

Leveraging System Dynamics and Value Modeling to Identify Strategic Priorities to Combat Human Trafficking in India

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Abstract: Human trafficking is a complex system defined by a multitude of endogenous and exogenous variables which drive an inhumane operation. This project aims to identify the key variables which drive the human trafficking market within a state in India for a non-governmental organization (NGO) to explain how such dynamics and structures contribute to the system and to what extent. System dynamics and value modeling were utilized to explore alternatives and their predicted impacts on the system. The goal of this soft systems exploration was to build a framework for understanding the problem to be applied throughout India and to outline strategic efforts for the NGO working in this space. The findings suggest that to have the greatest reduction in the number of girls trafficked, the NGO should focus their efforts on rallying political, judicial, and social support to galvanize change as opposed to individual raids, enemy disruption, or profit.

Keywords: Human Trafficking, Systems Dynamics, Value Modeling

1. Introduction

1.1 Background Information

Human trafficking is a prevalent problem throughout the world and the business model of human trafficking involves incredibly low variable costs. In 2017 alone, there were over 100,000 human trafficking victims identified (TIP Report, 2018). A majority of the costs associated with operating a brothel are start-up costs. Many girls who are victims of human trafficking are kidnapped from poor villages or lured by false promises of jobs in new cities or fraudulent marriages (Roy, 2017; Sarkar, 2014; Simkhada, 2008). To potential criminals, the constant demand and low operating costs outweigh the possibility of going to jail, therefore there is little risk associated with becoming a trafficker. Most countries do not effectively enforce the laws they have, or they simply do not have the necessary laws to prevent human trafficking (Sanyal, 2006). As a result, crime organizations are willing to take part in and spearhead trafficking operations. This paper will focus on human trafficking in India for the purposes of the sex industry. In India there are many factors that play a role in the prevalence of human trafficking (Raj, 2018). To affect change in the region, value modeling is used to help the decision maker choose between several courses of action for their organization.

Our team partnered with a non-governmental organization (NGO) focused on eradicating human trafficking of underaged girls in particular district in India. The client focused on an increase in social and political movements as means of ending child sex trafficking in the region, along with joint raids of brothels and other violators with local police. The NGO wanted assistance prioritizing their efforts in order to optimize their work. Models were formed to establish strategic priorities, including a system dynamics model (SDM) and a value model. At the time of the initial client meeting, the NGO was most focused on conducting raids to rescue girls. With a philosophy of simply continuing to save "the next girl," the client did not have a quantifiable measure for analyzing the overall strategic implications. Narrowing the scope of the problem became a necessity due to the immense cultural diversity of India, as well as this district being the next area of operations into which the NGO wanted to move. Focusing the problem on this district limited the economic, political, social, and cultural differences

modeled using endogenous and exogenous variables. Due to privacy and security concerns, the NGO will not be referred by name also the name of the district will not be named.

2. Methods

The Systems Decision Process (SDP) is a way to make informed decisions based on the values and needs of the stakeholder and organization. The process is meant to encompass the dynamic flow of the system throughout its current stages and into the final state. It is a collaborative process that involves feedback from the client and decision makers along with multiple levels of decision making to capture their values within different alternatives. The four steps in the SDP are Problem Definition, Solution Design, Decision Making, and Solution Implementation (Parnell, 2011). This project focuses on Problem Definition and Solution Design in constructing feasible alternatives for the NGO.

2.1 Problem Definition

The goal of the NGO is to have a reduction in the percentage of girls trafficked throughout this district. An SDM was used to develop different policies that help the NGO achieve their goals in the most efficient way. The SDM also created a common understanding as to how the system operated and how changes affected the entire system. In order to optimize the NGO's distribution of labor based on their priorities, a value model was configured in the unit of "Man-hours." By focusing on one district, the model was able to utilize refined numbers for simulation and analysis to frame the alternatives for the NGO.

2.2 Systems Dynamics Modeling

System dynamics seeks to analyze the interactions between different variables and how they change over time (Sterman, 2000). In our previous work, an SDM was built in conjunction with the client to gain a better understanding of the system by defining the interactions, variables, and dynamics in play. The model included a total of 51 variables which captured the interactions between many social, political, and economic factors which drive the human trafficking market. Once established, analysis of the model helped identify the emergent behavior of the system. The variables and their interactions were then explored to see what effect they have on the total number of girls trafficked in this district, the number of clients of human trafficking, and the number of brothels in operation.

There are two dominating loops in the system that have a strong effect on the number of girls who are sexually trafficked as seen in Figure 1. For the purpose of this analysis, a simplified version of the SDM is displayed.

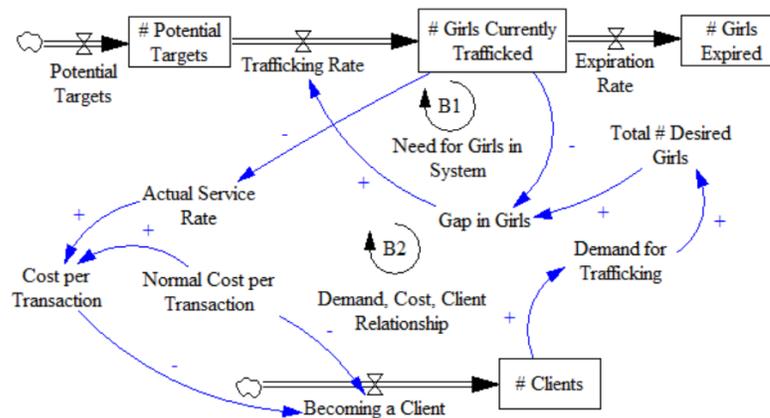


Figure 1. Excerpt of the SDM Created in Previous Work

The first loop, labeled as "B1" (Need for Girls in System), outlines the effect of the gap in girls in the system, which is the difference between the number of girls needed to meet demand and the number currently trafficked. As the number of girls currently trafficked increases, the gap in girls decreases, and subsequently lowers the trafficking rate. Alternatively, if there is a shortage of girls to fill the demand and the gap increases, the trafficking rate will increase to meet that demand,

thereby forcing more girls into the system. The model exhibits goal-seeking behavior as the trafficking rate increases or decreases to achieve the market-demanded number of girls in the system (Senft, 2019).

The second loop, labeled as “B2” (Demand, Cost, Client Relationship) shows how the cost per transaction and the generation of new clients affects the number of girls trafficked. As the cost for each transaction decreases, the amount of people who are clients increases because more people can afford the services. This increases the demand for trafficking which forces more girls into the system. If the cost per transaction becomes too expensive, the number of clients will decrease causing brothels to lower the cost to regain customers and maintain profit (Senft, 2019). Due to the law of supply and demand, the initial hypothesis predicted that rescuing more girls from the system will result in more girls being trafficked. The assumption was that as supply goes down, demand remains constant. The market then corrects this by adding more girls to the system. Over time, while each girl might be in the system for a shorter period, more girls will ultimately be exposed to the system.

The SDM was useful in generating courses of action and comparing their effects on the system. The different variables were manipulated multiple times within a range of values and the model was simulated to analyze the outcomes. This method was used to determine which variables have the most significant impact on the number of girls trafficked, and thus a direction for the NGO to focus their efforts. The optimal courses of action determined, using value modeling, can be simulated using the SDM to analyze the effect they have on the number of girls trafficked.

The findings from the SDM suggest that when more girls are removed from the system the number of girls who are trafficked over time also increases because as one girl is removed, a new girl must be added to fill the gap in the system. This one-for-one relationship implies that saving girls through raids may reduce the time each girl spends trafficked but ultimately forces more girls into trafficking over time. To create positive change and effectively reduce the number of girls trafficked over time, the SDM suggests that the NGO must focus on shutting down brothels and creating a social movement to reduce the demand for trafficking. These findings lead to the hypothesis that when fewer people are customers and there are fewer places to pay for child prostitution, the system will begin to deteriorate, and the number of girls trafficked will decrease as desired.

2.3 Value Modeling

Although the SDM provided valuable insights as to how to reduce sex trafficking, these courses of action are meaningless to the client if they do not align with their values. The purpose of value modeling is to give a decision maker the ability to quantify the importance of competing values to pick the best decision of where to focus their efforts moving forward. The first step of value modeling was to create a value hierarchy where the organization lists their top priorities, to include their fundamental objective and the different functions, or methods, they use to achieve this overall goal. A simplified version of the hierarchy with the fundamental objective and main functions can be found in Figure 2. Within each of these functions, the NGO listed the actions, or objectives, necessary to accomplish the task and named metrics associated with how to measure them.

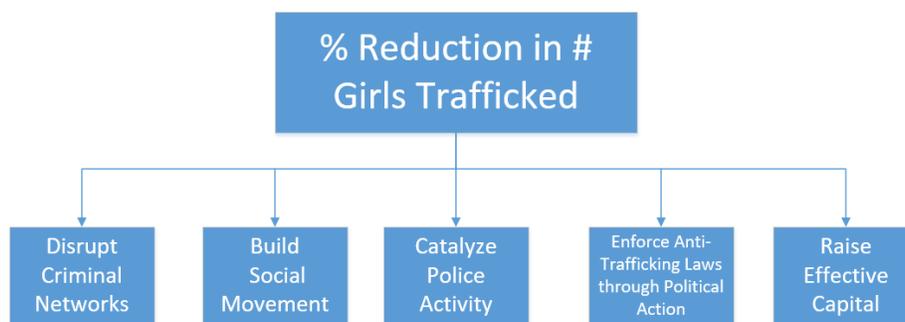


Figure 2. Value Hierarchy

The next step in value modeling was to comparatively rank each of the values chosen by the NGO, which can be found in Table 1.

After the values were selected, they were weighted based on the decision maker’s ability to affect change for that value as well as its importance in what is called a Swing Weight Matrix (Parnell, 2011). The swing weights are values between 0-100 which quantify the level of importance and variability of each individual value. The most important and varying value receives a 100 and the less critical values that vary less are assigned a weight by comparing them to the most important value

or a differently assessed measure. These are subjective measures assigned by the client and are based on their priorities as an organization.

Table 1. Values Determined by the NGO

Value	Description	Measure
Police Involvement	How active the police force is in the area of operation	# Arrests
Team Effectiveness	How powerful the team members are in accomplishing tasks	Low, Medium, High
Judicial Support	How the courts rule on sex trafficking cases	# Favorable court rulings
Profit	The amount of cash flow into the NGO minus costs	Dollars
Political Support	How local policies support the issue	Level of favorability of policies
Enemy Disruption	How well actions taken interrupt enemy networks	Revenue lost and # girls trafficked
Social Support	How much society supports stopping sex trafficking	None, Low, High, Unanimous

We guided the NGO through the process of ranking their priorities and choosing the swing weights for each measure they value. After meetings and discussions with the client, the finalized matrix as shown in Figure 3 was formed. “Police Involvement” was determined the most mission critical and variable component of their values because without it, there cannot be real, lasting change. The same may be said about “Social Support” being important for lasting change, but the client emphasized that the support from local communities is not variable. This is beneficial when the community supports stopping child sex trafficking, but it also means that social support is difficult to establish when they do not. “Enemy Disruption” was identified as the least important because after independently changing this node in the SDM, it had little impact on the rate of human trafficking in this district.

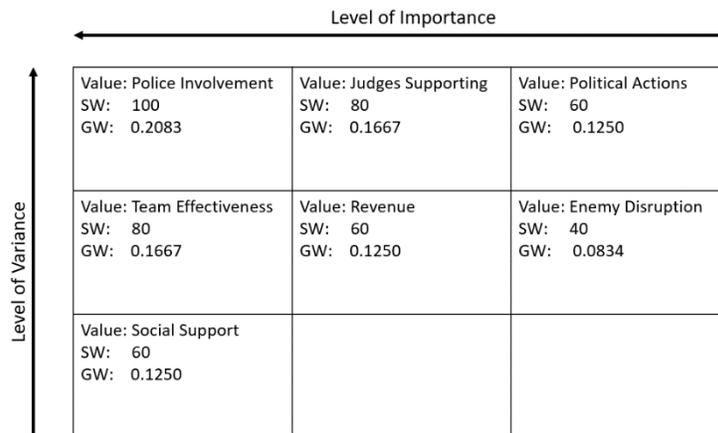


Figure 3. Swing Weight Matrix

Global weights are normalized weights between 0.0-1.0 and show the importance of each value measure in comparison to one another. To find the global weights, the swing weights are summed together, and each individual weight is divided by that sum to find the relative weight for each measure. These global weights are used to score different policies to see which alternative has the highest value to the organization.

2.4 Generation of Alternative Courses of Action

By leveraging Zwicky’s Morphological Box, a matrix of all possible values and attributes was generated in order to “[find] complete, systematic field coverage” (Parnell, 2011). All of the value modeling was completed using the “tidyverse”

library found in R (Lander, 2017). Six independent courses of action were designed for each subfunction in the value hierarchy, allowing the use of combinatorics to generate 279,936 possible alternatives. The alternatives underwent feasibility screening by the removal of illogical or infeasible solutions out of the combinations originally constructed. For a solution to retain feasibility, it had to meet the following criteria: (1) Man-hours, the x-axis of the tradespace, must be greater than 100, (2) Revenue must be over \$500,000, and (3) The cost of completing the course of action must be less than or equal to the revenue generated. Costs were estimated by consulting the NGO. Consequently, the number of feasible courses of action decreased to 40,980 candidate solutions. The raw data was input into value functions, which were predetermined by the NGO. Value functions are equations which convert raw data into terms of value between 0 and 100. These values are then normalized based on the importance of value measures in the Swing Weight Matrix. The summation of the normalized values became the total value of that particular course of action (Parnell 2011). A plot of the tradespace and associated data analysis ultimately determined the pareto optimal options for the NGO.

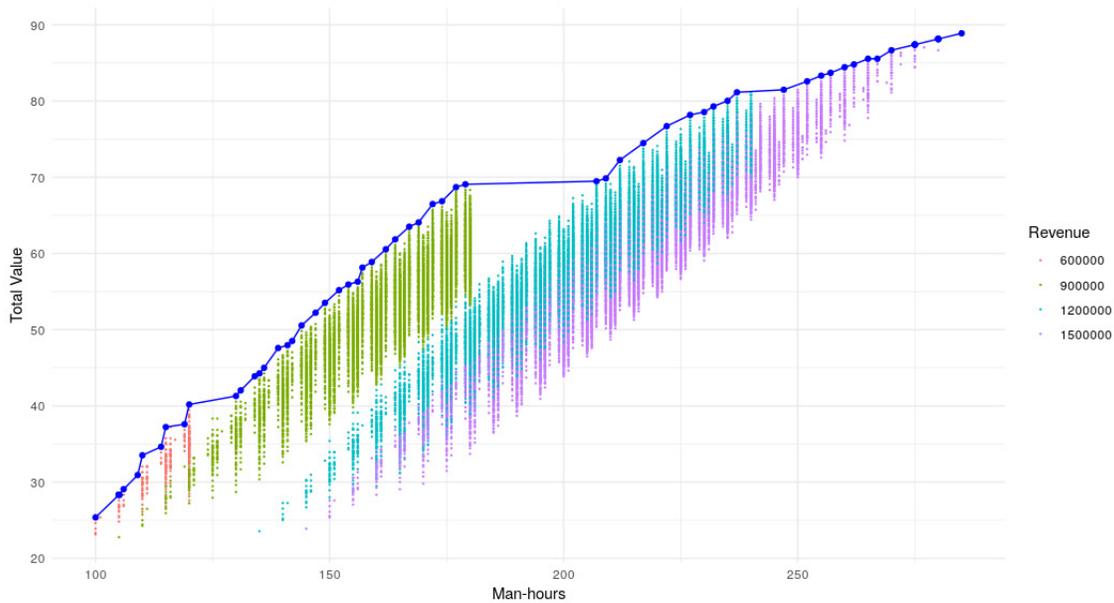


Figure 4. Tradespace of Candidate Solutions

3. Results

Out of the 40,980 courses of action, 69 of them exist on the Pareto frontier. The NGO serves as the decision maker who will ultimately choose which course of action will be implemented. A majority of the optimal courses of action involve maximizing police involvement, political action, and social support. In accordance with the findings from the SDM, enemy disruption through raids should not necessarily be the main focus to maximize total value (Senft, 2019). In fact, this value measure was only maximized in 4.3% of the pareto optimal courses of action. This suggests that the NGO should focus less on conducting raids and more on winning the support of the community. Additionally, the plot above is colored based on the amount of revenue the NGO generates. The four possible levels of funding create interesting stratification in the plot which is highlighted in the gap between the \$900,000 and the \$1,200,000 options. In order to achieve a total value score greater than 69.1, the NGO would have to put in an additional 28 man-hours for a 0.59% increase in total value. This result showcases the presence of diminishing marginal returns for the NGO, as seen in the non-linear, concave pareto frontier.

4. Discussion

According to the Value Model, the NGO would benefit most from implementing courses of action that increase police involvement, political action, and social support. The goal is for the police to have a significant effect on the system by arresting

traffickers or brothel owners, and to have the political support in place to ensure that laws and policies keep the offenders from being released back into the system. The social support will help prevent traffickers and brothel managers from even gaining a foothold in the area and will reduce the number of clients within the sex trade. These actions will have a strong impact on eradicating sex trafficking because they will not only punish the offenders but will also reduce the demand for girls, which is a major driving force in the system.

The simple solution for the NGO is to conduct more raids due to the instantaneous impact on the system of saving girls and arresting offenders. While this course of action is easier to measure in the short term, it will likely not have lasting effects on the system. The projected outcome is that more girls will be trafficked to fill the gap in demand created by the girls taken out of the system by being rescued in a raid. After analysis of the pareto optimal alternatives, it became apparent that to have lasting effects the NGO must gain social support to lower the demand of the trafficked girls. If this is not done, then new girls will continue to be trafficked in order to fill the ever-growing demand. The NGO requires law enforcement, judicial, and political support to make the raids they conduct more effective to induce long-term change. Without support from these government entities, many people that are arrested during raids will simply be released to continue their operations due to corruption in the area, and the system will continue to function.

Finding ways to reduce demand for trafficking will be the only sustainable method to achieve the NGO's fundamental objective of reducing the percentage of girls trafficked. Decreasing the demand for trafficking will lower the number of girls who are required by the market and will slowly bring fewer girls into the system over time. As reflected in the value model, the raids conducted by the NGO will have a limited impact on the system in the long term. In order for them to have a lasting impact, they must also reduce the demand for trafficked girls through rallying social, political, and legal support.

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