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ORIGINAL PAPER

Soft System Dynamics Methodology in Action: A study of the Problem of Citizen Insecurity in an Argentinean Province

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Abstract This paper illustrates an application of soft system dynamics methodology (SSDM). SSDM arose as a fusion of two well-known methodologies in the systems movement: system dynamics (SD) and soft systems methodology (SSM). SSDM includes 10 steps to orchestrate and implant change in social systems, based on a multimethodological and multiparadigmatic approach as an outcome of the combination of the mentioned methodologies. After a brief introduction, the paper starts by briefly explaining SSM and SD, their stages and their problematical issues as systemic methodologies, then goes on to explain SSDM, its philosophical roots and stages, ending with a comparison among the three. It then introduces the citizen insecurity problem in Argentina, specifically in Mendoza Province, where SSDM was applied to analyze this issue. The paper concludes with an explanation of the learning points that arose from the use of SSDM in this study and suggestions for further research on citizen security and SSDM.

Keywords Soft systems methodology · System dynamics · Soft system dynamics methodology · Citizen security

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Introduction

This paper provides a brief description of the experience of two of the three authors in developing a real-world consultancy for the Argentine Interior Ministry, using soft system dynamics methodology (SSDM). This project was developed between the years 2000 and 2001, and was supported by a grant from the Inter-American Development Bank.

The experience consisted of the application of SSDM in the analysis of the problem of insecurity of citizens in Mendoza Province, Argentina. SSDM was developed by Ricardo Rodríguez-Ulloa and his colleagues from the Instituto Andino de Sistemas (IAS) in Lima, Peru, in a real-world action research project conducted by IAS between 1992 and 2000, in a collaborative effort with private and governmental organizations in Peru and other Latin American countries. This consulting project is a proof of this experience, in which SSDM was the framework for guiding the study of the problem of citizen insecurity in looking for possible changes to address that situation that are culturally feasible and systemically desirable.

SSM, SD, and the Emergence of SSDM

Soft Systems Methodology

After years of conducting research within the systems movement, Professor Peter B. Checkland and his colleagues, Ronald H. Anderton and Brian Wilson developed Soft Systems Methodology (SSM) along with others at Lancaster University in England. The methodology revolutionized the way of approaching and solving management problems (Checkland 1971, 1972, 1979, 1981, 1999; Checkland and Scholes 1990; Checkland and Holwell 1998; Checkland and Poulter 2006; Jackson 1988; Rodríguez-Ulloa 1988, 1994, 2001).

The purpose of SSM was to orchestrate and implant viable changes in socio-cultural systems in which the positivistic–reductionistic tradition expressed in the practice of classical management sciences were unable to perceive and consider those "soft" variables that, in the majority of instances, define the course of action for organizations (i.e., political factors, power influence, culture, ideology, values, personal and group interests, misinterpretations, biased appreciations of the situation, etc.). SSM, consequently, represents a methodology for searching viable solutions to soft problems in social issues. A "soft" problem is one that is difficult to define, difficult to structure, and difficult to "solve." Examples of soft problems include the following:

- How can State to make State organizations, be made effective and efficient?
- How can corruption be eliminated, in the administration of justice?
- How should Latin American enterprises be managed to ensure their competitiveness in international markets?
- Is Global warming the problem?

One could formulate additional, highly complex questions, for which a unique "solution" does not exist, as the positivistic–reductionistic approach claims. The solution, on the contrary, will depend on an ideological position or beliefs, the power exerted by one or more persons in the problem situation, the academic background of the person solving the problem, and on what his or her experience dictates, among other factors (Rodríguez-Ulloa 1988). Consequently, the concept of "solution" is relative, and depends on who proposes it. The scientific tradition on which classical management sciences are based do not take this aspect into consideration; on the contrary, they promote the search for a unique and "true solution" for the situation.

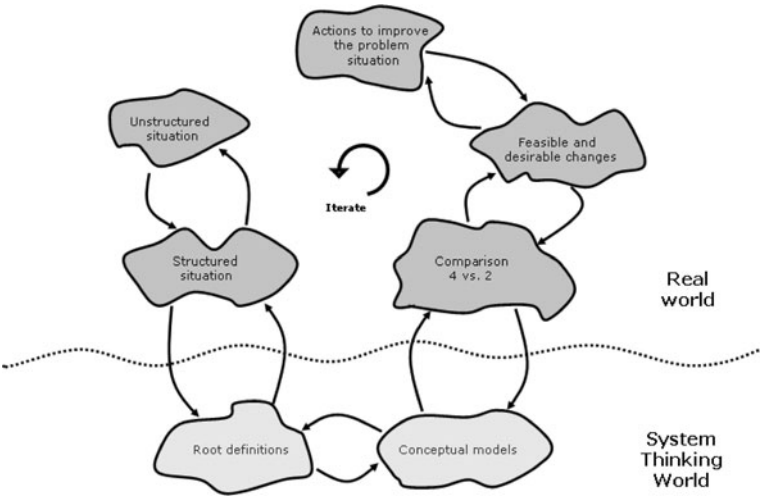


Fig. 1 Soft systems methodology—SSM (Checkland 1981; Checkland and Scholes 1990; Checkland and Holwell 1998)

By contrast, a "hard" problem is the one that is easy to formulate and to "solve." In other words, stakeholders can obtain a "solution" to a clearly defined problem without much discussion of *what* the "problem" is and *how* that problem might be solved.

In short, SSM is an intellectual tool used to design and implement changes in the social arena of the real world, where a human being or a group of human beings are doing something to transform the real world in some way and something seems necessary to be done in order to "improve" that situation. Thus changes proposed by SSM can be at the strategic as well as at the operational level in any social system.

SSM has seven stages in its better-known, former version (see Fig. 1) through which it is possible to orchestrate and implement a transformation process for an individual or for a group of persons (i.e., a social system).

Briefly, the stages can be explained as follows:

Stage 1: Unstructured Situation This is the first impression of a problematical situation under study. Since it is the first impression, the analyst(s) cannot clearly distinguish the identity of the stakeholders or the problems, conflicts, aspirations, beliefs, attitudes, habits and human relationships (formal and informal) that exists in that situation. Neither is it clear what is the power structure, the types of formal and informal relationships, and the historical trajectories of the stakeholders intervening in the situation. Neither is it clear which reference system[1] and its boundaries should be studied, nor which are the supra,[2] infra,[3] hetero,[4] iso[5] and subsystems of the reference system (Rodriguez-Delgado 2006). What happened in the past, what is happening at present, and what will happen in the future

[1] Reference System: Part of the real world that the observer decides to take as the focus of systemic study. Depends and serves the supra systems.

[2] Supra system: System that, being in the reference system environment, influences the reference system.

[3] Infra system: System that, being in the reference system environment, depends of the reference system.

[4] Hetero system: System that being at a hierarchical level similar to the reference system, does different things.

[5] Iso system: System that, being at a hierarchical level similar to the reference system, does similar things.

in the reference system and its environment, according to trends and the intentions of stakeholders. What are the trends in politics, society, economy, technology, ideology, ethics, culture, law and customs in the problematic situation (includes the reference system and its environment) is part of the analysis required at this stage.

In consequence, the analyst(s) will need to work with a very open mind and apply a variety of disciplines, techniques, technologies, methods, methodologies and approaches to understand and comprehend all the issues involved in the social situation under study.

Stage 2: Structured Situation This is the stage in which all the elements first become linked, shaping the structure of the problematic situation.

At this stage, the analyst(s) should be free of any prejudices that can influence and bias his/her/their perception(s) on what is happening in the real world. Factors like previous education, profession, personal interests, friendships and family relationships, ideologies, beliefs, failures and achievements in life, habits, customs and attitudes may be bias factors that distort the appreciation of the facts occurring in the problematic situation.

The conflicts, power structure, interests, beliefs and ideologies practiced, the cultural and ethical values, and the quantitative trends through time must be taken into consideration during this stage. It is also necessary to identify all the stakeholders, their relationships and their role in the power structure.

All these aspects must be expressed graphically, in which the reference system, the supra, infra, hetero, iso and subsystems through time must be registered graphically.

The graphic representation has to be epistemological,[6] phenomenological,[7] hermeneutic[8] and systemic.[9]

Stage 3: Root Definitions and CATWOE Analysis The rich picture elaborated at Stage 2 permits the identification of possible "problem candidates" and the beginning of the search for their "solution." This "solution," which implies a transformation process in the real world, is expressed through a root definition in SSM.

This description is made by an observer (or group of observers) based on a specific *weltanschauung*[10] (*W*), that means the specific worldview under which the description is made by the observer.

[6] Epistemological Description: A description of a concrete or abstract entity by what it supposedly "does" instead of describing it by its intrinsic characteristics. This depends on the interpretation by the observer of what the concrete or abstract entity is doing in a given place and time. Thus for example, a "pen" may usually be interpreted as an "instrument to capture ideas on paper," however, depending on how it is used, it may also be interpreted as an "instrument of personal protection."

[7] Phenomenological Description: Philosophical framework proposed by Edmund Husserl in which it is proposed that in order for us to describe the object (in the real world), there must be a subject (observer) that describes it. In this sense, the subject–object relationship is essential to describe the existential phenomenon. But that is not all, the subject that observes the object interprets it subjectively, more particularly, suggesting the intention.

[8] Hermeneutical: Philosophical framework proposed by Hans-Georg Gadamer. Hermeneutics is the combination of three philosophical frameworks, namely: the historicism of Dilthey, Sartre's existentialism and phenomenology of Husserl. The hermeneutic view of the real world involves a dynamic and phenomenological view of the real world, in which both the evolutionary process of the subject being observed and the evolutionary process of the observed object are relevant, thus giving rise to complex interpretation that impedes the understanding of phenomena occurring in the real world.

[9] Systemic description: Multi-interdisciplinary and transdisciplinary description of the real world.

[10] Taking a phenomenological philosophical position, Weltanschauung means the "filter" under which the observer interprets the events happening in the real world at a given space and time.

A root definition describes a transformation process from a state of S_1 to a state of S_2. In doing this, Clients (C), Actors (A) and Problem-Owners (O)[11] of the problem situation appear and are analyzed.

The transformation process is justified by a (W), which provides the interpretive arguments to justify it. The transformation process is conducted under some restrictions and climate (E) that has to be considered.

All of this makes up the mnemonic CATWOE, which provides the components of any root definition, as explained below.

The root definition defines the "what" (i.e., what transformation process was, is being or will be implanted in the real world aligned to a specific *W*).

On the other hand, a CATWOE analysis (Checkland 1981; Checkland and Scholes 1990; Checkland and Holwell 1998; Rodríguez-Ulloa 1994; Wilson 1984, 2000) of a root definition ensures that the definition includes the following components:

- Clients (C): Clients are the victims and beneficiaries of the transformation process intended to be implemented in the real world.
- Actors (A): Actors carry out the transformation process in the real world.
- Transformation (T): Transformation represents the change occurring or intended to occur in the real world.
- *Weltanschauung* (W): *Weltanschauung* is the group of beliefs and values that sustains the definition of the transformation process from a particular point of view.
- Owners (O): Owners of the problem are those persons and entities in the real world that have the power to permit or hinder the implementation of the transformation process.
- Environment (E): Environment is the internal and external climate inside/outside of the reference systemreference system under which the transformation process occurs. The environment includes the conditions (opportunities, threats, strengths and weaknesses) under which the transformation process occurs in the reference systemreference system.

Stage 4: Conceptual Models This refers to a set of human activity systems, logically interconnected that shows "how" to proceed in order to implant a transformation process proposed by a particular root definition, based in a specific W, in order to modify the Real World in some way.

A conceptual model is a verbal model that describes, in terms of epistemology, the activities needed to implant a transformation process. As can be seen in Fig. 1, this stage is done "under the line," which means that it is only a proposal of change to be implanted in the real world.

Each root definition has a corresponding conceptual model and vice versa. If some changes are made in the root definition, then the conceptual model needs to be changed and also aligned to the new root definition. On the contrary, if some changes are made in the conceptual model, then the root definition needs to be changed and aligned as well.

Stage 5: Comparison Between Stages 4 and 2 At this stage, a comparison is made between the conceptual model conducted at Stage 4 and the rich picture elaborated at Stage 2. The purpose here is to validate whether or not the conceptual model is viable and can be implanted in the real world.

To prove if the conceptual model is viable, it will be necessary to validate it. To do that, a comparison between the conceptual model made at Stage 4 and the rich picture made at Stage 2 is necessary.

From that comparison, changes will arise each activity of the conceptual model.

[11] Those who have the power to allow or not the implementation of the transformation process (T).

These changes should be culturally feasible and systemically desirable if they are expected to be implanted in the real world.

Stage 6: Culturally Feasible and Systemically Desirable Changes The objective of this stage is to list and classify all culturally feasible and systemically desirable changes obtained at Stage 5.

The criteria for classifying changes are:

- Logic criterion
- Importance criterion
- Urgency criterion.

Once all changes have been classified, they can be expressed in a PERT-CPM and Gantt charts that can permit, supervise and control the management of all changes detected and considered at Stage 5.

At this stage, the benefits, investments and costs of each proposed change are also analyzed and the person responsible for the performance of each one is identified.

Stage 7: Implanting of Changes in the Real World This stage corresponds to the process of implanting in the Real World the culturally desirable and systemically feasible changes in the order established by the previous step.

As pointed out earlier, SSM establishes two conditions to guarantee that a transformation process in the social arena can be implanted in the real world:

(a) Transformation must be culturally feasible (which implies that the stakeholders in the problem situation are in agreement on the proposed transformation) and
(b) Transformation must be systemically desirable (which implies that there are resources enough to accomplish the transformation process).

Reiterations of all the stages indicate, in each case, the implementation of a specific transformation process in the real world.

Applications of SSM have been conducted in a variety of places and cases. Researchers, consultants and business executives in Australia, Brazil, Canada, Chile, Colombia, France, Germany, England, Japan, Mexico, USA, Peru, Scotland, Spain, Sweden, Thailand and Venezuela are among those who have used or are using SSM. In Peru, application of SSM in the academia and real-world applications in government and in private organizations have been conducted since 1984. The experiences in which SSM has been applied include strategic management issues, cultural diagnosis and analysis of information requirements for organizations. The outcomes, valuable for stakeholders, have shown the benefits of SSM addressing ill-structured problems.

Problematic Issues in SSM

There are some critics of SSM.

(a) Problems with the kind of transformation process to be implanted in the real world Its critics claim that the problem with SSM is that it only proposes general and vague "solutions" to be implanted in the real world, because usually its propositions are expressed in a verbal language with no tool to measure whether the concrete change implanted in the real world was really the one proposed by SSM.

The main criticism of SSM, however, is that, although it tries to propose participatory changes in the real world as a result of considering various stakeholders, in the end the proposed changes implanted in the real world are those pertaining to the stakeholders with the most influence, so that the "solutions" proposed by this approach are biased and

usually are focused on "maintaining" the status quo rather than making radical changes to the issues tackled in the real world.

(b) No guidelines to build rich picture Another criticism of SSM is that it lacks guidelines to build the rich picture (2nd stage of SSM) of a problematical situation. Checkland gives few guidelines to build up rich pictures of real-world problem situations or the use of some problem structuring methods (Rosenhead and Mingers 2001) in order to enrich this stage. The idea seems to be "give the analyst all the freedom needed to work on it," but it can make the untrained analyst make mistakes of bias in his/her appreciation of a problematical situation in which all the required dimensions should be considered in order to analyze a complex social situation.

(c) Further guidelines to manage the process of implementing changes in the real world An additional aspect that seems to require further work in SSM is in the process of implanting the proposed changes in the real world (Stage 7). SSM proposes changes to be implanted in the real world, but again, it offers only general guidelines for managing it. Experience tell us, however, that this is a critical activity in any process aimed at implanting changes in a social system, and so it is important to take into account the qualitative and quantitative benefits of the changes to be implanted, the resources required, the identification of who is responsible for each change to be implanted, the costs required and the timeline of when those resources will be used to implant specific changes in the real world in a viable manner.

System Dynamics

Forrester (1965) and his team at the Massachusetts Institute of Technology (MIT) developed system dynamics (SD). Forrester created a scheme based on the systems approach that permits the graphic illustration of mental models in looped cause–effect relationships in which numerous variables interact, forming an interrelated whole that behaves in a specific manner, depending on its structure, the values of the variables and the types of relationships among them. A dynamic analysis of the set of different kinds of variables through time was possible with the support of computer-based simulation software and consideration of the role that causal feedback loops can play in structuring a problematic situation, culminating in what Forrester called system dynamics (SD) (Aracil 1981, 1989; Forrester 1965; Goodman 1988; Martínez et al. 1996; Martínez and Requena 1986; Richardson and Pugh III 1981; Roberts 1978; Roberts et al. 1983; Senge 1991; Senge et al. 1995, 2000; Sterman 2000). However, this approach, even though systemic, appears to be biased in favor of what the philosopher Martin Heidegger coined as "calculative thinking" (Heidegger 1966), a way of thinking that is more interested in the "hows" than the "whats," in that SD practitioners are usually more interested in the modeling process and calibrating the model to "reproduce" a trend in the real world than in examining whether the "problem" being analyzed is really "the problem" to be analyzed. It seems that because of this, SD methodology places little attention on its 1st phase: problem definition. One may observe, for example, a lack of questioning on who defines the problem and their intentions in defining the problem. Besides, adopting a realist philosophical position, SD assumes that all observers will agree that the problem chosen is the "right problem" to be chosen, as can be deduced from what Lane and Oliva pointed out some time ago (Lane and Oliva 1998, p. 223): "The theory of SD modeling places considerable emphasis on the need to have an issue or problem at the core of the process: "The SD process starts from a problem to be solved" (Forrester 1993, p. 199). This then focuses the effort and makes the model plausible". However, as is clear from the previous statement, there is not any

questioning of who defines the problem and what are his/her/their intentions, interests and consequences in defining the problem that way. This is an aspect that an SSM practitioner will ask herself/himself.

An additional argument for our position concerning the lack of orchestration for doing a wider analysis for defining the "problem" in the 1st stage of SD methodology is what Lane and Oliva (1998, p. 224) point out: "Yet the SD literature offers little comment on ways of eliciting, creating and examining different issues around which a model should be focused."

On the other hand, SD permits an appreciation of real world phenomena in systemic terms, determining their cause–effect interrelationships and behavior and, especially, to understand the structure underlying them.

The basis of the scheme that Forrester (1965) proposed is the belief that the world and its events reflect a rationality that can be explained mostly through flows and levels. A flow involves the relationship between variables divided by time, thereby increasing or decreasing their levels. Examples of flows include the number of persons born each month in a country, the number of enterprises created, the quality of life of a population, and the number of immigrants in a given year.

The net value of a level is the result of the cumulative value of the inflows and outflows. If the inflows are greater than the outflows, then the absolute value of the level will be increasing through time; if the outflows are greater than the inflows, then the absolute value of the level will be decreasing through time. A variable is usually considered to be to a level variable if it is critical for the model. Examples of level variables are the population, the number of enterprises, the quality of life or the total number of immigrants in a country at a given time. Levels are, metaphorically speaking, like photos of the situation being analyzed at a specific time.

There are additional types of variables in the SD modeling process to describe the real world in SD terms, these are: auxiliary variables, tables, rates (parameters), and exogenous variables (see Fig. 2).

An explanation of each of these variables is given below:

Auxiliary Variables

These are variables that allow the SD modeler to integrate and mix variables (flows and levels) with different kind of units. Thus the SD modeler can, for example, mix a line of flows and levels where the units are "persons" with another line of flows and levels where the units are "US$". Here the auxiliary variable is a variable that shows a ratio between "persons" and "US$" or vice versa.

Tables

Tables are composed of a pair of variables in which an SD model establishes a relationship of dependency of one variable (variable y) on an independent variable that causes that effect (variable x).

Rates

Rates are usually numbers that express a fraction or percentage of a level. They are unidimensional. Sometimes they follow a tendency, varying through time according to a experimental time series; on other occasions, they follow a probabilistic distribution.

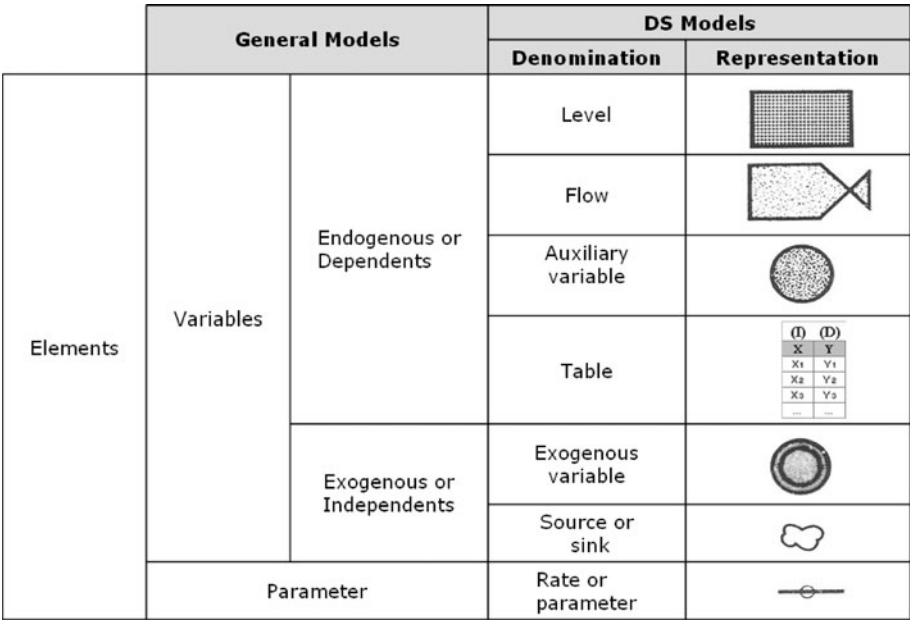


Fig. 2 Symbols for different type of variables in DS modeling (adapted from Martínez and Requena 1986)

Exogenous Variables

These are variables that in principle are outside of the reference system. Due to the fact that SD is an inclusive approach to analysis, however, exogenous variables are part of an SD model that are usually constant variables or follow some probability distribution, in an attempt to simulate behavior that is not within the control of the system.

The language of SD can be expressed initially in causal diagrams (known as qualitative system dynamics), which helps the modeler have a cause–effect understanding of both the defined "problem" and its "solution." The main hypothesis of SD is that the situations in the real world can be explained in closed causal loops, where there may be delays in the effects of the causal relationships, that express the structure of the situation being studied. The structure defines the behavior of the situation being studied. In what are called Forrester diagrams, the structure may express more clearly the type of variables that comprise a SD model, determining graphically which variables are levels, flows, auxiliaries, rates, tables, constants, or exogenous variables to the system as well as the delays of the effect of one of the variables over the other. Figure 3 illustrates an example of the correspondence between the SD modeling and its mathematical representation.

There is nearly a consensus among the main practitioners of the SD methodology which can be summed up in the following stages:

1. "Problem" definition
   In which the behavior of a particular variable that is not desired or understood is of concern to someone who wants something to be done.
2. Hypothesis
   Consists of discovering the causal structure that would explain why the "problem" arises.

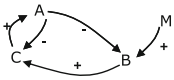
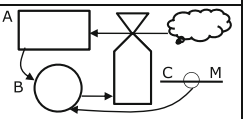
General Models	DS Models		
	Denomination		Representation
Communication Networks	System	Material Channel	
		Information Channel	
Delay	Delay		
Causal Diagram (Qualitative SD)	Feedback Loops		
Forrester Diagram (Quantitative SD)	Forrester Diagram *SDM* Diagram		
Equations	Equations		A = A + DT * (C); C= F (A,B); B = G (A,M)

Fig. 3 Correspondence among causal loop diagrams, Forrester diagrams and mathematical modeling (adapted from Martínez and Requena 1986)

3. Analysis
   Consists of testing the hypothesis in order to see whether or not the causal structure defined at Stage 2 is representative of the "problem" as it was defined in Stage 1.
   It also covers the need to reproduce the behavior of the "problem" in order to validate whether or not it is possible to explain the "problem" with the proposed causal loop structure.
4. Policy
   Consists of defining the strategy to achieve the desired outcome in order to "solve" the "problem".
   This requires the performance of simulations on possible courses of action to be implanted in the real world.
5. Implementation
   Consists of the actions needed to be implemented in the real world in order to implant the policies established during the previous stage.

Figure 4 (Richardson and Pugh III 1981) shows a dynamic causality among the five stages as part of the process of applying the SD methodology.

Problematic Issues in System Dynamics

While SD is a very powerful methodology for analyzing complex situations in the real world, there are some problematic issues that are worth analyzing.

(a) The problem of defining the problem First of all, one aspect that system thinkers from other sides criticize is the way SD practitioners begin defining the problem in SD interventions. As Lane and Oliva (1998) point out, SD practitioners have a preference for adopting a realist philosophical position when approaching problem situations in the real world This causes them to suppose that the system exists in the real world, not in the observer's mind, and as a consequence, the problem can be defined from certain "facts"

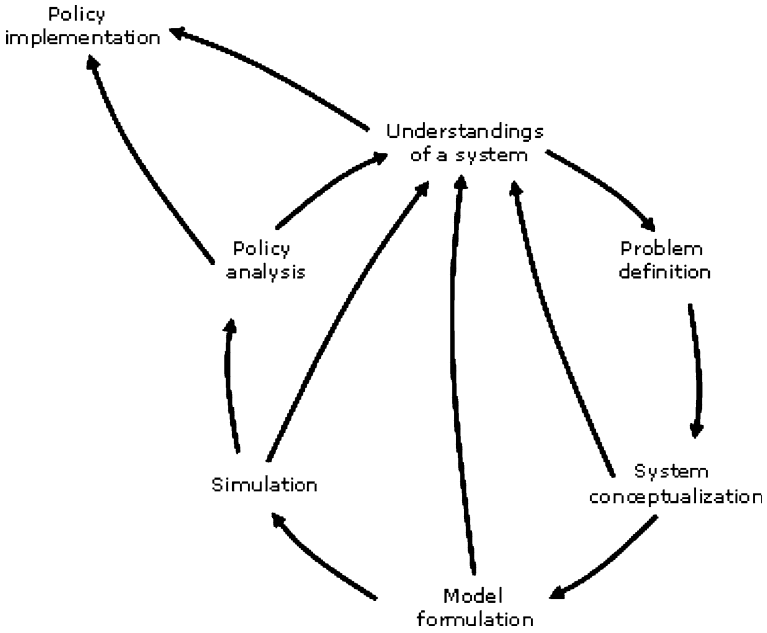


Fig. 4 Dynamic causality of stages in system dynamics methodology (after Richardson and Pugh III 1981)

that every observer can supposedly interpret in a similar manner as "problematic." This is not always the case, however. For example, in a study of corruption in the Peruvian judicial system, one can observe the facts that, statistically speaking, show the number of corruption cases to be increasing. If we take a realist position, then we can assume that everyone will see this tendency as "bad" (i.e., problematic), however, if this event is observed under a nominalist philosophical position, we see that at least one group (drug dealers) could interpret this tendency as being "good" (i.e., not problematic, but an opportunity). Here, then, we see as problematic the way SD practitioners assume that a sequence of facts can configure a "problem" just because some statistics show certain tendencies that in the interpretation of both, the SD expert and/or his/her client, after having adopted a realist philosophical position to observe the situation, affirm that in fact the situation in the real world is "bad" or at least is "challenging" and that something needs to be done to "solve" or "improve" that tendency. It could be "bad" for the SD expert or his/her client but "good" for specific "problem-owners" of the problematic situation, if we see it through the eyes of SSM. Thus in the case of SSM, which adopts a nominalist philosophical approach, the previously explained situation is fully understandable, because SSM has adopted since its very beginning a position that there are two "worlds" that we must distinguish: the one that is outside us, which it calls "the real world," and the "inner world," which stands inside each observer and constructs realities about the real world as a function of how the observer interprets the facts occurring in it.

In this issue also arises the discussion of whether one can talk about "a problem definition" in complex situations or it is an over simplification of the situation and that in the real world, we are really dealing with various problems at the same time, a situation that Checkland (1981, 1999) calls a "problematic situation" rather than simply facing "a problem." In conclusion, a great difference is seen between the approaches adopted by SD and SSM in this crucial issue.

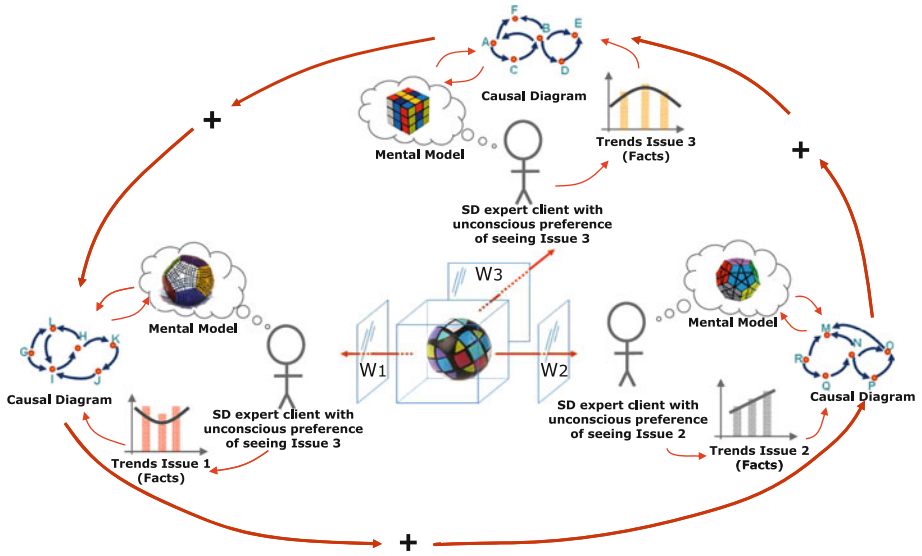


Fig. 5 SD approach to deal with complexity: an addition of issues coming from diverse Ws

A way that SD attempts to deal with the complexity of a problematic situation is by beginning with the definition of a specific problem (and modeling it in terms of causal loops). Afterwards, the SD modeler starts to aggregate more causal loops to represent all the problems that make up the problematical situation. All of this is done in a level of resolution that represents the complexity of the problematical situation. One thing that has not been observed, however, is that by doing it this way, the modeling process is moving into biased directions, according to the variety of unconscious preferences in different problem issues made by the SD expert(s) or clients, according to his/her/their interpretation of the events occurring in the real world. Figures 5 and 6 explain graphically this issue.

It can be argued, rather, that SSM can contribute to enhancing the SD methodology by giving its expertise in the subjects in which soft problems arise, thus contributing to enhancing the 1st phase of SD (i.e., the problem definition stage) by proposing to study the problematic situation as a whole (*holon*) from the beginning, rather than starting to simply define a specific problem, using SSM features like *rich picture*, *relevant systems*, *root definitions* and *CATWOE Analysis* as well as of the problem structuring techniques that exist nowadays (Rosenhead and Mingers 2001; Delp et al. 1977).

Entering into more detail, after building a rich picture of the problem situation, relevant systems and root definitions can be derived. Each relevant system and root definition contains the framework to define a problematic situation from a particular *W* (Checkland 1981). Here the advantage of the SSM approach over the way SD tries to deal with the complexity of a problematical situation is that the analyst is conscious under which W he/she is defining the "problematical situation." In the case of the SD approach, there is no consciousness under which worldview the SD analyst is modeling the problematic situation, due to the mixtures of worldviews taken from the stakeholders and joined in the model (refer to Fig. 6).

This will be the first stage in SSDM to be obtained with the contribution of SSM. Afterwards, a conceptual model (SSM Stage 4) derived from the root definition may serve

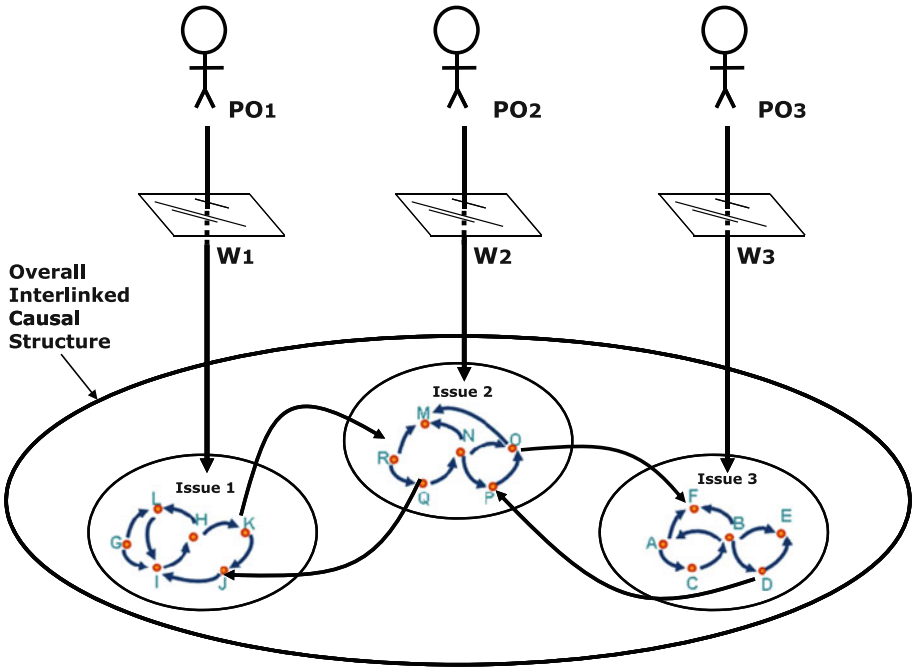


Fig. 6 SD approach to deal with complexity: an overall interlinked causal loop structure by adding causal diagrams coming diverse Ws pertaining to different problem-owners (POs)

to structure the SD context diagram, and within it, the modules that make up the overall SD model of the problematic situation based on a particular W.

Building the conceptual model, the context diagram, the causal loops diagrams and the SD models based on a general framework defined by a root definition may greatly help to have the coherent thinking required in the process of understanding a problematical situation.

(b) The problem of not being aware under which W the SD model is being built As mentioned previously, the assumption in the SD approach is that, after the problem is initially defined, one may go further and complete the entire problematical situation by adding system dynamics loops that can thus configure the overall problematic situation (refer Fig. 6). However if we look at this process from the point of view of the principles of systems thinking, it can be argued that the sum of the parts cannot be equal to the whole system. Our argument is that adding SD loops to the initial SD model in order to configure an entire SD model will not be equivalent to an entire SD model, which is a product of seeing and expressing the whole problematic-situation through a root definition at the beginning of the study and from it, formulating the entire integral SD model derived from an SD context diagram based on a previously defined conceptual model, which is also based on a particular root definition that pertains to a specific W. In other words, what SSDM seeks, working this way, is to obtain at this stage what Lane and Oliva (1998, p. 226) call "dynamic-coherence" when defining a problematic issue since a particular W, where the conceptual model and the SD model are aligned and coherent. They coin it as a W_{dc}.

It can thus be said that there are differences in the modeling process and modeling outcomes if it is conducted in an aggregated manner, or if the overall situation is being modeled on an SD context diagram that contains the modules (derived from a conceptual model and root definition), variables and causal relationships needed to express the problematic situation as a whole (holon) from a particular W.

In the first option, another issue is that the sum of aggregated system dynamics loops for modeling a problematical situation is made from various Ws so that in the end the modeler is unaware under which worldview the modeling of the problematic situation has been conducted. This issue is irrelevant in the SD modeling process because it has adopted a realist philosophical position, under the supposition that the "system" to be modeled is out there in the real world. However, the issue that the "system" is not "out there," but in the interpretation of the modeler's mind, is very important in the SSM nominalist modeling process in order to devise the potential consequences of interpreting the real world under a specific W and the probable and possible scenarios that can be derived from a specific W. Here again, SSM can contribute to enhancing the SD modeling process, incorporating the nominalist approach in studying, not a problem (an issue to be "solved"), but a problematic situation (a group of issues aligned to a specific W) occurring in the real world.

(c) Problems in the policy implementation stage SD methodology provides few details on how policies detected in the SD modeling process should be implanted in the real world. SD practitioners usually see this stage as an another matter apart from the process of SD modeling, which is seen as the main purpose of the SD approach. See, for example, the way Lane and Oliva (1998, p. 222) make a "rich picture" of the SD intervention process. As it can be seen, the "implementation and action" stage is disregarded in the main activities of the SD intervention process.

It can thus be argued that this very important area for implanting change in the real world has been neglected by the SD approach and that SSM can make a valuable contribution through the analysis of the viability of the changes proposed by the SD modeling process and the type of decision making it aims to recommend. As previously mentioned, SSM postulates that, in order to be implanted in the real world, changes must be culturally feasible and systemically desirable.

SSDM

Between 1992 and 2000, the Instituto Andino de Sistemas - IAS in Lima Peru undertook a long range research project under the direction of Ricardo Rodriguez-Ulloa on the strengths of the system dynamics approach for conducting studies of various problematic situations in the Peruvian reality (Rodríguez-Ulloa 1995, 1999, 2002a, b; Rodríguez-Ulloa and Paucar-Caceres 2005; Paucar-Caceres and Rodríguez-Ulloa 2007). At that time, Rodríguez-Ulloa was lecturing on the use of system dynamics in graduate and postgraduate courses, while conducting research and consulting on this approach. The experience in using system dynamics in diverse problem situations of the Peruvian reality prompted him to question the effectiveness of system dynamics to model and confront such problematic situations. His research posed, among others, the following questions:

- Under which *W* are the SD models built when they approach specific phenomena from the real world?
- Who is the observer, and why does he/she observe the real world under a specific and chosen *W*?

- What types of interest and values lead the observer to observe the real world under a specific *W*?
- How can a "solution" be provided if the observer has not clearly comprehended the problematic situation (i.e., he/she is defining a "problem," not a "problematic situation") or is unaware of the *W* under which the problematic situation is being observed?
- Are the "solutions" of the system dynamics approach culturally feasible and systemically desirable?

It was not possible to find satisfactory answers to these important issues in the SD tradition, which spawned the interest of Rodriguez-Ulloa to examine some aspects of the SD approach in more detail.

To do that, various pilot projects to study different kinds of problematic situations existing in the Peruvian reality were studied at different places and times. The studies were possible thanks to a framework of agreements between IAS and research centers and graduate academic institutions around the country in which students participated in the study of real-world problematic situations as part of their professional education. Thus, most of the research was conducted with the collaboration of students and members of the academic centers, who received instruction in the application of concepts related to systems thinking, SSM and SD through special courses. Under this modality, pilot studies emerged on problems related to regional development, the propagation of AIDS, education, urban growth, water management, drug dealing, urban delinquency among youth, childhood, the informal sector, the Peruvian publishing industry, the fishing sector, malnutrition, poverty, as well as strategic management for private and state organizations (Rodríguez-Ulloa 1994, 1995). Consulting and research using SSDM were also conducted in the case of the region of La Libertad (Peru), the study of the National Building Fund and its impact in the Peruvian economy and citizen insecurity in an Argentinean Province, which is explained in the present paper.

Such diverse applications revealed that the SD scheme did not explicitly consider the *W* concept during the construction of causal and SD diagrams, a concept that is proposed and managed well by SSM (Checkland 1981, 1999; Checkland and Scholes 1990; Checkland and Holwell 1998; Checkland and Poulter 2006). Following SSM then, each causal diagram should be the product of a particular observer's *W* or a product of a consensual worldview of a group of observers about a problem situation under analysis. Thus, because many worldviews exist, the same number of SD models can be created, each corresponding to a specific W. As a result, under SSDM as many SD models can be derived as worldviews can be detected from the stakeholders observing the problematic situation under study.

Further analysis of the SD approach also indicated that no biunivocal relationship existed between the causal diagrams and SD diagrams. Although most SD practitioners and modelers pay no attention to the need of a corresponding equivalence between the causal diagrams and the SD models built in SD software, our research showed that it is important to look for a biunivocal correlation between those variables in a causal diagram and the variables and their types in an SD model, because it facilitates building SD models for people not trained in the SD approach and because it brings more coherence to the process of model building.

To remedy the lack of biunivocal correlation consistency between the variables in the cause–effect diagrams and the variables in the SD models (i.e., Forrester diagrams), a set of rules was proposed to improve the consistency between them (Rodríguez-Ulloa 1993).

Warren (2008) noticed this when he proposed Strategy Dynamics as an SD approach directed to managers, a busy group of people who are more interested in following the logic of causality in the modeling process than in looking for the intricacies of the techniques needed to obtain an SD model. In Strategy Dynamics, Warren has gained coherence between causal diagrams and Forrester diagrams in one kind of diagramming used in software called MyStrategy.

Thus, the experience of Rodriguez-Ulloa and his team at IAS in the use of SSM in the Peruvian reality (Rodríguez-Ulloa 1988, 1990, 1994, 2001) led to some of the basic concepts, stages and philosophical principles of SSM being incorporated into the SD approach, in an attempt to answer the previous questions concerning SD, but without removing aspects of great use and potentiality shown by SD.

Stages of SSDM

Although there are several publications that explain SSDM (Rodríguez-Ulloa 1995, 1999, 2002a, b; Rodríguez-Ulloa and Paucar-Caceres 2005; Paucar-Caceres and Rodríguez-Ulloa 2007), this paper presents a brief view of SSDM so the reader will have an idea of what is it and what it proposes by looking for improved systemic interventions in the real world through the fusion of two widely known systemic approaches, SSM and SD. This results in an eclectic methodology that uses the more developed aspects of each one and proposes a methodological framework oriented to the analysis, design and implantation of viable changes in human social situations where some issues needs to be attended.

Briefly speaking, SSDM is composed of 10 stages that aim to implant a transformation process into a specific social situation under study (see Fig. 7).

As explained below, SSDM works in three worlds: (1) the Real Word, (2) the Problem-Oriented Systems Thinking World, and (3) the Solving-Oriented Systems Thinking World.

World 1: The Real World

Stage 1 (Unstructured Problem Situation) and Stage 2 (Structured Situation) These two first steps are taken from SSM as the starting points for any systemic intervention. It was known that Stage 1 (Unstructured Problem Situation) and Stage 2 (Structured Situation, also known as 'rich picture') are very powerful steps to understand what is happening in a portion of the real world in systemic, phenomenological, hermeneutic and epistemological terms. Consequently, these two stages were considered to be part of SSDM because they are already well established in SSM, with the addition of some concepts[12] and tools[13] to enrich the way 'rich pictures' are built up.

In this respect, the equivalent stages in the SD approach are to begin any systemic study by (1) "Defining the Problem" and (2) "Making a hypothesis" on the systemic causal

[12] For example, the use of concepts such as *weltanschauung*, human activity systems, infra systems, hetero systems, supra systems, iso systems, reference system, political climate, cultural issues, ethical issues, etc.; helps considerably to structure problematic situations.

[13] For example, the use of colors and different signals to express different types of relationships (i.e., considering and expressing the level and kind of influence of the problem owners, clients and actors, the informal relationships, the family and friendship links, and so on), as well as to add cause–effect relationships to events or to specify links describing the hermeneutic phenomena occurring in the problematic situation analyzed through time. Also used were different problem structuring methods and techniques in order to have a clear third party understanding of the problematic situation, such as: mind mapping, causal diagrams, SD, synectics, brainstorming, Regnier Abacus, Delphi Method, Structural Analysis, Cross Impact Matrix, Morphological Analysis, Nominal Group Technique, System Definition Matrix, Interaction Matrix Diagramming and Scenario Analysis.

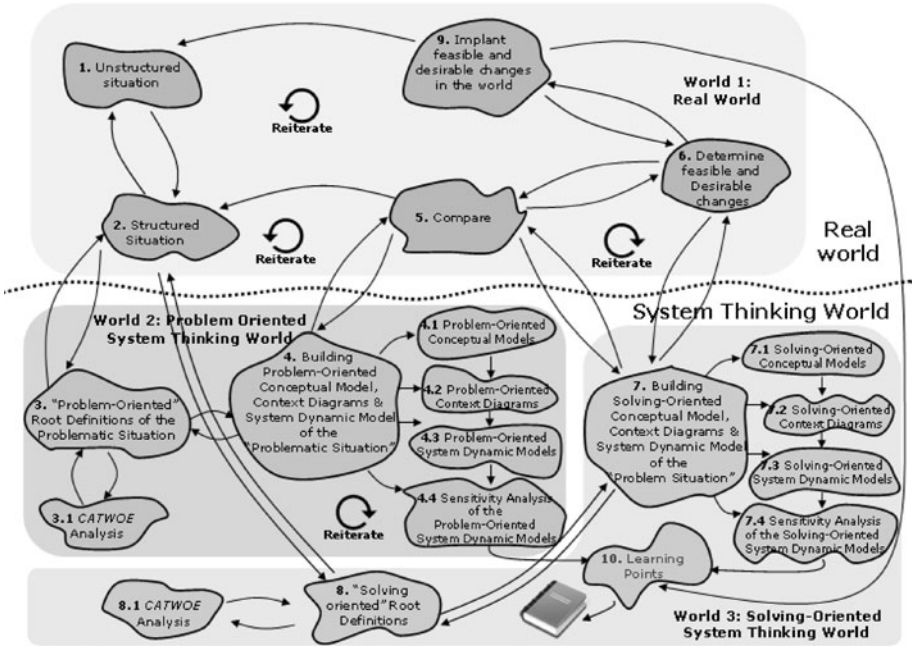


Fig. 7 An overview of soft system dynamics methodology—SSDM (after Rodríguez-Ulloa 1995, 1999)

structure that could reproduce the problem behavior (i.e., a context causal loop diagram) that is composed of 'nouns' (i.e., an ontological way of describing the real world) linked to each other by causal relationships, as the basis to understand the problem faced in the real world.

This causal structure is a particular manner for the practitioner of SD (the analyst) to interpret what is happening in the real world. He/she does it, however, without considering important aspects that require consideration, such as to identify problem owners, clients, actors existing in the situation, their worldviews, level and type of power relationships existing among them, the cultural issues, etc. These are precisely the aspects that make the situation problematic and difficult to understand if we are trying to make recommendations for its improvement. Because these aspects are well examined in Stages 1 and 2 of SSM, they were considered to be part of SSDM.

World 2: The Problem-Oriented Systems Thinking World

Stage 3: Problem-Oriented Root Definitions Stage 3 of SSM (root definitions) is used as part of SSDM as well, because of its importance for describing transformation processes and situational changes in systemic, phenomenological, epistemological, and hermeneutic terms. It has been found that in most of the situations where SSM has been applied, a root definition usually describes a human activity system which performs a transformation process that intends to 'improve' the problem situation encountered in the real world based on a specific *W*. Alternatively, the way root definitions are used in Stage 3 of SSDM is to try to understand why the situation is the way it is; for instance, why is the Peruvian population not well fed when Peru is one of the richest countries in world in seafood? Why is there so much poverty in the country if Peru has mineral resources enough to finance

high quality education system for its entire population? Why has Peru not yet developed a world class agricultural industry when it is one of the countries in the world with the most microclimates? Why is the country still 'underdeveloped' when it has more educated people than ever? Root definitions, then, were used here to describe epistemologically these types of 'illogical' situations; thus, the transformation processes described at Stage 3 of SSDM are *problem-oriented transformation processes* that are supposedly occurring in the real world and expressed in the 'rich picture' (Stage 2). From our point of view, this is a different way of using root definitions in the sense that, from this perspective, root definitions are used to express 'problematic' transformation processes instead of expressing transformation processes aimed at providing 'solutions' or 'improvements' to the problematic situation, as they are normally used in SSM. These root definitions are called "problem-oriented root definitions" here.

Stage 4: Building Problem-Oriented Dynamic Models After Stage 3 has been completed, each developed 'problem-oriented' root definition serves as the basis for beginning the modeling process (Stage 4 of SSDM). This modeling process starts building the corresponding "problem-oriented conceptual models", a variant of Stage 4 of SSM that builds "solving-oriented conceptual models". However this conceptual model, being problem-oriented, expresses "how" the problem-oriented root definition in Stage 3 has been done in the real world in order to implant precisely the mix of problematic issues the situation is now facing. This problem-oriented conceptual model constitutes the basis for configuring the SD "problem-oriented context diagram" that responds to the same particular (W) on which the previous problem-oriented conceptual model and root definitions were based.

If should the analyst change his/her role and assume that of another problem-owner/client or actor of the problematic situation, then the W under which he/she now observes the real world will be different and so, the problem-oriented root definition will be different and the same will happen with the new problem-oriented conceptual model and the SD problem-oriented context diagram. On the contrary, if some changes are made in the structure of the SD context diagram, some adjustments and changes must be made in the problem-oriented conceptual model and problem-oriented root definition, and by doing this, it will lead the analyst to detect which new W would justify its seeing the real world in that way.

The successful building up of the problem-oriented context diagram serves as the basis for developing SD causal loop diagrams that express the detailed structure of each module of the problem-oriented context diagram, which explains the "logic" and "rationality" of a problematic situation based on a particular W pertaining to a particular problem-owner, this being what Lane and Oliva call "dynamic coherence" (Lane and Oliva 1998, p. 226).

After considering the problem-oriented context diagram that, as mentioned earlier, depends on a particular W under which the analyst (assuming the role of some of the stakeholders) views the real world problematic situation, the structure of the problematic situation is also modeled in a detailed way as part of Stage 4 of SSDM, using for this purpose an SD approach with the support of an ad hoc SD software. Having obtained a logically coherent causal loop model that explains the behavior of the problematic situation observed under a particular W, one continues with its calibration and sensitivity analysis in order to examine the diverse consequences and sequels that may result from a particular problem-oriented view (from a specific W) of the problematic situation, under the simulation of different conditions of key causal variables.

Studying and understanding these SD causal-loop relationships and their sequels (i.e., the outcomes) is a key aspect of the learning process that the group of analysts (i.e., the observers) can perform, using this framework on the problem-oriented understanding of the

problematic situation. This process can be replicated "n" times according to the number of problem-oriented root definitions the analyst has elaborated in Stage 3 of SSDM. The objective is to learn from those different SD problem-oriented models generated at this stage in order to comprehend the variety of interpretations under which the behavior of a problematic situation can be understood according to each problem-oriented interpretation.

World 1: The Real World and World 3: The Solving Oriented Systems Thinking World *Stage 5 (Comparing the Problem-Oriented System Dynamics Model and the Rich Picture), Stage 6 (Determining Feasible and Desirable Changes) and Stage 7 (Building a Solving-Oriented System Dynamics Model of the 'Problematic Situation')*

World 1: The Real World (Stages 5 and 6 of SSDM)

Stage 5 of SSDM consists of the comparison of the problem-oriented conceptual model, SD context-diagram and SD models with the rich picture built up at Stage 2. The comparison emphasizes observing and validating these three levels of complexity and, if possible, all the nouns and causal relationships established in the problem-oriented SD model (context diagram and detailed SD models) compared to the rich picture, as well as observing whether the outcomes of the sensitivity analysis can "reproduce" the behavior of the focused variables of the problematic situation, that is, to validate whether or not the SD models adequately express the real world situation (or part of it) shown in the rich picture. If the problem-oriented SD model expresses adequately what is happening in the real world, it may be useful to look for culturally feasible and systemically desirable changes (Stage 6 of SSDM) in order to "improve" the problematic situation described through the SD model(s). In other words, Stage 6 is looking to obtain culturally feasible and systemically desirable changes in terms of which variables (in the context diagram as well as in detailed SD model[s]) and causal relationships must be removed, changed, and/or added (if possible, all of these actions) in order to improve (i.e., change) the problematic behavior of the situation encountered at Stages 3 and 4 of SSDM under a specific W.

World 3: The Solving-Oriented Systems Thinking World (Stage 7 of SSDM)

Since it is not possible to perform this culturally feasible and systemically desirable changes without the analysis of the effects of changes through time, one must go to Stage 7 of SSDM. At this stage, there is interesting support from the SD approach to SSM in that the use of this modeling methodology (i.e., SD) permits testing, delineating and perusing possible scenarios of course of action (i.e., policies) for 'improving' the problematic situation proposed through different, supposedly feasible and desirable changes determined at Stage 6. It has commonly been seen that what intuitively was supposed to be a possible 'good' change in ideal terms, was not like that in the real world. Stage 7 helps to understand precisely whether or not the proposed changes can improve the causal structure of the problematic situation. If they do not really contribute to any significant improvement in the short, medium or long term, we have to return to Stage 5 of SSDM and reiterate Stages 5, 6, and 7, until a culturally feasible and systemically desirable solving-oriented SD model arises.

Stage 7 involves building a SD context diagram of the solving-oriented approach to be implemented in the real world and going to the subsequent SD causal loop modeling details (the next levels of resolution in the SD approach) and performing a sensitivity analysis to observe the outcomes according to the variations of the causal variables and/or their causal relationships. This process gives the analysts important insights into the various consequences and sequels of the 'solutions' they are providing.

World 3: Solving-Oriented Systems Thinking World and World 1: The Real World
Stage 8 (Solving-oriented root definitions), Stage 9 (Implanting feasible and desirable changes in the real world) and Stage 10 (Producing learning points)

World 3: Solving-Oriented Systems Thinking World (Stage 8)

After the solving-oriented SD model has been achieved, Stage 8 of SSDM is then performed. The goal of this stage is to express the transformation process needed to implant 'improvements' in the problematic situation in SSM terms. After conducting all the linguistic corrections, it is important to carry out a Client, Actor, Transformation Process, *W*, Owner/s and Environmental Constraint (CATWOE) analysis in order to clarify the 'solving-oriented' transformation process that the solving-oriented SD model pertaining to the solving-oriented SD context diagram derived from a solving-oriented conceptual model proposed at Stage 7 is promoting in the real world. After conducting all the adjustments, a comparison is made between the 'solving-oriented' root definition and the real world; that is, a comparison between Stages 8 and 2 must be performed. If the analysts notice that the 'solving-oriented' root definition is interesting and culturally feasible, but the comparison with the real world shows that the transformation process proposed in the 'solving-oriented' root definition will be difficult to implement due to systemically undesirable factors, then some adjustments have to be made in Stages 2, 8, 7 and 6 until a 'good' adjustment is found for obtaining a culturally feasible and systemically desirable solving-oriented root definition.

World 1: Stage 9: Culturally Feasible and Systemically Desirable Changes in the Real World and World 3: Stage 10: Producing Lessons Learned

Once a proper balance has been found among Stages 2, 8, 7 and 6, it is time to return to Stage 6 of SSDM, where the final culturally feasible and systemically desirable changes must be chosen. Once this is done, changes are ready to be implemented at Stage 9 of SSDM. As Fig. 7 shows, Stage 9 has to do with the implementation of feasible and desirable changes in the real world. The project management approach of the Project Management Institute (PMI), following the Project Management Body of Knowledge (PMBOK), can be applied here.

The last activity of SSDM is Stage 10, where all lessons learned must be collected and saved for study and occasional reflection, thinking in apply them in future interventions. These lessons learned come from the analysis of the problem-oriented modeling process in World 2 as well as from the World 3 solving-oriented modeling process, and from the proper implementation of the action plan in the real world (Stage 9) in World 1.

Figure 7 shows the interrelation among the 10 stages of SSDM and its three worlds.

After the creation of SSDM, IAS researchers have used the methodology in a number of cases in Peru and elsewhere, ranging from simple applications in small business to the analysis and development of strategic scenarios for a region, the study of the impact of the National Housing Fund on the national economy as well as the present experience of citizen insecurity in an Argentinean province.

Some attempts to combine SSM and SD have been made in the past (Lane and Oliva 1998), in the line of what Mingers and Gill (1997) explain as the multimethodology approach. The difference of the present research, however, is that it aims to obtain an overall framework (a methodology) that incorporates both the SSM and SD approaches in a synergistic way and expressed in 10 specific stages.

To finish the theoretical section of this paper, a mental map comparing SSM, SD and the emergent SSDM in ontological, epistemological and methodological terms is presented in Fig. 8.

Applying SSDM to the Citizen Insecurity Problem of an Argentinean Province

Stage 1: The Unstructured Problem Situation

Over the last three decades, the most important political issue in nearly all Latin American countries has become citizen security, with the emergence of crime and the consequent loss of quality of life (Arriaga and Godoy 1999; Krauskpf 1996; OPS 1996; Dammert 2010). National, provincial, and local governments have responded to the challenge in a number of ways, but the outcomes have been, as expected, very poor or complete failures.

In the dynamic framework of society, security and insecurity are apparent in all aspects of life, as two sides of the same coin. The consideration of society as a living system consisting of millions of elements in reciprocal and feedback interactions allows one to reflect on insecurity, not as something that happens to others, but as a phenomenon of our own daily routine. All complex systems, including living organisms and communities, bring dysfunctional problems that affect the functioning of the system, requiring the appearance of controllers, repairers, and stabilizers that maintain the patterns of functioning in terms that fluctuate within boundaries of instability. When the malfunctions are increased to metastatic levels, surpassing critical thresholds, the system deeply alters its behavior patterns and, in extreme cases, enters a profound crisis that leads to its extinction.

Until the end of the nineteenth century, the rationalistic conceptions of the world, based on the enlightened view of the universe ruled by the Newtonian and Cartesian mechanicist view, extrapolated the social context to a similar mechanical consideration. This view illustrated the belief that malfunction and conflict were improper or abnormal, correctable under sentence or sanction to restore an alleged perturbed equilibrium. Through these actions, national states developed preventive, rigid, formal institutions dedicated to external control, such as police and security forces, as well as repressive and punitive institutions in which the judicial apparatus occupied a specific role.

However, this paradigm encountered a profound crisis during the twentieth century with the innovations of quantum theory, gestalt and genetic psychology, cybernetics, general systems theory, autopoiesis, non-equilibrium thermodynamics, fractal geometry, and the new sciences of chaos and complexity. All these new epistemological offshoots, generically embraced under the conceptualization of a new systemic-holistic paradigm and self-organized intellectual artifact, provide new tools to understand and manage the malfunction of organizations from a more flexible and adapted perspective. Through the conception of the real world as an integrated whole, different from the sum of its parts, and the perception of the world as a network of interconnected and interdependent phenomena, we face new perspectives in citizen insecurity issues.

Many state that the problem is multicausal. However, on only very few occasions has the prevalence of political strategies that effectively link insecurity themes (the emergence of delinquency and violence, for example) been associated with increases of inequity, corruption of power, impunity, the benefits of the mass media, the crisis of solidarity or the collapse of macrosystems such as education, justice and health care. Two social pathologies, among others, affect the relationship of political leaders to the insecurity issue: (a) the habit of reacting to emergent facts instead of approaching problems in an integral

Fig. 8 Mental map of an ontological, epistemological and methodological comparison among SSM, SD and SSDM

(i.e., systemic) manner with a preactive and proactive attitude, and (b) the habit of repairing instead of preventing problems.

Logically, the concept of citizen security moves beyond connotations that are altered in each context in which it is used. However, looking for a general definition of the idea of citizen security, one may assume that it involves ways in which persons and societies try to preserve their values, lives and goods from threats, risks and dangers. The expression may be somewhat ambiguous, with an emphasis on the fact that if public security does not exist, neither does private security exist. Thus, security is an underlying condition that societies try to obtain by increasing the levels of trust, predictability and quality of life while diminishing the levels of violence, crime, disorder and social exclusion.

Public policy refers to the production of policy instruments utilized to give social value to the sensation of trust that makes life in a community possible. To design public security policy, one must discover, comprehend, and critically review the mental models of a particular sector of society during a specific time. The process requires an important dose of humility to boost the diversity of alternatives, perspectives, and creative proposals that the construction of a new system demands. In this regard, SSDM has been seen as an appropriate response to this methodological aspiration.

Recently, reported crime increased significantly in Argentina, and then stabilized at a particularly worrying rate of delinquency. This observation is also true for Mendoza Province, with committed and reported crimes calculated to be between 25 and 30% of the total crime committed in any given period. The existing data (see Fig. 9) are useful to discover the underlying patterns and tendencies, but they are far from being exact.

Without doubt, criminal homicides in Argentina reflect the seriousness of the problem, being the crime that is reported for nearly all of the acts committed. In this case, the tendency of increase became significant between 1992 and 2006, stabilizing at a relatively

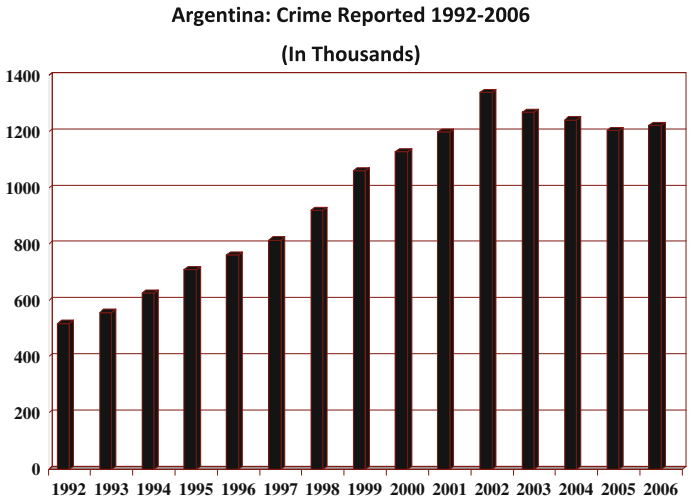


Fig. 9 Argentina: crime reported 1992–2006 (thousands). *Source*: Dirección Nacional de Política Criminal, Ministerio de Justicia y Derechos Humanos

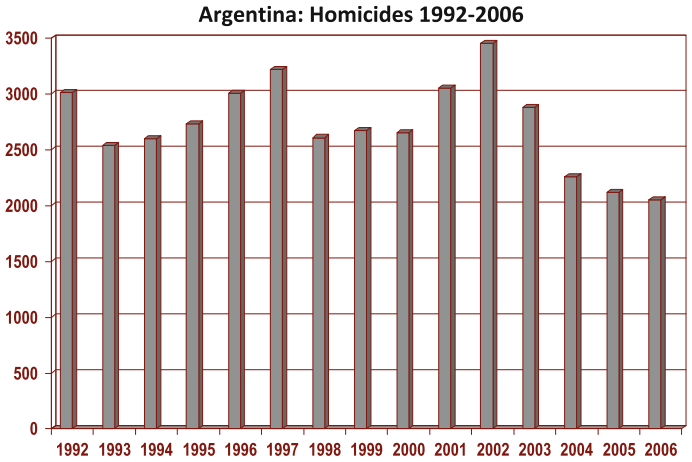


Fig. 10 Argentina: homicides reported (1992–2006). *Source*: DNPol Crim

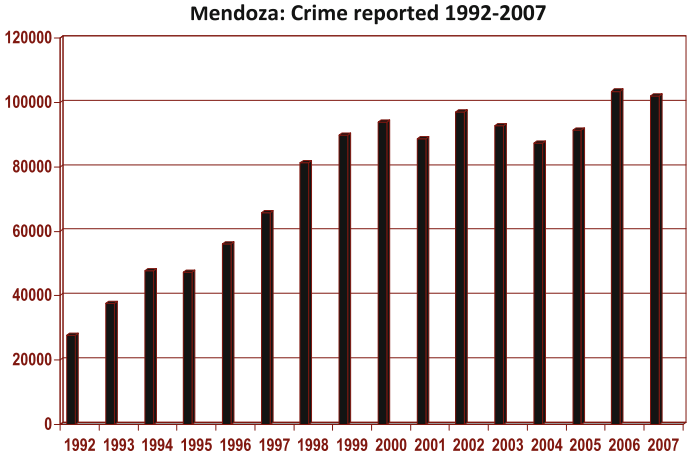


Fig. 11 Province of Mendoza: crime reported (1992–2007). *Sources*: 1992–1998, Policía de Mendoza; 1999–2006, Ministerio de Justicia y Seguridad

high rate in 2003 (see Figs. 9, 10). In the case of Mendoza Province, with a current population of 1,800,000 inhabitants, reports of increasing crime have become equally significant and worrisome figure, although the number of cases has stabilized and even decreased in recent years (see Figs. 11, 12).

The collapse of the traditional systems to manage social dysfunctions, based almost exclusively on a response to crime and judicial issues, together with the emergence of so-called new threats from a globalized criminal world in a real-time interconnected planet, generate epic challenges. As is evident in Fig. 9, the situation of crime in Argentina finds the corrective judicial system completely collapsed and practically in its metastasis phase. Again, Mendoza Province is not an exception to this trend. In the year 2000, of the 91,675 crimes reported there, the justice system produced 961 sentences. Six years later, in 2006,

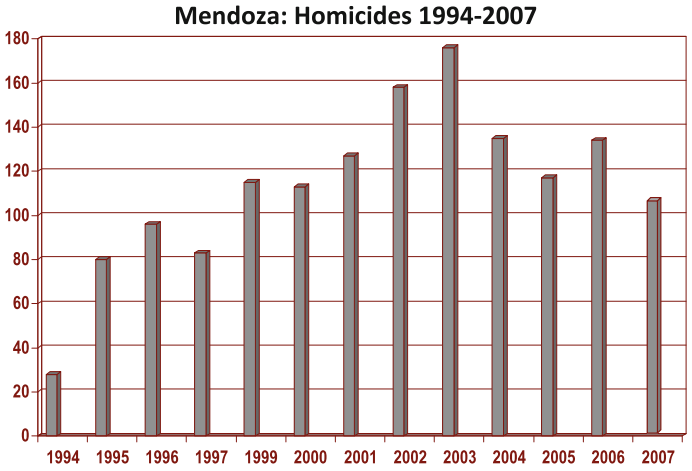


Fig. 12 Province of Mendoza: homicides reported (1994–2007). *Sources*: 1994–2004, DNPol Crim; 2005 and 2006, Ministerio de Justicia y Seguridad

the justice system achieved only 3,077 sentences and 5,742 dismissals for a total of 103,454 crimes reported.

Over the last two decades, political leaders from Argentina, and Mendoza in particular, repeated the broad repertoire of reductionistic, linear, and nonviable measures for the management of the complex problem situation under analysis. In this sense, the judicial system has systematically increased sentences for crime in the penal code and intended to speed up the judicial procedures through a variety of strategies, such as probation, suspended trials, creation of judicial police stations, construction of more courts, and the increase of personnel. The measures have mostly had a strong effect on the system of people's constitutional guarantees. With a judge's order in Mendoza Province, during the last 3 years police could inspect persons and vehicles, conduct massive searches at night, legally search employment and other records, and arrest persons without cause.

Another of the recurrent measures adopted was boosting the number of police through lowering the requirements to be accepted into the police institution, which affects the model of the policeman as a person who is highly trained and professional. No measure has been useful, however, in reducing crime levels in a consistent and verifiable manner. At the same time, rates of the socio-macroeconomic matrix, such as the GINI Index of Income Inequality, remain high, thus 52% of the population earns as little as 19% of the total income. The birth rate in teenagers has increased to a rate of 68 per 1,000, and is higher in vulnerable sectors. Over 20% of young people do not study or work. In addition, cases of failure, dropout, and repetition of school years are increasing.

The gap between macro-systems for managing coexistence (police, justice, schools) and the facts of the real world force changes in the dynamics of a globalized twenty-first century society. The rigid, mechanic, and hierarchical systems from the industrial society lack the capacity to create adequate responses. The gap is evident in the problem of the lack of adjustment of its processes to the new environment in which these systems must operate. Only through a paradigmatic change, explored in this research, can one understand the complex nature of the problem and elaborate measures for an effective intervention.

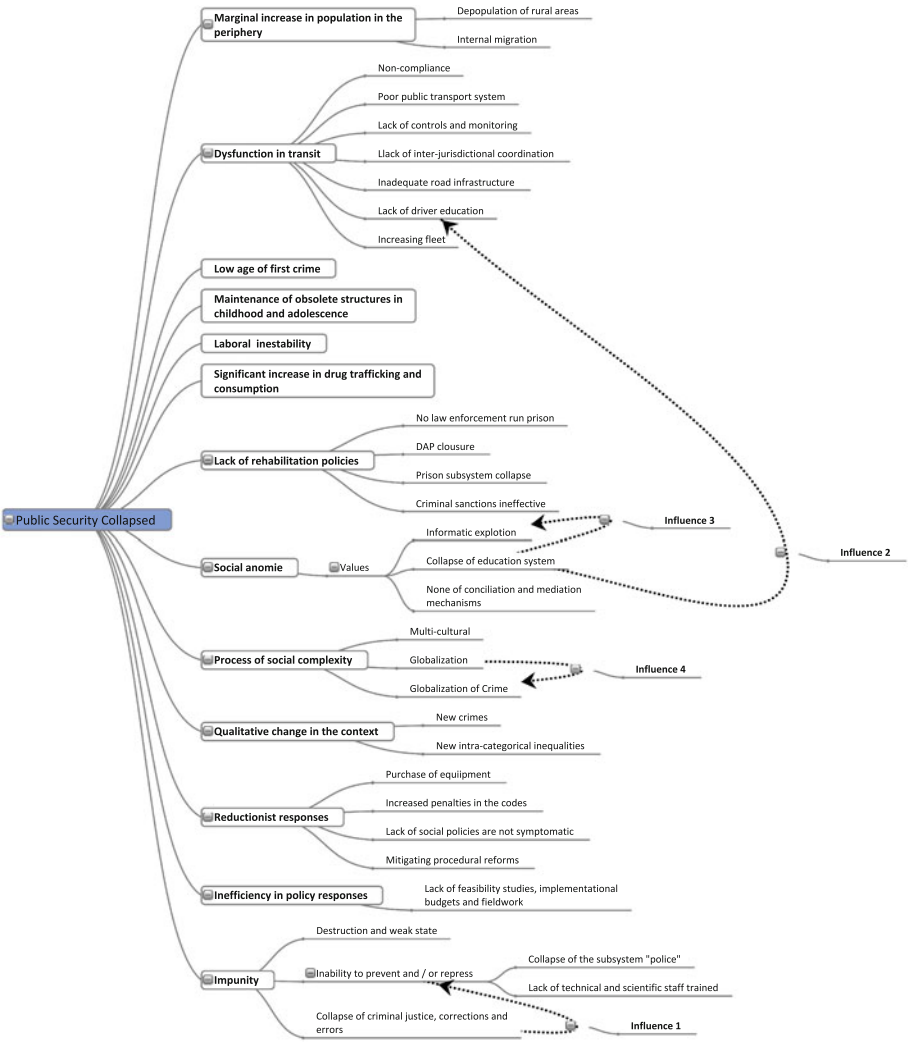


Fig. 13 Mental map on the collapse of public security of Province of Mendoza (Montbrun and Porras 1999)

Stage 2: The Structured Problematic Situation (Rich Picture)

To structure the problem situation of Mendoza Province, a mental map (Buzan 1996; Rose and Malcolm 1997) illustrates the problem of citizen insecurity (Fig. 13). In the present case, the rich picture is derived from the mental map elaborated by a group of participants at a SSDM seminar lead by Rodríguez-Ulloa in Lima and Mendoza in 1999, as well as from the working meetings for analyzing the insecurity problem in Mendoza Province that were held from November 4 to 6, 2000 (see Fig. 14). The rich picture provides a quick and global view of the existing problematic situation in Mendoza Province and identifies the main aspects of the citizen insecurity problem.

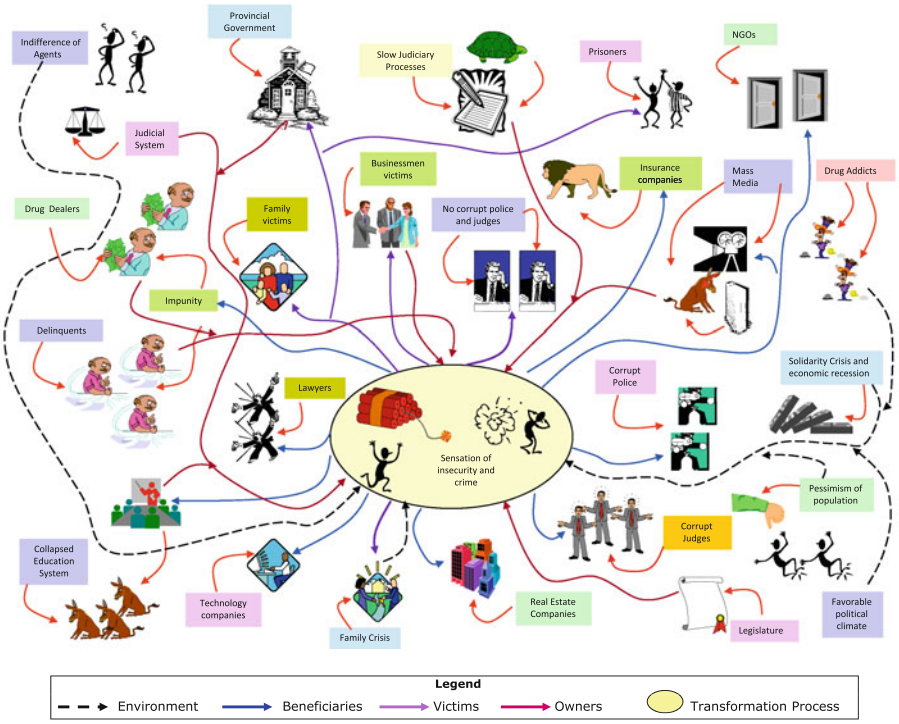


Fig. 14 Rich picture of the problematic situation: citizen insecurity in the Province of Mendoza, Argentina

The rich picture takes into account the owners of the problematic situation (those who have the power to allow or to hinder transformation processes), the clients of the problematic situation (beneficiaries and victims of transformation processes), and the climate under which the transformation process may occur. Figure 14 includes a representation of the interaction among the owners, clients, and actors. Figure 14 includes a legend to indicate the meaning of the arrows and the central process of transformation.

Stage 3: Problem-Oriented Root Definitions

Considering the rich picture (Fig. 14), Rodríguez-Ulloa and CEGESCO's researchers derived various problem-oriented root definitions from the owners, clients, and actors of the problem situation. Each of the problem-oriented root definitions illustrates the problem of citizen insecurity in Mendoza Province from a different W, obtaining as a result a consensual problem-oriented root definition that was validated by contrasting it with key problem owners, clients, and actors of the problematic situation. The following problem-oriented root definitions were the basis to obtain the mentioned consensual one:

Problem-Oriented Root Definition 1: A human activity system (HAS), which does not answer the current demands of the citizens from Mendoza Province in terms of timing and efficacy, operating only in a reactive manner and in a context of increasing risk factors.

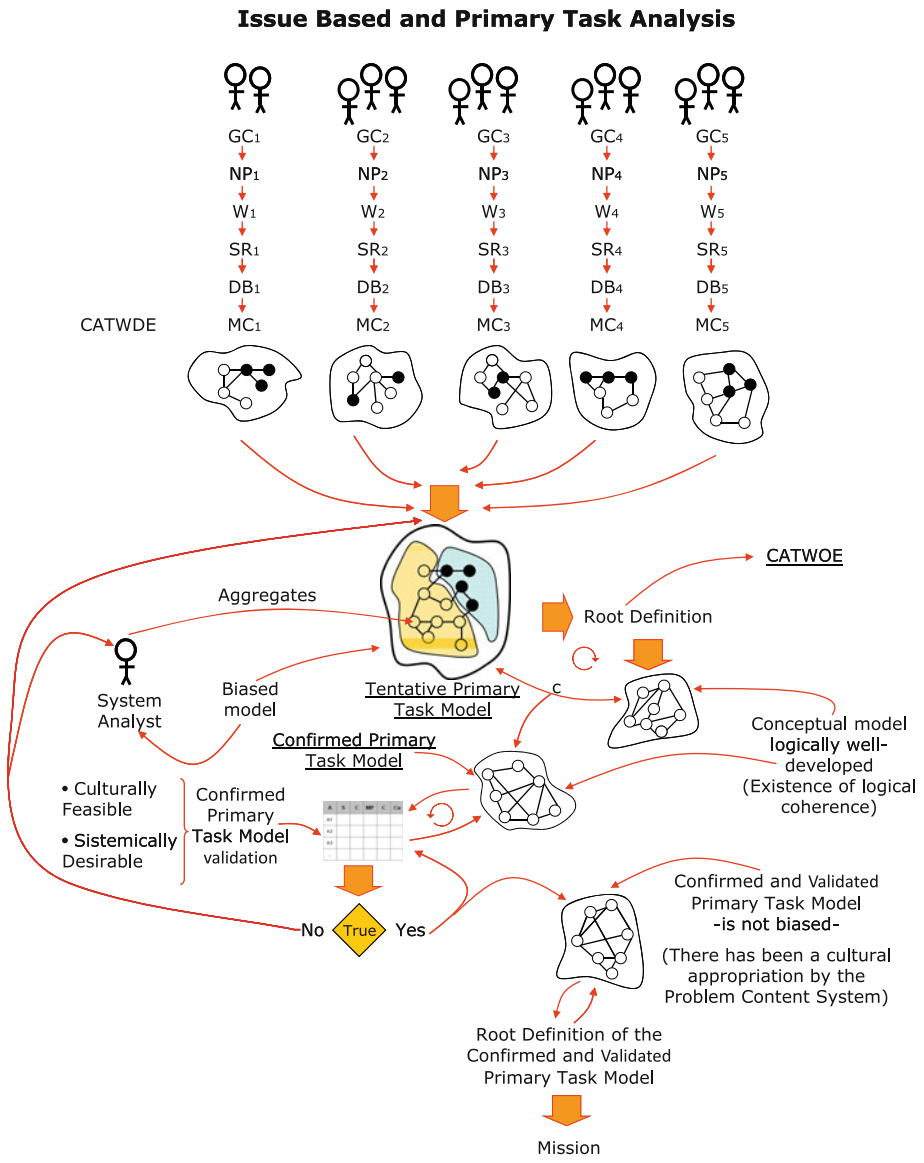


Fig. 15 Issue based and primary task analysis (after Wilson 1984, 2000)

Problem-Oriented Root Definition 2: A human activity system (HAS), which leads Mendoza Province's citizen security system to collapse, based on the problem of the provincial police, which has not had the needed elements and deep recycling in human resources and equipment throughout the years.

Problem-Oriented Root Definition 3: A human activity system (HAS), part of the professionally managed structure of the State that does not guarantee the human rights of persons and the fulfillment of their obligations, failing to accomplish its specific function to:

- Prevent, contain, monitor, and limit any lawbreaking activity and behavior
- Collaborate with the judicial system to accomplish the goals in the framework of the constitutional mandates and conditions of sustainability.

Considering the previous problem-oriented root definitions and applying the Issue-Based and Primary Task Analysis approach outlined in Fig. 15, for obtaining a consensual and validated conceptual model and root definition (Wilson 1984, 2000) in long sessions with stakeholders, the final consensual problem-oriented root definition read as follows:

Consensual Problem-Oriented Root Definition: A human activity system (HAS)—belonging to the provincial government, the legislative branch, the judicial branch, organized crime, drug dealers, common criminals, the educational system, Chambers of Crime,[14] media organizations, and businesspeople—that increases the insecurity and the sensation of insecurity in Mendoza Province by strengthening the impunity of some owners of the problem situation.

The system positively affects security-oriented businesses, the security educational system, construction businesses, security technology businesses, drug dealers, corrupt judges and police, non-governmental organizations dedicated to attending violence issues, common criminals, insurance businesses, media, and lawyers.

The system negatively affects crime victims, the population that does not have the power to change the situation, future generations (children and youth), honest police and judges, the ruling political party, the provincial and federal government, the penal system and families. This process occurs within a climate of crisis of solidarity, economic recession, pessimism in the population, cultural and economic globalization, financial and economic crisis, collapse in the educational system, slowness in the judicial system, poor budget allocation, poorly trained human resources, a reactive mentality by society, low salaries for police, increased consumption of alcohol and drugs (especially among youth), indifference among the agents of change and crisis of family and values, all of this occurring within a constructive political climate.

The CATWOE analysis for the consensual problem-oriented root definition produced the following findings:

- Clients (C): *Beneficaries*: private agencies, suppliers of security technologies, corrupt judges, corrupt policemen, mass media organizations, drug dealers, organized crime, lawyers, businessmen, security-oriented educational system, construction companies, criminals. *Victims*: Population without the power to change the real world, crime victims, next generations (children), government, honest policemen, honest judges, political party in power, Mendoza Province government officials, penal system, families.
- Actors (A): Criminals, organized crime, provincial police, corrupt judges, drug dealers, chambers of crime high-level Mendoza Province government officials, crime victims, businesspeople, media organizations, educational system and the penal system.
- Transformation (T):

- *Weltanschauung* (W): Increasing citizen insecurity and the sensation of insecurity is convenient for the enhancement of impunity in Mendoza Province.

[14] Chambers of Crime are tribunals in the Argentinean Justice System in charge of carrying out criminal processes of those who have committed a crime.

Owners (O): Governor, security minister, security sub-secretary, legislative branch, judicial budget office chief, judges, public prosecutors, organized crime, criminals, drug dealers, crime chambers, businesspeople, media, and security-oriented educational organizations.

- Environment (E): Crisis of solidarity, economic recession, pessimism in the population, collapse of the educational system, poor budget allocation, poorly trained personnel, reactive mentality of population, low police salaries, drug consumption among youth, indifference by agents of change, family crisis, and constructive political climate.

Next, we focus on the benefits that the transformation process offers to problem owners in order to determine why they are interested in maintaining the transformation process (i.e., increase citizen insecurity and the sensation of insecurity in Mendoza Province):

- Criminals: High incomes from illegal activities
- Drug dealers and organized crime: Higher incomes, power, and influence through increased corruption and impunity
- Businesspeople: Evade punishment, weaken forces of control, facilitate the commission of crimes within the sector, and displace possible competitors
- Media organizations: Increased income, power and influence
- Government: Evade punishment for violating the law, dilute responsibility, gain time and preserve the benefits of corruption
- Legislative power: Greater political prominence
- Governor: More viability for his or her government and further deals with the opposition, increasing the possibility of agreements
- Minister and sub-secretary: Possibility of justifying budget increase
- Educational organizations: Higher budget allocation; more earnings; additional demand, scientific activities and careers.

It can be seen that many problem owners gain from the transformation process, which increases the interest in not changing the situation prevailing in Mendoza Province concerning citizen insecurity and the sensation of insecurity.

Stage 4: Problem-Oriented Conceptual Models, SD Context Diagrams and SD Models

Problem-Oriented Conceptual Model

The stage after obtaining and validating the consensual problem-oriented root definition involves developing the problem-oriented conceptual model, the problem-oriented context diagram, the problem-oriented causal loop diagrams (CLDs) and problem-oriented SD models that make up the mentioned Context Diagram of the problematic situation under study.

A problem-oriented conceptual model is the epistemological description (i.e., a set of minimum and necessary, logically linked activities) of how to implement the transformation process established by a problem-oriented root definition. In the present case, the transformation process defined by a consensual problem-oriented root definition was "to increase the insecurity and sensation of insecurity in Mendoza Province" (see the transformation process in the CATWOE analysis, above). The activities indicated in the conceptual model (see Fig. 16) are the minimum and necessary activities required in a logical sequence to implement the problem-oriented transformation process.

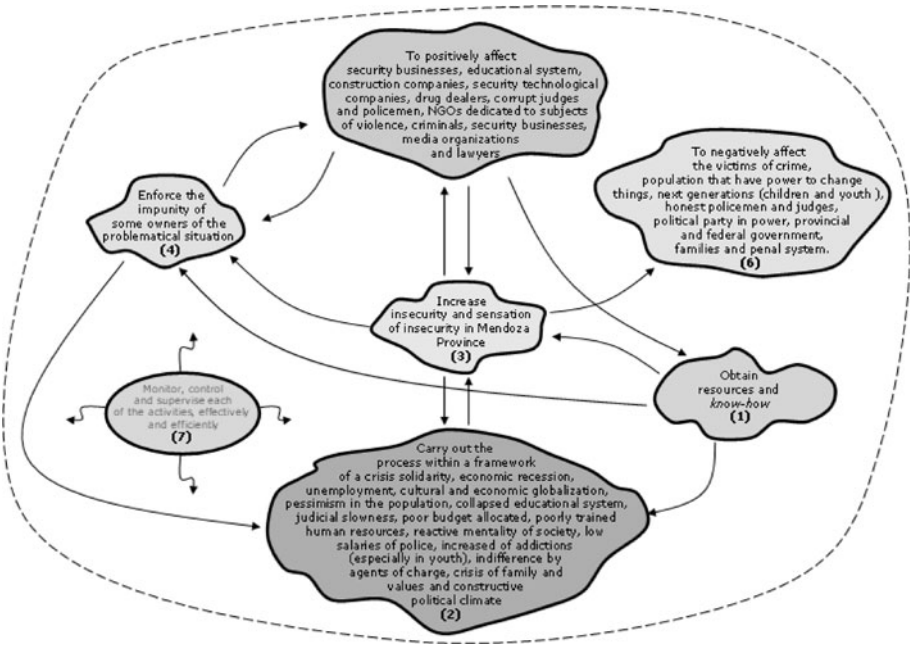


Fig. 16 Problem oriented conceptual model from the consensual problem-oriented root definition on citizen insecurity in Province of Mendoza, Argentina

Consensual Problem-Oriented Context Diagram

The next step involves deriving a consensual problem-oriented context diagram from the consensual problem-oriented conceptual model, which—it is important to remember—is derived from a specific consensual problem-oriented root definition as explained in the previous paragraph. For each module of the consensual problem-oriented context diagram, we can obtain problem-oriented CLDs,[15] permitting the construction of SD models in line with the chosen W under which the problematic situation is being studied. With the mentioned problem-oriented SD models being completed for all modules of the consensual problem-oriented context diagram, it is possible to build up a consensual problem-oriented dynamic balanced scorecard (Ballvé 2000; Bianchi and Montemaggiore 2006; Hassan 2009; Hassan et al. 2007; Kaplan and Norton 1992, 1996a, b, 1997; Olve et al. 1999; Rodríguez-Ulloa 2006) in which final users (decision makers) can use the problem-oriented consensual dynamic balanced scorecard to manage the model in a user-friendly way to simulate the problem situations of insecurity in Mendoza Province. After the overall consensual problem-oriented SD model was completed, it went through a process of calibration. The process implied validating the model by contrasting it with a panel of experts and against concrete "expected" numbers and outcomes obtainable through time in the topics under analysis.

Following SSDM, as previously discussed, the consensual problem-oriented context diagram arises from the consensual problem-oriented conceptual model, which is also based on the consensual problem-oriented root definition (see "Stage 3: Problem-Oriented Root

[15] CLD: Causal Loop Diagram.

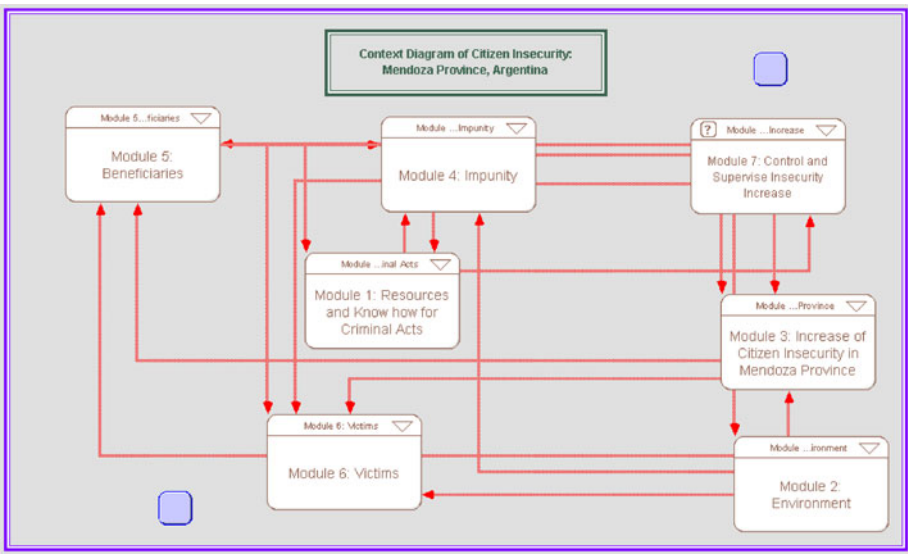


Fig. 17 Problem-oriented context diagram of the citizen insecurity problem of Province of Mendoza, Argentina

Definitions" section). The activities established in the conceptual model (see Fig. 16) are the basis of the problem-oriented context diagram of the problematic situation (see Fig. 17).

For each human activity system in the consensual problem-oriented conceptual model, there is a module in the consensual problem-oriented context diagram. In the present case, the problem-oriented context diagram includes seven modules that interact systemically. Each is developed at the next resolution level, which requires elucidation through SD CLDs (Sterman 2000; Ford 1999), module by module, until their systemic causal integration based on a consensual W.

The problem-oriented context diagram containing the seven problem-oriented modules is shown in Fig. 17.

Module 1: Resources and Know-How to Commit Criminal Acts This module involves the study of the behavior and structure of resources and know-how for committing criminal acts in Mendoza Province. The resources considered in this module are: buildings, means of transportation, cellular phones, computers, internet networks and the human resources required to commit crimes. A general CLD of this module appears in Fig. 18.

Module 2: Environment (Conditions Under Which the Transformation Process is Conducted) Figure 19 illustrates the CLDs relationships that explain the environment in which the problem situation of insecurity in Mendoza Province emerges. This module considers variables like the economic crisis affecting Mendoza Province, unemployment, poverty, educational crisis, indifference among the agents of change, political and social climate, crisis of values, drug addiction, family crisis, pessimism in the population, poor education and slowness in the administration of justice.

Module 3: Increase of Citizen Insecurity in Mendoza Province Module 3 is concerned with the increase in citizen insecurity in Mendoza Province. Some of the variables considered in this module are the prison population, the movement of prisoners in and out of jails, the number of jails, the number of prisoners per jail, the breakdown of moral values

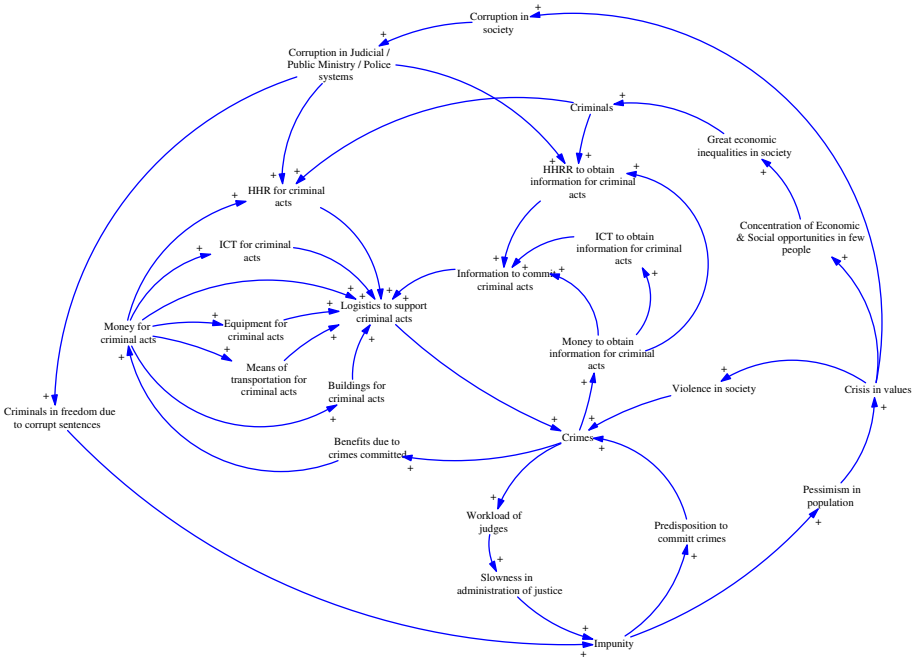


Fig. 18 CLD of Module 1: resources and know how to commit criminal acts

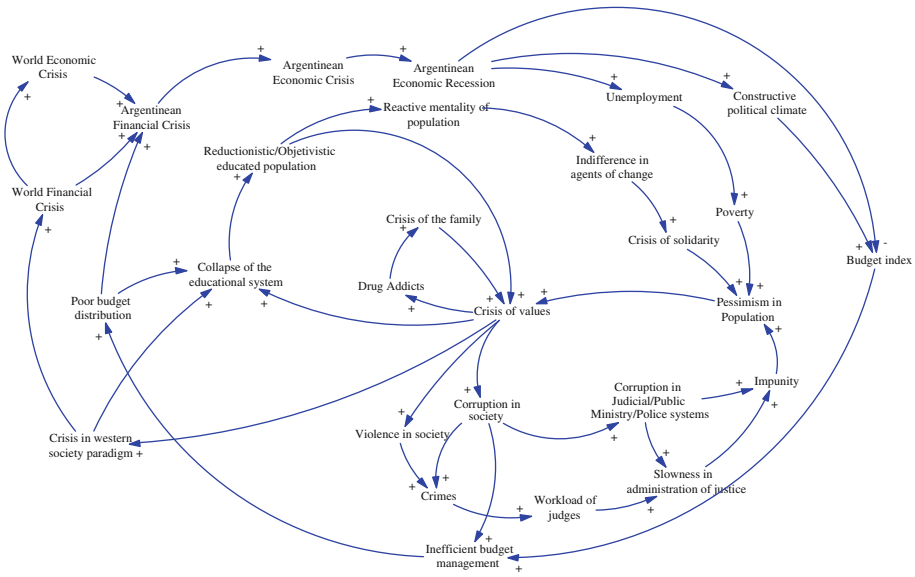


Fig. 19 CLD of Module 2: environment

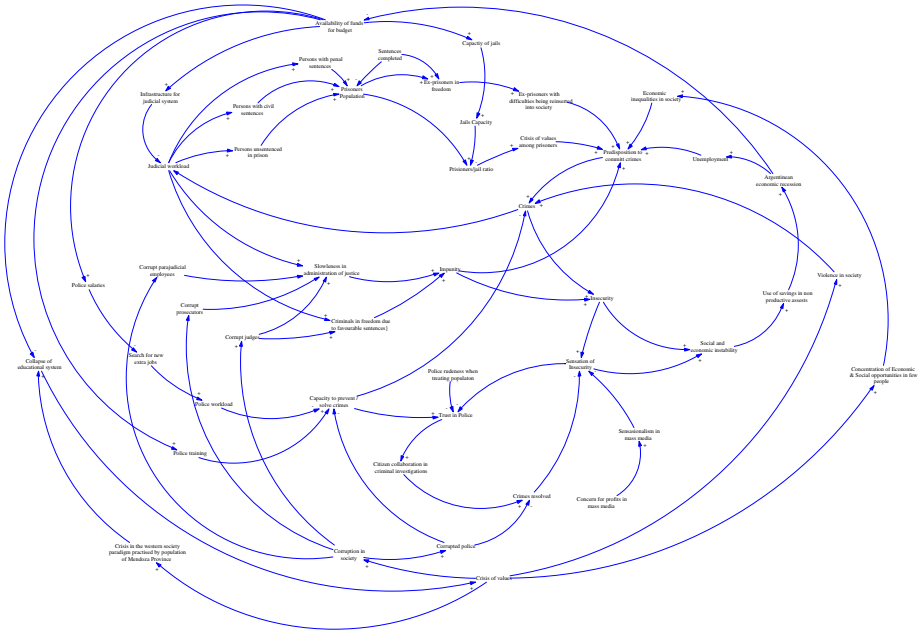


Fig. 20 CLD of Module 3: increment of citizen insecurity in Province of Mendoza, Argentina

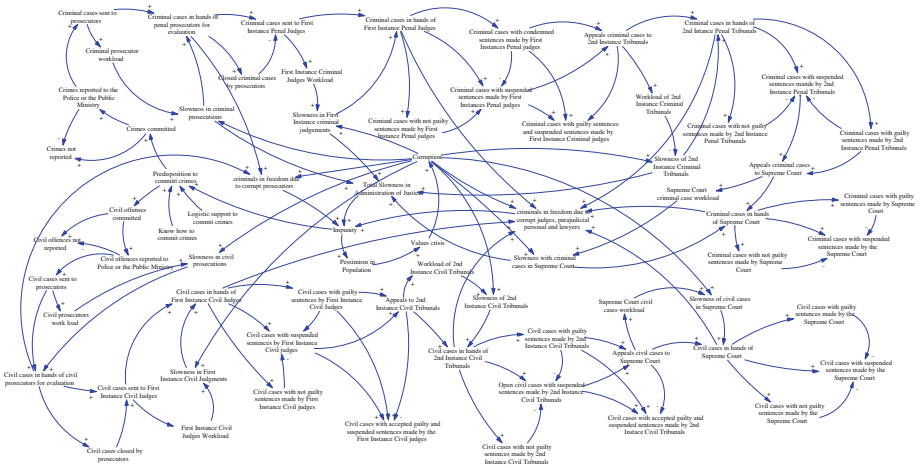


Fig. 21 CLD of Module 4: impunity

of prisoners, the number of crimes, mass media sensationalism, trust in the police and police work overload. Figure 20 shows a general CLD of Module 3.

Module 4: Impunity This module is related to the impunity of the system of insecurity in Mendoza Province. One of the main variables of this module is the criminal acts committed in Mendoza Province. Thus the variables are in civil and penal judicial processes in order to observe the stages in which impunity exists in these processes. Variables in all the stages of penal and civil processes where impunity may appear are taken into consideration in this module. Figure 21 shows a general CLD of Module 4.

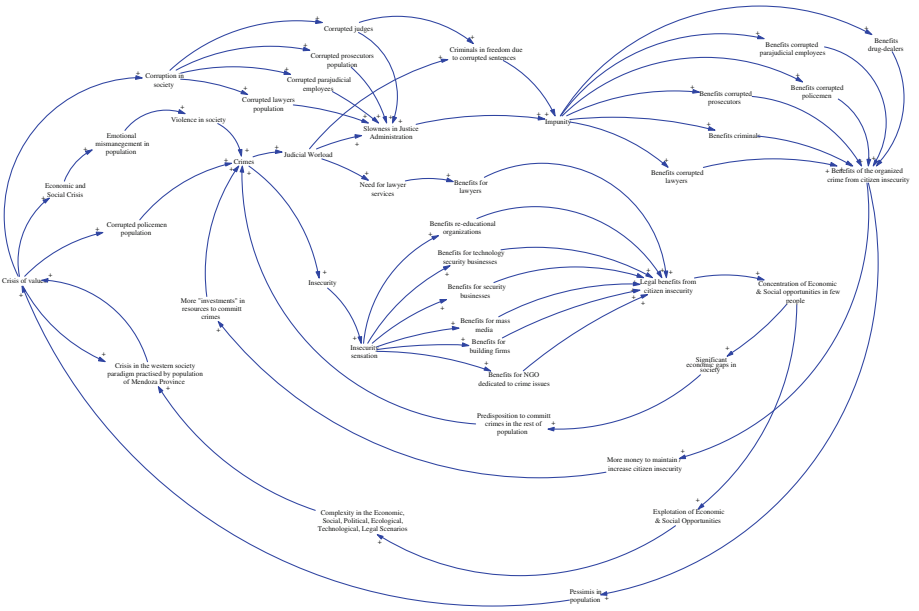


Fig. 22 CLD of Module 5: beneficiaries of the citizen insecurity problem

Module 5: Beneficiaries (who are the Winners and how much do they win) This module is related to the beneficiaries of the system of insecurity in Mendoza Province. It involves analyzing the direct and indirect beneficiaries of the system of citizen insecurity and measuring their benefits over time. The CLDs shown in Fig. 22 explain how much the gains of the beneficiaries are a part of the system of citizen insecurity in Mendoza Province.

Module 6: Victims This module involves counting and analyzing the direct and indirect victims of the system of citizen insecurity in Mendoza Province over time. Figure 23 shows a general CLD of Module 6.

Module 7: Control and Supervision of the Increase of Insecurity The structure of this module is related to the control and supervision of the increase in insecurity in the system of insecurity in Mendoza Province. The module includes an analysis of the variables that contribute to controlling, supervising, and preserving the increase of insecurity and the sensation of insecurity in the system of citizen insecurity in Mendoza Province. Figure 24 shows a general CLD of the intervening variables in Module 7.

Problem-Oriented Causal Diagrams

The next step is the development of problem-oriented CLDs to describe in causal terms the problem situation in each module of the problem-oriented context diagram shown in Fig. 17. Each of the modules reflects a respective problem-oriented CLD. The problem-oriented diagrams are the result of meetings with owners, clients and actors, as well as with members of the CEGESCO study group in Mendoza City. According to the problem-oriented context diagram, there were seven modules of problem-oriented CLDs. As mentioned previously, versions of the CLDs of these modules are shown in Figs. 18, 19, 20, 21, 22, 23 and 24.

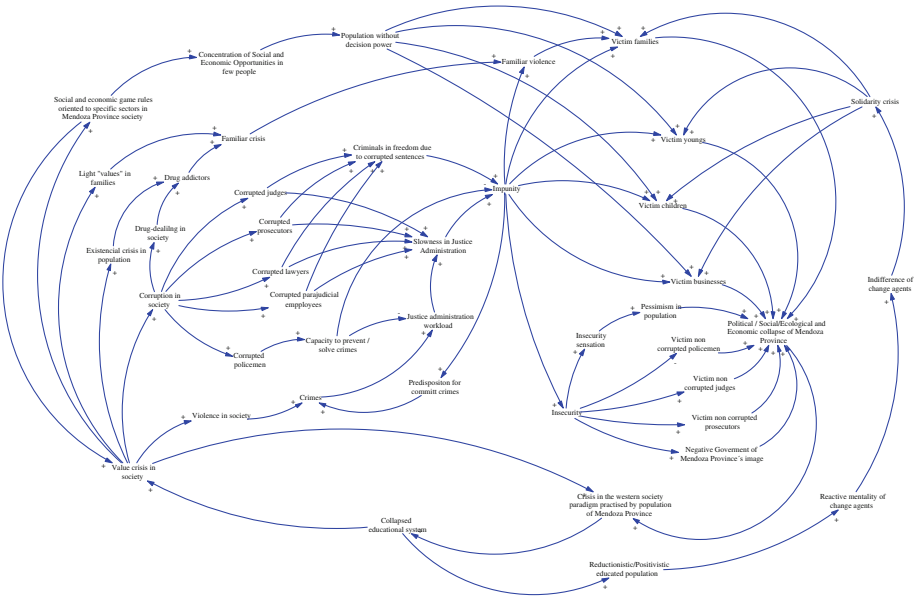


Fig. 23 CLD of Module 6: victims of citizen insecurity problem

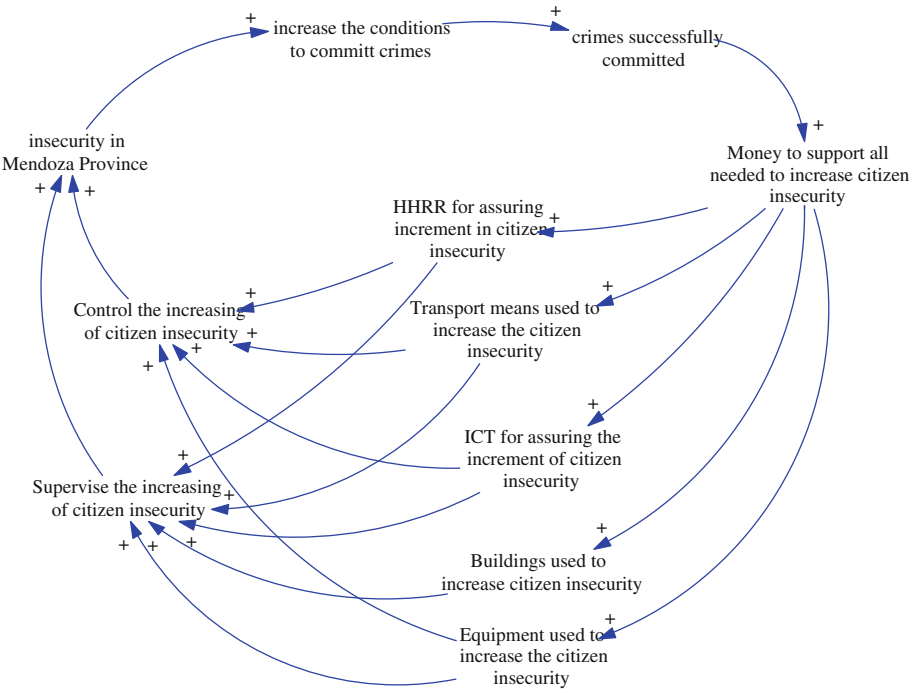


Fig. 24 CLD of Module 7: mechanisms to control and supervise citizen insecurity increment

Problem-Oriented System Dynamics Models

This refers the reader to specific problem-oriented SD diagrams (i.e., Forrester diagrams) on the problem of citizen insecurity in this section, which were derived from the problem-oriented CLDs shown in "Problem-Oriented Causal Diagrams" section. They were conducted for each module, but for reasons of brevity, are not shown here.

Stage 5: Validating Problem-Oriented Conceptual Model, Context Diagram, CLDs and SD Models Versus the Real World (Stage 4 vs. Stage 2)

This stage includes validating the problem-oriented consensual conceptual model, context diagram, CLDs and SD models. Validation involved the participation of a panel of experts from CEGESCO and stakeholders in the system of insecurity in Mendoza Province, such as the police, judges, social workers, physicians, psychologists, sociologists, lawyers, politicians, and victims, with whom each SD model was discussed, module by module. The consultation resulted in the need to make several changes and adjustments to some of the model's variables and/or their initial values. Modifications of some problem-oriented causal relationships were also made in most of the modules.

The points of view and impressions of the experts and stakeholders helped to refine the conceptualization of the SD models and validate the information so that, in the end, there was a problem-oriented dynamic balanced scorecard. An screenshot of it is shown in Fig. 25.

Stage 6: Systemically Desirable and Culturally Feasible Changes

From the dialogue with stakeholders, several interesting points of view surfaced. It was important, then, to look for desirable and feasible changes to improve the problematic situation, determining the evolution of changes over time and their impact on the behavior

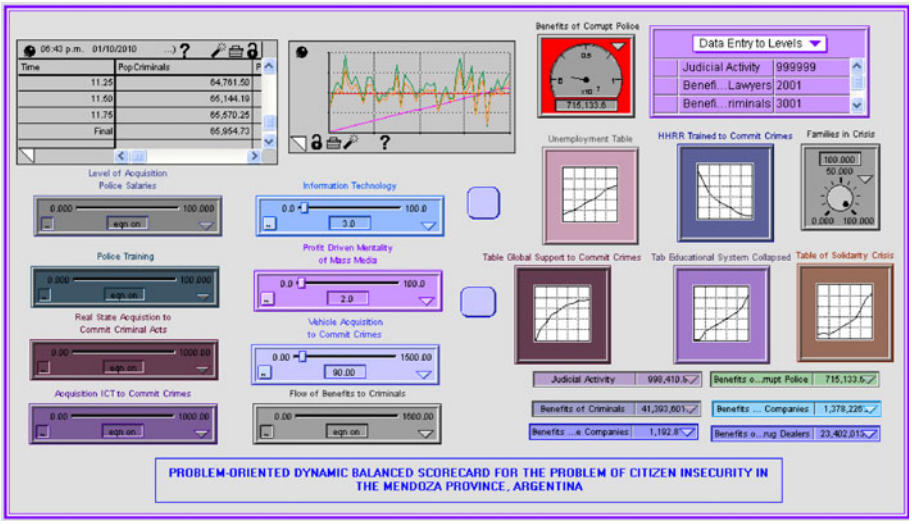


Fig. 25 Problem-oriented dynamic balanced scorecard for the citizen insecurity problem in the Province of Mendoza, Argentina

of the problematic situation. These changes must be culturally desirable and systemically feasible in order to improve the problem situation. The main changes stakeholders considered were crucial to the modification of the behavior of the problem-oriented SD model as a whole. Changes were as follows:

- Increase police salaries to avoid police corruption.
- Implement a training program to improve the effectiveness of the police.
- Improve the information technology of the police to ensure effectiveness.

Moreover, stakeholders also identified several variables they believed might play an important role in maintaining or increasing citizen insecurity in Mendoza Province. To solve the problem, the province needed to reduce or eliminate these variables. The variables discussed included the following:

- The buildings the criminal groups had acquired to commit criminal acts (infrastructure)
- The economic orientation and sensationalist mentality of the mass media as a result of the propagation of negative information among communities, creating a climate of insecurity in the population
- The vehicles used by criminals to commit criminal acts in Mendoza Province
- The inflow of benefits for criminals from criminal acts committed.

The problem-oriented system dynamics model included considerations of all these variables to examine their impact on the behavior of the overall problem situation, which will need to look for viable policies to be implanted in the problematic situation in order to "align" or "improve" it.

Stage 7: Solving-Oriented System Dynamics Models

From the consensual problem-oriented SD model and the consensual problem-oriented dynamic balanced scorecard, a solving-oriented system dynamics model and a consensual solving-oriented dynamic balanced scorecard emerged. In this section, we refer the reader to several figures that compare the behavior of several important variables of the problem-oriented SD model of the problematic situation with the same variables in the solving-oriented SD model in order to observe the improvements that can be implemented in the overall model, arriving in this manner to a solving-oriented proposal in this complex situation, making for this some decisions concerning the three variables examined in the problematic situation, previously discussed in "Stage 6: Systemically Desirable and Culturally Feasible Changes" section.

(a) Policies concerning the Police The first policy was increasing police salaries to avoid police corruption, which involved increasing the budget for the police. The measure was culturally feasible and systemically desirable because the government of Mendoza had sufficient funds to assign the amount required by the police to increase their salaries. The police budget increased by approximately 25%, as depicted in Figs. 26 and 27.

The second policy was to implement a training program to improve the effectiveness of the police. The measure involved increasing the budget assigned to the police to develop a training program. An increase of 15% of the current budget went to the training program.

The third policy was to improve the information technology available to the police. Toward this goal, the police received the information technology seized from criminals. In addition, a budget increase of about 10% was allocated to improve the information technology capacity of the police.

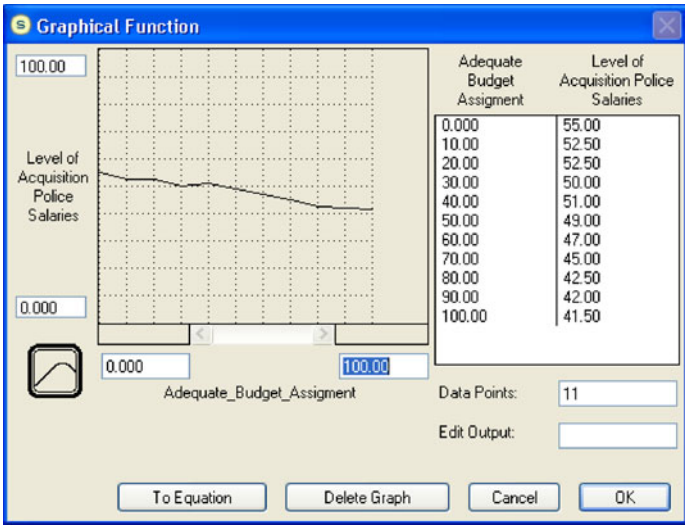


Fig. 26 Problem-oriented situation: negative increase in the level of acquisition of police salaries in relation to budget assigned

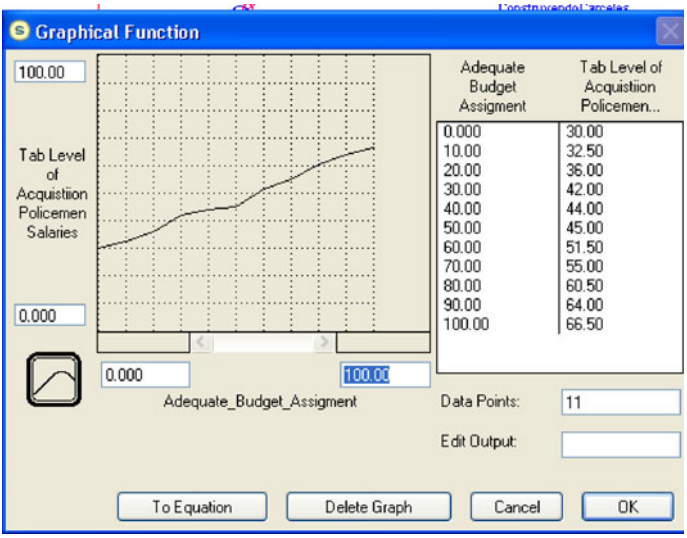


Fig. 27 Solving-oriented situation: positive increase in the level of acquisition of police salaries in relation to assigned budges

(b) Policies to diminish insecurity in Mendoza Province Parallel to the previous policies, the province implemented policies to diminish the value of the variables contributing to the increase in citizen insecurity in Mendoza. A summary of actions taken for each variable follows.

The first policy is related to the number of buildings that criminal groups use as logistical support (infrastructure) to commit criminal acts. Under the policy to decrease the stock of buildings in the hands of criminals, it was suggested to implement a control and

follow-up procedure for people acquiring properties around Mendoza Province. The measure would permit the discovery of inappropriate use of buildings by the sector of the population that supports criminal acts.

However, to decrease the rate at which criminals acquire buildings, it would be necessary to decrease the money dedicated to acquiring buildings for committing crimes from 60% of the total amount of money for committing crimes to 30% (a 50% decrease). Experts believed the action could be culturally feasible and systemically desirable because information on the sale of buildings is available in public registries, and the police could increase their control over informal financial transactions in Mendoza Province.

An additional policy should be to decrease the know-how of criminals on committing criminal acts, to reduce the amount of money obtained from committing criminal acts.

To decrease the incidence of punishable acts, one would need to decrease the global rate that contributes to the increase in punishable acts in Mendoza Province. This requires decreases in the rates of three aspects that contribute to the formation of the global rate for the occurrence of punishable acts: (a) know-how on committing criminal acts, (b) crime impunity, and (c) logistical support. Decrease in these three aspects is culturally feasible and systemically desirable because the main owners (police, justice system, and the government of Mendoza) have the power to implement such changes over other problem owners.

The third policy is related to the economic and sensationalist mentality of the mass media, which results in the propagation of negative information among communities, creating a climate of insecurity in the population. To change the mentality of the directors of the mass media, it was suggested to initiate communication and agreement on the sale of advertisements from the government of Mendoza Province in a reverse relationship to the sensationalism of news in the mass media. Thus mass media that treat crime in a sensationalist manner will not receive a quota of advertisements from the government in their periodicals.

In terms of the SD model, the measure relates to diminishing the propaganda budget to mass media that sensationalize citizen insecurity in Mendoza Province (see Figs. 28, 29).

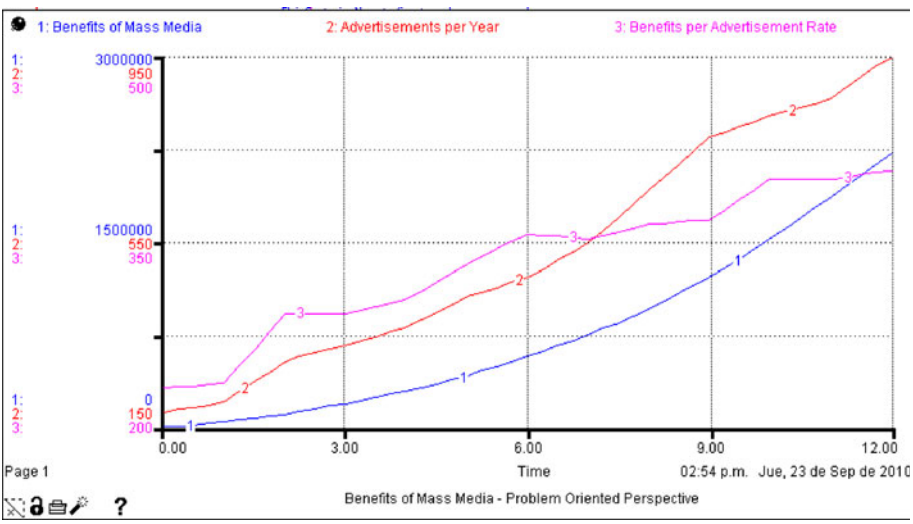


Fig. 28 Problem-oriented situation: increase in the benefits of mass media that contribute to increase the sensation of insecurity in the Province of Mendoza, Argentina

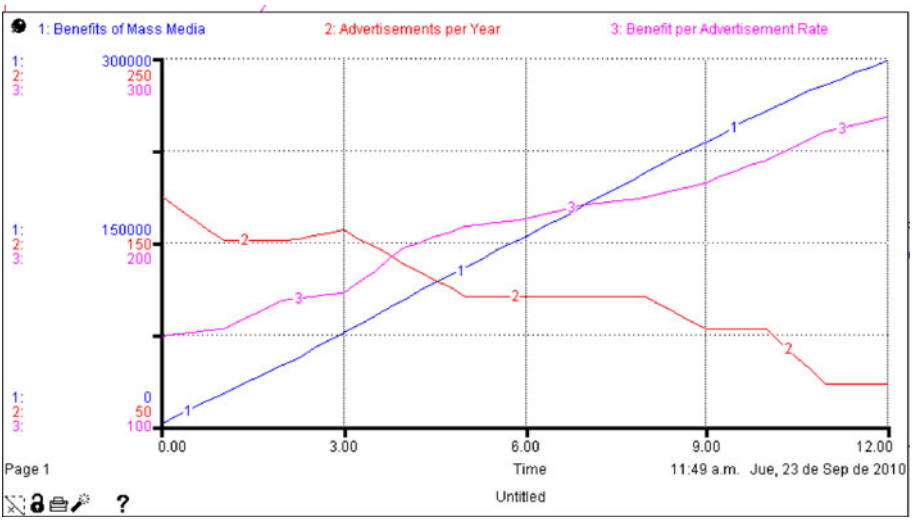


Fig. 29 Solving-oriented situation: increase in the benefits of mass media that contribute to increase the sensation of insecurity in the Province of Mendoza, Argentina

The figures illustrate a drastic reduction in the future budget for propaganda in sensationalist media. The table of advertisements also reflects a reduction over time. This measure should cause a reduction in the sensation of insecurity among the population of Mendoza Province.

The fourth policy is related to the vehicles used by criminals to commit criminal acts in Mendoza Province. To decrease means of transport in the hands of criminals, the government of Mendoza should diminish the informal commerce in vehicles in the province and increase in the control of vehicle theft.

The fourth policy is related to the benefits criminals receive for committing criminal acts. To limit the illegal income of criminals, police must reduce the rate of bank robberies and drug dealing in Mendoza Province. To achieve this task, police must receive a good salary, have access to excellent information technology, and receive effective training. These measures will aid in reducing benefits to corrupt people (see Figs. 30, 31).

The solving-oriented SD model adopted all of the measures discussed in this section, expressed in the consensual solving-oriented dynamic balanced scorecard. The measures changed the course of behavior of the social system under study and improved its overall behavior. These measures were meant to be applied in the real-world. See Fig. 32.

Step 8: Solving-Oriented Consensual Root Definition

After obtaining the consensual solving-oriented SD model, the next stage was to use it to generate a consensual solving-oriented root definition: "A human activity system (HAS)—belonging to the provincial government, the legislative branch, the judicial branch, organized crime, drug dealers, common criminals, the educational system, Chambers of Crime, media organizations, and businesspeople—that increases the security and the sensation of security in Mendoza Province to strengthen the punishment of some owners of the problem situation. The system negatively affects security businesses, security educational systems,

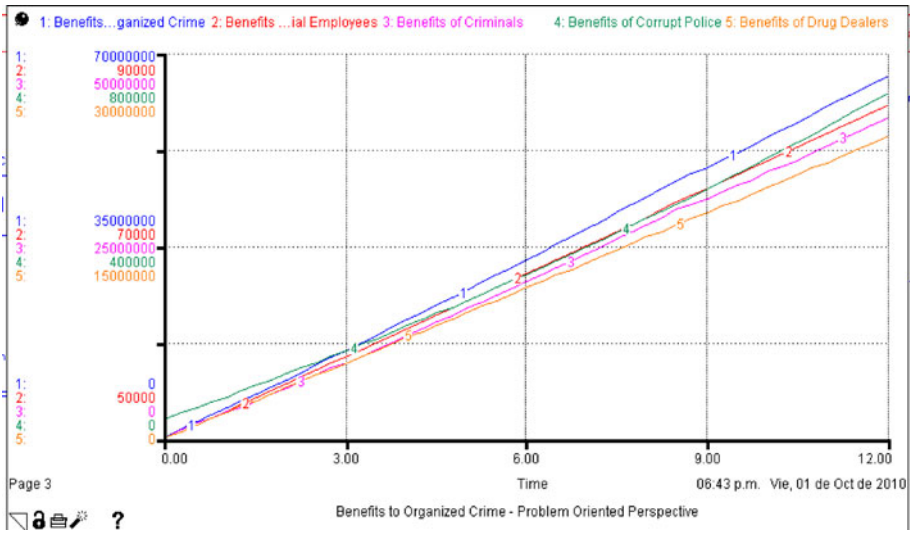


Fig. 30 Problem-oriented situation: trends in benefits to organized crime due to citizen insecurity in the Province of Mendoza, Argentina

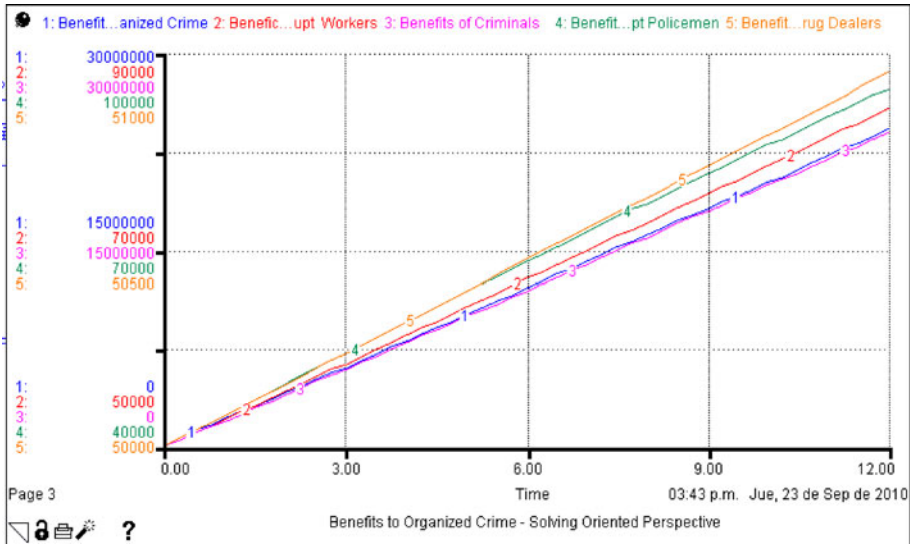


Fig. 31 Solving-oriented situation: lesser benefits trends of the organized crime due to citizen insecurity in Province of Mendoza, Argentina

construction companies, security technology businesses, drug dealers, corrupt judges and police, non-governmental organizations dedicated to attending to issues surrounding violence, common criminals, insurance businesses, media and lawyers. The system positively affects crime victims, the population that does not have the power to change the situation, future generations (children and youth), honest police and judges, the ruling political party, the provincial and federal government, the penal system, and families. The process occurs

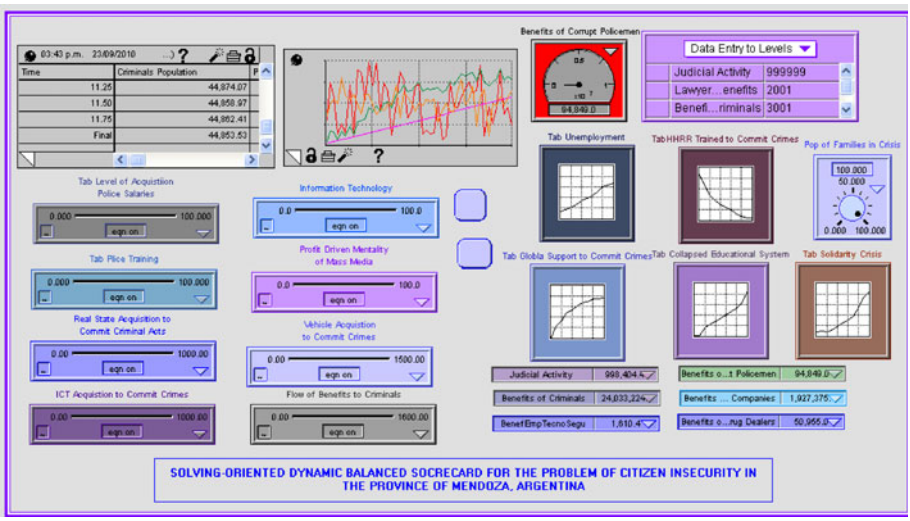
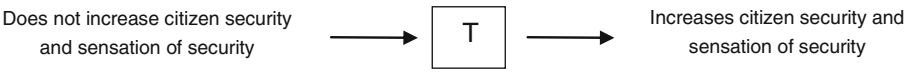


Fig. 32 Solving-oriented dynamic balanced scorecard for the problem of citizen insecurity in the Province of Mendoza, Argentina

within a climate of crisis of solidarity, economic recession, pessimism in the population, cultural and economic globalization, financial and economic crisis, collapse in the educational system, slowness of the judicial process, poor budget allocation, poorly trained human resources, reactive mentality of society, low police salaries, increased consumption of alcohol and drugs (especially among youth), indifference in the agents of change, crisis in values and the family, and a constructive political climate."

The CATWOE analysis for the consensual solving-oriented root definition produced the following findings:

- Clients (C): *Beneficiaries*: Crime victims, population that does not have the power to change the real world, future generations (children and youth), government, honest police and judges, political party in power, governors, ministers and secretaries, penal system, and families. *Victims*: private security agencies, suppliers of security technology, corrupt judges, mass media organizations, drug dealers, organized crime, lawyers, businessmen, security-oriented education system, construction companies, criminals, security companies, NGOs dedicated to the support of victims of crime and violence.
- Actors (A): Criminals, organized crime, provincial police, honest police and judges, drug dealers, Chambers of Crime, governor, minister, subsecretary, crime victims, businesspeople, media organizations, educational system, and penal system
- Transformation (T):



- *Weltanschauung* (W): Increasing citizen security and the sensation of security is beneficial to the wellbeing of society in Mendoza Province

- Owners (O): Governor, security minister, security sub-secretary, legislative branch, judge in charge of the budget, judges, prosecutors, organized crime, criminals, drug dealers, Chambers of Crime, businesspeople, media, and educational organizations
- Environment (E): Crisis of solidarity, economic recession, pessimism in the population, collapse of the educational system, poor budget allocation, poorly trained personnel, reactive mentality of the population, low police salaries, drug consumption among youth, indifference by agents of change, crisis of the family, and constructive political climate.

Next, we focus on the benefits/losses that the transformation process offers to problem owners to determine why the owners would be interested in maintaining the transformation process (i.e., increased citizen security and the sensation of security in Mendoza Province):

- Criminals: Low illegal incomes
- Drug dealers or organized crime: Low incomes, power, and influence due to the decrease in corruption and impunity
- Businesspeople: Enforced punishment, strengthened forces of control, hindered commission of crimes in the sector, and encourage competitors to open more businesses
- Media organizations: Decreased incomes from crime news, decreased power of the press to influence people on crime issues and increased dedication to more relevant issues
- Government: Improved image in the public eye due to an increase in the quality of management of the citizen security problem
- Legislative branch: Increased popularity as political protagonist
- Governor: More viability of his/her government and further deals with the opposition, increasing the possibility of agreements
- Minister and sub-secretary: Possibility of justifying an increase in the budget to improve security for society
- Educational organizations: Higher budget allocation, more revenue, higher demand, further scientific activities, and additional careers related to social development

It can be seen that many problem owners gain from this transformation process, which justifies the interest in changing the prevailing situation in Mendoza Province concerning citizen insecurity and the sensation of insecurity. There are losers as well, however, which in the future may have the power to reverse this transformation process. Depending on the progress in this power struggle among the problem-owners of this problematic-situation, new problematic scenarios on this issue will appear in Mendoza Province.

Stage 9: Implementing Desirable and Feasible Changes: An Action Plan

Taking into account the changes established in the solving-oriented SD model, this stage involves the development of an action plan to implement the changes in the real world. The action plan is as follows:

(a) Increase police salaries (duration: 2 months) To be developed during 1st and 2nd months of the action plan.

(b) A police training program (duration: 5 months) Program must cover a variety of subjects concerning values and technical and security issues; starting in the first month.

(c) Improve the information technology of the police (duration: 6 months) A technology training program and the provision of the required technological equipments to improve police intelligence activities, starting in the first month.

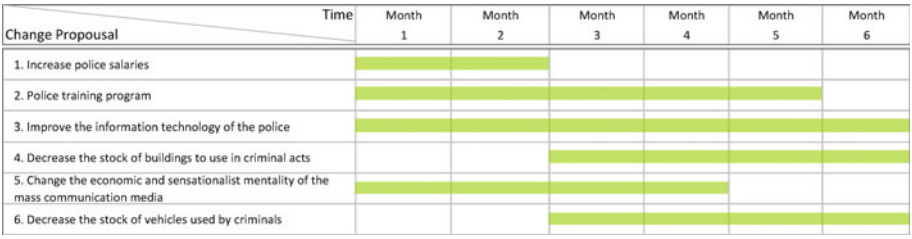


Fig. 33 Gantt chart of the activities needed to implement in order to "improve" the problematic situation on the citizen insecurity problem in Province of Mendoza, Argentina

(d) Decrease the stock of buildings to use in criminal acts (duration: 4 months) Aiming to limit the amount of buildings criminals have for their use. Starting in the third month.

(e) Change the economic and sensationalist mentality of the mass communication media (duration: 4 months) Implementation of an action plan in order to change the economic and sensationalist mentality of the mass communication media, using the budget assigned to mass media advertising to influence mass media to improve its management of the sensation of insecurity. The activity should start in the first month.

(f) Decrease the stock of vehicles used by criminals (duration: 4 months) This activity aims to decrease criminal activity by decreasing the stock of vehicles used by criminals. This activity should start in the third month of the action plan. Figure 33 shows a Gantt diagram of the Action Plan.

Stage 10: Lessons Learned

Several lessons were learned from this experience that pertain to citizen security issues and the use of SSDM. Lessons learned on citizen security issues include the following:

- Citizen insecurity is a complex problem that requires examination from a systemic perspective to capture the quantitative and qualitative factors of different worldviews, variables and interrelationships.
- After doing the present research work and understanding the complexity and the intricacies of how different "hard" and "soft" variables are interrelated for the emergence of the citizen insecurity problematic situation in Mendoza Province, the researchers are more convinced than before that this issue will become one of the most challenging problems in next decades for mankind unless leaders and governments begin now to study the problem from a systemic perspective.
- Little research exists on the problem of citizen insecurity, so building an information database will be needed in order to develop precise models in line with the model discussed in this paper.
- Improvements and changes to social systems proposed for the problem of citizen insecurity must be culturally feasible and systemically desirable.
- Training the police will be an important factor in remedying the problem of citizen insecurity.
- The police and the judicial system budgets need to be increased drastically to improve the multiple inefficiencies of these two important State organisms. Police require the latest information technology to manage a complex situation like the problem of citizen insecurity. Information technology should become the strategic tool that enables the police to deal with this complex problem.

- To reduce criminal acts, societies need to decrease the assets of criminals, usually registered under false names or entities. The government needs to maintain adequate control over the registration and transfer of property (buildings and vehicles).
- The mass media need to change their presentation of the news in order to contribute to a favorable climate for a remedy of the issues of insecurity in society. The mass media must become allies in the fight against citizen insecurity.
- It is important to establish new methods of control of the financial flows in the informal sector.
- Impunity is a key variable highly related to corruption, thus corruption in State organizations must be eliminated. A systemic approach is needed for it.

Lessons learned in the use of SSDM include the following:

- Consultants require in-depth training in all its steps in order to use SSDM correctly and thus avoid problems. Consultants must be very familiar with SSM as well as with SD.
- Defining the stakeholders (owners, actors, and clients) of the problematic situation is important for the proposal of culturally feasible and systemically desirable changes.
- In the SSDM, it is essential to consider the relationship between the problem-oriented root definition (during Stage 3) and the solving-oriented root definition (Step 8). Usually, but not always, the solving-oriented root definition indicates the transformation process, as opposed to that established as a process of transformation in the problem-oriented root definition. As the transformation process is expressed by a transitive verb, then the verb of the solving-oriented root definition should have the opposite meaning (e.g., the opposite action) to the action expressed by the verb contained in the problem-oriented root definition. So what SSDM does, precisely, is to reverse the problematic situation found and expressed in a problem-oriented root definition.
- Another point that deserves attention in SSDM is the relationship between two kinds of models: the conceptual model derived from the problem-oriented root definition and the problem-oriented context diagram obtained from the problem-oriented conceptual model. The relationship is evident in the way that the problem-oriented conceptual model provides the framework to devise the problem-oriented context diagram. This serves to define the reference system and the relevant environment of the focus of the problematic situation and their interrelationships. The problem-oriented context diagram sets its modules in accordance with the problem-oriented conceptual model, serving as the basis for deriving the problem-oriented SD models for each of the problem-oriented diagram context modules. This is considering only one W. Remember that SSDM can derive as many problem-oriented root definitions–problem oriented conceptual models–problem oriented context diagrams–problem oriented SD models (this from each module of the problem oriented context diagram)—as the different Ws of the stakeholders (owners, clients and actors of the problem situation). We can argue that this makes a fundamental difference in the use of SSDM from the usual use of the SD approach.
- The final lesson learned concerns the solving-oriented root definition, derived from the changes made at the level of the solving-oriented SD models, comprising each of the modules of the solving-oriented context diagram (Stage 7). Thus the solving-oriented root definition involves capturing the changes made in the system dynamics models and considering the aspects that make the solving-oriented transformational process viable to implement in the real world. To do that, one must obtain the respective solving-oriented conceptual model from the solving-oriented context diagram, which can clarify the linguistic structure of the solving-oriented root definition conducted at Stage 8 of SSDM.

Further Research

More research is required in SSDM to set up formal processes for obtaining consensus on the definition of the problematic situation. This applies to obtaining a consensual problem-oriented root definition and to proposing solutions for the problem content system expressed in a consensual solving-oriented root definition, following the path of Wilson (1984, 2000) in what he calls as the Issue Based and Primary Task Analysis.

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