The Power of Operational Thinking for Engineering Social Systems: A Tale of Crime and Police Work in an Urban District

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Abstract

Criminologists typically develop causal explanations for explaining crime rates. Such "laundry lists", as Barry Richmond called them, assume exogenous causes as the way to explain a problem and promote very abstract ways of thinking in terms of variables that might end up unrelated to concrete actors or improving actions— not to mention the absence of systemic thinking. System dynamics offers an alternative: the recognition of the performance of a social system as the outcome of the operations that take place between actors that display interests and choice. Such "operational thinking" promotes dynamic explanations that allows the identification of concrete courses of action for engineering (that is, transforming, redesigning and improving) a social system. Here we show the case of crime and security in an important urban district of Bogota. The police faces the challenge of improving a very complex social system that takes place and continuously evolves as the result of the continuous action of diverse actors. We developed a stock-and-flows conceptual model that illustrates how to boost operational thinking and how to envisage concrete interventions that consider the mental models and interests of actors. The latter condition is a requisite if the social system is expected to change.

Keywords: operational thinking, crime, Colombia, modeling, social systems.

1. Crime as the Outcome of the Operations of a Social System

Bogota has around nine million inhabitants and is divided into 19 districts. La Candelaria, the 17th district, is formed around the old town of Bogota. It is a rather small district with a relatively high level of criminality. La Candelaria is a singular place because it has only 24.000 residents but receives around two million visitants every day. These visitants are workers, students, shoppers and tourists who come to the rich and vibrant neighborhoods that belong to the district like La Catedral, Concordia, Las Aguas and Centro Administrativo. These neighborhoods concentrate 17 educational institutions, around 6.000 commercial establishments, at least 35 cultural places and also an important part of government offices. However, the district has also poorer neighborhoods such as Egipto, Belén and Santa Bárbara that do not receive many visitors and have problems with crime, drugs and homelessness. The longest lasting gang wars of Bogota also take place in these areas. Most of the criminals who act in the richer neighborhoods of La Candelaria are inhabitants of the poorer neighborhoods. Such a place provides a fertile soil for boosting complex social dynamics.

According to the data base of the Colombian National Police, the reported crime in La Candelaria shows a high rate that has remained over 15.000 (per 100.000 inhabitants) in the past 5 years. Crime in this district has an average rate of 19.000 with just two short decreasing periods in 2008-2009 and 2015 (Figure 1)—compare for instance with police-reported crime rates in Canada that has remained for the past 50 years always below 10.000 in the whole country with an average rate of 6.000 (Allen, 2016)).
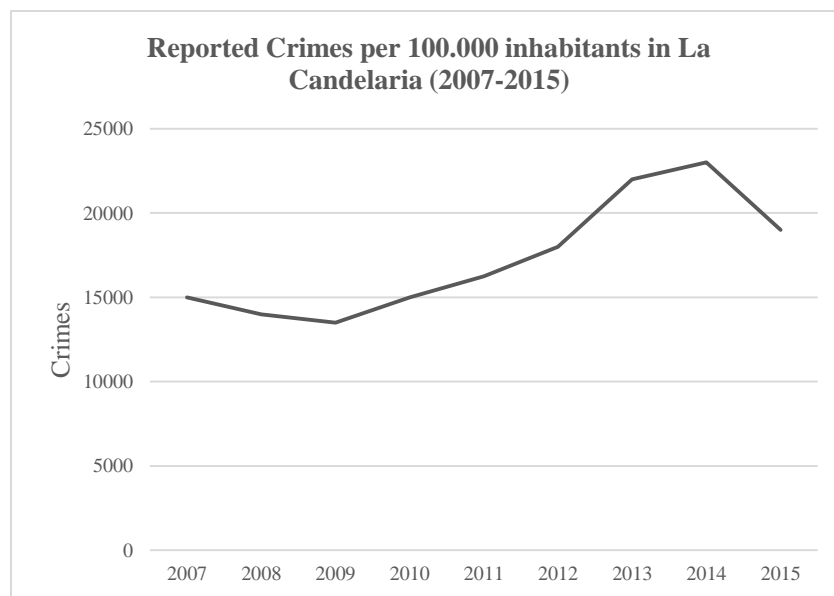

Figure 1. Crime pattern in La Candelaria district

The Colombian National Police has developed a model for improving civic coexistence and public safety called the National Community Surveillance Model by Quadrants (*Modelo Nacional de Vigilancia Comunitaria por Cuadrantes*, "MNVCC"). The MNVCC is based on developing good relations between police and citizens and depends on real time information about crime in order to take prompt decisions and design specific, task-oriented strategies. Policemen are expected not only to merely react to security problems but also to prevent the occurrence of those problems. The

MNVCC is flexible and establishes broad guidelines to develop police work. Police officers are expected to define how to apply the model according to local conditions in their districts.

In this paper we examine the implementation of the MNVCC in La Candelaria from a *systemic* and *operational* modeling perspective. By *systemic* we mean that the challenge is to conceptualize the *system* whose outcome is crime. It is much needed to understand crime as the outcome of a system if we expect to deal effectively with it. Richmond (1993, 1994) opposed this type of thinking to what he called the "laundry-list thinking", that is, to believe that to find or discover a set of one or more "causes" or "factors" or "determinants" will provide reliable explanations. Such paradigm has permeated almost every effort for tackling complex problems. Criminology is not an exception. The expression "the search for the causes of crime" is perhaps a good descriptor of the nature of the task that many criminologists think as the right strategy for understanding crime (Adams, 2009; Erickson, 2013; Eskridge, 2005; Miller, 2009; Welsh, Braga, & Bruinsma, 2013; Willis, Evans, & LaGrange, 1999; Wolfgang, 1963; Zahn, 1999). A "laundry list" means that to tackle the items of the list, i.e. the set of causes, will solve the problem. Criminologists have indeed identified some laundry lists—the main causes of crime. An example follows (Cooper, Walsh, & Ellis, 2010):
  - Unfair economic system
  - Lack of empathy and concern for others
  - Lack of educational opportunities
  - Impulsiveness and risk-taking tendencies
  - Lack of supervision and monitoring
  - Peer influences
  - Unstable family life

By *operational* we mean the emphasis that Barry Richmond (1993, 1994) placed on "operational thinking" as the way to tackle and model dynamic systems through the identification of "how the system works", i.e. in terms of the concrete operations that take place. For him, thinking in terms of operations is a key element of system dynamics (along with "system-as-cause thinking" and "closed-loop thinking") though at the same time it is a rather underappreciated skill. In his own words:

> It is precisely the failure to appreciate the critical importance of operational thinking that is causing many in the field to unwittingly dilute the essence of what we have to offer. In so doing, they are reducing the magnitude of their potential contribution, increasing the difficulty that we will experience in seeking to build systems thinking capability... We have failed to adequately appreciate this third thinking skill...that I feel represents the unique essence of system dynamics, and hence by my definition, of systems thinking. It is also this skill that poses the greatest challenges to disseminating systems thinking (Richmond, 1994, p. 140).

Operational thinking in *social* systems means to recognize and think explicitly in terms of the *actions of actors* that end up, unwillingly many times, forming a system. A special challenge for system dynamicists is to capture such operational dynamics. Here we present a way in which crime rates in La Candelaria can be understood as the outcome of various inter-related and motivated actors whose actions generate the system-level crime pattern shown in Figure 1. The relevance of operational thinking for addressing and improving social systems can be consulted elsewhere (Díaz & Olaya, 2017; Olaya, 2012, 2015; Olaya & Angel, 2014).

In this paper we propose a *systemic* and *operational* way to understand and deal with crime in La Candelaria district. The importance of addressing crime in that way cannot be overestimated.

3

Operational thinking leads to understand the transformation of a social system as a matter of problem dissolution in terms of *redesigning* a social system "in such a way as to *eliminate* the problem, precluding the possibility of its reappearance" (Ackoff, 2001, p. 344). By "redesign" we mean the implementation of new configurations, new systemic understandings, new relations between actors, the strengthening of some dynamic processes, the inclusion of new actors, new social arrangements, etc. The bet is: if the design of the social system changes then its performance will change; but if you just act on some "factors" but the design remains unchanged then problems will persist. In this paper we concentrate in the operational conceptualization with the aim of showing its possibilities even before having a full simulation model. Though we endorse the exercise of simulation as essential for boosting second-loop learning so as to improve mental models (Sterman, 2000), we want here to illustrate both the leverage power of operational thinking for enhancing mental models and why system dynamics is not just another tool but a distinctive way to transform successfully social systems.

2. Operational Modeling and Social Systems

Russell Ackoff reminds us that there are different types of systems (different ways to understand a system) and different types of models. He underlines that when a modeler uses a particular type of model, s/he should be aware that the type of model should match the type of system to be modeled. A mismatch can be disastrous (Ackoff & Gharajedaghi, 1996, p. 13). Our methodological approach places an emphasis on how a system dynamics model can match a *social* system.

Both a system and its parts might display choice. Following Ackoff (2001) we can classify systems accordingly (Table 1). For instance neither a machine nor its parts display choice. On the other hand, social systems are perhaps the most complex type of systems since both the whole system and its part are purposeful.

Type of system	Parts	Whole	Examples
Deterministic	No choice	No choice	Machine, car
Animate	No choice	Choice	Animal, person
Social	Choice	Choice	Corporation, institution, district
Ecological	Choice	No choice	Nature, forest

Table 1. Types of systems as proposed by Ackoff (2001)

Usually the interests of the actors that form a social system (persons, social units, etc.) clash with the goals of the system; moreover, usually the interests of actors belonging to the same system clash against each other. Thus, how to transform and improve a social system if its behavior is driven by free, purposeful actors? From a systemic point of view the performance of a system is the result of the way in which its parts interact. If we want to change such performance then we should change the "configuration" of the system, which for social systems translates to explore new or different ways for actors to interact, new relations, etc. A new design of a system should produce new results. Here is where operational thinking is needed.

Richmond (1994) underlines that operational thinking means neither feedback loops nor computer simulation. The value lies on the "stock infrastructure" in which feedback cycles take place:

> So, if operational thinking is not closed loops and does not necessarily involve computer
> simulation, then what is it? It's primarily just seeing key arrangements of stocks and flows,

with an occasional wire thrown in to make an information link. Stocks and flows are very profound building blocks. They precede feedback loops. They form the infrastructure of a system. They provide the substrate for feedback loops to exist... Without the infrastructure, there can be no feedback system. It is for this reason that I submit it is poor practice to use causal-loop diagrams before having laid out and understood the underlying stock-and-flow infrastructure of a system. Drawing causal-loop diagrams at the outset of a discussion or analysis encourages laundry list (or "factors") thinking... To make matters worse, once the causal-loop diagraming language is internalized, it actively impedes assimilation of the stock-and-flow language and hence operational thinking. It makes the task of assimilating systems thinking appear and actually be considerably more difficult (because of the unlearning that is required) (Richmond, 1994, pp. 143-144).

How to propose a key "stock infrastructure" for conceptualizing a model of the social system in which the implementation of the MNVCC in La Candelaria takes place? In operational terms it means to address the issue of "how the social system works". As a social system then the identification of decisions made by the actors that form such social system becomes the central guideline. We already have a reference mode to start working with (Figure 1) and thus our approach starts by identifying actors that are affected by or can influence that behavior pattern. This conceptualization will give us the basis for building an operational model based on the social structure that emerges from the decisions of those actors keeping in mind key stocks since some actions take time to implement, some processes take time to build, infrastructure takes time to construct, information takes time to collect and beliefs take time to update.

How to know what are the key interests of actors and what actions they take to defend those interests? The information for this project was obtained principally from two sources. First, information from National Police data bases, reports of the Local Mayor Office and from other entities regarding security. Second, first-hand information was acquired from semi-structured, in-depth interviews with different actors. These interviews included key people that reflect interests of diverse groups and institutions:
-   The Security Secretary of La Candelaria Local Mayor's Office.
-   One community leader of Belén neighborhood.
-   One community leader of Santa Barbara neighborhood.
-   Two gang leaders of Egipto neighborhood.
-   Three leaders of merchant guilds of La Candelaria (restaurants, jewelry and hostels).
-   One leader of a cultural association of the district.
-   Security Director of the largest university in the district and member of the alliance of local universities for safety and security in La Candelaria.
-   10 students of three universities from the district.
-   4 police patrolmen of La Candelaria and one commanding officer.

In the case of the residents and floating people the questions were focused on security perception and principal crimes, the image of the police, the relation with patrolmen and their knowledge about the MNVCC. We also inquire whether they organize their own strategies to prevent crime. Questions to merchants were similar but focused on their strategies to counteract crime in their sector and their articulated work with patrolmen, if any. Questions to institutions like Mayor's Office, universities and the cultural association, were directed to their relationships with patrolmen and commanding officers, their collaborative efforts between them to reduce crime and their particular interests to improve security. The interviews with gangs were focused on their role in the neighborhood, their actions against the police and their crimes, their relations with citizens, their participation in different crimes who affect other actors and their actions to block police work.

Finally, the interviews with the members of the police (patrolmen and commanding officer) targeted their daily routines, their perception and opinion regarding the MNVCC, the problems in their quadrants and the improvements to solve such problems.

The collected information was used to build a stock-and-flow model that includes key stocks and feedback dynamics that emerge from the understandings that actors have regarding their actions and the system in which they act, that is, from their mental models. An explicit model "pictures" such structure of the social system of security and crime in La Candelaria. We used such structure for developing a dynamic hypothesis that accounts for a possible explanation of the crime pattern in the district in terms of stock dynamics and feedback processes. Such higher-level statement is expected to provide intelligible and "insightful, system level understanding…"system stories"—coherent, dynamically correct explanations of how influential pieces of system structure give rise to important patterns of system behavior" (Mojtahedzadeh, Andersen, & Richardson, 2004, p. 1). Though such statements can be tested and enhanced with computer simulation, we want to show how and why operational thinking changes the discourse, the very language, with which crime in La Candelaria can be understood. The inclusion of a dynamic perspective that favors continuous processes over isolated events, the recognition of feedback processes that emerge from diverse actions taken by different actors, the possibility of transforming reinforcing loops from vicious to virtuous cycles, counterintuitive stock dynamics, and the recognition of short vs long term trade-offs, are part of this discourse. The operational explanation opens possibilities for exploring concrete courses of action that involve the interests and goals of diverse actors and the change in their mental models. We suggest various redesign possibilities for the social system of La Candelaria based on such a shift of thinking.

3. Conceptualization and Modeling

It has been a seemingly simple task to implement the MNVCC in La Candelaria due to its small size. It has one main police station. The police divided the district into two main zones according to the number of crime hotspots (zones with high crime intensity). Each zone has an Immediate Attention Center (CAI acronym in Spanish), which is a small police station. According to the particular geographic characteristics of each zone and relevant key problems, the police officers of each CAI in turn divide their zone in smaller areas called "quadrants". In La Candelaria each CAI has around 10 quadrants. Each quadrant is assigned a patrol (two officers) who should work closely with the community that live or work in their quadrant.

The MNVCC

The MNVCC is the result of a design process that started in 1993 out of the necessity to improve the image and the performance of the Colombian National Police since the trust of citizens in the police was so low that it gravely affected its ability to solve crime and provide security. Crime in Bogota takes many forms and changes rapidly over time. During the last two decades the model has evolved to answer society changes and new needs of the citizens. The MNVCC has required various organizational changes through time. We will focus on police work. The MNVCC divides police work into five steps that take place across three transversal dimensions: managerial, methodological and operational. These steps are:

1. **Identification:** Patrols, in close contact with citizens of their quadrant, identify key problems, actors and the information that they consider important to understand local security. Part of

their duty is to respond to citizen's emergency calls and to register crime and problems. This step is part of the operational dimension.

2. **Analysis:** Each patrol reports to the commanding officer of the corresponding CAI. According to the methodological dimension, the commanding officer has to collect and update data and develop analyses based on the information collected by patrols. The commanding officer is also responsible for coordinating the different quadrants that belong to the zone.

3. **Planning:** CAI officers report to the commanding officer of the main station. The commanding officer and patrolmen should together develop a plan with guidelines and actions to take for different problems identified in each quadrant. Sometimes those plans can be built with community leaders. This planning process takes place each or every other week depending on urgency and contingent situations. Each day the commanding officer of the main station should communicate updated actions and specific goals to patrols of all quadrants.

4. **Implementation:** Patrols have to implement both preventive and operative actions established in the plan accordingly with the defined goals. Preventive actions are oriented to find solution to coexistence problems among citizens in their own quadrant and to take preventive initiatives against crime; for instance patrolmen can launch campaigns to inform citizens about different issues and to support community leaders in their strategies to improve security. Operative actions are regular police work, i.e. surveillance, captures, confiscations, etc.

5. **Feedback:** At the end of each day the commanding officers should give feedback to all patrols according to the level of fulfillment of goals. This step is aimed at improving police work and adapting in real time according to changing enviromental condictions.

The interests and actions of police, as key actor of the social system, come from these previous steps. Figure 2 summarizes this police work.
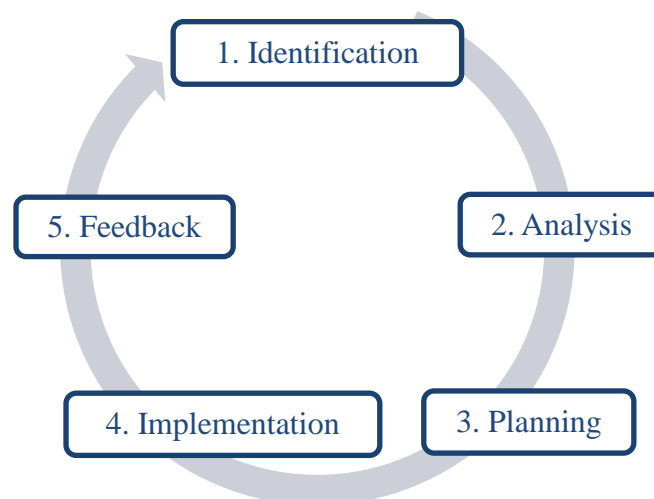

Figure 2. Summary of the organization of police work in the MNVCC

The Social System

Apart from the police other actors can be identified. The aim of developing an operational model requires to determine their interests and the actions that they take to accomplish those interests. Interests and actions are focused on those related to security and crime. Table 2 summarizes the results.

Actor	Interests	Decisions, Actions
Police: Armed police service, civilian in nature but with a strong hierarchical structure.	To protect citizens, enforce the law and ensure peaceful cohabitation among the population.	- The previously explained mandate of the MNVCC: identification, analysis, planning, implementation (both preventive and operative actions) and feedback.
Residents: People who live in La Candelaria. In 2015: 24000 persons. These inhabitants have a medium-low income.	Residents want to live in a place where they can have a normal life. It means for them to have a secure place where their basic needs are satisfied and they can pursue their activities in tranquility.	- They can choose to help (or not) the police with strategies of prevention. - They can choose to denounce crime or suspicious activities to the police. - They can choose to organize groups to prevent crime in the zone.
Floating population: La Candelaria receives around two millions of people per day. It is due to the concentration of government, administrative, financial, commerce, cultural and educational institutions in this locality.	Floating population is interested in a secure environment where they can pursue their activities without danger.	- They can choose to inform crime or suspicious activities to the police and to file criminal complaints.
Local Mayor Office: Each district has a local mayor who is responsible for managing the public resources of the district. They have to divide and use the budget according to priorities of inhabitants and floating population.	The Local Mayor Office should improve the quality of life of resident population in terms of security, education, health access, infrastructure, etc. It should also warrant security and access to primary services to the floating population.	- It uses public funds for creating programs and initiatives for improving the quality of life of both residents and floating population. - They can choose to work together (or not) with other actors.
Community leaders: They represent different groups, especially of the resident population. In Bogota there is a model of community governance in which social leaders represent the interests of people for interacting with different public institutions.	Leaders want to defend the interests of the population that they represent.	- They support crime prevention along with is other actors. - They can choose to inform crimes and other suspicious activities that take place in their own quadrants.
Educational institutions: La Candelaria has 17 universities which represent an important actor with particular interests and which is clearly distinguishable from other actors.	These institutions have to guarantee minimum safety conditions for students and workers. This includes security in and outside of the campus.	- They can improve security conditions for students and workers, either independently or in collaboration with other actors.
Commercial and cultural actors: La Candelaria has around 6000 industrial and commercial premises and 35 cultural scenarios.	These actors are interested in having a safe environment, a reliable infrastructure and good public services for delivering their services and for being attractive for visitors.	- They can choose to protect their business with cameras, alarms and other strategies to prevent crime. - They can choose to collaborate with prevention programs launched by the police or the Local Mayor.
Gangs: La Candelaria has the oldest conflict of gangs in the city. Four gangs have wielded their power over the population during the last 40 years.	These actors are interested in having a permanent control over the population in the neighborhood and breaking the law inside or around it.	- They can choose to recruit members. - They can choose to protect the inhabitants of the neighborhood in turn of a payment. - They can choose breaking the law.

Table 2. The social system: actors, interest and actions

A Model of the Social System

The success of the MNVCC depends on whether or not it succeeds in its interaction with the social system of La Candelaria. This means whether the police is able to adapt its work to that particular social context and also to change its strategy according to new problems. In the following we present a model for explaining the dynamics of the crime rate (Figure 1) in terms of "how the social system of La Candelaria works" according to the mental models of its actors. Following the mentioned emphasis of Richmond, for whom operational thinking lies on key arrangements of stocks that form the "infrastructure" of the system where feedback loops take place, we present a stock-and-flow model along with key feedback loops that emerge from actions taken by the actors of the district. We show the model in sub-structures that highlight key stocks and feedback loops; in some cases, for enhancing visual clarity, variables are rearranged in a different order or place. Feedback loops are labeled with an "R" (reinforcing) or "B" (balancing) followed by a number. We will explain the main stocks and feedback dynamics that illustrate the beliefs and their consequences of involved actors.

One key step in the five step arrangement of the MNVCC is planning. However, there are both opportunities and traps in the dynamics of commander officers and patrolmen. Part of the planning step is to define goals for both operative and preventive actions goals. Commanding officers define those goals by analyzing the information collected by patrols in their quadrants. Operative goals put pressure on patrols for implementing actions that end ep reducing crime (Figure 3, control loop B1); goals for preventive actions, though harder to implement, form also another control loop (Fig. 3, B12). However, usually there is not enough time for patrolmen to accomplish every goal, especially when they have many goals to complete; when this happens patrolmen generally prioritize operative actions over preventive ones. However, since they are not allowed to ignore preventive actions then patrolmen sometimes end up informing their superiors that they have allegedly done some preventive actions that actually never happened. Thus, commanding officers might believe that patrols achieved their goals when in fact they have not done so. The dynamic consequence is that commanding officers start to believe that even higher or more demanding goals are possible and so a vicious cycle of "faked performances" starts to take place; commanding officers increase goals, patrolmen end up trapped in a confirmatory process that demands for them to justify that they are able to do so (since they have "attained" them in the past) and then report supposed "successful" performances further boosting the reinforcement (Figure 3, R1 feedback loop). On the other hand, in the cases when patrolmen have truly attained their goals then crime decreases and the demands from their superiors decreases or at least do not rise to an unrealistic level which in turn diminishes pressure too (thanks to B1 and B12 control loops).
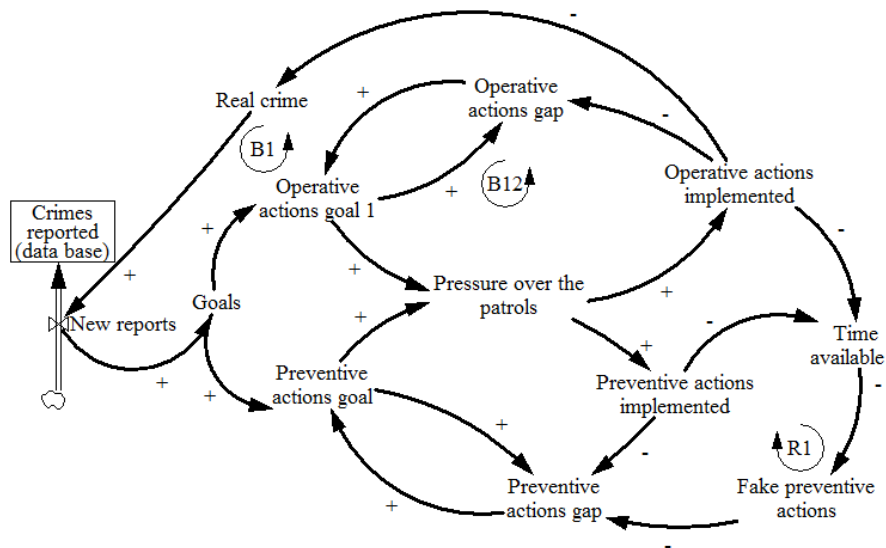
Figure 3. The control loops against crime (B1, B12) and the reinforcing trap of fake reported actions (R1)

Important control dynamics of crime have to do with welfare and training of police officers. To be effective and attain both operative and preventive goals, patrolmen have to be fit and well-trained. The MNVCC dictates that the planning process should include training and welfare for patrolmen (i.e. good working conditions, healthcare, etc.) which provide and warrant both new abilities and fit conditions for officers to deal effectively with security problems and crime (Figure 4, loops B2 and B3). Such effectiveness end up reducing real crime and thereby reported crime. However, it takes time to build effectiveness. Both training programs and welfare should take place regularly in order to at least maintain the stock of police effectiveness in appropriate levels because the demands and challenges for the police change rapidly in this district which makes tactics and actions obsolete through time, with the additional risk of reducing effectiveness if the increase rate is not equal or higher than the decrease rate of police effectiveness (Figure 4, loops B2, B3 and B10).
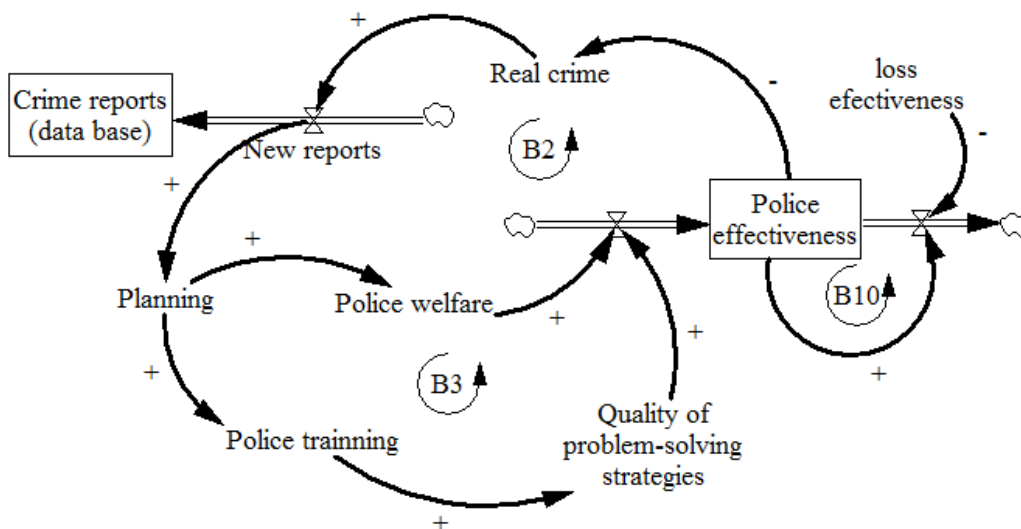

Figure 4. Control of crime through welfare and training (B2, B3) and the obsolescence of police effectiveness (B10)

The trust in the police may form either a vicious or a virtuous cycle. For instance, a damaged image inhibits citizen to report crime—they actually might feel that it makes no sense to report crime to unreliable policemen. Crime reports depend not only on real crime in the streets but also on crime complaints; if the latter decreases then the police will not have accurate knowledge to be more effective and its image will further go down; on the other hand, effectiveness can boost police image, confidence and collaboration of citizens become more likely which boosts crime reports and further increases the effectiveness of police work. (Figure 5, loop R9). Such reinforcing process takes time since four stocks are involved (crime reports, police knowledge, police effectiveness, perceived police effectiveness) and they take time to change. However there are limits to growth. When confidence is high and citizens are willing to report crime then police officers have has less time for taking preventive actions (since, as we explained earlier, in such cases they favor operative actions). Patrols have certain time available for fulfilling their goals and attend all sorts of situations that can occur in their quadrant. More reports imply more "office" work and less time for preventive actions and hence fewer increment in effectiveness which end up harming police image (Figure 5, loop B4).
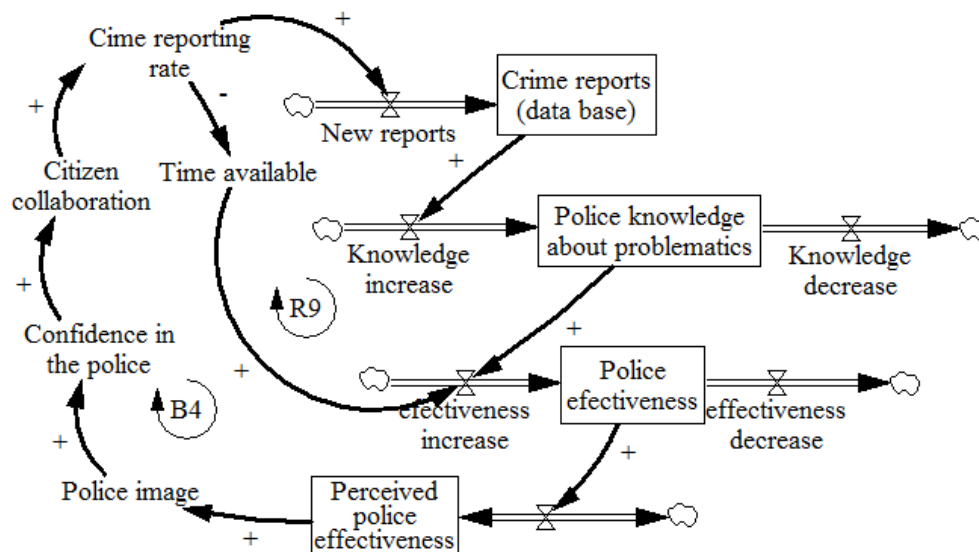

Figure 5. The reinforcement of effectiveness and confidence (R9) and its limits to growth (B4)

One problem that remains in the district is the persistence of gangs in some neighborhoods. Criminal gangs negatively affect the police-citizen relation because gangs threaten and intimidate citizens which then prefer not to talk to the police. Even sometimes criminal gangs form alliances with residents of poor neighborhoods. This scenario has two effects (Figure 6). On the one hand, the resulting rise in real crime prompts the police to increase operative goals and hence to dismantle gangs (loop B6). However, on the other hand, in such social situations in which citizens are intimidated or allied with criminals then reinforcing dynamics take place since it becomes very difficult for patrolmen to obtain information (for example for identifying crime hotspots, gang leaders, etc.) which further harms goals and operative actions (loop R3). Even the alliances with other actors such as commercial premises do not seem to solve the problem: part of the planning process defined by the MNVCC includes the creation of temporary alliances with other actors, typically with the Local Mayor Office and with community leaders. All of them attempt to work

together on problems in their quadrants to decrease crime. However, the challenge is the short-lived nature of such collaborations since when crime reports diminish, and therefore it appears that real crime also decreases, then those alliances are often dissolved and crime starts to rise again. Figure 6 shows such short-term control feedback (loop B7).
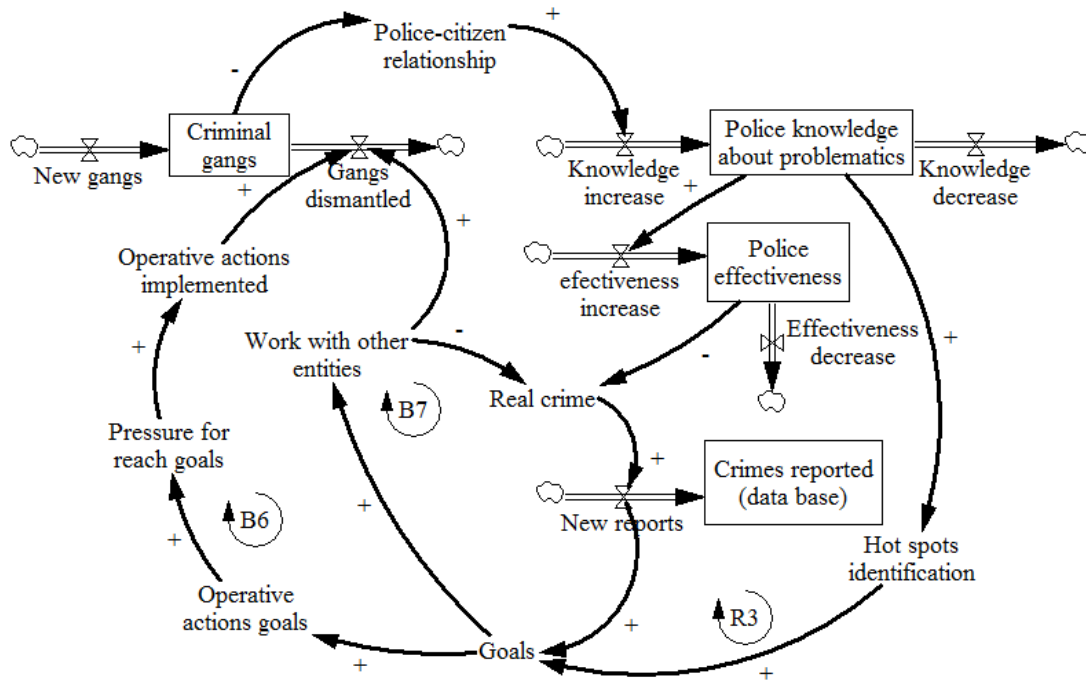

Figure 6. The control of criminal gangs (B6), short term alliances among local actors (B7) and the reinforcing dynamics of fear and intimidation (R3)

When the effectiveness of the police is low then other actors try to enhance security and reduce crime by taking alternative measures. For example, educational institutions and merchants guilds hire private guards, install security cameras etc. in order to improve the security of their students, workers or clients. (Figure 7, loop B8). Unfortunately, though such security actions are legal, they are typically taken without much collaboration or insight from the local police. While such measures help to reduce crime, they also harm the image of the police in the eyes of local citizens, and hence again decreases the amount of information the police can obtain from the public which furthers hampers its increase of effectiveness and hence other actors end up taking alternative measures which further damages the image of the police (Figure 7, loop R4). And the situation can be worse since with low confidence then problems of coexistence start to rise, which creates scenarios for crime to take place, perceived crime by citizens rises and police image is furtherly harmed (Figure 7, loop R2). Naturally both reinforcing loops can be "virtuous cycles" as long as police effectiveness is maintained high through time boosting in the long run confidence and citizen collaboration.
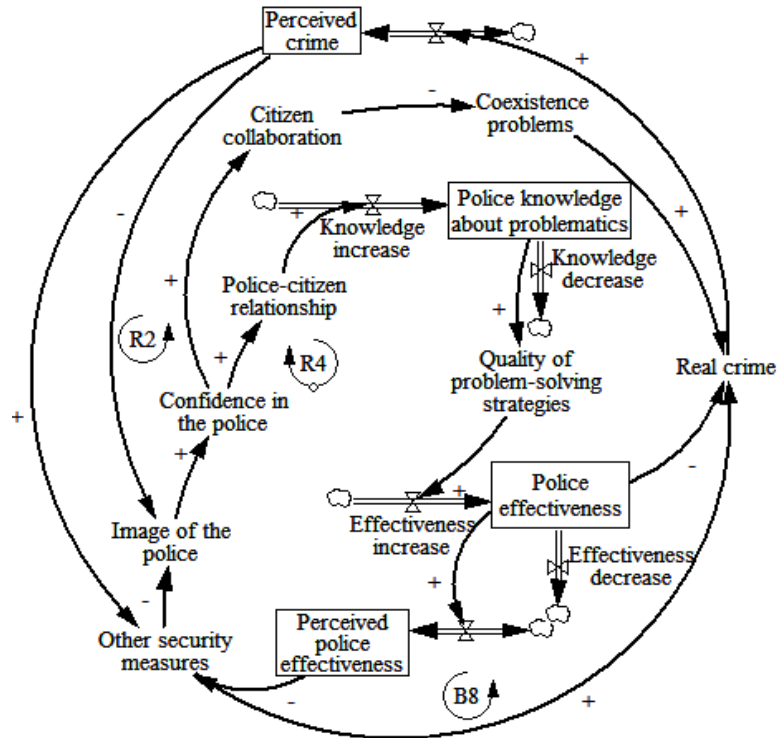
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Figure 7. The alternative control measures taken by other actors (B8) and the resulting reinforcing dynamics boosted by police effectiveness (R4) and citizen collaboration (R2)

Finally, the results of the implementation of the MNVCC in each district are constantly evaluated by the Citizen Security Department, a division of National Police. They rate the performance of patrols in the quadrants in terms of achieved goals, crime reports (the less, the better), work with other actors and hotspots identification. Unfortunately, there are artificial ways for commanding officers to improve the ratings of their quadrants in the short term. For instance they can impose more bureaucracy on the citizens who want to denounce crime and thereby effectively decreasing the number of reports (Figure 8, B11). However less reports implies less knowledge about crime in those quadrants. This lack of knowledge makes harder to identify crime hotpots which eventually would decrease their rating in the long run given the time that takes for the stock of knowledge to change (Fig. 8, loop R5). Such "fixes that fail" is one of the key aspects that police officers might start to recognize and represents another challenge for improving their mental models.
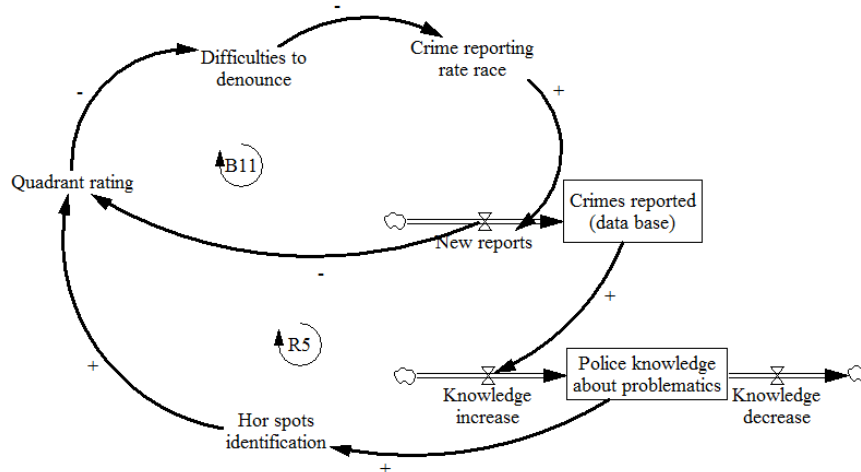

Figure 8. The short term fixes by commanding officers for improving their ratings (B11) and their long-term fail (R5)

4. Engineering a Social System: A Matter of Redesign

The aim of modeling is to improve a social system. Based on the previous operational model it is possible to propose qualitative hypotheses that explain that lack of effectiveness of the MNVCC for successfully reducing crime rates in the social system of La Candelaria. The operational perspective gives a clear picture of which actors might have prompted which dynamics through which specific actions according to the ways in which they imagine the system. Such perspective allows later to propose concrete actions closely related to specific actors.

Qualitative Hypothesis

Though Figure 1 shows crime reports, which differs from real crime, our hypothesis assumes that less real crime means less reported crime. We will now propose an operational explanation of that reference mode. The years 2007-2009 show a decrease of reported crimes. Why? In those years the MNVCC was launched and it was rigorously implemented which might mean dominance of the control loop B1 (Figure 3) through operative actions. However, after 2009 reported crimes increased. R1 feedback loop might have taken dominance since an increasing pressure from superior officers for fast and better results might have stimulated to boost operative actions at expense of preventive ones and patrolmen might have started to report fake preventive actions in order to not disappoint their superiors. Less real preventive actions move the police away from citizens. These dynamics also boosts R2 feedback loop (Fig. 7) with further decreases of citizens' collaboration which results in higher crime rates.

Such increase of crime damaged the image of the police in La Candelaria and thus contributed to worsen the police-citizen relationship. The accelerated increase of reported-crimes reported between 2012 and 2013 might have prompted other actors to take alternative measures against crime and hence furtherly damaging the image of the police (Fig. 7, R4). The effectiveness of police works started slowly to decrease which harms its relation with citizens and inhibits the creation of new knowledge and information about key problems in the district. Such vicious cycle seems to be dominant.

During 2013 and 2014 reported crime rate continued to rise but slower than before. The continuous depletion of the good relations between citizens and police (R1) made the former less motivated to denounce crime; police knowledge thus decreased too and confidence is further lowered with a possible dominant dynamics boosted by the corresponding loop R9 (Fig. 5). However, in the final year (2015) reported crime decreased drastically. A new version of MNVCC was launched in 2014, and just as in 2007 it has been enthusiastically implemented and again B1 might be currently dominant through fast-results operative actions (Fig. 3). What will happen next? Given the current design of the social system we might have some concrete clues. The goal is then to modify such design for improving the performance of the system.

Operational Guidelines for a Redesign

Using the previous qualitative hypothesis we are able to present some suggestions about how to improve the actual functioning of the MNVCC in the social system in La Candelaria. Although the MNVCC intends to be closer to the citizen, the evaluation system based solely on goals actually impedes this to happen. Since the results of the preventive actions are not immediately visible and since there is a limited amount of time the police officers prioritize operative actions. The R1 feedback loop dominance during the last years reflects that it seems a common practice inside the organization to fake preventive actions. Currently police activities do not include real engagement

with the community but only reactive actions. However, on the other hand, the implementation of successful preventive actions might take place at the expense of operative actions as well. The police could also work closely with other actors like merchants or cultural groups that might help to solve specific problems that create crime opportunities, like drugs dependence or abandoned children, which are not the police's specialty. This would allow the MNVCC to include some actors who are or could be part of the problem. Stronger and longer term alliances among local actors might strengthen the B7 control loop. To share responsibilities with other actors and to take a coordination role as a new strategy can diminish the workload of patrols and at the same time helps to decrease crime.

Another opportunity that emerges from implementing more preventive actions is the increase of citizen collaboration. Currently the citizen role in the MNVCC is rather passive and is understood just a source of information; however, citizens could be closer to the police and be more frequently included in the planning process and so engaging them with the security in their quadrant. When citizens and community leaders perceive a high compromise of the police with their security, they themselves might start to create initiatives to solve their own coexistence problems and thereby reducing crime opportunities while patrols become aware of crime situations. Such boost to the reinforcing dynamics of the R2 feedback loop might turn it into a virtuous cycle of better confidence, more collaboration of citizens, less crime, better police image and further confidence. An important lesson is the necessity of having continuous and sustained efforts for maintaining such reinforcing dynamics as a virtuous cycle.

When the police is effective then crime can decrease and the image of the police can improve. However, to increase and maintain police effectiveness means for police officers the need of developing basic knowledge of bathtub dynamics (Sweeney & Sterman, 2000). It takes time to increase a stock. It is also needed an integral view of both inflows and outflows. Since effectiveness can become obsolete through time then a sustained effort in improving and maintaining both welfare and training is required if the inflow of effectiveness is expected to outperform the outflow (Fig. 4). Commanding officers should give more importance to those control loops B2 (welfare) and B3 (training) even if in the short term results are not visible.

On the other hand, to understand the dynamics associated to information delays is crucial for planning police work in the MNVCC. According to the hypothesis the actions of the police take time to be perceived by citizens and hence the stocks of information delays should not be ignored; for instance, the police can collect information everyday but they can know instantaneously neither the real state of affairs nor all the information. It should be important to the police to make important efforts to close the gap between reality and reported crime. Mechanisms to obtain more, better and faster information from citizens might result in increasing their confidence and collaboration with the police which end up boosting reinforcing effective results.

Some Explicit Examples of New Configurations

The change in explicit models might lead to easier changes in our mental models. We will show just two examples focused on the relevance of understanding stock dynamics. For instance, police officers should start to recognize that the results of preventive actions are not immediate, which means to recognize it explicitly as a process that takes time to be developed. The MNVCC should include that fact. This understanding about the delayed processes of preventive actions would allow to define goals more achievable. Figure 9 shows this modification in explicit models. It also shows

the control loop B13 that may counteract the vicious dynamics of fake preventive actions (R1) through the collaborative work of the police with other actors through the implementation of preventive actions. This increases the time available to do other activities and promotes better work; it also contributes to accelerate the implementation of preventive actions and hence diminishes the gap between goal and actions and hence decrease the pressure over patrols. These changes also promote the dominance of the control loop B7 (Fig. 6).
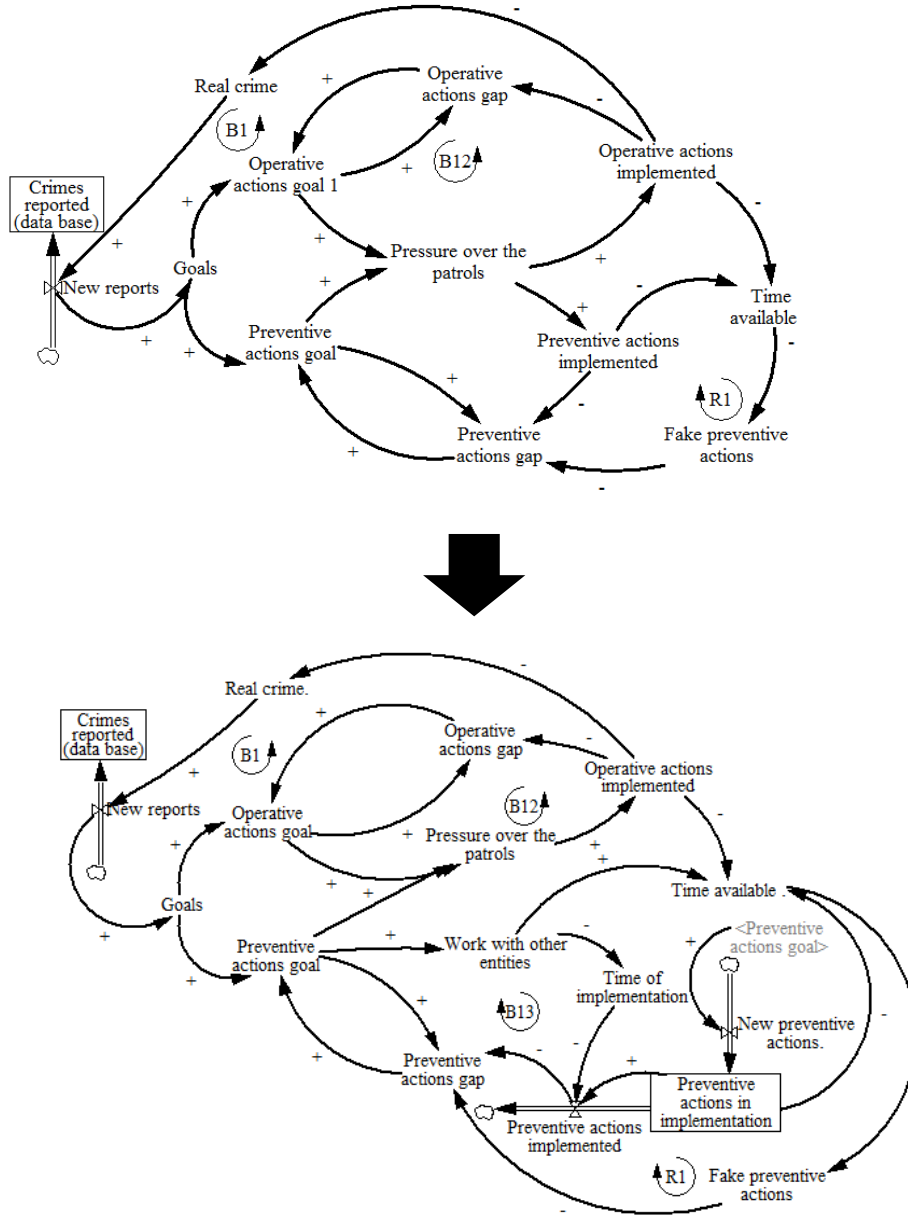

Figure 9. The original (mental) model and a modified version that identifies the time to take the implementation of preventive actions and the control loop of collaborative work (B13)

16

A second straight-forward example relates to the time that takes police training. Currently the commanding officers believe that just one capacitation course is sufficient for patrols instead of realizing that learning is a process that requires a sustained effort through time (Figure 10). The fact that training does not show visible results might explain also the weak influence that such control loop (B3) seems to have.
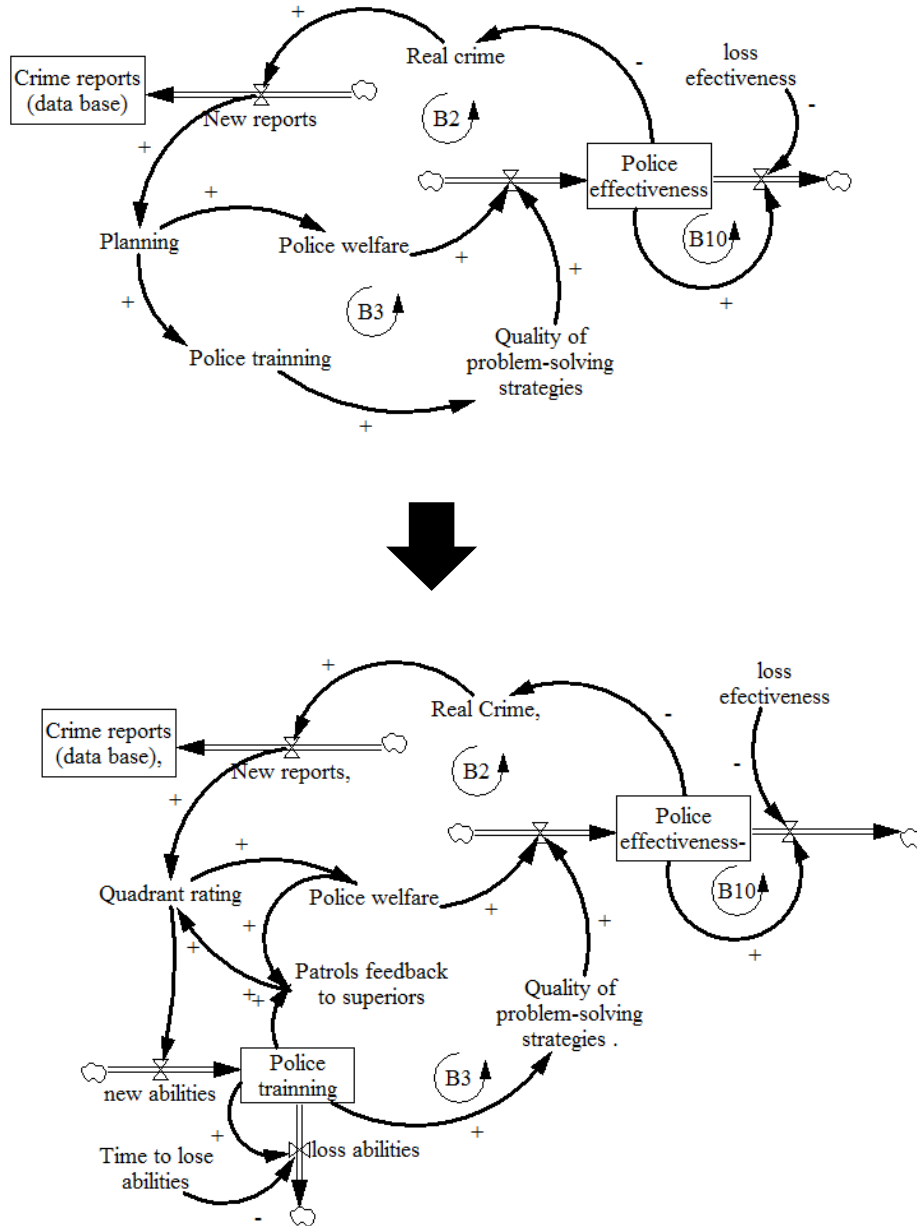

Figure 10. The original (mental) model and a modified version that acknowledges the time and long-term impact of police training

Though these examples might seem trivial in fact they represent challenging and radical tasks for changing the mental models of police officers and other involved actors. Our field work shows that traditional thinking, unaware of endogenous and operational dynamics, persists in the actors of the social system of La Candelaria. Its redesign requires the change of those mental models. Such

paradigm shifts require conceptual change. However, public discussions about the crime problem in the district are currently trapped either in "laundry list" thinking or in "a matter of resources" thinking. The shift to systemic thinking is a promising alternative that this work wants to promote for improving the quality of life of population that makes of that district their place to be.

5. Next Steps

We showed the possibilities of systemic thinking boosted by operational modeling through the combination of stock dynamics and endogenous thinking. This perspective allows proposing grounded guidelines for action attached to concrete actors and considering their goals and interests. The logical next steps for this project are at least two. On the one hand the first challenge is to start to convey to key decision makers this systemic and operational discourse; we propose to use systemic lenses for tackling the problem of crime in La Candelaria as the operational outcome of a social system. On the other hand, the task that remains is to build one or various simulation models based on the conceptualization presented here in order to test hypotheses and further challenge persisting beliefs. No doubt that computer simulation is essential for enhancing the mental models (Sterman, 2000) of decision makers of La Candelaria. These new steps will complement the conceptualization and might start a virtuous cycle that improves mental models of both modelers and actors by recognizing actors and operations and discarding simplistic laundry lists. The condition for improving security in the district lies in the recognition of the *operational* arrangements of the *social system* that produces crime.

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