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The implementation of enterprise risk management practices: some evidence from large firms in Italy

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Abstract. This exploratory study reports the results of a survey investigation into the enterprise risk management (ERM) practices of large manufacturing firms in Italy, especially in relation to risk identification stage and the use of sophisticated risk assessment techniques. The survey is based on a sample of 58 large firms. Responses reveal that more than half of the surveyed firms have implemented ERM or are in the process of implementation. Further, most of the responding firms explicitly focus on potential events that can affect firm performance and the ability to achieve objectives, and each source of strategic risk (operations risk, asset impairment risk, competitive risk, and reputation risk) is perceived to be highly important in risk identification efforts. The analysis on the use of sophisticated risk assessment techniques reveals significant adoption rates among the surveyed firms that explicitly focus on strategic risk sources. In particular, firms use both quantitative and qualitative techniques, suggesting that both the output of quantitative probabilistic and non-probabilistic models and managerial judgement involved in the use of risk maps can play a key role in estimating probability and impact of risk events. However, sophisticated techniques are mostly attributed a moderate degree of importance, and this could be a signal of the difficulties inherent in risk assessment. In fact, as acknowledged in literature, there are events whose impact can hardly be predicted.
The main limitation of the study concerns the number of the surveyed firms, that reflects the exploratory nature of the study. To increase the validity of the results and to help determine the extent to which they can be generalised, they should be tested on larger samples.

Key-words. Management control, large firms, risk identification, sophisticated risk assessment techniques.

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1. Introduction. Several researchers suggest that many firms have responded to the challenges of global competition by introducing new management and production techniques, controlling costs, investing in advanced manufacturing and information-processing technologies, implementing viable strategies for succeeding in the marketplace (e.g., Noreen et al. 2011). Further, risk management has emerged as a critical factor to the success of financial and non-financial firms. Bhimani and Bromwich (2010) explain that "[the] combination of extensive financial volatility, rapid technological change and the impacts of the force of globalization has produced a climate of extreme change and risk".

On one hand, risk management has become a crucial component of contemporary corporate governance reforms, in the wake of 2008 financial crisis and other corporate disasters. Many rules and codes of corporate governance have been introduced worldwide to regulate more carefully the composition and the functioning of the corporate tripod (board, shareholders and management), with the aim to design a more efficient set of internal controls of firm behaviours and help ensure adequate management of risks in the interest of the different groups of stakeholders (Riccaboni 2014). On the other hand, the concept of risk has also increased in importance because of the growing awareness that organisational objectives should not be defined without a complete analysis and evaluation of the different types of risk that can influence their achievement. This awareness has led to the diffusion of risk management models and tools supporting the strategic management processes and performance measurements, providing information on risk with the aim to improve decision making and to reduce uncertainty (Bozzolan 2008). From this perspective, risk management has entered the domain of management control, which include "all the devices or systems managers use to ensure that the behaviours and decisions of their employees are consistent with the organization's objectives and strategies" (Merchant, Van der Stede 2007). As a result, risk management embraces both conformance and performance aspects. Conformance deals with compliance with laws and regulations, the use of best practice governance codes and internal controls and the delivery of assurance to stakeholders in general. Performance deals with strategy implementation, value creation and guide for decision making to achieve objectives (IFAC 2012).

Risk management can be viewed as a dynamic process by which firms methodically address risk linked to their activities in pursuit of organisational objectives. In recent years many firms have moved from a traditional risk management approach, limited to insurance and financial risks handled separately, to a holistic approach known as Enterprise risk management (ERM) that deals with a wider set of risk sources. ERM broadly encompasses some main elements (Collier et al. 2006): risk identification, risk assessment, risk treatment and risk reporting.

Although the emphasis on these elements may vary among firms and over time, this view stresses the importance of event identification and risk assessment as basic stages to prepare reporting and establish appropriate risk treatments (Kaplan, Mikes 2016).

However, despite the growing spreading of risk management practices, there is still quite limited evidence on how they are carried out in firms. This study aims to provide some insights addressing risk identification and risk assessment as elements of the ERM process. The intent of the analysis departs from previous researches as most of the existing literature has tended to examine risk management at a high level of aggregation or as a one-dimensional variable (Paape, Speklè 2012). Findings are based on a questionnaire survey considering a sample of large manufacturing firms in Italy.

The analysis will be exploratory in nature, and the questionnaire responses are used to explore the following research questions:

RQ1) What is the extent of ERM implementation in large manufacturing firms?

RQ2) What is the perceived importance attached to the different risk sources in risk identification?

RQ3) Do large manufacturing firms use sophisticated risk assessment techniques and what is their perceived importance?

The paper is organised as follows: section 2 includes an overview on ERM; section 3 focuses on risk identification and risk assessment; section 4 describes the data collection and the research method; the survey results are then presented in section 5, followed by a discussion of the results with the conclusions (section 6).

2. Enterprise risk management: an overview. Risk management is the set of principles, framework and processes for managing risk, being risk "the likelihood that some factor or event will prevent an organization from achieving its objectives" (Bhimani 2013). All firms face risk in the implementation of strategies or altering their operations, and the process of handling risk appropriately has been problematic (Baird, Thomas 1985). As noted by Fraser and Simkins (2016), risk management was traditionally viewed very narrowly, considering the exposure to specific potential events from an insurance or financial perspective. However, since the mid-'90s, due to a number of economic and social causes, risk management has shifted from a calculative to a managerial conception (Power 2007), and many firms have moved from a narrow approach to a more holistic approach, known as Enterprise risk management (ERM). The move towards ERM has been triggered by regulation and corporate governance codes, stakeholders' demands and business competitiveness (Davila 2012). While the traditional risk management approach considers "one risk at a time, on a largely compartmentalized and decentralized basis" (Nocco, Stulz 2006), ERM is "a systematic and integrated approach to the management of the total risks that a company faces" (Dickinson 2001).

One of the most frequent definitions of ERM is provided by CoSO (2004), which is a worldwide used risk management framework for best practice, and states: "Enterprise Risk Management is 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 the entity's objectives" (CoSO 2004). ERM definition highlights board supervision, seeking to relate risk management to high-level strategic choices, through an integration of risk management into the strategic planning and the decision process (Gatzert, Martin 2015). With the emphasis placed on the strategic role and the achievement of long run objectives, ERM is being advocated as a strategic management control system (Mikes 2009). Under ERM, adequate risk-based controls need to be implemented to help ensure that firm objectives are achieved (Soin, Collier 2013).

An increasingly rich academic literature on ERM has arisen in the last decade, and three fundamental streams of research can be identified (Mikes, Kaplan 2013). The first stream aims at explaining the presence (or lack) of ERM in firms by searching for the determinants (firm characteristics or contextual factors) of its implementation, mainly using survey method and empirical analyses. Gatzert and Martin (2015) provide a thorough review of this stream of studies, that could be described as applications of a congruence approach (Gerdin, Greve 2004). The second stream of research seeks to identify the performance implications of ERM implementations and follow a contingency approach, assuming that a proper fit between contextual factors and ERM positively impact on organisational performance. Most of these studies reveal a positive effect of ERM implementation on performance and firm value, for example Florio and Leoni (2016) in Italy, although the results are not completely unambiguous. Finally, there is an emerging third stream of research that concentrates on small-sample or case studies with the aim to investigate risk management "in situ", as an organizational and social practice (e.g., Arena et al. 2010). The three streams of research are suggestive of an emerging contingency theory of ERM, indicating that there is no universally ideal ERM and that the choice of appropriate ERM demands to be tailored to firm-specific contextual factors.

The implementation of ERM may involve different organizational roles at different firm levels (Giovannoni et al. 2016). In particular, in order to foster proper coordination and effectiveness, a senior executive such as a chief risk officer (CRO) or a risk committee should direct the ERM process and work with other managers in establishing and improving risk management in their areas of responsibility (CoSO 2004). CROs are board-level appointees who report directly to the CEO or CFO. They often have an advanced technical expertise and the

communication skills necessary to report goals and results to the board on a timely basis and to inform external stakeholders of the firm's risk profile. Risk committee is typically created and designated as part of the board of the firm (Liebenberg, Hoyt 2003). CRO and risk committee should also ensure that risk management is properly integrated into business strategy (Schroeder 2014).

According to different risk management frameworks and standards, ERM can be viewed as an organizational process with different elements shaping an idealized sequence which owes much to cybernetic control based on monitoring and feedback (Power 2007). In particular, as outlined in the introduction, effective risk management involves, as main elements, risk identification, risk assessment, risk treatment and risk reporting (Collier et al. 2006). Risk identification and risk assessment are depicted in the following section.

3. Risk identification and risk assessment in the ERM process. The basic stage in the ERM process is risk identification, which entails preparing and updating a list of potential events (risk register) that can affect firm performance and the ability to achieve objectives (O'Donnell 2005). Risk events must be identified correctly before a firm can take the step of risk assessment, and firms find it helpful to classify them (IMA 2007). In literature, a relevant classification of risk events is provided by Simons (1999), describing four basic sources of strategic risk that can affect every firm: operations risk, asset impairment risk, competitive risk, and reputation risk. Operations risk derives from the consequences of failures in core operating, manufacturing, or processing capabilities, and may arise from the action of people, systems and processes. Asset impairment risk is linked to a loss of current value in balance sheet assets or intangible resources, limiting the possibility that they can spawn future cash flows. Asset impairment can arise from deterioration in financial values (e.g., credit risk or market risk), intellectual property rights, or physical condition of assets. Competitive risk is linked to market rivalry and can emerge from the actions of competitors, changes in regulation and public policy, shifts in customer preferences and changes in supplier pricing and policies. Finally, reputation risk arises when firm problems or actions negatively affect customer perceptions of value in using the firm's goods or services and the overall estimation that stakeholders have of a firm.

The identification of sources of strategic risk provides the basis for risk assessment (Baird, Thomas 1985). Risk assessment is shaped by an a priori investigation of probability and impact of potential events on the firm performance (Noy, Ellis 2003), and is based on the use of risk tools such as quantitative or qualitative techniques, or a combination of both. The use of quantitative techniques require numerical values (historical or simulated), gathering data from a variety of sources. It allows to generate quantified estimates of probability and impact on financial performance and en-

Degree of sophistication	*Risk assessment techniques*
High	Statistical analysis (probabilistic models) Scenario analysis (simulation) Sensitivity analysis
Moderate	Impact and exposure analysis (e.g., risk maps) Risk rating or scoring/risk indicator analysis
Low	Group facilitated qualitative prioritization Individual qualitative self-assessment

Figure 1. Relative sophistication of risk assessment techniques (adaptation from Bozzolan 2004).

ables more rigorous assessment (CoSO 2012). The use of qualitative techniques involves the role of managerial judgement, comprehension of potential events, experience and intuition (Mikes 2009). Qualitative assessment may address the use of descriptive scales or scoring methods (e.g., managers rate impact and probability of potential events to estimate risk). DeLoach (2000) and Bozzolan (2004) classify risk assessment techniques by their relative degree of sophistication, from low to high, according to the level of difficulty and amount of data required.

They attribute the lower degree of sophistication to individual qualitative self-assessment and the higher degree to statistical analysis based on probabilistic models. This is illustrated in Figure 1.

There are many possible factors affecting the selection of risk assessment techniques. Mikes and Kaplan (2015) refer to the "(1) availability of data and knowledge about a particular risk (loss) and (2) how relevant and reliable the available risk tools are in the eyes of risk experts and everyone else using the tools", where the selection "tends to be associated with the firm's calculative culture – the measurable attitudes that senior decision makers display towards the use of sophisticated risk models". Cost of implementation, level of capability desired by management and regulatory requirements (for example in the financial sector) are other factors (DeLoach 2000). Moreover, firm size is positively related to sophisticated controls, as larger firm size results in relative lower costs of information processing (Cadez, Guilding 2008).

The information obtained by risk assessment is then included in reports directed to managers to be analysed for prioritizing risks and informing decision-making about possible risk treatments (mitigation, acceptance, avoidance) aligning with the stakeholders' risk appetite and expectations (Bozzolan 2004).

4. Research method and data collection. Data used in this study were collected in 2013 employing a web questionnaire survey. The survey considered only large manufacturing

firms (firms with at least 500 employees), as a number of studies show that the size of a firm is a significant determinant of the ERM adoption (Beasley et al. 2005). An initial sample of 179 large firms was randomly selected from the population of 479 firms included in the dataset obtained by the Italian Chambers of Commerce (CCIAA). The survey was carried out in two phases. In the first one, an e-mail directed to the Chief Executive Officer (CEO) or Chief Financial Officer (CFO) of the firms was sent to present the topic of the research and to ensure participation. 70 firms agreed to be surveyed. In the second phase, an e-mail was sent enclosing the cover letter and web link to the questionnaire. A total of 58 complete and usable questionnaires were returned, giving a response rate of 32.4% (= 58/179). The respondents were mainly CFOs. The sample of respondents included firms from various sectors: engineering industries, food and beverages, textile, chemicals and pharmaceuticals, metal products, information technologies. In order to assess the possibility of non-response bias, a comparison of the profile of respondents was conducted against the sector of firms in the selected sample. This comparison showed that respondents are significantly similar to sampled firms with regard to sector. For the sample selection, the hypothesis of missing-at-random is considered. The questionnaire was designed to investigate the use of risk management practices in firms and other firm characteristics, after reviewing the literature and referring to well-known risk management framework (e.g., CoSO 2004).

The study employs the same approach of previous surveys (Fatemi, Glaum 2000; Bezzina et al. 2014), where firms were asked to rate the perceived importance of different aspects of the risk management practices. In particular, ordinal scores are employed, considering the median as measure of central tendency and the inter-quartile range (IQR) as measure of variability. The range is also reported. To explore whether certain items were rated significantly higher or lower than others, the study used the Friedman test, a non-parametric statistical test that detects differences across mean ranks in related samples (Conover 1980). Then, to determine which pairs of items significantly differ, a multiple comparisons post-hoc analysis (Wilcoxon test) was carried out. In post-hoc analysis, the Bonferroni correction was applied to take into account the problem of multiple comparisons inflating the Type I error (the probability of obtaining by chance a significant difference when there is no true difference).

5. Results. First, one of the objectives of the study is to explore the extent of ERM implementation, trying to find an answer to RQ1: "Which is the extent of ERM implementation in large manufacturing firms"? Based on an adaptation from Beasley et al. (2005), firms were asked to indicate their agreement with items representing different stages of ERM implementation on an ordinal scale. "Partial ERM is in place" means that firms

Table 1. ERM implementation stage.

	No. of firms	%
Complete ERM is in place	23	39.7
Partial ERM is in place	11	19.0
Considering and preparing ERM	9	15.5
Never considered ERM	15	25.9
Total	58	100.0

have adopted ERM but they are currently in the process of implementation (Paape, Speklè 2012).

Responses are summarized in Table 1. The results are consistent with Gates (2006) and Beasley et al. (2005), as the majority of firms (58.7%) responding to this survey appear to have either partially or completely implemented the ERM process. Compared to prior surveys, the percentage of firms claiming to have complete ERM in place is higher. However, also the percentage of firms that never considered ERM approach is higher than the result of previous studies (e.g., Paape, Speklè 2012).

Further, normative and technical texts agree that firms implementing an ERM approach need a senior executive, such as a chief risk officer (CRO), or a risk committee responsible for the coordination and the direction of the ERM process. Table 2, focusing on firms that have at least partial ERM in place, shows the number of firms who have appointed either a CRO or a risk committee, or both. In seven firms both CRO and risk committee are involved in ERM. This seems to be in line with the view that CROs and risk committees may be supplementary and are not mutually exclusive (Liebenberg, Hoyt 2003). Nevertheless, board of directors or CEO should retain the overall responsibility for risk management, and ERM can also be effective having neither a CRO nor a committee focused on risk (CoSO 2004). This is a condition regarding 15 firms in the sample. Actually, other actors such as internal auditors or management accountants may also be charged with relevant tasks and responsibilities in the sphere of ERM (Giovannoni et al. 2016).

To explore RQ2 ("What is the perceived importance attached to the different risk sources in risk identification?"), firms were first asked information on their periodic risk identification efforts by indicating whether or not they explicitly consider each of the strategic risk sources (Simons 1999): operations, asset impairment, competitive and reputation risk. Then, they were asked to rate the degree of the importance attached to each source on a Likert scale ranging from "1" (unimportant), to "5" (crucial). A description of the sources was provided in the questionnaire, to help ensure homogeneous understanding by the respondents. Table 3 suggests that the

Table 2. Presence of CRO or risk committee in firms with partial or complete ERM.

	No. of firms
CRO	3
Risk committee	9
Both CRO and risk committee	7
None	15
Total	34

Table 3. Firms explicitly considering strategic risk sources in risk identification.

	All firms		*Firms with complete or partial ERM in place*	
	No. of firms	*% (n = 58)*	*No. of firms*	*% (n = 34)*
Operations risk	37	63.8	28	82.4
Asset impairment risk	38	65.6	28	82.4
Competitive risk	38	65.6	29	85.3
Reputation risk	37	63.8	28	82.4

majority of the surveyed large firms have an explicit consideration of the sources of strategic risk in identifying potential risk. As it could be expected, the percentage increases (exceeding 80%) if only firms with complete or partial ERM are contemplated.

Table 4 focuses on the importance of strategic risk sources over the whole sample, and reports summary statistics, Friedman test and Wilcoxon signed ranks test output. The results show that large firms judge the risk sources to be important, as all of them have been rated high, and the median score is 4 for each one. In addition, Friedman test is not significant (p-value = 0.611), indicating that there are no overall differences as regards their importance in risk identification. Post-hoc analysis with multiple comparisons (Wilcoxon signed ranks test) strengthens the evidence that the importance of a strategic risk source does not significantly differ from each other (the letter "A" corresponding to each strategic risk source indicates that there are no statistically significant differences in importance across sources).

Competitive risk and operations risk were found to be relevant, with systematic identification and assessment, also in Fatemi and Glaum (2000) survey about risk management practices in German firms. Further, the results emphasize that reputation risk has become a notable concern and this finding corroborates the results of Deloitte (2014). In global markets, the possibility or danger of losing reputation can threat firms in many ways, and the loss of reputation influences competitiveness, the trust

Table 4. The importance of strategic risk sources in risk identification.

	Median	*IQR*	*Range*	*Mean rank*	*Wilcoxon signed ranks test summary*
Operations risk	4	3-4	2-5	2.50	A
Asset impairment risk	4	3-4	1-5	2.37	A
Competitive risk	4	3-4	2-5	2.66	A
Reputation risk	4	3-4	2-5	2.47	A

Friedman test: $\chi^2(3) = 1.82$, p-value = 0.611.

and loyalty of stakeholders, the legitimacy of operations, and the financial performance. Potential events that can damage firm reputation need to be accurately identified and staved off. A new challenge for firms is linked to the rise of social media and immediate global communication as potential drivers of risk exposure. Actually, contents shared and diffused in social media may impact on how firms are perceived in the marketplace and cannot be controlled in advance by firms (Aula 2010).

RQ3 ("Do large manufacturing firms use sophisticated risk assessment techniques and what is their perceived importance?") regards risk assessment. As risk assessment builds on risk identification, the analysis is developed on the sub-sample of 38 firms having an explicit consideration of strategic risk sources. Of these 38 firms, 20 have complete ERM in place, nine have partially implemented ERM, six are ERM preparers, and three never considered ERM.

Firms were asked to rate the perceived importance of sophisticated techniques used in assessing strategic risk. Again, next to each technique a Likert scale ranging from "1" (not important), to "5" (crucial) was placed. The set of techniques is drawn from CoSO framework (2004), and DeLoach model (2000) is considered to take only into account techniques with a high or moderate degree of sophistication. The set includes both quantitative (probabilistic and non-probabilistic) techniques and qualitative techniques. Quantitative probabilistic techniques are: such as value-at-risk, cash flow-at-risk, earnings-at-risk and loss distribution. They are based on statistical analysis and are attributed a high degree of sophistication. Quantitative non-probabilistic techniques are: sensitivity analysis, scenario analysis and stress testing. They are attributed a degree of sophistication from moderate to high. Finally, risk maps and benchmarking have a moderate degree of sophistication and are qualitative techniques. A brief description of each technique was provided in the questionnaire to help ensure an homogeneous understanding of each technique.

Table 5 shows that each sophisticated technique is used by more than three-quarters of the firms in the subsample. In particular, the techniques

Table 5. The use of sophisticated risk assessment techniques.

	No. of firms	*% (n = 38)*
Cash flow-at-risk	33	86.8
Value-at-risk	33	86.8
Earnings-at-risk	32	84.2
Sensitivity analysis	32	84.2
Scenario analysis	31	81.6
Risk maps	30	78.9
Loss distribution	30	78.9
Benchmarking	29	76.3
Stress testing	29	76.3

with higher frequencies are "performance-at-risk" methods, followed by sensitivity analysis.

These results contrast with previous surveys (Noy, Ellis 2003; Gates 2006), where the incidence of firms using sophisticated techniques is considerably lower. Further, the majority of large firms (31 firms) declared to use both quantitative and qualitative techniques, as well as manifold (generally more than three) techniques at the same time (33 firms). This is somewhat consistent with literature indicating that firms may use different techniques when analysing and estimating the impact of different strategic risk sources (Mikes 2009).

Finally, Table 6 focuses on the importance of sophisticated risk assessment techniques, and reports summary statistics, Friedman test and Wilcoxon signed ranks test output. Cash flow-at-risk emerges as the technique with the greater median score (median = 4, IQR = 3-5), Loss distribution with the lower (median = 2.5). Most of the techniques are attributed a moderate degree of importance, with median importance equaling the central point of the Likert scale. Friedman test (p-value = 0.017) displays that the importance (as perceived by the respondents) of at least one of the sophisticated techniques significantly differs from at least one of the others. To refine this finding, the Wilcoxon signed ranks test to make pairwise comparisons has been used. Statistically significant differences in importance across techniques at $p \leq 0.0014$ (after applying Bonferroni correction) are indicated by different letters. Multiple comparisons mostly reveal that no techniques were rated significantly higher than others, with only two exceptions: cash flow-at-risk and sensitivity analysis (which are the techniques with higher mean rank) are judged to be more important than loss distribution in the assessment of strategic risk. Cash flow-at-risk and sensitivity analysis are hence indicated by the letter "A", loss distribution by the letter "B".

As suggested by Andrén et al. (2005), the use of cash flow-at-risk is increasing its appeal among non-fi-

Table 6. The importance of sophisticated techniques used in risk assessment.

	Median	*IQR*	*Range*	*Mean rank*	*Wilcoxon signed ranks test summary*
Cash flow-at-risk	4	3-5	1-5	6.40	A
Sensitivity analysis	3	3-4	1-5	5.88	A
Risk maps	3	3-4	1-5	5.15	A, B
Scenario analysis	3	3-4	1-5	5.08	A, B
Benchmarking	3	2.5-4	1-5	4.85	A, B
Stress testing	3	2-4	1-5	4.69	A, B
Value-at-risk	3	2-4	1-5	4.63	A, B
Earnings-at-risk	3	2-5	1-5	4.48	A, B
Loss distribution	2.5	1-3	1-5	3.85	B

Friedman test: $\chi^2(8) = 1.82$, p-value = 0.017.

nancial firms as "it sums up all the company's risk exposures in a single number that can be used to guide corporate risk management decisions".

It provides managers with information on how different macroeconomic, market or internal variables are expected to affect firm's cash flow and its estimated variability. Further, Abdel-Kader and Dugdale (1998) highlighted the importance of sensitivity analysis as risk assessment technique, whose popular use is associated with its "simplicity and the availability of computer packages which can help in applying it in practice".

6. Discussion and conclusions. This exploratory survey conducted in Italy on a sample of 58 large manufacturing firms delivers some interesting results about the development of ERM practices among Italian firms.

Firstly, more than half of the surveyed firms have implemented ERM or are in the process of implementation. Complete or partial ERM in place is not necessarily associated with the presence of a CRO or a risk committee. Further, most of the responding firms explicitly focus on potential events that can affect firm performance and the ability to achieve objectives, and each source of strategic risk (operations risk, asset impairment risk, competitive risk, and reputation risk) is perceived to be important at the same extent in the risk identification process.

Overall, these results indicate that surveyed firms are linking risk management to strategic planning, with the awareness that the variety of risk sources need to be comprehensively considered in the decision process. Conversely, there is also a number of firms that do not engage in risk management practices.

The analysis on risk assessment among the sub-sample of surveyed firms explicitly focusing on strategic risk sources reveals a significant use of sophisticated techniques to estimate probability and impact of potential events on firm performance. The diffusion of such techniques

could be driven by the significant advances in the risk measurement capabilities and technologies over the past 15 years (Mikes 2009), while another possible interpretation is that the use of sophisticated techniques can contribute to the perceived effectiveness of risk management (Paape, Speklè 2012). In particular, firms use both quantitative (probabilistic and non-probabilistic) and qualitative (risk maps and benchmarking) techniques. This mainly suggests that both the output of quantitative models and managerial subjectivity involved in the use of risk maps can play important roles in assessing risk and that quantitative assessment cannot substitute managerial critical thinking as a basis of decision making.

However, it has to be noted that while sources of strategic risk are carefully addressed in risk identification efforts, sophisticated risk assessment techniques are mostly deemed valuable at a moderate extent (with the exception of cash flow-at-risk). This could be a signal of the difficulties inherent in risk assessment. In fact, as acknowledged in literature, there are events, especially in strategic areas (e.g., an acquisition or new product launch), whose impact can hardly be forecasted (Bromiley et al. 2016). Kaplan and Mikes (2016) note that "in the range of management disciplines, risk management is one where measurement is particularly difficult and, indeed, a source of problems in its own right. Measurement generally involves the attempt to quantify events or phenomena that have already occurred, or are now taking place. But risk management addresses events in the future, those that have not yet occurred, and may never occur. In many if not most circumstances involving risk management, completely objective measurement is clearly not possible".

The study has a number of limitations, which should be considered in results interpretation. The main limitation concerns the number of the surveyed firms, that reflects the exploratory nature of the study. To increase the validity of the results and to help determine the extent to which they can be generalized, they should be tested on larger samples. Similarly, due to the sample size there is a possible non-response bias. The test performed to check this threat were negative but they do not consent to eliminate it. Then, the survey mainly aimed at understanding if ERM and sophisticated risk assessment techniques are used, and to what extent, but do not investigate how and why they are implemented in manufacturing firms. For example, the survey do not enquire which is the relative pressure of conformance issues and performance objectives in determining ERM implementation. These concerns may also require a different research approach. The development of case studies to compare firms practices could offer more detailed descriptions of the implementation and the possible evolutions of risk management.

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