An ERM Maturity Model

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ABSTRACT

In recent years, Enterprise Risk Management (ERM) has emerged as a new risk management technique aimed at managing the portfolio of risks facing an organization in an integrated, enterprise-wide manner. Unlike traditional risk management, where individual risk categories are managed from a silo-based perspective, ERM involves a holistic view of risks allowing businesses to take into account correlations across all risk classes. The academic literature on ERM is focused on two main aspects: the analysis of the factors that influence ERM adoption and its effects on firms' performance. No studies have been conducted yet to propose robust and rigorous models to evaluate the quality, or maturity, of ERM programs implemented by firms. The aim of the research described in this paper is to fill this gap in the literature. To build a rigorous ERM maturity model, we have run an e-mail Delphi procedure involving a panel of worldwide experts on ERM who reached their consensus on the selection of a set of ERM best practice parameters, which are used to develop a structured questionnaire to be administered to firms. Expert consensus is also obtained on the scales and the scores for each questionnaire answer option. The output of the Delphi method is a scoring model that can be used to assess the maturity of an ERM program by administering a questionnaire composed of 22 closed-end questions to firms: Answers are collected and scored, and all scores are combined in a single final score, the ERM Index (ERMi). Finally, the robustness of the model has been tested on a small sample of firms. We foresee two different uses of the ERMi maturity model, one by scholars for further quantitative research on ERM topics, and one by practitioners, as ERMi is suitable to be used by firms for a self-assessment of their ERM programs (internal use) and by consultancy firms, auditors, and rating agencies (external use). The difference with other existing maturity models is its solid scientific base, the rigor with which it has been designed, and the fact that it is derived from a Delphi procedure involving leading ERM experts who reached consensus on the model detailed design.

1. Introduction

Enterprise Risk Management (ERM) is an integrated way to manage risks. It differs from traditional risk management, where risks are managed separately according to their category or the company department where they arise. ERM tries to align strategic objectives given by the Board of Directors with daily operations. A peculiar characteristic is that "risk" is seen not only from a down-side perspective, but also as an opportunity that can be exploited for competitive advantage.

In the literature the name ERM is sometimes replaced by synonyms like Enterprise-Wide Risk Management, Holistic Risk Management, Integrated Risk Management, and Strategic Risk Management. In addition, the definition of ERM is not unique, but several definitions have been proposed by different authors and entities; for the purpose of this research, the definition adopted is the one given by COSO: "A process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risks to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives."

The implementation of an ERM system is a big change management issue and absorbs many resources in terms of both finance and human resources. So why should firms embrace ERM? A number of theoretical motivations apply. According to COSO, ERM is intended to promote awareness of the sources of risks and address them by improving strategic and operational decision making. As a result of improved efficiency, firm performance should increase, volatility should decrease, and cost of capital should be reduced, and thus firm value should increase (Beasley et al. 2008).

Another hypothetic benefit of ERM is the creation of synergies between different risk management activities: by integrating risks across classes and departments, firms are supposed to be able to avoid duplication of expenditures (e.g., insurance) by exploiting natural hedges (Meulbroek 2002). Despite the theoretical motivations, if and to what extent ERM adds value is yet to be proven.

In fact, there is little evidence in the literature of empirical studies of the effect of ERM on firm value, and most of the available studies target only financial institutions. The few studies available generally report positive correlation between ERM adoption and firm value, but all suffer from the lack of a measure of the quality of the ERM implementation, which forces the authors to consider ERM implementation as a binary variable.

This paper aims to fill the gap in literature by building a rigorous and robust measure of the quality, or maturity, of ERM implementation. In order to design such a measure, first, a thorough literature review is performed to identify best practices and recommendations given by academics and practitioners. The validity of such indicators and their relative importance is determined with the use of a Delphi procedure, which is a group technique to obtain consensus from a group of selected experts. The experts are asked to select the best indicators of maturity of ERM implementation. In the following rounds of the Delphi procedure, the indicators are transformed into questions that make up a questionnaire to be used to collect data from firms. The Delphi procedure output includes the key to

assign a score to all the answers and therefore obtain a final score of the maturity of the ERM system implemented by the surveyed firm. Finally, the robustness of the model is verified with a pilot test run on a small-scale survey of real cases.

The scoring model thus built, called the ERM Index (ERMi), has scientific and practical relevance, and two different uses can be foreseen, one by scholars and one by practitioners, the latter probably being the most relevant. In fact, the ERMi is suitable to be used by firms for a self-assessment of their ERM programs or as a check list during the ERM first implementation phase (internal use), and by consultancy firms, auditors, and rating agencies (external use). It can also be used by scholars in further research studies using econometric models both as a dependent or an independent variable to investigate the determinants of ERM adoption and its effects on firm's value and performances.

2. Identification of ERM Best Practices

A literature review is conducted to identify the best practices in terms of ERM to be fed as starting inputs to the Delphi procedure, which requires experts to select a number indicators of ERM maturity from the given list or to add others of their own choice.

In order to identify best practices, not only academic literature but also reports and articles written by practitioners and consultancy firms and the most common ERM standards are reviewed. Evidence from the literature can be categorized in three main areas:

i) Risk culture
ii) Organization
iii) Process.

2.1 Risk Culture

Risk culture encompasses the values, norms, and behaviors shared by all members of an organization, which determine how they act toward the enterprise risks (Abrahim et al. 2012). The risk culture influences decisions at all levels of the organization and therefore the possibility of reaching the strategic goals, thus influencing enterprise value (IIF 2009).

Farrel and Hoon (2009) argue that developing a risk culture is a basic necessary element to implement good ERM practices. The importance of risk culture is also evident in the COSO ERM Integrated Framework, which considers the internal environment to be the basis for a correct functioning of the control system, including the ERM. Organizations lacking a strong risk culture may find themselves operating against their own policies, resulting in the inability to reach their strategic, tactical, and operating goals and in reputational and financial losses (IRM 2012). Brooks (2010) argues that risk culture is not an intangible concept but can be measured using the level of consistency between the decisions about risks and the existing policies and the desired risk profile.

Several entities and aspects characterize a solid and well-developed risk culture:

- *Board of Directors and top management commitment*
  (Lam 2003; COSO 2004; Lawrence 2005; Beasley and Frigo 2007; Farrel and Hoon 2009; IIF 2009; Shenkir and Walker 2011)

- *Clear definition and communication of an ERM policy*
  (Lam 2003; COSO 2004; Aabo et al. 2005; DeLoach 2005; Deloitte 2006; KPMG 2008; Lawrence 2005; Moeller 2007; PwC 2008; Cendrowski and William 2009; ISO 2009a,b; Rochette 2009; AIRMIC, ALARM, and IRM 2010; Fraser and Simkins 2010)

- *Definition of risk appetite and of an explicit risk-appetite statement*
  (COSO 2004; DeLoach 2005; Deloitte 2006; Barfield 2007; Moeller 2007; Chase-Jenkins and Farr 2008; KPMG 2008; Dean and Giffin 2009; IIF 2009; Rochette 2009; Ernst and Young 2010; Govindarajan 2011; Milliman 2011; Protiviti 2011, 2012; Rittenberg and Martens 2012)

- *Definition, considering the risk appetite, of a risk tolerance threshold for each objective of the organization*
  (COSO 2004; DeLoach 2005; Barfield 2007; Deloitte 2008; KPMG 2008; PwC 2008; Dean and Giffin 2009; Ernst and Young 2010; M_o_R 2010; Govindarajan 2011; Milliman 2011; Rittenberg and Martens 2012)

- *Clear communication of objectives, policies, and risk tolerance thresholds throughout the entire organization*
  (COSO 2004; Deloitte 2008; KPMG 2008; Ernst and Young 2010; Cendrowski and William 2009; ISO 2009a,b; AIRMIC, ALARM, and IRM 2010; Rittenberg and Martens 2012)

- *Sharing a common risk language within the organization*
  (CAS 2003; Aaboe et al. 2005; DeLoach 2005; Moeller 2007; Giorgino and Travaglini 2008; Shenkir and Walker 2008; IIF 2009; Abrahim et al. 2012; Deloitte 2012; IRM 2012; Zurich and HBRAS 2012)

- *Sharing and communicating risk information*
  (COSO 2004; Frigo 2007, 2008; Rochette 2009; ISO 2009a,b; Frigo and Anderson 2009; Lai and Samad 2010; Zurich and HBRAS 2012)

- *Organizing learning programs for employees*
  (Lam 2001, 2003; DeLoach 2005; Lam and Associates 2008)

- *Designing a remuneration and incentive system*
  (Lam 2003; COSO 2004; Deloitte 2008; Farrel and Hoon 2009; Rochette 2009; David-O'Neill and Stephens 2010; Segal 2011; IRM 2012; Rittenberg and Martens 2012)

– *Integrating the ERM with the Performance Measurement System (PMS), in particular with the Balanced Score Card (BSC)*
(Beasley et al. 2006; Calandro and Lane 2006; Oracle 2009; Protiviti 2010b)

2.2 Organization

As one of the distinctive features of ERM is its integrated approach, adequate organization choices are fundamental to spread the risk culture, to gain commitment to the program from the personnel, and to guarantee that the ERM process is effected in the correct way and policies and procedures are respected.

There is agreement in the literature on the necessity of a high-level champion to conduct ERM activities and of a structure that supports his job. To give details, a proper organizational design should consider the following elements:

– *Appointment of a Chief Risk Officer (CRO)*
(Lam 2001, 2003; Liebenberg and Hoyt 2003; Economist Intelligence Unit 2005; Moeller 2007; Deloitte 2008; Frigo and Anderson 2009, 2011; Rochette 2009; Segal 2011)

– *Building a dedicated ERM function*
(Lam 2001; Moeller 2007)

– *Designation of an ERM group or team to support CRO's job*
(Moeller 2007; Zurich and HBRAS 2012)

– *Independence of the ERM function (direct reporting of CRO to the Board or to the CEO)*
(Lam 2000, 2003; Moeller 2007; Deloitte 2008; Rochette 2009)

– *Identification of the risk owners responsible for the identification and management of each risk*
(DeLoach 2005; Fraser and Simkins 2010; Aabo et al. 2005; Beasley et al. 2010; ISO 2009a,b)

– *Clear definition and communication of roles and responsibilities for the management of risks*
(COSO 2004; DeLoach 2005; Deloitte 2006, 2008; ISO 2009a,b; Rochette 2009; Lai and Samad 2010)

– *Integration of the process of ERM among all the business functions and units*
(COSO 2004; PwC 2008; ISO 2009a,b; Frigo and Anderson 2011)

– *Involving all employees, at all levels, in the ERM process*
(COSO 2004)

2.3 Process

A description of the ERM process is common to all the main frameworks proposed in literature. They all describe the phases that compose the process, from the setting of the objectives to the risk identification and valuation to the treatment and control of risks, and their reporting.

The ERM frameworks and the literature provide a series of key elements that should be included in the design of ERM systems:

- *Integration of ERM in the strategic and business plans*
  (Lam 2001; COSO 2004; DeLoach 2005; Lawrence 2005; Beasley et al. 2006; Deloitte 2006; Beasley and Frigo 2007; Frigo 2007; KPMG 2008; PwC 2008; ISO 2009a,b; Rochette 2009; Protiviti 2010a, 2011)

- *Implementation of an efficient and effective process to identify all relevant potential risks*
  (COSO 2004; DeLoach 2005; Frigo 2008; ISO 2009a,b; Moeller 2007; PwC 2008; Rochette 2009; Lai and Samad 2010)

- *Creation and maintenance of a risk register*
  (Meulbroek 2002; Nocco and Stulz 2006; Giorgino and Travaglini 2008; Melnick and Everitt 2008; Vose 2008; Antonucci 2011)

- *Classification of risks into risk categories (e.g., strategic, operational, financial, and compliance, or strategic, operational, financial, and hazards)*
  (Miccolis and Shah 2000; IRM 2002; CAS 2003; COSO 2004; Shenkir and Walker 2008; Protiviti 2010a)

- *Definition of a formal process for risk assessment with qualitative and quantitative techniques*
  (Covello and Merkhofer 1993; Altenbach 1995; Coleman and Marks 1999; Miccolis and Shah 2000; CAS 2003; COSO 2004; PwC 2008; Risaliti 2008; ISO 2009a,b; Rochette 2009; Lai and Samad 2010; Berta 2011)

- *Periodical repetition of the risk assessment process*
  (Giorgino and Travaglini 2008; KPMG 2008; Paape and Speklé 2012)

- *Prioritization of risks on a residual basis*
  (COSO 2004; Aabo et al. 2005; PwC 2008; ISO 2009a,b; Antonucci 2011)

- *Integration of all risks in a risk portfolio and evaluation of correlations between them*
  (Meulbroek 2002; CAS 2003; Lam 2003; Nocco and Stulz 2006; Beasley and Frigo 2007; Moeller 2007; KPMG 2008; Rochette 2009; McShane et al. 2010; Lin et al. 2011)

- *Definition of a treatment strategy (avoidance, reduction, sharing, retention) for each risk, considering a trade-off between costs and benefits*

(Lam 2000; CAS 2003; ACT Insurance Autority 2004; COSO 2004; Frigo 2008; Giorgino and Travaglini 2008; PwC 2008; ISO 2009a,b; Fraser and Simkins 2010; Lai and Samad 2010)

- *Development of adequate contingency plans*
  (CAS 2003; Protiviti 2010a; Milliman 2011)

- *Development of a KRI system to monitor risk exposure and ensure it is coherent with KPIs and firm strategy, inclusive with a correction and escalation plans if risks exceed the limits*
  (Beasley and Frigo 2007; Frigo 2008; Giorgino and Travaglini 2008; Lam and Associates 2008; PwC 2008; Beasley et al. 2010; Ernst and Young 2010; Lai and Samad 2010)

- *Existence of a periodic risk-reporting system targeted at the different levels of the organization with different information granularity*
  (Lawrence 2005; Beasley and Frigo 2007; Farrel and Hoon 2009; Giorgino and Travaglini 2008; Beasley et al. 2010; Shenkir and Walker 2011)

- *Proper use of the technology as an aid to support risk management activities*
  (Lam 2000; Lam 2001; COSO 2004; Lawrence 2005; DeLoach 2005; Giorgino and Travaglini 2008; Shenkir and Walker 2008; Deloitte 2010)

3. Running the Delphi Procedure

In the literature one finds many discussions of ERM best practices and recommendations, but the absence of rigorous studies aimed at evaluating the level of maturity and quality of ERM systems and practices from which information and quantitative data can be obtained to develop the ERMi forces one to use an alternative methodology based on experts' opinions to obtain quantitative measures of the available best practices. Many best practices, recommendations, and indicators of ERM implementation quality are available in the academic literature, reports, and articles written by practitioners and consultancy firms and in international ERM standards (ISO 31000, COSO, the Australian Risk Management Standard, AS/NZS 4360, etc.), but they are of a qualitative nature only.

In the absence of relevant literature, to build a quantitative measure for ERM maturity, *experts' opinion* is solicited, where experts include scholars, practitioners, and managers with ERM-specific experience. To be able to consult experts dispersed in many countries and to reach their consensus in a scientific way, a *Delphi procedure* is applied.

Skulmoski et al. (2007) report that "The Delphi method is an iterative process used to collect and distill the judgments of experts using a series of questionnaires interspersed with feedback. The questionnaires are designed to focus on problems, opportunities, solutions, or forecasts. Each subsequent questionnaire is developed based on the results of the previous questionnaire. The process stops when the research question is answered: for example, when consensus is reached, theoretical saturation is achieved, or when sufficient information has been exchanged."

Rowe and Wright (1999) argue that the Delphi method is based on four key elements: anonymity, iteration, controlled feedback, and statistical reports of group answers.

The literature on the Delphi method reports that there are not specific guidelines on the number of experts required, which can range from 10 to 1000, and on the minimum grade of consensus, which is a subjective choice of the researcher (70 percent is a typical value); what is important is selection of the experts.

Two key elements are the anonymity of the experts (experts' identities are known to the researchers but not disclosed to other participants or other parties) and the controlled feedback, defined as a synthesis of the result of the previous iteration (Hsu and Sanford 2007), which ensures group learning and reaching consensus (Rowe and Wright 1999). The Delphi method is particularly useful in the case of a geographically dispersed group, when organizing a physical meeting would be impractical or excessively expensive.

Advantages and disadvantages of the Delphi method are debated in the literature. The main disadvantages are actually connected more with the efforts required to complete the procedure than to the quality of the method itself:

- Barnes (1987) argues that the method relies on the opinions of a selected group of people that could be not significant; however, it has to be noted that statistical significance is not the objective of the

Delphi method. Instead, the method is based on group dynamics to arrive at a consensus among experts who have a deep knowledge of the investigated topic (Okoli and Pawlowski 2004).

- It is a time-consuming, labor-intensive method, and thus expensive (Fitzsimmons and Fitzsimmons 2001). Witkin and Autschuld (1995) argue, instead, that the problem of the cost is overcome by the use of modern electronic technologies (e-mail, video/audio/web conferences), which speed up the process, make feedback elaboration easier, and improve anonymity.

- Sackman (1975) argues that anonymity may induce a lack of engagement and poor efforts because answers are not traceable.

- The method requires the facilitator to have strong written communication ability to avoid introducing involuntary bias (Barnes 1987).

- It requires a long time and substantial effort on the participants' side (Barnes 1987).

- In the literature there are not universally accepted indications on the optimal dimension of the panel and on the consensus level to be employed, which usually varies between 55 percent and 100 percent (Powell 2003).

Once the cost issues are solved, the method proves to give strong results. One of its advantages is that it leaves the participants the time to reflect on their answers, also in light of other participants' answers, without the time pressure of face-to-face meetings; this improves the quality of the answers (Hanafin 2004). It is also helpful when the presence of dominant personalities may influence other participants' ideas or prevent some of the participants from freely expressing their opinions.

Another important advantage is the high scientific relevance of the results obtained through this method. In fact, Mitroff and Turoff (1975) argue that an empirical generalization can be considered objective, true, or factual, if there is a sufficiently ample consensus of a group of experts.

Finally, it has to be noted that the results of the Delphi method are well accepted by the scientific community because its leading experts have contributed their own ideas to those results.

This study uses the *ranking-type Delphi*, a widely used variant of classical Delphi method especially convenient for reaching consensus in a panel of experts on the relative importance of issues (Okoli and Pawlowski 2004).

3.1 Selection of Experts

Three categories of experts have been identified and invited to participate in the Delphi procedure:

CATEGORY	SELECTION CRITERIA

Academics (no. 20)	▪ The top 20 cited authors in the ISI Web of Knowledge for a paper on the ERM topic
Consultants (no. 20)	▪ Executives of leading global consultancy firms on ERM topics ▪ Consultants serving as members of committees assembled for the definition of one of the main ERM frameworks
Practitioners (no. 20)	▪ Well-known figures in the ERM field, opinion leaders, and executives operating in firms renowned for their use of ERM ▪ Practitioners serving as members of committees assembled for the definition of one of the main ERM frameworks

The final panel is made up of 16 experts who agreed to participate and complete all the phases and rounds of the Delphi procedure; its composition is as follows:

- Academics: 5 (31.25 percent)
- Consultants: 3 (18.75 percent)
- Practitioners: 8 (50.00 percent)

3.2 Pilot Test

Before running the procedure with the full group of experts, a pilot test is run on a smaller group made up of only five experts, whose selection is based on their ample availability to go through the procedure and, in addition, to provide a detailed feedback on usability of the tool and clarity of the instructions and questions, at each step. The entire procedure is fine-tuned with the pilot test group.

The pilot test is also used to determine the optimal number of parameters to be included in the full Delphi procedure to obtain an acceptable trade-off between completeness of data and length of the questionnaire, which should not be too long to discourage firms to complete it when used in surveys for empirical studies and state-of-the-art reports. The result is 22 parameters, obtained as the arithmetic average of the five replies, which are all made up of between 20 and 25.

3.3 Consensus Level

Unanimity is not required in the Delphi method; instead, an agreement (or consensus) level has to be predetermined. While there are no universally accepted rules on the minimum level of consensus to be employed, Sumsion (1998) suggests 70 percent consensus be achieved in each round; 70 percent is a commonly used level and considered to be "strong consensus." The present study employees 70 percent consensus in each round.

3.4 Questionnaire Administration and Feedback Reporting

The procedure is run on the web platform powered by SurveyMonkey. Experts receive at the beginning of each round an e-mail containing the link to the questionnaire and detailed instructions and examples on how to complete the questionnaire of the specific round. The main elements of the instructions are repeated at the beginning of the questionnaire web page. The questionnaire provides the space to add comments and to suggest elements or parameters not originally considered by the researchers.

After each round, a statistical report of all the answers in an aggregated form is circulated to all participants, together with the comments/additions received, presented in the report in a unanimous way. After receiving the feedback, at each round the participants are given the option to change their initial answers however they desire.

The process is repeated for each round until at least 70 percent consensus level is reached.

3.5 Phases

The Delphi procedure is made up of several rounds, which can be grouped in different phases, each with its own objective and output. The phases' description is as follows:

Phase 0—Best practice preliminary identification

The best practices are identified from a thorough literature review and transformed into specific parameters by the researchers

Phase 1—Parameters selection by the experts

After having received comprehensive information on the purpose of the Delphi method and what kind of contribution is expected from them, experts are asked to select 22 parameters from the original set of best practices obtained from the literature review and/or to suggest new parameters and justify their choices.

Phase 2.5—Transformation of parameters into questions

The 22 selected parameters with consensus ranging from 70 percent to 100 percent are transformed into questions by the researchers making up the Delphi team, and possible answers are provided to make the questions closed ended.

Phase 3—Assignment of question weights and answers scores

In this phase the experts are asked to review the transformation of parameters into questions and review the possible answers suggested by the Delphi team. They are also asked to assign a score ranging from 0 to 10 to all the possible answers of each question, where a higher score means a greater maturity of the ERM system. It should be noted that the value of the "best" answer is not predetermined (i.e., it does not have to be the maximum, 10, necessarily), but reflects the experts' opinion on the importance of each question. Experts' opinion on the weights of the questions is therefore obtained in an indirect way, before they are asked to confirm. For this phase, the consensus obtained is over 70 percent.

4. The ERM Index (ERMi)

The final output is a questionnaire made up of 22 closed-end questions on ERM practices, analyzing company risk culture, the organization, and the ERM process. Each possible answer has a score attached to it, reflecting the consideration that the experts have of those ERM choices.

Depending on the type of consensus obtained, each score is obtained in one of the following ways:

- Consensus greater or equal to 70 percent on a single score (at least 12 identical answers out of 16) on a single score
- Consensus greater or equal to 70 percent on a narrow range of scores (at least 12 out of 16 answers in the range); the score is obtained as the arithmetic average of the scores reaching consensus (in the range). The range can include two or a maximum of three scores.

The second way is introduced in order to avoid repeating the procedure too many times, which could create a forced consensus instead of obtaining it in a spontaneous way and losing the experts' attention, considering that, however, the incremental decision would have been low, at least too low to justify the extra effort by the experts and the risk of incurring the above dangers.

The total score for a company is calculated by simply summing up the 22 scores associated with the company answers to the 22 questions of the scoring index ERMi. The maximum score, obtained by selecting the "best answer" for all 22 questions, is the decimal number 197.77.

For better clarity of the score reporting, a final step is applied to normalize all the scores to a 100-score scale. To do so, each score obtained by the Delphi procedure is divided by 97.77 and multiplied by 100. In this way, ERM maturity ranges from 0 to 100 and can be expressed as a percentage

The ERMi is illustrated in **Error! Reference source not found.**. For each answer both the score assigned by the panel of experts (second column) and the normalized score (third column) are reported.

Table 1

ERM Index (Full Questionnaire and Scores)

1. Does the organization have an ERM program (process) in place?	Score	Normal score
Yes	10	5.1
Not yet but we're implementing it	5.0	2.5
No	0	0
2. Has a RM/CRO been designated in charge for enterprise-wide risk management?	**Score**	**Normal Score**
Yes	9.75	4.9

No	0	0
3. Has an ERM policy been defined?	Score	Normal Score
Yes	9.43	4.8
Not yet, but we're defining it	4.29	2.2
No	0	0
4. Is the ERM integrated with strategic and business plans?	Score	Normal Score
Yes	10	5.1
No	0	0
5. Who is the prime sponsor of ERM in the organization?	Score	Normal Score
BOARD	9.67	4.9
CFO	6.88	3.5
CEO	9.43	4.8
Internal audit	1	0.5
6. Does a dedicated ERM function exist in the organization?	Score	Normal Score
Yes	9.75	4.9
No	0	0
7. Is it clearly specified who is accountable for every identified risk as well as who is responsible for controls to treat the risk?	Score	Normal Score
Yes	9.44	4.8
In part	5.71	2.9
No	0	0
8. Does a formal and well-defined process exist to identify or review potentially significant risks?	Score	Normal Score
Yes,	8.50	4.3
Not yet but we're defining it	5.85	3

No	0	0
9. Has a formalized process been defined to evaluate risk appetite in accordance with shareholders?	Score	Normal Score
Yes	6.14	3.1
No	0.33	0.2
10. Are company objectives, policies, and tolerances for risks clearly communicated through the organization?	Score	Normal Score
Yes	8.45	4.3
Only in part	6.14	3.1
No	0	0
11. To whom does the RM/CRO (or other equivalent position) report?	Score	Normal Score
Board	10	5.1
CEO	8.38	4.2
CFO	2.33	1.2
Controller	0.75	0.4
12. Do interdisciplinary risk management teams exist to support the CRO (so that each functional area can understand where it fits into the entire company strategy and how it affects other areas)?	Score	Normal Score
Yes	9	4.6
No	0.89	0.5
13. Are roles and responsibilities of everyone involved in the management of risks clearly documented and communicated?	Score	
Yes	9.5	4.8
Only in part	5.43	2.7
No	0	0
14. Are risks integrated within scorecard or corporate performance measurement criteria?	Score	Normal Score
Yes	9.5	4.8
No	0.5	0.3

15. Is the risk tolerance threshold, defined by considering the risk appetite, applied to each organizational objective?	Score	Normal Score
Yes, it is applied to each organizational objective	9	4.5
No, it is applied only to the most important organizational objectives	7	3.5
No, it isn't applied to any organizational objective	0	0
16. Is the incentive system for management linked to risk-adjusted profitability measures?	Score	Normal Score
Yes	8.71	4.4
No	0.25	0.1
17. Is risk management fully integrated across all functions and business units?	Score	Normal Score
Yes	8	4
No	0.33	0.2
18. If a formal and well-defined process to quantify risks exists: Are quantitative or qualitative methods primarily used?	Score	Normal Score
Quantitative methods	7.57	3.8
Qualitative methods	7.22	3.7
Both qualitative and quantitative methods	9.43	4.8
19. Does a periodic risk-reporting system exist?	Score	Normal Score
Yes	9.75	4.9
No	0.33	0.2
20. Does a register exist containing the list of identified risks and the potential responses?	Score	Normal Score
Yes	7.90	4
No	0.75	0.4
21. Does the organization train employees on ERM?	Score	Normal Score
Yes	8.71	4.4

No	0.43	0.2
22.Has a specific ERM standard been adopted?	Score	Normal Score
Yes	9	4.5
No	0.17	0.1

5. Robustness Analysis

The design of the index is based on the personal judgment of a limited number of experts; therefore it is important to check the robustness of the index: A small set of firms are invited to complete the survey, ERMi is calculated for each firm, and an ordered list (ranking) is obtained. Order list robustness to small changes in the ERMi parameters scales and weights is verified with a sensitivity analysis. Each score composing the ERMi is modeled as a normally distributed stochastic variable, with the average equal to the score given by the panel of experts. Robustness is checked with 0.5 and 1.0 standard deviation. One thousand different combinations of changes in the scores are obtained using random values for each score; for each combination, the ERMi is recalculated for each firm and order list is checked. The number of permutations is a measure of the robustness of the model.

The analysis run on the answers to the questionnaire obtained from 12 companies shows that for changes to the score within 0.5 standard deviation there are no permutations in the ranking, while for larger changes up to 1.0 standard deviation in 105 over 1,000 cases there is one permutation.

6. Conclusions

This paper illustrates the development of the ERM Index (ERMi), a model to assess the maturity of the ERM implementations in nonfinancial firms. The ERMi is the first ERM maturity model available in literature that is constructed in a rigorous and scientific way.

To compensate for the lack of quantitative measures for the many qualitative best ERM practices and recommendations available in the literature, after a thorough literature review, experts' opinion is solicited and group consensus obtained through a Delphi procedure. One of the advantages of the research method chosen is that the ERMi, as an output of a Delphi procedure, is an instrument already approved by the group of ERM leading experts who participated in the panel.

In particular, the Delphi procedure has engaged for four months 16 experts, out of the initial selection of 60, who agreed to participate and complete the procedure. The panel was composed of five academics, three consultants, and eight practitioners, thus representing the opinions of different types of parties with an interest in ERM practices and creating a fruitful debate. In fact, the panel experts showed active interest and provided

a number of different comments and justifications of their choices that were circulated (in anonymous form) among all the participants, thus creating an enriching exchange of ideas.

The ERMi is a tool that can be used both by academics in their empirical research, thus contributing to advancing academic knowledge in the ERM field, and by practitioners and consultants as evaluation tools. In particular, firms may use the ERMi to self-evaluate the adherence of their ERM system to the best practices and eventually to spot any area that should be improved to align ERM performance with its objective and contributing to the ultimate goal of any firm: increasing value.

It should be considered, however, that ERMi is not a comprehensive evaluation tool, but the number of parameters included was deliberately limited, keeping in mind the use of the tool in large numbers of empirical research projects using survey instruments, which require a trade-off between completeness and ease and speed of data collection.

The best practice indicators identified in the literature listed in the second section but excluded from the ERMi could still be used in a self-evaluation exercise by firms in a qualitative way, to complement the quantitative exercise of the ERMi.

A drawback of the present research is the low number (16) of experts who completed the procedure compared with the number of experts (60) initially identified and invited to participate. Considering that the ERMi is based on the personal opinion of 16 experts, a robustness check has been applied to verify if and how the evaluation of the firms through the ERMi changes for small variations in the scores of the answers and weights of the questions. In particular, a test has been run with real data from 12 firms obtained through a survey. In a test based on 1,000 different sequences of scores within 0.5 and 1 standard deviation, the firms' ranking did not undergo significant variation, and therefore the ERMi proved to be robust.

The ERMi is therefore an easy-to-use and a robust model that forms a starting point for future empirical works on ERM, contributing to advancing knowledge on the topic.

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