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Requirements for an Ontological Foundation for Modelling Social Service Chains

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Abstract

The Social Services Chain is the network of social services through which clients flow. At an abstract level, this is very much like a job shop in that each client moving through the chain requires a unique set and sequence of services, but that these services often have to be repeated as required by the individual needs of a client. When we consider realistic problems for social services, however, the representations underlying traditional approaches, such as job shops, lack the expressiveness required for high fidelity models. In order to apply industrial and systems engineering techniques to the social services chain, we must first understand and be able to represent/model the characteristics of clients and services that uniquely distinguish social services from other service sectors. This model is to be used in a multi-agent simulation environment to test theories to optimize social service delivery. This paper presents a set of requirements that a social service model must satisfy in order to achieve high fidelity. These requirements combine an industrial/systems engineering perspective with a social sciences perspective in order to capture the unique behavioural characteristics of clients and service providers.

Keywords

Social Services Chain, Ontology, Agent-Based Simulation.

1. Introduction

The Social Services Chain is the network of social services through which clients flow. At an abstract level, this is very much like a job shop in that each client moving through the chain requires a unique set and sequence of services, but that these services often have to be repeated as required by the individual needs of a client. When we consider realistic problems for social services, however, the representations underlying traditional approaches, such as job shops, lack the expressiveness required for high fidelity models. In order to apply industrial and systems engineering techniques to the social services chain, we must first understand and be able to represent/model the characteristics of clients and services that uniquely distinguish social services from other service sectors.

Our approach to understanding the unique characteristics of the social services chain is to develop a multi-agent simulation environment that reproduces social service chain behaviours with high fidelity. There are four key components in the Social Services Chain we wish to model: 1) clients; 2) services; 3) the processes that define the activities where clients and services intersect; and 4) the society that provides the context for and constraints on client and service demand and delivery. In order to model a Social Service Chain, we must be able to represent the underlying knowledge about services and their processes, organization structure, resources, constraints and most importantly behaviours of the client and service agents involved [1].

A variety of social scenario models have been incorporated in many different computer simulations used by social workers to assist their clients [2]. The benefits of using computer simulation to handle training has been discussed for many years [3]. Simulations using actors for training social workers has already shown to be affective [4]. Our approach is to develop detailed behavioural models of both clients and service providers in the form of intelligent agents, in order to simulate large numbers of clients moving through the social services chain. From our simulation we hope to extract both micro and macro data enabling the analysis of various Operations Research and Computer Science methods and theories. Compared to traditional scheduling and optimization problems, a social service client

and service agent require a greater level of configuration complexity. A multi-agent simulator has the flexibility of modeling complex human simulation systems [5], and will be used in the assessment of derived models.
Next, we identify a set of requirements that client agents, service agents, process models and society must satisfy.

2. Client Agent Requirements

In order to achieve high fidelity in the modeling and analysis of the social services chain, we believe it is necessary to model the behavioral characteristics of a broad spectrum of clients. These characteristics should include the physical, medical, emotional and fiscal as they all impact the behavior of the client as they interact with services in the social services chain.

At the core of our client model is a reasoning system. A great deal of research has been conducted to understand the human reasoning process. A long thought view has been that humans are completely rational beings. For example, *Decision Theory* is based on the principle of maximum expected utility [6]. The main premise of this theory is that "choices among alternatives involving risk can be explained by maximization of expected utility" [7]. However, the work of Kahneman and Tversky tells us that humans don't reason in this way [8], and that the human decision process is based on a weighted function. But people overestimate low probabilities and underestimate high probabilities. Though we have yet to select a reasoning system, it must support the requirements that follow.

2.1 Teleological

Clients are teleological, meaning that they are goal directed. Client agents perform activities oriented towards a set of goals. These activities are constrained internally by the agent's rationality and externally by the agent's environment. Through the notion of rationality, agents have the ability to reason. Furthermore, agents are dynamic - their behaviour (activities and goals) can change over time. This characterization leads to the following requirements for the client of a Social Services Chain.

Goals. Goals are responsible for deciding what actions to pursue and are the driving force in a client's decision process [9-10]. Hobbs' declaration that humans are intentional beings encompasses our necessity to have goals, develop plans to achieve those goals, execute those plans, monitor execution to see if expectation has been reached, and modify plans to execute new plans [11]. Goals can be of various types, such as *knowledge goals* that allow us to express a desire to understand, to be curious, inquisitive, or nosy. Such desires all have a goal perquisite without which they would not be possible. Goals can be categorized by the roles they play in our lives. Chulef et al. (2001) identify multiple personal and social categories such as "personal projects", "life tasks", and "current concerns".

Expectations: Each client will have different expectations associated with their goals. Sometimes these are based on values past down from their parents [12] or on their social status and situation [13]. An expectation can be viewed as a weight assigned to a goal that represents how important meeting that goal is to the original motivating factor, and what represents successful goal completion [8]. How much weight we put behind particular goals depends on various factors. For example, van Horen [16] identifies individual goals and social goals, such as our personality traits and the goal's type.

Sub-Goals: Clients will need to make decisions about goals which are too complex to be satisfied by a single action. A simple and concrete goal such as work placement is most often than not made up of various sub-goals, such as evaluating current skills, searching for openings, as well as scheduling and preparing for interviews. Even if we simply consider the skill evaluation sub-goal, we quickly see that a person may have a multitude of skills, and preference of skills which relate to personal beliefs or social constructs. Such internal and external sub-goals often compete for our attention [15-16].

Sub-goals can be related through various goal composition dependencies. For example, a dependency exists when the knowledge goal of knowing something is a prerequisite of another goal which acts on that knowledge. The goal could also elate to the method of performing an action, for example the goal of planning or executing a plan in a certain manner [11]. Ford suggests the conversion of individual goals to sub-goals by aligning them within a single plan towards a greater single goal [9]. This is especially beneficial when multiple motivations exists for each goal's fulfillment, either by one person or multiple people working together. Simon's notion of a *pay-off function* is comparable to a sub-goal, where a vector pay-off is introduced to handle a situation where a multiple goals are being acted on at once [17]. For Simon, such goals may have come from a single individual, a group of people, or a single goal that has multiple consequences and each consequence is weighed against the others.

Goal Temporality. A common property of various human behaviour theories is the temporal element of executing an action. Some actions are executed right away, and some are planned as future actions. For example, Ford developed the Motivation System Theory (MST) which defines motivations as a set of "organized patterns, personal goals, emotional arousal processes and personal agency beliefs" [9]. These are not meant to influence specific actions, but a *direction* a particular person leans towards, and on what each possible actions should be based on. In this sense motivation is future-oriented.

Planning. A key part of a client's successful reasoning and decision making is planning. Planning can be defined broadly as a sequence of required actions to successfully satisfy a goal. Planning one's own behaviour cannot be done without knowledge and appropriate use of goals [10]. Schank et al. view goals themselves as a structure to represent a control sequence of behaviour called a script or plan [18]. Such a plan or script may be made up of one or more goals, while the existence of sub-goals absolutely constitutes a multi-step plan [11].

An individual's type of planning is greatly influenced by their socioeconomic status. Higher income households have more opportunity to plan long term goals [12]. Lower income families more often plan short term goals, adjust their plans at the last moment at higher frequencies, suffer from multiple time obligations and limited resources [16].

2.2 Constraints

A client attempting to achieve their goals is constrained by a variety of factors. These factors need to be taken into account when choosing a reasoning system.

Environment: The environment one lives in greatly influences the types or requirements, constraints, and resources one must consider in their everyday life [12][16]. It can hinder or enhance the achievement of a client's goals. It is one of the four prerequisites identified by Ford for motivating someone towards a goal, mainly "the cooperation of a responsive environment that will facilitate, or at least not excessively impede, progress toward desired goals" [9].

There are many types of environmental factors that need to be taken into account. For example, social norms constrain how one show act towards others. Legal constraints do not allow for certain types of behavior, e.g., verbal and physical abuse. Finally, fiscal constraints limit what goals can be achieved.

Organization. Two types of organizational dimensions pertain to social services and the psychological affect they have on a client's progress. The first is at the macro level, which is the service provider. More often than not, a social service provider is supported by some combination of public funds and private donations, the source and timing of which influences the manner with which those funds are distributed [13]. The other dimension is at a more micro level, which is the social structure within the service provider and in the lives of its clients [15]. This includes the relationships a client has with service agents, other clients, and in their personal lives [14].

Social: Clients will be interacting with service agents and other clients. An individual's social network is a key factor in decision making. Social networks often compete with professional services by attempting to provide those services through its members [19]. Whether one's social group is closed or open to new ideas also greatly impacts the groups evolution and the individual's own development. The impact one's social group has affects an array of personal matters, from how they plan their everyday life [12][16][20], to their mental state [21], with specific examples discussed in further details in the *Perception* sub-section of section 2.3.

Social relationships and interactions play a significant role in the way humans behave and is one of the most important environmental factors which affect our behaviour. The weight put on social goals depends partly on the type of personality trait one exhibits. As discussed in the *Emotions and Beliefs* section, *interdependents* assign a greater weight to social goals than they assign to individual goals [14], where as *dependents* assign equal weight to both types of goals. Rawn demonstrated empirically that the want for interpersonal approval may be stronger than the need to avoid personal harm [22]. Our social relationships also determine the types of goals we strive for. For example, Chulef et al. identified a number of goals which capture the personal differences between individuals [10].

2.3 Rationality

A core characteristic of various theories of planning and decision making is that decision makers are rational. As Simon (1955) recognized early on, decision makers often act irrationally, or more specifically display bounded rationality where they are bounded by their computational power and the information available. Das outlined the

importance of incorporating bounded rationality when configuring multi-agents in a complex [23]. In this section we explore the various requirements that affect a client's ability to act rationally.

Motivation. Clients must have a source of motivation in order to create and satisfy goals. For example, an individual may be more motivated to pursue higher education to achieve greater career goals if they have been exposed to an education system that demonstrates a clear pathway to opportunities and conditions to achieving those goals [9]. Motivation has been identified as fundamental to our most basic developmental processes. In Evolutionary Theory of Human Motivation, Bernard et al. [24] define motivation as the "purposeful behavior that is ultimately directed towards the fundamental goal of inclusive fitness". The authors identify motives as the guiding principles of behaviour and interest within a larger system that encompasses the social domains of self-protection, mating, relationship maintenance and parental-care, coalition, as well as symbolic and cultural domains.

The guiding measure of a decision and rating of a utility function is determined by the subject's motivation to execute various tasks to achieve a certain goal or goals, and their ability to execute those tasks successfully. Ford's MST identifies *motivation* as the key factor in decision making and successful skill building [9]. The first component of MST is *motivation* itself, which has a psychological dimension that decides what to do, what to pursue, what to avoid, and how to feel about particular things. These factors are used to weigh the experience of reaching a goal or not, as described in MST's *Principles for Motivating Humans*. The second component of MST is the subject's *skills* needed to carry out the decisions made. This component focuses on the current situation, the "here and now". Motivation is guided by three components, mainly goals, sub-goals, and beliefs, each playing an equal and constant part in the decision making process. According to MST, some compensation exists when a motivational component is weaker, but each has "veto power" over the rest.

In the field of artificial intelligence, Ford's (1995) MST defines motivations as a set of "organized patterns, personal goals, emotional arousal processes and personal agency beliefs". These are not meant to influence specific actions, but a *direction* a particular person leans towards, and with which possible actions should be based on.

Emotions and Beliefs: A client's personal, unique emotions and beliefs influence their motivating and decision making process. Emotions and beliefs play a central role in the Evolutionary Theory of Human Motivation [24]. At a cognitive level, Zelazo et al. discuss the *Executive Function*, a biological mechanism that underlies emotion regulation, and plays a key role in goal motivation [25]. At the level of self consciousness, humans see themselves in relation to others within a social standard, otherwise known as their *culture*. We are motivated to act within that culture in ways that are consistent with personal values, attitudes, and beliefs. As part of that culture, our social network influences greatly how our beliefs develop [19]. As outlined in the *Social* sub-section in section 2.2, open networks allow for new beliefs to influence existing ones, and a more lax mode of transmitting beliefs between individuals. Closed networks however, exert considerable pressure on its members to conform to existing beliefs, and discourage new ones from challenging them. For example, whether a social network is *for* or *against* seeking professional help from a social service provider greatly influences whether someone will in seek professional help.

Unfortunately, but not surprisingly, there is no consensus among psychologists, philosophers, and biologists, on the definition of human emotion [24]. In fact, not all languages have the word "emotion" in their vocabulary, suggesting that any labels assigned to its meaning are language and culture dependent. However, attempts at classifying basic emotions have resulted in some overlapping theories. For example, one theory identifies seven emotional states as existing at birth: joy, anger, interest, disgust, surprise, sadness and fear. Social emotions such as pride, shame, and guilt are thought to have developed later in life. Other theories focus on the role emotions play in supplementing external stimuli, goals and potential behaviours, affecting our decision making, memory, behaviour, and motivation. According to MST, Emotional and Personal Agency Beliefs help us decide which actions and goals to pursue [9]. They point out what factors may help or inhibit a successful outcome. Beliefs may result in conflicting advice, whether the conflict exists in the proposed actions or in trying to achieve opposing goals. van Horen et al. identifies two types of personalities: independent and interdependent [14]. In each, goals are acted on differently because the same goal can have a different weight function assignment by each personality trait. *Interdependents* see themselves as embedded in and interconnected with others, so more weight is assigned to social goals, such as harmony within a group, verses individual goals. *Independents* see themselves through unique internal attributes which enables their separation from others. They assign equal weight to both social and individual goals. A person's emotions and beliefs are also heavily affected by competing sub-goals, in which case a weight assignment to each sub-goal is required to make a decision [9]. However, specifying the weight of a goal is difficult if it is made up of conflicting

sub-goals [11]. Chulef et al. have created a taxonomy of human goals which establishes a hierarchical precedents which may stand in the place of weights [10]. Chulef identified five major traits guiding human behaviour, mainly openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism.

Perception: Each client will perceive their environment, definition of a successful goal, and other factors, differently. Many goals we construct are based on the differences we perceive in others [10]. As a result, the perception of our environment has a direct affect on our actions [26]. Psychological priming has demonstrated that such a perception-behaviour relation can be unconscious, automatic, and even unintended [27-28]. Our perception of individuals in relation to ourselves also has direct influence on how we perceive a particular situation, our personal competency, and our mental state. Zola interviewed Italian and Irish patients and found that while both groups put off seeking professional help, they did so for different reasons [29]. Irish patients tended to go when a symptom interfered with performing tasks, and downplayed the severity of those symptoms. Italian patients tended to go when it affected their lifestyle, and spoke of symptoms they experienced in general. Kimbrough et al. [21] conducted a study which found that perception plays key roles in the interdependent phenomena of social support availability, acculturation, depression, and suicidal ideation among African American college students. Chartrand et al. (1999) found that by mimicking others, we can be perceived as friendlier and more receptive, which ensures smooth and easy interactions in individual and group settings [28]. Such people are called *high-perspective takers*, ones who consider the perspective of others, and are often able to guide social interactions through their perceived familiarity.

Irrational Behaviour: Complete rationality in humans is unrealistic. Instead we carry out bounded rationality [17] or near-rationality [30], i.e., agents are rational but their rationality is limited by the resources available, including information, goals, and potential harm from complete rationality. In addition we are programmed to balance multiple goals at any one time [15][17][22]. Anderson suggests that this is a requirement, not just a choice, and that we strive for the attainment of all such goals [15]. This type of multi-level goal model has been identified previously as the conflict between multiple sub-goals [11].

Irrational behaviour is often associated with the lack of self-control or the inability for logical reasoning [16][24]. An empirical investigation into self-control of human subjects has revealed that interpersonal approval may come at the expense of personal harm [22]. Domains such as excess alcohol consumption or impulsive buying are often associated with the single failed goal of self-regulation. The author suggests that the goal of social acceptance by one's peers may lead someone to strategically and consciously enact self-harm. This type of goal multiplicity is an example of an irrational decision where two competing goals, social acceptance and avoiding self-harm, compete to bring person satisfaction. The author continues that too often, personal goals are inconsistent with society's goals. To take another example, the term "welfare behaviourism" characterizes the view that welfare recipients live disorganized lives because they make irrational decisions, and lack the ability to plan ahead [31]. It has been demonstrated previously, however, that low-income families frequently suffer from multiple, often last minute and competing requirements, the immediacy of which makes organizing future plans difficult [16].

Ehrlich defines the concept of *subjective well being* (SWL), which is the idea that humans constantly focus on a particular goal they are trying to achieve, by approaching or avoiding various sub-goals [32]. Individual sub-goals may be the pursuit of pleasure, altruism, out of necessity, or self-esteem, which the author calls goal-striving. Any number of these sub-goals can conflict with each other, but Ehrlich points out that all four must be considered simultaneously, guaranteeing one or more sub-goals not being satisfied to some extent. Also the content of a sub-goal, its object, may be different than or in conflict with the underlying goal a person is trying to achieve.

2.4 Learning

Clients will in general interact with the Social Service Chain through a number of cycles. A client will need to retain or adjust its internal states in order to incrementally reach their goals. Learning, however, comes in many different forms, at different times, with varying degrees of success, and with both conscious and unconscious acquisition of information [24]. The unconscious process however makes up the vast majority of our learning, whether it is the acquisition of cognitive procedures or the execution of cognitive operations such as encoding and interpreting our environment. Conscious learning on the other hand speaks more to our conscious goals and motivations [9]. The way we learn is also significantly impacted by our social environment and social status [21]. Whether conscious or unconscious, a client's learning abilities must span simple remembering of information. Note that clients may have various abilities to remember information such as learning new skills as well as learning new goals.

3. Service Agent Requirements

The other class of agents are those who provide services used by client agents, and as such, they have a distinctive set of requirements that arise from their role within the Social Services Chain. A service agent provides services directly to a client and has direct contact with the client. A service organization employs multiple service agents to deliver multiple services to its clients and employs other agents in supporting roles. In order to achieve high fidelity the following requirements have to be satisfied.

3.1 Service Specification

The services that a service agent provides must be modeled, including their inputs and outputs, the resources consumed, and the process they perform to deliver them.

Social service workers provide a variety of services, often spanning multiple areas such as mental heath, education, vocational, recreational and operational [33]. Often multiple services are provided by a single service provider to a single client. As a result, it may not be easy to categorize the provisioning of social services into discreet, easily identifiable descriptions [34]. At the same time, there is a need for social service practitioners and researchers to identify these services in more concrete terms [35]. Aside from helping clients, there are legal and administrative reasons for creating a common knowledge base of social services [36], which must be considered in the context of accountability and effectiveness.

Services are also categorized by the stage of a treatment plan a client is in [33]. The first stage is *supportive*, which includes protective services, child supervision, general guidance, mental health, and family services. The second type of service is *supplementary* which includes financial assistance, income maintenance, home aid services, and respite care. In extreme cases, the final stage of *substitute* services is applied, which includes the separation of the client and circumstances that were not sufficiently addressed by the previous two stages. In the majority of cases, this involves women and children, and includes shelter services, foster care, or adoption.

Within the areas listed, Loffell et al. [37] identified several key positions that span the array of services provided. These include *social workers* that work directly with clients, other organizations, and community groups to provide a wide range of preventative and developmental services. *Care workers* often special with specific groups, such as children or the elderly, and provide specialized care. *Probation officers* act as intermediary between clients or other service workers, as well as the justice system and its personnel, such as courts and police. *Community development workers* mobilize communities and facilitate their involvement in identifying and addressing localized social issues. *Practitioners* from other areas such as nurses, teachers, occupational therapists, psychologists, and psychiatrists, play a supportive role in the Social Service Chain. *Volunteers* are also an important group, especially in impoverished neighborhoods. Finally, there are the *managers*, *administrators*, and *support staff* which ensure the continuous operation and provision of services.

Quantifying resource consumption in a Social Service Chain is a very difficult task [34]. This is primarily due to the subjective nature of the work, and the multiplicity of elements involved at different levels of the process that need to be combined into proper representation of resource usage.

3.2 Metrics and Effectiveness

The effectiveness of a service needs to be qualified by specific metrics. The ends and means of a service must be understood by researchers, practitioners, as well as various stakeholders including the clients themselves [34]. It has been acknowledge that due to the enormity and complexity involved, the delivery of social services is a difficult process to measure [34][38]. It is often difficult for a service agent to grasp the totality of a client's circumstances when choosing a treatment or evaluating progress. It is especially difficult to measure the impact of services at the family level due to heterogeneity of family members [38]. Treatment is made more difficult by the fact that the client's family members or extended social network is in competition with the social service provider for assisting the client [13]. It is, however, important to capture this information, as it has a positive impact on performance, value for money control, transparency and accountability [39].

Cheetham (1992) identified two key categories of measurable aspects of social work delivery. The *nature of outcomes* is a service-based measure that focuses on the nature, extent, and quality of the service provided. By focusing on the service provisioning, and how it is being implemented by practitioners, we can identify services which have caused service agents and organizations difficulty in their implementation. The second is *client based*

measures, and is identified as the more important of the two measures. It focuses on the effects a provision has on its recipients. It is a comprehensive measure which considers not only the recipient themselves, but also the impact a service has on their community. The community is especially important when it influences the client's progress, and when the service itself requires community involvement.

There are many methodological difficulties that have been identified in assessing social services [40]. Although statistics are still the main source of information gathering, concrete criteria that capture quality are often absent. It is important then to recognize that effectiveness derives only in relation to its context [34]. Goals might change with a change at the state level, or a new government might have a different focus, and these changes must be considered in measuring effectiveness of a service.

3.3 Constraints

Service agents work within various constraints when interacting with clients. Those constraints can be in relation to the service agent, the client, the client's own constraints, or the social service organization. In order to determine the life span of a service, Albert has identified key dependent variables to ensure sufficient quantity and acceptable quality of social service supply [41]. He identified the service-specific expenditure ratio, level of service supply, number of units of target group, staffing ratio, and take-up ratios (% of target group with access to services).

The quality of service is directly tied to funding [41], by either diminishing funds for services which do not have quality benchmarks, or offloading funding responsibilities for services which a funding organization is not concerned with. As a result, cost must be analyzed with economists, accountants and stakeholders to ensure the monetary constraints are not surpassed. When putting a dollar value on a service, consideration of the economic burden placed on the client must also be factored in. If an organization's savings put additional financial burden on a client, it may be counter productive, and the treatment less effective.

3.4 Accountability

In order to keep the quality of services high, a service agent must be held accountable. The pressures of social work on its practitioners is compounded by the expectations of various stakeholders. The greatest need for accountability comes from the client and funding sources, and the greatest challenges from changing requirements and demotivation of practitioners [34]. Without accountability, there is no concrete incentive to meet expectations or improve services [33][39][42]. While many key factors affecting accountability are external and at the macro-level, as will be covered in the *Society Requirements* section, they have an immediate impact at the micro-level, mainly on the individual practitioners [42]. This micro-accountability is undermined by macro changes in constraints and requirements, which has a direct impact on the goals being pursued by service agents and their clients.

4. Process Requirements

A key component of the Social Services Chain is a process ontology, which characterizes the activities that can possibly occur together with the constraints on their occurrences. The domain of social services introduces additional requirements. Clients follow possibly multiple plans specified by the service providers they visit. The aggregate of these plans define process flows through a network of service providers. By analyzing these flows, we can gain insight in how to more effectively and efficiently plan and deliver services. Our process requirements stem from the insight that if we view the social services chain from the perspective of Operations Research (OR), many of the theories in the latter may be applied to the former. OR has contributed a great deal to our understanding of process efficiency by identifying versions of processes, such as single machine, job shop, and flow shop, for which specific theories can be defined and optimal results derived.

For example, a social service provider must schedule many appointments, and often reschedule missed appointments and accommodate emergency situations. Additional resources must be allocated for different types of appointments. Many scheduling problems of this type, such as flow shop and many job shop problems, are NP-complete, meaning no efficient method exists for finding their solution [43-44]. OR mathematical modelling techniques have been instrumental in reducing such problems to a polynomial representation. OR techniques have also been applied to quality control problems such as those needed to measure the quality and effectiveness of service agents [45]. Finally, OR has been used to solve various constraint problems, like those defined for client and service agents [46].

In order to enable the application of OR, the following requirements need to be satisfied:

4.1 Process Modelling

We need the ability to model processes. As service and client agents produce and consume services, we need to be able to capture these events and aggregate them into process flows. This requires the modeling of activities, resources, agents, time, causality and constraints on their performance metrics. Adopting a process ontology is a good start. An ontology can be viewed as a shared understanding of a particular domain, which encompasses the domain's entities, attributes, and processes [47]. A process ontology defines concepts required to model a process, the semantics defining related entities and process attributes. This framework makes it possible to represent a Social Service Chain, including client and service agents, as well as associated process planning and activity constraints.

4.2 Process Instrumentation

In order to extract the process flows that clients follow, we need to be able to instrument both the clients and service agents. We must be able to not only track what tasks they perform, but what resources they consume, the time it takes and the reasons underlying the decisions they make.

5. Society Requirements

Clients and service agents do not operate in isolation, but rather are embedded in the rich variety of interactions that constitute society at large. The requirements above focused on internal constraints on agents' behavior; we turn now to the external constraints that arise from social factors. It should be noted that the society in which the social services chain operates place both formal and informal constraints on its operations and behavior.

5.1 External Constraints

Various sources of external constraints and goals on clients, services and processes affect the quality of service.

- **Legal Constraints:** All levels of government impose constraints on the delivery and consumption of social services: who can use them, how often, what constitutes fraudulent use, etc. Service practitioners often focus too much on the technical aspects of their role, and less on the therapeutic and overall well being of people in their care. Concerns of litigation or pressures to protect clients and others involved in their case is often the cause [36]. We must be able to incorporate these constraints in the operation of both service and client agents.
- **Cultural Norms**: There are also cultural norms that govern the behavior of both service and client agents. These norms affect both the consumption and delivery of services.

5.2 Accountability

To keep quality of services high, involved parties must be held accountable. Hence we have to model accountability.

- **As an organizational responsibility:** We stated previously that accountability is the responsibility of both the social service practitioner and the organization as a whole. The organization's role, however is more important because it decided what it will be accountable for. Decisions on what constitutes a successful service, how it will be measured and enforced are organization-level responsibilities [42].
- **As a necessity for funding agencies:** The source of funding is a major contributing factor to what a service agency will be responsible for. Whenever a change of funding agencies occurs, a new set of requirements is also created, and perhaps existing requirements are removed. This type of change has several negative side effects which affect the providers ability to deliver services and meet agreed on expectations [42]. It is especially difficult for social service practitioners to adopt to new requirements and guidelines. With these inevitable drawbacks, funding agencies must include accountability measures within their agreements [33][39].

6. Conclusion

As outlined in the *Client Agent Requirements* section, a client agent exhibits very complex multi-layered, rational, and irrational decision making. A representation of such an agent must be able to model concepts such as motivation, goals, and planning in relation to the client's decision making process. It must be able to capture the various degrees of importance a client places on related and competing goals, the role emotions play in formalizing those goals, and how they are perceived. Various competencies must be represented which can be used to determine if a particular goal can be achieved, or if a knowledge acquisition goal is required.

Equally, the service agent model outlined in the *Service Agent Requirements* section must be able to represent the competencies required to accommodate a client's decision making process, available skills, and related constraints. To that end, the client model must represent its own constraints, capabilities, available resources, and monitoring metrics to ensure planned activities sufficiently benefit a client.

It is our belief that in order to effectively apply Industrial and Systems Engineering theories and methods to the social services chain, we must first understand its unique characteristics. Many of these characteristics stem from the behaviours exhibited by both clients and services, and others from the processes and social norms imposed upon them. A multi-agent simulation of these characteristics will enable a greater understanding of the social services chain and how we can make it more effective.

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