



A Transdisciplinary Understanding for Economic Risk Management

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Starting from the assumption that transdisciplinary is becoming a fourth research method (alongside the empirical, interpretive and critical approaches), we believe it is the favorable context for analysis as well as for sustained attempts to understand sophisticated economy in a new conceptual framework placed at the forefront of knowledge. As a matter of fact, in accordance with the “Charter of Transdisciplinary” (Freitas & Morin & Nicolescu, Convento da Arrbida, [1]), from which we quote Article 12: “The development of a transdisciplinary economy is based on the postulate that the economy must serve the human being and not the reverse”, we will focus on several categories specific for the economic risk, such as enterprise risk management, financial risk. In an attempt to systematize this approach, we searched to identify in the academic literature similar concerns and formulate some theoretical pillars on which to establish the transdisciplinary understanding and behavior concerning the existence of risks with economic particularity.

Keywords: economic risks; transdisciplinary knowledge integration in risk management; vulnerability risk assessments.

1 Introduction

Risk and uncertainty are pervasive and central determinants of economic progress and well-being. They influence microeconomic decisions, as well as the

final analysis and synthesis of macroeconomic performance. Risks even derive from cognitive limits of economic agents and their interaction. Furthermore, modern economies also use markets to price and business risk, so that quantitative analysis of these risks is more important than ever. A deeper understanding of the nature of the economic risk is therefore essential to improve and manage the economic situation of companies, families and nations. Growing and extending our understanding of economic risk is the central objective of this research, which aims to be a part of the interdisciplinary and transdisciplinary future development for applied economics (through social banking), statistics, mathematics and welfare. Ultimately, the objective of our research is to improve the decision-making capabilities of both public and private institutions by reducing economic risks and better exploiting economic opportunities. Furthermore, the research aim is to expand a theoretical and methodological framework for the enhancement of decision-making in the area of risk management according a transdisciplinary attitude with the perspective of improving the quality of economic life for the individuals of society. From a similar “people first” transdisciplinary perspective, in the future there could be developed some projects in applying the success conditions of squaring problems with people, cross-applying methods and tracing knowledge dynamics.

According to Nicolescu “transdisciplinarity is a rel-

atively young approach: it emerged seven centuries later than disciplinary, due to the Swiss philosopher and psychologist Jean Piaget (1896-1980). The word itself first appeared in France, in 1970, in the talks of Jean Piaget, Erich Jantsch and André Lichnerowicz, at the international workshop Interdisciplinarity – Teaching and Research Problems in Universities, organized by the Organization for Economic Cooperation and Development (OECD), in collaboration with the French Ministry of National Education and University of Nice” [2]. Research and concerns are continuous in the areas of sustainability, risk perception, risk aversion and risk acceptance criteria and in accordance with the “Charter of Transdisciplinary” (Freitas & Morin & Nicolescu, Convento da Arrbida, 1994), from which we quote Article 12: “The development of a transdisciplinary economy is based on the postulate that the economy must serve the human being and not the reverse.” Although the project is focusing on the specific of enterprise risk management area, the developed approaches will be generic and transcultural. The conceptual framework of the knowledge universe about enterprise risk management, promoted for this proposal, is based on:

1. studying the research activities of renowned scientists for contributions in transdisciplinary (Jantsch [3], as cited in Apostel et. al. [4]; Lichnerowicz [5], as cited in Apostel et. al. [6]; Piaget [7], as cited in Apostel et al. [6]; Nicolescu [8]), and
2. on the review of several key documents that were identified in a comprehensive review of the literature.

The methods for review can be described as follows. We shall continue and use a study design of descriptive qualitative content analysis based on literature review related to the project mentioned topic areas: financial risk, operational risk, enterprise risk management. Electronic sources searches were performed using also “multidisciplinary”, “interdisciplinary”, “transdisciplinary” and “definition” as keywords to identify the pertinent online literature. The result may indicate that transdisciplinary attitude maintains theoretical and empirical linkages between studies of risk management and of regulatory processes. Furthermore, by developing interdisciplinary studies at the intersection of management,

sociology, organization theory, economics, political science and law, we arrive at a transdisciplinary in risk management. Tiziano Raffaelli [9] reconsiders the relationship between economics and physics and biology, even if not included and not identified as transdisciplinary [10] in Marshalls seminal idea of the self-development of mental machine, developed in his earlier studies in psychology and neurophysiology. The core of his vision consists of economic and social evolution as the gradual absorption of novelties in an increasingly complex structure through successive phases of standardization and specialization.

A transdisciplinary approach consists in finding a way to integrate the various disciplines (e.g. physics and biology) into economics to understand the risks to a complex economic world as an integrated system [11]. Economic risk assessment limits without global regulations allow the exacerbation of global systemic risks including transdisciplinary feed on money raised from anywhere in the world. It has represented a failure of the collective imagination of many bright people the way of preventing stability from creating future vulnerability. It will require rethinking a great deal about economics and the way global economic risks operate in an unconventional approach to risk management. The globalization of the economy and the risks that are originated in the development based on the sophistication and the innovation of financial services coming from financial institutions are based on the technology of informatics (which is likely to create irreversible gaps and unforeseeable risks) which also has the ability to understand the economic environment, to act effectively and in line with the biodiversity of financial services. In addition, it made material resources seem limited in relation to the creative imagination applied in the banking environment. These are the most important reasons and the global market is now pressing banks to take more risks far-reaching global seemingly unpredictable and independent, and banking system, facing in the first line with the economic risks, is responding through a regulated, uniform behavior. Systemic transdisciplinarity cooperation will be necessary, in which the pillar 3 of Basel - banks should establish a coherent disclosure and communication strategy around risk management – could be insufficient. It is expected to extend towards the global economic environment outside the banks and completion of the Basel agreements on the adequacy of risk of the social dimension and ethics by which

profits to generate streams transdisciplinary.

2 Transdisciplinary Axiomatic for Risk Management

The question of the risks is more and more extended to the whole of the risks incurred by a population, territory, business concern with a masters or overall management (it is undertaken with a concern of control or integrated risk management). It is the merit of systemic and singularity of risk analysis to have clarified this situation and its complexity. It is also in particular operational limit. A certain level of systemic complexity is not controllable by systems but by the communities concerned. It is there the socio-performance intervenes to build the conditions and their achievements.

We must recognize the nature of the economic literature consistent from one epistemological initial risk. The idea is that risk and uncertainty is concerning the unknown, but that risk is an attempt to control misunderstood by applying knowledge-based world order. Uncertainty, on the other hand, represents the entirely unknown fortuitous and therefore it cannot be controlled or predicted [12].

2.1 Fields of Complexity in Risk Management

First of all the multiplicity of the types of risks appears. In all cases this concerns people physically and morally, individual property and collective human communities and their issues. It also comes with temporal moments of different apprehension. There is speculation, an early confrontation with threats and events imaginable risks, which involves the emotions and imagination. There is the moment of crisis with safeguard issues, responsiveness, resources and specific skills. There is the restoring time, resilience, material and human reconstruction. Finally, there is the time of integration with memory and its complex processes, lessons, skills progression, the evolution of means and methods and decision-making. It will be noted that the initial speculation will be nourished from this final capitalization, until changing the course of the things. Everybody is often focused on one of these moments and even one of its phases, multiplied by the various sets of themes, generates a large number of specialties.

Let us add that the crossing between the risks is a dimension to be considered. On the imaginary and emotional level, the memory crosses the fields and a test resounds on all the later speculations. Fear, worry, anxiety are major parameters of the experience, interpretation, anticipation, evaluation, and even behavior, reasoning, postures and arrangements. In the same way, the material effects are linked only by the economic plan. Intellectual models tend to become widespread and thus to transpose the solutions but also the analysis of the problems; finally it is always in the sphere of collective or community human affairs that different risk areas will interbreed in relation to common issues and even every apprehension and individual practices necessarily taken in the collective life cultural context. Let us consider community question of socio-performance for example. How get out established consistency in the scientific and operational approaches while many experiments appear to be legitimate despite patent misunderstandings, which appear each time. The multiplicity of issues, areas, circumstances led to an indefinite fragmentation that finds its consistency into a transdisciplinary unit that includes the diversity of situations and their apprehension. This is probably the condition of the capitalization of knowledge, skills and control situations. But this is the way the risk analysis born a systemic vision with the methodological humanism and there is no question here of a comparative critical analysis which would notably make sure at what stage of the systemic design the risk management arrived, with the experience of its founder on human things. It will just provide an overview of the issue through three analyses: the epistemological analysis of the risk superior judgment and practical action to improve resilience to adversity and improve agility to seize opportunity [13]; structural analysis of the experience and human situations; proficiency levels and failure situations. Those allow to link risks to more general issues-related aspects in which they fit.

The above definitions of complexity from risk management are important because they give us a way to complete many different strains of modern economy in a single unifying concern—including the meaning of complexity and biodiversity of economic transdisciplinary risks. Acceptance of the economic profession they have to perform, with the fact that the economy is complex, signals openness to new ideas for economy, and other disciplines will be a complex

transdisciplinary field. The work done – falling into this broad approach to complexity–includes:

- (a) economists, sociologists and anthropologists facing from biological contexts are redefining by the mathematical theory of games the way that institutions are integrated into the analysis;
- (b) ecological economics is redefining how nature and economy are seen as interrelating in a transdisciplinary formulation;
- (c) psychological economics is redefining how rationality is treated;
- (d) econometric work dealing with the limitations of classical statistics is redefining how economists think of empirical proof;
- (e) the complexity theory is offering a way of redefining how we conceive general equilibrium;
- (f) agent-based computational economic (ACE) analysis is providing an alternative to analytic modeling;
- (g) computer simulations are offering a way to re-define models and how they are used;
- (h) experimental economics is changing the way economists think about empirical work [14].

Our discussion is regarding the research that involves more than one discipline. Multidisciplinary is somehow probably the oldest term. It is usually applied to situations where persons representing different disciplines get together and contribute ideas from their separate disciplines in ways that maintain the distinct identities of their disciplines, as in separate chapters within a book. Interdisciplinary as a more recent term was used as involving a greater integration of the ideas of different disciplines. Following the lead of the literature, we favor the term transdisciplinary to describe the new developments in the cutting edge, which implies a more thoroughgoing and profound interaction between the disciplines leading to some kind of new synthesis and transcendence [15].

Based on the new complexity, economics also becomes increasingly a transdisciplinary economics; in this area, there could be much to gain from financing research in agent-based models of the macroeconomics with three interrelated goals. Using the insights gained from agent-based models it is possible to develop an analytical model of a decentralized

market system, and apply it in a way that includes a sophisticated, highly articulated financial sector. Second, predicting economic fluctuations by using large-scale agent-based models. Third, the ability - defined as risk intelligence - to distinguish effectively between two types of risks: the risks that must be avoided to survive by preventing loss or harm; and the risks that must be taken in order to gain some competitive advantages. Risk intelligence means the ability to transform these insights into superior transdisciplinary reasoning and into practical action, to improve resilience to adversity and to improve ability to seize opportunities.

It will involve collaboration between economists and computer programmers: economists funded in this area should be thoroughly capable of writing such agent-based programs at a professional level and supervising the work of programmers not trained in economic theory [16]. Modern economy including risk management is now much more willing to accept it; it seems that the formal part of the economy has limited applicability, at least as currently developed and therefore it is difficult to integrate the methods of other disciplines into their methods.

2.2 Epistemological Limits of Risk Between Considered to be Taken or Void

Four directions mark out an epistemological compass as many postures of knowledge with their presupposed and their own logic. The risks are the result of threats existence, the potential violence with which different attitudes are possible: suffer them, dominate them. All occurs as if they were an otherness of the threat, source of deterioration, an opposite enemy to defend from. The risks are the possibility of a malfunction, of the intervention of a hazard into a system. The failure of a control loop can produce chain dysfunctions. There is also a need of strengthening the control systems and anticipating hazards. There is, of course, a possible competition between the complexity of the control system and the controlled system. The ideal is to establish a self-learning loop control system and to avoid the human error, which never captures the complexity with a perfect safety. These two logical approaches share certain fatalism about the risk origin. The risks are those disorders involved in a project. They show a limit in the control of operational procedures and streamlining of intervening factors. Disorders

could be avoided if one would enact rules allowing the anticipation of the imponderable ones and that one would improve the means and competences of situation rationalization. The two previous logics easily take actors to factors more than humans. The risks are the translation of the imperfection of the human condition. They invite us to cultivate coping skills related to the issues involved. Collective intelligence and collective responsibility are the result of a confrontation at risk, its hypothesis and experience. The risk assessment is based on the value of the issues themselves reflecting community values and the common good. This is the area of social performance. The two preceding logics make relative the risk with stakes and their level of control. The last and the first personalize the risk and the reactions with respect to its occurrence.

To each epistemological position [12] we can associate both modes of knowledge in force in the scientific universe, joining major issues of our time where the report to the world and the realities are in question, including the replacement of what is human in the trial of knowledge such as subject, object and project.

3 A transdisciplinary Perspective in Microeconomic Risk Management

Starting from an analysis of the significances of the risk management and financial field, we will wonder about convergences and specificities of these various disciplines for tending towards an integrated system of control approaches by the conciliatory processes efficiency, effectiveness, safety, solvency, profitability in the organization. After a short presentation of the issue of risk in the enterprise, we develop how to handle it through an instrument built on four levels: planning, management, simulation, self-monitoring on a daily basis. Finally, we highlight the importance of the actors in the risk management by a change in the specialists approach towards the development of self-control in the business to better understand the risks.

During the last decade, other approaches different from the transdisciplinarity were developed and described by several eminent researchers and teachers. Starting from the meaning that includes a collaborative process of a new way of organized knowledge

generation and integration by crossing disciplinary boundaries for designing and improving solutions to unstructured problems, one can easily see that “phrases of collaboration, shared knowledge, unity of knowledge, distributed knowledge, common knowledge, and integration of knowledge, integrated disciplines, beyond discipline, complex problems, and societal fields” are the major convergences [17]. Even if a precise definition of the transdisciplinarity is debatable, the current definitions and expressions can be defined as follows. Transdisciplinary Knowledge is a shared, common set of information from diverse disciplinary knowledge cultures (engineering, natural science, social science and humanities). Transdisciplinary Knowledge Integration is a social process, which only works if the participants are open to share and discuss their different perspectives. From this point of view we intend to explore – now and in the near future – how – from an economic perspective - transdisciplinary knowledge integration can be facilitated in the context of integrated assessments (IAs) and vulnerability risk assessments (RAs) of enterprise management. Even though knowledge from a wide range of social science and economic disciplines must be integrated in some transdisciplinary assessments (TAs), the actual process of integration is rarely addressed explicitly and methodically. Knowledge integration is conceptualized into the two subsequent phases of the elaboration of a shared language and the design of a methodology. Three devices for facilitating knowledge integration are put forward: (a) semantic ascent or the shift from speaking in a language to speaking in a meta-language about the former, (b) formalization or the translation of statements made in ordinary or technical language into a formal language, and (c) knowledge integration methods, which are methods that provide a meta-language for speaking about the knowledge to be integrated and organize the process of integration. Transdisciplinary assessments (TAs) address problems that cannot be solved by a single scientific discipline, or by science alone. People from different disciplines and from outside of science all possess unique knowledge about distinct aspects of the problem and need to collaborate to design and implement effective solutions. Integrated assessment (IA) and risk assessment (RA) are two variants of TA which are prominent in the context of problems associated with financial crisis and a transdisciplinary approach to sovereign debt [18] such as

how to mitigate financial risk components and how to disconnect mathematical incentives from excessively stimulating leverage as to optimize investment performance. The transdisciplinary way of problem solving in the wider sense is labeled frequently as assessment instead of research. The term 'research' is reserved for the intra-scientific practice of problem solving whereas the term 'assessment' refers to the joint problem solving amongst science and other stakeholders [19]. The Transdisciplinary Research Process can be understood as collaboration among specialists from various disciplines to develop and use integrated conceptual frameworks, tools, techniques and methodologies to solve problems without a common structure research. Transdisciplinary research leads to the creation of new patterns and provides pathways to new frontiers.

3.1 Enterprise Risk Management – A Transdisciplinary Framework

The risk can be defined as a damaging situation related to the daily activity of the enterprise whose occurrence is uncertain and with detrimental impact to the company or its stakeholders. The risk is inherent in any action, in any economic involvement. From a discipline to another, there is a specific meaning of the risk. However, similarities also exist for the integration of different control approaches for a more comprehensive risk management. Thus, the management activity covers three sets of actions necessarily integrated: to choose the objectives, for the company or a subset of it; to determine and arrange the means to implement and to achieve these goals; to place the tools for assessing the methods used and actual results. That is to say that the management control must ensure that the actions have been undertaken economically (available resources at least cost), efficient (use of the means available in the most productive manner without waste) or effective (movement towards the goals of the organization).

Earlier managers were seeking to control the operation of their business by imposing centralized systems. Control was mainly focused on results and supplemented by procedures controls. The internal control function was designed to ensure the protection of the heritage of the company, the reliability of the accounting records and annual accounts.

Then, in the seventies, the black box was changed. The multiple causes behind this crisis are well known: the end of the post-war shocks on commodity mar-

kets, development of international trade and competition, financial market development. Moving from curative to preventive, organizing the change, standing up to competition, recreating a human environment conducive to performance, restoring public confidence in the operation and the management of the companies: these are the tasks facing those responsible for control in and over the company. In order to provide a common vision to participants for what control means in the company, for its objectives, its multiple dimensions and levels involved, there is a need for designing an organization framework. It is at the elaboration of a referential that (at the end of the '80) the American practitioners of management control of corporate finance, internal audit, the external audit were involved together with corporate law and specialist teachers in these areas. When defining internal control we describe any systematic measures (such as reviews, checks and balances, methods and procedures) taken by an organization to enhance adherence to its policies and plans by managing the significant risks, having regard, in particular, to any significant failings or weaknesses that have been reported.

The definition of internal control has evolved over recent years as different internal control models have been developed. In the United States many organizations have adopted the internal control concepts presented in the report of the Committee of Sponsoring Organizations of the Treadway Commission [20]. The COSO reports describe internal control as consisting of five essential components. These components, which are sub-divided into seventeen factors, include:

1. control environment;
2. risk assessment;
3. control activities;
4. information and communication;
5. monitoring.

The COSO model is depicted as a pyramid, with control environment forming the base for control activities, risk assessment, and monitoring. Information and communication link the different levels of the pyramid (SARBANES-OXLEY SECTION 404, 2008 & COSO, [20]). As the base of the pyramid, the control environment is arguably the most important component because it sets the tone for the

organization. The factors of the control environment include employees integrity, the organization's commitment to competence, management's philosophy and operating style, and the attention and direction of the board of directors and its audit committee. The control environment provides discipline and structure for the other components. Risk assessment refers to the identification, analysis and management of uncertainty the organization is facing with. Risk assessment focuses on the uncertainties in meeting the organization's financial, compliance and operational objectives. Changes in personnel, new product lines or rapid expansion could affect an organization's risks. Control activities include the policies and procedures maintained by an organization to address risk-prone areas. An example of a control activity is a policy requiring approval by the board of directors for all purchases exceeding a predetermined amount. Control activities were once considered to be the most important element of internal control, but COSO suggests that the control environment is more critical since the control environment fosters the best actions, while control activities provide safeguards to prevent wrong actions from occurring. Information and communication encompass the identification, capture and exchange of financial, operational and compliance information in a timely manner. People within an organization with timely, reliable information are more able to conduct, manage and control the organizations operations. Monitoring refers to the assessment of the quality of internal control. Monitoring activities provide information about potential and actual breakdowns in a control system that could make it difficult for an organization to accomplish its goals. Informal monitoring activities might include managements checking with subordinates to see if objectives are being met. A more formal monitoring activity would be an assessment of the internal control system by the organizations internal auditors.

3.1.1 The Financial Risk

The economical characteristic of the transdisciplinary model for risk management – in our point of view – is that it is characterized by a consumer-oriented view. In this view of evaluation is often referred to as a consumer-oriented, consumer-based or needs-based evaluation, even if they differ slightly in their meanings. In the transdisciplinary view, evaluation affords the consumers the primacy in eval-

uation and therefore the main function of evaluation is the determination of the merit or worth (or value) of a risk management framework or risk assessment framework in terms of how effectively and efficiently they are serving those affected, particularly those receiving, or who should be receiving the services provided and those who pay for consequences. The characteristic of the transdisciplinary model (similar to statistics, ethics and logic) is that evaluation is a discipline that can be characterized by the study and improvement of certain tools (e.g., methods) for application between and within other disciplines [21]. The disciplinary characteristic of the transdisciplinary view of evaluation can be separated into three components: disciplines (e.g., social sciences, economy); fields of evaluation (i.e., types of risks, performance, portfolio); and fields of application (e.g., banking, health, audit, enterprises financial activities, services).

Graphically, the conceptual transdisciplinary model based on some disciplinary elements can be represented by spatial planes in three dimensions. In this model, each plane represents the three disciplinary components. The rear plane on the x and y axes represents the disciplines, the vertical plane on the y and z axes represents the fields of evaluation, and the horizontal plane on the x and z axes represents the fields of application. Any particular risk model (for evaluation) can then be located as a point or volume (e.g., a cube) in a three-dimensional space [18]. Before a transdisciplinary view on evaluation, economics was represented in a two-dimensional space, where firms are located on a plane at coordinates based upon their position with respect to two strategic dimensions, with clustering of firms indicating the strategic groups within the industry. This representation of strategic dimensions is very widely used, as it enables an easy understanding of the strategic positioning of firms and therefore it is particularly successful as a didactic tool. Later research into strategic groups extended the two dimensional model to use multiple strategic variables [22]. Whilst the positioning of firms using two strategic dimensions can be accomplished by representing the positioning on a plane, and whilst the positioning of firms using three strategic dimensions can be accomplished by representing the position of the firms within a cube, problems occur when one tries to represent firms in a space with more than three strategic dimensions. However, higher dimensional

space can be represented by using the mathematical notion of a hypercube: the analogue in a space of four or more dimensions of [a cube above] in ordinary three-dimensional space [22]. We can therefore represent n-dimensional risk strategy space by using an n-dimensional hypercube. Thus, the location and movement within the n-dimensional hypercube can represent a firms risk management strategy.

Financial risk is a key variable to enterprise risk management that not only leads to business failure but also brings about associated enterprise’s financial crisis. The exploration of the expansion law of financial risk is an important part for an enterprise to improve its risk management ability. The expansion of financial risk has a cyclical direction, strength and coupling features. The constituent elements of financial risk expansion include the source of financial risk, financial risk motivation, financial risk vehicle, financial risk pathway and financial risk expansion threshold. From inside of an enterprise, financial risk expansion is mainly following the space-time theory with some direction and intensity. Enterprise’s three-dimensional financial risks reflect macro, medium and micro levels, with expansion in time and succession in space. Financial environment-adaptation risk (FER), financial resource-allocation risk (FRR) and financial stakeholder-cooperation risk (FSR) constitute the three transdisciplinary dimensions of financial risks of enterprise. We need to build three matrix identification models, which are the FER identification model, FRR identification model and FSR identification model. FER identification model uses “Financial environment adaptation rate” as its horizontal axis and “Value creation rate of investment capital as its vertical axis. It reflects the two-dimensional relationship between value creation capability and environmental adaptability. FRR identification model uses “Financial resources optimization rate” as its horizontal axis and “Free cash flow rate of investment capital” as its vertical axis. It reflects the two-dimensional relationship between cash support ability and resource allocation capability. FSR identification model uses “Financial interests synergy rate” as its horizontal axis and “Cash value added rate of capital investment” as its vertical axis. It reflects the two-dimensional relationship between cash added ability and interest coordination capability [23]. To identify three-dimensional financial risks of enterprise an analytical index system must be mapped (See Tab. 1).

Calculation of FER identification matrix adopts the following formula:

$$\begin{aligned} x_1 &= (\prod_{i=1}^3 \nu_i)^{1/3} - 1 \\ y_1 &= \nu_4 \end{aligned} \tag{1}$$

Calculation of FRR identification matrix adopts the following formula:

$$\begin{aligned} x_2 &= (\prod_{i=5}^6 \nu_i)^{1/2} - 1 \\ y_2 &= \nu_7 \end{aligned} \tag{2}$$

Calculation of FSR identification matrix adopts the following formula:

$$\begin{aligned} x_3 &= (\prod_{i=8}^{11} \nu_i)^{1/4} - 1 \\ y_3 &= \nu_{12} \end{aligned} \tag{3}$$

Suppose the sample number of enterprise is n in an economic environment, which means the domain is $U = \{u_1, u_2, L, u_n\}$. If the calculated data matrix of X and Y of every matrix are the following:

$$\begin{bmatrix} X_{11} & X_{12} & X_{1n} \\ X_{21} & X_{21} & X_{2n} \\ X_{31} & X_{31} & X_{3n} \end{bmatrix} \text{ and } \begin{bmatrix} Y_{11} & Y_{12} & Y_{1n} \\ Y_{21} & Y_{21} & Y_{2n} \\ Y_{31} & Y_{31} & Y_{3n} \end{bmatrix}$$

Then we sort the data from small to big according to the row of the data matrix and we get:

$$\begin{bmatrix} X_{11} & X_{12} & X_{1n} \\ X_{21} & X_{21} & X_{2n} \\ X_{31} & X_{31} & X_{3n} \end{bmatrix} \text{ and } \begin{bmatrix} Y_{11} & Y_{12} & Y_{1n} \\ Y_{21} & Y_{21} & Y_{2n} \\ Y_{31} & Y_{31} & Y_{3n} \end{bmatrix}$$

Then, the thresholds of X and Y axis in every matrix can be obtained from the following formulas:

$$X_{i-} = \frac{1}{k} \sum_{j=1}^k X_{ij} \quad \text{for } X_{ij} < 0, \tag{4}$$

$$X_{i+} = \frac{1}{n-k} \sum_{j=k+1}^n X_{ij} \quad \text{for } X_{ij} > 0, \tag{5}$$

$$Y_{i-} = \frac{1}{k} \sum_{j=1}^k Y_{ij} \quad \text{for } Y_{ij} < 0, \tag{6}$$

$$Y_{i+} = \frac{1}{n-k} \sum_{j=k+1}^n Y_{ij} \quad \text{for } Y_{ij} > 0, \tag{7}$$

Table 1: Analytical Matrix.

Index name	FER variables	FRR variables	FSR variables
Market environment adaptation degree	V_1	-	
Investment environment adaptation degree	V_2	-	
Financing environment adaptation degree	V_3	-	
Value creation rate of investment capital	V_4	-	
Cash cycle dominance degree	-	V_5	
Cash deferred payment dominance degree	-	V_6	
Free cash flow rate of investment capital	-	V_7	
Capital synergy satisfaction degree	-	-	V_8
Customer synergy satisfaction degree	-	-	V_9
Employee synergy satisfaction degree	-	-	V_{10}
Supplier synergy satisfaction degree	-	-	V_{11}
Cash value added rate of capital investment	-	-	V_{12}

where: X_{i+} , X_i , Y_{i+} and Y_i are thresholds of X and Y axis, k is the number of negative, $n - k$ is the number of positive, i represents risk dimensions, $i = 1, 2, 3$ [23].

3.1.2 Transdisciplinary Knowledge Integration on Enterprise Risk Management

The next step concerns the compliance of the organization - how to reconcile the required efficiency, effectiveness, safety and solvency in a transdisciplinary approach. There should be understood the areas and significant systems of risk and the latter, the financial information flowing. These flows are taken into account for the initialization of the operations that are an expression in financial terms, to their translation in the accounts. The apprehension and understanding of these flows determine the nature and extent of their controls. This dynamic approach by flows induced an approach to control by activity and activities by the various functions that contribute to their achievement. Such an approach is

usually recommended by the states company of the auditors as regards control. The analysis process, that is to say the sequence of tasks, activities or operations performed by different entities (services, departments) with resources (human, equipment, materials, procedures, information) in dealing with business objects (information, contracts, records, orders, invoices, inventories, regulations) to outputs (services or products) allows for a comprehensive approach to risk in both angles of management, legal and financial. So what are the similarities – it is specific to say – to the convergence characteristics or elements that the disciplines of management, financial or legal, share (universal character) that can identify overlaps and synergies (resulting from an inherent transdisciplinary view) for specific characteristics or elements of each discipline and that bring a wealth complementarity in their group? Why the efforts of these various disciplines are in most cases implemented in isolation without real coordination? Can it be integrated into an overall system of control? It means to differentiate multidisciplinary by

transdisciplinary. The simplest form of collaboration between disciplines has been called multidisciplinary where an issue is regarded from the perspectives of various disciplines, but each discipline produces its own results. Multidisciplinary research is essentially additive not integrative. A more sophisticated form of collaboration is the interdisciplinary research, in which a common problem is solved jointly by different disciplines; knowledge from several disciplines is not simply added up but integrated. Interdisciplinary research produces one common result, rather than segregated disciplinary perspectives. Above all, the collaboration that at the same time (not only integrates disciplinary knowledge) aims at transcending disciplinary boundaries, has been called transdisciplinary research [19].

3.1.3 Transdisciplinary Assessments on Risk Control System

We can identify three convergence criteria for the four control functions: independence, lack of decision-making, contingency generic. For other criteria, the summary is as follows. The functional field is covered by all the activities of the company (operational and functional) for management control, internal control and quality, different from the financial analysis for the perimeter, which is more restrictive (high resource-consuming activities including financial ...). The functions of financial analysis, internal control and quality are subjected to external audit (inspection, self-control device, statutory audit, certification ...); it is rarely the case for management control. If the financial analysis and internal control can be considered as functions regulated nature (technical professional standards, ethics, responsibility...), the character is relaxed to prescribed quality standards (professional technical, safety, ...) and more to management control (mainly technical professional standards, ...). As for cutting short-term / long-term analysis, we find that the functions for financial analysis and management control and time control assessment follow a continuous process for the functions of quality and internal control. The financial analysis and internal controls are involved from time to time, upon request, intermittently while the control and quality management functions are more rooted in the company with periodic and recurrent interventions. Management control and quality of feed management accounting information as the internal control and financial analysis derive their raw

material from financial accounting. The nature of information is mainly quality and quantitative for the quality, quantitative and financial for the management check, financial for the financial analysis and the three at once for the internal check. Users or recipients of the control functions are external for financial analysis (shareholders, bankers, tax), internal (players in the organization) for the management audit function; for the quality and internal control they are both internal (players in the organization) and external (third party or client). As for the preferred values of each control function: productivity, efficiency in management audit, reliability, compliance, integrity, sincerity, security for the internal control solvency, liquidity, profitability, profitability for financial analysis, compliance, satisfaction, expectations and certification for the quality, they unite around the three key variables of control: cost, performance and risk. It is then the approach control under the angle of measurement or the evaluation in order to apprehend these key-variables of costs, performances and risks. For each key-variable, one must define the criteria to deduce their characteristics or properties. One must also measure or evaluate some of their impacts, i.e. the effects discounted on the activity. Finally, one must follow their evolution in time using indicators. The risk and performance, measurement or costing conveyed by the functions of management audit, financial analysis, internal control and quality lead to an integrated system of approaches of control.

4 Conclusion

Risk management, even when it applies, as explained, has been the constant object of change and revision, which is not unusual in a matter of such dynamic and permanent evolution. This explains how an eminently single-hazard vision has seen the convenience of migrating toward a multiple-hazard approach. This greater complexity is compensated by the integral nature that it takes on when dealing with different conditions of risk within a single political, economic and social reality, thereby allowing for the identification of generalities and particularities, common and divergent areas, and interest groups with differing needs and expectations. In few words, integral risk management includes a systemic vision, coherency in policies and decisions and rationality in the use of resources. Considering everything ex-

pressed until now, it seems redundant to affirm the need to approach this complex matter of risk management from the multidisciplinary, interdisciplinary and ideally, transdisciplinary point of view. A multidisciplinary focus comprises a way of approaching a process concentrated on the treatment of one or several issues from the perspective or view of one discipline, yet including the contents or contributions of the others. According to Piaget, this constitutes the lowest level of integration. An interdisciplinary focus means that two or more disciplines or forms of knowledge are combined or coordinated at conceptual level to see their inter-relationships and/or to explain an object or problem. A transdisciplinary focus deals not with a single discipline, but rather with a field of knowledge. This focus allows for the interaction of different disciplines to develop a common perspective, while conserving the riches and power of their respective areas of knowledge. The complexity and interdependence of topics that fall under the so-called risk management heading require an equally complex approach. Some of the most relevant include development, economic development, culture, poverty, vulnerability, environment, risk, resilience, marginalization, governance, and democracy, to mention only a few of them. Although it is undeniable that leadership in economic and banking risk management matters requires disciplines such as economy designing methodologies in its multiple anticipative facets, financial synergies, financial engineering, economy and public health, the contribution of the sciences, such as transdisciplinary jurionomics, mathematics, econometrics, computational statistics, cybernetics, anticipative systems, econophysics and computer science, are of undeniable value. Still other disciplines such as sociology, anthropology, health and political sciences and many others make a potentially enormous contribution around this interdisciplinary approach. When mentioning interdisciplinary and transdisciplinary approaches, we cannot fail to consider two, in particular, which mark clear tendencies in the changing world situation: the sectorial and organizational aspects. Sectorial factors are understood to be the interaction of institutional groups, recognized for their representation in areas of economic and social development, education, governance and similar considerations. Organizational considerations refer to the administrative structures, from the centralized level, through the organizations on the operational base, including the intermedi-

ate structures of different denominations, such as profit centers, branches or departments, or units indistinctly referred to as local network or mobile units. Sectorial and territorial aspects interact and illustrate how a matrix of multiple inputs is able to generate multiple results. Risk management integrates this matrix as a transversal element, present in practically all situations, adding a related factor of complexity to the mix, but distributing the load among the components of the process.

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