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A Systemic Maturity Model

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***Abstract*—**Maturity models, used descriptively to explain changes in reality or normatively to guide managers to make interventions to make organizations more effective and efficient, are based on the principles of statistical quality control and PDCA continuous improvement (Plan, Do, Check, Act). Some frameworks developed over the concept of maturity models include COBIT, CMM, and ITIL.

This paper presents some limitations of traditional maturity models, most of them related to the mechanistic and reductionist principles over which those models are built. As systems theory helps the understanding of the dynamics of organizations and organizational change, the development of a systemic maturity model can help to overcome some of those limitations.

This document proposes a systemic maturity model, based on a systemic conceptualization of organizations, focused on the study of the functioning of the parties, the relationships among them, and their behavior as a whole. The concept of maturity from the system theory perspective is conceptually defined as an emergent property of the organization, which arises as a result of the degree of alignment and integration of their processes. This concept is operationalized through a systemic function that measures the maturity of organizations, and finally validated by the measuring of maturity in some organizations. For its operationalization and validation, the model was applied to measure the maturity of organizational Governance, Risk and Compliance (GRC) processes.

***Keywords*—**GRC, Maturity Model, Systems Theory, Viable System Model.

I. Introduction

KOHLEGGER, M., Maier, R., & Thalmann, S. [1] define a maturity model as a conceptual representation of the quantitative or qualitative incremental changes that occur in the capacity of an element in order to assess their progress against defined areas of interest. Usually the element that undergoes such changes under some areas of interest measured by maturity indicators can be a person, an object or a social system. The model structures the development of maturity of an element into a number of sequentially ordered phases separated by "triggers". The element moves through the various stages to the extent that will comply with the condition "triggers." Maturity models can be used both descriptively explaining changes in reality or normatively, to guide managers to make "interventions" required generating more effective or efficient changes that lead to maturity.

Regarding organizations, De Haes, S., & Van Grembergen [2] consider maturity models as tools to help them easily understand their current and desired state, on the extent to which they follow best practices and standards. Using a maturity model as an assessment tool is lead to the discretion of each company, which uses it as a diagnostic tool to help setting its goals and methods, based on its own business scenarios, plans and needs [3].

In the domain of IT most of maturity models are based on the "Capability Maturity Model" (CMM) developed by Watts Humphrey in the 80s, and built on the principles of statistical quality control promulgated by Walter Shewhart in the 30s. Developed later by Edwards Deming and Joseph Juran, these principles were adopted by the Software Engineering Institute (SEI) as a maturity framework for quality control of the software development process [4]. Improving the quality of these processes, according to Deming [5], is achieved by applying the PDCA (Plan, Do, Check, Act) continuous improvement cycle.

Using the CMM has been widely spread to all sectors, with a particular host in the commercial areas of IT. The CMM is considered as a framework for measuring and improving performance in the application of the principles of security through the adoption of standard measurement and progress in the implementation of these principles [4]. In the field of software development, the philosophy of CMM has gained wide acceptance, as it provides management the hope and illusion of control. This methodology provides a step by step to turn something meaningless into something following a solid plan [6]. As the organization gains maturity in their software development processes, CMM help to build an infrastructure and a corporate culture upon which rest all the methods, practices and procedures of the business, working to the permanence of the organization in the market [7].

Another framework that develops the concept of maturity model is COBIT (Control Objectives for Information and related Technology). This framework in its latest version (COBIT 5) allows information and information technologies be governed and managed holistically for the entire organization, considering all business and functional areas of responsibility (both internal and external), particularly on issues related to information technology areas of interest. COBIT 5 is based on five principles (meeting the needs of stakeholders, covering the company from start to finish, applying a single integrated framework of reference, enabling a holistic approach, separating government administration) and in seven enablers (principles, policies and frameworks; processes; organizational structures; culture, ethics and behavior; information, services, infrastructure, and applications; people; skills and competences).

COBIT 5 proposes a reference model of processes and practices that subdivides information technology activities into two main areas: governance and administration. Each area is divided into process domains conceptually framed within the PDCA cycle of continuous improvement. Similarly, COBIT 5 proposes a model of process maturity, which according to the

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value of attributes of processes, classified on six levels between 0 and 5 (0 – Incomplete, 1 - Executed, 2 - Managed, 3 – Set, 4 – Predictable, 5 - Optimized) [8].

The Office of Government Commerce in the United Kingdom (OGC) develops a different assessment of the maturity and organizational performance approach. The goal of this office is to present a set of best practices to be employed in the IT service management (ITSM) [9]. This approach is built on the "Service Delivery" and "Service Support" components of ITIL (Information Technology Infrastructure Library).

The maturity model for the implementation of ITIL, seeks to evaluate the effectiveness of the organization management on the key activities described in the ITIL operational and tactical areas. The course of action assessment begins with the formation of the teams responsible for the assessment process, continues with a realistic assessment of their activities by reference to both the guides and the definitions of maturity, continues with an analysis of the result of the evaluation to help determine areas of improvement along with their priorities, and ends with the allocation and monitoring of immediate improvement initiatives [10]. Having no formal mechanisms for measuring, ITSM is not as comprehensive as COBIT or CMMI on which it is based [11].

Rogers [11] proposes the following basic classification of maturity models according to their scope:

1) IT Governance – COBIT.
2) Enterprise Architecture: EAMM (CMMI / TOGAF).
3) Security: ISM3 (ISO9001: 2000).
4) Design and Development: CMMI.
5) Service Management: IT Service CMM (ITIL / CMM Software).

An extended taxonomy covers additional or complementary categories such as:

1) Program Management-Project-Portfolios: OPM3, P3M3, PRINCE2.
2) Data architecture, storage management: DBAMM, ILMMM.
3) Security Architecture: CMM for Security, Security Maturity Model.
4) Application Architecture: SOA MM, Service Integration Maturity Model.
5) Quality Control, Testing, Support: MM Testing, Software Maintenance MM.
6) Configuration Management: Configuration Management MM. IT Governance – COBIT.

In the case of technology management process, these rankings show that maturity models, although may have common origins, are developed according to specific categories. According to Rogers [11], it is certain that organizations that measure their business processes and take actions to improve them, achieve significant benefits, regardless of the framework or methodology they decide to use. Models that measure maturity in different fields of application within organizations have a common factor: its focus in measuring process performance factors. Their focus is on the adoption of best practices to enable organizations improving the performance of processes that support specific fields of application according to of each model.

II. Limitations of Traditional Maturity Models

Although maturity models developed around the concepts of process engineering and quality have contributed to the development of organizations in their business processes and value creation, there are scholars concerning points of reflection and analysis questioning its benefits. One of the arguments made by the community is the lack of a consistent definition of quality. Another argument is the failure of some organizations on improving their quality by implementing concepts such as Total Quality Management (TQM), Business Process Reengineering (BPR), Management by Objectives (MBO), T-Groups, Six Sigma, and ratings of 360° [12]. However, failures like the Project Management System Cases in which the FBI invested more than $170 million in 2005; the Government of the United States remains the largest sponsor of such process methodologies [13].

Some authors claim that concepts like TQM are aimed at ensuring the survival of the organization through the full use of all its technical resources, but leaving aside the role of human resources and the contribution each individual can make to organizations [14]. Cutting [15] found that TQM has some limitations such as restrictions to innovation, intense focus on internal processes, and isolation from the outside world. While methodologies such as CMM and ISO 9000 tend by law and order within organizations, encouraging repeatable production processes, quality, and reducing development time of projects, these limit the generation of people's ideas. Project team ends advocated to comply with established procedures, at the cost of maintaining their freedom. Such limitations expose the organization to its demise, because of their inability to adapt to changes in the environment [16].

Getting a certification for repetitive processes, does not guarantee an automatic quality improvement neither increases creativity, but leads to an implementation foolproof. Such methodologies help to achieve those objectives, and those results depend ultimately on innovative solutions and on the quality of work provided by the human resource [17]. Moreover, as CMM methodologies that apply to large organizations, they are not always suitable for small businesses to attack their vulnerabilities. Such instruments are usually too heavy to be implemented in small businesses, especially because they require investing a large number of hours in their understanding and implementation to solve medium magnitude problems of small organizations [18].

By achieving higher levels of maturity, in the case of the CMM, the software development process would resemble a production process in which the discipline of operations would ensure predictable results [19]. Such bureaucratic rationalization fires a halo of skepticism about the motivational effects of CMM. Considering that the process of software development has not yet been fully automated, it requires developer's commitment and creativity to obtain efficiency in non-routine aspects of the process. Similarly, the fact of having to meet externally defined standard processes,

such as the CMM, makes the organization loses its focus on real improvement processes and products. Adler [19] believes that to understand how methodologies such as CMM affect organizations it is necessary to understand the effect of these approximations on the job object itself. For Adler [19], the CMM represents a strong problem of bureaucratic rationalization. CMM ends up affecting long-term motivation and creativity required to develop innovative and high quality software.

Linberg [16], meanwhile, says that the TQM approach is similar to the mechanistic approach to organizational management theory. The central error of this approach is the assumption that people are tools used to achieve certain purposes, and that their work can be planned without taking into account the variable and the reactions of human behavior. For the definition of requirements this approach lacks of flexibility for adaptation and continuous evolution of products, so customers will not be completely satisfied. Mechanistic principles do not consider employees as mature people, but as people with little control over their workplace, passive, dependent, subordinate, low-skilled, and productive despite unfavorable conditions that keep them on the edge of a psychological collapse. Under these principles, the employees create a simplified continuous improvement approach, whereby limited to reduce variation in their traditional products without generating ideas that lead to renewal.

TQM is listed by Jackson [20] as an administrative fashion, urging managers to be responsible for all matters with which they interact and can affect the quality of the "output" of the organization. Focused on meeting the needs of customers, TQM does not give equal importance to "stakeholders" and their needs. Another point of criticism of TQM is raised by Ackoff [21], indicating that continuous improvement in the "out of anything that does not want" does not guarantee that you will get automatically what you want. Paradoxically, the only way an organization can reduce the gap with its leading market competition, is through "jumps" innovative, leading to large qualitative changes, i.e. via a "discontinuous improvement". Additionally TQM pays little attention to organizational design required to obtain quality products. Creating a culture of quality through recommended by TQM methodologies is an aspect that has not been able to develop within organizations, leading to the failure of quality programs within them. By not being able to create a culture of sustainable quality, there is neglect of the quality policies and little recognition to the management that is generated around it. Ackoff [21] cites Drucker when he says "We spend a lot more time trying to do things right than trying to do the right things."

When treated as a management fad, a trend towards superficial practice of this theory by managers is generated. The use of "slogans" does divert attention from the managers of the solution to structural problems. Such "slogans" among workers promote the concept of TQM is simply a fad that will pass over time. Finally, although the TQM expresses the need for a philosophy of quality, it is not based on principles widely supported, and apart from the "Quality Circles", has no proven methods that lead to the development of quality culture [20].

III. Contributions of Systems Theory to Maturity Models

Systems theory is a conceptual framework that helps the understanding of the dynamics of organizations and organizational change. This theory makes possible the generalization of a specific phenomenon so that can be investigated from different angles, assumptions, techniques, fields of knowledge, etc. Theoretical models describe how the systems work; are descriptive, not normative. The formulation of a model is a conceptual representation of a complex perception. This involves replacing part or parts of the complex perception by some representation of symbols. Any model is a pattern of symbols, rules, and processes that fit partially or completely with a complex perception. Each model thus provides some correspondence with reality, any relevance of the items in the model to reality, and some form of verification between model and reality [22].

Systems theory allows viewing organizations as open systems in constant interaction with their environment, as complex systems made up of parts that exist in a close relationship [23]. Hall and Fagen [24] define systems as a set of objects linked together with relationships between them and between their attributes. Modelled systemically, an organization consists of a set of components that support a set of common goals. These components have simultaneous and complex interactions among them. A change in one component causes changes in all other components. Although all systems can be analyzed in parts (sub-systems) in order to scientifically study the essence of them, that essence can only be identified when systems are studied as a whole. The interdependencies among sub-systems produce behavior and features that are unique to the system as a whole [25]. Modeling organizations as systems facilitates understanding of organizational behavior, conducting assessments of the status of activities and organizational processes.

A systemic maturity model must be based on a systemic conceptualization of organizations. It is necessary a holistic maturity model which should consider the environment and the relationships between the elements that are the subject of analysis. Unlike the reductionist approach that focuses on the study of the functioning of the parties, the systems approach is based on the system and the relations among its parts, and how they work as a whole [26]. The systems approach can provide the theory of organizations with the necessary theoretical foundation for organizational management is a scientific activity, without falling into reductionist practices. Based on the ideas of emergence and hierarchy, communication and control, this approach faces problems of irreducible complexity through a form of holistic intelligence that complements the scientific reductionism [27].

A system is developed or mature to the extent that it is acquiring knowledge or developing new ways of thinking. Argyris [28] says that the success of an organization leads on the process of achieving a higher state of maturity by learning. This is evident when the organization acquires new concepts

and is changing its form of behavior, which can only be given by a continuous process involving the organization as a whole. Involving the organization as a whole leads to a natural question of the existence of different interpretations and judgments about the system under development based on different standards or values.

Strategic management involves making decisions about the goals of the organization together with the formulation and implementation of plans. Those plans are particularly related to the allocation of resources looking forward the achievement of organizational objectives. As such, strategic management is a complex and dynamic process that must consider short-term, long-term, internal and external factors. The effectiveness of strategic management of an organization can critically impact their viability. There are many reasons why the strategic management process may fail. Many of these reasons can be attributed to reductionist approaches to strategic management. From a systems perspective it can be argued that these approaches represent strategic management who deny the complex, embedded and dynamic approaches of modern organizations. Systems methodologies as Viable System Methodology and Soft Systems Methodology, provide a significant contribution to the effectiveness of the strategic management process [29].

The Viable System Model created by Stafford Beer has been used as a conceptual tool for understanding organizations, redesigning and supporting their process of change [30]. This model, built on the fundamental principles of cybernetic communication and control, is a tool that helps members of the organization to have a fully integrated organization and its communication processes under a systems view. Its recursive nature makes the VSM a flexible and robust model, ideal for being used in rapidly changing environments.

The VSM is particularly useful as a diagnosing and organizational designing tool. Unlike the management model of command-and-control which structures organizations as pyramids, where decisions are made at the top and are implemented at the lower levels, the VSM is derived from biological systems, in which the hierarchy replaced by structural recursion. Viable systems, from the simplest to the most complex structures, are self-organizing and self-regulating. As they evolve, become more complex, forming viable systems embedded within other viable systems.

The general systems theory provides the ability to research the systems approach, and is held up as an alternative to analytical-mechanics associated with the application of the conceptual schemes of the scientific method [31]. The systems paradigm provides a new way of thinking organizations, complementary to the previous schools of organization theory [31], considering the organization as a system whose operation can be explained in terms of concepts such as systemic cybernetics.

IV. A Systemic Maturity Model

Maturity modeled from systems theory is conceptually defined as an emergent property of the organization, which arises as a result of the alignment and integration of processes. This definition is operationalized through a systemic function measuring the maturity of an organization in terms of the degree of alignment and integration of processes, and is implemented on an instrument to measure this maturity. Finally, the instrument should be validated by its application in measuring the maturity in organizations. For the development and validation of the model, it application to the processes of Governance Risk and Compliance (GRC) organization was chosen, seeking to provide organizations with a mechanism that allows them to diagnose the state of maturity of the processes of governance, management risk assessment and regulatory compliance; and provide a means to demonstrate that progress towards maturity.

Governance, risk management, and compliance, are disciplines that have been handled in isolation within organizations. To Kark, Othersen, & McClean [32], the Governance consists of the definition of decision-making structures, processes, and communication mechanisms that will enable organizations to support the business goals and realize an efficient and consistent monitoring progress in meeting the obligations of the business. Basically Governance determines how decisions are made, who makes them, who should be held accountable for them, and how they measure and monitor results.

Organizational risk management is a process developed by the Board of Directors, management and other personnel of an entity, which is applied in the formulation of strategies and throughout the company, and is designed to identify potential events that may affect the entity, and manage risk to be within the limits of risk, in order to provide reasonable assurance regarding the achievement of entity objectives [34].

Compliance is a system of policies and controls that organizations adopt to prevent violations of the law and to ensure that external authorities are taking measures to stop violations of the law [33]. From the perspective of IT, Kark, Othersen, & McClean [32] defines compliance as a process to establish an appropriate set of controls within the IT environment and management and to implement such controls. IT Compliance must ensure that organizations not only adhere to the law and regulations, but also comply with corporate responsibilities and standards of the industry. Adopting a unified and consistent management of these three disciplines, can lead organizations to create efficiencies, reduce costs and risks, and provide a holistic view of the IT environment and ensure proper accountability [32].

In an effort to help organizations make a diagnosis on the state of maturity of their GRC processes, and to show a way forward to improve their level of maturity, different companies and consulting groups have been made available to managers some governance, risk and compliance maturity models. These models focus primarily on process management and seek to classify GRC processes in one of the following levels within a hierarchy [5]:

1) Unconscious or ad-hoc.
2) Fragmented and isolated.
3) Integrated or unified.

4) Aligned or automated.
5) Optimized

Maturity models can be presented either as a reference framework, or as a set of assessment questions with answers focused on classifying organizations in one of five levels.

For organizations, integration seeks to achieve operational and organizational efficiencies through collaboration between its internal areas as well as with other companies [35], [36]. Integration includes functional or departmental interactions. Ideally these interactions are built on communication and information sharing and are characterized by coordination, collaboration and cooperation between different groups that focus their efforts to jointly achieve common goals [37]. These authors highlight the connectivity and simplification as key components of integration.

Connectivity is crucial regardless the focus of the organization is transactional efficiency or management of relationships. For organizations with business process-oriented transactions, connectivity is required to ensure that transactions flow as standard across their functional areas. For business processes focused on structured relationships, connectivity is required to establish relationships between firms on different levels [38]. Moreover, the simplification of business processes by eliminating duplication is equally important. It does not just have to connect relevant processes but also has to identify and remove unneeded elements within them. In other words, the processes must be redesigned to improve its efficiency and effectiveness [39].

A systemic GRC maturity model is conceptually based on the integration points of the model developed by Vicente and Pedro Miguel Mira da Silva (Internal Controls, Risk, Processes, Objectives, Policies), on the three levels of integration of processes and information of the model developed by Ralf Klischewki (Vision: Deconstruction and Conceptual Modeling, Strategy: Cooperation between managers and Implementation: Systems Development), and on the components that guide the relationship between the processes: Alignment and Integration.

Conceptually, GRC Maturity can be defined as an emergent property of the organization, which arises as a result of the alignment and integration of GRC processes. Norbert Fenzl [40] defines an emergent property of a system that cannot be deduced or previously observed as a functional characteristic of a system. In its conceptual reference of the GRC model, Pedro Vicente and Miguel Mira da Silva, identify four main features of GRC (Audit Management, Policy, and Risk of Incident). GRC processes are those processes of the organization through which those functions are implemented.

The proposed model is based on a systemic conceptualization of organizations. Following the systemic organization concept formulated by Fuenmayor [41], the vision of the organization defines its purpose, around which different activities that are orchestrated. A holistic approach, in addition to considering the environment, takes into account the relationships between the elements of the organization that are being analyzed. In a traditional management model of command-and-control, the vision of the organization is established at high hierarchical levels, and implemented at lower levels. Under the VSM model, derived from biological systems in which the hierarchy is replaced by structural recursion, the vision of the organization is established from the simplest to the most complex structures, guiding their self-organization and self-regulation.

A mapping between GRC Maturity Model and the Viable System Model (VSM) is shown in Fig. 1. The organizational vision reflects the shared vision for change. In the VSM model vision equals the intelligence function. This function is related to the future, planning how organizations can invent their own future looking forward changes in the external environment and their internal capabilities [30].

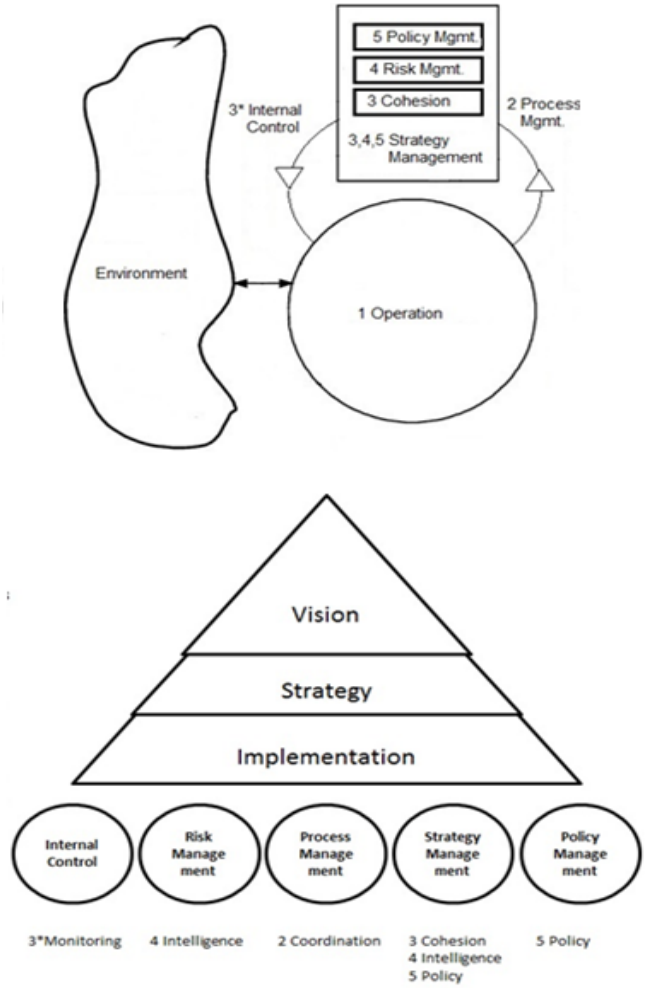

Fig. 1 Mapping GRC Maturity Model - VSM

Under the VSM model, the strategic thinking of the organization relates the information of vision with that of the existing capabilities and operational requirements. This interrelationship is aimed to identify the strategies that the organization should follow to ensure their survival in the midst of a world of constant change. Survival is achieved by integrating operational elements into a cohesive whole, so that the total system performs better than the sum of its parts working independently [42]. An organization based on the

VSM model has mechanisms and opportunities for growth and learning, to evolve and adapt, to become more and more powerful than its environment [43].

In a systemic approach, the first element to the development of a strategy is that it has to operate on multiple levels simultaneously. The strategy must look for the reconciliation of different interests at different parts of the organization. This requires a set of conversations between different levels so that each management team must check the consistency of its proposals with the rest of the organization. Based on these conversations, each management team can modify their own plans, influence others and generate an appropriate strategy for the organization, keeping its consistency with other teams.

A strategic decision process begins with the assessment of the current state, the decision of the future state, and the planning of how to get to the future state from the current state. Within the VSM model, the assessment of the current state of the system is performed within 3 Cohesion administration, while the decision of the future state is made within the intelligence system 4. A successful strategic decision-making process requires a discussion between the elements of cohesion and intelligence. These debates are monitored and balanced by the policy subsystem 5. The process of strategic decision making seeks to identify "strategic gap", the gap between what is currently being done and what has been identified to do in the future. This process opens and closes the gap to lead strategic organization in a continuous evolution and adaptation over time. The subsystem 3 Cohesion is responsible for closing the gap, while the subsystem 4, the Intelligence, is responsible for opening it [43].

The implementation is modeled within the Subsystem 1 of VSM (Operations). The operation includes the primary activities of the organization done to deliver value to external customers, as opposed to support activities of the organization done to keep it running. Primary activities are broken down into sub-activities according to four concepts of complexity: technology, geography, customers, or time. The activities are structured according to the technology if the organization aims to produce different products. Geography guide the structure of the organization if its production has a geographic differentiation and involves the formation of different teams located in different geographical locations. Customers guide the structure of the organization if its goal is guided by particular customer's characteristics such as the size of their accounts. Weather guide the structure of the organization if it is aimed at continuity of production or service provision.

Regarding the integration points of the model developed by Pedro Vicente and Miguel Mira da Silva (Internal Controls, Risk, Processes, Objectives, Policies), which form the conceptual basis of GRC Maturity Model, these are also mapped on the Viable System Model, as can be seen in Fig. 1. Policy Management is modeled within the Subsystem 5 of VSM (Policy Management). This subsystem ensures the proper structure and discusses the strategy that must be followed by the organization, understands and manages the corporate identity, and understands how the organization fits into the larger system of which it is part. Thru Policy Management organizations seeks to have all the mechanisms needed to ensure both their internal cohesion and efficiency, as well as a good performance in the environment (that great system which they are part of) [44].

Management Strategy is implemented by the subsystems 3, 4, and 5 of VSM (Cohesion, Risk Management, and Policy Management). As mentioned above, a successful process management strategy requires a discussion between the elements of cohesion and intelligence. These debates are monitored and balanced by the subsystem 5 of VSM (Policy). Process Management is part of the activities of the subsystem 2 of VMC (Coordination), which ensures that the different primary activities do not fall in conflict with each other. Process Management helps keep the formality of the different coordination mechanisms.

The Internal Control is part of the monitoring mechanisms of the Subsystem 3 of VSM (Internal Control), which helps to have the confidence that managers in their units do what they are supposed to do, and that there is a provision of rules and processes that govern organization's operations. Risk Management Subsystem is an essential part of Subsystem 4 of VSM (Intelligence and Development). Risk management seeks to minimize the uncertainty that may be received by the organization, identify future scenarios and develop action plans to mitigate either undesirable effects of future events, or potentiate unwanted effects that may occur. Fig. 2 shows the GRC Maturity Model from the point of view of the VSM, the Viable GRC Maturity Model.

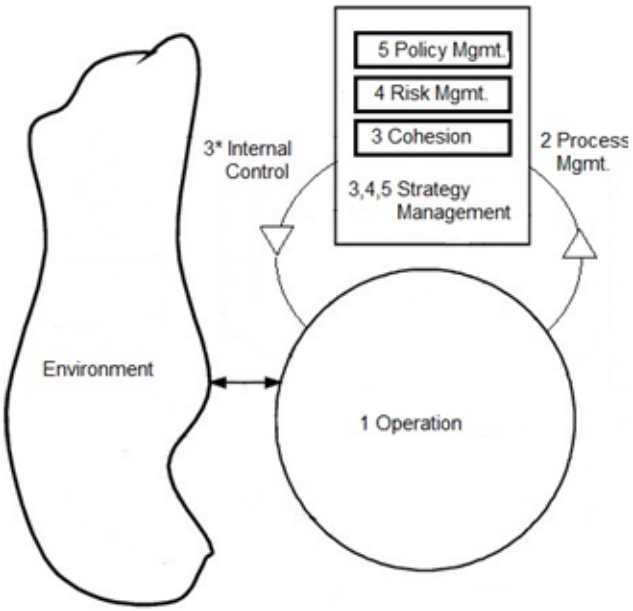

Fig. 2 Viable GRC Maturity Model

Operationally, the GRC Maturity is measured by the degree of alignment and integration of processes. The degree of alignment measures the processes that are guided by the same vision of GRC; supports strategies aimed at the realization of that vision, and operationalize the implementation of these

strategies. The degree of integration, in turn, is measured on the relationships between the elements of the organization: people, processes and technologies (people running technologies leveraged processes). Given that these three elements are guided by the organizational vision, and implement the GRC strategy, the degree of integration between them is measured on three levels, the vision, the strategy and the implementation.

Under the VSM model, the elements of the organization (people, processes and technology) are structured recursively, from the simplest to the most complex structures: groups of people, task processes, and components of technological systems. Just as the vision is established, it guides to self-organization and self-regulation in response to changes in the external environment and internal capabilities [30]. The strategy is the result of a process-oriented decision-making that guide the organization from a current state to a desired future state. The strategy comes as a product of different conversations at different levels of the organization.

If any process of the organization involves the key activities of GRC (Internal Control, Risk Management, Process Management, Strategic Management, and Policy Management) in an integrated manner, if these activities are oriented by the vision of GRC, and if the GRC strategy support and operationalize this strategy, we can say that there is a certain level of maturity of GRC in the organization. To determine the level of maturity of GRC on the organization, it is necessary to take two measurements: the alignment and integration of processes.

The GRC maturity level can be measured in any process of the organization. If this measurement can be made from the simplest to the most complex processes, you can start building measuring GRC maturity across the organization recursively. It is important to add that the measurement of maturity made of any process or set of processes in the organization is a current view of the same, which may improve or not depending of the process throughout its existence. It is not a static measure, but a view in a moment of time, which requires a statement of the organization's sustainability if you want the results improve.

GRC Maturity is defined as an emergent property of the organization, which arises as a result of the alignment and integration of GRC processes. The operational definition states that GRC Maturity is measured by the degree of alignment and integration of processes. The proposed method should consider the systemic connotation of the concept to be measured, and also the relationship between GRC Maturity and the alignment and integration of GRC processes. GRC Maturity (MGRC) can be formulated as a systemic function in terms of the levels of alignment (AL) and integration (IN) of the process.

$$\text{mGRC} = m_s\,(\text{AL}, \text{IN}) \tag{1}$$

The coefficient of determination (r^2), an accurate measure of the relationship between the variances of two variables (process alignment and process integration), was considered the most appropriate to use as systemic function intended to measure the degree of maturity of GRC in the organization.

$$\text{mGRC} = r^2\,(\text{AL}, \text{IN}) \tag{2}$$

The organization selected to implement and validate the GRC systemic maturity model and to perform the measurement of the level of maturity of GRC, requested to comply with a confidentiality agreement that restricts the publication of its identity. This organization has a unique nature in Colombia. Its highest governing body is a board of directors, responsible for the management and execution of the functions of the organization. The unique nature of this organization, its commitment to excellence, transparency and sustainability, the particular characteristics of its corporate governance, aimed at strengthening their risk management and process management initiatives, and its demanding control framework and accountability, made this organization an enabling institution to implement and validate the GRC systemic maturity model and to perform the measurement of the level of maturity of GRC.

A sample size of 244 people was calculated among the 2,399 employees of the organization throughout the country. This measurement was based on the statistics made by Bonilla [45] for the particular case when the population size is known:

$$\text{n} = z^2\text{PQN}/\left((\text{N}-1)\text{E}^2 + Z^2\text{PQ}\right) \tag{3}$$

Z = 1,65 Critical value corresponding to a degree of confidence (90%)

P = 0.5 Population proportion of occurrence of the phenomenon

Q = 0.5 Population proportion of non-occurrence of the phenomenon

N = 2399 Population size

E = 5% Maximum allowable sampling error

n = 244 Sample Size

From 377 surveys distributed, 300 responses were received. In this study, 300 measurements of two variables (process alignment and process integration) were obtained. The hypothesis was that there is a relationship between those two variables and that the relationship is not necessarily causal. The values of correlation coefficient (r) and coefficient of determination (r^2) were:

$$\text{r} = 0{,}5009$$
$$r^2 = 25\%$$

The obtained value of the coefficient of determination r^2 indicates that the level of maturity of the organization under study is 25%.

In order to ensure the predictive validity, the results of the instrument must be submitted to the chi-square (x^2) test. This test is used to determine whether there is association between two variables in the data from a probability sample, eliminating the possibility that it occurs due to chance. If there is perfect agreement between observed and expected

frequencies, the statistic will take a value of 0, on the contrary, if there is a large discrepancy between these frequencies, the statistic takes a large value and, consequently, rejects the null hypothesis [46].

The result of applying the chi-square test to 300 measurements of variables alignment and integration of processes was:

$$x^2 = 0$$

This confirms that the association between variables of alignment and integration of processes exists. This association is to measure the level of maturity of GRC as a systemic function of these two variables.

V. Conclusion

This research was based on systems theory as an epistemological foundation to acquire knowledge of organizational reality as is his level of maturity in the field of Governance, Risk and Compliance (GRC). The Viable System Model (VSM) was built based on cybernetics and on the systemic thought, and was used as a tool to understand the organization by modeling their reality. The use of VSM led to the development of the concept of GRC Maturity as an emergent property of the organization, which arises as a result of the alignment and integration of GRC processes.

Beyond modeling GRC Maturity, this research raised the need to define a "systemic function" to measure it. Based on the conceptual definition of Maturity of GRC as an emergent property of the organization which arises as a result of the alignment and integration of GRC processes, the determination coefficient (r^2) was introduced as the "systemic function" appropriate to measure it. This coefficient shows the proportion of variance shared by the alignment and the integration, i.e., as the strength of the relationship between the processes of the organization measured in terms of alignment and integration.

Until the development of this research, all maturity models used to diagnose and prescribe the organizations were based on reductionist approaches, focused on the study of the functioning of the parties. The systemic approach undertaken in this research is based on the system and on the relations between the parties, and how they function as a whole. This approach recognizes the complex, embedded and dynamic nature of modern organizations, which is not covered by reductionist approaches.

Traditional measures of maturity are based on the application of questionnaires to a group of experts of the organization. The opinion of this panel is taken for diagnosis and prescription. With the systems approach, diagnosis is a collective product, which takes into account the perception of the different areas and at different levels of the organization. The diagnostic tool is a perception survey which evaluates the degree of maturity of the organization. Systemic and cybernetic nature of the model on which the instrument is based allows the model to be applied recursively, and to be useful for diagnosis at different hierarchical, functional, or even on certain processes of the organization levels.

Maturity is measured as a "systemic function" showing the degree of determination between two variables (the proportion of variance shared by the alignment and integration of process), but not as a causal link, preventing the mistake of trying to improve the level of maturity of GRC through actions on "independent variables". The diagnostic model leads the analyst to observe the results of the organization as a whole, and to generate recommendations in order to advance on several coordinated fronts that generate the effect of improvement in the maturity of GRC activities.

Table I summarizes the emergent result of this research, contrasting the essence of traditional maturity models grounded in reductionist approach and the essence of the proposed maturity model grounded in the systems approach. The answers to questions such as “What the maturity model focuses?”, “What is maturity?”, “What measures the maturity model?”, “How is maturity measured?”, and some assumptions of measurement, generate a corollary of this research, which provides organizations a complementary approach that will allow a more precise targeting toward reaching their goals and achieving their objectives.

TABLE I
Emerging Outcome Research

Maturity:	Reductionist Approach	Systems Approach
What is the focus of the maturity model?	Process Performance	Process Relationships
What is maturity?	an State	An emergent property
What measures the maturity model?	Process Capacity and performance	Strength of process relations
How is maturity measured?	Level	Tendency
Some assumptions of the measurement.	There is a causal relationship between variables	There is a correlation between variables

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