

# Mexico's Cartel Problem: A Systems Thinking Perspective

Sibel McGee, Ph.D., Michael Joel, Robert Edson

Applied Systems Thinking Institute, Analytic Services, Inc.,  
2900 S Quincy Street, Suite 800, Arlington, VA 22206

[Sibel.McGee@anser.org](mailto:Sibel.McGee@anser.org); [Michael.Joel@anser.org](mailto:Michael.Joel@anser.org); [Robert.Edson@anser.org](mailto:Robert.Edson@anser.org)

## Abstract

The unprecedented increase in recent years of cartel-related violence has presented growing challenges both to Mexico's socio-political stability and to the United States' (US) National interests. Current efforts to address Mexican cartels treat these organizations as only drug-trafficking networks and focus on law enforcement measures to interdict their operations. In this paper, we approach the cartel problem from a systems thinking perspective and present a holistic assessment of these complex criminal networks operating in multiple domains. By highlighting the dynamic relationships and complex feedbacks between critical variables involved in different domains of cartel operations, we identify the inherently systemic causal factors contributing to the problem situation. We argue that the efforts that rely purely on law enforcement measures will fail to produce lasting change unless they are coupled with high leverage strategies that address the root causes of illicit activities in Mexico.

## Introduction

Beginning in December 2006 with the Mexican government's crackdown operations, Mexican cartels have escalated in violence as they fight government forces and each other for survival. Many sources report members or supporters of these criminal organizations have infiltrated major areas of public service (particularly the Mexican police force) and allegedly have established links with significant Mexican political and business entities (GAO 2007). With the growing power of cartels, Mexico has emerged as "a major drug producing and transit country" (Cook 2007, 2). Furthermore, over the last decade, Mexican cartels "are... branching out into other businesses within Mexico and on the US-Mexico border...developing into illicit multinational conglomerates" (O'Neil 2010). In addition to trading narcotics, Mexican cartels are now involved in trafficking illegal immigrants into the US, and smuggling drug profits and weapons out of the US into Mexico. Cartels are also increasingly involved in activities such as kidnapping and extortion (Finklea et al 2011). A GAO (2010) report estimates between \$18 billion and \$39 billion in drug sales is smuggled into Mexico each year. This contraband revenue in turn facilitates the acquiring of weapons and other means necessary to sustain narcotic trade.<sup>1</sup>

---

<sup>1</sup> Many of the weapons used in cartel violence are illicitly trafficked from the United States across the Southwest border (GAO 2009a).

Mexican cartels have led to some alarming trends in various areas. The U.S. Joint Forces Command's Joint Operating Environment (USJFC 2008) report cited Mexico, next to Pakistan, as being in danger of rapid and sudden collapse. Accordingly, "Mexican government, its politicians, police and judicial infrastructure are all under sustained assault and pressure by criminal gangs and drug cartels (36)." According to the National Drug Threat Assessment (2010) by the National Drug Intelligence Center (NDIC), Mexican cartels "represent the single greatest drug trafficking threat to the United States" (NDIC 2010) and "maintain drug distribution networks or supply drugs to distributors in at least 230 U.S. cities" (NDIC 2009). In addition to the increase in Mexican cartel-related crimes and arrests in the US, sources report an increase in attacks on US border patrol agents by drug traffickers (NDIC 2010). Additionally, officials at Customs and Border Protection point to growing attempts by Mexican cartels to infiltrate into their ranks through designated job applicants (Archibold 2009). Human smuggling rings on the US-Mexico border coordinate their activities with local cartels and use their safe routes into the US to enable illegal immigration (HCHS 2006, 4). Most alarmingly, officials worry that Mexican cartels will help individuals with ties to terrorist groups enter the US through the Southwest border (NDIC 2008; GAO 2010). Finally, the physical and financial well-being of border communities is threatened by concerns of spillover of violence into the US.

It is clear that current developments regarding cartels pose a significant challenge to the stability of Mexico and to the national security interests of the US. This is, however, not a simple problem. Its complexity and the high stakes involved require a holistic and high leverage response strategy. In this paper, we approach the cartel problem as a system and identify the root causes of the current crisis along with possible ways of intervention for a sustainable solution. In light of our analysis, we also evaluate current response efforts' potential in bringing about long-term improvement to the problem situation.

## ***Methodology***

**Approach.** Leveraging systems thinking principles, concepts and tools, this study views Mexico's cartel problem as a complex system that cannot be completely understood or resolved by addressing its parts in isolation. We use systems thinking tools such as causal loop diagrams to define the cartel problem as a system and uncover underlying structures that facilitate and sustain cartel operations in multiple domains. In addition, we also leverage the systems thinking framework known as the Conceptagon (Boardman and Saucer 2008). Using the Conceptagon we gain a deep appreciation of critical systemic attributes of this problem space such as wholes, parts, relationships, processes, and transformations. Combined, this systemic approach informs not only our evaluation of the problem space, but also our efforts to identify possible intervention points and policy recommendations to improve the problem situation.

**Data Collection.** Data for this study were collected from open source literature and information sources such as academic studies, newspapers, government reports, and expert/decision-maker testimonies given to the US Congress.

## **Systemic Assessment of the Cartel Problem**

**Overview of Systemic Attributes.** To gain a comprehensive and robust understanding of the cartel problem, we applied the Conceptagon framework to the problem space.<sup>2</sup> This application ensures that we explore all significant attributes of the cartel problem as a system and provides a sound basis for our subsequent systemic inquiry. Broadly speaking, it is appropriate to consider the problem space as consisting of two related domains: cartel-related networks and anti-cartel alliance. Cartel-related networks encompass drug, human, illicit revenue and gun smuggling groups, their supporters as well as drug producers and consumers. Anti- cartel alliance, on the other hand, includes various US and Mexican government agencies that are involved in countering Mexican cartel operations. The cartel problem space as a whole consists of different domains of illicit activities (such as cultivation and trade of illegal drugs, trafficking of immigrants and weapons, transportation of illicit profits into Mexico etc.) all of which combined leads to the broader cartel operations and their growing power/ influence in Mexico.

Due to space constraints, we provide only selected highlights of the Conceptagon application here.<sup>3</sup> As an example, the assessment of inputs/transformations/outputs triplet of the Conceptagon in the context of cartels reveals two types of transformations: while an immediately visible transformation is the cartels' ability to turn contraband (to include illegal drugs and immigrants) transportation into profits, a more long-term transformation is concerned with the changing nature of the Mexican society and political life as a result of cartels' growing power within Mexican society. Serving as powerful centers of corruption capable of challenging legitimate government authorities and laws, cartels contribute to decaying democratic institutions and a grim prospect for Mexico's future.

**Dynamic System Behavior.** Up to this point, we laid out a descriptive overview of the cartel problem. In this section, we will present a dynamic assessment of the problem space as we begin exploring the nonlinear and complex feedbacks between critical variables involved in the operation of cartel phenomenon. The detailed examination through the Conceptagon framework of boundaries, relationships, functions, processes, and other systemic elements of the cartel problem informed our efforts to develop a causal loop diagram (CLD). Presented here only in some of its component pieces, this CLD establishes the causal relationships between the domains of cartel operations and the underlying structures in Mexican society that reinforce this system.<sup>4</sup> This exercise enables a holistic view of the problem and, in turn, facilitates more effective identification of high-leverage intervention points to alleviate the problem situation.

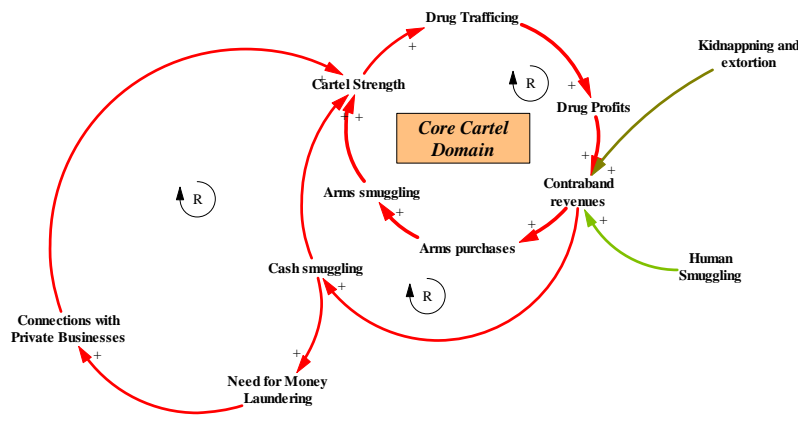
Figure 1 displays the core cartel domain which is characterized by the diverse nature of cartel activities. These activities feed into each other, reinforcing the strength and power of the cartels as they grow into complex enterprises of organized crime.

---

<sup>2</sup> For further explanation and a tutorial on the Conceptagon see (McGee and Edson 2010).

<sup>3</sup> A full version of this application is available upon request.

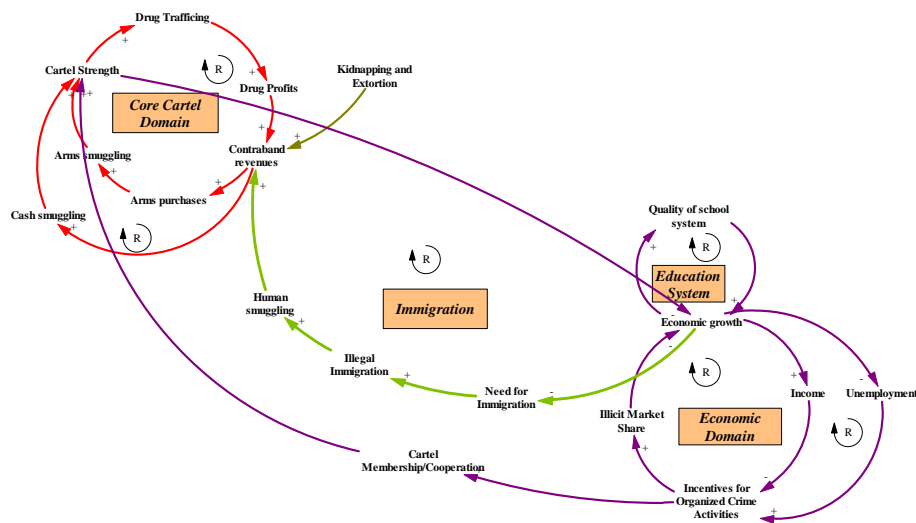
<sup>4</sup> A more detailed and exhaustive review of this CLD is available upon request.



**Figure 1: Illicit Cartel Activities**

Southwest border as they look for new profits.

In addition to economic underdevelopment and a dysfunctional public education system, corruption serves as the third systemic ill contributing to cartel activity (Figure 3). With their extensive wealth, cartels are known to bribe government personnel, public officials, and military officers (GAO 2007, 8-9). Systemic corruption allows contraband to easily cross borders



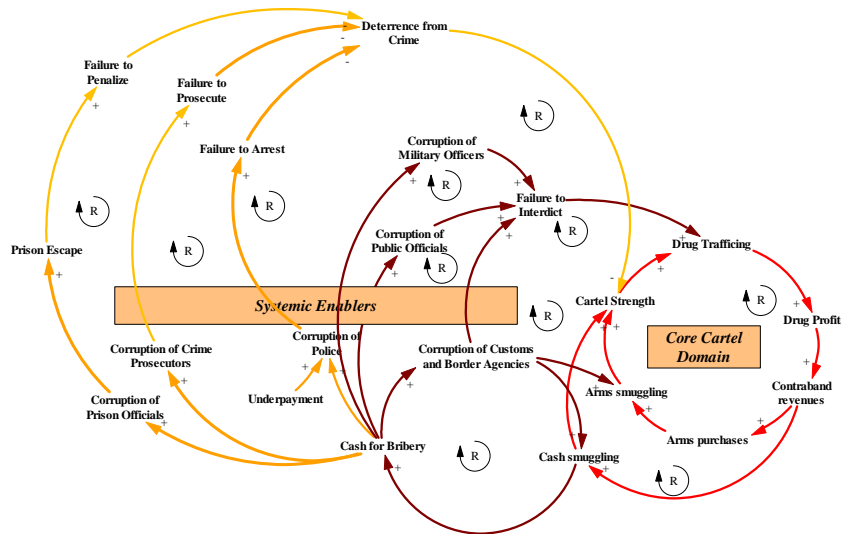
**Figure 2: Illegal Immigration and Cartels**

with impunity. Failure to arrest, prosecute, and penalize criminals creates a low risk environment for criminal activity.

Figure 4, the complete CLD, displays the daunting complexity of the cartel problem as we further step back to see the broader trends and issues involved with critical dynamics involved in cartel activities. This CLD shows that some of the significant drivers of the problem are systemic in nature. The influence that the cartels have gained over many aspects of the

Figure 2 illustrates the link between socio-economic deficiencies and illicit activities. The trends of immigration tie into this complex problem through human smuggling activities. While poor socio-economic conditions in Mexico are a key factor driving high Mexican immigration rates into the US, cartels have become increasingly involved in human smuggling across the

with the help of sympathizers and agents in customs and border agencies, government offices (GAO 2009a), and possibly the military. Similarly, corruption among police forces, prosecutors, judicial personnel, and safety officials in penitentiary system allow Mexican cartels to operate



**Figure 3: Systemic Enablers of Cartels in Mexico**

Mexican public life is a result of the complex interplay of various systemic factors that contribute to, facilitate and tolerate organized crime activities in Mexico. While individually they are important, it is the feedback between them and their overall impact on Mexican domestic environment and individual perceptions that provide the

incentives, motivations, and favorable cost/benefit evaluations for cartel operations. These systemic enablers - an education system that exacerbates economic underdevelopment; widespread corruption in critical public sectors such as police force, judicial system, prisons and customs - create an environment where illicit activities emerge as viable alternatives. These root issues generate a context that lacks credible deterrence from crime and that facilitates criminal organizations to operate with impunity. As a result, Mexico “cannot fully rely on the very institutions — the police, customs, the courts, the prisons, even the relatively clean army — most needed to carry [anti-cartel war] out (Lacey 2009).”

### ***Evaluation of the Merida Initiative***

Different US government agencies and local/state/federal law enforcement units have been working together at an unprecedented level with their counterparts in Mexico to tackle this mutual problem. The leading effort in this field is the *Mérida Initiative*, a 2008 security cooperation agreement the United States entered into with Mexico and other Central American governments. This 3-year program promises an overall aid of \$1.4 billion to confront issues (e.g., under equipped forces, federal/state/law enforcement agency corruption, human rights abuses, and drug cartel impunity) which affect Mexican and US efforts to ensure public safety and security. However, the majority of the funded provisions (i.e., helicopters, surveillance aircraft, inspection and communications equipment etc.) are designed for interdiction and rapid response rather than promoting systemic economic and institutional reforms.

Table 1 (Seelke 2010) shows that funding in the Merida initiative is overwhelmingly directed towards Foreign Military Financing (FMF) and International Narcotics Control and Law Enforcement (INCLE). Economic Support Fund (ESF) which, according to

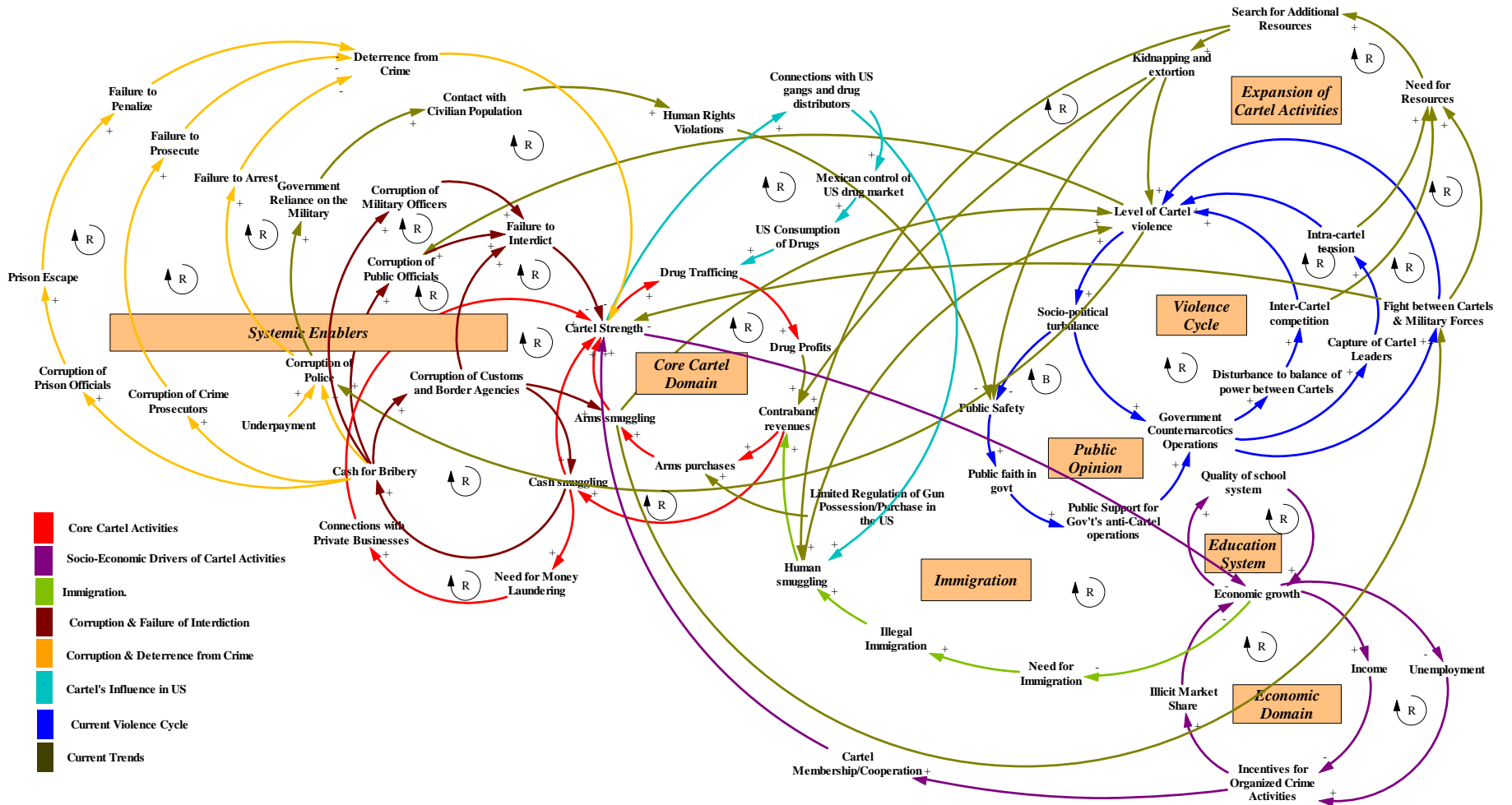


Figure 4: Complete Causal Loop Diagram of Mexico's Cartel Problem

**Table 1: FY2008-FY2010 Mérida Funding for Mexico by Aid Account (\$ in millions)**

**Table 1. FY2008-FY2010 Mérida Funding for Mexico by Aid Account**  
(\$ in millions)

Account	FY2008 Supp. (P.L. 110-252)	FY2009 Bridge (P.L. 110-252)	FY2009 (P.L. 111- 8)	FY2009 Supp. (P.L. 111- 32)	FY2010 P.L. 111- 117)	Account Totals
ESF	20.0	0.0	15.0	0.0	15.0	50.0
INCLE	215.5	48.0	246.0	160.0	190.0	859.5
FMF	116.5	0.0	39.0	260.0	5.3	420.8
<b>Total</b>	<b>352.0</b>	<b>48.0</b>	<b>300.0</b>	<b>420.0</b>	<b>210.3</b>	<b>1,330.3</b>

**Sources:** U.S. Department of State, FY2008 Supplemental Appropriations Spending Plan, FY2009 Appropriations Spending Plan, and FY2009 Supplemental Spending Plan. FY2010 Consolidated Appropriations Act (P.L. 111-117).  
**Notes:** ESF=Economic Support Fund; FMF=Foreign Military Financing; INCLE=International Narcotics Control and Law Enforcement.

**Table 2: Strategic Objectives and Deliverables of ESF programs**

Improve the capacity of justice systems in the region	<b>Equipment</b>
	Forensic lab equipment delivered 14 drug test kits delivered <sup>5</sup> Range of police equipment procured, estimated delivery between now and February 2010 <sup>6</sup>
	<b>Training</b>
	Various types of training provided to law enforcement and correctional officials Example: 1,300 Mexican Secretariat of Public Security (SSP) investigators trained
	<b>Judicial reform</b>
Various types of judicial exchanges, training, and technical assistance conducted Example: technical assistance provided to the Mexican Office of the Attorney General in the design and implementation of a modern and efficient case management and court administration system	
	<b>Human rights</b>
	United Nation's human rights project, inaugurated July 2009

State Department sources, “will be used to promote rule of law and human rights by supporting Mexico’s justice sector reforms and respect for human rights” (GAO 2009b), has received a negligible fraction of funds compared to the others.

Similarly, Table 2 (source: GAO Report 2009b) lists the deliverables proposed by the State Department for “Judicial Reform” under the ESF program. The table shows that even this program seems to focus mainly on training and equipment. Judicial reform is elaborated as “technical assistance provided” for case management and system administration, and Human Rights is not expanded upon.<sup>5</sup>

### ***An Effective and Long Term Response to Cartel Problem***

**High versus Low Leverage Interventions.** As assessed above, the funding and the majority of the provisions for the Merida initiative, the leading response framework, are designed

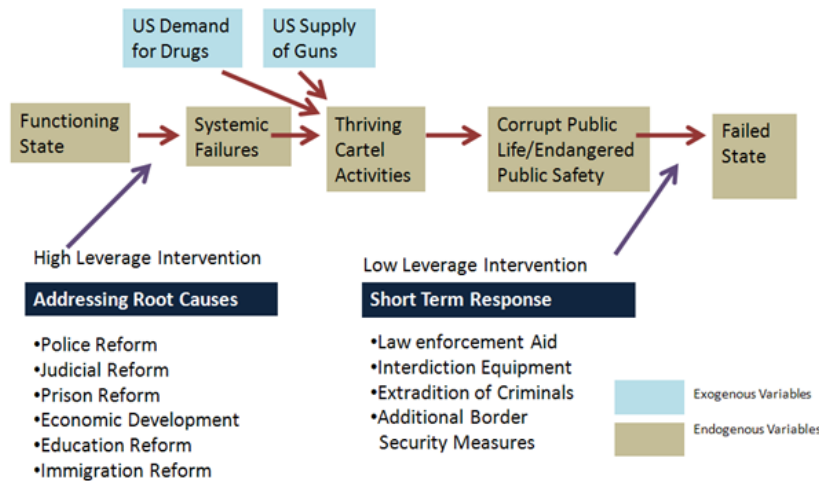
primarily to support Mexico’s response capability, and to control increasing cartel violence. As such, they rely heavily on law enforcement measures designed to interdict cartel operations, halt cartel-related violence, and seize drugs and other contraband by addressing equipment and training deficiencies.

Figure 5 depicts a notional diagram of the chain of events in Mexico leading to the current cartel problem, placed on a continuum of state viability. As systemic failures prepare the ground for thriving cartel operations, Mexico moves further away from being a healthy functional state and approaching closer to the prospect of a failed state. Current circumstances indicate that Mexican public life has been infected by the cartels’ illicit activities and their code of conduct to a great extent, which has endangered public safety and the future of rule of law in that country.

<sup>5</sup> Other reviewers of the Merida initiative appear to agree that it focuses less on the systemic failures that provide the environment for cartel activity, and more on law enforcement assistance in the form of interdiction and rapid response. A recent GAO Report has concluded that the Merida funding requests and status focus almost exclusively on equipment and response training (GAO 2009b). Similarly, the Washington Office on Latin America (WOLA) assessed that “[the initiative] does not offer sufficient support for long term police and justice reform in Mexico and lacks built-in accountability measures”(WOLA, 2008).



Given the exceptional current levels of violence in Mexico, the concerns over public safety and the desire for quick fix solutions is understandable. As such, quelling this violence,



interdicting the flow of drugs/cash, gun smuggling operations and diminishing cartels' control over certain hub areas in the country are appropriate immediate response actions and integral tactics of an overall response effort; however, these tactics are *low leverage* interventions and should not be emphasized over

**Figure 5: Intervention Points in Mexico's Cartel Problem**

a holistic, long-term strategy for a sustainable solution. Low leverage interventions prioritize nonsystemic fixes and require significant amounts of resources for minimal results. Such quick fix solutions are known to engender, in the long run, a need to apply more and more of the same solution with no clear improvement in the problem situation.

In light of the dynamic systems analysis presented earlier, for long lasting change, *high leverage* interventions are needed in the form of reforms addressing the underlying causes/systemic ills identified. Addressing one or two elements involved in the problem situation in isolation without addressing the “big-picture” issues deriving from complex feedbacks between all the critical elements involved will not generate sustainable improvement. Unless simultaneous reform programs address the failures of the Mexican criminal and judicial system, particularly the police force, the short term interdiction and law enforcement measures alone will not be enough to solve the cartel problem. The short term improvement in public safety is likely to be negated in the long run by adaptive multidimensional cartels that will find ways of bypassing these law enforcement measures with the help of persistent systemic enablers.

In addition to corrective policies emphasizing the criminal and judicial system, other long term domestic policies, especially in economics and education are necessary. Combining improvements in these areas will help to stand up reputable institutions within Mexico that can sustain legitimate sources of income and reduce incentives for illicit activities. A comprehensive response strategy will also benefit from addressing exogenous factors. US authorities' focus may benefit from an expansion as issues emanating from the US-side (such as US demand for drugs, laws and regulations on gun sales to “straw buyers” or foreign nationals) are, indeed, within the boundary of problem space. Finally, ongoing efforts to enhance policing the US side of the border to prevent the transfer of cash and guns into Mexico are indispensable elements of a holistic response strategy.



These are long-term strategies that will not come to fruition quickly. They will require long term commitment and a great deal of resources. Nonetheless, given the systemic and long term impact they are likely to generate, such high level interventions often times outweigh the low leverage interventions in a cost-effectiveness evaluation over long time scales.

## ***Recent Developments***

The Merida Initiative which was scheduled for completion in September 2010, has recently been extended into what is often referred as “Beyond Merida.” The initiative involves an overall aid of \$310 million, which was factored into the Obama Administration’s FY2011 budget proposals. \$175 million of this aid amount is matched against justice-related reform efforts.

According to recent sources (Seelke and Finklea 2011), Beyond Merida is designed to promote for pillars:

- Disrupting and dismantling criminal organizations
- Institutionalizing the rule of law
- Building a 21<sup>st</sup> century border
- Building strong and resilient communities

The novel approach to US support to Mexico’s struggle with Cartels is mainly characterized by the last two pillars. According to Seelke and Finklea (2011), while the 21<sup>st</sup> century borders focus on developing a new border understanding that can address transnational and modern nature of activities and transactions associated with borders and customs, building resilient communities refer to efforts that invest in providing communities with training and education programs that can improve their resistance to illicit activities. As such, initial rhetoric appears to place stronger emphasis on non-law enforcement measures associated with systemic propensities. There appears also to be a renewed awareness of the need for addressing demands for drugs and rehabilitation and awareness programs for population that is impacted by or vulnerable to drug use.

The specific budget allocation and approval for Beyond Merida is yet to be seen. Similarly, effectiveness of this program and its specific measures will need to be evaluated in terms of their long-term outcomes. Nonetheless, based on the initial information available on this initiative, Beyond Merida may constitute a step in the right direction.

## ***Summary***

Taking a systems thinking approach to the issue, this paper assessed the cartel problem in Mexico as a complex system. Using systems thinking tools, it identified comprehensive boundaries, leading actors, inputs, outputs and other significant systemic elements of the problem. It also investigated the dynamic relationships between the different domains of the

problem, uncovering the root causes of thriving cartels in Mexico. In light of these findings, this paper evaluated the potential of the Merida initiative to address the cartel problem. Pointing to its predominantly short term vision, the Merida initiative is assessed to be a low leverage program that falls short of providing a lasting solution to the cartel problem. We argued for a high level strategy that adopts a more holistic view of the problem that appreciates the role of several systemic ills in Mexico and the complex interrelationships between them, enabling and facilitating the cartel activities. Accordingly, we recommend long-term institutional reformation of the Mexican law enforcement and judicial systems as well as reforms in the education and economic systems to be incorporated into the overall counter-cartel response strategy. Unless authorities devise simultaneous high-leverage interventions to address the systemic failures and their relationships in Mexico, cartel problem will be hard to control and mitigate with partial response efforts.

## References

- Archibold, R.C., "Hired by the Customs, but Working for Mexican Cartels," *New York Times*, 18 December 2009. <http://www.nytimes.com/2009/12/18/us/18corrupt.html>.
- Beittel, J., "Mexico's Drug-Related Violence," *CRS Report for the Congress*, May 27, 2009. <http://www.fas.org/sgp/crs/row/R40582.pdf>.
- Boardman, J. T., Sauser, B. J., John, L., & Edson, R. "The Conceptagon: A Framework for Systems Thinking and Systems Practice." *IEEE International Conference on Systems, Man, and Cybernetics*, (San Antonio, TX, October 12-14, 2009). <http://www.house.gov/mccaul/pdf/Investigaions-Border-Report.pdf>.
- Cook, C. W., "Mexico's Drug Cartels" *CRS Report for Congress*, October 16, 2007. <http://www.fas.org/sgp/crs/row/RL34215.pdf>.
- Finklea, K.M, W.J. Krouse and M.A.Randol. "Southwest Border Violence: Issues in Identifying and Measuring Spillover Violence" *CRS Report for Congress*, January 25, 2011. <http://www.fas.org/sgp/crs/homsec/R41075.pdf>.
- GAO Report, "Drug Control: U.S. Assistance Has Helped Mexican Counternarcotics Efforts, but the Flow of Illicit Drugs into the United States Remains High", October 25, 2007. <http://www.gao.gov/new.items/d08215t.pdf>.
- GAO Report, "Firearms Trafficking: U.S. Efforts to Combat Arms Trafficking to Mexico Face Planning and Coordination Challenges" June 18, 2009a. <http://www.gao.gov/products/GAO-09-709>.
- GAO Report. "Status of Funds for the Merida Initiative," December 3, 2009b. <http://www.gao.gov/new.items/d10253r.pdf>.
- GAO Report, "Moving Illegal Proceeds: Challenges Exist in the Federal Government's Effort to Stem Cross-Border Currency Smuggling" October 2010. <http://www.gao.gov/products/GAO-11-73?source=twitter>.
- Lacey, M., "In Drug War Mexico Fights Cartels and Itself," *New York Times*, 29 March 2009 [http://www.nytimes.com/2009/03/30/world/americas/30mexico.html?\\_r=1](http://www.nytimes.com/2009/03/30/world/americas/30mexico.html?_r=1)
- McGee S. and R. Edson, Extending the Conceptagon as an Analytic Framework: A Case Study of Public Preparedness in Israel, *8<sup>th</sup> Conference on Systems Engineering Research*, Hoboken, NJ, March 17-19, 2010.
- National Drug Intelligence Center, *National Drug Threat Assessment 2008*, October 2007. <http://www.justice.gov/ndic/pubs25/25921/index.htm>
- National Drug Intelligence Center, *National Drug Threat Assessment 2009*, December 2008. <http://www.justice.gov/ndic/pubs31/31379/index.htm>.
- National Drug Intelligence Center, *National Drug Threat Assessment 2010*, December 2009. <http://www.justice.gov/ndic/pubs38/38661/index.htm>
- O'Neal, S., *Moving Beyond Merida in U.S.-Mexico Security Cooperation*, Council on Foreign Relations , 27 May 2010. <http://www.foreignaffairs.house.gov/111/one052710.pdf>.
- Seelke, Calire Ribando, Merida Initiative for Mexico and Central America: Funding and Policy Issues, CRS Report

for Congress, April 19, 2010

<http://wilsoncenter.org/news/docs/Merida%20Initiative%20for%20Mexico%20and%20Central%20America.pdf>

Seelke, Calire Ribando and Kristin M. Finklea, U.S.-Mexican Security Cooperation: the Mérida Initiative and Beyond, CRS Report for Congress, February 16, 2011

<http://www.fas.org/sgp/crs/row/R41349.pdf>

US Joint Forces Command, *Joint Operating Environment: Challenges and Implications for the Future Joint Force*, November 25, 2008. <http://www.jfcom.mil/newslink/storyarchive/2008/JOE2008.pdf>.

Washington Office on Latin America, "The Merida Initiative and Citizen Security in Mexico and Central America," *WOLA Memo*, March 2009.

[http://www.wola.org/index.php?option=com\\_content&task=viewp&id=668&Itemid=2](http://www.wola.org/index.php?option=com_content&task=viewp&id=668&Itemid=2)

## Biography

**Sibel McGee, Ph.D.** is a Senior Analyst at the Applied Systems Thinking (ASysT) Institute of Analytic Services Inc., Arlington, VA, providing systems and research analysis for various federal departments and agencies to include Department of Homeland Security and Defense. She is also an adjunct Professor at the University of Maryland University College. Dr. McGee holds an MS in International Relations from Middle East Technical University, Turkey, an MA in European Studies from University of Bonn, Germany, and a Ph.D. in Political Science from Texas A&M University.

**Michael Joel** is currently an analyst with the Marine Corps Intelligence Activity, Quantico, VA. Mr. Joel was previously a Senior Associate Analyst at the Applied Systems Thinking (ASysT) Institute of Analytic Services Inc., Arlington, VA. He holds a BA in History and an MA in Public Policy/National Security Policy from George Mason University.

**Robert Edson** is Vice President for Enterprise Development at Analytic Services Inc., and Director of the Applied Systems Thinking Institute (ASysT). In his role as Director of ASysT, he leads an institute whose mission is to advance the application of systems thinking principles in the fields of national security and homeland security. He has over 25 years of experience in dealing with complex systems issues and systems thinking. Mr. Edson is an Adjunct Professor at Stevens Institute of Technology and has a BS in Biology from George Mason University and a MS in Physical Oceanography and Meteorology from the Naval Postgraduate School.