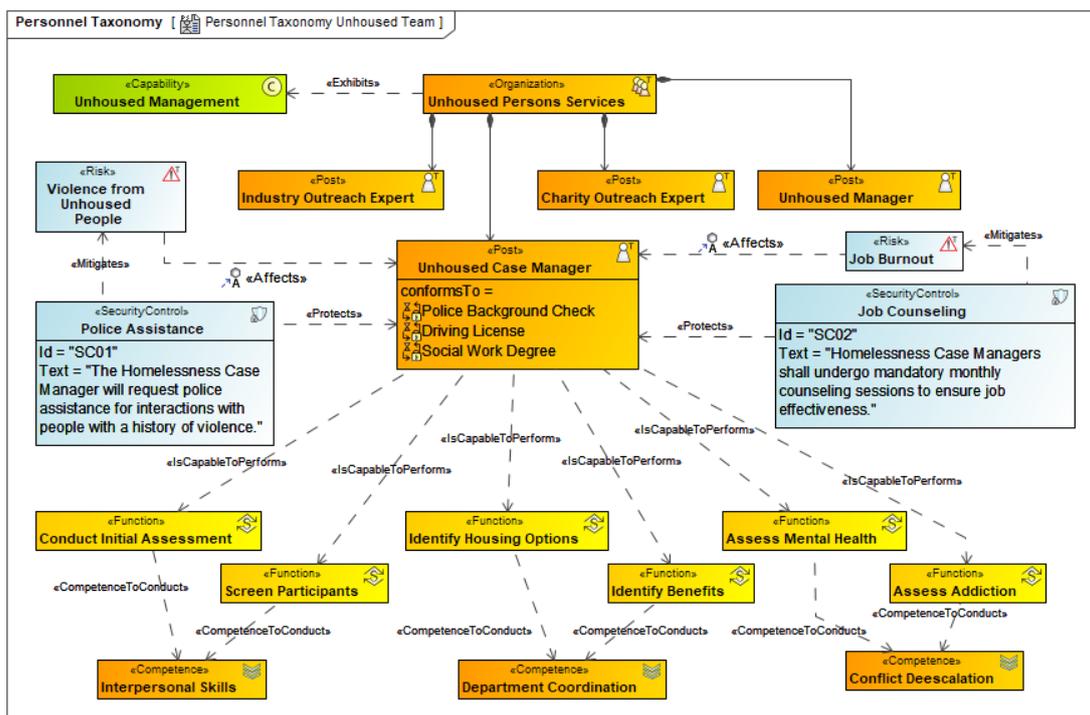

Figure 13. Unhoused Persons Services Organization

Job burnout is a possible risk for social workers, so also for the Unhoused Case Manager. It is just as important for a city to create this role as it is to protect the person (or people) fulfilling this service. This is another immediate benefit of the modeling effort of the human situation. Additionally, a holistic strategy can be created to address housing insecurity that includes government departments, industry, medical facilities, and addiction services to find solutions. To the benefit of all the human resources involved with the situation, risks and mitigations have been identified and proposed.

The Strategic View

Figure 14. defines a strategy to help Unhoused People and improve Autoville. This presents the holistic strategic motivation to address housing insecurity including challenges, opportunities, drivers, and risks. This example defines the goals of Autoville regarding Addiction Treatment and a Safe Environment. The Detox Clinic and Alcoholics Anonymous support the Addiction Treatment Capability. This is impacted by the opportunity of Opioid Settlement Funds, provided by drug companies as part of government lawsuits provoked by drug companies pushing opioids causing widespread addiction and deaths. These can fund their operations and provide much needed help and enable the goal of addiction treatment. This is motivated by the Drivers of Increased of housed and Unhoused Deaths which presents the Challenge to Reduce Addiction. A similar set of relationships is provided for the Goal for a Safe Environment. In this case, the Unhoused Management department can be financed by Government COVID Funds, provided by the US and other governments during the COVID pandemic. This will lead to Reduced Crime and Unhoused, which were motivated by Urban Flight, Negative Public Perception, and Increased Crime. The established opportunities also come with risks, such as Misspent Funds. Mitigating systems and procedures can be put in place to prevent these risks from being realized. By laying out these logical strategies, city planners and stakeholders can find a way forward that is both useful and practical as well as possible. It also helps to understand some of the root causes of housing insecurity and determine the feasibility of the strategy.
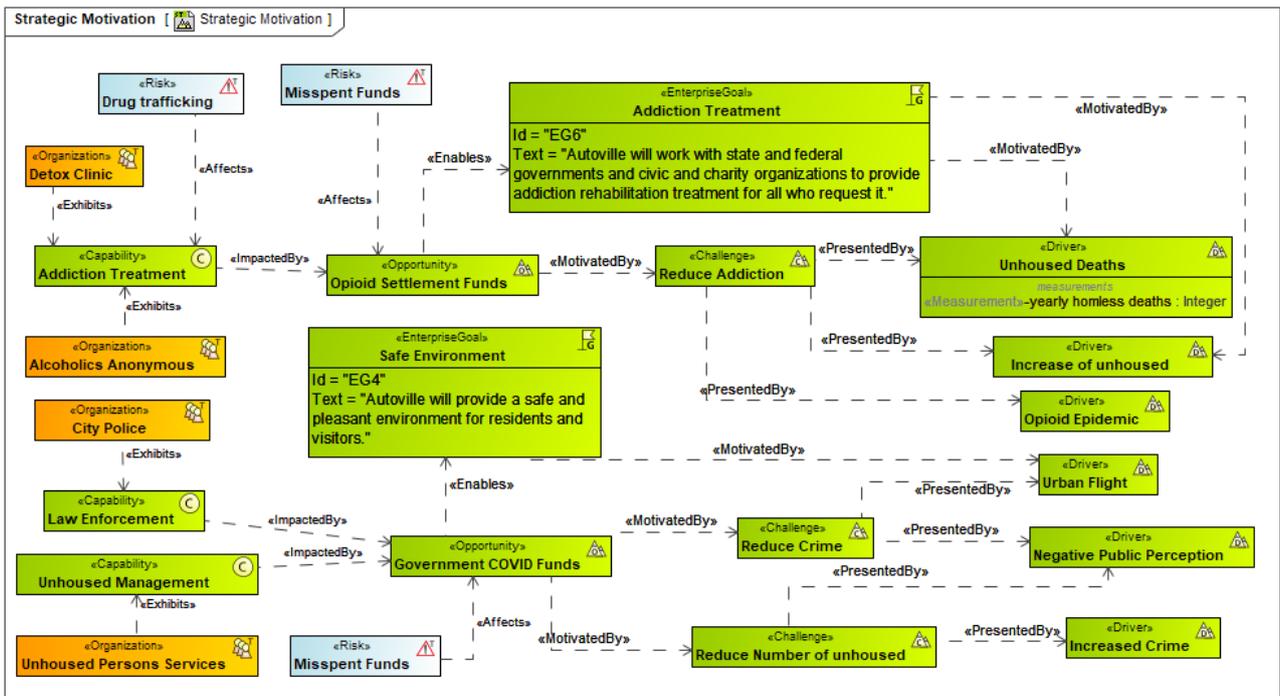

Figure 14. Strategy to Help Unhoused People and Improve Autoville

Measuring Success

Finally, metrics have been created as a means of quantifying the goals, desired effects and outcomes of the various capabilities, and organizations defined so far. The Smart Cities Initiative developed a set of potential metrics a city could use to measure its performance. The metrics are being published

currently through the INCOSE Smart City Definition, Metrics, and Framework. (Dugar, et. al., 2022) Some of the metrics are directly applicable to the unhoused scenario modeled here. All of the potential SCI metrics can (and should) be further broken down to assess specific efforts. In the case of unhoused people, sample relevant city metrics include:

- Unhoused rate
- Mortality rate
- Population health index
- Number of non-governmental organizations (business or philanthropic) per capita

Each of these metrics should be further defined to capture the specific goals of each city and its efforts. For example, the Unhoused rate, Population health index, and Number of NGOs are further refined in the model described here. Figure 15. identifies the measures and the correlated effects. The unhoused rate is broken down to consider the number of unhoused services locations and number of unhoused case managers. These factors contribute to the unhoused rate reduction effect of the services. The population health index is broken down to define mental health and substance abuse. While the overall effect of improvement from unhoused conditions may not affect the city's total population health index, these same factors can apply to the unhoused population and provide clear metrics. Finally, the number of NGOs can be broken down to capture the number of industry outreach experts and charity outreach experts. The model helps visualize and understand how the metrics are allocated to specific services (capabilities) within a city and how well the services are performing.
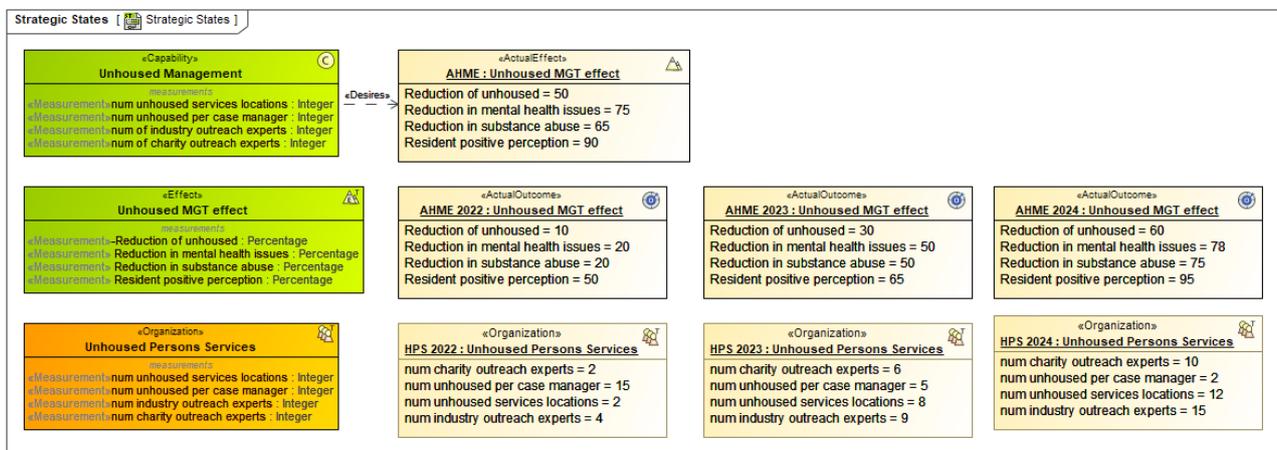

Figure 15. Autoville Strategy Metrics

Future Work and Research

As stated previously, the model is by no means complete. It is the first step in a long journey to understand these issues and figure out the best way that these can be addressed. It is the initial phase of the project to demonstrate feasibility, and usefulness of models, and to socialize the concepts. There were several things that we did not include. We did not add the next stage of development of proposing and performing trade-off analysis of solutions to enable the smart city to take advantage of the details in the model. The context for the model has been simplified as have the interactions, states, analysis, etc. The intention is to add these details in future papers as the model is developed and integrated with other models. Other areas of research will include studying initiatives that are already under way in various cities and comparing them to the aspects defined in this model. Now that the initiative has been started and this model has demonstrated some degree of usefulness, additional people have joined the team and will provide new insights and ideas.

Conclusions

By understanding the causes of housing insecurity, what the major events are, and the cycle of housing insecurity, Autoville leaders can attempt to intervene and end the cycle. A specialized department will be created and funded with authority and responsibility to address the problem. Help will be provided with treatment, counseling, jobs, and shelter. Funds made available will be used to improve the city. Autoville will monitor the situation to ensure that the money is well spent, and that the situation is improving for both the city and the unhoused people. Understanding the human dimension allows us to evaluate technology that might help – people before systems.

By using MBSE to evaluate this difficult and situationally unique problem, municipalities can begin to visualize housing insecurity holistically. The holistic perspective and visualized resources offer new insight into new or under-utilized resources and may identify needed resources. In fact, this demonstration resulted in the recommendation of creating an unhoused case manager position within a city to manage and coordinate resources for unhoused people. This is the same solution that was implemented in January 2022 in Kansas City, Missouri, USA. The City Mayor and City Manager prioritized housing insecurity as an issue and created a Homelessness Prevention Coordinator to serve in this specific capacity. Over the past year, the Coordinator has been building coalitions and partners across the city and has successfully begun implementing services successfully transitioning unhoused Kansas Citians into housing. We don't know yet if that Coordinator has access to job counseling to protect from burn-out. Perhaps that's a good next question…

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Biography

Matthew Hause is an SSI Principal and MBSE Technical Specialist, a former PTC Fellow, a co-chair of the UAF group and a member of the OMG SysML specification team. He has been developing multi-national complex systems for over 45 years as a systems and software engineer. He started out working in the power systems industry and has been involved in military command and control systems, SCADA, distributed control, office automation and many other areas of technical and real-time systems. His roles have varied from project manager to developer. He has written over 100 technical papers on architectural modeling, project management, systems engineering, model-based engineering, human factors, virtual team management, product line engineering, systems of

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Jennifer Russell, EISE, CSEP is the Program and Management Support Leader on Garver's Water team and is the Smart Cities Initiative Chair for INCOSE. Over the past 25 years, she honed her West Point leadership motto of being a "Leader of Character." From strategic planning to tactical logistics, Jennifer has invested in public service and infrastructure. The domains of her experience are a testament to the portability of her skill set and include water systems, software systems, high-speed rail, transit systems, highway systems, and multi-modal connectivity. Jennifer holds a B.S. in Engineering Psychology from the United States Military Academy and an M.S. (2003) and Engineer Degree (2007) in Industrial and Systems Engineering from the University of Southern California.

Lars-Olof Kihlström. Lars-Olof Kihlström is a principal consultant at CAG Syntell where he has worked since 2013, primarily in the area of MBSE. He has been a core member of the UAF group within the OMG since its start as the UPDM group. He was involved in the development of NAF as well as MODAF. He has worked with modelling in a variety of domains since the middle of the 1980's such as telecommunications, automotive, defence as well as financial systems. He is specifically interested in models that can be used to analyze the behavior of system of systems..