

Exploring the Causal Relationship between Factors Affecting US Army Recruitment

Graham Ungrady and Matthew Dabkowski

United States Military Academy
Department of Systems Engineering
West Point, NY

Corresponding author's Email: graham.ungrady.mil@mail.mil

Author Note: Cadet Ungrady is a fourth-year student in the Department of Systems Engineering at the United States Military Academy (USMA). His thesis advisor is Colonel Matthew Dabkowski, the Director of the Systems Engineering Program at USMA.

Abstract: Every year, United States Army Recruiting Command (USAREC) dedicates considerable resources to recruiting and accessing soldiers. As the largest branch of the United States Armed Forces, the Army must meet a high recruiting quota while competing in the free-labor market for quality recruits. Over the past two decades, the Army's success in recruiting ebbed and flowed within the broader context of society and global events. While numerous studies have examined the statistical relationship between factors associated with recruitment, these studies are observational and definitively ascribing causality in retrospect is difficult. With this in mind, we apply fuzzy cognitive mapping (FCM), a graphical method of representing uncertainty in a dynamic system, to model and explore the complex causal relationships between factors. We conclude our paper with implications for USAREC's efforts, as well as our model's limitations and opportunities for future work.

Keywords: United States Army Recruiting Command (USAREC), Fuzzy Cognitive Mapping (FCM), Recruiting.

1. Introduction

1.1 United States Army Recruiting Command (USAREC)

The mission statement of the United States Army Recruiting Command (USAREC) is to “[r]ecruit America’s best and brightest volunteers that are able to deploy, fight, and win.” (USAREC, n.d.). Despite its simplicity, achieving USAREC’s mission statement proves to be more difficult in practice. Perhaps unique to an organization as expansive as the US military is its status as an all-volunteer force. The principal challenge associated with an all-volunteer military is recruiting personnel suited to a military lifestyle and motivated to serve. Additionally, USAREC competes in today’s highly diversified labor market to acquire such individuals. Given the widely held perception that the United States has the most capable military in the world, the logical inference is that the all-volunteer system works quite well. Explaining the Army’s success in recruiting personnel begins by understanding the structure of USAREC.

USAREC’s headquarters, located in Fort Knox, Kentucky, is responsible for 10,900 recruiters and support personnel located in 1,400 different recruiting stations across the country, on all military installations, and even overseas (USAREC, n.d.). USAREC’s expansive size and footprint affirm the importance of recruiting for the Army. The breadth of USAREC is justified by its considerable recruiting quota. As the largest branch of the military, the Army’s annual recruitment goal is nearly twice the next-largest of the other three branches. From 2000 to 2008, USAREC’s accessions quota was between 70,000 to 80,000 recruits per year, when the demand for soldiers swelled due to the simultaneous wars in Iraq and Afghanistan. USAREC’s ability to meet the needs of the Army in terms of quantity was blemished by a substantial drop in recruit quality in 2007 (Asch, 2019). The mid-2000s proved that the caliber of recruits was equally as, if not more, important than the number of recruits. Simply put, for USAREC to successfully achieve its mission, it must deliver quality at scale on an annual basis.

1.2 Filling the Ranks

1.2.1 How do They Join – From Conscripts to Volunteers

Throughout its extensive history, the United States military has been a volunteer organization. However, in the face of great international conflicts, including World War II, the country instituted drafts to meet the demands of war. The most

recent example of conscription in the United States is the Vietnam War, which continued into January 1973 until it ended for several reasons. First, at the close of the costly and unpopular conflict, public opinion towards the military was quite negative. Second, although conscription is a powerful tool for quickly fielding forces, a period of relative peace from active warfare followed the Vietnam War in which the United States no longer needed immediate access to large troop formations (Shields, 2020).

Eliminating the draft occurred at an inopportune time for the Army. As mentioned above, public opinion of the Army at the end of the Vietnam War, during a period of social and political upheaval, was unprecedentedly low for the 20th century (Bailey, 2007). Not only did the Army have the task of recruiting volunteers in a competitive market, but it also had to rebuild its relationship with the public. Army recruiting needed to adopt the modern recruiting techniques championed by large corporations in a highly competitive, post-Vietnam world (Bailey, 2007). Moreover, competition increased because of the diversification of knowledge that yielded a greater variety of potential career paths that people could pursue over the Army. Therefore, the Army was forced to evolve by offering benefits such as funding for college, signing bonuses, and retirement pensions to increase recruitment (Asch, 2019). Another factor that helped make the Army more competitive in the free-labor market was an organizational change in the incentives for recruiting well. Specifically, USAREC moved away from a point system, which promoted recruit quantity over quality, to a system that focused on individual recruiter efficiency and incentive plans centered around the cumulative performance of recruiting stations (Asch, 2019).

1.2.2 Who Joins

An important step in understanding the recruiting process is first understanding who decides to enlist. There exists a prevailing sentiment that those who join the military are mainly Caucasian and minority men with low socioeconomic status and low intelligence (Asoni et al., 2020). Moreover, these recruits are more likely to geographically originate from Southern and Western states (Philipps and Arango, 2020). It is important to recognize that in the 1970s, the composition of the Army reflected this sentiment and is likely the source of the recurring belief today. Historically, the ease of recruiting in the southern and western states is probably due to the prevalence of Army posts in those geographic locations. More generally, the more physical exposure communities have to the Army, the easier it is to recruit from those communities (Philipps and Arango, 2020). Additionally, in the 1970s, statistically significant data revealed that those who joined the Army were generally from low-income minority families with low cognitive testing scores. However, as early as the 1990s, the data shifted and revealed that those who joined the military generally scored higher than their civilian counterparts cognitively, and the relationship between low income and military enlistment no longer showed a significant relationship. In fact, the average wealth and income of both male and female veterans, along with their cognitive skills results, were higher than civilians (Asoni et al., 2020). Moreover, regression analysis conducted on 1997 recruiting data proves that Black and Hispanic demographics were not more likely to join the military because of low socioeconomic status. They are equally as likely to join the military as other groups given their proportional size in the United States population (Asoni et al., 2020).

1.2.3 Why Do They Join

Understanding the motivation for enlisting in the military is equally as important as understanding who enlists. The first reason people often join the Army is high unemployment in the job market. That is, when the labor market tightens and civilian jobs become scarce, the Army sees higher levels of recruiting. Conversely, when there is low unemployment in the civilian sector, the Army feels the strain of competition and recruiting levels fall. A multivariate time series analysis on all seven of USAREC's brigades in the 1990s reflected this result (Burger, 2000).

The second reason people enlist in the Army is linked to the availability of USAREC recruiters. The number and quality of recruiters directly correlate to enlistment rates of the Army (Asch et al., 2009). As recruiters increase, so too does exposure of the Army in different locations, thus increasing the number of recruits.

The final and most compelling reason that people enter the Army is a familial connection to the service. Survey data indicates that 83% of recruits have family that served in the Army and nearly 30% have members who were on active duty at the time of the recruits' decision to enlist (Rostker et al., 2014). This statistic is important for two reasons. First, the knowledge that a majority of recruits have family who have served indicates that serving in the Army is a "family business". Therefore, there is a significant portion of the population that is not aware or willing to serve in today's military due to an absence of relational servicemembers (Rostker et al., 2014). Second, this result reaffirms two points of discussion: the draft was important for bringing awareness and familiarity to the military, and the competition of the free-labor market proves a unique challenge to USAREC, as its recruiters are unable to effectively access portions of the target market without family ties to the Army.

2. Fuzzy Cognitive Mapping

2.1 Motivation

Extensive research has been conducted on who joins the military as well as their reasons for enlisting. Such research is valuable for understanding the relationships between the different factors that could impact Army recruiting. However, this research does not capture the causal relationship between variables, nor does it allow for experimentation with the influence of unknown factors or relationships in the future. For these reasons, applying fuzzy cognitive mapping (FCM) to Army recruiting is worth investigating.

2.2 Cognitive Mapping

Cognitive mapping was first introduced in the 1970s by Robert Axelrod to visualize important concepts and variables that share a connection (Kosko, 1986). As a political scientist, Axelrod aimed to provide policymakers with a strategy to better understand complex issues without oversimplification (LaRue, 2017). Cognitive maps were designed to show the relationship between a person's individual beliefs and specific political policy. By mapping the relationships between a person's belief systems and the policy in question, Axelrod claimed he could offer a causal explanation for why people maintain certain ideas and opinions about specific policy domains (Axelrod, 1976). Cognitive maps consist of concepts and causal beliefs, known as nodes and edges respectively. While the structure is simple, the maps can become quite complicated considering the many interconnected beliefs a person may have regarding a specific policy (Axelrod, 1976). Although originally designed as a tool for users to examine their beliefs before making a final deduction regarding public policy, cognitive mapping can also be applied to other areas since it can be used to simplify the complexity of causal relationships shared between different concepts. Although the simplicity of cognitive mapping is attractive, Axelrod failed to account for the causal relationships between concepts. More simply, not all relationships share the same level of causality and, therefore, a degree of "fuzziness" is missing in Axelrod's digraphic cognitive mapping technique (Kosko, 1986).

2.3 Fuzzy Cognitive Mapping

2.3.1 Background

In the 1980s, Bart Kosko introduced FCM as a method of modeling the relationships between factors that share "imprecise" connections (LaRue, 2017). Due to the application of uncertainty in FCMs, Kosko introduced an ideal tool for modeling the behavior of people and complex systems. Furthermore, FCMs supplement and expand the work of Axelrod by broadening the scope in which cognitive mapping can be applied by adding more realism and precision. Recruiting is a process that depends on a multitude of external factors that can deter or encourage an individual from joining the military. For this reason, FCM can be applied to map the interdependencies that may exist among factors impacting recruiting but are not well researched or documented. Collecting qualitative information from expert analysis regarding the concepts in question is the first step in producing an FCM (Papageorgiou, 2014). This data better informs the connections between different factors and identifies which concepts have a higher degree of interdependencies within the system (Penn et al., 2013). Moreover, not only does FCM allow for the creation of an organizational map to visualize the causal relationships between nodes, it also allows an opportunity for the stakeholder to understand complex problems from previously unexplored perspectives (Penn et al., 2013). In the context of this project, FCMs have the potential to take a list of seemingly unrelated concepts and, through research, logic, and expert opinion, develop and quantify the causal relationships between them and Army recruiting.

2.3.2 FCM Methodology

To understand how FCMs model the imprecise causal relationships or connections between factors associated with a system of interest (e.g., Army recruiting), one must first understand their mathematical structure. FCMs consist of concepts representing the different factors or constraints of the system ($\{C_1, C_2, \dots, C_n\}$), and they are given starting values, known as the initial state vector ($A_0 = (a_1, a_2, \dots, a_n)$), via expert opinion (Kok, 2009). The connections between concepts are denoted by directed edges ($C_i \rightarrow C_j$), and the strengths of these connections are indicated by weights ranging between -1 and +1, where the sign represents the direction of the causal relationship and the absolute magnitude represents the strength (Kok, 2009). For example, if the weight of $C_i \rightarrow C_j$ is -0.7, when C_i goes up it causes C_j to go down. Once established, these connections are assembled into an $(n \times n)$ adjacency matrix E , where the element in row i and column j (e_{ij}) represents the connection between concepts C_i and C_j . The evolution of the initial state vector over time represents the principal output of the FCM. It is calculated by iteratively adding the state vector at time (or iteration) t to the product of the state vector and the adjacency matrix (i.e., $A_{t+1} = A_t + A_t \times E$), rescaling it between 0 and 1 using the standard logistic function (i.e., $1/(1 + e^{-A_{t+1}}) \rightarrow A_{t+1}$),

and continuing until the concepts reach their equilibrium values (Papageorgiou & Salmeron, 2014). The hypothetical example in Figure 1 shows an FCM with four concepts and eleven connections, along with one iteration of state vector updating.

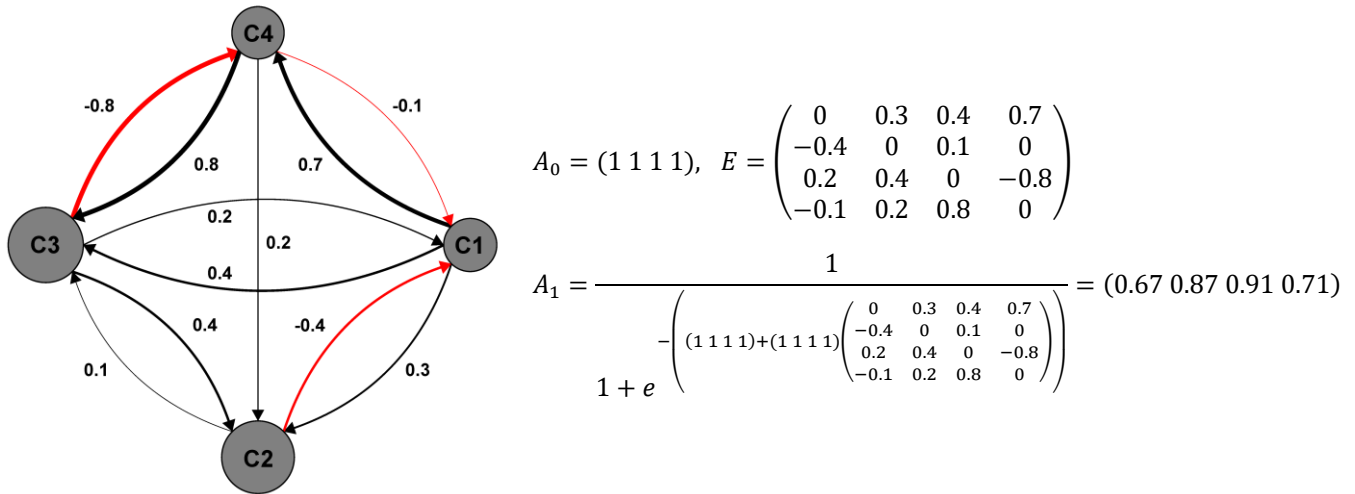


Figure 1. Hypothetical FCM

The *FCMapper* package for the statistical software R provides an easily accessible way to create and explore FCMs. Created by Turney and Bachhofer (2016), it automatically performs the above calculations and quickly iterates the FCM’s state vector to equilibrium, allowing the researcher to investigate the impact of new concepts and connections on the system of interest.

3. Building and Investigating an FCM for Army Recruiting

3.1 Factors of Interest

Producing a holistic list of factors that affect recruiting is the first step to creating an FCM of Army recruitment. The intent behind building such a list is to contrast specific events, that are known to have some impact on recruitment, with general events, that are anticipated to have an impact on recruitment. Such factors take form in an assortment of ways that are categorized into two bins: the domestic tier and the external tier.

3.1.1 Domestic Tier

The domestic tier includes factors that occur specifically within the borders of the United States. While these factors may not have been avoidable, their existence was created and/or controlled through the direct action of national or state governments and organizations. The preliminary list of domestic tier concepts is as follows: domestic unemployment, number of USAREC recruiters per population, and the probability that a family unit has one or more prior service members.

3.1.2 External Tier

The external tier includes any international event that is not within the control of the individual, USAREC, or the United States Government. By convention, the factors that populate the external tier have the power to drastically impact the lives of a large demographic of people, thus either positively or negatively affecting the recruitment of soldiers. While external tier factors are not necessarily large enough to impact society as a whole, the majority of these events were some of the most significant occurrences of the last two decades. The preliminary list of external tier concepts is as follows: the economic climate, international terrorism threat on the United States, global pandemic, and United States involvement in international conflict.

3.2 Principal FCM Development

3.2.1 Adjacency Matrix

The adjacency matrix for the principal FCM should both distinguish the positive and negative correlations among the different factors and recognize connections between the different concepts. Creating an accurate initial matrix was important since subsequent excursions were based on changes to the original weighted values. These follow-on trials consist of different hypothetical combinations of weighted values intended to simulate specific factors proving to be more or less relevant to Army recruiting than initially anticipated.

Sensitivity analysis for FCMs is difficult given the uncertainty and subjectiveness built into assigning weighted values to different concepts. For the purposes of this research, credibility of the weighted values was enhanced by creating a system that denotes the source of a specific weighted value and the certainty of that source. The source is labeled as research (“R”), logic (“L”), or expert opinion (“E”), and the certainty is scaled as either low certainty (“1”), moderate certainty (“2”), or high certainty (“3”). This notation, which displays both the source and the certainty of a specific weighted value, is helpful for two reasons. First, it allows the researcher to identify areas where further research would add robustness and veracity to the adjacency matrix. The accuracy of the FCM would improve if more connections are denoted as “R2” or “R3” rather than “L1”. For further consistency, the cells denoted with an “R” are labeled with a letter corresponding to a reference located in section 5 of this paper. Awareness of where values are coming from and substantiating their dependability opens up further avenues of research intended to strengthen the connections between different concepts. Second, it is important to be aware of the “unknowable” connections that exist within this system. A connection is unknowable if there is a lack of research or literature regarding the relationship between two events and their mutual connection to Army recruiting. Noting these vague relationships is important when analyzing the FCM and corresponding equilibrium values because of the limitations these factors offer in understanding their impact on Army recruiting.

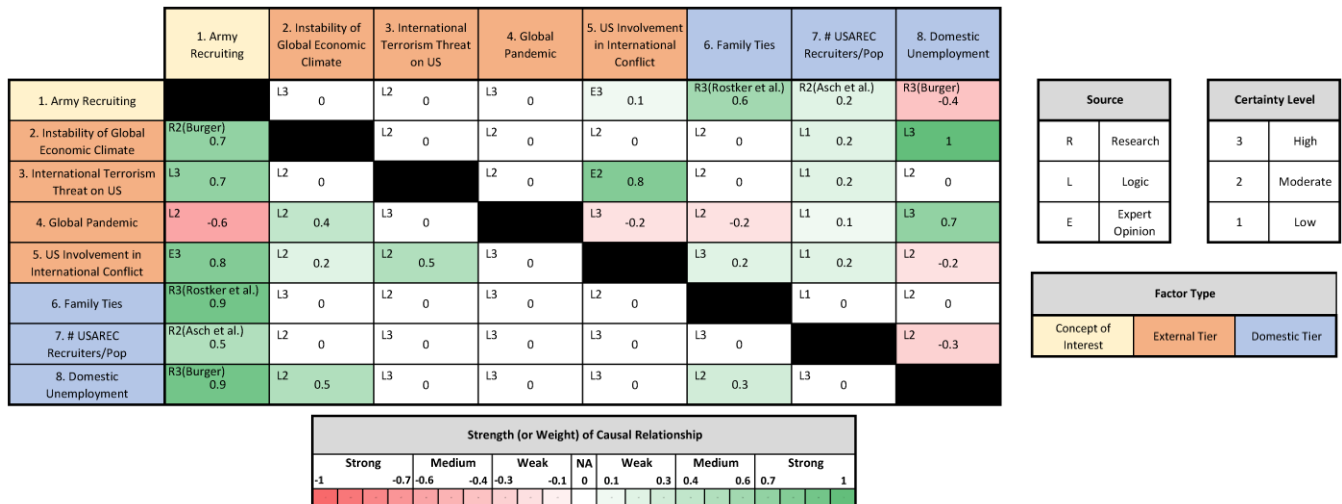


Figure 2. Principal FCM Adjacency Matrix

The adjacency matrix presented in Figure 2 illustrates the connections that exist between different factors in the system. Factors that share a positive or negative causal relationship with other factors are indicated by either green or red with the intensity of its color representing the strength of the relationship. Factors that do not share a causal relationship have a value of 0 in their intersecting cell and are not shaded. The main data of interest is the first row and column as it pertains to the weighted values of Army recruiting. While it is important to see what factors impact Army recruiting, observed by analyzing the weighted values in the first column, it is equally as important to find what factors are affected by Army recruiting, observed by analyzing the first row.

For example, the cell at Row 8 and Column 1 indicates that high domestic unemployment strongly influences an increase in Army recruiting. In other words, as domestic unemployment rises, people are more willing to enlist in the Army. On the other hand, while the cell at Row 1 and Column 8 displays a causal relationship, it has a reciprocal effect. That is, as Army recruitment increases, previously unemployed people obtain jobs, and domestic unemployment drops. This completes a cycle where rising domestic unemployment increases recruitment which drives domestic unemployment down. Such

relationships are important for USAREC to understand, as conditions that facilitate recruiting success can partially precipitate the end of such success.

3.2.2 Principal FCM

Using the adjacency matrix in Figure 2 as input for R's *FCMapper* package, an FCM reflecting the weighted connections between different factors was created. Shown in Figure 3, this FCM represents the base case scenario for Army recruiting, and it serves the starting point for subsequent excursions or what-if analysis. The weights of the connections are indicated by the formatting of the directed edges between different factors, where thicker edges denote larger absolute values and colors denote positive (black) or negative (red) relationships. Additionally, the equilibrium value for each factor is signified by the size of the node, where larger nodes imply larger equilibrium values. Notably, equilibrium values are only useful in a relative way when they are compared to the equilibrium values of excursions.

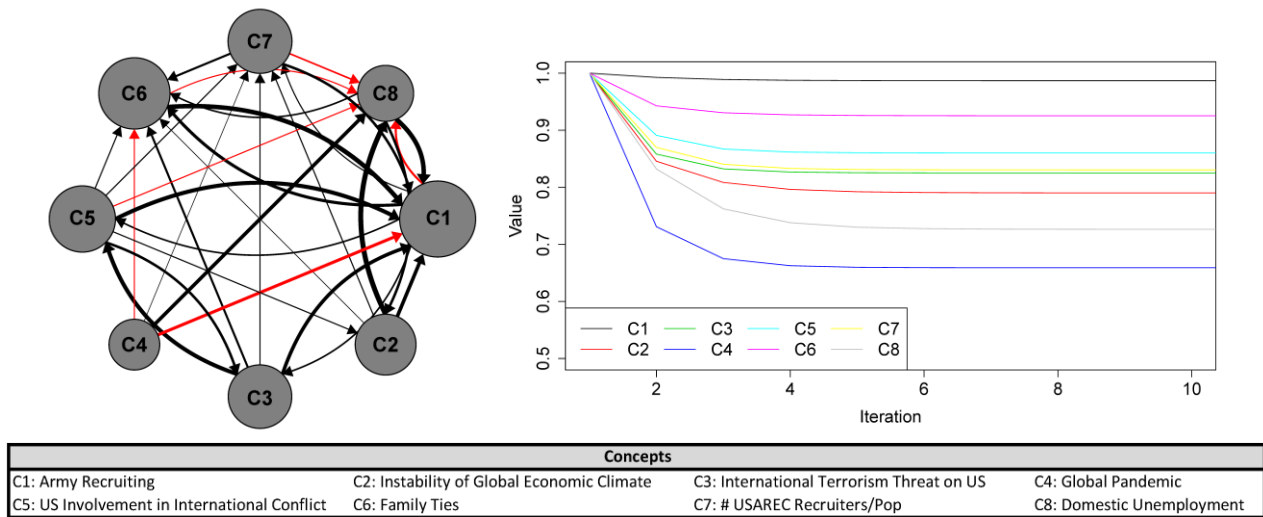
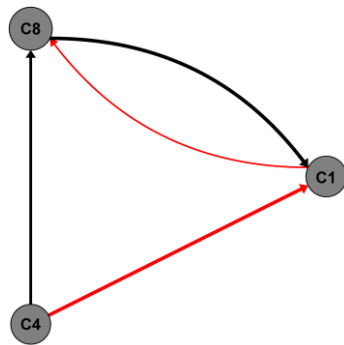


Figure 2. Principal FCM and Equilibrium Values

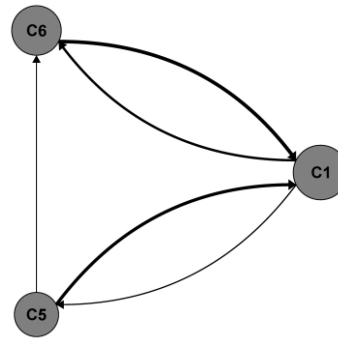
3.3 Subsequent Excursions

The ease with which the adjacency matrix can be changed opens the door for investigating different combinations of causal relationships or excursions from the base case scenario. As was already discussed in Section 3.2.1, while the emphasis for the FCM and equilibrium values falls on Army recruiting (C1), it is important to analyze every relationship that exists in the system for second and third order effects. Such effects may appear to be unrelated to Army recruiting; however, after initial observation, they can prove to either help or harm USAREC's efforts.

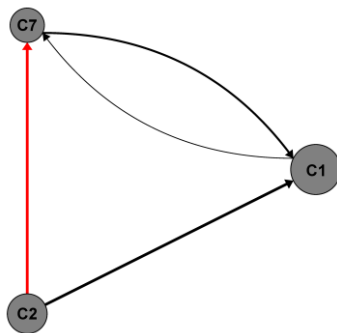
To understand the different effects that various factors can have on recruiting, several excursions were created. These excursions differ from the principal FCM in the weighted values between specific concepts. Importantly, the modified FCMs are based on hypothetical scenarios and do not represent the data gathered during initial project research. As seen in Figure 4, these FCMs are narrowly scoped and propose alternative causal relationships between Army recruiting and pairs of factors.



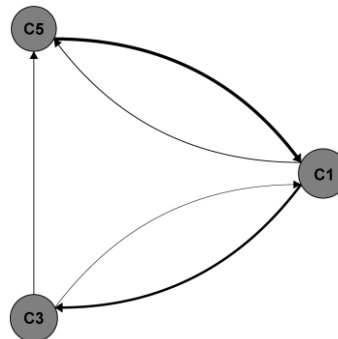
Excursion 1. Global Pandemic (C4), Domestic Unemployment (C8)



Excursion 2. Family Ties (C6), US Involvement in International Conflict (C5)



Excursion 3. Instability of Global Economic Climate (C2), Number of USAREC Recruiters per Population (C7)



Excursion 4. International Terrorism Threat on US (C3), US Involvement in International Conflict (C5)

Figure 3. FCM Excursions (Note: Relationships between factors are notional.)

Excursion 1 considers the relationship between a global pandemic, domestic unemployment, and Army recruiting. This excursion was designed to reflect the impacts of COVID-19 on USAREC’s recruiting efforts. Specifically, if a pandemic increases domestic unemployment, which in turn facilitates Army recruiting, then it can have a positive impact on recruiting. However, as seen with COVID-19, a pandemic can limit individual mobility, which could make recruiting more challenging. Excursion 2 models the national fervor that can occur at the outset of an international conflict, which can prove to be a powerful recruiting tool. In this case, the strengths of the causal relationships were increased to reflect increasing family ties, which tends to facilitate Army recruiting. Excursion 3 observes a negative relationship between instability in the global economic climate and the number of USAREC recruiters present per capita. In particular, poor economic conditions can push people towards the Army; however, if the economic challenges ultimately necessitate USAREC budget cuts, then the number of recruiters in key populations will drop and negatively impact Army recruiting. Finally, Excursion 4 hypothesizes a subdued positive influence between international terrorism and both Army recruiting and US involvement in international conflict. In this situation, a significant terrorist threat could precipitate an isolationist policy, which might decrease our willingness to engage in international conflict relative to the base case.

Each of the above excursions focuses on how a pair of factors could impact Army recruiting. While considering these combinations in isolation is important, analyzing how these changes can impact the entire system is crucial. To examine this, the weighted value adjustments for each excursion were reflected in the principal FCM adjacency matrix, and new equilibrium values for Army recruiting were found using *FCMapper*. Interestingly, Excursions 1, 2, and 3 saw virtually no change to the original 0.984 concept value of the Army recruiting node (i.e., concept C1). On the other hand, Excursion 4 dropped from 0.984 to 0.977. Therefore, of the four hypothetical scenarios seen in Figure 4, only a significant, paralyzing terrorist threat should be of any concern to USAREC. In such circumstances, USAREC could push for more recruiters in target rich locations.

4. Conclusion

FCMs are an ideal method of representing the uncertainty that exists between concepts that may seem unconnected. The strength of the positive and negative arcs that exist between different factors in the system can easily be observed and updated in light of new information or evolving conditions. In this way, FCMs are useful for conducting what-if analysis on factors affecting Army recruiting, and the adjacency matrix created for the principal FCM reflects the base case. While the goal is to validate every relationship in the adjacency matrix with reliable research, there currently exists a lack of literature regarding the interaction between different, seemingly unrelated concepts and their mutual connection to Army recruiting. The flexibility of FCMs allows for hypothetical scenarios to be modeled by changing the weights between factors, allowing USAREC to anticipate how certain events could impact its ability to accomplish its mission. To further refine this work, conducting more research to increase the frequency of research-based versus logic-based connections in the adjacency matrix would add validity to the principal FCM. Additionally, although the principal FCM was built from recent, relevant literature, it is likely that USAREC would add new concepts to and adjust the weights of the principal FCM. Ultimately, FCMs inspire fruitful dialogue about complex systems, and sharing the current model with USAREC is the obvious next step.

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