Rule Dynamics:

Understanding Commonalities in the Process of Emergence of *Best Practices* in *System Dynamics Modeling* and in *Financial Markets' Risk-Management Initiatives*

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Introduction

It is the dynamic process of rule creation and change that is at the hart of this analysis. Individuals in organizations formulate, follow, and break rules all the time. Because this dynamics happen in a social context, this research focuses on processes of rule creation, modification, and termination seeking to explain both successes and failures in governance, performance improvement, and accountability in organizations. Two questions that has guided this research are:

- Why do similar organizations in similar environments sometimes develop effective rules that guide their success and sometimes the rules developed are completely inefficient?
- Are there any particular settings or activities for rule making processes that especially enable an organization to achieve desired outcomes of governance, performance, and accountability?

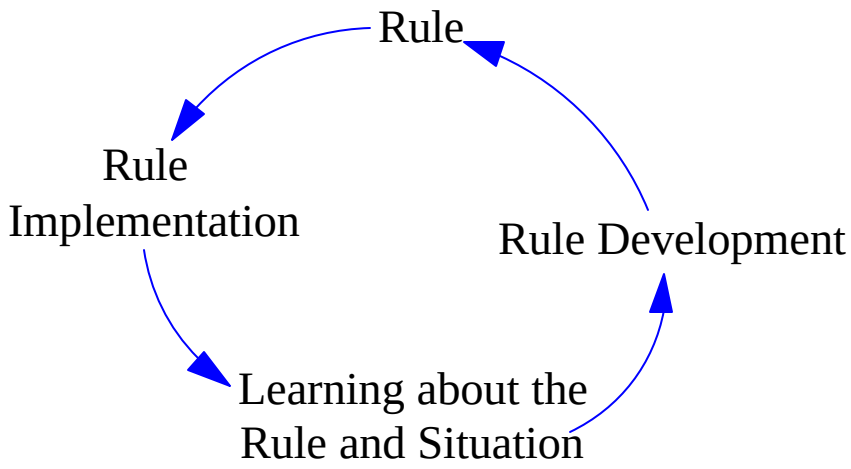

Figure 1—Rule Cycle

Rules and rule-based action are central features of all human society and human behavior. Human actions are organized around rules and these rules try to fit together to create and maintain social systems. Social norms or rules are powerful forms of control, fundamental to human behavior, that sometimes create impossibilities by design because they contradict each other. Yet, despite the powerful role of rules and possible important learning associated with them, rule formation and its dynamics have been

infrequently studied. Rules are developed in order to make life simpler to individuals in organizations. Rules are developed, formalized, and implemented to help deal with 'situations'—see Figure 1. One very important element that conditions the development of systems of rules is the learning process asociated wit it.

Both in the public and in the private sector, organizations try to organize rule systems that can improve performance and accountability. The ways in which these systems of rules influence organizations vary over time and depend on several interrelated factors. Part of the problem that arises when one studies *rules* is that there is a linguistic tolerance that allows for both the descriptive and the prescriptive dimensions to exist in words like 'rule', 'norm', and 'law' (Schauer, 1991a, p. 14) causing problems of interpretation and understanding. Each of the words described previously is used to refer both to an empirical regularity and a normative requirement in complex systems. This duality is difficult to understand and manage.

To talk about rules in organizations we need to identify where in organizations we see them. I present an organizational framework with three elements—see Figure 2. The elements are (1) organizational problems, (2) organizational rules, and (3) organizational performance. I know that this is not a complete view of the organization for many people but it might be if we consider the some assumptions about these elements.

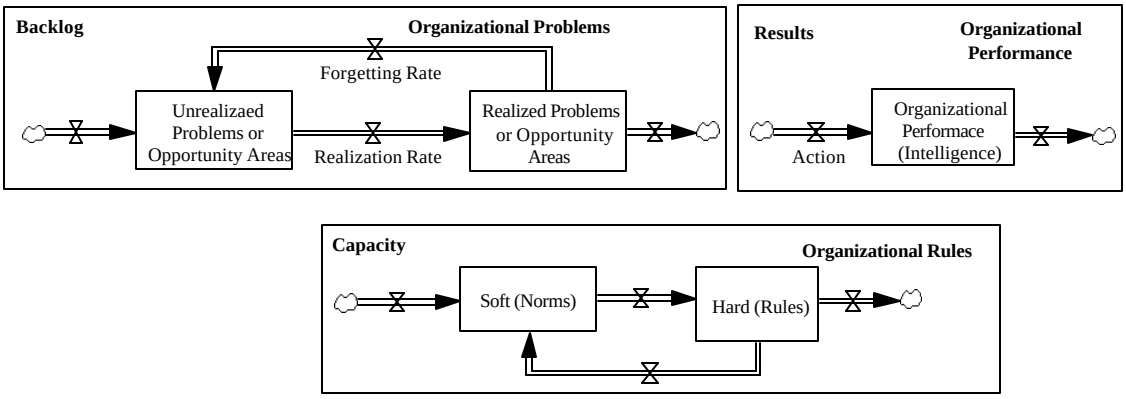

Figure 2—Organizational Elements

Organizational problems include all problems and opportunities that the organization faces over time, changes in the environment, changes in regulation, entry and exit of competitors to the market, etc. We say that there is an accumulation of problems and opportunities for the organization that the organization is not aware of until a *realization process* occurs. Once these activities are realized by the organization they become a stock of things to be addressed by the organization, a type of *backlog* of things to be addresses. These things to be addressed will be transformed into performance through organizational action.

Actions are the activities that the organization performs in the day-to-day activities. It includes problem-solving activities, decision-making activities, production activities, etc. All of these actions will contribute somehow to the organizational performance.

Organizational performance is the accumulated result of the activities of the organization. Some actions will contribute positively to the performance and some other actions will contribute negatively to it. The balance of contributions is what we call organizational performance. The specific measurement of performance can be quantifiable or hard—like profits per month, number of citizens served, product and service quality, or longevity of the firm—or fuzzy and difficult to measure, a soft type of variable—like employee satisfaction, impact on social welfare, or innovation and creativity.

Organizational rules are the conditioners of behavior in the organization. The rules can be seen as a monolithic element including all rules that condition behavior inside the organization or as different subgroups that constitute different rules. In this differentiated view of rules, rules can vary from soft to hard rules. Organizational culture would be the collection of soft, unwritten rules that shape the way things happen in it. It is very difficult to get your hands around the culture, yet surrounds people in organizations all the time. John Mack, CEO of investment bank Credit Suisse First Boston (CSFB), when asked about how he found CSFB first when he came from Morgan Stanley to manage it (Thornton, 2002), he said: "this firm [CSFB] had a history of tolerating cowboys [egomaniacal personalities who compete fiercely for deals often at the expense of their own clients and investors], […] and I do not like cowboys." Statements like this illustrate what organizational culture is about and how these unwritten rules

[tolerance, liking] shape behavior and configure possibilities in an organizational setting. Norms, customs, and guiding principles of the organization like the vision, mission, and values can be seen as special types of rules that will set behavioral mechanisms in motion. Also, the strategy of the organization can be seen as a specific set of rules. Objectives, goals, and targets for performance can also be defined as *the rule* in a certain point in time. The more specific and binding the statements of rules become, the harder they are considered to be.

Pressures that individuals—specially managers—in organizations face to generate results (performance) are increased by the pressures to do it in a responsible way that can be traceable and clear (accountability) to protect all constituencies interested in the results of the organization. In order to help organizations have better levels of performance, I argue that creating better systems of rules can help. However, individuals in organizations not necessarily accept rules of behavior because these can be intellectual threats or increased responsibility. The two major schools of thought that deal with how individuals follow rules are the particularistic school—that views rules as practical guidelines to achieve optimal behavior—and the standards school—that advocates the use of rules *by the book* without bending them or interpreting them to achieve better results (Goldman, 2002).

Governments and organizations in general could opt to establish decision-making processes solely based on rules. Alternatively, they could opt to use decision-making processes in which individual judgment, uncontrolled by rules, should be the source of decisions at any given time. However, in order to have the latter one, apparently in the absence of rules, the organization should have a set of rules in place empowering individuals to use their uncontrolled judgment in the decision-making process (Schauer, 1991a, p. 11). This speaks to the power of rule-based behavior in organizations, even when the rule systems are not entirely formal or written.

This paper—following reasoning presented by McCaffrey, Faerman and Hart (1995)—explores factors related to best practices generation and rule dynamics in two apparently very different settings—System Dynamics Modeling and Risk-Management Practices in Financial Markets—to understand better

the dynamics of rule creation and change. Researching rule dynamics tries to identify the way in which systems of rules influence both the structure and behavior of complex systems.

This paper is structured as follows. The first section presents the literature and definitions of rules more completely. The second section examines the emergence of best practices present in system dynamics modeling and risk-management practices in international financial markets. Despite the fact that these two areas appear to be extremely different—one relates to a field of knowledge and the other to practices in the financial world—both are highly competitive, results oriented, and influencing by their work a larger 'market' for everyone involved. A legitimate worry for how the work of individual firms, and individual practitioners affects *the market* is present in both areas. This section describes more in depth both the system dynamics method (following in part rationale presented in Martínez-Moyano and Richardson, 2002) and the risk-management activities in financial markets (following in part rationale presented in Faerman, McCaffrey and Slyke, 2001). The third section presents a theory that addresses how to explain change in systems of rules based on the findings of the literature and the lessons learned from the cases examined. At the end, a discussion section deals with issues that I believe need to be recognized and explored to help make sense of the discrepancy between the appeal to 'know' what best practices are, and actually 'research' to know them, and finally 'act' to use them as rules of behavior in organizations. Suggestions for extensions in future research are presented.

The Literature and Definitions of Systems of Rules

Major Literature Threads

The research method used for this work includes a review of the literature on rules to identify the major lines of thinking related to the topic. Literature ranging from 1938 to 2002 was reviewed. Two major areas related to rules were identified coming from six different, and somehow consolidated, threads of literature. A summary of the literature reviewed is presented in Table 1—below.

Table 1							
	Period	Decision Making	Organizational Theory	Economics		Anthropology, Sociology, Psychology, and Mathematics	Philosophy, Linguistics, Government, and Law
				Policy Analysis, Game Theory, and Institutionalism	Public Choice		
1	1936-1940					(Durkheim, 1938) B	
2	1941-1945						
3	1946-1950						
4	1950-1955						(Rawl, 1955)
5	1956-1960	(March and Simon, 1958) B					
6	1961-1965						
7	1966-1970						
8	1971-1975					(Gumb, 1972) B	(Ganz, 1971) B **(Raz, 1975) B**
9	1976-1980			(Kydland and Prescott, 1977) TA			
10	1981-1985	(Meindl, 1982) TA	(March, 1981)	(Buiter, 1981) TA	**(Brennan and Buchanan, 1985) B**		
11	1986-1990	(Brady, 1987) TA (March, 1988) B		(Borio, 1986) TA (Barro, 1986) TA (Rowe, 1989) B		**(Swidler, 1986) EA** (Hayes, 1989) B	
12	1991-1995	**(Schauer, 1991a) B** (Lant, 1992) SA	(Lant and Mezias, 1992) EA (Cohen and Bacdayan, 1994) EA		**(Vanberg, 1994b) EB** (Vanberg, 1994a) BCh (Vanberg and Buchanan, 1994) BCh	(Casti, 1992a) B (Casti, 1992b) B (Zhou, 1993) EA (Giddens, 1993) B	(Schauer, 1991b) A (Alexander, 1991) TA (Postema, 1991) (Baldwin, 1995) B
13	1996-2000	(March, 1997) B (Zhou, 1997) B (Schulz, 1998) EA (Greve, 1998) EA (March, 1999) B **(March, Schulz and Zhou, 2000) B**		(McClennen, 1997) TA		(Ensminger and Knight, 1997) EA (Brinton and Nee, 1998) EB (Conlisk, Gong and Tong, 2000)	
14	2001-2005	(Denrell and March, 2001) SA (Greve, 2002) SA		(Hayes, 2001) B (Lemola, 2002) EA	(Mudambi, Navarra and Sobbrio, 2001b) EB (Mudambi, Navarra and Sobbrio, 2001a) BCh (Buchanan and Yoon, 2001) BCh (Mueller, 2001) BCh (Vanberg, 2001) BCh		(Nichols, 2002) EA **(Goldman, 2002) B**

EA—Empirical Article; TA—Theoretical Article; SA—Simulation-based Article; B—Book; EB—Edited Book; BCh—Book Chapter

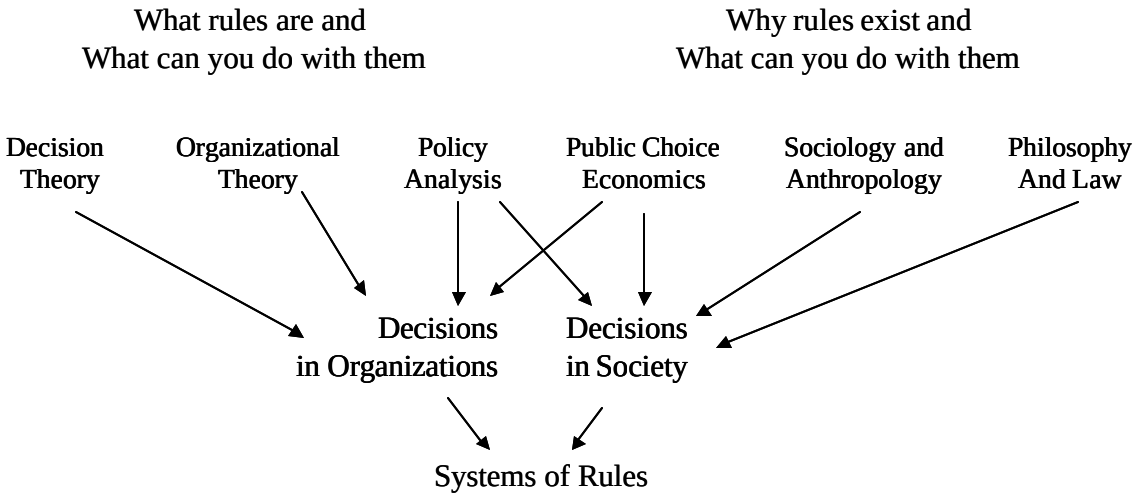

Figure 3—Preliminary Distinctions

The two major areas identified in the literature are related to what rules are and why rules exist. These two major areas feed two threads, one deals with decisions in organizations and the other deals with decisions in society. Combined understandings of these threads can become essential to clarify the dynamics of systems of rules.

Definitions and Explanations

Rules, Reasons, and their Characteristics

Rules are statements of the way things work or how they should. Rules have a descriptive or a prescriptive nature. Most of the time, the word *rule* is associated with a prescription of how things *should* be. According to Schauer (1991a, p. 15), rules are "a form of decision making characterized by its reliance on entrenched but potentially under- and over-inclusive generalizations." He distinguishes rules from principles by explaining that rules implies the existence of a degree of precision, specificity and canonicity while principles imply absence of these elements. Additionally, Schauer introduces a distinction between conclusive and overridable rules. This distinction speaks to the possibility of not complying with specific rules in certain situations.

Goldman, (2002) explains that "what determines the status of [such] a rule is its role in controversial cases where values conflict, whether the factors it mentions are granted priority or special

weight." (, p. 20) According to Goldman there are three types of rules, rules of thumb, strong rules, and prima facie rules. He asserts that "prima facie rules are supposed to pick out properties that are always relevant in the same way, that are never nullified or reversed, and that leave a moral reminder when overridden is not relevant to reasoning about what to do once these properties have been identified." (Goldman, 2002, p. 20)

Rules are not created in a vacuum; rules exist for a reason or motivation. Schauer (1991a, Chapter 7) presents a clarification of the different reasons that motivate the creation of rules. According to his analysis, there are five main reasons related to the creation of rules. The reasons are fairness, reliance, efficiency, stability, and coordination. Out of these reasons, Schauer (1991b; 1991a) distinguishes fairness as one of the key reasons. Rawl (1955), in his exploration of fairness in rule application, explains that according to utilitarian theory, punishment and promise keeping are two basic elements that give rules the capacity to regulate behavior. Punishment is linked both to the justification of the rule and to the justification of an action derived by the rule. Actions derived by rules can become the center of attention sometimes raising doubts about the rules that allowed the actions to take place (e.g. the action of killing someone in death row as the result of the death penalty rule to be in place).

Rules have certain characteristics that create the opportunity for them to be fuzzy and problematic when used as guides for action. Rules "are often described as under- or over-inclusive with respect to their generating justifications" (Schauer, 1991a, p. 50) at any given point in time. This miss-inclusiveness characteristic is related to the fact that rules are probabilistic generalizations of specific situations. And because of that, there are some necessary outcomes of that generalization. One is selection; you choose what to incorporate in the generalizations, the features that apply to all cases. And the other is suppression, you choose what to suppress from the description based on your understanding of today's considerations. These two outcomes generate the possibility of, when applying a rule, encountering two types of situations. The possible situations are recalcitrant or adequate (Schauer, 1991a). Recalcitrant experiences contradict the specifications of the generalization because the probabilistic warranted

generalization is incorrect on this specific experience, or because a supposedly universal generalization turns out not to be universal, or because a suppressed property of the generalization is now germane.

Rules, therefore, can be considered as having 'open texture'. Open texture "is the ineliminable possibility of vagueness, the ineradicable contingency that even the most seemingly precise term might, when it confronts an instance unanticipated when the term was defined, become vague with respect to that instance." (Schauer, 1991a, p. 36) Rules' open texture creates the possibility of interpretation and clarification of even the clearest rules. Rules' open texture can be considered the result of the interaction of two different elements in rule making processes. First, the rules to make rules or the rules of process that influence how systems of rules are created and changed. Second, the rules to express rules or the rules of language that influence how we structure the rule, its meaning, its justification, and consequences. Rules expressed in English will differ from those expressed in Farsi or in mathematics. The rules will not differs enormously, but slight differences due to the language used can become salient for interpretation purposes. See Figure 4 for a description of the influences.

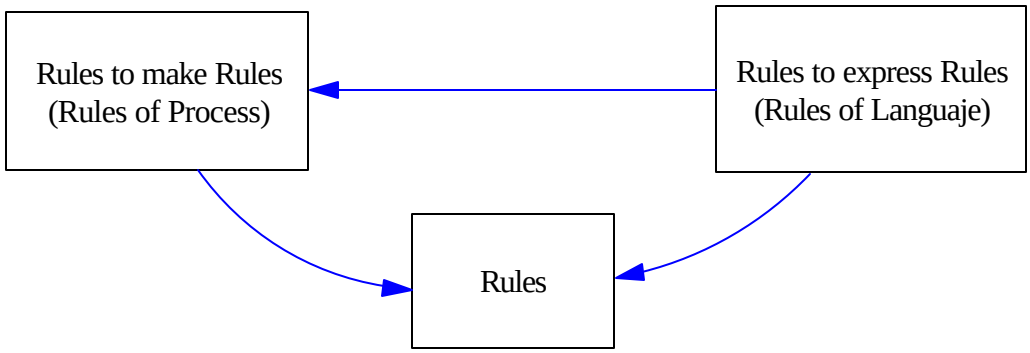

Figure 4—Influences on Systems of Rules

Types, Structure, and Considerations for Change in Systems of Rules

Rules can be identified as being part of different kinds or types. The most salient distinction for our purposes is the distinction between descriptive and prescriptive rules (Schauer, 1991a, Ch. 1). In rule-based decision making research understanding the role that rules play is crucial to be able to influence change. Rules will convey two different things depending on their origin. If the rules that we are talking about are *descriptive* rules, we are talking about statements of empirical regularity or generalizations

about the state of the world (Schauer, 1991a, p. 1). In the descriptive case, the word follows the world. Or more precisely, the rule follows reality. Descriptive rules are used to report empirical regularities trying to explain uniform behavior. In this case, rules differ from singular observations in being general and not particular. When you are describing the phenomenon, no analysis precedes the report. Alternatively, prescriptive rules are used to state a mandate with normative force. Prescriptive rules are used to guide, control, or change the behavior of agents with decision making capacities (Schauer, 1991a, p. 2). These rules have normative semantic content. Prescriptive rules are used not to reflect the world but to apply pressure to it. In the case of prescriptive rules, the world follows the word. Or, again, more precisely, reality follows the rule. When you use prescriptive rules you are making an effort to create a new reality based on analysis and understanding. In reality, both descriptive and prescriptive rules interact creating a feedback loop in which the description sometimes becomes the prescription and the prescription becomes only a description of what has become the norm[1].

Rules also can be identified as mandatory or optional. "Mandatory rules, when accepted, furnish reasons for action simply by virtue of their existence *qua* rules, and thus generate normative pressure even in those cases in which the justifications (rationales) underlying the rules indicate the contrary result." (Schauer, 1991a, p. 5). Optional rules are described as formulas, instructions, or 'rules of thumb' that can be used if your interest is to succeed in a certain enterprise. Instructions provide directions for success in a given activity while rules of thumb represent useful guidelines for action. However, even when accepted, these rules do not provide reason for action *per se*.

Schauler (1991a, pp. 6-7) presents another way to create a distinction among rules, regulative and constitutive. According to Schauer, regulative rules govern antecedently existing behavior (e.g. speed limits) while constitutive rules create the very possibility of engaging in certain behavior (e.g. castling in

[1] In this research I have realized that norms can be considered a special case of rule that has some interesting characteristics that will be explained later in this document. For our purposes, *rule* will be the overarching concept within which norms can be found and described. From this assumption, the indistinct use of the words rule and norm is valid and in some cases even desirable to convey the meaning. In the *rules* literature is quite common to have the indistinct use of these two words. Unfortunately, this common use is not clarified and therefore flawed.

chess). Another distinction comes from Goldman (2002) that depicts rules as dispensable or prudential and indispensable or moral. According to Goldman, in rule-based decision making, the creation, evolution, and use of rules is highly related to a moral choice in which the *character* of the rule is crucial.

Systems of rules are composed by rules . Rules, in turn, are composed by elements, the protasis, the apodosis, and the goal of the rule. The goal—or justification—of the rule is crucial for the usefulness of the rule, in fact, the justification of the rule precedes any type of action. Also, the goal of the rule has a motivation of the goal. Sometimes the motivation is explicit and sometimes is implicit. Understanding the motivation and justification of the rules is key in order to clarify the pressures for the formation and change in rules systems. The protasis is the part that contains the 'operative facts' of the rule also referred to as the 'factual predicate' (Schauer, 1991a, p. 23) or the hypothesis (If x—where x is the descriptive statement) of the rule statement. The apodosis is the part the contains the consequent (Schauer, 1991a, p. 23) of the rule or the consequence (If *x* then *y*—*y* being the descriptive statement of what consequence will have if *x* happens) of the rule. To understand the dynamics of rules we have to understand that originally a motivation is translated into a goal that then is operationalized as a rule which, in turn, is implemented. Once an implemented rule is available, the opportunity of interpreting it appears. This process can be inductive, accumulating experiences, perceptions, or triggering events that activate motivations, or it can be deductive by means of existing rules. These inductive or deductive processes can generate pressured for change in the rule systems. Schauer (1991a, p. 45) identified three sources of pressure for change in rule systems. These sources are: the presence of the 'minority' *x*, in probabilistic generalizations, the presence of an unexpectedly different *x*, in the case of open texture, and the presence of a now relevant non-x property of a particular x, in the case of suppression of potentially relevant properties. Changes in rules can trigger change in other rules and rule systems due to their interconnectedness and inherent entrenchment. However, because of the same reasons, the systems of rules can become stagnant and very difficult to change. The hypothesis is:

> **Hypothesis 1 (H1):** When the relative dependency of a rule system on another in the organization increases, the probability of observing

correlated change (volatility/stationary) in those rule systems will increase.

Sources of Power in Rule Systems, Best Practices, and [Second] Best Practices

Rules systems are powerful mechanisms for controlling behavior (March, 1988) in organizations. However, "organizations are continually changing, routinely, easily, and responsively, but change within them cannot be arbitrarily controlled. […] Change in organizations depend on a few stable processes" (March, 1981, p. 563) that can modify the strength of the rule systems in place. Besides, "action can be seen as the application of standard operating procedures or other rules to appropriate situations" depending on the interpretation of the rules and the meaning assigned to them by individuals in organizations. The interpretation of the rule system will be influenced by the perception of the strength of the system itself. The sources of power of the rule systems can be found in their meanings (what is the intended purpose and meaning of the rules), sanctions (what are the sanctions and/or rewards attached to the behavior intended by the rule), and attitudes (what attitude towards the rules the addresses have independently of the meaning and sanctions) of the rule subjects. In addition, prohibition and compulsion can be understood as the poles of a continuum that entitles strength to the rule system.

Hypothesis 2a (H2a): When the relative strength of a rule system increases (via meaning, sanctions, or attitude), the probability of observing changes in it will decrease.

Hypothesis 2b (H2b): When the frequency of changes in a rule system decreases, at least one of the sources of power (meaning, sanctions, or attitude) has been saturated reaching an equilibrium state.

Systems of rules can be understood as 'best' options for decision making or as 'second best' depending on the type of assumptions that the individual makes while following the rules. Best practices then can be considered a special case of rule when reaches certain level of meaning and generated a certain attitude in the individuals of the organization. Also, rules can be described as [second] best practices when the rule follower considered them the 'benchmark' to beat when confronting a decision. If the decision maker can generate a better way to deal with the situation at hand, then he will not use the

rule, but if he cannot find a 'better' solution, then he will follow the rule provided. This type of rule following encourages creativity but can generate inconsistency across organizational actors.

Emergence of Best Practices

Studying the mergence of best practices in system dynamics modeling has been instrumental enhance the understanding of the dynamics of rule systems in organizations. Additionally, by means of comparing the process observed in the System Dynamics Community with the one documented by Faerman, McCaffrey, and Slyke (2001) in the Policy Derivatives Group, lessons about the way in which best practices become norms and rules were identified.

Best Practices in System Dynamics Modeling

System Dynamics: Some Assumptions, The Modeling Process, and Terminology

System Dynamics was developed in the late 1950's and early 1960's at the Massachusetts Institute of Technology's Sloan School of Management by Jay W. Forrester as he consciously applied control principles to management and economics (Lane and Oliva, 1994, p. 219). And since then, many people in system dynamics including Jay Forrester (1979, p. 14) have said that "the most important and difficult step in system dynamics is perception of a model structure appropriate to the chosen purpose." One of the questions asked constantly is: how is a model structure determined? Many answers revolve around words like, art, craft, intuition, expertise, process, style, and science. According to Forrester (1979, p. 15), "perceiving model structure is akin to the process of invention," and "[perception of model structure] is not easy." Forrester goes on by saying that (p 15), to him, "it is a trial and error process" where models are formulated, tested, evaluated, discarded, and replaced over time in "a gradual shaping of a unity between the structure of the *real system*[2], the behavior of the real system, the [structure of the] model, the behavior of the model, and the model builder's purpose."

[2] Italics added

System Dynamics is a computer-aided approach to policy analysis and design (Richardson, 1996, p. 656). It applies to dynamic problems arising in complex social, managerial, economic, or ecological systems – literally any dynamic system characterized by interdependence, mutual interaction, information feedback, and circular causality (Richardson, 1996). System dynamics concentrates on the circular causality and feedback nature of systems in order to understand their behavior throughout time. The main purpose of system dynamics is to try to discover the 'structure' that conditions the observed behavior of the system over time. System dynamicists try to pose 'dynamic' hypotheses that *endogenously* describe the observed behavior of systems. The 'endogenous' view is critical to system dynamics modeling allowing the existence of feedback rich explanations for certain types of phenomenon. System dynamics is fundamentally interdisciplinary and is grounded in the theory of nonlinear dynamics and feedback control developed in mathematics, physics, and engineering (Sterman, 2000, pp. 4-5).

Mathematically, the basic structure of a system dynamics model (Richardson, 1996, p. 657) is a system of coupled, nonlinear, first-order differential (or integral) equations that can be written in the form:

$$(1)\ \frac{dx}{dt} = \dot{x}(t) = f[x(t), u(t)]\ ;\ \text{Given}\ x(t_0)$$

Where:

$x(t) = n^{th}$ Order vector of system states (or levels) $\quad u(t) =$ Vector of exogenous inputs

$x(t_0) =$ Initial value for state vector at $t = t_0$ $\quad f(\ ) =$ Nonlinear vector function

$\frac{dx}{dt} = \dot{x}(t) =$ Time derivative of the state vector

And the set of equations representing a system dynamics model can always be manipulated into the form of (1). This can be identified as *the structure of the model.*

Model Building Process

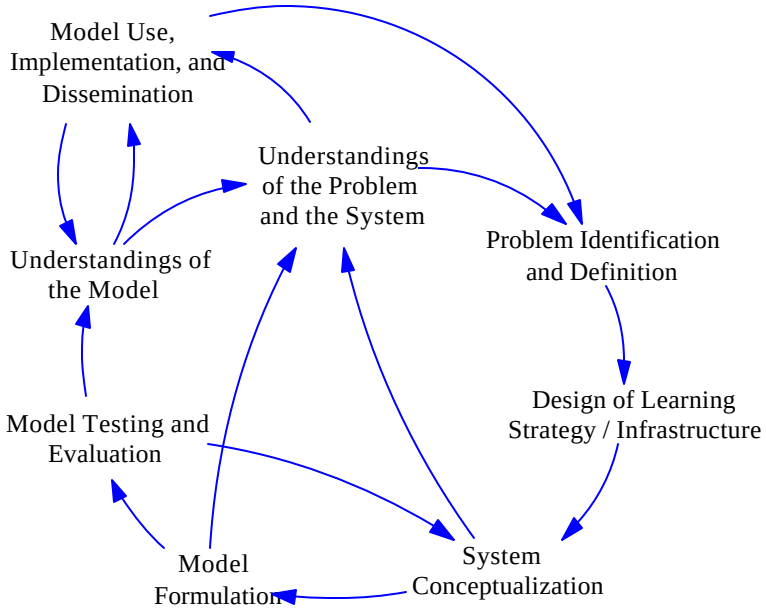

Figure 5. – Overview of the System Dynamics Modeling Approach (adapted from Martínez-Moyano and Richardson, 2002).

The system dynamics model building process involves six key activities as shown in Figure 5— above. The activities are (1) problem identification and definition, (2) system conceptualization, (3) model formulation, (4) model testing and evaluation, (5) model use, implementation and dissemination, and (6) design of learning strategy / infrastructure. The key products generated are (1) the understandings of the model, and (2) understandings of the problem and the system. System dynamics modeling has proven valuable for modeling dynamic behavior in a number of settings (Sterman, 2000, pp. 792-800), specially in public and corporate policy.

According to Richardson and Pugh (1981, p. 16), "the model is a means to an end, and the end is understanding" both the model and the system under study. In order to develop a system dynamics modeling effort, the modeler will develop all six activities and through that process will generate understanding of the model and of the system under study that will lead the policy recommendations and implementation.

Best Practices in System Dynamics Modeling

If what Fey (2002, p. 8) argues, while discussing the philosophy of the system dynamics methodology, is true, and "SD [system dynamics] is a science-aided art, rather than a true science", then there cannot be any magic formula that tell you how to do it in the *best* way possible. However, because it—system dynamics modeling—can be learned in practice, there *can* exist some general guidelines to do it. These guidelines, if they come from wise practitioners, can embody knowledge and expertise in such a way that will avoid common pitfalls in this difficult process. Martínez-Moyano and Richardson (2002), researching best practices in system dynamics modeling, have started to scratch the surface of this general guidelines and present, in their paper, 71 'best' practices grouped into the six categories of the modeling process—15 for problem identification and definition, 9 for system conceptualization, 11 for model formulation, 8 for model testing and evaluation, 8 for model use, implementation and dissemination, and 7 for design of learning strategy/infrastructure—and more importantly, they present 13 practices identified as controversial in which the experts that participated in their study appeared to disagree. Table 2 summarizes the modeling process, the activities, the purpose of each activity, the main recommended practices (according to the results of the study by Martínez-Moyano and Richardson, 2002), and the products.

		Purpose	Recommended Practices
1	Problem identification and definition	To gain awareness of the problem and create an unambiguous definition of it.	• Talk and listen reflectively to problem owners (clients). • Clarify the purpose (e.g. strategy/policy, theory building, education, and training). • Identify the reference mode: The central "process" or time development to be studied and use reference mode diagrams to explore people's expectations of future behavior. • Ask why is current behavior of key variables generated, and what is causing it. • Formulate the dynamic hypothesis (i.e., "this behavior is caused by that structure").

2	System conceptualization	To develop the physical structure, information flows, perceptions, and arising pressures that influence change in the system. Articulate a *dynamic hypothesis* of the problem.	• Recognize that conceptualization is creative –there are no recipes– approach it from different angles and avoid rigid separation of the identification / conceptualization stages. • Generate a dialogue with the problem's owners that addresses their mental models and the dynamic hypothesis. • Start with major stock variables to describe the system, draw their reference modes and make sure their names are nouns, not verbs or action phrases.
3	Model formulation	To translate model structure into mathematical equations. To transform the conceptualization from a qualitative view to a quantitative representation.	• Work up through a series of simple—to more comprehensive—models adding detail as needed to improve realism and show policy impacts quantifying the structure a bit at a time. • Leverage the power of dimensional consistency; use it from the very beginning. • Be sure equations make sense: all parameters must have real-life (explicable) meaning.
4	Model testing and evaluation	To gain confidence in the model structure, refine and reformulate if necessary. Also, to learn about the model and the system by means of sensitivity analysis and generate [policy] recommendations.	• Compare behavior patterns against real ones, use statistical measures of pattern fit, not point-by-point fit. • Ensure that the model responds appropriately to extreme (but plausible) shocks and values. • Test each equation for logical plausibility. • Analyze unexpected results from predicted upcoming behavior to find their causes.
5	Model use, implementation and dissemination	To clarify the recommendations for change that understanding from the model created and structure the way in which problem owners will be able to use in the real world these recommendations.	• Understand that the entire exercise most revolve around the problems of concern for the audience (problem owner, client). • Communicate the findings of the process in a clear language telling "system stories" that identify problems, causes, and solutions.
6	Design of learning strategy / infrastructure	To design the way in which the recommendations can be used to create deep understanding of the system in which the problem exists. To lever the power of the model learning.	• Use simplified causal-loop diagrams (CLDs) and tell system stories repeatedly and in many ways—do not let the model tell its own story. • Ensure that learning exercises are always debriefed carefully and adequately so that players understand what really happened and key learning are reinforced. • Use counterintuitive results to explain reality (via the model).
	Products		Main Focus of the Product
1	Understandings of the model	To gain deep knowledge about the model being used to understand the problem and system.	• Lessons learned from the model that can be actionable in the real world. • Lessons about the model structure and the way these relate to the real world.
2	Understandings of the problem and the system	To gain deep knowledge and understanding about the problem under study and how the feedback rich system in which it appears participates in the problematic behavior.	• Insights with respect to how the system works • Insights with respect to where to intervene to change behavior • Insights with respect to how to implement different policies to achieve the desired changes • Insight related to the overall capability of the system under study

Table 2—Description of activities and products of the System Dynamics Modeling Method

Figure 6 shows a summary of the results of the study per activity of the model building process. An interesting result is that out of 198 practices ranked, 126 or about two thirds of all suggestions are considered indistinct issues. Martínez-Moyano and Richardson (2002) report that the 'indistinct practices' are the practices that were not considered important enough[3] by the group of experts of the study.

		Areas of the Model Building Process							
		Problem Identification and Definition	System Conceptualization	Model Formulation	Model Testing and Evaluation	Model Use, Implementation, and Dissemination	Design of Learning Strategy /Infrastructure	Total of practices	Relative Percentage
Type of agreement	Highest Rated	5	3	3	1	1	1	14	**7%**
	Highly Rated	5	3	3	3	1	2	17	**9%**
	Moderately Highly Rated	5	3	6	4	6	4	28	**14%**
	Indistinct Issues	32	26	28	21	11	8	126	**64%**
	Controversial	2	3	2	3	1	2	13	**7%**
Total		49	38	42	32	20	17	198	

Figure 6. – Summary of Results of the Study per activity

Table 3shows a summary of the 'controversial practices' identified in the study. It is important to mention that the controversial category was identified by selecting those practices that were ranked two standard deviations above the mean with respect to importance and two standard deviations above the mean with respect to the variability of the rankings assigned to them. This means that the controversial practices were considered the most important practices by a portion of the participants of the study and also were considered the least important practices by other portion of the subjects. However, this is a

[3] In the prioritization stage of the study, these practices were ranked two standard deviations around the mean.

measure of relative importance, therefore it does not mean that these practices were considered not important. What it means is that other practices in this sample were relatively more important than these.

Controversial Practices		
1	Problem identification and definition	• Identify the class of systems to which the particular case belongs. • Model the class to which the case belongs, not the case at hand.
2	System conceptualization	• Iteratively sketch causal loop diagrams, identify state variables / levels, identify system boundary. • Draw the structure of your dynamic hypothesis as a causal-loop diagram if stock-and-flow structure presents difficulties. Concentrate first on identifying main connections and major loops (loop explanations for reference modes). • Identify / draw stock-flow structures (resources, customers, products / services) and identify influences on flows.
3	Model formulation	• Select a "core" piece of structure and grow from it (select / add / analyze) never straying too far from a running model. • Think of extreme condition tests in writing equations; simulate different extreme conditions and check if equations work in those conditions; otherwise modify the model.
4	Model testing and evaluation	• Ensure that dimensional consistency of model equations exists. • Test and validate as an iterative process. • Ask, Do I understand the behavior?
5	Model use, implementation and dissemination	• Ask, Do I understand if the study is related to an important, dynamic problem?
6	Design of learning strategy / infrastructure	• Build and use interactive gaming versions (flight simulators) of the model(s). • Emphasize the learning process and outcome, more than the model itself.

Table 3—Controversial Practices

In *problem identification and definition*, there is disagreement over whether to model the class of the system or the case at hand. In *system conceptualization*, even though there is agreement on starting with major stock variables, there is disagreement on iteratively using a casual-loop diagram approach or a stock-and-flow approach to conceptualize. In *model formulation*, there are two major areas of disagreement on how to formulate models. The first relates to the issue of starting small and continuously simulate and, preferably, always have a running model. This disagreement tells us that there is groups of experts who formulate piece by piece, always trying to have a running model at hand; and another group who prefers to formulate in big chunks and is not concerned about continuously having running

prototypes. In *model testing and evaluation*, the three controversial practices seem 'not' so controversial. The most important controversy is related to the iterative approach to test and validation. This controversy can be understood as a way to gain confidence in the model; some practitioners seem to prefer incremental actions; while others are more definite. In *model use, implementation, and dissemination*, the controversy seems to be related to the timing of the proposed question, possibly a procedural difference. Conceivably, to ask this question at this point of the model building process could be too late. In *design of learning strategy/infrastructure*, an interesting difference of opinion divides the experts' view of what is important when trying to learn from the models we build.

The emergence of best practices in the system dynamics community has been slow and controversial. Some people within the community think that this effort is extremely good and necessary. However, there are several members of the community that have expressed their concerns about the idea, the method, the usefulness, and the desirability in the first place. The emergence of best practices in system dynamic modeling has been equated by many as the first step towards a type of regulation that will harm creativity and expansion in the field. These interpretations of the effort are welcome and encouraged. However, avoiding the responsibility of creating a solid knowledge base for future practitioners in the field could prove to be worse in the long run.

Being subjects of regulation is something that many people try to avoid at all costs; the system dynamics community is no different than other communities in this respect. However, in order to have a shared social order and a way to coordinate our actions in an ideological market, it seems sensible to try to identify and formalize ideas about how to solve the common problems identified in the system dynamics modeling process.

The international financial markets have gone through a similar process that culminated in the issuance of a 'framework for voluntary oversight' that tried to capture the 'best' way to go about trading 'over the counter derivatives (OCD)' in the market to prevent failures due to individual or firm misbehavior. Best practices, in this case, served to *protect* their market against themselves and the competition.

The Derivatives Policy Group's "Framework for Voluntary Oversight"

The Derivatives Policy Group's "Framework for Voluntary Oversight" was based on three key and interrelated factors (Derivatives_Policy_Group, 1995).

> ***First,*** the DPG's initiative constitutes part of a process, not an event. The DPG views its initiative as an important part of a continuing evolution of policies and practices from which participating firms, as well as the SEC and the CFTC, will gain important experience and insights. In that process, and as the relevant markets inevitably evolve, the DPG anticipates further refinement and adaptation of the framework it is advocating.
>
> ***Second,*** in order to facilitate its analysis, the work of the DPG was divided into four major components. Although particular observers may focus on selective elements of the framework, the DPG views its initiative as an integrated whole in which the component parts complement each other.
>
> ***Third,*** the firms represented on the DPG are only six firms participating in a marketplace that is large, diverse and global. As a result, the DPG recognized the need to be sensitive to the competitive environment in which these activities occur.

As determined in the second factor, the participants of the group determined an analytical framework for the 'framework' which allowed the possibility of developing the practices that were considered as basic to ensure the proper behavior of individuals in the market. The analytic framework consists of four elements (Derivatives_Policy_Group, 1995), management controls, enhanced reporting, evaluation of risk in relation to capital, and counterpraty relationships.

With respect to management control, the primary objectives were "to build upon existing controls and to provide a comprehensive framework for professional intermediaries in the OTC derivatives markets to implement their business judgments as to the appropriate scope and level of OTC derivatives activity they wish to undertake." (Derivatives_Policy_Group, 1995) The proposed framework was carefully designed to provide a comprehensive outline of relevant considerations flexible enough to contain options suitable for different organizational structures, different management philosophies, and different organizational cultures.

The DPG's focus with respect to enhanced reporting was directed to "determining the scope and extent of the information that would be appropriate and useful for voluntary oversight of the OTC derivatives business. The objective of the DPG was to provide a mechanism for reporting information that

reflects the measurement and execution of prudent management policies and oversight functions established within the firms with respect to risk exposures." (Derivatives_Policy_Group, 1995)

Wit respect to risk evaluation in relation to capital the group identified "a verifiable framework for the estimation of the market and credit risks associated with an OTC derivatives portfolio so as to facilitate the evaluation of such risks in relation to a firm's capital." (Derivatives_Policy_Group, 1995) In this area, two considerations were made: (1) The development of minimum standards, audit, and verification criteria that all models could satisfy to estimate the "capital at risk" associated with OTC derivatives activities was designed. "These minimum standards and verification techniques are, to the best of the knowledge of the DPG, the first such common standards to be developed for this purpose. As such, they are not the last word on this subject. Rather, the DPG anticipates that they will evolve with experience and the passage of time." (Derivatives_Policy_Group, 1995) (2) Second, the acceptance of a common approach to calculating estimates of exposure or risk of loss associated with a given portfolio of derivative products had to assessed and accepted.

Counterparty relationships guidelines for firms "address a number of subjects, including: the promotion of public confidence; the provision of generic risk disclosure statements; clarification of the nature of the relationship between professional intermediaries and nonprofessional counterparties; and the preparation of marketing materials, transaction proposals, scenario and other analyses and valuations and quotations. The guidelines also address matters pertaining to the professional intermediary's internal policies, controls and supervision of personnel." (Derivatives_Policy_Group, 1995)

According to statement of the group (Derivatives_Policy_Group, 1995), "the major emphasis of the DPG and its working groups has been directed toward the identification of prudential policies relating to the safety and stability of the major professional intermediaries as well as the markets for OTC derivative products and their underlying financial instruments." The effort of the group in identifying best practices and guidelines for the over the counter derivatives market helped reduced the risk of systemic risk in their operations increasing the confidence of all parties involved.

Faerman, McCaffrey, and Slyke (2001) identified four key elements that allowed the effort of the group to become a success. The elements are: the initial dispositions toward cooperation, the extant issues and incentives, leadeship, and the number and variety of organizations involved. Figure 7 presents a feedback view of the elemts presented in Faerman, McCaffrey, and Slyke's (2001) analysis.

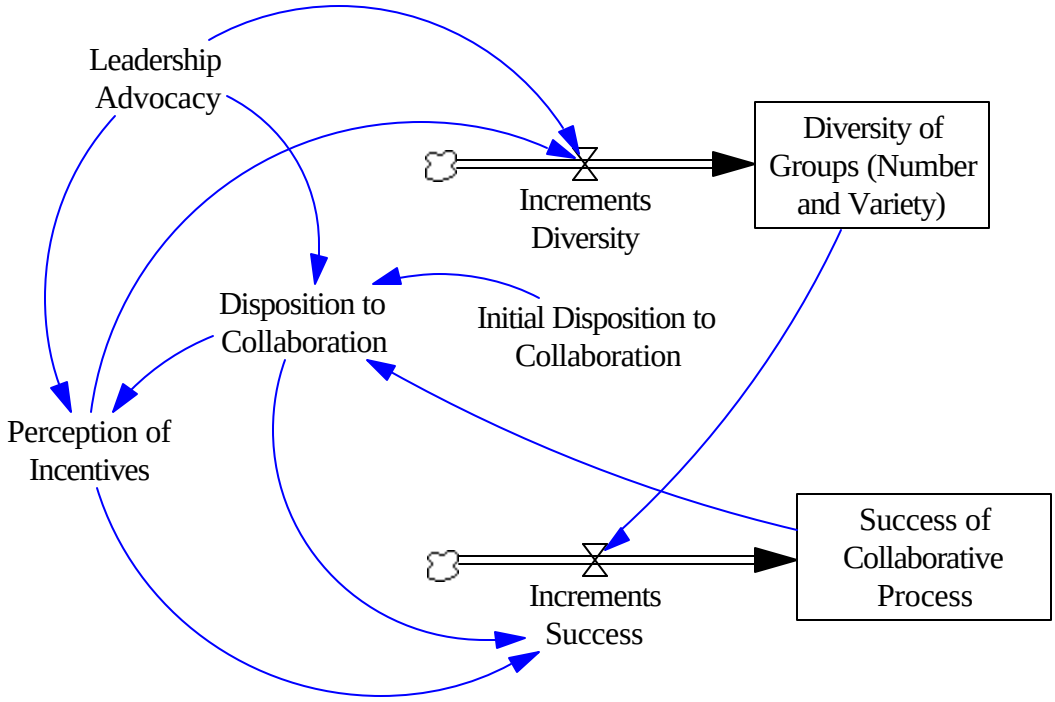

Figure 7—Understanding Interorganizational Cooperation

According to Faerman, McCaffrey, and Slyke's (2001) the success of the collaborative process of the policy derivatives group was highly influenced by the disposition to collaboration that influenced the perception of the incentives involved in the process. This increased perception of incentives added to the success of the project influencing further the disposition for collaboration. These perceptions of incentives also influenced the diversity of the groups that participated incrementing the success of the effort influencing the disposition of collaboration even further. These reinforcing processes acted as growth engines that allowed for the overall success of the effort. The leadership advocacy identified acted as multiplier of this reinforcing cycles permitting the initial development of disposition for collaboration and perception of benefits and incentives.

Explaining Change in Systems of Rules

Rule Following Models

Acording to Goldman (2002) there are two rule following models, the particularistic model, and the standards model. In the particularistic model, the decision maker uses the rule if it is the best option at hand while in the standards model; the decision maker uses the rule even if it is not the best option at hand. The way rules evolve and unfold in organizations can be related to the two extremes of the continuum on how people see the use of rules. As we said, the particularistic view of following rules tries to optimize the use of rules in organizations by adjusting them to the specific situation and context. The standards view of applying rule tries to get a high degree of predictability and accountability in the use of rules by not modifying them even when the individual can identify an optimal—or at least better—option in that specific situation. One view pushes for optimality and justice while the other pushes for predictability and fairness. Over time (see Figure 8), the pressures generated in the system by this two views change the way people use and modify the rule system. When the particularistic view is the dominant way of applying rules, generates partial use of information and situational turbulence that can create resentment and resistance by the parties subject to rules reinforcing the standard view of how to apply rules in the organization. Alternatively, when the standard view is the dominant one, the restricted use of information that is generated, the reduction of situational influence, and the reductions of individual control for optimizing reinforce the advantages of the particularistic application of rules.

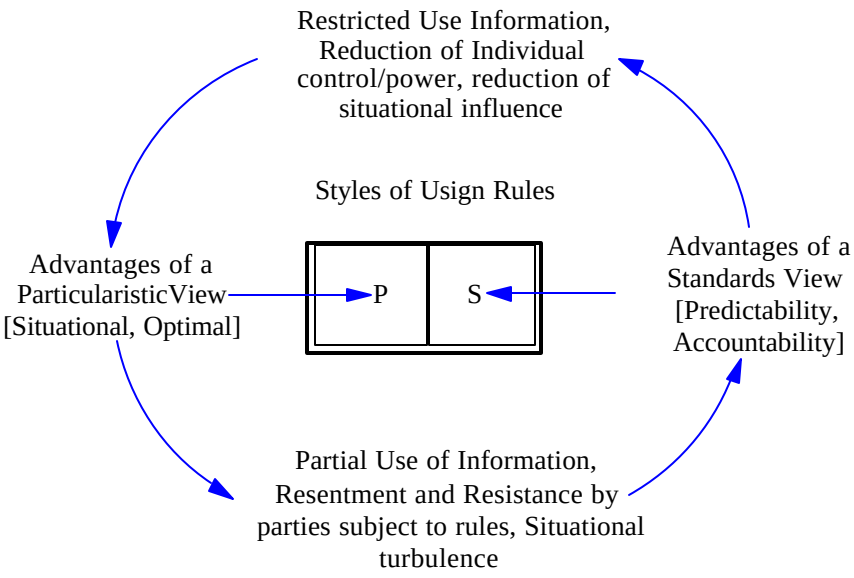

Figure 8—Competing Influences on using Rule Systems in Organizations (idea based on framework presented in McCaffrey, Faerman and Hart, 1995, p. 605)

Dynamic Hypothesis

As we have said, rules in organizations can be seen as the institutionalized capacity to transform problems into performance through action. The better the system of rules of an organization is, the higher the possibilities to transform opportunity areas and problems into organizational performance and, allegedly, the more valuable the organization can become. If this is true, then systems of rules in organizations should be considered an asset, a capital investment if you will, that needs to be managed adequately to increase the overall capability of the organization. Also, we know that organizations people's regulatory orientation—interest in maximizing regulatory benefits by extending regulatory controls, than in minimizing regulatory costs (McCaffrey, 1982, p. 407)—vary over time. This variation might be related to a 'performance gap' that, when realized, by comparing the desired organizational performance with the actual organizational performance, influences the creation or modification of organizational rules to 'correct' for deviations in performance.

Once the organizational rules are changed as a function of a performance gap, the new performance obtained through time can become and influence on the desired organizational performance itself creating a sliding-goal mechanism that will tend to adjust the goal over time. Also, by modifying

the system of rules over time, organizations can go beyond a certain optimal system rule for the organization. If, over time, the system rule deviates from this optimal it will create a certain gap that will contribute to create problems to the organization derived from its implementation. In turn, an increased number of organizational problems will create the opportunity to create new rules to take care of them. These reinforcing processes will trigger the formation and modification of rules allowing the organization to transform problems into performance but also will crate more problems over time. Also, the recognition of an optimal system of rules for the organization can influence a certain identification of optimal organizational performance that will affect the desired—and sometimes expected—organizational performance over time. This last influence will have an impact on individual and organizational expectations that will create another pressure on individuals and the system of rules within the organization. Changes in rules can have several different consequences including changes in the way managers conceive the options available to act. Like in the case of stock option rules that Leonhardt (2003) describes.

> "If options are expensed," Elizabeth B. Robert, chief executive of the Vermont Teddy Bear Company, recently wrote to regulators, "I can tell you that a small company like V.T.B. will no longer grant them." Louis J. Lavigne Jr., chief financial officer of Genentech, the biotechnology company, said an accounting charge "would most likely eliminate broad-based stock option plans."

Figure 9 shows a complete view of the elements and its interrelationships that contribute to the dynamic behavior of rules in an organization.

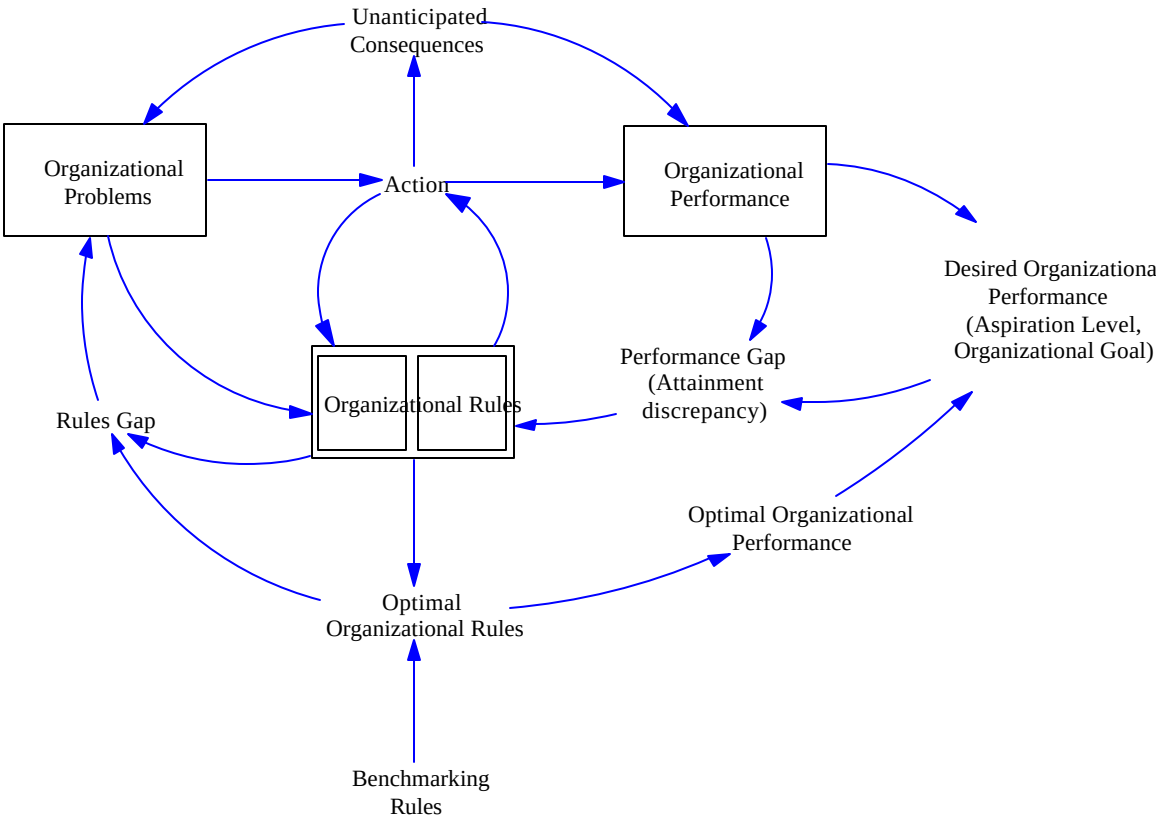

Figure 9—Dynamic Hypothesis

Discussion

In the study of the dynamics of rules several factors seem to be relevant in order to explain why rules change over time and how best practices con become norms and rules in organizations. By comparing the findings of Faerman, McCaffrey, and Slyke (2001) in the emergence of best practices in financial markets with those of Martínez-Moyano and Richardson (2002) in the emergence of best practices in system dynamics modeling, we can identify lessons that can be useful in many domains. Lessons can be recognized in the identification and use of best practices in organizations, also, lessons can be identified in the way rules change and evolve over time. Finally, lessons can be identified in how to manage change processes and collaborative efforts. Table 4, below, present a comparison of the framework, participants, and expectations of the two cases studied.

	System Dynamics Modeling	Financial Markets Innovation
Framework	(1) Problem identification and definition (2) System conceptualization (3) Model formulation (4) Model testing and evaluation (5) Model use, implementation and dissemination (6) Design of learning strategy / infrastructure	(1) Management controls (2) Enhanced reporting (3) Evaluation of risk in relation to capital (4) Counterpraty relationships
Participants	Knowledgeable and influential individuals in the field of system dynamics. Presidents and Award winners of the System Dynamics Society	Knowledgeable and influential individuals in the field of financial risk management. E. Gerald Corrigan Chairman of the International Advisors Goldman Sachs John G. Heimann Chairman, Global Financial Institutions Merrill Lynch William P. Bowden, Jr. General Counsel CS First Boston David H. Komansky President and Chief Operating Officer Merrill Lynch Jacob D. Goldfield Partner and Head of Worldwide Fixed Income Derivative Trading and Marketing Goldman Sachs John G. Macfarlane, III Managing Director and Treasurer Salomon Brothers Peter Karches Managing Director and Head of Fixed Income Division Worldwide Morgan Stanley Thomas A. Russo Managing Director and Chief Legal Officer Lehman Brothers Edward J. Rosen, Esq. Partner Cleary, Gottlieb, Steen & Hamilton
Expectations	One solid group statement. "As the firms and supervisory authorities gain more experience with this overall framework, and depending on the evolution of thinking and policies within the international community of supervisors, this approach to voluntary oversight may require further refinement or modification. For the present, however, the experience that will be gained with these new tools, techniques and approaches will constitute a significant advance in risk management and effective oversight." (Derivatives_Policy_Group, 1995)	Several solid individual statements. "This could be consider an inadequate list because includes extremely OBVIOUS statements about how to do system dynamics" "New fields seem to need to find best practices. This can be a powerful tool in the future." "We need better definitions of the practices." "We might not be able to articulate best practices in system dynamics modeling." "The field is too complex to 'simplify' it like this." "This is one of the most important projects that the field could embark in."

Table 4—Comparison

The study of rule dynamics can be a great aid in searching for better ways to understand and implement best practices in organizations. Improved understanding of best practices implementation and use in organizations can be extremely valuable to improve organizational performance.

The process of the identification and formalization of best practices in organizations is long, difficult, and political in nature. The emergence of best practices can be identified as a negotiation process of a new social order in organizations. Formalization of the findings is a first step towards the use of best practices as norms or rules only if the meaning of the practices is shared, sanctions for their use are identified and enforced, and an attitude towards compliance is developed. This road to organizational improvement seems to be hard and long, but the benefits appear to be colossal. It reminds me of Sterman's (2002, p. 527) description of system dynamics as being "demanding work. But also a joy […] to create the future we truly desire—not just in the here and now, but globally and for the long term."

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