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A SYSTEM FOR THE 21st CENTURY

Ctrl+Alt+Del: Rebooting Immigration Policies Through Socio-technical Change

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LATIN AMERICA INITIATIVE IMMIGRATION RESEARCH PROJECT
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CTRL+ALT+DEL:
REBOOTING IMMIGRATION POLICIES
THROUGH SOCIO-TECHNICAL CHANGE

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Abstract

The immigration policy of the United States has become a dysfunctional socio-technical system where technology deployment has little relation with the way the system behaves. An escalating law enforcement narrative has encouraged the research and development of linear simple technologies to try to solve complex adaptive situations, thus remaining ineffective and actually becoming harmful to US interests. It is a process that neglects the evolving nature of the immigration policy space and the desirable effects of migratory behaviors, and instead insists on the technological fortification of the borderlands to interdict the negative ones. It has also failed to identify counterintuitive points of intervention to improve the performance of the migration socio-technical regime. Under these conditions, most immigration technologies have demonstrated limited capacity to “pivot” and adapt to a changing environment, with the exception of the clandestine technologies developed by deviant actors to penetrate the border interdictions. The study of socio-technical systems provides a good tool to understand the limitations of the current technological architecture of the immigration policy of the US, as well as an approach to reboot the whole system, in order to update it to a more adaptive design.

Introduction

Humanity is acquiring all the right technology for all the wrong reasons.

R. Buckminster Fuller

The immigration policy of the United States has become a dysfunctional socio-technical system deprived of clear purpose, in part because an escalating law enforcement narrative for the border region has created systemic conditions for a design that favors aspirational technologies over effective ones. This narrative encourages the research and development of linear, simple technologies to try to solve adaptive, complex situations. This process neglects the evolving nature of the immigration phenomenon and focuses instead on the static technological fortification of the border. Consequently, immigration policies suffer a technological disconnect between the real nature of immigration trends, patterns and behaviors, and the deployment of technology developed to regulate that system of interactions. Deployed immigration technology has demonstrated limited capacity to pivot and adapt to changing social behaviors, but when it has done so, it has provided examples of technologies that can scaffold well-designed

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immigration policies to make the U.S. more secure, innovative, and user friendly. One example is the trusted-traveler programs.

Rebooting the immigration policy of the United States is a critical condition to sustain the role of the country as the global hub for entrepreneurship, innovation, freethinking, and progress. Rebooting the system, however, must involve creating a socio-technical design where technology responds to real inputs, instead of mere aspirations. In this section I will present a framework of analysis to understand the role of technology in the immigration policy space, with the objective of making an explicit connection between technological innovation and immigration processes, providing policymakers and interested parties with a new frame of reference to make sense of the limitations of the current system.

The paper is divided in three parts. The first will define the terms “socio-technical system” and “socio-technical regime” in the context of innovation for immigration policymaking, establishing the framework of analysis. The second will apply that framework to the context of the immigration system. Finally, the paper will provide some policy alternatives to radically improve¹ the immigration system of the U.S. through a better technology design and an explicit understanding of the interdependencies and counterintuitive forces affecting the immigration socio-technical system.

Socio-Technical Systems and Regimes: A Public Policy Issue

The technology evolution and adoption cycles are relevant forces that shape the strategic landscape in which public policies are designed and implemented. This observation is frequently neglected during public policy negotiations because the sense-making capacities of stakeholders to understand technology lag behind the impact that technological innovation can have in the social environment. This is especially true when policymakers design regulation or legislation not directly related to a high-tech policy (e.g., mobile technology, the space industry, Internet,

¹ What innovation theory would call “disrupt,” as in Clayton Christensen’s disruptive innovation concept. In innovation theory, the term disruption does not have a negative connotation.

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etc.) and where technology is thought of as a tool rather than a central component of a socio-technical system. The immigration policy of the United States falls into this category.

While immigration policy is affected by technological innovation, the public policy debate around it ignores the consequences of social changes produced by the adoption of new technologies and disregards the creative patterns that produce unpredictable transformations in the policy space itself. Immigration is, after all, a subsystem of a larger sociotechnical system. It responds to inputs like access to money (labor and business), entertainment (tourism), love (marriages or divorces), fear and need for protection (asylum), among others. Technology is deployed on top of these social phenomena and interacts in complex ways with them. Public policies are, then, undertakings within socio-technical systems that emerge from the complex adaptive interactions between social agents, regulatory efforts, and technological artifacts. They are complex because “large networks of components with no central control and simple rules of operation give rise to complex collective behavior, sophisticated information processing, and adaptation via learning or evolution” (Mitchell 2009) and they are adaptive because “they do not, like a game of chess, simply wait for the players to make moves. They move on their own, whether the players take that movement into account or not” (Dorner 1997, 420).

Thus, technological innovation is relevant to the analysis of public policies because “technology plays an important role in fulfilling societal functions, but artifacts only fulfill functions in association with human agency and social structure” (Geels 2005, 445). The design, research, development, and adoption of technologies transforms human environments and behaviors iteratively, and public policies emerge also iteratively to regulate (often with unintended consequences) and influence (in nonlinear ways) environments and behaviors. For example, no public policy for law enforcement, public safety, and policing can ignore the fact that weapons technologies and ballistics have produced artifacts that multiply the force of individuals well beyond their biological capacities. Therefore, a series of regulatory efforts have created coercive and facilitative norms and guidelines to influence individual and social adoption of weapons technologies. In fact, much legislation in the United States has been created to influence the way in which individuals and social groups adopt these technologies, including the Second Amendment of the Constitution. But while hardly anyone would negate the fact that handguns

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and rifles are technological in nature, few would consider the Second Amendment a technology adoption roadmap.

The study of socio-technical systems provides a complexity-based approach to understand interdependencies between public policy formulation, human behaviors, and technology in the immigration public policy space. It provides a way to describe how the different parts of a complex adaptive system interact among themselves and with the environment. It is also an appropriate framework of analysis to study the evolution of technology that keeps altering the policy landscape. It also signals that policymakers need to improve their understanding of technology evolution and adoption into future-thinking capacities.

The history of the study of socio-technical systems shares with the field of immigration policies a special interest in the workplace and the labor environment. Eric Trist has traced with great detail the evolution of the concept to a series of field projects “undertaken by the Tavistock Institute in the British coal mining industry.” Trist explains how “the idea of separate approaches to the social and technical systems of an organization could no longer suffice ... work organizations exist to work—which involves people using technological artifacts ... to carry out a set of tasks related to specified overall purposes.” Accordingly, a conceptual reframing was proposed in which organizations were envisaged as socio-technical systems rather than simply as social systems (Trist 1981, 7). The definition of socio-technical system has been expanded from its original context in the workplace to any other social environment where technology, rules and human behaviors interact forming a complex adaptive system and the concept “has developed in terms of systems, since it is concerned with interdependencies” (Trist 1981, 7). These interactions among different components of socio-technical systems have been described by Thomas Hughes as a “seamless web” and, in his view, shared with many other complexity scientists, “analytical categories—such as technology, science, politics, economics and the social—should be used sparingly if their use leads to difficulty in comprehending interconnection.” Innovators who play the role of system builders are “no respecters of knowledge categories or professional boundaries” (Hughes 1986, 285) as they will mix all these categories to make sense of this seamless web.

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The actions of system builders “travel between domains such as economics, politics, technology, applied scientific research and aspects of social change” and therefore, “new technologies and the user environment are constructed in the same process” (Geels 2004, 898). The role of these system builders in socio-technical systems is not unlike that of what Thaler and Sunstein more recently labeled a “choice architect.” For them, the role of a choice architect is to be the stakeholder who “has the responsibility for organizing the context in which people make decisions” (Thaler and Cass 2008). Legislators are key choice architects in the immigration public space as they regulate the socio-technical environment, but behavior by other agents involved in the immigration process brings nonlinearity to the way the system behaves. What this means is that an immigration rule created by a legislator does not automatically signify that the human agents of the socio-technical system will behave as intended. For example, interdiction policies that affect the immigration environment do not mean that people will no longer attempt to cross the border, but instead triggers a series of innovative adaptations in the behaviors of individuals that may seek alternatives to accomplish what they want. This then produces nonlinear ripple effects that affect the entire socio-technical system.

Changes in the immigration regime produce adaptation because migration is an adaptive phenomenon. The shape of the immigration system is frequently very different from what the rules intended. In fact, as Massey and Pren state, “paradoxical as it may seem, U.S. immigration policy often has very little to do with trends and patterns of immigration. Even when policies respond explicitly to shifts in immigration, rarely are they grounded in any real understanding of the forces that govern international migration.” They add that “intervening forcefully in complex social and economic systems without understanding their dynamics can lead to unintended consequences and unanticipated policy feedbacks” (Massey and Pren 2012, 2). Not surprisingly, it is quite common for socio-technical systems to evolve faster than the rules that regulate them because the innovation process is designed to keep testing the limits of those rules. The failure of immigration policies to adapt to socio-technical changes is often remarkable. Immigration policymakers and stakeholders are choice architects, but they have not demonstrated a good sense-making capacity to understand how their actions (or lack of action) affect the socio-technical system.

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Geels' (2005, 449) three dimensions of the sociology of technology to analyze the immigration socio-technical system and its context help understand this. These dimensions are:

1. Socio-technical systems, i.e., the tangible elements needed to fulfill societal functions;
2. Social groups who maintain and reproduce the elements and linkages of socio-technical systems (making them adaptive); and
3. Rules (understood as regimes) that guide and orient activities of actors and social groups.

Using these three dimensions, socio-technical systems can be defined as a seamless web of complex adaptive interactions among technological components, social agents, and the reward and punishment regime that shapes the forces affecting the system iteratively. Choice architects (including those involved in immigration reform) have a particular preference in trying to affect the regulatory dimension of socio-technical systems, but often without being capable of identifying the system's leverage points to effect changes in behavior. They see technology as a tool instead of a dimension of the system. This is risky. Social systems, as Forrester (1971, 120-122) demonstrated, often show counterintuitive behaviors that make linear policymaking part of the problem and not the solution. Forrester describes the following three characteristics of social systems relevant to the study of socio-technical systems:

1. Social systems are inherently insensitive to most policy changes selected to alter the system's behavior. In fact, a social system tends to draw our attention to the very points at which attempts to intervene will fail.
2. Social systems seem to have a few sensitive influence points through which the behavior of the system can be changed. These influence points are not in the locations where most people expect. Furthermore, if one identifies in a model of a social system a sensitive point where influence can be exerted, the chances are still that a person guided by intuition and judgment will alter the system in the wrong direction.
3. When it comes to social systems, there is usually a fundamental conflict between the short-term and long-term consequences of a policy change. A policy that produces improvement in the short run, within five to ten years, is usually one that degrades the system in the long run, beyond 10 years.

Regulatory efforts are oriented to affect the regime dimension of socio-technical systems, because the policy process naturally responds to challenges through linear changes of rules. In

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fact, leverage points susceptible of being affected by changes in public policy are not intuitive, and this makes linear policymaking part of the problem and not the solution.

I define the immigration socio-technical regime as the components of the immigration socio-technical system that relate to the rules that govern behaviors in this policy space. While the socio-technical regime for immigration is a subsystem of a larger socio-technical complex adaptive system, it is a very important one, as it provides the explicit and implicit rules that stabilize (or destabilize) the whole system. Socio-technical regimes are fundamental structures that provide resilience to the system by hardening through regulation system behaviors. The immigration regime is no exception.

As Rip and Kemp (1998) argue, socio-technical regimes are relatively stable configurations of institutions, techniques and artifacts, as well as rules, practices and networks that determine the normal development and use of technologies. Socio-technical regimes emerge around socio-technical systems in the form of laws, regulations, contracts and problem definitions, political positioning, monopolistic concentrations etc. Socio-technical regimes have become a focal unit of analysis for which a central public-policy challenge is “to transform them into more sustainable configurations” (Berkhout 2002, 3). They reinforce certain behavioral patterns and stabilize the system, making it resilient and resistant to change. Understanding the immigration socio-technical regime signifies studying the ways in which institutions, techniques, rules and technological artifacts have self-organized to provide resilience to that regime, as well as if that resilience is beneficial or harmful to the overall policy objectives of the socio-technical system. The socio-technical regime for immigration is formed by many parts that interact with each other. Some of the most important ones are:

1. The immigration laws and other rules that affect the immigration system (e.g. identity rules and mechanisms, traveling rules, custom rules, aviation rules, etc.) and regulate the legal flow of people and the operation of points of entry.
2. The moves by stakeholders in their role as securitizing actors (Buzan, Ole and Jaap 1998) framing the immigration dynamics as a security threat (e.g. a demographic threat [Kaplan 2012], a national identity and assimilation challenge [Huntington 2004], and

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economic risk, a spillover of violence, an operational control of the border need, terrorism, etc.).

3. The contracts with private companies to “solve” those security problems (e.g., the contract awarded to Boeing to build SBInet, the so-called virtual wall).
4. Scientific grants, requests for information (RFIs), requests for proposals (RFPs) or any other mechanism that funds research and development (R&D) of technology “solutions” to the immigration problems as defined by the funding agencies, or solicits the procurement of a particular technology to deal with the immigration process.
5. The political stance of legislators, lobby groups and the different branches of federal, state and local governments, which triggers social behaviors and technology responses within the socio-technical system (e.g. Arizona Gov. Janice Brewer’s support for the SB1070 law or President Barack Obama’s policy of deferred action for the so-called “DREAMers”).

When socio-technical regimes are mature, innovation in a given socio-technical system occurs incrementally and disruptive change is hard to accomplish. This is exactly the state of the immigration socio-technical system today. Factors such as barriers to exit (e.g., rejection of because policy change is viewed as soft on immigration), personal or institutional commitment to certain projects (e.g., the Prevention through Deterrence strategy of the Border Patrol), or sunk costs and loss aversion (e.g., support for the security fence/wall and SBInet in spite of failure) are elements of the regime that provide stability to the system, directing policymakers to follow the same technology paths that reward individual past success, even at a cost of systemic dysfunction. The resilience of socio-technical regimes has no relation with the stated goals of the policy trying to affect a socio-technical system. Like the rest of the complex adaptive socio-technical system of which it is part, a socio-technical regime is dynamic, and while resilience of the regime may indicate in some cases a capacity to adapt to changing policy environments, it can also indicate that the regime is capable of resisting change as forces perpetuate its current shape. When this happens, a divergence between the stated policy and social behavior emerges.

The socio-technical regime can increase resilience by adapting to changes in the policy space (i.e. adaptive policies) or it can build resilience by resisting and openly opposing changes in

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patterns and in the environment with the assistance of other forces operating in the system. In such case, policymakers “double down” on failed policies to try to force with more resources the socio-technical system to behave in the linear way the regime describes. This kind of policy regime shows no understanding of the counterintuitive forces affecting systems. From a systemic perspective, this explains why failed policies persist, despite being ineffective. In the case of immigration, the constant escalation in security measures as the dominant solution to the immigration “problem” is a good example of this persistence of failed socio-technical regimes.

Clandestine innovation is one of the most interesting responses to this kind of resilience in socio-technical regimes. This innovation happens when social components of the system change to counteract the inflexible structures of the regime. This is one of the most important sources of nonlinearity in the immigration socio-technical system, as clandestine technologies emerge to circumvent limitations in public policies, reinforcing in the process the escalation arguments that created the regime’s inflexibility in the first place. The more that clandestine actors circumvent the stated rules and regulations of the socio-technical regime, the more reasons policymakers will have to insist on them.

The methods employed by human smugglers to pierce the security measures deployed by the Department of Homeland Security are technological responses to the set of rules created by the socio-technical regime. The construction of a Microsoft Campus in Canada (an organizational innovation, not unlike an “intellectual maquiladora”), near its headquarters in Redmond, Washington, built in order to respond to what the company labels the “challenge we have in the United States of hiring very qualified people, many of whom are graduating from schools in the U.S., but who cannot acquire the necessary documentation to work in the U.S.” (Fried and Broache, 2008), is also an innovation to respond to the limitations of the regime.

What these adaptive forces demonstrate is that socio-technical regimes not only produce the behaviors they are formally meant to encourage, but they also produce unexpected ripple effects that may reward different and often opposed behavioral patterns opposed to those officially stated in public policies. In another application of the so-called Schrinky principle that “Institutions will try to preserve the problem to which they are the solution” (The Technium, The

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Shirky Principle 2010), socio-technical regimes often preserve the problems they were created to eliminate.

This paper advances three central arguments vis-à-vis the socio-technical regime that currently surrounds immigration policy in the United States.

1. The regime has self-organized to its current form and its technology legacy hardens its current shape.
2. The regime encourages deviant innovation and clandestine technologies to be developed to respond to the challenge created by its technology.
3. The regime has not adapted to changes in the socio-technical system it scaffolds. Innovation impacting the immigration socio-technical system has modified the environment, but the regime lags behind.

Using this framework of analysis, the next section studies some components of the immigration socio-technical system of the U.S., explaining how an escalating law enforcement narrative for the border region has created systemic conditions for a technology design that prefers aspirational technologies over effective ones.

Aspirational technologies are defined as the result of a design that responds to different goals than those stated in the official objectives. It is meant to send a strong message regarding social values or political narratives. Aspirational technologies play a symbolic role important to stakeholders, often disconnected from the real capabilities of the artifact. For example, the stated goal of the tactical technology deployed by the Border Patrol is to obtain control of the border (Congress 2006). While the border wall does not accomplish this, the militarized landscapes of the border territories communicate a visual technological commitment to law enforcement and border security and are used as part of what Andreas calls “border games.” Andreas states (2001):

The politics of opening the border to legal economic flows is closely connected to the politics of making it appear more closed to illegal flows...the escalation of border policing has ultimately been less about deterring the flow of drugs and migrants than about recrafting the image of the border and symbolically reaffirming the state’s territorial authority. Indeed, border policing has some of the features of a ritualized

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spectator sport, but in this case the objective of the game is to tame rather than inflame the passions of spectators.

If public policy for border security and immigration management is a kind of symbolic game, then aspirational technologies are the artifacts used to play it. It is a process that neglects the evolving nature of immigration, insisting on the technological fortification of key territories (geographic borders and points of entry) as the main design feature of immigration technologies.

The aspirational fortification of the national territory through the use of tactical infrastructure and other technologies has failed to affect the immigration socio-technical system in the linear way that the policy desires, but the regime keeps encouraging research, development and deployment of technology, including walls, sensors, UAVs, Tethered Aerostat Radar Systems, surveillance technology, etc., to manage the “immigration problem.” These technologies in the immigration socio-technical system perpetuate geopolitical conflicts in the borderlands and reinforce the political representation of immigration as a threat that has to be neutralized, instead of a human behavior that has to be managed through a good technological design.

Legacy Technology: The Immigration Socio-Technical Regime of the United States

Outdated technologies have important effects in the way socio-technical systems and regimes co-evolve. Legacy technologies stabilize the system and reward a continuation in past decision-making because the rules that surround legacy technologies are mature and proven. There is no learning curve in adopting them as users have developed the necessary skills and mental models to interact with these technologies. Legacy systems reinforce previous behavioral patterns and limit the sense-making capacity of stakeholders to perceive environmental changes (i.e. future thinking skills), producing rejection of radical (disruptive) innovations in the system. This is what Christensen called the innovator’s dilemma (1997). Designing a system from scratch, meaning questioning the need for each and every technological artifact, is complicated and often unfeasible because of organizational constraints. For immigration reform to be comprehensive, legacy systems (including sense-making models) must be migrated to a new technological design that scaffolds the goals of the new policy.

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Many of the technological artifacts and responses employed in the immigration policy space today are legacy technologies, resulting from the way the system has self-organized. Politics helps define the specifications for technological responses of that legacy technology through laws, securitization moves, public contracts or scientific grants. These technologies in turn influence the political environment (e. g, stakeholders could not ask for the construction of a border wall if we did not know how to build walls), thus building feedback loops between technological design, adoption of immigration technologies and the political process. Therefore, the legacy system is perpetuated by a socio-technical regime that under the effects of risk-aversion avoids radical systemic changes and encourages instead slow incremental updates, most aspirational in nature.

For example, the introduction of radio frequency identification (RFID) in passports is an incremental and aspirational update to the travel document, instead of completely rethinking identity management at international border crossings. The so-called e-Passports or biometric passports allowed policymakers to frame RFIDs as a high-tech solution to increase the identity security of the travel document, providing the aspirational role of the technology in the context of the post-9/11 border game. In fact, RFIDs also created a series of new vulnerabilities for passports. They became remotely readable (e.g. with the right technology, an identity thief can extract information without ever being in contact with the document), without providing any significant update to identity management, data protection or an answer to the question: Are RFID passports the best technological response to improve the socio-technical system? (Meingast, King and Mulligan, 2007). RFID tags were hacked and cloned even before the Department of State had issued the very first e-passport (Lyman 1998).

Because of its complex adaptive nature and its close association to the human condition, immigration behaviors touch multiple socio-technical systems. However, it is possible to identify some of the most important subsystems directly associated with immigration governance and the public debate, but it is important to understand that, like any other effort to reduce complex systems to their parts, immigration patterns transcend the limits of those subsystems all the time, and have unexpected second-degree consequences throughout multiple social environments.

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The three subsystems are formed by government, business, and clandestine technologies. Intervening in any of these subsystems will provoke counterintuitive ripple effects on the others.

Figure 1. Different subsystems that interact to form the immigration socio-technical system

A good socio-technical approach to immigration needs to integrate systems thinking practices to understand how to better intervene in all these systems to obtain the desired policy objective. As Meadows (2008, 169) explains:

Systems can't be controlled, but they can be designed and redesigned. We can't surge forward with certainty into a world of no surprises, but we can expect surprises and learn from them and even profit from them. We can't impose our will on a system. We can

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listen to what the system tells us, and discover how its properties and our values can work together to bring forth something much better than could ever be produced by our will alone.

Subsystem 1: Government Technologies

The first socio-technical subsystem consists of technologies governments use to manage immigration flows. Transportation control, identity management, surveillance, and securitization artifacts constitute the majority of them. The immigration experience is defined by this group of technologies. Legal migration (permanent or temporary, including international travel of short duration for tourism or business) happens in the context of governmental technologies and the socio-technical regime that makes them legitimate. Illegal migration, on the other hand, has to defeat one or more of them.

The geopolitics of how technologies are deployed parallels the geopolitics of migration. As individuals or groups move from one territory to another, they interact with three singular spaces: the country of origin, the borderlands, and the destination country. In the borderlands, there is an important differentiation between the planned, organized, surveilled, and controlled points of entry and the rest of the border territories that in the case of the U.S.-Mexico border are at the same time represented as vast, empty, and chaotic, but also as a place where a heavy deployment of tactical technologies has to take place.

In each of these territories, governments deploy technologies that affect immigration behaviors. The immigration experience starts far from the border and before the decision to migrate has been made in the country of origin. In fact, the first technologies of the immigration socio-technical system are deployed into the social environment of a human being just a few hours after having been born, in the form of identity documents, birth certificates, databases and biometric technologies to manage identity. In fact, identity management is an essential component of the immigration socio-technical system, as the main role of the technologies deployed in points of entry is to control the flow of individuals and discriminate between the right and the wrong identities. This decision follows two steps:

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1. Determine if the person trying to gain access to the national territory of a state is the same person identified in the documents being used to demonstrate identity.
2. Decide if the information provided by the travel documents and other supporting information to which the border agent may have access (visa databases, paper bank statements brought by the migrant, terrorist lists, vehicle transponders etc.) authorizes the migrant to cross the border.

Each nation manages identity differently. This is one of the reasons why nations have agreed to certain standards in passport design that allow for what technology developers call interoperability. That is, passports allow for the different socio-technical systems that manage identity in different nation-states to interact with each other using a common protocol. For example, the requirements to obtain a passport in the United States and the requirements to obtain a passport in Mexico are different because of the different socio-technical identity systems in each country. Nevertheless, the authorities of each country do not have to be aware of the different rules that govern identity in the other country as long as they can assess that an individual in possession of a passport is in reality its lawful holder. Passports make the legal identity systems of Mexico and the United States interoperable.

Identity mechanisms are deployed for all individuals and not only immigrants, but they have particularly important effects on the behaviors of migrants in the territory of the destination country. In the U.S., the identity mechanisms that citizens, naturalized citizens and legal residents (permanent and some temporary) use to demonstrate that they are who they say they are depend on what is the de facto national identification number in the U.S.: the Social Security number (SSN) and the de facto ID mechanism: the driver's license. The illegal immigration experience is defined by not having these tokens or by the need to obtain them through illegal means. The lack of national identity card system in the U.S. increases the complexity of interaction between law enforcement agencies and legal migrants, as more identity rules are imposed on permanent residents than on the citizens (i.e. they are legally mandated to carry their immigration tokens all the time). On the other hand, nothing in the driver's license distinguishes a permanent resident, a naturalized citizen or a U.S. born citizen. So, while a naturalized citizen has no need to carry a "green card" as he or she is a citizen of the country, the same person the day before he became a citizen would have the obligation to carry that identity token all the time.

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This ambiguity creates niches for legal definitions like “reasonable suspicion” to emerge as a socio-technical rule in some states, like in Arizona, producing ripple effect in the way immigrants, naturalized citizens and U.S.-born citizens of Hispanic descent interact with identity issues.

From a technology perspective, the only differentiator between who has to carry an identity token (a permanent resident) and who does not have to carry it (the same permanent resident the day he becomes a citizen) is not naturally designed into the system. A naturalized citizen looks and talks exactly like the permanent resident he once was, but his technological requirements and obligations are different. And law enforcement agents are now being mandated to make sense of those differences without any tool to allow them to visualize the necessary information for them to replace “reasonable suspicion” with the better standard of “informed decision.” In countries where all citizens carry a national ID card that establishes the immigration or citizenship status, reasonable suspicion is an irrelevant concept because the socio-technical regime that creates the rules of the system is in agreement with the way the technological artifacts for identity are deployed. This is a clear example of how design choices of socio-technical systems and the political environment shape each other, sometimes in counterintuitive ways.

The specification requirements for identity technologies are complex. How to determine that a person is who he or she says without any previous contact and what access rights does he or she have? The progression is the following, according to Schneier (2003):

1. They have to identify a user from other users of the system. (Who are you?)
2. They have to authenticate the identity. (Are you who you say you are?)
3. They have to provide authorization. (Can you do what you want to do?)

Current technologies approach this challenge using one of three methods—knowledge-based, token-based, or biometrics (Clarke 1994, 14) or a combination of them. In knowledge-based technologies, the individual has to provide a piece of information that only he or she has (e.g., Internet passwords, ZIP codes at gas-station pumps, Social Security numbers, etc.). In token-based technologies, the individuals must show an artifact, (a passport, a visa, a driver’s license, etc.) that provides information that may or may not be complemented by access to databases. Biometric authentication is based on information that physically identifies an individual and

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cannot be changed, (e.g. a fingerprint), which is supported by a database that stores and compares the information. This entire technological infrastructure deployed at points of entry serves one purpose, access control. Identity-management technologies control the flow, while surveillance technologies provide response and deterrence capabilities for those trying to break the rules of the system.

A well-built point of entry is almost inexpugnable using a brute force approach (i.e., trying to outrun or defeat customs guards) because of the overwhelming force that governments deploy in those territories. That is certainly the case of the legal point of entries of the U.S. Instead, organized crime designs and deploys technology solutions to counteract governmental technologies, e.g., smuggling and concealment. They are constantly adapting their methods, producing deviant innovation. In response, the government also has to develop and deploy new surveillance technologies in the points of entry in an escalation process.

When that process neglects or ignores risk-management principles, the point of entry can rapidly become inefficient, aggravating unnecessarily the migration experience for the millions of lawful users who have to be served by those technological deployments. Border management, like risk management, is about trade-offs between security and performance. A border without bridges and with anti-personnel mines, armed robots and other lethal technologies would arguably provide a higher degree of security. It would also create a self-imposed embargo and challenge the principles of an open and democratic society as well as the heritage as a nation of immigrants. Risk-management assessments can and should be made when deploying immigration management technology. Any inclusion or removal of a technological artifact will have an impact in other aspects of the performance of the socio-technical system and ripple effects in the way clandestine and business technologies co-evolve.

Nowhere are these considerations more evident than in the adoption of trusted-traveler programs, e.g., Global Entry, Nexus, or Sentri. All of these migration technologies combine risk-assessment methodologies and identity technologies to pre-approve low-risk travelers, improving the quality

of the travel experience.² In theory, the other positive consequence is that trusted-traveler programs liberate scarce law enforcement resources that can then be used to inspect more extensively high-risk flows. Border flow-control mechanisms are unique because, while the great majority of system users are lawful citizens, residents or visitors, the system assumes that each and every entry is unlawful. The individual must demonstrate the contrary. As a consequence, visas do not guarantee entry into the US and further evidence may be requested at a time when the migrant is hundreds of miles from his records. This introduces a high degree of uncertainty to land-based travel to the United States.

Between points of entry, border technologies serve a different purpose. If the main challenge of points of entry is access control, the technology deployed between points of entry has a different objective, interdiction. The re-bordering of North America is a direct consequence not of 9/11 as it is often assumed but of the change of strategy by the Border Patrol, called “prevention through deterrence.” Walling technologies are aspirational technologies of border games. They are visual artifacts providing a narrative of law and order, of control and surveillance, which is more important than their real capacities to interdict or deter illegal immigration flows. Andreas describes the counterintuitive effects of the deployment of border technologies as follows:

The border crackdown fueled the emergence of more skilled and sophisticated transnational migrant smuggling groups, creating a more serious organized crime problem along and across the border. Drug smugglers also responded to law enforcement pressure by integrating more with legitimate cargo, using the NAFTA-encouraged boom in trade to more effectively camouflage their illicit shipments. One negative unintended result was to create closer ties between licit and illicit trade. After years of intensified enforcement, the tasks of drug and immigration control at the border had actually become harder. New law-enforcement initiatives were systematically countered by new law-evasion techniques [Andreas 2003].

² The Electronic System for Travel Authorization (ESTA) would be an exception to this pattern. ESTA is another risk-management tool used to determine in advance the admissibility of citizens from countries in the Visa Waiver program before they initiate their trip, but in this case, the system increased the burden of traveling to the United States.

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This codependence between the deployment of border technologies and evasion techniques developed by criminals is the reason why the second socio-technical subsystem for immigration is formed by clandestine technologies.

Subsystem 2: Clandestine Technologies

Clandestine technologies are developed as second-degree consequences to governmental technologies. In a kind of border grand challenge, finding innovative ways to “hack” governmental interdictions through technological design is rewarded with a “prize” in the form of big profit margins. Clandestine innovations in the borderlands are a technological response to a human desire limited by a socio-technical regime. In this case, the human desire can be a product, as in the case of smuggling drugs or weapons; or it can be access to a forbidden territory, as it is the case of human smuggling and illegal migration.

In fact, the design of legal and clandestine technologies is codependent, as legal contractors and deviant entrepreneurs constantly innovate in a competitive environment to neutralize the capacities of each other. Deviant entrepreneurs are economically rewarded every time they successfully impose their will to the migratory and customs system. This creates a market for their counter-interdiction products. Those deviant technologies can assume many forms. For example, they can be a successful concealment technique to smuggle individuals or products through a legal point of entry or they can be a research effort to exploit geographic advantages and organizational behaviors of the border patrol, creating new smuggling routes.

Deviant technologies are developed using success-driven metrics in a process that is not centrally planned, and it rewards and punishes in real time. What this means is that bad technologies (e.g., a concealment compartment easily found by custom agents) or neutralized technologies (e.g., a smuggling tunnel) are rapidly replaced by new approaches, some of which will be successful and subject to incremental innovation. Governmental technologies react to clandestine technologies and clandestine technologies react to governmental technologies. This interplay has a big role in shaping the user’s experience. This codependent innovation creates tension and constant fluctuation in the socio-technical system, often decreasing the performance of governmental border technologies.

Subsystem 3: Business Technologies

Given the critical role that the workplace environment and the job market have in shaping immigration patterns, the business technologies used in the workplace for manufacturing, construction, agriculture, Information Systems (IT), management and supply chain technologies, among others, impact the migratory socio-technical system. The rapid pace of innovation in the past 20 years in workplace technologies has often been ignored by stakeholders when debating the state of the labor environment. Instead, they use 20th century sense-making models to debate workplace enforcement, guest-worker programs, and labor-based migration.

Historically, labor and territory have been directly correlated. For example, a worker could not operate heavy equipment without being physically present in the factory. Sales would always occur in a brick and mortar shop. Government agencies were not legally mandated to have a tele-work policy. Thanks to some recent technologies deployed in socio-technical work environments, geographic location is no longer a requirement for work and the relation between the migratory experience and labor has changed. While offshoring and outsourcing are well-studied consequences of this separation of work and territory, transformations in the job markets and the supply, production, and distribution chains is still an ongoing phenomenon with unpredictable ramifications.

The Future Freight Flows project of the Center for Transportation Logistics of the Massachusetts Institute of Technology (MIT) produced a scenario-planning tool to increase the future thinking capabilities of decision makers and stakeholders involved in the deployment of infrastructure technologies in this unpredictable environment. The project identifies “small changes in technology, demographics, regulations, economics, or a myriad of other factors have dramatic and unintended impacts on how companies source, manufacture, distribute and operate in general. These non-linear impacts are very difficult to predict using traditional forecasting methods and techniques since they, by definition, do not follow any historical patterns” (CTL Future Freight Flows 2010).

Work availability and the geographic distribution of available jobs impact immigration patterns more than any other factor, with the exception of family reunification. Therefore, workplace

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technologies like robotics, 3D printing, or the virtualization of work environments, to cite a few examples, will influence the future shape of the immigration socio-technical environment as much as the governmental and the clandestine technologies previously described.

The level of uncertainty introduced by the current state of development in workplace technologies makes it impossible to forecast what the nature of the job market will be in the near future. Even so-called low-tech jobs are transformed by the changes that happen at the top of the job market. For example, urban planning may be very different if intelligent manufacturing or the virtualization of office space become a reality, affecting the job market for construction, altering the kind of skills required to build the houses of the future, as well as the geography of where those houses would be built.

There is another way in which immigration and business technologies are correlated. As Wadhwa and Salkever (2012) state:

Immigrants occupy founding or key managerial roles in the highest-impact startups at a rate far disproportionate to their share of the U.S. population. A 2011 National Foundation for American Policy (NFAP) study of founding and management teams at the Top 50 venture-backed companies in the United States, as ranked by VentureSource, found that immigrants started nearly half of America's 50 top venture funded companies and are key members of management or product development teams in more than 75% of those companies.

The impact that an immigration-friendly environment has in the creative economy is well established as a key factor that has made the U.S. an innovative nation (West 2010). It produces a kind of self-selection where entrepreneurial or highly skilled individuals migrate to the U.S. and contribute to its prosperity. Through this link between innovation and migratory patterns, the immigration socio-technical system impacts other components of the American experience.

Nation of Immigrants 2.0? Some Policy Recommendations

Many policy recommendations can be made to improve the immigration socio-technical system. New identity technologies could be used to update the international immigration regime and replace passports in the same way that airlines replaced the paper ticket with e-tickets. Also, it

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would be simple to remove the uncertainty of the visa regime by changing the relation of the custom agents with the traveler, so the visa actually guarantees access to the country unless some supervening evidence is found by the custom authorities after the visa was granted. A national ID system could provide better information to employers and law enforcement agencies about individuals legally residing in the national territory, including permanent and nonpermanent residents and citizens. However, the most important changes to the socio-technical immigration regime will not come from incremental changes like these, but from rebooting U.S. immigration policy through a better socio-technical design, combined with a system thinking approach. The current state of the immigration system is the result of the unintended and counterintuitive consequences of laws promulgated without a real understanding of the systemic forces that the laws were trying to affect, compounded by the recent acceleration in the pace of innovation that has created the most dynamic environment in the history of the immigration policy regime.

Effectively managing this socio-technical complexity should be a central objective of immigration reform. Public policy design is no different from other technological design challenges. When initial poor design choices are made, unnecessary complications will render the technology complicated or ineffective. A good way to identify how well-designed a policy is is to see if it understands the way the human agents interact with the technical components of the socio-technical system. Good design accepts the shape of a system. For example, in neighboring countries with friendly international relations and strong trade ties, people from both sides of the border interact with each other, get married, have kids, travel for business or pleasure and migrate to where the jobs are. No technology solution deployed in the context of a democracy will stop people from forming a family with the person they love, wanting to be reunified with their mothers or providing for their children. Those are human needs that drive human behaviors. In the same way, regulation that gets in the way of the innovation capacities of the country is not only counterproductive, but also has negative ripple effects on the systems that support the creative economy of the United States. Finally, policies that fail to be adaptive will not be able to respond with enough velocity when confronted by clandestine innovation that produces technological adaptations to hack governmental interdictions.

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For all these reasons, an effective immigration policy will necessarily be complex, because immigration is a complex activity. As multiple components evolve, self-organize and change, they will continue to render the policy environment unpredictable, counterintuitive, and prone to unintended consequences. But good design practices provide some effective principles to deal with the challenges of complex technology systems and some of those principles may prove to be an effective meta-strategic guide for a new adaptive immigration socio-technical policy. Below are nine policy recommendations based in some of these principles.

Leadership for Sense-making

Because the leverage points in socio-technical systems are often counterintuitive and provide little political gain to policymakers, good strategic leadership must arm public opinion with sense-making tools to improve understanding of the inherent complexity that immigration systems must manage. Disruptive innovations are rarely understood by the majority of the people before they are adopted and tested and incremental innovation (the only kind in current management of the immigration policy) can lead to failure when environmental conditions have evolved but the regime has not.

Strategic leadership needs to lead the way when disrupting a socio-technical environment. When Steve Jobs said “It’s really hard to design products by focus groups. A lot of times, people don’t know what they want until you show it to them” (Jobs 1998), he was referring to this important design challenge. Innovation theory explains it like this, “... a disruptive technology is initially embraced by the least-profitable customers in a market ... Hence, most companies with a practiced discipline of listening to their best customers and identifying new products that promise greater profitability and growth are rarely able to build a case for investing in disruptive technologies until it is too late” (Christensen 1997). Public policies are technology products that have to be accepted by a large percentage of the population in order to affect in any meaningful way the socio-technical system. Public opinion polls, the equivalent in politics to the focus groups Jobs was talking about, are not going to lead the way to any disruptive transition.

Adaptive Designs

A sustainable and resilient socio-technical policy to deal with the complexities of immigration would have to be adaptive, responsive to environmental and contextual transformations, and sensible to human requirements and the technology adoption cycle that transforms the labor environment and the flow of people. It would also have to factor the unpredictable ripple effects the deployment of new technologies would have in the workplace, in the border zone, and in clandestine technology responses. Technology should be considered a central element of engineering change in the immigration regime and not just an accessory of border policies left in the hands of engineers.

Technological Transition Is Negotiation

The challenges of intervening in socio-technical systems to produce a transition have been explained by Smith, Stirling and Berkhout (2005, 1498) in detail:

Interventions have to be negotiated through governance processes involving multiple agents, none with decisive power. These networks of actors include regime members and other actors seeking to influence regime transformations. ... Governance is therefore carried out through negotiation and bargaining between interested state and non-state actors with interdependent resources relevant to maintenance and change of the regime. Impulses for change, especially major, long-term shifts, will often fail because they represent uncoordinated interactions between shifting, poorly articulated selection pressures and struggling adaptive capabilities.

Data, Not Aspirations

The design of aspirational technologies should be replaced by a technological architecture where real performance data is displayed clearly in immigration “dashboards” that provide information in real time about the state of the immigration socio-technical system. New computational social science tools can assist in the process of building these sense-making capacities. That said, certain human concerns such as family reunification, asylum, love, and the natural curiosity and risk-taking that drive human movement cannot be and should not be reduced to quantitative measurements or computational analysis.

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A CIO to Adapt Immigration Flows

Under current policies, there is no authority to fulfill the role of a Chief Information Officer (CIO) for immigration with power to deploy technologies to support efforts to manage the complexity of immigration behaviors. Responding to changes in human flows is as challenging as responding to changes in financial flows, but the effort to understand the movement of people pales in comparison to the resources deployed to make sense of capital movements. A good socio-technical design for immigration would need to reverse that trend because managing immigration is about managing changing flows and patterns and not about building rigid policy structures. Immigration technologies in the border and elsewhere produce counterintuitive feedback loops among multiple components of society that must be actively managed.

Risk Management Approaches

Risk management for immigration is a technology design challenge. Immigration technologies look for anomalies among a large amount of legitimate and desired interactions. A risk-management design must balance the need to detect unlawful behaviors, while efficiently managing legitimate flows.

Future Thinking Capacities for the Age of the Unthinkable

New technologies, like intelligent manufacturing, artificial intelligence, robotics, communication and computing, are opening the doors to unforeseen public-policy possibilities that will continue to change the strategic environment of the immigration policy space, but also empower policymakers to reframe the narrative in new ways. How would a labor policy for international tele-work look like when more bandwidth becomes available in the developing world? What happens to immigration if three-dimensional printers replace an important percentage of manufacturing being done today in production lines? How will robotics and precision agriculture impact the countryside jobs market? How will behavioral recognition systems alter our tolerance to profiling as an identity tool? New technologies create affordances that allow us to do things not thought possible in the past. Stakeholders and policymakers should improve their imagination and future thinking skills to understand different plausible scenarios in an unpredictable world.

Zero-Day Vulnerabilities and the Obsolescence Path

Technological transformations will provide new alternatives for clandestine actors to hack government technologies in unthinkable ways. What happens if biometric identity is stolen, given the fact that we cannot “change the password”? How will human smuggling change if the immigration socio-technical regime becomes skill-based? A socio-technical system that is complex is also hackable at multiple levels, constantly exposing unknown vulnerabilities of the system (i.e., zero-day attacks). A good public policy for immigration needs agility to deal with those unpredictable challenges and to “pivot” whenever systemic conditions change. What this means is that immigration technologies should be designed thinking about when they will become obsolete. For example, the technology designer of immigration security systems should be asking the question: “What happens when this technology is penetrated?” instead of “What happens if this technology is penetrated?” A clear obsolescence path should be embedded in the policy for when a security layer is no longer effective or when conditions change.

Immigration is the product of systemic patterns that can be reframed as a positive consequence of a strong socioeconomic model. Those patterns have to be scaffolded, not stopped, by an intelligent, adaptive socio-technical regime. High-skilled and entrepreneurial migration is the best antidote to any population imbalance that may affect the competitiveness of the U.S. in the future, but all migrants demonstrate a desirable risk tolerance just by making the difficult decision to migrate from their home country to look for better opportunities. Explorers, adventurers, and pioneers have always been, by the nature of their actions, migrants. This behavior, coupled with a good socio-technical design, should be encouraged and not punished, as it is directly correlated to the innovation capacities of the U.S. to imagine and build the future.

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