Establishing a conceptually founded maturity development model for Enterprise Risk Management System in Austrian non-financial Enterprises

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supervised by

Univ. Prof. Arena Marika (Polimi)

Univ. Prof. Dr. Walter Schwaiger, MBA (TU Wien)

Scuola di Ingegneria Industriale e dell'Informazione
Management engineering - Ingegneria gestionale

Davide Raffaele
836745
Academic year 2018-2019
Affidavit

I, Davide Raffaele, hereby declare

That I am the sole author of the present Master Thesis and that I have not used any source or tool other than those referenced or any other illicit aid or tool

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Date                                                Signature
Abstract

Enterprise risk management (ERM) has recently emerged as a new paradigm to support organizations in facing risk in an integrated, enterprise-wide manner, and policy makers continue to focus on mechanisms to improve corporate governance and risk management (e.g., COSO). Despite these developments, many companies still struggle with ERM development, as there is a lack of good information on the management of ERM, on how to bring all the risk silos together. In order to cover this gap, and support entities in overcoming the ERM development challenge, this research proposes a maturity development model for Enterprise Risk Management System. In developing this maturity development model, a structured framework is followed where an agreed upon conceptual model is before developed and subsequently operationalized (via a questionnaire). Once the maturity development model is in place, results are gathered in a sample of Austrian non-financial enterprises and statistical insights into their maturity levels and their determinants are provided.
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1. Introduction

In recent years, the enterprise risk management (ERM) is rising up the agenda of companies as an important topic of discussion. It emerged as a powerful technique to drive managers evaluating and managing risk in an integrated, enterprise-wide way. COSO claims that ERM helps to identify the sources of risks and to address them by improving strategic and operational decision-making (Monda & Giorgino 2013). As a result, firm performance should increase, volatility decrease and the cost of capital should be reduced, positively influencing firm value (Beasley et al. 2008).

No sector and no country is exempt of risks, and neglecting them is the only sure way to disaster (Österreichische Nationalbank 2006). For these reasons, in order to make firms embracing (enterprise) risk management, Austria has a few legal requirements in place (i.e., § 267 Abs. 1 Unternehmensgesetzbuch (UGB), § 243 UGB and unternehmensrechts-Änderungsgesetz 2008). However, as evidenced by surveys and research, many companies still struggle with ERM development (Fraser & Simkins 2016) as there is a lack of good information on the management of ERM (Bromiley et al. 2015). Fraser et al. (2010, p. 400) found that many of the articles describe what the process [of ERM] should look like and how it should function, but there are few that provide details of how to get to that step. Many of the articles use great overarching statements that seem very much like motherhood statements. There is a distinct lack of information on how to bring all the silos together—other than to say that a common reporting system and language are important.

In order to cover this gap, and support entities in overcoming the ERM development challenge, the Institute of Management Science of the Vienna Technical University, sponsored by the Funk foundation, made a research project (which is at the basis of this thesis) to establish a maturity development model for Enterprise Risk Management System in Austrian non-financial Enterprises. This research aims to provide a conceptually founded framework that triggers ERM-system development through assessing the as-is situation, benchmarking it across the Austrian industrial sector and presenting a development roadmap for improvement.

Although there is no accepted methodology for impartially measuring management practices across different industries (Ibbs & Kwak 2000), we considered that maturity models could contribute to the discussion on how to measure and gain control of enterprise risk management practices, because they initially judge the sophistication of a specific process of an organization to then identify the key practices that are required to increase the maturity of those processes (Cienfuegos 2013).

To develop the enterprise risk management maturity model presented in this study, an advancement of the predictive validity framework (PVF) of Bisbe et al. (2007) and Libby et al. (2002) from theory-based empirical research was followed. Primary, a classification schema for the conceptual modeling of the maturity model (the Enterprise Risk Management Maturity Assessment [ERMMA] classification schema) was established. Accordingly, a three-dimensional/five stages maturity model

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1 The research project team was led by Univ. Prof. Mag.rer.soc.oec. Dr.rer.soc.oec. Walter S.A. Schwaiger and formed by Michael Brandstätter, Theresa Fröschl, Maximilian Irro, and Davide Raffaele.
was deductively derived, namely operationalized by specifying a set of progressive observable indicators for each dimension of the model (i.e. the ERMMA model). The indicators are binary and, in the last step of the PVF, they are translated in valid and reliable questions (ERMMA questionnaire). Eventually, the questionnaire was also implemented in an intelligent web application (named ERMMA online).

Following this approach, the questionnaire developed in this research differs consistently from traditional surveys. First of all, the questions asked in the ERMMA questionnaire are not formulated ad hoc but rather are deductively deduced using a refined version of the Predictive Validity Framework (Bisbe et al. (2007) and Libby et al. (2002)); from the ERM system theoretical construct, questions are explicitly modeled via observable indicators. Second, different levels of ERM implementation are not addressed by generic questions and then measured using a Likert-scale but rather each question measures the presence or absence of indicators assigned to the five maturity levels of ERM system via dichotomous (yes / no) answer options. These indicators (multiple for each of the five ERM maturity levels) represent, by their consecutive arrangement, the progressively increasing maturity levels of a development model. Thanks to this arrangement, not all companies are asked the same questions but rather they are asked only questions as long as they have the attributes required for the consecutive maturity levels. Finally, the participating companies do not have to wait until the study is evaluated to get results. After completion of the survey, the maturity level achieved and the related indicators as well as the development roadmap for the next maturity level are directly provided to the participants. As the ERMMA questionnaire is designed not to be a one-time endeavor but a recurrent monitoring tool to control the ERM system development of enterprises, companies can also follow the evolution of their maturity levels over time.

The ERMMA maturity development model will include COSO, as the most well known framework, but also ISO 31000 (and other frameworks as well) for additional perspective and guidance on implementation considerations, as The Institute of Internal Auditors suggests. An effective enterprise risk management cannot be based on just one framework, but needs to go further and include more perspectives, because those are just different aspects of Enterprise Risk Management. COSO, ISO 31000, Three Lines of Defence and the over 80 risk management frameworks reported worldwide do not match entirely, but there is a lot of overlap (Olson, 2008).

The methodology used for this thesis will clearly start from a literature review, where the existing (enterprise) risk maturity models found in the literature will be discussed. Then, following a refined version of the predictive validity framework (PVF) of Bisbe et al. (2007) and Libby et al. (2002), we will first build an agreed upon conceptual model that will be subsequently operationalized (via a questionnaire). Eventually, the results gathered through the operationalized questionnaire in a sample of Austrian non-financial enterprises will be analyzed and presented.

This research will provide a twofold contribution. On the scientific level, a novel development model for maturity measurement will be provided; and on the empirical level, statistical insights into the present Austrian non-financial enterprises' risk maturity levels and their causes will be shown.
The thesis will proceed as follows. First, a literature review about enterprise risk management maturity models will be presented. It establishes the foundation from which to develop, providing a common language and highlighting the benefits and limitations of the current works. Then, the focus will move towards the literature of theory-based empirical research to investigate how to correctly address the definition of a construct. Then, the measurement instrument for the operationalization of a construct will be discussed. The following section will examine the (cumulative) stage model theory, which gives theoretical basis to maturity models supporting the principles behind this method. The following chapter will then present the theoretical construction and the operationalization of the construct of the proposed ERMM model. The results gathered in a sample of Austrian non-financial enterprises will be then analyzed and presented. Finally, a last section closes the paper, where conclusions are drawn and future research possibilities are highlighted.

2. Background and Conceptual Frameworks

In this section, the previous literature in the empirical (E)RM maturity assessment research will be elaborated and presented. Next to that, additional conceptual frameworks which are relevant for the development of the ERMM study will be presented as well.

In addition, it was noticed an inconsistent use of terminology within the research area. A lack of a common language presents a number of issues for research. From a literature perspective, inconsistent use of terminology makes comparing and contrasting extant literature more complex as the exact meaning of a term, as used within an article, may be open to interpretation (de Bruin 2009). Consequently, in order to pursue clarity, the terminology of Bisbe et al. (2007) will be followed and the diverse terms used by different authors will be reported to this common terminology. In particular, we use the term construct to refer to a theoretical creation that can be defined in conceptual terms but cannot be observed and therefore is anchored to observable reality by means of indicators ... We use indicator (observables) to refer to an observable variable that represents an observable manifestation or an observable facet of a construct ... Operationalization is the process of developing operational definitions of indicators. Operational definitions are empirical referents that specify the exact operations to be carried out in measuring such indicators ... Operational variables (attributes, items) are the variables that result from such operational definitions ... Finally, we use the term measure to refer to an observed score of an operational variable ... Bisbe et al. (2007, p.790).

2.1 Overview of Maturity Models and Literature review of (E)RM Maturity Models

Maturity methodology has found increasing acceptance and interest by practitioners and scholars (MacGillivray 2006b); and this is confirmed by the steadily
rise of maturity-related topics publications over the last decade (Wendler 2012). Its success is driven by the fact that maturity models offer organizations a simple but effective method to measure the quality of their processes (Wendler 2012). They capture the “current” and “desired” state of implementation of a specific discipline (Maier et al. 2006), and define an evolutionary plateau to cover these two states (SEI 2009). The way to maturity is usually broken down into specific levels, where each level consists of related practices for a predefined set of process areas (SEI 2009). An enterprise reaches a new maturity level when a set of practices has been established to provide results that the firm did not have at earlier levels. The way of transformation is different at each level but always requires capabilities established at previous levels. Consequently, each maturity level provides a foundation of practices on which procedures at subsequent maturity levels can be built (MacGillivray et al. 2007).

In the following section, a number of maturity models in the (enterprise) risk management domain, which are considered relevant for this article, will be elaborated and presented.

### 2.1.1 (E)RM Maturity Models

A few proposals of (Enterprise) Risk Maturity Models are provided in the literature as well as in the applicative studies of consultants. All available models follow a general idea of construction with a gradual description of risk management advancements towards full maturity. These models differ, however, with the number of (maturity) levels evaluated and the dimensions (called attributes in the original publication) examined (Wieczorek-Kosmala 2014, p. 141). Accordingly, maturity models are classifiable via its one (1-dim.) or more (n-dim.) dimensional constructs and its two or more (n-stage) maturity levels.

Hillson’s proposal, published in 1997, should be considered as the pioneering model in risk management (Wieczorek-Kosmala 2014). Hillson adapts the Capability Maturity Model (CMM)2 to the context of risk, implementing a 4-dimensional/4-stage “risk (management)” maturity development model. The suggested maturity levels (naïve, novice, normalized and neutral) hinge on the idea that the approach of organization towards the management of risk can be categorized into groups which range from those who have no formal process through to organizations where risk management is fully integrated into the business (Hillson 1997, p.36). The 4 construct’s dimensions (culture, process, experience and application; called “attributes headings” in his publication) intend to provide more details to the model, and indeed its content is specified via

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2 The Capability Maturity Model (CMM) is a maturity model in the field of software development. In the CMM model, five consecutive (cumulative) maturity levels are defined: 1) Initial (where processes are only sporadic or not defined at all), 2) Repeatable (where processes are subject to simple monitoring), 3) Defined (where processes are defined company-wide), 4) Managed (where processes are controlled by quantitative measures) and 5) Optimizing (where processes undergo a continuous improvement process). The content of the five levels of maturity is covered by indicators, which are essentially based on dichotomous variables (i.e. yes / no to answer questions) (SEI 2009).
detailed indicators (called “attributes” in Hillson’s publication) representing the observable manifestation of the dimensions. However, Hillson remains at the conceptual level, as he does not assign any operational variable to the indicators of the 4 dimensions. The aim of the author is to provide a development model to organizations so as to assess their current level of maturity, identify realistic target for improvement, and produce action plans for developing or enhancing their risk capability (Hillson 1997, p.35).

Beasley et al. (2005) define an n-dimensional/5-stage “ERM” implementation maturity model, where the implementation maturity stages are defined in an ordinal increasing scale. In contrast to Hillson, Beasley et al. studied ERM at a high level of aggregation, as they do not clearly define dimensions nor indicators of the ERM construct and, instead, base their scale on broad statements regarding ERM implementation derived by the COSO ERM framework (2004). This because the authors investigate the entity’s stage of ERM maturity merely as a mean to explore organizational factors associated with it. The firm’s ERM maturity is aimed to be an ordinal dependent variable that reflects a value ranging from 1 to 5 and thus, a high-level description of the as-is situation is sufficient.

As Beasley et al. (2005), Monda & Giorgino (2013) focused on the specific field of Enterprise Risk Maturity, improving its implementation measurement quality by specifying a 3-dimensional/continuous-stage “ERM” implementation maturity model. In their research, the authors run an e-mail Delphi procedure (involving a panel of experts on ERM) to select and prioritize best practices of enterprise risk management found in the literature (in the area of organization, risk culture and process), which are then used to develop a structured questionnaire. Each participating firm answers the 22 closed-end questions and receives eventually a final score: the ERM index (the higher the value, the higher the maturity of the company). For aggregating the question responses to the ERM index, weightings for the answer options, calibrated through the Delphi procedure, are used. The aim of the authors is to propose a robust and rigorous model to evaluate the quality, or maturity, of ERM programs implemented by firms (Monda & Giorgino 2013, p. 1).

Cienfuegos (2013) establishes a 5-dimensional/5-stage “risk (management process)” maturity model for municipalities, focused on the Nederland; and although the author named it as “risk management maturity model”, it is built on organization-wide risk management processes. The author strongly relies on the literature of organizational change and organizational learning for the theoretical reasoning that guides him towards the construction of his risk maturity development model. However, confusing is that he uses the stage modeling for defining the five “stages” in the risk management process (i.e. context and objectives, identification, analysis and measurement, decision or control as well as implementation, review and feedback) which are then use as dimensions of the maturity model. Cienfuegos (2013, p.9) eventually aims to diagnose accurately the present state of risk management processes in Dutch municipalities, guiding them as well on the implementation of the best practices of risk management ... by focusing on a limited set of activities and working aggressively to achieve them.
Lundqvist (2015) develops a 2-dimensional/4-stage “ERM” implementation maturity model by assuming that two latent dimensions (called components in the original publication) determine the ERM: traditional risk management and risk governance. The four stages are generally defined on a range from zero to three, while the dimensions are more in details specified by 59 sub-dimensions. These stages and dimensions are then operationalized in a survey methodology used to get inside firms risk management/implementation and gain information about the implementation of a variety of dimensions of ERM (Lundqvist 2015, p.8). The author uses the results of the survey for analyzing the drivers of the implementation maturity through an explanatory factor analysis. The resultant factor loadings are analyzed with respect to the additionally measured “environmental/contingent” variables (e.g. size of the firm) in order to determine the drivers of the implementation maturities. As for Beasely et al. (2005), the aim of Lundqvist (2015) in developing a maturity model is to collect information regarding the current as-is state of an organization in regards of enterprise risk management, to then further analyze this information; thus, making the maturity model purely descriptive.

Finally, Oliva (2016) develops a 4-dimensions/5-stages “ERM” maturity assessment model focused on supply chain. In his research, differently from the previous scholars, the author identifies stages and dimensions in retrospect, based on extensive open-question-interviews to expert in the field and a survey proposed to a sample of large Brazilian companies, whose responses are then clustered into dimensions and stages that constitute the maturity model. As the author explicitly states, his research aims to analyze the enterprise risk management in the supply chain of Brazilian companies... [proposing] a maturity level assessment model with respect to enterprise risk management (Oliva 2016, p. 66-67); making the maturity model purely descriptive.

In Table 1 the (enterprise) risk maturity models considered relevant for this article are summarized with respect to their levels, dimensions and model aim. For this latter, ● is indicative of a primary focus and ◗ denotes what the researcher sees as a secondary focus of the model.

<table>
<thead>
<tr>
<th>Model</th>
<th>Stages</th>
<th>Construct Dimensions</th>
<th>Model Aim</th>
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<tbody>
<tr>
<td>Hillson (1997)</td>
<td>4 Stages</td>
<td>4 Dimensions</td>
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<td></td>
<td>o Naive</td>
<td>o Culture</td>
<td>◗ Descriptive Model</td>
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<td></td>
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<td>o Neutral</td>
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<tr>
<td>Beasely et al. (2005)</td>
<td>5 Stages</td>
<td>n-Dimensions</td>
<td>◗ Development Model</td>
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<tr>
<td></td>
<td>o No Plans to implement ERM</td>
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<td></td>
<td>o Investigating ERM; No decision yet</td>
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<td></td>
<td>o Planning to implement ERM</td>
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Table 1 - Comparison of stages, construct dimensions and aim of relevant (enterprise) risk management maturity models found in the literature

Descriptive and development model can be seen as distinct model types, though they actually represent evolutionary phases of a model: before being a supportive tools to assess the as-is situation of an entity, to then derive and prioritize improvement measures and subsequently control the progress of their implementation (Becker et al. 2009). A maturity development model serves first as scale for the appraisal of the position on the evolution path; a snap-shot of the organization regarding the given criteria is made (i.e. description of as-is situation). Once maturity is assessed, the development model provides guidelines for planning and orchestrating the evolutionary journey so that steps can be taken towards higher maturity (Hillson 1997; Solli-Sæther & Gottschalk 2010).

All (enterprise) risk maturity models presented in this chapter, assume that firms at first stage essentially do not manage risk, or if they do, they are chaotic, ad-
hoc and are unaware of the need for (enterprise) risk management and of its benefits (Cienfuegos 2013; Hillson 1997; Wieczorek-Kosmala 2014). The subsequent levels of (enterprise) risk management reflect the maturity advancements an organization may undertake in developing and improving the implementation of a strategic (enterprise) risk management framework (Wieczorek-Kosmala 2014, p.142). From the second to the second-to-last level of maturity, a firm first understands that it has risks that require formal management and thus experiments application of (E)RM, and then builds management of risk into routine processes throughout the whole organizational hierarchy and across all functional boundaries. Finally, at the highest level of maturity, the firm has developed a risk-aware culture with a proactive approach in all aspects of the business, it is an adaptive entity, learning continually and improving its (enterprise) risk management processes (Cienfuegos 2013; Hillson 1997).

Existing literature provided us with insights into how different criteria are applied when measuring the progression of (enterprise) risk management within organizations. The different models showed a wide range of possible approaches and procedures. For the purposes of ERM system design, Hillson's 4-dimensional / 4-level Risk Maturity Model is the most insightful. Through the progressive specification of maturity indicators, the risk maturity model is a development model that provides normative clues for improving maturity levels.

2.2 Theory-based Empirical Research: The Predictive Validity Framework

The previous section presented a number of risk maturity models which are, except of Hillson (1997), freely operationalized in questionnaires without previously undertaking a clear conceptualization of the (enterprise) risk management construct. A lack of attention concerning conceptual specification can lead to considerable ambiguity regarding the specific meaning of the constructs under consideration, which, in turn, threaten the subsequent operationalization of the construct by hindering its validity (Bisbe et al. 2007). Enterprise risk management is not a directly observable construct, and in this section we discuss an advancement of the predictive validity framework (PVF) of Bisbe et al. 2007 and Libby et al. 2002: a theory-based empirical research methodology through which unobservable (i.e. latent) constructs are conceptualized and then modeled on the basis of dimensions and indicators before being operationalized into an operational measurement model. Following this framework, the latent construct becomes measurable, before through a conceptual measurement model and then through an operational measurement model.

The predictive validity framework elaboration presented in Figure 1 derived from Bisbe et al. (2007) and Libby et al. (2002) is a framework that, as said, provides a description of the process by which an operational measurement model can be derived by a latent construct. Within the PVF, two levels are distinguished: the conceptual level and the operational level. At the conceptual level (top part of Figure 1), theory identifies the construct of interest and specifies its meaning. Theory subsequently develops a model that represents the expected relationships between construct, dimension(s) and
indicator(s). Research moves from the conceptual to the operational level (bottom part of Figure 1) by engaging in an operationalization process by which constructs are translated into operational variables that measure the variability associated with constructs.

As suggested by Mackenzie et al. (2011), a structured framework in developing measurement instruments is required (1) to avoid the risk of failing to adequately define a construct domain, and (2) to avoid the risk of improperly specifying the measurement model that relates the latent variable representing a construct to its measures. Failing to adequately define the conceptual domain of a construct causes confusion about what the construct does and does not refer to and fuels the risk that indicators may be deficient as the definition of the construct is not properly deepened. Misspecifying the measurement models (i.e., not correctly distinguishing between formative and reflective measurement models) can cause structural parameter estimates to be biased, when indicators that should be modeled as having formative relationships with a construct are modeled as having reflective relationships, and can undermine construct validity, if a scale development procedure recommended for latent constructs with reflective indicators is applied to latent constructs with formative indicators. To prevent these issues, the proposed framework should be followed.

The first step of the PVF displayed in Figure 1 is to identify the construct of interest, specify its meaning and its conceptual domain. A construct is a conceptual term used to describe a phenomenon of theoretical interest (Bisbe et al. 2007, p.791). Although constructs are literally constructed terms put together by the researchers, constructs refer to phenomena that are real and exist separately from the interpretation of the researcher and the persons under study (Edwards & Bagozzi 2000). Referring to
A real phenomenon does not make itself real in an objective sense, instead, constructs are elements of scientific discourse that serve as verbal surrogates for phenomena of interest. These phenomena can be either observable or unobservable but in any case, the construct itself remains an abstract term that describes the phenomenon (Edwards & Bagozzi 2000). The researcher should specify the construct in clear, unambiguous terms, preventing it to be subject to multiple interpretations, overly technical (i.e., using terms with narrow meanings) or be affected by circular or tautological definition. Additionally, a discussion of how the construct differs from other related constructs should be undertaken (Mackenzie et al., 2011). Each of these elements is essential. It is important for researchers to be as clear and concise in their definition as possible at this stage of the construct development (Churchill 1979). The failure to adequately specify the conceptual meaning of a study's focal constructs...triggers a sequence of events that undermines construct validity (primarily due to measure deficiency), statistical conclusion validity (due to the biasing effects of measurement model misspecification), and ultimately internal validity (due to a combination of factors) MacKenzie (2003, p. 323).

Once the construct has been carefully defined, it is important to step back and, in the second step of the PVF (box B displayed in Figure 1), explicitly specify the signs of the presence or absence of the construct under study. These signs of presence or absence of the construct are captured by observable variables referred to as indicators. Indicators identify the signs of the presence of a construct by referring to its observable manifestations (i.e., indicators as reflections of an underlying construct) or to its observable constitutive facets (i.e., indicators as the diverse aspects that combine to form a construct) (Bisbe et al. 2007, p. 791). For example, Rai et al. (2006) identified a set of indicators that collectively form the construct of operational excellence. These indicators include product delivery cycle time, timeliness of after-sales service, and productivity improvements in terms of assets, operating costs, and labor costs. A second example can be found in Onsi (1977), who identified three observable indicators for the construct “presence of budgetary slack”: easiness of budget attainability, setting of different budget levels across the hierarchy, and enabling of non-officially approved actions.

In some cases, it is not possible to directly observe the manifestation or constitute facets of a construct, as they are in turn manifested through, or constituted by, indicators. We refer to these cases as multidimensional constructs, and at the non-observable manifestation or constitutive facets as dimensions, which are in turn sub-constructs of a higher-order construct (Edwards 2001; Bisbe et al. 2007). For example, Rai et al. (2006) defined firm performance as a multidimensional construct, with customer relationships, revenue growth and operational excellence as dimensions (this latter was already exemplary specified through indicators in the previous paragraph). Once the researcher has delineated, through reviewing relevant literature, along with case study and formal interview, what is included and what is not included in the constructs (i.e., its dimensions and indicators), its domain is explicitly established (Segars 1997).

Having defined the three entities construct, dimensions and indicators, a researcher needs to subsequently determine, at the conceptual level of PVF, the nature...
and direction of the relationships among them (i.e. between a construct and its indicators, or between a construct, its dimensions and its indicators in case of multidimensionality) (Bisbe et al. 2007). We refer at this conceptually-defined relationship between a construct, (its dimensions) and its indicators as *epistemic relationship* (Hulland 1999). There exist two alternative types of models to represent different natures and directions of epistemic relationship between construct and indicators: reflective models and formative models (Bollen & Lennox 1991). Under a reflective model an underlying construct is reflected or manifested by a series of indicators. The direction of causality implied by the conceptual specification is from the construct to the indicators. Because indicators are conceptualized as reflections or manifestations of an underlying construct, changes in the construct are expected to cause changes in the indicator,... Alternatively, if a construct is formed or induced by indicators that describe its inherent constitutive facets, a formative model applies. The direction of causality flows from the indicators to the construct, and the indicators as a group jointly determine the conceptual meaning of the construct. The indicators are not driven by an underlying construct, ... and indicators are not necessarily interchangeable (Bisbe et al. 2007, p. 800).

In Figure 2, the two types of models can be seen. Note that the direction of the arrows from the X’s to the ξ and η is the mark of whether the construct is thought to be, and thus modeled, as formative or reflective. As suggested by Petter et al. (2007), a way of reading this directionality is to think of the ξ as “causing the indicators” in case of reflective construct and to think of the η as “being caused by the indicators” in the case of formative construct.

![Diagram of reflective (figure a on the left) and formative measurement (figure b on the right) models (from Edwards and Bagozzi 2000).](image)

Edwards and Bagozzi (2000) illustrate the relationship between reflective indicators and the construct mathematically as

\[ x_i = \lambda_i \xi + \delta_i \]  
(1)

Each indicator of a reflective construct is thus represented by its own equation, in which each of the \( x_i \) measures is influenced by the construct \( \xi \), the random measurement error \( \delta_i \) and the \( \lambda_i \) are factor loadings depicting the magnitude of the effect of \( \xi \) on the \( x_i \).
In a similar manner, also the formative concept is presented by Edwards and Bagozzi (2000) through the equation:

\[ \eta = \sum_i y_i x_i + \zeta \]  

(2)

Where \( y_i \) depict the magnitudes of the effects of the indicators \( x_i \) on the construct \( \eta \), and \( \sum_i \) represent the summation of the \( y_i x_i \) products (with \( i \) ranging from 1 to 3 in the model in Figure 2). For this latter, MacKenzie et al. (2011) proposes an alternative to the solely summation view. The authors claim that for some constructs is legit to combine indicators in a compensatory fashion to induce the meaning of the construct in such a way that the effect of each indicator on the construct is independent of the effects of the other indicators; in this structure, a change in one indicator is sufficient (but not necessary) to produce a change in the meaning of the construct. However, this summation approach is not appropriate for all constructs. For some constructs the indicators are necessary and jointly sufficient for the meaning of the construct (MacKenzie et al. 2011, p.302), thus suggesting that the construct represents the intersection of, for example in Figure 3, indicator \( x_1 \) and indicator \( x_2 \) and indicator \( x_3 \). Accordingly, a structure of this kind can be practically represented through a multiplicative interaction among the indicators; formally representable as:

\[ \eta = \prod_i y_i x_i + \zeta \]  

(3)

In equation 2 and 3 a disturbance term represented by \( \zeta \) is observable. In a relationship between construct and dimensions seems as casual, \( \zeta \) represent that part of the construct \( \eta \) not explained by the \( x_i \) indicators, and thus may be interpreted as measurement error. While in contrast, the \( x_i \) are considered as error-free causes of \( \eta \) (MacCallum & Browne 1993). However, the relationship between a construct and a measure is not necessarily causal, and a formative construct can be viewed as having a definitional rather than a causal relationship. In a definitional case, no measurement error \( \zeta \) would raise as no part of the construct would remain unexplained (Edwards and Bagozzi, 2000).

Either causal or definitional, a major difference between formative and reflective models is the extent to which a measure is required in order to completely represent the construct (Petter et al. 2007). Dropping a measure from a formative-indicator model may omit a unique part of the conceptual domain and change the meaning of the variable, because the construct is a composite of all the indicators.

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3 According to Edwards and Bagozzi (2000, p.157), four conditions need to be satisfied for establishing causality. First, causality requires that the cause and the effect are distinct entities. When two variables are not distinct, their relationship is tautological and therefore should not be viewed as causal. Second, causality requires association, meaning that the cause and the effect covary. Association is usually viewed as probabilistic rather than definitional, meaning the cause increases the likelihood of the effect but does not guarantee that the effect will occur. Third, causality requires temporal precedence, such that the cause occurs before the effect. Although causality may be nearly instantaneous at the micromedial level, the cause must precede the effect by some minimal time interval. Finally, causality requires the elimination of rival explanations for the presumed relationship between the cause and the effect.
(Mackenzie et al. 2005, p. 712). Instead, under a reflective model, indicators are essentially interchangeable and removing specific reflective indicators does not alter the conceptual domain of the construct and does not cause direct consequences in terms of conceptual misspecification (Bisbe et al. 2007, p. 800).

Related to the concept of formative and reflective constructs is that of multidimensional constructs. These latters are constructs with more than one dimension, where each dimension can be measured using either reflective or formative indicators (Petter et al., 2007). These multiple dimensions are grouped under the same multidimensional construct because each dimension represents some portion of the overall latent construct (Law & Wong 1999, p.144). Mirroring the differences between reflective and formative models, two basic types of epistemic relationship between a multidimensional construct and its lower-order dimensions may be proposed: latent models (also named “reflective second-order models”) and emergent models (also named “formative second-order models”). A latent model assumes there is a multidimensional construct that exists at a deeper and more embedded level of abstraction than its dimensions ... a change in the higher-order latent construct is expected to result in changes in all dimensions. ... Under a latent model, dimensions are essentially interchangeable and removing specific dimensions does not need to cause direct consequences in terms of specification problems, since dropping a dimension should not necessarily alter the conceptual domain of the construct... Unlike latent multidimensional constructs, emergent multidimensional constructs exist at the same level of abstraction as their dimensions and are defined as combinations of their dimensions. ... Dimensions are not interchangeable and leaving out constitutive dimensions of the higher-order construct may provoke severe specification problems. Omitting a dimension that represents a facet has serious repercussions because it means omitting a part of the multidimensional construct itself... (Bisbe et al. 2007, p. 804).

In Figure 3, the two types of models, as illustrated by Edwards and Bagozzi (2000), can be seen. The model on the left shows that the effects of the construct $\xi$ on its $y_i$ indicators are mediated by multiple dimensions, $\eta^*_j$. In the model on the right, the $x_i$ indicators induce one or more dimensions $\eta^*_j$, which in turn induce the construct of interest, $\eta$.

![Diagram of latent (figure a on the left) and emergent model (figure b on the right) (from Edwards and Bagozzi 2000).](image-url)
As reflective models, latent models can also be illustrated mathematically through a set of equations. One representing the epistemic relationship between dimensions and construct:

\[ \eta_j = \gamma_j \xi + \varepsilon_j \]  

(4)

and a second equation representing the relationship between indicators and dimensions, which are in turn sub-constructs (thus, equation 5 is conceptually identical to equation 1):

\[ y_i = \lambda_{ij} \eta_j + \varepsilon_i \]  

(5)

In Equation 4, \( \gamma_j \) indicates the effect of the construct \( \xi \) on the dimensions \( \eta_j \), and in Equation 5, \( \lambda_{ij} \) captures the effects of the dimensions \( \eta_j \) on the indicators \( y_i \) (with \( i \) and \( j \) ranging from 1 to 3 in Figure 3). Combining Equation 4 and Equation 5, the following can be obtained:

\[ y_i = \lambda_{ij} \gamma_j \xi + \lambda_{ij} \varepsilon_i \]  

(6)

An important remarks can be gained by observing Equation 6. The relationship between the indicators \( y_i \) and the construct \( \xi \) are represented by the product \( \lambda_{ij} \gamma_j \). Therefore, any estimate of the relationships between the construct (\( \xi \)) and the indicators (\( y_i \)) necessarily confounds the relationships between the construct (\( \xi \)) and the dimensions (\( \eta_j \)) with the relationships between the dimensions (\( \eta_j \)) and the indicators (\( y_i \)) (Edwards and Bagozzi 2000).

In a similar manner, also emergent models are presented mathematically by Edwards and Bagozzi (2000) through the set of equations:

\[ \eta_j = \sum \gamma_{ji} x_i + \varepsilon_j \]  

(7)

and

\[ \eta = \sum \beta_j \eta_j + \zeta \]  

(8)

Where equation 7 illustrates the relationship between indicators and dimensions (which are sub-constructs and thus equation 7 is conceptually identical to equation 2), and equation 8 illustrates the relationship between dimensions and construct.

In Equation 7, the \( \gamma_{ji} \) represent the magnitudes of the effects of the indicators \( x_i \) on the dimensions \( \eta_j \), and \( \sum \) is the summation of the \( \gamma_{ji} x_i \) products over \( i \) (with \( i \) ranging from 1 to 3 in Figure 4). In Equation 8, the \( \beta_j \) indicate the magnitudes of the effects of the dimensions \( \eta_j \) on the construct \( \eta \), and \( \sum \) is the summation of the \( \beta_j \eta_j \) products over \( j \) (with \( j \) ranging from 1 to 3 in Figure 4). The relationship between the
construct ($\eta$) and the indicators ($x_i$) can be further clarified substituting equation 6 into equation 7, obtaining:

$$\eta = \sum_{j} \sum_{i} \beta_{j} x_{ij} \gamma_{ij} + \sum_{j} \beta_{j} \zeta_{j} + \zeta$$

Equation 9 shows that the relationship between the indicators ($x_i$) and the construct ($\eta$), is represented by the summation of the $\beta_{f} \gamma_{ij}$ across all the dimensions ($\eta_{f}$). Thus, an estimate of the effect of the indicators ($x_i$) on the construct ($\eta$) confounds the effects of the indicators ($x_i$) on the dimensions ($\eta_{j}$) with the effects of the dimensions ($\eta_{j}$) on the construct ($\eta$). In addition, variance in the construct is attributable not only to its indicators ($x_i$) but, when the construct is not seen as definitional (i.e. error-free), also to the disturbances $\xi$ and $\zeta_j$.

Since emergent model are a formative second-order models, the multiplicative interaction proposed by MacKenzie et al. (2011) in opposition to the summation approach proposed in equation 7, 8 and 9 is still valid. In multidimensional constructs, a summation view on the dimensions suggest that a change in one dimension is sufficient (but not necessary) to produce a change in the meaning of the construct; while a multiplicative view on the dimensions suggests that dimensions are necessary and jointly sufficient for the meaning of the construct.

Having clearly specified the differences between reflective and formative models (as well as between latent and emergent models), should help a researcher to achieve completeness at the conceptual level of PVF through determining the nature and direction of the relationships between a construct and its indicators, or between a construct, its dimensions and its indicators in case of multidimensionality. This task is undertaken at conceptual level, as specifying what is the nature and direction of epistemic relationship should not be based on post hoc empirical evidences (Bisbe et al., 2007). The justification of defining indicators (and also dimensions in case of multidimensional constructs) as manifestation or constitutive facets of a construct must be conceptually justified (Jarvis et al. 2003); it should be regarded as a crucial step, grounded on the conceptual underpinnings of indicators, dimensions and constructs (Edwards and Bagozzi, 2000). The identification of dimensions and indicators as well as the consequent establishment of the domain of the construct, is of a conceptual nature and consequently corresponds to the conceptual level of PVF (i.e. box B in Figure 1) (Bisbe et al., 2007).

Once the conceptual level of the PVF is specified, the research moves from the conceptual to the operational level, where operational definitions (i.e. the specification of the exact operations to be carried out in measuring indicators) are specified and measured (bottom part of Fig. 1) (Bisbe et al. 2007). Operational definition are of salient concern in the PVF as measured variables often provide the keys to understanding underlying processes that produce the effects of interest (Libby et al., p 800).

Researchers may opt for three approaches to operationalize constructs into empirical constructs. In case of latent models (i.e. a second-order reflective models), since [these] are realized through their dimensions, ... operationalize is to represent the
multidimensional constructs as the common factor underlying the dimensions (Law et al. 1998, p. 750). In case of an emergent model, the researcher can either define the multi-dimensional construct as an algebraic function of its dimensions (i.e. aggregate approach) ... or ... use different combinations of the dimensions to form various profiles of the multidimensional construct (i.e. profile approach) (Law et al. 1998, p. 750).

In the aggregate approach, the overall multidimensional construct is formed as an aggregate (i.e. an algebraic function (Jarvis et al., 2003)) of its dimensions and thus, the dimensions are components of the overall multidimensional construct (Wong et al. 2008). For example, Locke (1969) clearly defined overall job satisfaction as the sum of factors such as satisfaction with pay, promotion, coworkers, the supervisor, and the work itself. Important is, that before a research estimates the operationalization of an emergent construct under an aggregate approach, all its parameters are identified because enough information needs to be available for the estimation of every parameter in the model (Bisbe et al. 2007). Under the profile approach instead, constructs are specified as discrete combinations of various levels of their dimensions because the dimensions of these multidimensional constructs cannot be combined algebraically (Law et al., 1998, p. 746). In other words, the nature of a profile multidimensional construct precludes the overall construct from being defined as an algebraic function of its dimensions (Wong et al. 2008) and consequently, the researcher should artificially partition each dimension into discrete levels and state the overall construct as a combination profile of the levels of its dimensions. For example, Jung (1971) proposed a model to define the personality of individuals using four personality dimensions (extraversion–introversion, intuitive–sensing, thinking–feeling, judgmental–perceptual). He then used all possible combinations of the four personality dimensions to form 16 different personality profiles. According to Jung, individuals in each personality profile have totally different orientations and behavioural tendencies in their daily lives.

In this chapter, a framework that provides a description of the process by which an operational measurement model can be derived by a latent constructs was explained. Following the PVF of Figure 1, a questionnaire (the operational measurement instrument of interest in this research) can be developed on a sound theoretical foundation. The questions asked in the questionnaire are not formulated ad hoc. Rather, the questions are deductively derived from explicitly modelled constructs via observable indicators. A researcher is guided from the conceptualization of the construct of interest, through the conceptualized measurement model (i.e. a classification schema that conceptually provides a categorisation for an entity under evaluation) towards the operationalized measurement model (i.e. the definition and measurement of operational variables and the subsequent empirical construct). For this last step of the PVF however, further insights on the development of the operational definitions (i.e. questions) are required in order to drive the researcher towards an optimal choice. The following chapter will address this issue.
2.3 Operationalization of a construct: the measurement instrument

The construction of the measuring devices is perhaps the most important segment of any [empirical] study. Many well-conceived research studies have never seen the light of day because of flawed measures (Schoenfeldt 1984, p. 78). Additionally, at the same time, the greatest difficulty in conducting research in organizations is assuring the accuracy of measurement of the constructs under examination (Hinkin 1998).

The main measurement instrument in the social sciences is a questionnaire (Dolnicar & Grün 2007), thus putting deep enough thoughts into formulating its questions and choosing their correct answer format is needed, or answers to carelessly formulated questions are useless, meaningless and potentially misleading junk (Dolnicar 2013).

A survey question consists of two parts: the query and the return. The query can be a statement or a question. ... The return is what respondents return in response to the query. The return can be open, requiring respondents to use their own words when responding. Alternatively, the return can consist of a check, or tick, to one or more response options, or answer options listed in the questionnaire. ... Response options can be anticipated, meaning that they contain the kind of answer the survey designer anticipates. The number of anticipated answer options provided to respondents can range from one only to many (Dolnicar 2013, p. 552). Bad choices with respect to these elements can significantly reduce the quality of survey measures which, in turn, will decrease the validity of knowledge developed from a survey study (Dolnicar 2013).

The query may or may not require input from persons other than the researcher. The more the construct under study is perceptual, the more likely is the scholar to seek for support (e.g. interviews or focus groups) in order to size every important aspect that needs to be captured in the query (Dolnicar, 2013). In any case, the key challenge in formulating survey questions is to ensure that respondents interpret them the same way, because as Payne (1980) reports in his experiments4, minimal wording differences can lead to a consistent variability of interpretation.

Concerning the return, open questions play an important role in survey research because respondents are not influenced. The main advantage of closed questions instead, is that they are more specific because all participants see the same responses (Dolnicar, 2013). Presently, the most popular answer format for maturity models is a five-point Likert scale (De bruin et al. 2005); however, popularity is not a measure of quality, and indeed Rossiter (2011, p. 79) notices that all the findings in the social sciences based on Likert items ... are suspect—and this means the majority of findings! As for Maturity Model literature, ordinal answer format dominates empirical research in general, however this preeminence is surprising given the methodological problems associated with it. The first problem concerns the question about ‘who is making the

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4 Payne (1980) reports, for example, that using the word should versus the word might in the following question: “Do you think anything should/might be done to make it easier for people to pay doctor or hospital bills?” leads to a 19% difference in agreement: 82% say it “should,” but only 63% say it “might.”
measurements”. Measurement presupposes an objective standard ... The usual case, however, is that respondents individually answer questions about, for example, the degree to which they agree with one or another statement – and it is hardly tenable that these respondents can be viewed as identically calibrated instruments. In practice, uncalibrated measurement will lead to ambiguous results, and to the impossibility of comparing respondents (Kampen & Swyngedouw 2000, p. 90). The second problem is the lack of equidistance, that makes it difficult to justify the use of analytic techniques developed for metric data, thus limiting the available methods to those specifically designed for ordinal data. Finally, the last issue is the distributional assumptions typically made for parametric tests, which cannot be tested, as even the existence of an underlying metric variable cannot be proven (Dolnicar & Grün, 2007). Although these several issues with ordinal answer formats identified in the literature, a possible reason for the popularity is its user-friendliness. Preston & Colman (2000) investigated this matter and found that individuals can better express their feelings when a number of categories are offered (e.g. Likert-scale). This is to the disadvantage of perceived speed, which is instead associated with lower numbers of answer categories (e.g. dichotomous).

Measures matter in developing a questionnaire. Even more since saturation of people with survey puts pressure on questionnaire development; the shorter and simpler the questionnaire, the higher the probability that potential respondents will agree to participate, thus potentially reducing response bias and possibly fatigue effects (Dolnicar & Grün, 2007). One way of achieving this is to replace traditionally used ordinal multi-category answer formats (such as Likert scales) with binary scales. This proposition is only attractive if it indeed shortens the survey time while not compromising the quality of managerial insights from the data. A few studies were made in this matter and the results are in favour of the suggestion. Grassi et al. (2007) compared a binary and a Likert-scale version of a standardised health survey, concluding that despite the loss of information due to the reduction of response’s possibility, our results indicate that ... the binary recoding ensure the [original] underlying structure ... is not jeopardized. In addition, it meets at least the same required standards, giving the possibility to propose a new version of smarter and easier methodology of administration, compilation, score calculation, and data processing (Grassi et al. 2007, p. 487). Or similarly, Dolnicar et al. (2011) investigate the two answer formats (i.e. binary and Likert-scale) concluding that (1) the binary format led to equally reliable results; (2) managerial interpretations based on typical managerial analyses would not differ; (3) the binary format saved respondent time; and (4) the binary format was perceived as simpler (Dolnicar et al. 2011, p. 247) and that binary format outperforms ordinal multi-category formats with respect to survey efficiency, without generating different results from a typical positioning analysis point of view (Dolnicar et al. 2011, p. 247). Or finally, Komorita and Graham (1965, p. 989) after the comparison of reliability and validity measures conclude that the major implication is that, because of simplicity and convenience in administration and scoring, all inventories and scales ought to use a dichotomous ... scoring scheme.

In this chapter, the formulation of survey questions, and specifically the choice of a correct answer format, was discussed. Despite the popularity of five-point Likert scale
answer format, the methodological problems associated with it were addressed. Additionally, it was noticed the nowadays saturation of people with surveys and the consequent pressure that a researcher has to develop short and simple questionnaires to obtain a high response rate and potentially reduce response bias and possibly fatigue effects. One way to avoid these two issues, was found in replacing traditionally used ordinal multi-category answer formats (such as Likert scales) with binary scales. Several studies were reported as having found at least the same required standards when using binary scales instead of Likert scales, and thus this configuration is suggested and will be use in the operational measurement instrument developed in this study.

2.4 The (cumulative) stage model theory, a ground for maturity development models

As stated in the introduction, this research aims to establish a maturity development model for Enterprise Risk Management System in Austrian non-financial Enterprise in order to support entities in overcoming the ERM development challenge. In chapters 2.2 and 2.3, before a framework to solve the methodology gap for measurement model development was presented. Then, a further discussion on the development of the operational definitions was reported. These two are needed to correctly develop the measurement instrument to assess the as-is situation of entities under examination. In this chapter, we will engage in the discussion on how to gain control of enterprise risk management practices (i.e. the development issue of considered entities).

2.3.1 Stage model theory

As presented during the literature review, (enterprise) risk maturity models suggest that organizations could progress in the implementation of risk management practices through stages sequentially followed. This assumes a process of development, wherein the entity experiences a transformation from an immature application of a discipline to an optimal application in the organization (Cienfuegos, p. 85). These principles can be traced back to the theories on stage models.

Stage models are one specific class of development model... [They] describe and explain change. They trace the condition or activities trough trasformations across time period.... and always describe discontinuos processes. In a stage model, change is characterized as a fixed sequence of static and deterministic stages, separated by predictable, programmed ... trasformations (Stubbart & Smalley 1999, p.274). These models support the evolution of an entity as they emphasize the direction of change through which perfection can be increased over time, ultimately reaching an end state (Damsgaard and Scheepers, 2000). To support this development, or growth, Solli-Seether & Gottschalk (2010) suggest that the stages in this type of models should be (1) sequential in nature, (2) occur as a hierarchical progression that is not easily reversed,
and (3) involve a broad range of organizational activities and structures (Solli-Sæther & Gottschalk, 2010 p. 3).

2.3.2 Maturity (development) model

Based on these assumptions of predictable patterns and stage models, maturity models developed, representing how organizational capabilities evolve in a stage-by-stage manner along an anticipated, desired, or logical maturation path (Pöppelbüs & Röglinger 2011). Although some authors argue that multiple paths through the stages might exist, contrary to linear progress through stages, Kazanjian (1988) applied dominant problems to maturity models. Dominant problems imply that there is a pattern of primary concerns that firms face for each theorized stage. Either implicitly or explicitly, stages of growth models share a common underlying logic: organizations undergo transformations in their design characteristics which enable them to face new tasks or problems that growth elicits. The problems, tasks or environments may differ from model to model, but almost all suggest that stages emerge in a well defined sequence such that the solution of one set of problems or tasks leads to a new set of problems or emerging tasks which the organization must address (Kazanjian & Drazin 1989, p. 1489).

With maturity models representing theories of evolution in a stage-by-stage manner, their basic scope consists of describing stages and maturation paths (Pöppelbüs & Röglinger, 2011). Accordingly, characteristics for each stage and the logical relationship between consecutive stages need to be explicated (Kuznets 1965). For their practical application, maturity models are expected to acknowledge current and desirable maturity state and to include respective improvement measures. The intent is to diagnose and eliminate deficient capabilities (Pöppelbüs & Röglinger, 2011). Rummler and Brache (1990) indeed metaphorically refer to such tools as roadmaps for guiding organizations. Formally, De Bruin et al. (2005, p. 2) distinguished the application-specific purposes of maturity model use in descriptive, prescriptive or comparative in nature. If a model is purely descriptive, the application of the model would be seen as single point encounters with no provision for improving maturity or providing relationships to performance. This type of model is good for assessing the here-and-now i.e. the as-is situation. A prescriptive model provides emphasis on the domain relationships to business performance and indicates how to approach maturity improvement in order to positively affect business value i.e. enables the development of a roadmap for improvement. A comparative model enables benchmarking across industries or regions. A model of this nature would be able to compare similar practices across organizations in order to benchmark maturity within disparate industries.

Determine the purposes of the desired model (i.e. descriptive, comparative, or development) is the first of six phases in developing a maturity model, identified by De Bruin et al. (2005) in their generic (standard) model development framework for MM. This proposed framework intends to guide the design of a descriptive maturity model and its advancement towards prescriptive and comparative purposes. The phases of the De Bruin et al. (2005) framework are: scope, design, populate, test, deploy and maintain. The first phase is to determine the scope of the desired model, deciding the focus of the model. Focus refers to which domain the maturity model would be targeted
and applied. With the initial focus of the model identified, stakeholders from academia, industry, non-profits and government can be identified to assist in the development of the model. The second phase of the proposed framework is to determine a design or architecture for the model; this is of particular importance as in this phase the needs of the intended audience are defined and how these needs will be met. Once the scope and design of the model are agreed, the content of the model must be decided. In this phase it is identified what needs to be measured in the maturity assessment and how this can be measured. Once a model is populated, it must be tested for relevance and rigor. Following population and testing, the model must be made available for use and to verify the extent of the model’s generalisability. Finally, evolution of the model will occur as the domain knowledge and model understanding broadens and deepens and thus, it needs to be maintained.

In connection with the theory-based empirical research, the scope and design phases are of special importance. The latter, identifies the principles of form and function that maturity models should meet (Pöppelbuß & Röglinger). The model design needs to strike an appropriate balance between an often complex reality and model simplicity. A model that is oversimplified may not adequately reflect the complexities of the domain and may not provide sufficient meaningful information for the audience. Whilst a model that appears too complicated may limit interest or create confusion. In addition, a model that is too complicated raises the potential for incorrect application resulting in misleading outcomes (de Bruin et al. 2005, p.12). In order to avoid these issues, design principles for the development of maturity models should be followed. Pöppelbuß & Röglinger (2011), De Bruin et al. (2005) and Johansson et al. (2008) suggest four main principles to follow: (1) to represent maturity as a number of cumulative stages, (2) to hierarchically structure MM into multiple layers referring to different levels of granularity of maturation, (3) to operationalize maturity in a multidimensional manner and (4) to ensure that maturity levels architecture follow the stage-gate approach:

(1) A common design principle is to represent maturity as a number of cumulative stages where higher stages build on the requirements of lower stages with 5 representing high maturity and 1 low. This practice was made popular by the CMM and appears to have wide practical acceptance. ... Stages should also be named with short labels that give a clear indication of the intent of the stage. (de Bruin et al. 2005, p.4).

(2) Maturity models can be structured hierarchically into multiple layers referring to different levels of granularity of maturation. A high level of abstraction provides a simple means for comparing and documenting maturity levels (e.g. on corporate level) ... A lower level of abstraction, in contrast, enables to cope with maturity within complex domains and provides better help with choosing among improvement measures. ... Maturity models following a descriptive purpose of use need to propose assessment criteria for each available level of granularity... Maturity models following a prescriptive purpose of use need to include improvement measures for each available level of granularity (Pöppelbuß
This approach\textsuperscript{5} removes the potential for losing insight and context from only viewing a single rolled-up figure (de Bruin et al. 2005).

(3) With maturation as primary subject matter, maturity models are required to define constructs associated to maturity and maturation (Becker et al. 2010). It has to be defined what maturity means in relation to the application domain under investigation. \textit{Such an explication may be one-dimensional. Many maturity models, however, operationalize maturity in a multi-dimensional manner}. \textit{A multi-dimensional approach facilitates the definition of assessment criteria for a descriptive purpose of use and the classification of improvement measures for a prescriptive purpose of use} (Pöppelbuß & Röglinger 2011, p. 7).

(4) The idea of the gated maturity assessment is to support the assessment and evaluation of the level of maturity through a stage-gate process (Johansson et al. 2008). The stage-gate concept was originated by Cooper (1990) in the field of innovation management. He defined the stage-gate system as a process \textit{subdivided into a number of stages}. \textit{Between each stage, there is a quality control checkpoint or gate. A set of deliverables is specified for each gate, as is a set of criteria [that must be passed]}… \textit{before moving to the next work station. The stages are where the work is done; the gates ensure that the quality is sufficient} (Cooper 1990, p. 46). Similarly, Johansson et al. (2008) suggest that in a maturity assessment, an entity should remain at a defined level until all the attributes defined at that level (i.e. the "sufficient quality" as defined by Cooper (1990)) are achieved. Assessing maturity using a gated assessment technique is \textit{essentially about comparing the 'as-is' level with a predefined 'pass profile' (i.e. 'to-be') on the components that are being assessed} (Johansson et al. 2008, p. 5). The pass profile is a combination of the necessary conditions required for an entity to develop on the maturity scale. Once all the necessary conditions are reached, the sufficient condition to pass the gate is achieved. In Figure 4 an overview of a stage-gate system of Cooper (1990) adapted to the maturity model concept is visible.

\textsuperscript{5} This approach is named "stage-gate" by de Bruin et al. (2005). However, in this research it was preferred to report the definition of Pöppelbuß & Röglinger (2011) to not confuse the reader with the design principle (4), which is instead named "stage-gate".
In this chapter, guidance to correctly address a stage model were collected and presented as it is important to avoid the problems often found in stage model applications: many of the published stage models were presented without defining their stages, without showing evidence of transformations, without explaining the use of stages, and apparently without understanding fully the pitfalls of stage models (Stubbart & Smalley 1999, p.284). From stage models, the concept of maturational process was broadened, including the research on maturity models. Adding the notion of descriptive, comparative and prescriptive models, as well as the design principles for the development of maturity models, a researcher has a sound theoretical basis to establish a development model.

Having examined the predictive validity framework as well as the maturity model theory, the following chapter will discuss their application into the enterprise risk management context.

3. ERMMA ERM-System maturity development model

Following the predictive validity framework, the first task in building a survey is not to start with the specification of questions. Instead, the conceptual model underlying the construct to be measured has to be specified first. In order to be able to specify a conceptual model the requirements of the model have to be determined. This occurs in the scope and design phases of the maturity model development framework from De Bruin et al. (2005). Once these stages have been performed, it has been clarified that the ERM system maturity model to be specified should:

- be based upon a comprehensive (i.e. multi-perspective) view upon the ERM system that has as primary audience the top management (including the top supervisory entity) of all firms in the non-financial industry;
- represent maturity as a number of cumulative stages;
- be hierarchically structured into multiple layers, so that more granular maturity assessments can be derived for other audiences as well;
- include descriptive, comparative and prescriptive model characteristics, so that it can be used by the firm to diagnostically assess its current as-is
maturity level, to get a roadmap for improvement to the to-be level and to allow a comparative benchmarking with other firms;
- ensure that the maturity levels architecture follows the stage-gate approach;
- avoid the circular reasoning pitfall\(^6\), so that it can be used for causal investigations in explorative statistical analyses to find drivers of the maturity levels;
- define cumulative attributes within each stage, so that the meaning of the progressions in the maturity levels are determined by design and not interpreted by the respondents of the survey;
- define binary attributes for better understanding and increased answering stability.

A maturity model with all these characteristics, would be an advancement of a prescriptive model, and thus named development model.

In order to define the ERM system conceptual measurement model, Enterprise Risk Management standards, as well as academic articles and reports written by researchers, practitioners and consultancy firms in the area of enterprise risk management were reviewed. Ultimately suggesting the ERM system construct to be defined upon three dimensions (i.e. ERM-Governance, ERM system and Risk-based planning and control system), each of them formed by three sub-dimensions (Figure 5). Clearly, the relationship between dimensions and construct (as well as sub-dimensions and dimensions and later indicators and sub-dimensions) is not seen as causal but rather definitional. Thus, no measurement error is assumed to raise, as no part of the construct remains unexplained.

The first dimension is ERM-Governance: the direction and control of Enterprise risk management. Risk Governance sets the organization’s tone, reinforcing the importance of, and establishing oversight responsibilities for, enterprise risk management (COSO 2017). It provides the structure of the risk management system and specifies responsibilities, authority, and accountability in the risk management system as well as the rules and procedures for making decisions in risk management (Lundqvist 2015). Enterprise risk governance is intended in this study as the combination of risk strategy, risk understanding and risk organization and it is a central identifying component of enterprise risk management. Enterprise risk governance is about encouraging a culture of risk-awareness throughout the firm, having an organizational structure to support the risk management system, and having in place governance mechanisms to oversee the system in a formal manner (Lundqvist 2015).

The second dimension is the RM system: the risk management system (itself), supported by adequate skills and a suitable risk information system. The enterprise risk management system is an iterative and structured process that includes two parts: the sequence of logical steps often referred to as the risk management process (i.e.

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\(^6\) As explained by Stubbart & Smalley (1999, pp.278–279), a tautology occurs when stages are used to “explain” observations which are actually features of the stages themselves. For example, you can’t explain your son’s “defiance of authority” by the fact that he is a teenager, if defiance of authority is one of the characteristics that defines “teenager”.

determining the objectives of risk management, identifying the risks, evaluating the risks, considering alternatives and selecting the risk treatment devices and implementing and reviewing the risk management program (Cienfuegos 2013) as well as coordination efforts to include the whole enterprise. However, this cannot be achieved without the support of adequate skills, because education of managers is, in reality, a key enabler for the implementation of advanced RM systems. As Colquitt et al. (1999) reports in fact, there are statistically significant differences between companies using and non-using advanced risk management tools based on management qualification, and they emphasize how the already important role of risk management in organizations will become even more critical as the movement toward an enterprise view of risk management continues (Colquitt et al. 1999, p. 55). Lastly, Babalyev (2012) notices how the management of risk data and information is key to the success of any risk management effort regardless of an organization’s size or industry sector. Agreeing on this matter, risk management information system makes the last sub-dimension of ERM system. These systems support expert advice and cost-effective information management solutions around the RM system.

Finally, the third area is the Risk-based planning and control system: the capability of the firm to plan and control its risk at strategic, business performance and process level. At the lowest level, the operational processes are planned and controlled, focusing on what Kaplan & Mikes (2014) define as preventable risks. At business performance level, the management has to understand the characteristics of the strategy execution risks (Kaplan & Mikes 2014), those risks, which are now connected also with chances, that have to be taken into account in order to generate superior returns for the enterprise. Finally, at the strategic level, the risk has to be considered within a long-term perspective, focusing on the external risks (Kaplan & Mikes 2014), which are here connected with chances as at business performance level, but cannot be influenced by the firm.

![Figure 5 - Dimensions and sub-dimensions of the Enterprise Risk Management system (i.e. the ERMMA model)](image_url)

In attempting to describe the dimensions and sub-dimensions that represents a construct, it is important to pay attention to the degree to which those items ... reflect the content universe to which the instrument will be generalized (Straub & David 2004, p.424), i.e. the content validity issue. Bisbe et al. (2007, p.812), define content validity as the degree to which a measure covers the relevant domain of a construct or its range
of meanings. It is a definitional issue and concerns the matter of capturing the extent to which an operationalization sizes the relevant domain of a construct. The previous attempt of describing the ERM system construct as a combination of ERM-Governance, Risk Management system and Risk-based planning and control system, needs to be justified as representing all facets of the construct. In this matter, the COSO (2017) framework provides the theoretical foundation for the selection of these dimensions. The Commission of Sponsoring Organization of Tread way (COSO) was formed as a joint effort of five international private sector organizations7. COSO ERM is one of the most widely cited frameworks among the academic researchers (Bovairt, 2011; Cienfuegos, 2013; Manab et al., 2012; Monda & Giorgino, 2013; O’Donnell, 2005). According to COSO (2017), governance is the first pillar of foundation for ERM, it is defined as the organization’s tone, reinforcing the importance of, and establishing oversight responsibilities for, enterprise risk management (COSO 2017, p. 6). Secondly, identifying and managing risk entity-wide (i.e. RM system dimension) is a clear purpose of COSO (2017)8. Every entity faces myriad risks that can affect many parts of the organization. Sometimes a risk can originate in one part of the entity but impact a different part. Consequently, management identifies and manages these entity-wide risks to sustain and improve performance (COSO 2017, p. 3). Finally, COSO (2017) suggest to integrate ERM into the existing systems (i.e. Risk-based planning and control System dimension); risk shall be evaluated primarily in relation to its potential effect on an already-determined strategy. In other words, the discussions focus on risks to the existing strategy: We have a strategy in place, what could affect the relevance and viability of our strategy? (COSO 2017, p. 4).

The approach of organizations towards the management of enterprise risk as previously defined, can be categorized into groups that range from those who have no formal process, to organizations where enterprise risk management is fully integrated into the business (Hills on 1997). In order to reflect this concept with clarity, the ERM classification scheme here proposed, includes five levels of risk maturity (Figure 6).

At the bottom, we find the ‘silo-centric’ management systems (ISO 31000:2011) where the different departments and functions are seen as closed doors, managing risk in an atomistic way. In this perspective, the responsibility of handling a specific risk is assigned to the units “threatened” by the risk (Cienfuegos 2013). Companies classified as having this approach would be sharing little of information and even less sharing techniques and methodologies with other functions and departments of the firm (Drennan and McConnell, 2007). Moving further in the maturity levels, the silo perspective is replaced by a more holistic approach to risk management that

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7 The five private sector organisations are the American Accounting Association (AAA), the American Institute of Certified Public Accountant (AICPA), Financial Executives International (FEI), the Institute of Internal Auditors (IIA) and the Institute of Management Accountants (IMA).

8 COSO (2017) provides a strong reference in regards of RM system concerning the management of risk in an entity-wide manner. However, this advanced approach of risk management is in the ERMMMA maturity model addressed from the 3rd level of maturity. Thus, for the lower maturity levels that refer to the risk management process (including silo-oriented risk management), a strong contribution of the ISO standard (ISO-RM 2011) is included.
proactively increases the organizational performance, as suggested by the COSO framework (2017). At this level of maturity, risk management becomes a wider Enterprise risk management, which aligns strategy, processes, technology, people and knowledge with the objective of assessing and managing threats and opportunities that firms face in creating value (Cienfuegos 2013). Under this perspective, there is a more centralized risk management function that directs the management of the risk management policy of the entity. This integrated perspective of risk management assumes that whether at the planning stage, during the development of a new project or as a part of day to day operational management, risk needs to be managed in an integrated way, encompassing potential threats in each level of the organization (Drennan and McConnell, 2007). Finally, the highest maturity for an organization is reached when single- and double-loop learning (Simons 1990) capabilities are developed. Single and double loop learning is related to the execution of the strategy according to plan. In the single loop learning managers receives and incorporate feedbacks regarding their planned risk strategy and if it’s executed according to plan; these feedbacks are used to make corrective actions and adjust the execution process. Double loop learning is a further development of a single loop. Next to the corrective control inputs, managers question their underlying assumption and reflect upon the theory under which they are operating remains consistent with current evidences, observations and experience. Managers need information to question whether the fundamental assumptions made when they launched the strategy are valid (Kaplan & Norton 1996).

Figure 6 - ERMMA classification schema (i.e. a 5-stage maturity model)

The high level ERMMA classification schema, needs to be then explicitly specified into observable and named indicators. The result of this transformation step is the corresponding ERMMA attribute schema. This schema contains the binary,
cumulative attributes for all nine sub-dimensions of the ERMMA classification schema.

Exemplarily, the transformation from the risk management process (ML1) in the RM-System (B1) to the risk management systems (ML2) is taken for illustration purposes (Figure 7). This transformation is defined according to the distinction between the risk management process and the risk management framework in the ISO 31000 Risk Management standard (2009), where the framework governs the risk management process by monitoring and adjusting it over time to ensure its effectiveness.

In order to assure independency from specific industry requirements, only functional (e.g. management function) and conceptual (e.g. risk aggregation) attributes and no institutional (e.g. manager) and technical (e.g. Monte Carlo simulation) attributes are used.

Note that the inclusion of binary attributes constitutes an important deviation from the traditional maturity assessment approach. In fact, all the maturity models mentioned during the literature review, with Hillson (1997) as only exception, are latent model types, as defined in the predictive validity framework. That means that the (E)RM constructs defined there are seen as underlying constructs that appear in form of the correspondingly defined indicators. With the attribute-based approach taken in this survey study instead, the ERM system construct gets explicitly defined via the indicators specified in its dimensions. As such the ERM system construct is not a latent, but an explicitly defined construct corresponding to an emergent model type.

<table>
<thead>
<tr>
<th>ML 1</th>
<th>ML 2</th>
<th>ML 3</th>
<th>ML 4</th>
<th>ML 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.1 Risk management (RM-Process)</td>
<td>B.1 Risk management (RM-System)</td>
<td>B.1 Risk management (E-wide RM System)</td>
<td>B.1 Risk management (Learning RM-System)</td>
<td>B.1 Risk management (Debated RM System)</td>
</tr>
<tr>
<td>1. RM Process is partially documented</td>
<td>1. docum. RM System exist because of docum. RM Process with Monitoring (+1a, +1b, +1c)</td>
<td>1. E-wide coordinated RM System is documented (+1a', +1b', +1c',+1d')</td>
<td>1. documented ERM system exists by incorporation of enterprise-wide risk aggregation (+1a, +1b, +1c, +1d)</td>
<td>1. Audited ERM-System is debated and discussed (according to culture and impact) (+1a', +1b', +1c', +1d', +1e, +1f)</td>
</tr>
<tr>
<td>+1a. Risk identification</td>
<td>+1b. Risk assessment</td>
<td>+1c. Risk mitigation</td>
<td>+1e. ERMgr coordinates the RM System</td>
<td>+1g. Top Management debates and discusses the ERM</td>
</tr>
<tr>
<td>2. RM Process is not reviewed</td>
<td>2. RM System is reviewed (regarding its appropriateness)</td>
<td>2. Reviewed E-wide RM System</td>
<td>2. Reviewed ERM System</td>
<td>2. (+2a', 2b, 2c)</td>
</tr>
<tr>
<td>2a. IA or other instances performs the review</td>
<td>2a'. IA review</td>
<td>2b. IA includes realized risks in the review</td>
<td>2c. Internal audit includes unrealized opportunities in the review</td>
<td></td>
</tr>
</tbody>
</table>

Figure 7 - ERMMA attribute schema. Example of the B1 sub-dimension: Risk Management System. Note that the apostrophes identify those attributes that are a development of previous one in the conception of the new maturity level (e.g. 2a, 2a‘ and 2a”)

The attribute in the the ERMMA attribute schema are seen as binary, as each item can either be or not-be in place in the entity under assessment. The binary measurement of dichotomous indicator variables allows a precise measurement with

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An extract of the ERMMA attribute schema considering the sub-dimension B1 is displayed in Figure 7. The whole ERMMA attribute schema can be found in the appendix.
respect to the intended indicators as it restricts the answer choice to the respondent and gives a lower base level instability (Dolnicar & Grün 2007) in compare to polytomously defined variable (e.g. traditional Likert-scales). Additionally, this binary structure ensures the maturity assessment to follow the stage-gate approach. To move throughout the maturity levels, all the attributes (i.e. the necessary conditions) needs to be in place for each level. This would ensure the sufficient condition to pass the gate to be reached. All attributes of each maturity level are necessary and jointly sufficient conditions for the development through the maturity model.

Finally, the cumulative binary attribute arrangement allows the precise setting of attribute sets for delineating the five maturity stages and thus establishing a layered maturity model that enables the provision of more differentiated maturity assessments within complex domains...by providing additional layers of detail that enable separate maturity assessments for a number of discrete areas, in addition to an overall assessment for the entity. These layers can be represented by the domain, domain components (dimensions) and sub-components (sub-dimensions) (de Bruin et al. 2005, p.4).

3.1 Survey Methodology: translating binary attributes into an intelligent questionnaire

After having explicitly defined the binary ERMM A attribute schema, this latter can be translated into questions\textsuperscript{10} to build the questionnaire for the ERMM A survey. An entity answering all the proposed questions undertake the assessment of the ‘as-is’ situation, ultimately summarized by a maturity score. Following de Bruin (2009), in calculating the maturity score a bottom-up approach was used, calculating scores at lowest level and then rolling these up to provide scores at higher level. This means that the scores for each sub-dimension are combined to give a score for each dimension, and that the scores for the three dimensions are combined to provide an overall score assessment (as seen in Figure 8). This additional granularity removes the potential for losing insights and context from only viewing a single rolled-up figure. Equal weighting was applied to each sub-dimension as well as to all dimensions as there was no clear reason that any one was more or less significant than the other.

\textsuperscript{10}Questions in the ERMM A questionnaires are statements to be answered with a Boolean logic
Figure 8 - Calculation of layered Maturity Score

Table 2 shows a sample of subsequent questions for the sub-dimension B1 Risk Management System.

<table>
<thead>
<tr>
<th># Questions and multiple answers</th>
<th>Maturity Level</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 The identification of risks is documented for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Selected areas of the company (e.g. production, logistics, finance, ... )</td>
<td>1</td>
<td>B1.1a</td>
</tr>
<tr>
<td>o All important areas with different methods (e.g. top-down and bottom-up)</td>
<td>3</td>
<td>B1.1a</td>
</tr>
</tbody>
</table>

Table 2 - Extract of ERMMA questionnaire, questions regarding sub-dimension Risk Management System.

The ERMMA questionnaire was available on-line on the ERMMA online application, developed upon a modern web-based 3-tier information technology. Differently from a traditional questionnaire design, where all respondents get the same questions in the same order, the ERMMA questionnaire is an “intelligent questionnaire” as the questions proposed to each participant depend on the previous answers given. Such intelligence is enabled by the multi-dimensional layered structure of the ERMMA attributes, which permit a flexible navigation through the ERMMA questionnaire. From an IT perspective, the intelligence of the questionnaire is implemented by a branch-and-cut mechanism that is used for the hierarchical single label classification that guides the application intelligently through the questions by taking into account the answers given.

In Figure 9 a sample of screen shots from the ERMMA online are presented. The panel on the left shows the homepage of the ERMMA online application. With the left-sided button the registration can be started. After registration, the survey can be started by pressing the right-side button. The panel on the right shows an introductory question to the ERMMA questionnaire.
The maturity score previously described is also provided to each participating firm in the form of feedback format after submitting the ERMMA questionnaire. Exemplarily, in Figure 10 a firm with a quite good overall ERMMA maturity score of 2.44 (blue box) is taken for illustration.

Figure 9 - ERMMA online - sample of screen shots

Figure 10 - Feedback format for participants of ERMMA questionnaire. In green is highlighted the ERMMA profile, in yellow the aggregated scores and in violet the comparison with other participants.

The overall score is the most aggregated feedback information the participants get. The three bars in the yellow box are the scores that the firm reached in the three dimensions. Compared to the overall score, they deliver additional information by showing the ERMMA scoring results in less condensed form. The finest granularity of
score information is given in the nine bars in the green box. They are called “ERMMA profile” and they give the most complete picture of the as-is maturity stages.

In addition, the feedback format provides information regarding the comparative benchmarking with other firms (i.e. the comparative purpose of the maturity model). This is visible in the violet box of Figure 10. From this, it can be seen that 70% of the survey participants have a lower score than this exemplary firm.

As firms differ among each other, they might have different to-be plans for the specific shape of the ERMMA profile, i.e. ERMMA profile target. So, when monitored the profile over time, the focus might lie on the development of only specific and not all sub-dimensions. The roadmap information for improvements in all nine sub-dimensions is given to the participants as well (i.e. the prescriptive purpose of the ERMMA model). This information specifies all reached attributes as well as the attributes to be achieved in order to progress to the next maturity stage. An example is provided in Figure 11.

- Figure 11 - Exemplary roadmap information for improvement

4. Survey Results: a sample of Austrian non-financial enterprises

The ERMMA survey closed at the end of September 2017. In the ERMMA questionnaire also exploratory questions (e.g. size of the firm) were included next to the attribute questions used to measure the ERM system maturity levels. In this chapter, an overview of the results in a sample of Austrian enterprises will be presented, obtaining information concerning the implementation of enterprise risk management best practices in these entities. Next to descriptive results, also an explorative analyses aiming to investigate the drivers of ERM system development will be shown.

4.1 Testing and Piloting the Questionnaire

Before using the questionnaire to collect data, the ERMMA framework and the questionnaire were presented to a small group of Austrian risk managers from different industries. The discussion that followed the presentation, led to several improvements of the questionnaire as parts of the questions were changed, technical terms were reduced to a minimum, and multiple examples in the questions were added to clarify concepts.
In the Autumn of 2015, the first version of the questionnaire was published as a pilot test. Eight companies\(^{11}\) chosen among the partners of the technical university of Vienna and interested in the topic were approached to perform the questionnaire in the presence of two ERMMA research team members\(^{12}\). Although we cannot claim representativeness, the pilot questionnaire produced sufficient information for a first evaluation on the quality of the questions, identifying and diagnosing problems that were improved: ambiguous questions have been simplified, technical terms usage has been kept to a minimum, and additional examples have been added to questions for further clarity. The results of the pilot test were not included in the main survey.

### 4.2 The population and the sample

Tables 4 to 6 are intended to give an overview of the total number of companies in Austria and their distribution across the various industry sectors, size classes and turnover amount.

Following the Austrian Economic Chambers industry classification, the industry sectors have been grouped into the following main industries\(^{13}\):

- Construction
- Service
- Retail
- Wholesale
- Transport and Logistic
- Manufacturing
- Utility

Additionally, as it is expected a higher response rate by larger firms than by SMEs (Bartholomew and Smith 2006), a fine classification of the formers is provided.

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\(^{11}\) The sample size of a pilot test is subjected to widely different approaches in the literature. Henschel (2007) for example, analyses risk management practices of 28 German SMEs collected via postal questionnaires. Clink (2001) instead, in his research of risk management and small businesses evaluated a pilot test involving 20 completed questionnaires.

\(^{12}\) Namely Davide Raffaele and Michael Brandstatter

\(^{13}\) As mentioned in previous chapters, financial firms are taken out of the population.
<table>
<thead>
<tr>
<th>Industry sector</th>
<th>Total number of enterprises in Austria</th>
<th>Share in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>35.078</td>
<td>10.8%</td>
</tr>
<tr>
<td>Service</td>
<td>113.553</td>
<td>35.1%</td>
</tr>
<tr>
<td>Retail</td>
<td>52.007</td>
<td>16.1%</td>
</tr>
<tr>
<td>Wholesale</td>
<td>25.801</td>
<td>8.0%</td>
</tr>
<tr>
<td>Transport and Logistic</td>
<td>14.141</td>
<td>4.4%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>25.037</td>
<td>7.7%</td>
</tr>
<tr>
<td>Utility</td>
<td>4.600</td>
<td>1.4%</td>
</tr>
<tr>
<td>Others</td>
<td>53.695</td>
<td>16.6%</td>
</tr>
<tr>
<td>Total</td>
<td>323.912</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 4 - Number of businesses in Austria by sector. Source: Austrian Economic Chambers (www.statistik.at)

<table>
<thead>
<tr>
<th>Employees number</th>
<th>Total number of enterprises in Austria</th>
<th>Share in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 49</td>
<td>316.309</td>
<td>97.6%</td>
</tr>
<tr>
<td>50 - 499</td>
<td>6.443</td>
<td>2.0%</td>
</tr>
<tr>
<td>500 - 999</td>
<td>606</td>
<td>0.2%</td>
</tr>
<tr>
<td>1000 - 4999</td>
<td>435</td>
<td>0.1%</td>
</tr>
<tr>
<td>5000 +</td>
<td>119</td>
<td>&gt;0.1%</td>
</tr>
<tr>
<td>Total</td>
<td>323.912</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 5 - Number of businesses in Austria by employees number. Source: Austrian Economic Chambers (www.statistik.at)

<table>
<thead>
<tr>
<th>Turnover (in 1.000 €)</th>
<th>Total number of enterprises in Austria</th>
<th>Share in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1.999</td>
<td>278.653</td>
<td>86.0%</td>
</tr>
<tr>
<td>2.000 - 49.999</td>
<td>43.351</td>
<td>13.4%</td>
</tr>
<tr>
<td>50.000 – 249.999</td>
<td>1.013</td>
<td>0.3%</td>
</tr>
<tr>
<td>250.000 – 1.000.000</td>
<td>713</td>
<td>0.2%</td>
</tr>
<tr>
<td>1.000.000 +</td>
<td>182</td>
<td>&gt;0.1%</td>
</tr>
<tr>
<td>Total</td>
<td>323.912</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 6 - Number of businesses in Austria by turnover. Source: Austrian Economic Chambers (www.statistik.at)

Once the total population has been determined there remains the problem of selecting a suitable sample.

As Kalafatis and Blankson (1996) suggest, having a sponsor can substantially improve the effectiveness of mail surveys. Therefore, two partners were identified to support the handover of the questionnaire: The Funk Foundation and Creditreform. Next to them, the TU Vienna own network was identified as third mean to reach participants. Before sending the questionnaire, information regarding the customers of the two partners as well as the firms part of the TU Vienna own network were identified.
and organised to obtain an overview of the sample\(^{14}\) of the contacted companies. This is visible in tables 7 to 9.

<table>
<thead>
<tr>
<th>Industry sector</th>
<th>Total number enterprises in sample</th>
<th>Share in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>89</td>
<td>8.3%</td>
</tr>
<tr>
<td>Service</td>
<td>187</td>
<td>17.4%</td>
</tr>
<tr>
<td>Retail</td>
<td>103</td>
<td>9.6%</td>
</tr>
<tr>
<td>Wholesale</td>
<td>78</td>
<td>7.3%</td>
</tr>
<tr>
<td>Transport &amp; Logistic</td>
<td>143</td>
<td>13.3%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>263</td>
<td>24.5%</td>
</tr>
<tr>
<td>Utility</td>
<td>88</td>
<td>8.2%</td>
</tr>
<tr>
<td>Others</td>
<td>121</td>
<td>11.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,072</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

*Table 7 - Firms included in study sample presented by sector.*

<table>
<thead>
<tr>
<th>Employees number</th>
<th>Total number enterprises in sample</th>
<th>Share in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 49</td>
<td>466</td>
<td>43.5%</td>
</tr>
<tr>
<td>50 - 499</td>
<td>228</td>
<td>21.3%</td>
</tr>
<tr>
<td>500 - 999</td>
<td>210</td>
<td>19.6%</td>
</tr>
<tr>
<td>1000 - 4999</td>
<td>122</td>
<td>11.4%</td>
</tr>
<tr>
<td>5000 +</td>
<td>46</td>
<td>4.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,072</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

*Table 8 - Firms included in study sample presented by size class.*

<table>
<thead>
<tr>
<th>Turnover (in 1,000 €)</th>
<th>Total number enterprises in sample</th>
<th>Share in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1,999</td>
<td>359</td>
<td>33.5%</td>
</tr>
<tr>
<td>2,000 - 49,999</td>
<td>270</td>
<td>25.2%</td>
</tr>
<tr>
<td>50,000 – 249,999</td>
<td>218</td>
<td>20.3%</td>
</tr>
<tr>
<td>250,000 – 1,000,000</td>
<td>158</td>
<td>14.7%</td>
</tr>
<tr>
<td>1,000,000 +</td>
<td>67</td>
<td>6.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,072</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

*Table 9 - Firms included in study sample presented by turnover amount.*

There are major differences between the population and the identified sample in terms of industry sector (the manufacturing, transport & logistic and utility sectors being overrepresented, while service and retail being underrepresented), in terms of size classes (smaller companies are underrepresented, while larger companies are overrepresented), and due to the correlation between size and turnover (Benson et al. 1987), also in this latter characteristic is visible an overrepresentation of high-turnover companies and an underrepresentation of low-turnover firms.

\(^{14}\) As previously said, financial firms were not considered
Based on the biased representation of the population in the identified sample\textsuperscript{15}, the respondents’ data collected within this sample shall be interpreted with several caveats, as the sample cannot be claimed as representative of the whole population.

### 4.3 Responses and bias

The appropriate response rate is subject to controversial discussion in the literature. In Table 10 an overview of the response rates of researches dealing with questionnaires in the risk management field is displayed.

<table>
<thead>
<tr>
<th>Research</th>
<th>Response rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bodnar, Hayt and Marston (1996)</td>
<td>17.5%</td>
</tr>
<tr>
<td>De Ceuster et al. (2000)</td>
<td>21.9%</td>
</tr>
<tr>
<td>Bartholomew and Smith (2006)</td>
<td>27.0%</td>
</tr>
<tr>
<td>Henschel (2007)</td>
<td>17.4%</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>20.95%</strong></td>
</tr>
</tbody>
</table>

*Table 10 - Response rates comparison*

Dennis (2003) noticed that in survey researches it is becoming increasingly difficult to obtain responses. The respondents often complain of the high number of surveys in which they are asked to participate. There is a high degree of questionnaire fatigue. Concerns for inherent bias in surveys with low response rate have then encouraged researchers to determine techniques for improving the effectiveness of surveys. Kalafatis and Blankson (1996) identify a summary of successful techniques being: pre-notification, identity of sponsor, repeat contacts, incentives, and foot-in-the-door techniques. However, much of these techniques have been based on populations of consumer; while there are fundamental differences between them and industrial populations. Jobber & O'Reilly (1996) then, only focusing on firms, identified a list of methods that can specifically raise the response rate of industrial respondents: prior telephone calls, prepaid monetary incentives, being introduced by known partner, non-monetary gifts, granting anonymity to respondents, and following up the first mailing with a second covering letter and questionnaire.

As previously introduced, the present investigation included the introduction by known partners (The Funk Foundation, Creditreform and TU Vienna) as well as anonymity was granted to respondents and the first mailing was followed up with a second covering letter and questionnaire. Nevertheless, the achieved response rate has been only 8.1% (including 26 partially filled but unusable questionnaires), that raises to 12.4% including those respondents that only logged into the questionnaire but didn’t fill it even partially.

In table 11 to 13 an overview of the 61 respondents who completely filled the questionnaire is given.

\textsuperscript{15} Data are biased if some individuals or firms are more likely to take part in the research than others (Saunders, Lewis and Thornhill 2009).
### Table 11 - Respondent firms presented by sector.

<table>
<thead>
<tr>
<th>Industry sector</th>
<th>Total number enterprises completely filling the questionnaire</th>
<th>Share in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>7</td>
<td>11%</td>
</tr>
<tr>
<td>Service</td>
<td>10</td>
<td>16%</td>
</tr>
<tr>
<td>Retail</td>
<td>3</td>
<td>5%</td>
</tr>
<tr>
<td>Wholesale</td>
<td>5</td>
<td>8%</td>
</tr>
<tr>
<td>Transport &amp; Logistic</td>
<td>6</td>
<td>10%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>22</td>
<td>36%</td>
</tr>
<tr>
<td>Utility</td>
<td>5</td>
<td>8%</td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>61</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

The respondents’ distribution reflects the sample characteristics. The highest amount of responses was received by the largest represented groups in the sample. Significantly higher responses were in fact received, in absolute number, from the manufacturing sector (22 respondents and 36% of the total), followed by service providers (16%), construction companies (11%), transport & Logistic (10%), utility and wholesale (8%), retail (5%) and others (5%). In contrast with the considered

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36 One firm did not declare its turnover and it was recorded as “N/A”. Thus, not appearing in this table.
sample, retail and others are the only underrepresented groups when compared to their share in the sample.

Small companies represent the biggest share of respondents (26%), tightly followed by larger companies. Firms having between 500 and 999 employees were 21% of the respondents, 18% were the respondent’s firms with 1000 to 4999 employees and 18% the firms with more than 5000 employees. Comparing the respondents with the sample and population, we notice how the very large enterprises (5000+ employees) were the most interested into our research. 24% of the contacted very large enterprises answered to the survey, which account for the 11% of the whole population of very large Austrian industrial firms. The smallest companies instead, although in absolute value were the highest respondents, were relatively much less responsive. Only 3% of the contacted companies with less than 50 employees answered to the questionnaires, which account for <0,001% of the population of very small Austrian industrial firms. Between these two extreme groups, a gradually increasing interest of larger companies can be seen. 6% of the contacted firms with 50 to 499 employees (accounting for 0,2% of the whole population) in fact answered to the questionnaire, and 9% of the contacted firms with 1000 to 4999 employees (accounting for 2,5% of the whole population) answered to the questionnaire.

Conforming to the above results, the groups of firms with a turnover lower than 50 million euros (i.e. larger firms), is comparable, in absolute numbers, with those with more than 250 million of turnover (i.e. bigger firms). The former group accounts for 42% of the respondents, and the latter group for 36% of the respondents. However, the smaller firms were much less responsive, as only 3% of the contacted firms answered to the questionnaire (accounting for <0,001% of the population), while 10% of the contacted larger firms answered to the questionnaire (accounting for 2,5% of the whole population).

Although we will be hardly able to generalize the finding drawn from these respondents due to the convenient sample used\textsuperscript{17} and the low number of respondents, the highly informed sample obtained during this investigation can provide reach information about the topic (Percy et al. 2015).

4.3 Participants details

As already discussed, the questionnaire was promoted through two sponsors: the Funk Foundation, a German Foundation (operating also in Austria) that promotes primarily scientific and practice-oriented projects in the field of risk management, and Creditreform, a firm that provides an international expert network for credit reporting and debt collection services. Additionally, the Vienna university of technology (TU Wien) own network was used to reach out further participants. This distribution method is reflected in the constituency reached, in that there is, for example, a limited response

\textsuperscript{17} Convenience sampling (also known as Haphazard Sampling or Accidental Sampling) is a type of nonprobability or nonrandom sampling where members of the target population that meet certain practical criteria, such as easy accessibility, availability at a given time, or the willingness to participate are included for the purpose of the study. It is also referred to the researching subjects of the population that are easily accessible to the researcher (Etika 2016)
rate from Vienna-far regions (Figure 12), where the influence of the sponsors and the reputation of TU Wien is weaker. The lack of responses from Burgenland is maybe due to a number of factors: the distribution networks not reaching this region, the actual lower number of firms in this area, or a general lack of awareness of risk management in the region. Still, it was found that with the numbers of returns, we received a meaningful number of people interested in the domain.

Figure 12 - Geographic distribution of responses (the darker the colour, the higher the number of respondents)

The most common legal form in the sample of respondents is the limited liability company (69%), which is in contrast with the data from the WKO that named in 2018 individual companies as the most common legal form among Austrian firms (WKO 2018) (this latter account for just 3% of our sample), but makes sense because individual companies are such small businesses that are not interested in enterprise risk management, rather limited liability companies and public limited companies (this latter account for 25% of our sample) are more complex and require more attention on enterprise risk management.

Figure 13 - Questionnaire participants a) by turnover b) by legal form
A further demographic characteristic collected, regards the years since Compliance Management (CM), Internal control system (ICS), Internal Audit (IA) and Risk Management (RM) are established. Interestingly, in our sample of respondents, ICS is commonly implemented since long time (57% of the participating firms established it more than 5 years ago). Also risk management and internal audit are implement from almost half of the firms in our sample since more than 5 years (precisely 49% of the participating firms in both risk management and internal audit), even though the latter is still not implemented from 33% of the firms. CM instead, is not implemented from 30% of the participating firms, is implemented since just 1 year from 8% of the firms, since 3 years by 21% of the firms, since 5 years by 13% of the firms and about one-third (28%) of the participating firms implemented CM more than 5 years ago.

![Bar charts showing questionnaire participants by duration of CM, ICS, IA, RM use.](image)

**Figure 14 - Questionnaire participants a) by Compliance Management (CM) b) by Internal control system (ICS) c) by Internal Audit (IA) d) by Risk Management (RM).**

### 4.5 ERMMA score distribution of respondents

The ERMMA questionnaire resulted in the calculation of quantifiable maturity scores for each responding firm. Figure 15 shows the distribution of ERMMA maturity score achieved by all responding firms that completed the questionnaire. As indicated earlier, the overall score has been calculated by averaging responses from the three dimensions/nine sub-dimensions: 0 reflects low maturity and 5 high maturity. The line in the middle of the box indicates the median (second quartile) amounting to 1.33. The
1st quartile is 0.73 and the 3rd quartile is 1.95. The minimum and maximum scores reached are 0.11 and 4.67. The “x” in right side of the box indicated the average value, amounting at 1.57. From the plot, it can be seen that the distribution is skewed to the right, as the dispersion from the median is larger on the right-hand side than on the left. The small circles in the plot indicate the outliers\textsuperscript{18}. They come from the very large firms in our sample that have substantially higher overall ERMMA maturity scores.

Figure 15 - Distribution of ERMMA maturity score for all responding firms

Figure 16 shows the additional layers, or granularity, of the maturity assessment. The diagram on the left shows the distribution of ERMMA maturity score achieved by all responding firms for each dimension. The diagram on the right shows the distribution of ERMMA maturity score achieved by all responding firms for each sub-dimension.

In Figure 16a it is visible a more right-skewed distribution for the dimension “ERM-governance” (dim A) and “RM-system” (dim B) in compare with the “Risk-based planning and control system” (dim C). Thanks to the higher granularity displayed in Figure 16b, it is evident that this skewness derives from the more dispersed values of the sub dimensions A1-B3. The C dimensions (as well as the C1-C3 sub-dimensions) is more uniformly distributed as it is of interest for both small and large firms in our sample. However, Figure 16b shows that the responding firms have directed more attention towards the sub-dimensions B1 (risk management system), as it displays the highest median and average. This should be caused by the fact that most survey respondents undergo public audits where normally a strong focus is given upon the risk management system. The worst sub-dimensions are reached in the risk organization (A3) and the risk management training system (B2), where the 1st quartiles are zero and the average is the lowest. This indicates deficiencies in the organizational implementation of the risk governance and weaknesses in the risk communication within the firms in our sample.

\textsuperscript{18} Outliers are here defined as those values lying 1.5 times below or above the inner quartile range.
4.6 ERMMA score and its relationship with firm’s characteristics

The descriptive analysis has so far shown the distribution of maturity levels measured by the ERMMA measurement model. However, given the importance of ERM it is paramount to understand the determinants of it, at least within the limit of our sample. Which conditions favor ERM development and which hamper it? Are there underlying factors that need to be in existence so that ERM can develop? In this chapter, the ERMMA measurement results are examined with regards to their dependence on exogenous variables (i.e. its determinants).

In the ERMMA questionnaire, as introduced in chapter 4.2, several data regarding exogenous variables were collected: yearly turnover, number of employees, existence of a risk management function and its organization, (non) externally audited, sector of activity, legal form of the enterprise, region of domicile, owner managed/non owner managed, years of activity, existence of a compliance management function and its organization, existence of an internal audit function …

Two academic studies mentioned in the literature review (chapter 2) addressed a similar investigation of ERM adoption determinants. Beasley et al. (2005) examined characteristics of 123 US and international organizations finding the stage of ERM implementation to be positively related to the presence of a chief risk officer, board independence, CEO and CFO apparent support for ERM, the presence of a Big Four auditor, entity size, and entities in the banking, education, and insurance industries (Beasley et al. 2005, p. 521). Lundqvist (2015) used leverage, size, market-to-book, managerial ownership, managerial option compensation, diversification, dividend, board independence, CEO on board, publicly rated debt, big 4 auditor and industry sector to examine the determinants of ERM adoption. The author found that size, board independence, publicly rated debt and being in the financial industry have positive influence in the adoption of ERM.

To further examine this area, while taking into consideration the previous results, four further hypotheses of determinants are explored: having a well-established internal audit function, having a well-established risk management function, having a well-established compliance management function, and being (non-)owner managed.
4.6.1 Results

Figure 17 shows the mean, and standard error of the overall ERMA score for the first group of determinants investigated: employees number (above 1000 or below 1000), turnover (above 250M or below 250M), firms legal entity (limited liability or public joint-stock company), externally audited (yes or no). Table 14 shows the analytic results: mean, median, standard deviation and the result of Kruskal-Wallis Test. This latter indicates for each determinant (e.g. number employees), if one sample-split (e.g. number employees above 1000) stochastically dominates one other sample-split (e.g. number employees below 1000).

Employees number and turnover are both an approximation of the size variable also investigated by Beasley et al. (2005) and Lundqvist (2015). As for these two authors, for the firms in our sample the level of maturity of ERM is found to be positively related to the size of the entity. As we can see from the result and the significance of the Kruskal-Wallis test in fact, the group of firms with less than 1000 employees, has a statistically significant lower median maturity score than the group of firms with more than 1000 employees. The same applies for the group of firms with less than 250 million turnover, which has a statistically lower median maturity score than the group of firms with more than 250 million turnover. Similarly, in our sample when the firm is externally audited, the ERM maturity level is found to be consistently higher than the maturity level of firms which are not externally audited. Finally, being a public joint-stock company or limited liability company is found, in our sample, to have no influence in the adoption of ERM; as displayed in Table 14 in fact, the two groups of firms are not having different median score on a statistically significant level.

<table>
<thead>
<tr>
<th>Number of Employees</th>
<th>Median</th>
<th>SD</th>
<th>H-statistic</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>below 1000</td>
<td>2.50</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>above 1000</td>
<td>3.00</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Turnover</th>
<th>Median</th>
<th>SD</th>
<th>H-statistic</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>below 250M</td>
<td>2.00</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>above 250M</td>
<td>2.50</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Legal Form</th>
<th>Median</th>
<th>SD</th>
<th>H-statistic</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited liability</td>
<td>2.00</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public joint-stock</td>
<td>2.50</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Externally audited</th>
<th>Median</th>
<th>SD</th>
<th>H-statistic</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>2.00</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1.50</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 17 - Explanatory Analysis for a) Number of Employees b) Turnover c) Legal Form d) Owner Managed/Non Owner managed.
Following the hypothesis of Beasley et al. (2005) and Lundqvist (2015), variables for region of domicile and sector of activity were also collected and investigated as determinants for ERM adoption in our sample. However, as evident in Figure 18, Figure 19 and Table 15, these variables are not significant, not positively nor negatively influencing ERM adoption. No region nor sector shows in fact a statically higher median maturity score than the others in our sample.

**Table 14 - Explanatory Analysis for Number of Employees, Turnover, Legal Form, Owner Managed/Non Owner managed, Kruskal-Wallis Test.**

```
<table>
<thead>
<tr>
<th>Number Employees</th>
<th>Employees</th>
<th>Turnover</th>
<th>Legal form</th>
<th>Externally Audited</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1000</td>
<td>1.09</td>
<td>1.06</td>
<td>0.68</td>
<td>14,2118</td>
</tr>
<tr>
<td>&gt;1000</td>
<td>2.41</td>
<td>2.11</td>
<td>1.46</td>
<td></td>
</tr>
</tbody>
</table>

| <250Mln          | 1.05      | 1.11     | 0.59       | 16,5058            |
| >250Mln          | 2.48      | 1.78     | 1.45       |                    |

| GmbH (limited liability) | 1.42 | 1.27 | 0.99 | 2,2897 |
| AG (public joint-stock)  | 2.24 | 1.44 | 1.55 | 0.13023 |

| Externally Audited | Ja | 1.74 | 1.44 | 1.21 | 12,0931 |
|                    | Nein | 0.61 | 0.56 | 0.42 |        |

* significant at p < 0.1; ** significant at p < 0.05; *** significant at p < 0.01

**Figure 18 - Explanatory Analysis for region of domicile**
Table 15 - Explanatory Analysis for region of domicile and sector of activity. Kruskal-Wallis Test.

In the last group of determinants investigated, four further hypotheses are considered: having a well-established (i.e. more than 1 year) internal audit function, having a well-established (i.e. more than 1 year) risk management function, having a well-established (i.e. more than 1 year) compliance management function, and being (non-)owner managed. Note that the three institutional aspects investigated in this
group (i.e., internal audit, risk management and compliance management) were collected by the specified exploratory survey variables. As these variables were not used in the attribute variables, with which the ERM systems maturity levels are measured, the circular reasoning pitfall (Stubbart & Smalley 1999) has been avoided. In Figure 20 and Table 16, it is evident how well-established internal audit, risk management and compliance management functions are found to have a positive influence in the adoption and development of ERM for the firms in our sample. In fact, firms with a well-established internal audit, risk management and compliance management functions, are found to have a statistically significant higher median maturity score than firms with a less-than-one-year internal audit, risk management or compliance management functions. In contrast, when the owner directly manages the firm, the ERM maturity level is found to be statistically lower.

![Figure 20 - Explanatory Analysis for a) well-established internal audit function b) well-established risk management function c) well-established compliance management function d) (non-)owner managed.](image)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>H-statistic</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Internal Audit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 year or less</td>
<td>0.81</td>
<td>0.83</td>
<td>0.42</td>
<td>22.855</td>
<td>0.00001***</td>
</tr>
<tr>
<td>More than 1 year</td>
<td>2.10</td>
<td>1.78</td>
<td>1.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Risk Management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1y or less</td>
<td>0.84</td>
<td>1.44</td>
<td>0.61</td>
<td>8.2693</td>
<td>0.00403***</td>
</tr>
<tr>
<td>More than 1y</td>
<td>1.75</td>
<td>0.78</td>
<td>1.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Compliance Management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1y or less</td>
<td>0.86</td>
<td>0.67</td>
<td>0.54</td>
<td>16.9304</td>
<td>0.00004***</td>
</tr>
<tr>
<td>More than 1y</td>
<td>2.00</td>
<td>1.56</td>
<td>1.29</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Owner Managed**
Table 16 - Explanatory Analysis for well-established internal audit function, well-established risk management function, well-established compliance management function, (non-)owner managed. Kruskal-Wallis Test.

<table>
<thead>
<tr>
<th></th>
<th>Ja</th>
<th>Nein</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,136</td>
<td>2,235</td>
</tr>
<tr>
<td>1</td>
<td>0,857</td>
<td>1,78</td>
</tr>
<tr>
<td>0,857</td>
<td>1,353</td>
<td></td>
</tr>
<tr>
<td>12,817</td>
<td>0,00034 ***</td>
<td></td>
</tr>
</tbody>
</table>

* significant at p< 0.1; **significant at p< 0.05; *** significant at p< 0.01

4.6.2 Implications of determinants

The findings shown in Table 14 to Table 16, suggest that size, external audit, internal audit, risk management, compliance management and owner proprietorship would matter considering the implementation of more sophisticated enterprise risk management practices in Austrian industries, observing then a clear pattern indicating that large firms, firms which are externally audited, firms with a well-established internal audit, risk management, compliance management or which are non-owner managed in our sample tend to have a higher overall ERMMA maturity score.

As an organization’s size increases, the scope of events threatening it is likely to differ in nature, timing, and extent. In addition to having a greater need for more effective enterprise-wide risk management techniques, larger entities may have greater ability to implement ERM due to greater resources. Thus, it’s logical that larger firms are more likely to have further-developed ERM deployments, and in fact it is not new the relationship between firm size and advanced ERM process implemented in a firm (Colquitt et al. 1999; Beasley et al. 2005; Lundqvist 2015) that we also found in our sample. However, firm size is not directly influenceable via management decision and is more a context-driver characteristic of a firm (Pervan & Višić 2012). Thus, its exploitability to develop ERM maturity is limited.

More interesting is the group of variables directly dependent from management decisions: internal audit, risk management, compliance management. Any of these can be triggered by executives’ decisions to commit the firm to develop an internal audit function, to establish a risk management or to create a compliance management function.

It is possible that organizations committed to engaging in internal audit are also more committed to risk management. This, because internal audit not only looks closely the financial risks and statements as external audit does, but may also consider wider issues such as the organization’s reputation, growth, its impact on the environment and the way it treats its employees (IIA 2009). Research has shown (Deloitte & Touche 2003) that the two most important ways that internal auditing delivers value to the organization are in providing objective assurance that the major business risks are being managed appropriately and providing assurance that the risk management and internal control framework is operating effectively. Additionally, internal audit may provide consulting services that improve an organization’s governance, risk management, and control processes (IIA 2009). Internal auditor’s expertise in considering risks, in understanding the connections between risks and governance and in facilitation means that the internal audit activity is well qualified to act as supporter and developer for ERM, especially in the early stages of its introduction. Thus, an enterprise interested in developing its ERM maturity, shall
establish an internal audit function. As the ERMMA questionnaire is designed not to be a one-time endeavor but a recurrent monitoring tool to control the ERM system development of enterprises, it will be interesting to follow the evolution of the enterprises that currently answered not to have an internal audit, but they are willing to implement it in the short term, to monitor how their maturity score will be affected.

Given the important role of the risk management function and of risk managers in promoting ERM (Kleffner et al., 2003), it is logic our finding that the presence of a risk management function is positively associated with an enterprise’s stage of ERM deployment. Thus, an enterprise interested in developing its ERM maturity, shall establish a risk management function.

Compliance management is the discipline of ensuring an organization is acting according to a set of predetermined rules (Adams & Bernstein 2013). In other words, compliance is an enterprise-wide commitment to acting within pre-determined norms that enable the organization to act legally and ethically. Noncompliance is then a type of risk and compliance management a clear enabler for an enterprise-wide risk management approach. Thus, enterprises willing to develop their ERM maturity, shall establish a compliance management function.

We acknowledge limitations in our analytics approach. First, as already discussed, the response rate and absolute number of respondents to our survey instrument is not as high as some other survey-based research. Additionally, the sample collected does not reflect the characteristic of the population of Austrian industrial firms, and thus we cannot claim the current results to be generalizable to the whole population. Therefore, we limited our discussion within the boundary of our sample. Nevertheless, the results achieved appear consistent with other ERM survey studies: Lundqvist (2015) and Beasley et al. (2005). A second is that, due to the limited data, we have not considered interactions among the variables analyzed.

5. Conclusion

The main objective of this work was to establish a maturity development model for Enterprise Risk Management System in Austrian non-financial Enterprises. By reviewing current (enterprise) risk maturity models found in the literature, it was noticed a limited attention in addressing the issue of development of an entity and rather previous literature focused on the evaluation of the as-is state of ERM programs implemented by organizations or on the analysis of the factors that influence ERM adoption.

To reach the goal of this thesis, the standardized research process prescribed in the predictive validity framework of Bisbe et al. (2007) and Libby et al. (2002) was refined and followed. First, an adequate definition of the construct ERM (system) was settled by following the emergent model type. Then, the construct was operationalized by following the profile approach. In chapter 3, specific aims for the ERMMA maturity development model were set and subsequently achieved. By using binary attributes for the specification of the different maturity levels, a layered ERM system maturity model could be established for the first time. In the ERMMA model, evidence of the transformation from one stage to another is explicitly specified by fulfilling all
attributes of the preceding stage. Additionally, this attribute-fulfillment-logic provides also the clear stage-gate approach. Through the feedback format that participants obtain by taking part of ERMMA questionnaire, each entity receives an evaluation of the current as-is status as well as information regarding the comparative benchmarking with other firms. This, next to the roadmap information for improvements.

When applying the ERMMA maturity development model to a sample of Austrian non-financial enterprises, interesting results were found. For example, that Austrian firms in our sample have directed more attention towards the sub-dimensions "risk management system" (as it scored the highest), while neglecting "risk organization" and "risk management training" (as they scored the lowest). Additionally, the ERMMA questionnaire provided statistical evidences that the overall ERMMA maturity score of firms in our sample is driven by the size of the firms, the owner-management, the well establishment of an internal audit/risk management/compliance management function and the audit of external auditors. Although, because of the size of our sample, we cannot generalize for the whole population, we acknowledge that the results achieved appear consistent with other ERM survey studies (Lundqvist 2015; Beasley et al. 2005).

Lastly, by implementing the ERMMA questionnaire in the intelligent ERMMA online application, the ERMMA study is not a one-time event. Instead, the application allows the study to be run several times. Each time, additional information will be collected in order to determine the development of the overall ERMMA score distribution overtime. This information is not only interesting for academic purposes, but also for the participating firms as they can monitor their individual development overtime and comparatively benchmark this with the other participants. Accordingly, the ERMMA online application can be used by firms as a tool for diagnostic control and improvement by monitoring the maturity performance of its ERM system over time.

5.1 Strengths and weaknesses of the research

The framework and questionnaire presented in this research can be used by organizations wishing to enhance their enterprise risk management approach. It can serve for determining the weaknesses possessed in the area of ERM and develop further. The model can also aid in developing ERM awareness and familiarity with the concept by presenting the practices and processes that an organization should possess to have an advanced capability in enterprise risk management.
The main strength of the ERMMA framework is certainly its comprehensiveness. The comprehensiveness of the developed ERM system maturity assessment in fact, is incorporated by taking a multi-perspective view. For better understanding this view, the metaphor of the “The blind men and the elephant” (shown in Figure 21) can be used. Applied to the ERMMA model this metaphor means that the constructor (king perspective) of the conceptual model oversees three distinct dimensions, i.e. the risk management system itself (B), its master mind in form of the risk governance (A) and the risk-based management systems (C). Comprehensiveness means that the risk information provider, i.e. the B-dimension, which is governed by the A-dimension, generates and distributes risk information that is used in the C-dimension (risk information user) by establishing and running the planning and control systems at the operational process level, the financial business level and the strategic corporate enterprise level.

Furthermore, the ERMMA model has the advantage of a more precise measurement of the maturity stages compared to polynomial (Likert) scales due to limiting the decision discretion of the respondents to yes/no decisions (survey answers). As the specification of this model happened at the conceptual level and by following the revised predictive validity framework, the advantage of the model directly carries over to quality of the operational model and to the thereof measured results.

Also, an important aspect of the ERMMA model is the hierarchically structure into multiple layers. This is particularly relevant in the ERMMA questionnaire, as more granular maturity assessments can be derived for multiple audiences. Top management can focus on the overall ERM maturity, while lower management can have focused information regarding their sphere of competences.
Thanks to the inclusion of descriptive, comparative and prescriptive model characteristics, the ERMMA framework and questionnaire can be used by firms not only to diagnostically assess their current as-is ERM maturity level, but also to get a roadmap for improvement to the next level and to allow a comparative benchmarking with other firms.

Finally, differently from previous research, the ERMMA model defines cumulative attributes within each stage, so that the meaning of the progressions in the maturity levels are determined by design and not interpreted by the respondents of the survey.

On the other side, a few shortcomings of the research can be highlighted. Although the findings of the analysis on the collected data revealed that the results are consistent with previous finding, supporting the validity of the research, they also highlighted the need of more respondents to apply more advanced analytics methodologies and possibly generalize the results to the whole population. Although the questionnaire was designed to achieve a low fatigue for each respondent, 30% of the respondent who started the questionnaire did not finish it, and if we include the respondent which logged-in but did not even start the questionnaire, the percentage of incomplete questionnaire raises over 50%. Additional efforts need to be put to elaborate a shorter questionnaire, retaining the fundamental information for the ERM maturity assessment.

Also, the difference in responsiveness between large and small companies (24% of the very large contacted firms answered the questionnaire, while only 3% of the very small firms did), let us understand how the relevancy of the ERM topic, which is mandatory for law in case of publicly listed company, could be a driver of responsiveness. Thus, apply the framework and questionnaire to a different population than the Austrian industrial firm one, which is made for more than 99% of very small firms, might help in receiving a higher number of respondents, providing a better basis for statistical analysis. For example, Germany or United states, where the average firm size is bigger, could obtain a better respondent rate and thus, a stronger basis for quantitative analysis.

As already highlighted, as a consequence of to the limited data, during the analysis of possible factors that influence higher ERM maturity only single determinates were investigated, while interactions among the variables analyzed was not considered.

5.2 Contribution

In summary, this research provided a twofold contribution. On the empirical level, statistically insights into a sample of Austrian non-financial enterprises maturity levels and their determinants were shown. This thesis also achieved a scientific contribution through the development of an innovative development model for the self-assessment of ERM system maturity. The research objective in this context was to close the gap found in the literature with regard to a methodologically sound conceptualization and operationalization of maturity models for ERM system design. To close the gap, the methodology of the Predictive Validity Framework was used. The
resulting ERMMA measurement model has, on the one hand, its (ERM) foundation on the best practice model in the form of the COSO/ISO standards, and on the other hand, the indicators and dichotomous operational variables provide an objective, reliable and valid measuring methodology. Then, making the ERMMA online application available as an ERMMA monitoring tool provides the opportunity for the companies participating in the study to initially determine their maturity level and then monitor it over time. Thus, the monitoring tool provides an important support for the maturity controlling, with which initially the weak points in the ERM system can be identified and on the basis of the given feedback information concrete improvements can be worked on. Over time, the monitoring tool then measures the development of maturity, and if there are any discrepancies between the targeted and actual score values, then corrective or adaptive measures to eliminate them can be taken.

5.3 Future research

A more drastic path could be to evaluate a totally different method of measuring enterprise risk management practices implemented in organizations. This is related to the fact that there is not a single methodology accepted to impartially assess practices in organizations (Ibbs and Kwak, 2000). Additionally, the use of a case study to perform a more in-depth qualitative comparison could be considered, which might give a further perspectives of how enterprise risk management is being implemented in enterprises in Austria and abroad.

The application of an improved version of the ERMMA survey over several periods in the Austrian industrial sector as well as enlarging the catchment area (e.g. including Germany in the study), seems like an evident task to consider in future research. In addition, including secondary information in combination with the ERMMA survey proposed, might give extra quantitative data for further statistical analysis, which could also add more formality and validation to the model.

Finally, as already discussed, once more data are collected, more advanced methodologies, shall be included for the analysis of the determinants of ERM maturity, in terms of e.g. regression analysis or structural equation modeling.

6. References


Beasley, M., Pagach, D. & Warr, R., 2008. The Information Conveyed in Hiring Announcements of Senior Executives Overseeing Enterprise-Wide Risk


Johansson, C. et al., 2008. Gated maturity assessment - Supporting Gate Review
Decisions with Knowledge Maturity.


7. Appendix

7.1 ERMMA attribute schema

In the following three tables, the attributes for the five levels of maturity are displayed for each of the three dimensions/nine sub-dimensions. The attributes are distinguished between original attributes, which are collected directly from questions, and derivative attributes, which are indirectly derived from original attributes.

Original attributes can be newly introduced (red colour), extended from a lower maturity level (green colour) or unchanged compared to a lower maturity level (black colour). The scope of original attributes is limited to the respective sub-dimension. Derivative Attribute are derived from original attributes and are displayed with blue colour. The scope of derivative attributes is unlimited. As they can be used flexibly in all (sub-)dimensions.
Figure 2 - Attributes Dimension A

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Definition</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension A</td>
<td>Attributes</td>
<td>Additional information</td>
</tr>
</tbody>
</table>

2. Description of the attributes.
<table>
<thead>
<tr>
<th>Dimension C: ink (based) planning and control systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Figure 24 - Attributes Dimension C</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute 1</th>
<th>Attribute 2</th>
<th>Attribute 3</th>
<th>Attribute 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description ofink-based planning and control systems</td>
<td>Description of ink-based planning and control systems</td>
<td>Description of ink-based planning and control systems</td>
<td>Description of ink-based planning and control systems</td>
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<tr>
<td>- Implementation of ink-based planning and control systems</td>
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<td>- Integration of ink-based planning and control systems</td>
</tr>
<tr>
<td>- Performance of ink-based planning and control systems</td>
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<td>- Performance of ink-based planning and control systems</td>
<td>- Performance of ink-based planning and control systems</td>
</tr>
</tbody>
</table>

*Note: The table and diagram provide a summarized view of the attributes related to ink-based planning and control systems.*
7.2 ERMMA questionnaire

Based on the attribute schema, each question of the ERMMA questionnaire directly addresses one of the attributes. Other comparable studies (e.g. Cienfuegos 2013), defined multiple questions per each indicator as a way to improve the validity of the questionnaires. However, due to the large amount of developed indicators, following this same approach would cause a cumbersome questionnaire, thus a single-question approach is kept and validity is assured in different manners, including, but not limited to\(^\text{19}\), adding clarifying examples per each question (an example is visible in Table 17).

\(^{19}\) a pilot study as well as one-to-one survey sessions with representative from engaged Austrian enterprises were undertaken to directly test the understanding of the participants

<table>
<thead>
<tr>
<th>#</th>
<th>Questions and multiple answers</th>
<th>Maturity Level</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The identification of risks is documented for</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Selected areas of the company (e.g. production, logistics, finance, ...)</td>
<td>1</td>
<td>B1.1a</td>
</tr>
<tr>
<td></td>
<td>o All important areas with different methods (e.g. top-down and bottom-up)</td>
<td>3</td>
<td>B1.1a</td>
</tr>
</tbody>
</table>

Additionally, to diminish the length of the questionnaire, and since the choice of dichotomous and multichotomous question type allows it, one single question can address:

a) one attribute per multiple levels of maturity  

b) similar attributes per multiple sub-dimensions but same maturity level  

In these cases, the question text sets the context and the multiple answers address the multiple levels/subdimensions. To understand better this concept, an extract of one questions of type a) and one question of type b) is depicted in Table 18.
Table 18 - Extract of ERMMA questionnaire showing the possible combinations of one indicator per multiple levels of maturity (question #1) or similar indicators per multiple subdimensions but same maturity level (question #2)

<table>
<thead>
<tr>
<th>#</th>
<th>Questions and multiple answers</th>
<th>Maturity Level</th>
<th>Indicator</th>
<th>Sub dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The identification of risks is documented for</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Selected areas of the company (e.g. production, logistics, finance, ...)</td>
<td>1</td>
<td>B1.1a</td>
<td>B1</td>
</tr>
<tr>
<td></td>
<td>o All important areas with different methods (e.g. top-down and bottom-up)</td>
<td>3</td>
<td>B1.1a</td>
<td>B1</td>
</tr>
<tr>
<td>2</td>
<td>At which management level are key risks or key risk indicators (KRIs) monitored and controlled?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Strategic level</td>
<td>3</td>
<td>C1.1c</td>
<td>C1</td>
</tr>
<tr>
<td></td>
<td>o Business performance level</td>
<td>3</td>
<td>C2.1c</td>
<td>C2</td>
</tr>
<tr>
<td></td>
<td>o Process level</td>
<td>3</td>
<td>C3.1c</td>
<td>C3</td>
</tr>
</tbody>
</table>

In the above table, we can see how in question #1 the same attribute B1.1a (i.e. documentation for risk identification) is addressed for two subsequent maturity levels. This is possible thanks to the progression logic included in the indicators, which requires the same concept (in this case risk identification) to exist in each level of maturity but to be more advanced for higher maturity levels. Question #2 instead, presents the b) possibility (i.e. similar indicators per multiple subdimensions but same maturity level). In this case, the three sub-dimensions of risk-based planning and control system are included in one question, because, although with different scopes, in each management domain (operational, financial and strategic) the same overall requirements need to be fulfilled.

As evident from the extracts of the ERMMA questionnaire showed in this annex, each question directly addresses specific attributes. To clearly display this direct connection between question and respective attribute, the questions derived for the subdimension “Risk Management training system” are shown in Table 19.
### Table 19 - Extract of ERMMA questionnaire. The questions refer to the Risk Management training system sub-dimension.

<table>
<thead>
<tr>
<th>#</th>
<th>Questions and multiple answers</th>
<th>Indicator</th>
<th>ML</th>
</tr>
</thead>
</table>
| 1  | Those responsible for risk management are instructed on the proper functioning of the risk management process  
   o Yes, applies                                                                                                                                                                                                                       | B2.1      | 1   |
| 2  | Those responsible for risk management are instructed on the proper functioning of the risk management System  
   o Yes, applies                                                                                                                                                                                                                      | B2.1      | 2   |
| 3  | Those responsible for risk management are instructed on the proper functioning of the company-wide risk management system  
   o Yes, applies                                                                                                                                                                                                                      | B2.1      | 3   |
| 4  | Those responsible for risk management are instructed on the proper functioning of the Enterprise risk management system  
   o Yes, applies                                                                                                                                                                                                                      | B2.1      | 4   |
| 5  | The Top management is instructed to engage in interactive discussions regarding the effectiveness of the ERM system  
   A. Yes, applies                                                                                                                                                                                                                      | B2.1f     | 5   |
| 6  | When instructing the person responsible for the risk management is taken into account inter alia  
   B. The design, implementation, monitoring and improvement of the risk management process  
   C. The consideration of opportunities and risks with regard to set goals  
   D. The distinction between preventable risks, strategy execution risks and external risks  
   E. The company-wide aggregation of risks  
   F. The review of the ERM system in terms of its appropriateness                                                                                                                                                                         | B2.1a     | 2   |
|    |                                                                                                                                                                                                                                                                                            | B2.1b     | 3   |
|    |                                                                                                                                                                                                                                                                                            | B2.1c     | 3   |
|    |                                                                                                                                                                                                                                                                                            | B2.1d     | 4   |
|    |                                                                                                                                                                                                                                                                                            | B2.1e     | 4   |
| 7  | Risk owners are trained to manage their respective risks  
   G. Yes, applies                                                                                                                                                                                                                     | B2.2      | 1   |
| 8  | Internal Audit (or other entity) continues to be trained to assess the appropriateness of the risk management system  
   H. Yes, applies                                                                                                                                                                                                                      | B2.2a     | 2   |
| 9  | The Internal Audit (or other entity) continues to be trained to assess the appropriateness of the company-wide risk management system  
   I. Yes, applies                                                                                                                                                                                                                      | B2.2a’    | 3   |
| 10 | The internal audit (or other entity) continues to be trained to examine the appropriateness of the ERM system                                                                                                                                                                                |           |     |
In Table 19 is evident how, per each question, is made explicitly clear (during the construction phase) the addressed indicators in the second column. The indicators are different per each subdimension, as reflected from the coding method of the attributes: subdimension. (e.g. attribute number B2.1 means B2 dimension, which is RM-training system, #number 1).