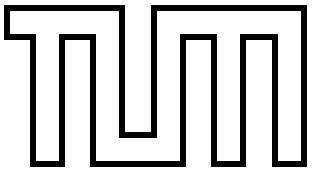


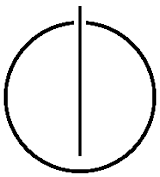
FAKULTÄT FÜR INFORMATIK

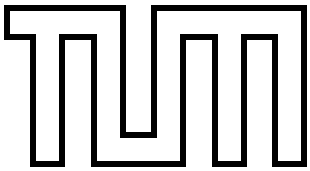
DER TECHNISCHEN UNIVERSITÄT MÜNCHEN

Master's thesis in Informatics

Establishing KPI systems for Enterprise Architectures: Risks and Countermeasures

Erdisa Subashi





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Establishing KPI systems for Enterprise Architectures: Risks and Countermeasures

Etablierung von Kennzahlensystemen für Unternehmensarchitekturen: Risiken und Gegendmaßnahmen

Author:	Erdisa Subashi
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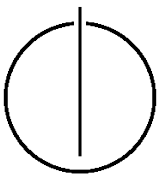
Date:	05.09.2013



I assure the single handed composition of this master's thesis only supported by declared resources.

Munich, January 23, 2014 Erdisa Subashi

Abstract

Enterprise Architecture Management (EAM) strives for aligning business and IT, facilitating the communication between stakeholders, and fostering the continuous transformation of organizations. As in any other management discipline, EAM applies the concept of KPIs, which allows for the measurement of the actual goal fulfillment. Moreover, related tools support architects in efficiently gathering, processing, and disseminating information related to the current and future state of the enterprise architecture. However, given that the current EAM tools only offer a limited KPI support, the threat from the risks related to the definition, design and implementation of KPIs becomes substantial. Therefore, this thesis has the objective of investigating possible risks in the EA management related literature and present guidelines to cope with them.

The core contribution of the thesis is the list of KPI-related risks, allocated in eight categories and their respective countermeasures. This list is a product of a thorough literature research and employment of an iterative method for text interpretation. Furthermore, this thesis describes each of the risks and countermeasures in detail, depicting also the literature sources where more information is available. The findings are summarized in a tabular representation to facilitate the reading.

Moreover, the findings collected iteratively from the literature review have been evaluated in a survey. EAM practitioners had the possibility to evaluate the correctness and completeness of the findings and to give their feedback based on their knowledge and experience.

As a further contribution of this work, a guidelines checklist is presented. The objective of checklist is to ensure that the stakeholders have a general overview of what they should consider important during the definition and implementation of KPIs. The checklist is presented in three possible designs: in alignment to the risk categories, in alignment to the evaluation results, and in alignment to a design method for the definition of KPIs.

Contents

List of Figures

List of Tables

1. Introduction

Rapid advancements in information systems (IS) in recent years have driven the increasing focus on enterprise architecture (EA), which is widely accepted as an essential mechanism for ensuring agility, consistency, compliance, and efficiency [6]. Therefore, this discipline has been in the focus of both practitioners and academia.

EA is described in the ISO Standard 42010 [15] as *"the fundamental organization of a system [enterprise] embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution"*. As specified in the formal definition, in the context of IS, EA considers a holistic view of an enterprise. Thereby EA is related to various aspects of the enterprise. On the one hand, it is concerned about IT and IT artifacts e.g., software components, applications, IT processes, services etc. On the other hand, it is concerned about business artifacts e.g., performance, organizational goals, business processes, organizational units, projects etc. These aspects can be organized in interconnected layers [8]. This alignment between business and IT is one of the key goals of EA. This aspect is so important, that Aier [1] defines EA in terms of this characteristic. The author describes EA as "fundamental structures of a company (or government agency) and enables its transformation by bridging the gap between business and information technology (IT)" and EA management as a discipline "concerned with the establishment and continuous development of EA".

This continuous development of EA and management functions is usually described by a planning, leading, organizing, and controlling dimension [4]. These dimensions are developed in different organizations individually following a multitude of approaches. Preserving the consistency during the evolution process of the architecture is one of the key issues of EA management [19]. Therefore, this evolution has to be in line with the strategies and business goals [8] of the organization.

1.1. Motivation

The achievement of the organizational goals can be measured only by employing Key Performance Indicators (KPIs). A KPI can be defined as *"an item of information collected at regular intervals to track the performance of a system [enterprise]"* [29] (c.f. Section 2.2).
The importance of the integration of KPIs in EA management is apparent from the well-known phrase [11]: "You Can't Manage It If You Can't Measure It". However, despite the increasing usage of KPIs and the research related to it, the field in general is considered less developed. Many organizations consider measurements that are not really contributing in future decision making, but instead serve as reporting tools for the management.

The intention of practitioners is to use KPIs in particular for setting goals, showing the status quo and potential for improvement, as well as communicating facts about an application landscape [22]. However, currently, there is very little guidance on measurements that can be captured to help assess the EA [19].

Many approaches and frameworks are developed and employed to guide an organization through the measurement process (for a more detailed view see Section 1.2). The Chair of Software Engineering for Business Information Systems (SEBIS) at Technische Universität München, has developed the EA management KPI catalog [27]. The catalog offers a set of KPIs, specifically valuable for the field of EA management, that conduct the goal-driven management. The dedicated profile used to describe each of the EA management KPIs, structured in the form of a template, offers necessary information to guide the design of KPIs. The use of this template guarantees several advantages:

- improve a KPI's completeness
- enhance quality
- foster communication among the multidisciplinary stakeholders

However, the correct design of a KPI, does not guarantee the success of the applicability of this KPIs in a given organizational context. The method described in the EA management KPI catalog aims on the design of a single EA management KPI [28]. Related literature ([16], [13], [34]) suggests the use of a number of KPIs to drive management decisions. The collective application of these KPIs, despite of the fact that the KPIs may be designed following a well-defined template, can produce counter-productive consequences [16]. Some of the challenges related to KPIs are already listed in the EA management KPI catalog:

- KPIs can focus on a subset of EA management goals
- KPIs can be too generic
- The KPIs are documented and structured differently
- KPI description does not detail on the required data
- KPIs sometimes cannot be adapted to the specific enterprise context.

As previously stated, the key purpose of EA management is the alignment of business and IT. Therefore, counter-productive consequences, related to KPIs in the IT field, should also be taken into account. Steinberg [39] lists challenges related specifically with measuring the IT, caused probably by rapid technology advancement, too much attention on technology or simply too great a divide between IT and the business:

- IT is the only business organization that almost never measures its operational effectiveness and efficiency.
- IT seldom measures the costs incurred for the services it delivers outside the budget it is given.

- IT monitors technologies but almost never monitors labor in terms of rework, waste and misuse.

- IT implements technologies with little measurement of deficiencies and defect rates

Franceschini [16] suggests that these consequences can happen also in the case when the chosen KPIs seem right and are easy to measure. Therefore it is essential for organization to define qualitative KPIs and in the same time to acknowledge possible risks related to them. The UNI 11097 Standard (cited in [16]) classifies as quality indicator "the qualitative and/or quantitative information on an examined phenomenon (or a process, or a result), which makes it possible to analyze its evolution and to check whether quality targets are met, driving actions and decisions".

The necessary elements needed to correctly design a KPI, as presented in the EA management KPI catalog [27], do not guarantee that for example, the introduction of a KPI in an organizational context will have only positive effects. The risks related to the impact of new KPIs in the organization, the KPI instantiation data or the graphical layout used to present the KPI to different stakeholders, have to be taken into account.

The existing literature suggests artifacts to cope with risks related with KPIs, but usually these artifacts are too general. The context of a problem or issue, the organization type or size, the organizational goals and strategies require a deeper analysis.
The literature also offers general guidelines to design "good" KPIs, but there is a lack of information on how to guide the maintenance process. Kaisler [19] emphasizes the importance of maintenance as an essential process to an EA, because operational consistency must be preserved while the organization continues to evolve the architecture. The author considers this issue as one of the most important issues related to EA, and points out that maintenance has received little attention in the technical literature.

Therefore the aim of this thesis is to investigate possible risks and suggested countermeasures, and to suggest guidelines to overcome these issues, or ease the negative consequences. This analysis raises several research questions which will be addressed in the following chapters:

1. **RQ1**: How does the related literature harmonize the definitions of concepts related to KPIs?

2. **RQ2**: Which risks related to the KPI definition, design and implementation and which countermeasures are defined in literature?

3. **RQ3**: Are the identified risks and countermeasures in line with the experience of the industry experts?

4. **RQ4**: How can a guidelines checklist of the findings look like?

5. **RQ5**: How can this checklist be applied to a given method for the definition of KPIs?

1.2. Overview of relevant EA management approaches

During the past years, a number of approaches and frameworks have been designed by different authors and research groups to address the issue of embedding the IS architecture into the organizational environment (for a complete coverage of the state-of-the-art of the related work see [9]). One of the first approaches was described by Zachman in [44]. However, because the rapid change of the complexity of the organizations, also the mechanisms required to manage such organization contexts have changed.

1.2.1. TOGAF

One of the well-known EA management approaches is the "The Open Group Architecture Framework (TOGAF)", published by The Open Group. The Open Group is a vendor and technology-neutral consortium [41] with the objective to foster information flow via open standards for enterprises. This framework consists of a detailed method and a set of supporting tools, for developing an EA.
TOGAF defines the enterprise as both "an entire enterprise encompassing all of its information and technology services, processes, and infrastructure" and a specific domain within the enterprise. As specified in TOGAF, the key purpose of the EA, is the creation of an integrated environment, where different processes embrace change and support the business strategy of the enterprise.

The Architecture Development Method (ADM) cycle is one of the most well-known parts of TOGAF. It describes an iterative process consisting of eight phases, interconnected with each other, that describe how to develop and manage the life cycle of an EA. Figure 1.1 illustrates the structure of the ADM.
The ADM cycle, starts with a *preliminary phase*, which is a complementary phase of the cycle. In this phase the EA management project environment is set e.g. the tools that will support the process are defined and the EA team is selected. Afterwards the iterative process begins, through all the phases of the cycle:

- Phase A - *Architecture vision*: In this phase the scope of the EA endeavor is defined, along with the identification of the stakeholders.
- Phase B - *Business architecture*: In this phase different aspects of the business environment are described, to determine how the enterprise needs to work to archive the organizational goals.
- Phase C - *Information systems architecture*: In this phase the target architecture is developed in alignment with the architecture vision (phase A) and the current state of the EA.
- Phase D - *Technology architecture*: In this phase the target architecture evolves considering new possible technology building blocks and/or redefining existing technology building blocks.

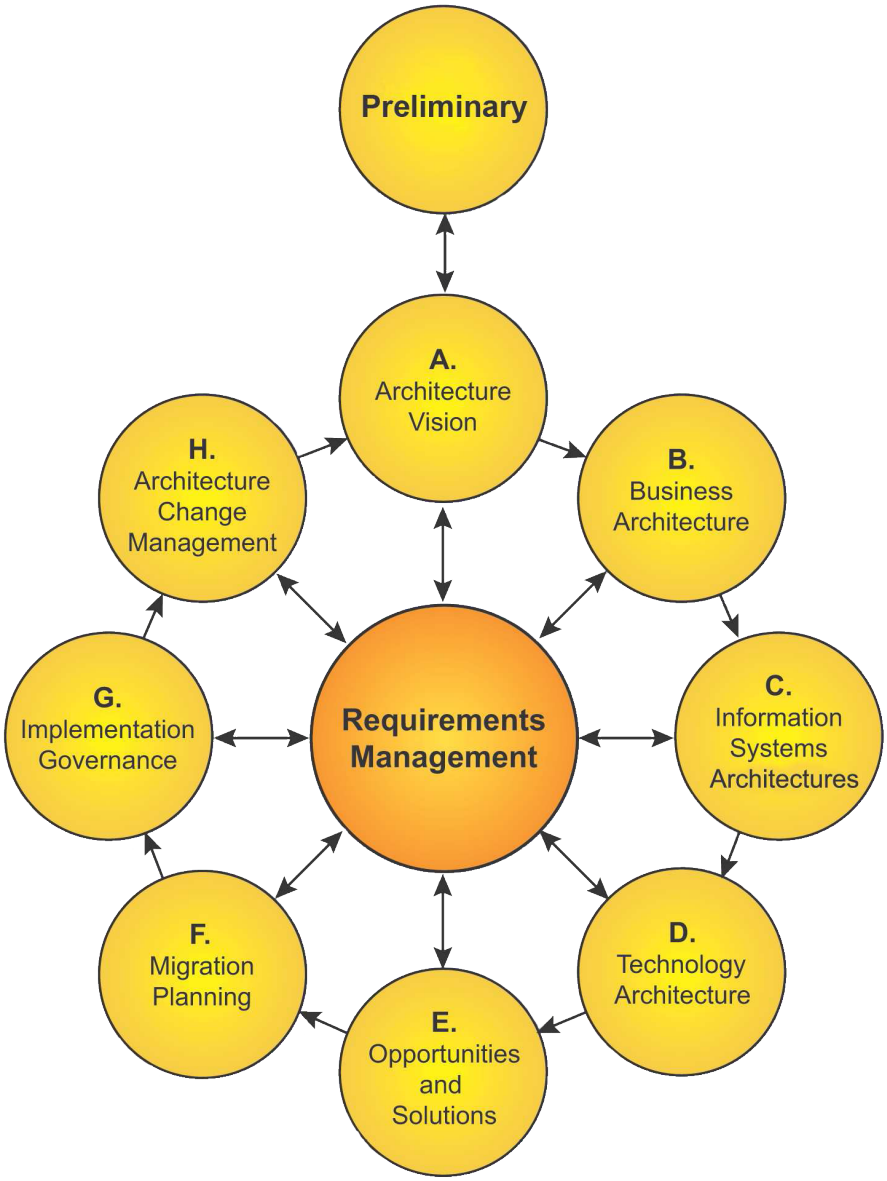


Figure 1.1.: The Architecture Development Method (ADM) cycle

- Phase E - *Opportunities and solutions*: In this phase the intermediate transition architectures are defined. They describe how to realize the target architecture and integrate and consolidate the output of phases B, C and D.
- Phase F - *Migration planning*: In this phase an Implementation and Integration plan is created to specify how to transition from the baseline architecture (current state) to the target architecture.
- Phase G - *Implementation governance*: In this phase the implementation projects, as specified in phase F, are running while ensuring compliance with the target architecture.
- Phase H - *Architecture change management*: This is the last phase of the ADM cycle. In this phase the changes implemented in the architecture are managed, while ensuring that the business value of the target architecture is met. Afterwards another ADM cycle can begin.

Many organizations in the area of EA management have embraced the approach proposed by TOGAF to manage EA management projects (as specified by the research analysis conducted at SEBIS in [26]). However, the disadvantage of this approach compared to approaches who focus on the continuous EA management function, is that each project has to start with information gathering as no up-to-date information and description of the EA is available [9].

1.2.2. BEAMS

Building blocks for Enterprise Architecture Management Solutions (BEAMS), is an approach developed by the SEBIS chair (for more development details see Buckl et al. [7]). The core advantage of the BEAMS approach is the design of an organization-specific EA management function, aligned with the organizations context and its goals. The need to have an organization-specific approach is related to the lack of consensus regarding which information is required in which of the interconnected layers [8] of an enterprise. Therefore, Matthes et al. [26] propose the basic structure of such an information model for EA management as illustrated in Figure 1.2.
The model contains horizontal layers, ranging from infrastructure to business, and orthogonal cross-functions.

- *The business and organizational layer* describes entities like: the processes, products, and organizational units, which are related to the business. The business capabilities consist of processes, people and resources.
- *The application and information layer* describes business applications and their interconnections. The business service contains business services provided by the applications to the business.
- *The infrastructure and data layer* describes entities that provide to the business applications, the technical infrastructure and data.

  The cross-cutting functions refer to concepts, which influence the elements organized in the horizontal layers:

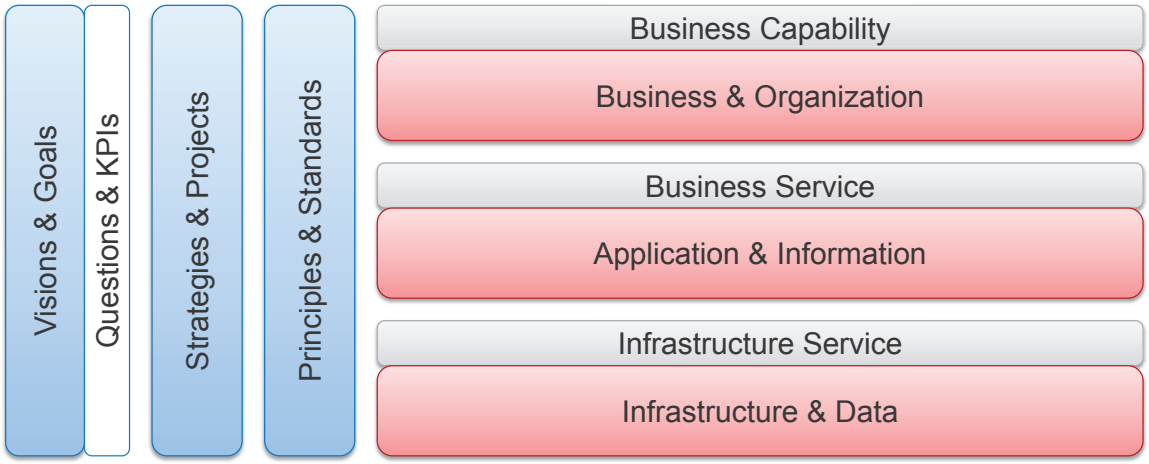


Figure 1.2.: Layers and cross-cutting functions of EA management

- *Principles and standards* describe the guidelines and rules that guide the processes of analyzing, describing, and adapting EA elements.
- *Vision and goals* are derived from the horizontal layers, and generate *strategies and projects* (layer 2) that describe the actions that need to be taken.
- *The questions and key performance indicators (KPIs)* support planning and controlling the different layers.

At the core of the BEAMS approach lies the collection of best-practice building blocks, that guide the enterprise architect towards well-known practice-proven solutions. Based on the literature, Buckl et al. devise a method framework for EA management consisting of four activities as shown in Figure 1.3:

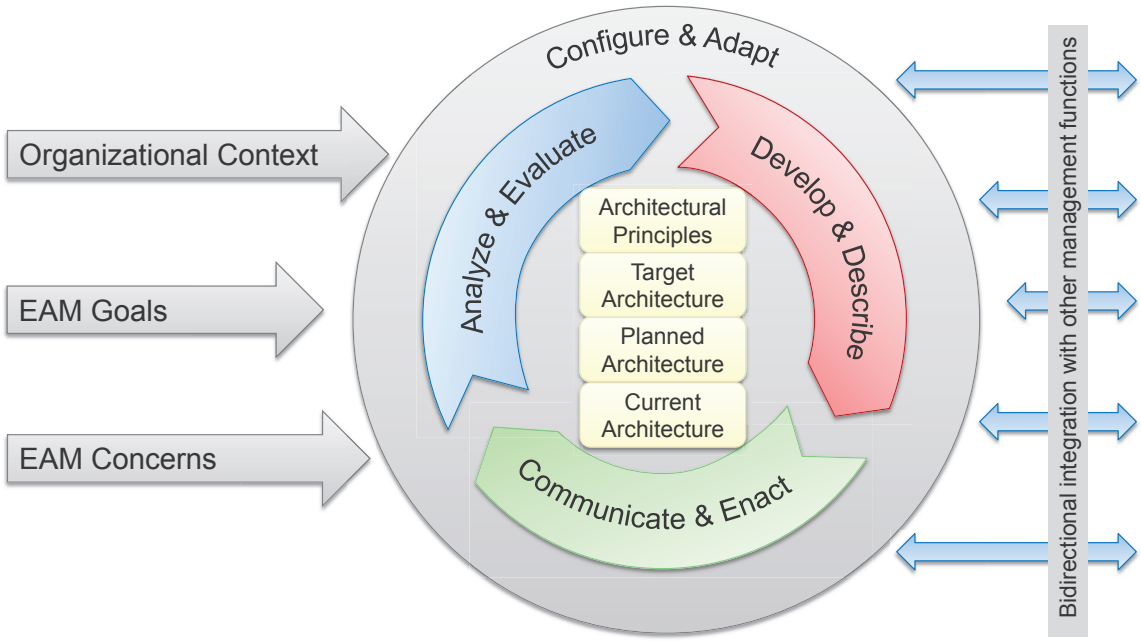


Figure 1.3.: The EA management method framework of BEAMS

- *Develop and describe* a state of the EA, either a current state describing the as-is architecture, a planned state or a target state, i.e. an EA vision.
- *Communicate and enact* architecture states and principles to EA-relevant projects and to related management functions, as project portfolio management.
- *Analyze and evaluate* architectural scenarios (planned states) or analyze whether a planned state helps to achieve the target state or not.

- Configure and adapt the EA management function itself, i.e. decide on the management concerns, goals, and methods.

Despite the fact that "Questions and KPIs" is one of the cross-cutting functions that influence the EA management model developed by SEBIS, the detailed approach that describes how to develop the controlling aspect of the EA and which KPIs to use in an enterprise environment was not integrated in BEAMS.

1.2.3. The EA management KPI catalog

To assure the fulfillment of organizational goals (c.f. [7]) the focus is on the controlling dimension of EA management. This dimension can be adequately maintained and evolved by employing KPIs in a timely manner.
The advantages of using a measurement mechanism are described by Basili [2] as follows:

- It helps support project planning;
- It allows to determine the strengths and weaknesses of the current processes and products;
- It provides a rationale for adopting/refining techniques;
- It allows us to evaluate the quality of specific processes and products;
- It helps, during the course of a project, to assess its progress, to take corrective action based on this assessment, and to evaluate the impact of such action.

The research group of the SEBIS chair, closed the research related to the collection of goal-driven EA management KPIs. The outcome of this research is the EAM KPI catalog [27].
The EA management KPI catalog provides a set of 52 KPIs particularly suitable for the field of EAM. These KPIs are the product of the research at SEBIS, the literature study and the collaboration with industry partners. Therefore the EA management KPI catalog offers a combination of KPIs such as:

- KPIs that are applied during the development of research projects with industry partners
- KPIs that are observed in practice at the industry partners and KPIs proposed by literature

All EA management KPIs are aligned with ten organizational goals (the goals are specified in related EA management literature [7]).

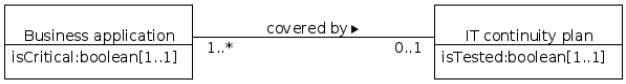
In addition to the list of 52 KPIs provided in the EA management KPI catalog, another contribution is a method to define EA management KPIs [28]. The method proposes a template containing a uniform structure to document EA management KPIs, which was validated by an expert survey carried out in April 2012. An example of this template in use is illustrated in Figure 1.4.
The template is includes further structure elements:

Application continuity plan availability

Description

A measure of how completely IT continuity plans for business critical applications have been drawn and tested up for the IT's application portfolio.

Information model



Organization-specific instantiation

Mapping:

Name in model	Mapped name	Contacts	Data sources
Business application			
isCritical			
covered by			
IT continuity plan			
isTested			

Properties:

KPI property	Property value	Best-practice
Measurement frequency		Quarterly
Interpretation		Problematic if < 60% Normal if between 60% - 80% Good if > 80%
KPI consumer		
KPI owner		
Target value		80%
Planned value(s)		70%, 75%
Tolerance value(s)		
Escalation rule		

Goals

Ensure compliance
Foster innovation
Improve capability provision
Improve project execution
Increase disaster tolerance
Increase homogeneity
Increase management satisfaction
Increase transparency
Reduce operating cost
Reduce security breaches

Calculation

The number of critical applications where tested IT continuity plan available divided by the total number of critical applications.

Code

EAM-KPI-0001

Sources

CobiT 4.0

Layers

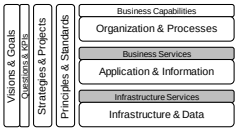


Figure 1.4.: Example of the documentation of an EA management KPI

- General structure elements, e.g., title, description, and calculation.
- Organization-specific elements, e.g., mapping and properties.
- KPI characteristics applied in the context of EA management, e.g., EA management goals, EA meta-model, KPI's mapping with EA layers.

However, the EA management catalog and the design method, do not provide further information about risks and countermeasures related to the EAM KPIs. The application of these artifacts guides the organization towards the "proper" definition and design of EAM KPIs, which by all means helps to avoid many risks. Nevertheless, a general walk-through risks related to EAM KPIs is not currently provided.

1.3. Outline of the thesis

The following section presents the outline of this thesis while summarizing briefly the contents of each chapter.

Chapter 2 gives an overview about the literature review. Section 2.1 describes the method used for the literature review. In Section 2.2, the relevant terms and concepts related to KPIs are discussed. Section 2.3 describes a method to interpret texts in an iterative way. Afterwards, in Section 2.4, the collection of risks and countermeasures in introduced and further described. The chapter concludes with a summary of all the literature findings presented in tabular form.

Chapter 3 presents the evaluation of the literature findings. In Section 3.1 the design of a survey, implemented to carry on the evaluation is described. Section 3.2 presents and describes the findings of the first part of the survey. In Section 3.3, the prioritization of the risks is described. Finally, in the summary of the chapter general findings, conclusions and expectations are further discussed.

Chapter 4 presents a guidelines checklist, implemented through the combination of findings of the literature review and the evaluation of results. Section 4.1 describes how this list is generated and how will it be presented. In Section 4.2, a list of guidelines ensured by previous research is presented. Sections 4.3 and 4.4 present the alignment of the guidelines to the risk categories and risk priorities respectively. In Section 4.5, a method for the definition of organization-specific KPIs is described. Afterwards, in Section 4.6, the guidelines are adapted to this method.

Chapter 5 concludes this thesis with a summary of the results (Section 5.1) and an outlook for possible future research (Section 5.2).

2. Literature review

This chapter describes the research method used to investigate the current state-of-the-art of the KPI-related literature and respective findings. The research has been subdivided in the following research phases:

- selection of relevant literature
- interpretation of relevant literature findings

Each of these phases follows a specific research approach, respectively *the effective literature review process* [25] (c.f. Section 2.1) and *a hermeneutic methodology* [10] (c.f. Section 2.3).

Furthermore, in this chapter the terminology base of the literature finding is discussed, focusing on the concept of KPI and the understanding of this concept in different publications.

Finally, concrete risks and suggested countermeasures are discussed. For each of them a detailed description, and often also an illustrative example, is provided.

2.1. Selection of relevant literature

Taking into account the characteristics of the IS discipline, Levy and Ellis propose a three-step literature review process [25] to guide an effective literature review. This process is designed specifically to support the literature review process in the field of IS, but, as the authors assure, it can be generalized to any field of social and behavioral science. The proposed process, as illustrated in Figure 2.1, has three main phases:

- Inputs (literature gathering and screening)
- Processing
- Outputs (writing the literature review)

In this thesis, this systematic approach is used to identify relevant publications. The process is described in detail in the following sections.

Inputs

Based on the increasing importance of EA management and KPIs in recent years, there is also an increasing amount of literature available that covers these topics. However the terms and definitions used to describe them are very diverse ([24], [13], [37], [16]). To

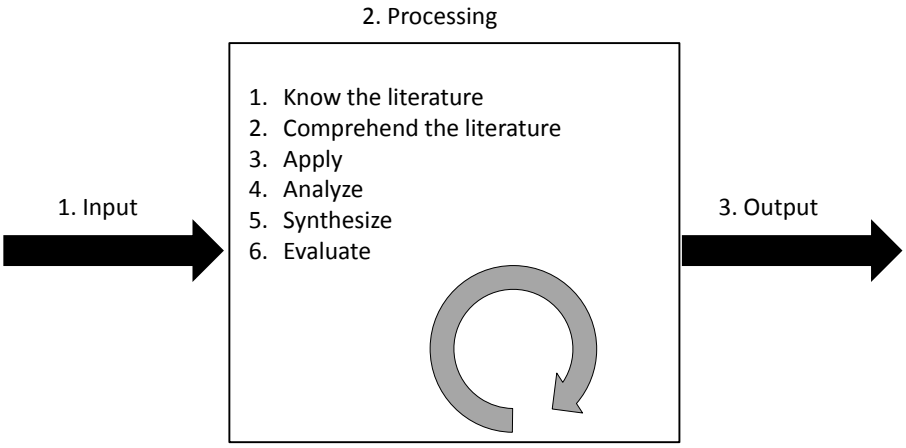


Figure 2.1.: The three stages of effective literature review process

collect all relevant literature sources, we searched for contributions in the leading journals and in the electronic resources for library services , as suggested in [25]. We used the following three search engines: Google, Google scholar, and the search engine of the TU Munich's library, which provides access to publications databases e.g., IEEE, ACM and CiteSeer. The research was conducted between September 2012 and January 2013, following three techniques suggested in [25]:

1. **Keyword search**

   The literature search was performed using the following search terms: ”EA”, ”Enterprise Architecture”, ”EAM”, ”EA management”, ”KPI”, ”indicator”, ”metric”, ”measurement”, ”risk”, ”issue”, ”threat”, ”drawback” and ”limitation” and possible combinations between them.

2. **Backward search**

   The backward search was conducted in three sub-steps: *backward references search* (review of the references of the articles identified by the keyword search), *backward authors search* (review of prior publications of the authors identified by the keyword search) and *previously used keywords* (review of the keywords used in the keyword search). With these techniques we refined our list of publications and discovered new related sources.

3. **Forward search**

   The forward search was conducted in two steps: *forward references search* (we reviewed additional publications that have cited a particular publication in our list)

and *forward authors search* (we reviewed the publications that the identified authors have published after the publication in our list)

Processing

After collecting sufficient literature, the sources have to be analyzed and refined. Therefore we conduct a terminology analysis to constructively review what has been learned and clarify the scope of the work in relation with the identified literature. The terminology review, as described in detail in Section 2.2, specifies also our understanding about central concepts related to KPIs.

Outputs

The publications identified in the input phase, are organized depending on the related research field as illustrated in Figure 2.2.
In this table we present literature sources from three different fields: EA management, IT management and business management. These fields differ regarding the way they deal with KPIs:

- EA management focuses on the fulfillment of the organizational goals;
- IT management focuses on measuring IT processes, IT services and software applications;
- Business management focuses on measuring performance and processes e.g. production;

The aim of this thesis is to look at KPI development as a complex process, focusing on specific aspects as well as the whole picture. Therefore we find relevant the literature provided for each of the fields, and we analyze the used terminology to detail the understanding. The detailed terminology review is described in the following section.

	Literature review	
	Key	Publication/Book
EA Management	[27]	Eam kpi catalog v1.0. Technical report, Technische Universität München, München, Germany. 2012.
	[41]	The Open Group. TOGAF "Enterprise Edition" Version 9. 2009.
	[19]	Enterprise architecting: Critical problems. 2012.
	[22]	Metrics for Application Landscapes – Status Quo, Development, and a Case Study. 2008.
	[8]	State of the art in enterprise architecture management 2009 . Technical report, Technische Universität München. 2009.
	[1]	Understanding enterprise architecture management design - an empirical analysis. 2011.
	[28]	A template-based design method to define organization-specific KPIs for the domain of enterprise architecture management. 2012.
	[29]	Towards a unified and configurable structure for EA management KPIs. 2012.
	[6]	Analysis and application scenarios of enterprise architecture: An exploratory study. 2006.
IT Management	[39]	Measuring ITIL: Measuring, Reporting and Modeling - The IT Service Management Metrics That Matter Most to IT Senior Executives. 2006.
	[40]	Metricm: a modeling method in support of the reflective design and use of performance measurement systems. 2012.
	[16]	Management by Measurement: Designing Key Indicators and Performance Measurement Systems. 2012.
	[37]	Modeling organizational performance indicators. 2006.
Business Management	[2]	The Goal Question Metric Approach. 1994.
	[3]	Performance indicators: good, bad, and ugly. 2005.
	[4]	Management: meeting new challenges. 2000.
	[5]	Implementing performance measurement systems: a literature review. 2003.
	[12]	The Performance Measurement Manifesto. 1991.
	[13]	Performance Dashboards: Measuring, Monitoring, and Managing Your Business. 2009.
	[17]	Metrics: you are what you measure. 1998.
	[20]	The balanced scorecard – measures that drive performance. 1991.
	[21]	Leading Change: Why Transformation Efforts Fail. 2007.
	[23]	Scorecard Best Practices: Design, Implementation, and Evaluation. 2007.
	[30]	The performance measurement revolution: why now and what next? 1999.
	[31]	Business Performance Measurement: Theory and Practice. 2004.
	[32]	The performance prism: the scorecard for measuring and managing business success. 2002.
	[33]	Performance measurement system design: A literature review and research agenda. 1995.
	[36]	Effective Use and Misuse of Performance Measurement. 1998.
	[38]	Why balanced scorecards fail. 1999.
	[42]	The interplay of different levers of control: A case study of introducing a new performance measurement system. 2005.

Figure 2.2.: The literature review

2.2. Terminology

This section provides an overview of the basic terminology relevant for this thesis. In addition to the general understanding of KPIs, we describe the concepts of metrics, measurements and other related concepts in the existing literature.
The importance of performance measurement in an organizational environment has attracted a great deal of interest in industry and academia. Because of this ever growing interest, there are numerous definitions of the related concepts in the offered literature([24], [13], [37], [16]). As Neely describes [30]: "performance measurement is a topic often discussed but poorly defined".

Much of the existing literature uses diverse terms to define similar concepts. Therefore, this chapter investigates the major definitions related to performance measurement, following research in different publications. To identify possible definitions of KPIs we reused the literature collected previously, by following the research method described in Section 2.1. Using these sources, we explored the terms and definitions that were currently available. Then we extracted the terms denoted as key concepts by the respective authors. The list of all relevant concepts, publications and the respective authors is illustrated in Figure 2.3.

One of the most discussed terms is *performance*. Lebas and Euske in [24] show how everyone describe performance the way it suits them, letting the context take care of the definition. According to the authors the different meanings of the term performance (as specified in both French and English dictionaries) are described as showed below:

- measurable by either a number or an expression that allows communication (e.g., performance in management is a multi-person concept);
- to accomplish something with a specific intention (e.g., create value);
- the result of an action (the value created, however measured);
- the ability to accomplish or the potential for creating a result (e.g., customer satisfaction seen as a measure of the potential of the organization for future sales);
- the comparison of a result with some benchmark or reference selected or imposed either internally or externally;
- a surprising result compared to expectations;
- acting out, in psychology;
- a show, in the "performing arts," that includes both the acting or actions and the result of the actions as well as the observation of the performers by outsiders;
- a judgment by comparison (the difficulty here is to define who the "judge" is, and to know on which criteria the judgment will be formed).

These specifications highlight the importance of *measuring* performance, showing therefore the need of using indicators to lead managers to take appropriate actions for the future

		Terms			
	Publication/Book	Indicator	Metric	KPI	Measurement
EA Management	[27]			✓	
	[41]		✓		
	[19]		✓		
	[22]		✓		
	[8]		✓	✓	
	[28]			✓	
	[29]			✓	
	[6]	✓	✓		
IT Management	[39]		✓	✓	
	[40]	✓			
	[16]	✓	✓	✓	
	[37]	✓			
Business Management	[2]		✓		
	[3]	✓			✓
	[5]	✓	✓		✓
	[12]				
	[13]		✓	✓	✓
	[17]	✓			
	[20]	✓			
	[21]				
	[23]	✓	✓	✓	✓
	[30]		✓		✓
	[31]		✓		✓
	[32]		✓		✓
	[33]		✓		✓
	[36]	✓			✓
	[38]	✓	✓		✓
	[42]	✓	✓		✓

Figure 2.3.: The terminology review

of the organization. We use the term indicator here, in line with Lebas and Euske [24], who prefer the word "indicator" to the more traditional one of "measure". The justification of this decision lies in the fact that, according to the authors, "a measure often implies precision; it is usually well-defined, and in similar circumstances its numerical value should be the same. An indicator may be less precise, but meaningful; indicators tend to allow for more timely and sensitive signals."

In terms of performance, Lebas and Euske suggest the following definition for performance indicators: "Performance indicators are constructs designed to create a model of organizational performance appropriate for a specific purpose. They are conceived by purposeful abstraction based on the plausible assumption that managing large organizations requires the reduction of complexity in order to avoid information overload."

Other authors ([13], [37], [16]) consider other terms for similar concepts i.e. performance indicator, metric, measurement, KPI or Key Result Indicators (KRIs).

Popova in [37] defines performance indicators as "a quantitative or qualitative indicator that reflects the state/progress of the company, unit or individual". In particular, KPIs are defined as "A subset of indicators, that can give a representative picture of the performance and the costs of measuring and monitoring are reasonable".

Eckerson in [13] suggests the following definitions:

- "A KPI is a metric measuring how well the organization or individual performs an operational, tactical, or strategic activity that is critical for the current and future success of the organization".
- "A metric is the standard measurement of a known object or activity".
- "The measurement is the result or output of measuring an object or activity".

Franceschini [16] considers the terms "metric" and "performance indicator" as synonyms. Nevertheless he suggests a definition for KPIs: "Indicators that "properly" represent the process", where process is "an integrated system of activities that uses resources to transform inputs into outputs".

Both authors, Eckerson and Franceschini, mention the term "output" to emphasize the importance of the results provided by measurements or processes (in line with the terms used by the authors).

Other authors, such as Neely et al. [33] describe performance measurement in terms of efficiency and effectiveness. They propose the following definitions for the terms performance measurement, performance measure and performance measurement system:

- "Performance measurement can be defined as the process of quantifying the efficiency and effectiveness of action."
- "A performance measure can be defined as a metric used to quantify the efficiency and/or effectiveness of action."

- "A performance measurement system can be defined as the set of metrics used to quantify both the efficiency and effectiveness of actions."

Parmenter [35] introduces the concept of KRIs and describes the KPIs as artifacts that increase the performance. He suggests the following definitions:

- "KRIs tell you how you have done in a perspective."
- "Performance indicators tell you what to do."
- "KPIs represent a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization. KPIs tell you what to do to increase performance dramatically."

Steinberg [39] uses both terms, metric and performance, to define KPIs and suggests that KPIs have a great impact on leading management decisions. According to him "KPIs are metrics that are used to indicate the performance level of an operation or process. They are used to provide a basis for actionable management decisions".

Fitz-Gibbon [14] focuses on the role of KPIs in keeping track of the performance. He defines a KPI as: "an item of information collected at regular intervals to track the performance of a system [enterprise]".

In this thesis the above mentioned terms, such as KPI, metric, measure and indicator will be used interchangeably. In our understanding, KPIs "enable enterprise architects to plan, forecast, benchmark, and assess the EA management goal fulfillment. Furthermore, they provide a quantifiable rational for adopting and comprehensive means for controlling." [27]

The separate interpretation of indicators as leading the future decisions or measuring the effect of these decisions in the outcomes of an organization is irrelevant in terms of threats and risks related to such indicators. We consider both aspects and we evaluate risks related both to "bad decisions" and "bad numbers".

2.3. Interpretation of the literature

One of the keys aspects of our research is the identification and categorization of risks related to the development and implementation of KPIs. Therefore we develop a list of possible risks as mentioned in different sources. The attempt to create a genuine source of useful data is supported by the interpretation of relevant text following the hermeneutic cycles' iterations. The process, is described in detail in the following section.

2.3.1. Hermeneutic text comprehension

To build on the knowledge base for the risk categorization, we investigate the state-of-the-art in literature with respect to typical risks and proposed countermeasures relevant to the design and implementation of KPIs. Thus, we build the foundation to answer the RQ2 (c.f. Section 1.1).

The approach used for the literature review is based on text interpretation, specifically on a hermeneutic method. Hermeneutics (from the Greek hermeneuien "to interpret"), means that interpreting a text or phenomenon is strongly affected by the background of our previous understanding of the whole and that while reading the text or observing a phenomenon (and its component phenomena) we acquire new knowledge that leads to a better understanding of the whole.

According to Wallace et. al [43], hermeneutics deals with two aspects of text interpretation:

- the problems of analyzing texts in a way that looked beyond the surface features
- the problems of verifying the analyses so produced

The reason to employ such a method is the fact that texts are not just more or less meaningful, they are also more or less useful [43]. Therefore the usefulness of the respective literature sources is tested by this method, to guarantee the *relevance* of findings.

One of the fundamental aspects of hermeneutics is the circular structure of the text understanding. This circular structure is known as the *hermeneutic circle* (Figure 2.4) (called also as the hermeneutic circle of understanding by Heidegger [18]). The idea behind this concept is that the understanding expands in concentric circles. Figure 2.4 represents the hermeneutic circle, as an adaptation of the conceptual figure introduced by Butler [10]. The figure reflects the fact that the understanding expands in concentric circles (from A to E). Once we are the circle, understanding augments, making the text clearer to the reader. Therefore, we gain a deeper knowledge about the text, investigating the text through a number of iterations.

The risks related to the design and implementation of KPIs are dependent to the organization, its context and culture. Moreover, the literature does not always provide specific information about these risks and the respective countermeasures. Therefore, the iterative nature of a hermeneutic method provides a means to lower the complexity of the investigation. After each iteration new research outcomes are collected. These outcomes serve as

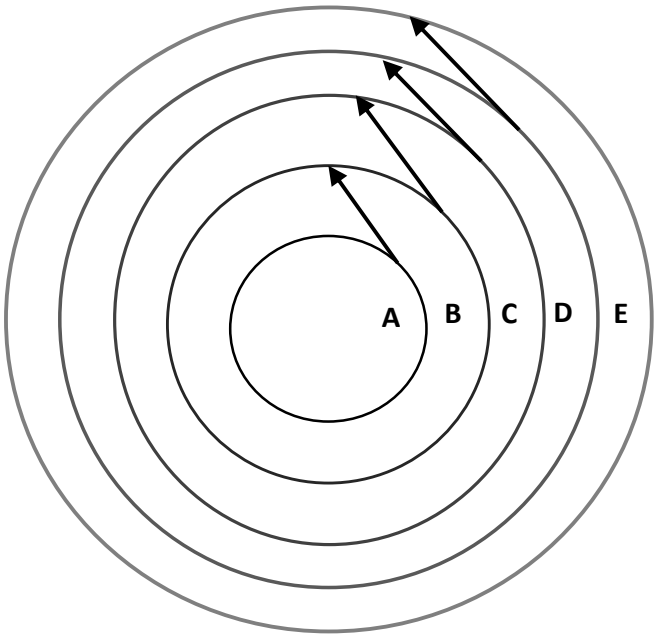


Figure 2.4.: The Hermenutic Circle(adapted from Butler 1998 [10])

an input (are part of the acquired background knowledge) for the next iteration.

The intended outcome of the application of a hermeneutic method in this thesis, is the identification of a set of risks as well as a set of suggested countermeasures, structured in comprehensible risk categories. Following a hermeneutic cycle, newly identified risks and countermeasures might cause a necessary restructuring of the risk categories. These categories are adapted, in a stepwise manner, to include the new research outcomes.

In this thesis, only the findings from the last iteration are described (see Section 2.4).

2.3.2. Risk categorization

Based on a hermeneutic method the following categories of risks related to KPIs were elicited:

- General
- Data
- Organizational goals
- Targets
- Number of KPIs

- Ethics
- Rewards
- KPI presentation

Following the same approach, for each of these categories, a number of specific risks and countermeasures is identified.
Each of the categories, the specific risks and the suggested countermeasures are described in detail in Section 2.4.

2.4. Risks and countermeasures

2.4.1. General risks

In this category we classify risks related to the measurement process of KPIs in general. In this context different aspects of the process are relevant. Such aspects include: the relevance of the measured KPIs, their definition, the level of abstraction, relationships between management and the KPI team, customer satisfaction, and the time period when the KPIs are measured.
The concrete risks that belong to this category are:

- Use of irrelevant KPIs
- KPIs are not properly defined
- KPIs are too abstract
- Resistance to change
- Automation of the measuring process
- Standard terms
- The KPI team is not constantly informed
- Customer satisfaction is not measured
- Short term focus only

Risk 1.1. Use of irrelevant KPIs

As previously stated, one of the main reasons to use KPIs is to measure the fulfillment of organizational goals. Nevertheless, often the measured KPIs do not reflect properly what is really occurring in an organization. Even if the organization is measuring properly a defined KPI, and the results that these KPIs produce are accurate, they can still be irrelevant [36]. The reasons for this can be different. As the related literature states ([36], [17]), organizations are interested to have good statistics and the relevance of the data provided is often of no great matter. Moreover, as Hauser in [17] points out, many managers are prone to seek for KPIs that can be measured precisely. But, unfortunately this does not guarantee that the produced values are right and relevant.

Example:

"Many service firms sought to enhance its customers satisfaction with a telephone-service center. In an effort to create incentives for the telephone representatives, the firm began to measure a variety of metrics including the number of rings until the phone was answered, the time spent in the queue until a live representative could come on the line, the number of calls answered per hour by each representative, the number of times the customer was put on hold, and the percent of each hour that each representative spent connected to a customer. All of these metrics could be measured easily, accurately, and automatically by the telephone equipment. Soon the firm improved dramatically on all of these measures, but the customers were still dissatisfied. To increase the number of calls per hour and be ready to answer the next call immediately, telephone representatives rushed customers and gave them the most convenient answer. Some reps even gamed the system by hanging up on a customer or two immediately after answering (without saying anything) in order to improve their metrics, hoping that no one would be the wiser! To decrease the number of times the customer was put on hold, reps were reluctant to transfer a call, even if they themselves did not know the answer. The service center became precisely what it measured a place to process lots of calls quickly. However, customer research showed that customers did not just want quick answers they wanted accurate answers. Most customers would not mind waiting an extra ring or staying on the telephone a bit longer if they were then connected or transferred to a knowledgeable person who could answer their question accurately. Accuracy was much harder to measure than speed, but that was the true goal. Accuracy and customer-satisfaction measures were less precise, but far more relevant to the real goals of the telephone service center."

"*Metrics: you are what you measure*". Hauser, Katz [17]

Countermeasures

- *Measure what is truly important, not just what is easy to measure*

  This countermeasure is suggested by Hauser in [17]. According to the author it is better to have relevant KPIs that are difficult to measure, than having KPIs that can be measured precisely but their value is not relevant to the real goals of the organization. Lawson in [23] emphasizes also that every organization should consider carefully the value of each KPI. The author suggests that if you have KPI that are highly correlated it is wise to drop some of them because they all provide very similar analytical ability, therefore no-added value.

Risk 1.2. KPIs are not properly defined

Many literature sources ([30], [5], [34]) warn about the fact that KPIs are often properly defined. The poor definition of KPIs is related to different aspects.
Firstly, the use of non-standard terms (c.f. Section 2.4.1) for the KPI definition can cause confusion and false interpretation.
Secondly, partial definitions that contain gaps in the information about the KPI can cause misunderstandings and increase the level of abstraction, which directly contradicts one of the guidelines for designing good metrics: "Good metric should be simple and easy to understand" [38].

Countermeasures

- *Provide clear, unambiguous and understandable definitions*

  To avoid misunderstandings KPIs should be clearly defined [3, 13]. When KPIs are not well-defined, it becomes difficult for the team that is working on these KPIs to calculate them [13]. If it is not possible to define KPIs in advance, then at least the terms of criteria should be agreed beforehand. This means that the general definitions, standard terms and related glossary should provide a common understanding for all stakeholders, even if the concrete KPIs list is still to be specified.

- *Use a template for KPI design and provide all the necessary data*

  The gaps of information in the KPI definition can be better identified if the design and implementation of each KPI follows a template. The use of this uniform structure provides many benefits [28] e.g., ensures the compatibility of KPIs, fosters their reuse, and guides their development process. Such a template is developed by the chair of SEBIS [29], and it is described in detail in Section 1.2.3.

Risk 1.3. KPIs are too abstract

Eccles in [13] warns that one of the main problems related to KPIs, is that they are difficult to understand or implement. The cause often is the fact that KPIs are not properly defined (see also Section 2.4.1). KPIs that have an abstract definition can confuse the involved stakeholders. On the one hand, it can be difficult to identify the properties of a KPI such as the data needed for the calculation, the calculation rule or the related targets. On the other hand, abstract KPIs, while not being understood correctly can also be misused, e.g. they can be aligned to the false organizational goals (see also Section 2.4.3).

Countermeasures

- *Measure well-defined and well-designed KPIs*

  This countermeasure is suggested by Eccles in [13]. The author emphasizes that the team must clearly understand what is being measured, how it is calculated, what the targets are, how rewards work, and, more important, what they can do to steer the decision making process in a positive direction.

- *Test KPIs in advance*

  According to Perrin [36], KPIs should be tested in advance. The author considers it essential to pretest how the KPI work in practice, their accuracy and data validity. In an iterative way, the organization should test the common understandings while keeping the stakeholders involved in the KPI definition process. If the definition and properties of a KPI cause divergent interpretations, that KPI is a candidate for revision.

Risk 1.4. Resistance to change

Many organizations have a dynamic set of KPIs, that changes as the organization changes with time. Therefore the need to introduce new KPI is inevitable. This process can cause a risk related to these new KPIs known as "resistance to change" [42]. This risk outlines issues with managers or other stakeholders that are not prone of accepting the newly introduced KPIs. Tuomela [42] suggests that resistance to new strategic KPIs may arise from the increased visibility of actions. Some managers may feel threatened while implementing new KPIs, because their performance would be questioned afterwards.

Countermeasures

- *Inform the team and keep them involved*

  The discussion about this countermeasure and the risk related to it, is outlined in detail in Section 2.4.1.

Risk 1.5. Automation of the measuring process

The measuring process of the KPIs includes all related activities from data collection to calculation and generation of output values. This process, in many organizations, is done by hand (i.e. using tools that require frequent input from users). This way of operating can cause a variety of problems and is related to such risks as: false input data, false formulas, or false output values. All these risks can later on contribute to false decisions, and danger the organizations business model.

Countermeasures

- *Use related tools*

  As explained by Lawson [23], an automated process can help minimize the time spent gathering data and and to maximize the time available to analyze and act on results. Therefore the efficiency of the measuring process can be increased. Moreover an automatic measuring process can help the organization to provide accurate output values. The accuracy of the KPI values is highly important, because they are often used as an input [31] in the decision making process of the organization. False values can therefore lead the organization toward a path that is not aligned to the organizational goals and to the previously set targets.

Lawson [23] describes that an automated process also motivates employees to analyze the results and use the information to determine ways to improve, because the collection of measure values is not too painful, the results reported are up-to-date, and the presentation of the reports is attractive and automated.

Risk 1.6. Standard terms

As Eckerson in [13] specifies, a big challenge in creating KPIs is getting people to agree on the definitions of terms. The author strongly emphasizes the criticality of standard terms, especially if the organization is going to distribute the KPI results to different groups at multiple levels of the organization and roll up the results. Perrin [36] says that KPIs, no matter how clearly described, are invariably used, recorded and interpreted in varying ways. Therefore, without standards, the organization risks producing a set of inconsistent KPIs whose information cannot be easily used.

> Example:
>
> I recently interviewed court clerks in a number of courthouses about how they go about recording their statistics. It became apparent that measures such as "inquiries", "cases involving child support", "applicants with (or without) legal representation, and "judicial orders" were counted in varying, often inconsistent ways, at different courthouses and even by different staff working side by side. As a result, aggregated statistics about court workload and outcomes based upon these reports are meaningless at best-although they have not been treated this way by senior management who apparently are unaware that these "straightforward" terms are anything but!
>
> "*Effective Use and Misuse of Performance Measurement*". Perrin, B. [36]

Countermeasures

- *Provide clear, unambiguous and understandable definitions*

  As previously stated (c.f. Section 2.4.1), KPIs should have clear and unambiguous definitions. Using standard terms minimizes the risks related to the various possible interpretations of a specific KPI. On the same time, while striving for well-defined KPIs, the standardization of terms is constantly checked.

- *Test KPIs in advance*

  Perrin [36] suggests using pretested KPIs (see also Section 2.4.1). The pretesting process focuses mainly in the identification of various interpretations of KPIs by different stakeholders. If this is the case, KPIs should be redefined.

- *Train the staff*

Stakeholders can also be trained, to make sure that they share the same understandings about different terms. Perrin [36] explains that training and orientation as well as active involvement of the staff helps in leading to common interpretations. In this case bottom-up have resulted seem more helpful than the often used top-down approaches.

Risk 1.7. The KPI team is not constantly informed

Communication is one of the most important aspects of the organizations strategy. If the communications has flows, the employees can feel threatened, used and not part of a strategic process for which their role is important. As Lawson [23] warns, unless fully explained, employees are likely to take a negative view of how the results might be used to to punish or reward.

Countermeasures

- *Inform the team about changes*

  To enhance the communication, it is crucial to communicate to all stakeholders not only the organization goals, vision and strategy but also the reasons [23] why the KPI system is being implemented. The stakeholders should be actively involved [36] in all the steps of the measurement process to guarantee the relevance and the consistency of the KPIs.

- *Inform the team about the KPI owner*

  Every KPI needs an owner. The KPI owner is the person responsible for the outcome of an KPI. Eckerson [13] points out that some companies assign two or more owners to a KPI to engender teamwork. In any case the team should be informed about the team owner/s.

- *Delegate authority to the team*

  To truly move forward in alignment to the organizational goals the organizations should delegate authority to the team. Lawson [23] describes how the further down in the organization that KPIs are used, and the more they are used for evaluation (e.g., of objectives, people, initiatives, departments, products, etc.), the better the chances management and staff will align with strategy. Eckerson [13] explains that companies with hierarchical cultures often have difficulty here, but they should delegate authority to the employees so that they can make decisions of their own and not only follow top-down orders.

Risk 1.8. Customer satisfaction is not measured

Customer satisfaction should be considered one of the most important KPIs ([20], [31], [12]) that should definitely be past of the organization's KPI set. The importance of this KPI is also indicated by the fact that Kaplan and Norton included it in their prominent balanced scorecard management system. A satisfied customer leads the organization to increased loyalty and lower marketing costs [31]. Nevertheless there is the risk that organizations

completely disregard of this KPI. The example below, testifies the importance of customer satisfaction in a successful organization.

Example:

David Hsiao, the director of quality data infrastructure at Cisco, just received an automated "Red Alert" e - mail message, indicating that there has been a spike in product returns from one of Cisco's top 250 customers. Hsiao knows that product returns directly correlate with customer satisfaction, which Cisco measures continuously via customer surveys. He also knows that a 10 percent drop in customer satisfaction can decrease Cisco's revenues from that customer by 40 percent in just one quarter. Thus, he must take swift action.
Hsiao immediately calls the customer's account manager, who also received the Red Alert. Together, they create a "Tiger team" - an ad hoc, cross-functional group of individuals who work to address a specific process, measurement, or performance issue. In this case, the Tiger team consists of specialists from sales, supply chain, engineering, and technical services. Within the next 48 hours, the team investigates the cause of the alert and reports to Cisco executives about the source of the problem and potential resolutions.
In this case, the Tiger team discovered a false alarm: The customer had been accumulating parts and shipped a big batch to Cisco to clear its loading dock. Nonetheless, the Tiger team proposes ways that Cisco can help the customer better manage its inventory in a volatile economy. The team's proactive attention to customers and quick response to a potential problem stems from Cisco's commitment to customer success and culture of metrics-driven performance.

"*Performance Dashboards: Measuring, Monitoring, and Managing Your Business*".
Eckerson, W.W. [13]

Countermeasures

- *Define KPIs that measure customer satisfaction*

  The countermeasure related to this risk is to measure also the customer satisfaction. Beyond this fact, the measurement of the customer satisfaction can have obstacles of its own. Neely at [31] list some of these issues:

  - In a well-developed economy, most customers are satisfied. Therefore, having many equally satisfied customers with competitive products does not influence the management decisions.
  - Customer satisfaction KPIs can be difficult to implement because they are more subject to manipulation.

  Although the fact that measuring customer satisfaction can face many issues, the take away note remains the same: "measure it". Different organizations can also

overcome these issues with customized solutions to properly implement this KPI e.g. implement more than one KPI related to customer satisfaction that measure different properties of the advertised product. The literature can also help with testimonies of success stories. One of these examples can afterwards be tailored for a specific case.

For more information, Eckerson in [12] describes in detail how a successful organization like Cisco measure customer satisfaction.

Risk 1.9. Short term focus only

Most organizations only collect financial and operational data, forgetting to focus on the longer-term measures [16]. Therefore, there is no focus on the interpretation of the strategic steps that the organization has taken over a period of time. Bird [3] points out that the analysis and the interpretation of these data should obtain the same consideration as the measurement of KPIs itself. Therefore, some effort should be spent on the analysis and presentation of data collected over a relatively long period of time.

Countermeasures

- *Target long-term goals*

  This countermeasure comes in alignment with the suggestion to align the KPIs to the organizational's goals. KPIs that are mapped to long-term goals provide data that describe the long-term behavior of the organization. For more details on the organizational goals see Section 2.4.3.

Summary

Table 2.1 depicts the collection of risks and countermeasures, as well as the respective literature sources, classified in the category *"General"*.

2.4.2. Data

In this category of risks we classify risks related to the data collection used for measuring KPIs. The quality of KPIs is highly affected by the amount of the data considered, the quality of the data collection, the data sources and the data format.
The concrete risks that belong to this category are:

- Considering too much (or too less) data
- Using defective data

Risk 2.1. Considering too much (or too less) data

The collection of data used to measure KPIs is one of the most important aspects of the whole measuring process. At the same time is also very vulnerable. For many KPI calculations there are considered too many or too less data [16]. This is apparently an issue with which the organizations are faced frequently. As Brown (cited by [16]) writes: "The most

General		
Risk	**Countermeasure**	**Sources**
Use of irrelevant KPIs	Measure what is truly important, not just what is easy to measure	[36], [17], [23]
KPIs are not properly defined	Provide clear, unambiguous and understandable definitions	[3], [13], [30], [5]
	Use a template for KPI design and provide all the necessary data	[28], [29]
KPIs are too abstract	Measure well-defined and well-designed KPIs	[13]
	Test KPIs in advance	[36]
Resistance to change	Inform the team and keep them involved	[42], [23], [36]
Automation of the measuring process	Use related tools	[23], [31]
Standard terms	Provide clear and unambiguous definitions	[3], [5], [13],[30], [34]
	Test KPIs in advance	[36]
	Train the staff	[36]
The KPI team is not constantly informed	Inform the team about changes	[23], [36]
	Inform the team about the KPI owner	[13]
	Delegate authority to the team	[13], [23]
Customer satisfaction is not measured	Define KPIs that measure customer satisfaction	[12], [20], [31]
Short term focus only	Target long-term goals	[3], [16]

Table 2.1.: Risks, countermeasures and sources of category "General"

common mistake organizations make is measuring too many variables. The next most common mistake is measuring too few".
Eckerson in [13], explains that when there are no data to support a metric, even if KPIs are well-defined, they will be irrelevant [13], which can cause another risk to fire (see Section 2.4.1).
Another problem is that sometimes the data required to calculate a KPI is spread across multiple systems [13]. Even if the distributed data are in good condition (which is rarely the case), the team must spend a lot of effort to integrate the data in a consistent way.

Example:

"Our company used to make decisions on gut feel", says a director of business information and analysis at a major U.S. manufacturer, "but now our executives believe strongly that fact - based decision making gives us a competitive advantage. Executives now ask, 'Where are the data to back up this decision?' and they expect sales people to use information to close deals, not just rely on the strength of their client relationships. And it's working!"

"*Performance Dashboards: Measuring, Monitoring, and Managing Your Business*".
Eckerson, W.W. [13]

Countermeasures

- *Appoint a system analyst to scout data sources for potential KPIs*

  This countermeasure is suggested by Eckerson [13]. According to the author a system analyst is to be appointed to identify the data required for a KPI. This analyst can be an employee of the company or, if the organization does not have a specialized expert, an outside consultant can be contracted. However, Eckerson warns that if the organization uses a consultant, the transfer of knowledge to the internal employees should be guaranteed, so the company is not dependent on the consultants (see also Section 2.4.1).

Risk 2.2. Defective data

Eckerson in [13] warns that inaccurate and untrustworthy data are the main cause of damaging the credibility of a project. These defective data may be extremely misleading [3]. Therefore, considerable attention should be dedicated to data quality.

Countermeasures

- *Ensure data quality*

  This countermeasure is suggested by Bird at [3] and Eckerson [13]. According to Bird a first step to ensure data quality is to determine for each KPI the data collection that supports its calculation. Thereafter, the author suggest that data quality checks should often be performed at two levels:

  – to confirm that individual KPIs measure what they are supposed to measure, and have not been corrupted

  – to isolate suspect individual values that are incorrect or produced by misunderstandings, which may seriously affect final conclusions

Summary

Table 2.2 depicts the collection of risks and countermeasures, as well as the respective literature sources, classified in the category *"Data"*.

2.4.3. Organizational goals

Each organization must have a strategy defined primarily through organizational goals, as well as KPIs for measuring progress toward reaching these goals. The importance of the definition of organizational goals is discussed intensively in literature ([20], [36], [3], [17]). Therefore the important role of KPIs, as a means of measuring the achievements of the organization is implied. When these goals and the respective measurements are put at risk, the whole organization strategy is also threatened. In this category of risks the focus is on the definition of the organizational goals.

Data		
Risk	**Countermeasure**	**Sources**
Considering too much (or too less) data	Appoint a system analyst to scout data sources for potential KPIs	[13], [16]
Defective data	Ensure data quality	[3], [13]

Table 2.2.: Risks, countermeasures and sources of category "Data"

The concrete risks that belong to this category are:

- Goal displacement
- Vague organizational goals
- Negotiated goals

Risk 3.1. Goal displacement

The so-called "goal displacement" happens when KPIs become the objective [36] and this leads to emphasis on the wrong activities in an organization such as "meeting the numbers" and not focus on the real organizational goals.

Countermeasures

- *Choose KPIs in alignment with organizational goals*

  This countermeasure is suggested by many literature sources e.g. [20], [36], [3], [17]. Its importance is related to the impact that the alignment of KPIs to the organizational goals has in the realization of the organization's strategy. In this context Hauser [17] points out that the key concept is that the KPIs are chosen so that actions and decisions which move the KPIs in the desired direction also move the organization's desired outcomes in the same direction.

- *Measure KPIs, not only outcomes*

  Every organization is prone to look for the right numbers, and these are produced by the outcomes. Nevertheless, the focus should not be on KPIs that measure only financial aspects of the organization. According to Perrin [36], KPIs should cover different

aspects e.g., processes, outputs and outcomes. This aspect is on the center of the implementation of the well-known Balanced Scorecard Management System [20]. The objective was to give to the stakeholders a more "balanced" view of organizational performance, urging them to define both financial and operational KPIs.

- *Review, revise and update the KPIs frequently*

  Lawson in [23] emphasizes the need to update the strategy, KPIs, objectives and initiatives as the organization's business needs and situation change. The author lists some of the issues that may arise when this countermeasure is not considered:

  - There are too many KPIs being tracked. (See also Section 2.4.5)
  - There are multiple KPIs, with different names, measuring the same thing. (See also Section 2.4.1)
  - Scorecards become too difficult to analyze due to too many measures. (See also Section 2.4.5)
  - Data entry and tracking of data becomes expensive and unwieldy.
  - Out-of-date strategy statements wreak havoc with scorecard success.
  - Incorrect responsibility assignments cause confusion.

Example:

We worked with an office furniture manufacturer a few years ago on the design of seating products. This manufacturer, which wanted to create chairs that were highly durable, was using sophisticated testing procedures to assure durability. The engineering-design and the quality-testing teams were among the best in the business. However, as part of a desire to continually improve profit, the firm questioned established procedures to determine whether it was measuring the right things. After all, few of their chairs ever failed, and many in the firm expressed the belief that their products were "over-engineered". Furthermore, there were few users who weighed 550 kg and few users who would ever sit down 50,000 times over the lifetime of the chair. While such over-designed durability might be good at some level, this over-engineering added significant cost to the chair and limited the ability of the engineers to provide other valued features to the customer. By refocusing and balancing the ultimate goals of customer satisfaction and long-term profit, the firm was able to modify its metrics to encourage better designs.

"*Metrics: you are what you measure*". John R. Hauser, Gerald M. Katz. [17]

Therefore, KPIs need to be reviewed, revised and updated frequently. As Neely [32] says, a KPI system is a living entity which must evolve and be nurtured over time. Even if your set of KPIs is "perfect", it is almost certain [36] to become out of date due to introduced changes over time.

Risk 3.2. Vague organizational goals

The KPIs developed in an organization should be strongly related to the organizational goals. Therefore while designing a KPI the concept of the goal towards which the KPI is being developed, has to be really precise and not ambiguous. In many companies these goal definitions are vague, because the organization lacks a vision. As described by Kotter [21], without a vision the organization can move towards the wrong direction or nowhere at all.

> Example:
>
> A company gave out four-inch-thick notebooks describing its change effort. In mind-numbing detail, the books spelled out procedures, goals, methods, and deadlines. But nowhere was there a clear and compelling statement of where all this was leading. Not surprisingly, most of the employees with whom I talked were either confused or alienated. The big, thick books did not rally them together or inspire change. In fact, they probably had just the opposite effect.
>
> "*Leading Change: Why Transformation Efforts Fail*". Kotter, John P.. [21]

Countermeasures

- *Align KPI structure with the goal structure*

  Popova [37] suggests to crystallize in the KPI the relevant characteristics of the goal. In this phase it is also possible to start with a KPI that appears to be important. Afterwards this metric can be divided into smaller, more specific KPIs.

Summary

Table 2.3 depicts the collection of risks and countermeasures, as well as the respective literature sources, classified in the category *"Organizational goals"*.

2.4.4. Targets

To monitor the progress toward achieving the organizational goals, organizations use KPIs and set targets. Each KPI can have one or more targets assigned the them. In this category we classify risks related to the values assigned to these targets.

The concrete risks that belong to this category are:

- Setting extreme target values
- Unchanged targets

Organizational goals		
Risk	**Countermeasure**	**Sources**
Goal displacement	Choose KPIs in alignment with organizational goals	[3], [20], [17], [36]
	Measure KPIs, not only outcomes	[20], [36]
	Review, revise and update the KPIs frequently	[23], [32]
Vague organizational goals	Align KPI structure with the goal structure	[37]

Table 2.3.: Risks, countermeasures and sources of category "Organizational goals"

Risk 4.1. Setting extreme target values

Targets are strongly related to the organizational strategy and show the milestones through this previously set strategic path. Therefore, it is appropriate to set target values based on a reasonable evaluation of the progress that the organization plans to achieve during a defined time span. These values can be influenced by numerous factors such as: management initiatives, organizational culture [3], available new resources [3]. According to Eckerson [13] targets should not be so challenging that they discourage workers, nor should they be too easy, which creates complacency. The SMART (Specific, Measurable, Achievable, Relevant and Timed) properties apparently can be applied also while setting target values.

Example:

Extreme target value: "no patient shall wait in accident and emergency for more than 4 hours". This target value is inappropriate because as soon as one patient waits in accident and emergency for more than 4 hours, the target is foregone, and thereafter irrelevant)
Better target value: "95% of patients wait in accident and emergency for under 4 hours". This is a more cost-efficient and continuously relevant target value.

"*Performance indicators: good, bad, and ugly*". Bird, S. M., David, C. S., Farewell, V. T., Harvey, G., Tim, H. [3]

Countermeasures

- *Interview executives and managers*

  Eckerson [13] suggests that the best way to create realistic targets is to interview executives and managers in an attempt to understand their goals and objectives for the areas they manage. In these areas, they are the most informed people in the company, so in an early stage the targets can be based on their intuition and ideas.

- *Consider last year's targets*

  Another possible way to set a reliable base for target values are last year's targets [13]. From that point, considering also the alignment with the organizational goals, the current targets can be developed. In setting these values, also best practices defined by a another organization (e.g., a competitor) can be helpful.

Risk 4.2. Unchanged targets

Lawson in [23] argues that it is important to review the targets on a regular basis, to ensure the ongoing validity of the targets. When targets are not reviewed regularly, the chances increase that employees and managers will become less motivated.

Countermeasures

- *Revise targets continuously*

  Target values should be updated regularly, as the KPIs associated to them change over time (see Section 2.4.3).

Summary

Table 2.4 depicts the collection of risks and countermeasures, as well as the respective literature sources, classified in the category *"Targets"*.

2.4.5. Number of KPIs

Risk 5.1. Using too many KPIs

In many organizations there is an overload of data provided in the form of KPIs. These KPIs are often generated in the form of reports which are sometimes redundant and do not provide any added-value for the stakeholders. In these cases, comments such as "we measure everything that walks and moves, but nothing that matters" [30] are common. To the question: "How many KPIs?", Eckerson at [13] answers: "As few as reasonably possible". Many organization keep adding KPIs through time without deleting any of the old ones. This way the attention from the real organization goals is lost as employees have too many KPIs to track.

Targets		
Risk	**Countermeasure**	**Sources**
Setting extreme target values	Interview executives and managers	[3], [13]
	Consider last year's targets	[13]
Unchanged targets	Revise targets continuously	[23]

Table 2.4.: Risks, countermeasures and sources of category "Targets"

Example:

"...the production manager of a small manufacturing business throws a freshly delivered 200-page performance report straight into the bin, without even glancing at it. When asked why, the production manager replied: "what use is the report to me? All it contains is last month's labor absenteeism figures. I need up-to-date information to manage production, not spurious figures from the accounting department."

"*The performance measurement revolution: why now and what next?*". Neely, A. [30]

Countermeasures

- *Select a minimal set of KPIs*

  Some experts say that organizations should limit the number of KPIs to between three and seven per user, because most people have difficulties concentrating on more than seven things at the same time. However the optimal number of metrics depends more on a person's role and level in the company than on an arbitrary number.

  Eckerson in [13] explains that the total number of metrics depends on the size of the organization, the scope of the project and the complexity of the organization's business model. Therefore there is no "correct" number of KPIs. The focus should be on selecting KPIs that are aligned to the organizational goals.

  Moreover, while keeping the number of the metrics low, organizations have to establish such a set of metrics. Steinberg at [39] lists a few challenges related to the

establishment of a minimal set of metrics:

- Many disparate data collection and reporting tools in place with poor ability to aggregate and summarize data
- No clear authoritative source for metrics
- No staffing priorities to collect, analyze and report on metrics
- A lack of tools and automation to report on metrics

These challenges may drive organizations to do no measurements at all. An alternative is to select a minimal set of measurement to use as a starting point. The main benefit of establishing a metrics program with minimal metrics is to establish a culture of measurement goals and to focus on IT service quality. Steinberg [39] suggests also a general approach for establishing such a set of metrics:

- Select a small subset of measurements that are "representative" of the quality of service being delivered
- Develop assumptions as to their accuracy level and how they will be used
- Review and agree these with senior management
- Report on these as if a full-fledged metrics program were in place.

- *Review, revise and update the KPIs frequently*

  See Section 2.4.3

Summary

Table 2.5 depicts the collection of risks and countermeasures, as well as the respective literature sources, classified in the category *"Number of KPIs"*.

Number of KPIs		
Risk	**Countermeasure**	**Sources**
Using too many KPIs	Select a minimal set of KPIs	[13], [39]
	Review, revise and update the KPIs frequently	[23], [32]

Table 2.5.: Risks, countermeasures and sources of category "Number of KPIs"

2.4.6. Ethical issues

Ethics and social effect of KPI measurements on involved stakeholders should receive the right consideration. These aspects, often do not catch the attention of the management. Nevertheless, both the confidentiality and the properly informed consent of stakeholders [3], is a need that should be respected. Other aspects e.g., the intentional manipulation of the KPI results and the use of the KPI values to frame and punish specific individuals, require a special attention, as these can harm the organization's climate.
The concrete risks that belong to this category are:

- Access of confidential data
- Manipulated outcomes
- KPI values used to punish

Risk 6.1. Access of confidential data

Frequently, the data required for a KPI calculation includes personal information of employees of an organization. In these cases, the data protection should be guaranteed for all involved stakeholders [3].

Countermeasures

- *Inform people and ask for their consent when using confidential data*

  The data collection used for the calculation of many KPI can contain confidential information about a stakeholder. Therefore, it is recommended to inform the affected people and ask for their consent prior using their personal data. Nevertheless, this is not a guaranteed solution. As Bird [3] points out, even if involved stakeholders may have agreed implicitly to the monitoring of their personal data, it should be not deduced that this agreement allows publication of analyses in a form in which they can be identified.

- *Design a special agreement when the data are to be published*

  Bird [3] explains that there should be a precise agreement regarding the confidentiality of the data, in case the results are to be published. Therefore, make sure to clarify every aspect of the use of confidential data with the affected individuals, prior to the presentation of results.

Risk 6.2. Manipulated outcomes

Perrin [36] explains that when the employees feel that the future of their program or even their own jobs may be dependent upon making the numbers look good, they inevitably will interpret definitions in a way that is most favorable to the agency. These manipulated outcomes are more dangerous than not measuring at all.

Countermeasures

- *Ensure data quality*

  See Section 2.4.2

- *Test KPIs in advance*

  See Section 2.4.1

Risk 6.3. KPI values used to punish

The organizations that measure KPIs should also give high importance to the accuracy of the KPI values [31], as these values are used afterwards as a means to drive the decision-making process. Nevertheless Neely in [31] gives also a reason why sometimes vague values can be better for the overall performance. According to the author less precise measurements, can make it harder to align specific KPI outcomes to individual actors, therefore can enhance the performance.

Countermeasures

- *Use KPI values to empower*

  As Lawson [23] suggests, KPIs should never be perceived as punitive methodology, but one that encourages the best for the organization and its employees. Therefore, when aligning KPI results to employee performance, make sure that no punishments are triggered by these results. Communication between managers and employees, in the form of meeting to review the performance, should be encouraged instead.

Summary

Table 2.6 depicts the collection of risks and countermeasures, as well as the respective literature sources, classified in the category *"Ethical issues"*.

2.4.7. Rewards

Many organizations link specific KPIs to rewards and compensation. If this alignment is advantageous or not is still part of a debate. Logically is expected that rewarding an employee for achieving a goal or reaching a target motivates the employee. As Eccles [12] writes: "What gets measured gets attention, particularly when rewards are tied to the measures". However this is not always the case. Monetary compensation of employees comes often with risks.

The concrete risks that belong to this category are:

- Delayed rewards
- Attach compensation to KPIs too soon

Ethical issues		
Risk	**Countermeasure**	**Sources**
Access of confidential data	Inform people and ask for their consent when using confidential data	[3]
	Design a special agreement when the data are to be published	[3]
Manipulated outcomes	Ensure data quality	[3], [13]
	Test KPIs in advance	[36]
KPI values used to punish	Use KPI values to empower	[23]

Table 2.6.: Risks, countermeasures and sources of category "Ethical issues"

Risk 7.1. Delaying rewards

Many organizations align the rewards to specific targets. Following this scheme, the employees are to be compensated when the target is reached. However, since managers and employees change jobs or get promoted, they are more short-term oriented [17] than the organization. Therefore their interest is focused towards current rewards not future ones.

Countermeasures

- *Reward staff as soon as appropriate*

  Hauser in [17] point out that the organization should give rewards at the present time, not after the long-time profit comes.

- *Look for KPIs that are measured today but impact future outcomes*

  Hauser [17] suggests to look for KPIs that impact future outcomes. However these KPI should be measured today and check in accordance to the current targets. If the current targets are met then the managers and employees should be rewarded today. Setting unrealistic target values (see Section 2.4.4) and attaching rewards to these targets will not motivate employees. As Lawson [23] says: "If the targets are too low, employees will not strive to improve. If they are too high, employees may decide not to try to attain them because they feel that they will only fail anyway." Therefore, the KPIs should be aligned to the long-time organizational goals (see Section 2.4.1).

Risk 7.2. Attach compensation to KPIs too soon

As pointed out by Lawson [23], the downside of attaching rewards to KPIs is that employees may focus on those KPIs that impact compensation and rewards, which may not be the ones that will help move strategy forward.

Countermeasures

- *Do not promise rewards too soon in the process*

  Rewards should not be attached to KPIs too soon in the process. Lawson [23] suggests to monitor compensation measures for a sufficient period of time to ensure that they truly motivate employees to act in line with the organization's strategy.

Summary

Table 2.7 depicts the collection of risks and countermeasures, as well as the respective literature sources, classified in the category *"Rewards"*.

Rewards		
Risk	**Countermeasure**	**Sources**
Delaying rewards	Reward staff as soon as appropriate	[17]
	Look for KPIs that are measured today but impact future outcomes	[17], [23]
Attach compensation to KPIs too soon	Do not promise rewards too soon in the process	[23]

Table 2.7.: Risks, countermeasures and sources of category "Rewards"

2.4.8. Presentation of KPIs

In this category we classify risks related to the presentation of KPIs, covering different aspects such as: the "look and feel" of the graphical representation, the consistency of the related terms and definitions, the quality of the design etc. However, the risks presented here are risks of a general nature. The more specific issues related to the visualization techniques and methods are not in the scope of this thesis.
The concrete risks that belong to this category are:

- The presentation illustrates ambiguous relations
- The presentation causes divergent interpretation
- Static KPI structure

Risk 8.1. Ambiguous relations between KPIs

The presentation of the KPIs usually contains displays of more that one KPI. Therefore, the KPIs are often presented in relation to each other. Precisely this fact, causes in many cases problems with the understanding of the relations between KPIs. These relations can be ambiguous, resulting in confusion among stakeholders, or producing wrong estimates and decisions.

Countermeasures

- *Use standard and consistent names for each relation between KPIs*

  The consistency of the KPI presentations can be achieved by performing frequent consistency checks. These consistency checks should be done anytime a presentation is altered or when a KPI is added or deleted from the presentation. In any of these cases the relationships between the KPI should ensure the use of standard terms, so that all stakeholders will share common understandings. The lack of semantics of concepts [40] for the presentation of KPIs, pushes the stakeholder to adapt the presentation with textual explanations. Nevertheless, the resulting diagram should maintain the consistency of the KPI system.

Risk 8.2. The presentation causes divergent interpretation

The presentation of the KPI results usually targets different stakeholders. Therefore the presentation should fulfill the requirements for different audiences. In many cases, this can lead to overly complex representation of results, that can cause divergent interpretation among stakeholders.

Countermeasures

- *Use standard terms*

  The use of standard terms and definitions is a requirement that has to be fulfilled during all the activities of the KPI definition, design and implementation. As previously mentioned, the lack of standardization is a concrete risk (Section 2.4.1) that every organization should take into account. Therefore, also during the presentation of the KPIs, the terms and definitions that are determined in earlier phases of the KPI design, should be maintained. If the standardization is ensured, the presentation will have the necessary intuitive appeal [3].

- *Recruit design experts and train staff*

  The presentation of the KPIs can cause divergent interpretation also in the case of bad design. Bad design often occurs when the presentation is prepared by untrained staff. Therefore, as literature suggests([13]), it is desirable to previously train the staff with guidelines for an effective design. Moreover, design experts can be recruited as consultants, to train the staff, or to provide feedback on design mock ups or full presentations.

- *Test the effects of the presentation by using prototypes*

  KPI prototypes are an effective way to test in advance the effects that the presentation will have on the stakeholders. Prototypes are a lightweight representation of the actual presentation, that include key aspects but not the actual implementation. If divergent interpretations occur, the design can be altered without investing a lot of time and cost. Bird [3] explains that when additional feedback is collected from stakeholders, the presentation can afterwards incorporate more complexity in the following iterations.

Risk 8.3. Static KPI structure

Static KPI structures are risky for any organization because they do not allow an adaptation of the structure to new/altered requirements. Over time, the stakeholders will change their preferences, and if the KPIs are represented with static structures, the whole visualization will have to be reimplemented.
Regarding the former case, we elicited nine quality criteria using a hermeneutic method.

Countermeasures

- *Design dynamic structures*

  The dynamic structures allow the redesign of KPI presentations without many costs. If the structures are designed to embrace change, it will be easier to redesign the display. As Eckerson [13] points out, the display is never finished, at it will have to go under a number of iterations, even if prototypes or tests are previously done. Therefore, it is by all means better to prepare in advance for an ever changing presentation.

Summary

Table 2.8 depicts the collection of risks and countermeasures, as well as the respective literature sources, classified in the category *"Presentation of KPIs"*.

2.5. Summary

In this chapter the research design underlying this thesis and the findings from the literature review were discussed.

In Section 2.1, the research method used for the literature review process was described. This research method guided the process of the search and the selection of the literature sources relevant for this thesis.

Afterwards, in Section 2.2, all these relevant sources were visited to investigate the terminology base. This section of the thesis focuses in particular on the term KPI and on the understanding of related concepts (metric, measure, indicator, measurement).

Presentation of KPIs		
Risk	**Countermeasure**	**Sources**
Ambiguous relations between KPIs	Use standard and consistent names for each relation between KPIs	[40]
The presentation causes divergent interpretation	Use standard terms	[3]
	Recruit design experts and train staff	[13]
	Test the effects of the presentation by using prototypes	[3]
Static KPI structure	Design dynamic structures	[13]

Table 2.8.: Risks, countermeasures and sources of category "Presentation of KPIs"

In Section 2.3 the literature sources were iteratively interpreted following a hermeneutic method to produce a resulting set of eight risk categories: *General*, *Data*, *Organizational goals*, *Targets*, *Number of KPIs*, *Ethics*, *Rewards*, and *KPI presentation*. Each one of these categories contains specific risks and respective countermeasures, as suggested in the literature.

Finally, in Section 2.4, each of the risks an the respective countermeasures were described in detail. Some of the risks were illustrated with practical examples (also collected from the literature), to further clarify the risk context in practice.

Table 2.9 depicts the collection of all risks and countermeasures as provided in the respective sources.
In the next chapter, the evaluation of the literature findings is described.

	Risk	Countermeasure	Sources
General	Use of irrelevant KPIs	Measure what is truly important, not just what is easy to measure	[36], [17], [23]
	KPIs are not properly defined	Provide clear, unambiguous and understandable definitions	[3], [13], [30], [5], [34]
		Use a template for KPI design and provide all the necessary data	[28], [29]
	KPIs are too abstract	Measure well-defined and well-designed KPIs	[13]
		Test KPIs in advance	[36]
	Resistance to change	Inform the team and keep them involved	[42], [23], [36]
	Automation of the measuring process	Use related tools	[23], [31]
	Standard terms	Provide clear, unambiguous and understandable definitions	[3], [5], [13], [30], [34]
		Test KPIs in advance	[36]
		Train the staff	[36]
	The KPI team is not constantly informed	Inform the team about changes	[23], [36]
		Inform the team about the KPI owner	[13]
		Delegate authority to the team	[13], [23]
	Customer satisfaction is not measured	Define KPIs that measure customer satisfaction	[12], [20], [31]
	Short term focus only	Target long-term goals	[3], [16]
Data	Considering too much (or too less) data	Appoint a system analyst to scout data sources for potential KPIs	[13], [16]
	Defective data (Collecting inconsistent, conflicting and unnecessary data)	Ensure data quality	[3], [13]
Organizational goals	Goal displacement	Choose KPIs in alignment with organizational goals	[3], [20], [17], [36]
		Measure KPIs, not only outcomes	[20], [36]
		Review, revise and update the KPIs frequently	[23], [32]
	Vague organizational goals	Align KPI structure with the goal structure	[37]
Targets	Setting extreme target values	Interview executives and managers	[3], [13]
		Consider last year's targets	[13]
	Unchanged targets	Revise targets continuously	[23]
Number of KPIs	Using too many KPIs	Select a minimal set of KPIs	[13], [39]
		Review, revise and update the KPIs frequently	[23], [32]
Ethical issues	Access of confidential data	Inform people and ask for their consent when using confidential data	[3]
		Design a special agreement when the data are to be published	[3]
	Manipulated outcomes	Ensure data quality	[3], [13]
		Test KPIs in advance	[36]
	KPI values used to punish	Use KPI values to empower	[23]
Rewards	Delaying rewards	Reward staff as soon as appropriate	[17]
		Look for KPIs that are measured today but impact future outcomes	[17], [23]
	Attach compensation to KPIs too soon	Do not promise rewards too soon in the process	[23]
Presentation of KPIs	Ambiguous relations between KPIs	Use standard and consistent names for each relation between KPIs	[40]
	The presentation causes divergent interpretation	Use standard terms	[3]
		Recruit design experts and train staff	[13]
		Test the effects of the presentation by using prototypes	[3]
	Static KPI structure	Design dynamic structures	[13]

Table 2.9.: Risks, countermeasures and sources for all risk categories

3. Evaluation of literature findings

This chapter is dedicated to the evaluation of the literature results, presented in the previous chapter. The goal of the evaluation is to demonstrate the validity of the results, to check their completeness and to collect feedback regarding the correctness of the identified risks and countermeasures.

The evaluation of the literature results has been carried based on a survey. The survey was conducted in two steps. In the first step, the survey was distributed to EAM practitioners and academia researchers at the conference Softwareforen Leipzig, in March 2013. The event was attended by EAM experts from both IT and business departments.

In the second step, the survey was conducted online, from April 3, 2013 to April 21, 2013 and was accessible to a hand-picked audience of experts from various companies that have been selected from current and past research projects at the SEBIS chair. To guarantee its comprehensibility, the survey was tested and revised by research assistants at the SEBIS chair before being handed out at the conference.

In both iterations we manged to collect a total of 17 full responses. The survey contained 12 mostly closed questions in two groups, *background information* and *risks and countermeasures*, that could be completed in about 17 minutes. The full survey is provided in Appendix A.

The results of the survey are presented in Section 3.2 and section 3.3.

3.1. Organization

The "Risk prioritization survey" (c.f. Appendix A) was conceived as a means to further evaluate the correctness of literature findings, presented in Chapter 2. The body of knowledge obtained from the extensive literature search and the iterations following the hermeneutic circle (c.f. 2.3) was assessed by EAM practitioners, who have real-life experience in the development of KPIs.

The risks described in this thesis and the respective countermeasures are collected through a review of literature sources from different fields e.g., EA management, IT management and Business management. Of particular interest, is the insight of the EAM practitioners regarding the risks, relevant in the field of EAM. Hence, the main objective of the survey was to discover which risks are the most important in the field of EAM, according to the expert's judgment and personal experience.

To be able to better interpret the results provided by practitioners, we structured the survey in two main parts: the background information and the risk prioritization.

Background information

The background information, holds records about the respondents' experience in the field of EAM and his familiarity with (EAM) KPIs.

The concrete questions (all questions along with possible answer alternatives are listed in Appendix A) belonging to this part are:

- What industry branch are you working in?
- What is your current professional occupation?
- For how long have you been working in the area of EAM?
- For how long have you already been working with KPIs in general?
- For how long does your company already employ EAM?
- Why does your organization need EAM KPIs?
- Which stakeholders in your organization are interested in EAM KPIs?
- What are the (expected) benefits of using EAM KPIs?
- If your company already uses or plans to use EAM KPIs, please briefly describe the three most important ones.

These questions were mostly closed, therefore it was straightforward for the respondent to provide an answer. Moreover, the participants had the possibility to write notes or comments, if the suggested answers were not optimal, or specify their own individual answer in the option "Other".

The results provided in this section of the survey, provide a foundation for the further analysis of the risk prioritization.

Risk prioritization

The risk prioritization was the main part of the survey. Here the participants were presented with the whole collection of literature findings. The body of knowledge was presented in a structured way, where each risk was aligned with the respective countermeasures. Moreover, the respondents were invited to provide comments about any of the countermeasures. To further enhance the comprehension, comment field were provided specifically for every countermeasure.

The concrete questions (full questions and other details are described in Appendix A) belonging to this part are:

- Please select the top five risks you experienced/expect to face on the definition and implementation of EAM KPIs? Feel free to give us your feedback regarding the identified countermeasures.

- Are some relevant risks, success factors or countermeasures regarding the design and implementation of EAM KPIs missing?

The participants were asked to determine the top five risks, according to their knowledge and expertise. We asked only for the five most important risks (not more) and we did not ask for a ranking (i.e., to provide a scale for the importance of the selected risks), to facilitate the answering process and not frustrate the respondent.

The interpretation of results about the risk prioritization is outlined in Section 3.3.

3.2. Interpretation of results

As the empirical data show (c.f. Figure 3.1), more than half of the respondents (59%) are currently working in the finance field (e.g., banking, insurance). This was a satisfactory result, because the literature review covered in chapter 2, inculdes also risks for KPIs employed in this industry branches.

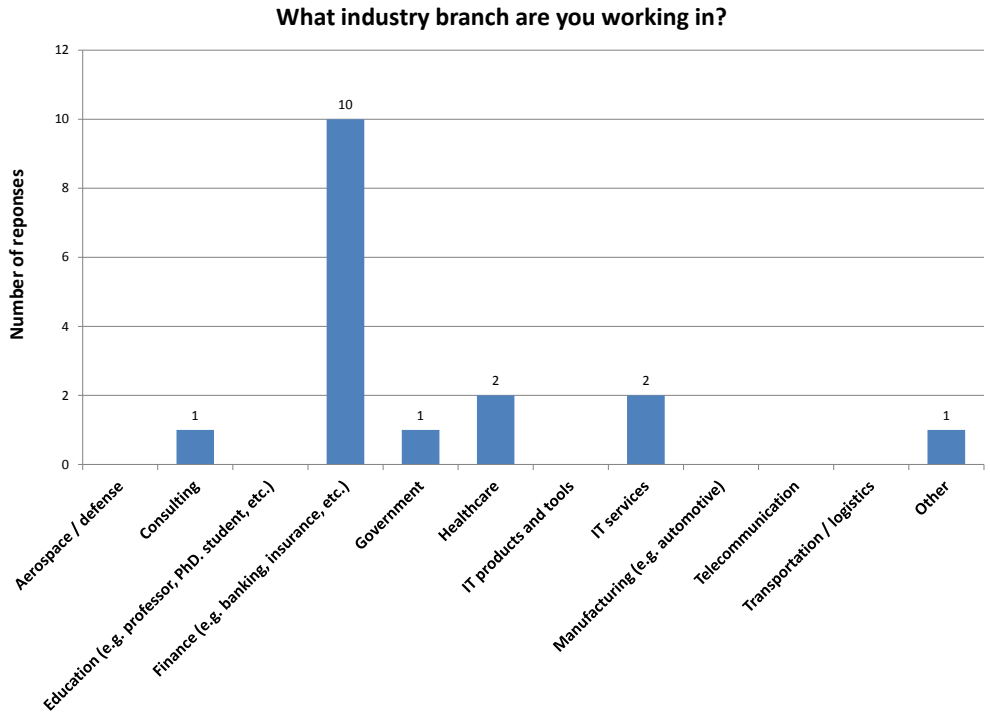


Figure 3.1.: Industry branches

As illustrated in Figure 3.2 and Table 3.1, a considerable number of the organizations that participated in the survey have already integrated EAM within their structures. This is demonstrated by the fact that 76% of the organizations employ EAM aproaches since 1-5

	Less than 1 year	1 - 5 years	6 - 10 years	More than 10 years
For how long does your company already employ EAM?	12%	76%	12%	0%
For how long have you already been working in the area of EAM?	0%	71%	23%	6%
For how long have you already been working with KPIs in general?	65%	23%	12%	0%

Table 3.1.: Background information - EAM and KPIs

years.

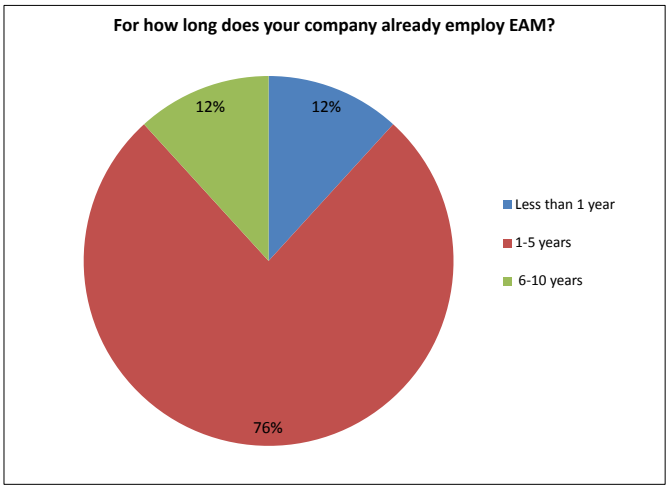


Figure 3.2.: Integration of EAM in the organization

The majority of the survey participants (c.f. Figure 3.3) currently holds the position of an enterprise architect (47%) or IT architect (41%), therefore they are directly involved in the organizations' strategy and decision making process.
Moreover, 71% of the respondents have aready worked in the area of EAM for 1-5 years (c.f. Figure 3.4). This fact indicates an adequate reliability in their responses based on observations gained through actual work experiences.

The participants of the survey were also asked about their experiences with KPIs (c.f. Figure 3.5). The collected results indicate that all respondents (100%) are familiar with the KPI

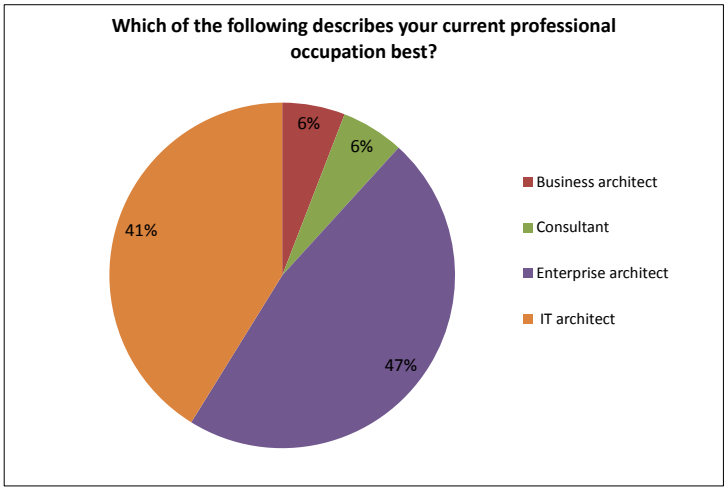


Figure 3.3.: Current occupation

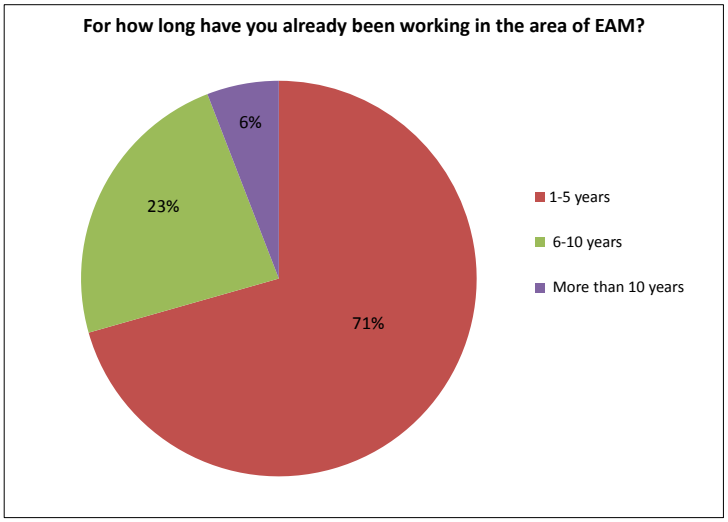


Figure 3.4.: Experience in the EAM field

concept, and they have worked with KPIs in general (not specifically with EAM KPIs).

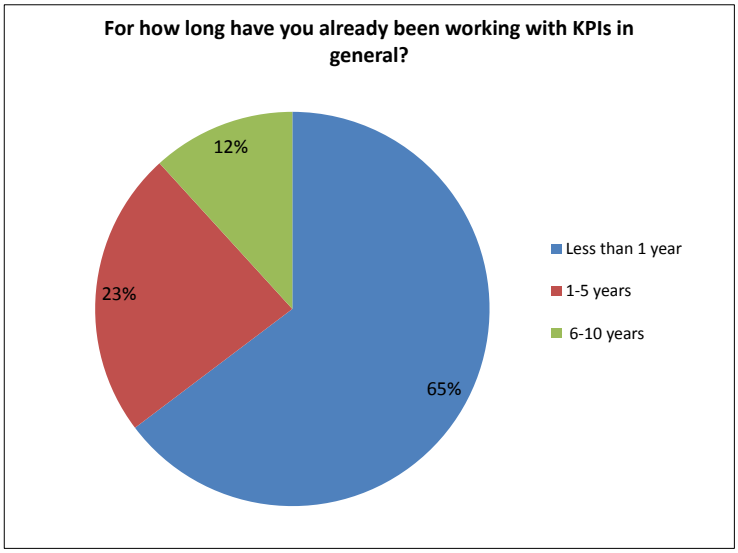


Figure 3.5.: Experience with (EAM) KPIs

When considering the time factor we collect mixed results. On the one hand, all participants have been working with KPIs in general.
On the other hand, only 44% of them have more than a year of experience.
Nevertheless, considering the fact that the field of KPIs is still considered less developed (c.f. Chapter 1), it can be assumed that the general knowledge of the participant regarding the field of KPI design and implementation is ample enough to guarantee the reliability of results.

The data provided in Figure 3.6 and Table 3.2 describe the role of EAM KPIs within the organization. The participants were asked to assess the reasons why organizations employ EAM KPIs. A list of possible reasons was provided in the survey, and the respondents had the possibility to choose as many reasons they consider applicable in their own experience.

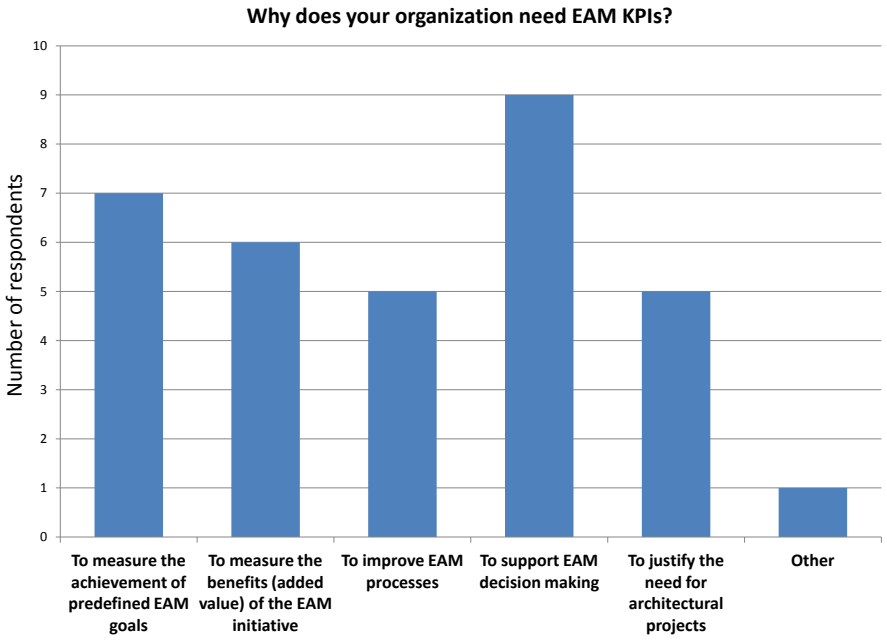


Figure 3.6.: The reasons to employ EAM KPIs

As results show, a slightly more relevant (28%) reason to employ EAM KPIs, is the provided *support in decision making*. Nevertheless, the results provided by the responses show almost equal values for all items in the provided list. This fact leads to the conclusion that the reasons to employ EAM KPIs are highly correlated.

Moreover, we investigate the benefits that the participants have experienced or expect to experience by employing EAM KPIs (c.f. Section 3.7). The question was left open-ended, to allow the respondents to describe freely the benefits based exclusively on his knowledge and experience.

Even though the question was open-ended, the results confirm what was previously noticed in the related literature: the benefits of EAM KPIs are highly correlated with the controlling aspects of an organization's strategy. Other important aspect are also, the transparency of the results, the information produced by KPIs and the support that KPIs provide for the decision making process.

As illustrated in Figure 3.8, according to the majority of the participants, the most important KPIs that an organization measures are "Number of applications" and "Complexity". These gives us the insight that the level of complexity (that is also dependent on the number of applications) is an important measure, and the risks related to this particular KPI should also be considered relevant.

Reasons to employ EAM KPIs	% of respondents
To measure the achievement of predefined EAM goals	21%
To measure the benefits (added value) of the EAM initiative	18%
To improve EAM processes	15%
To support EAM decision making	28%
To justify the need for architectural projects	15%
Other	3%

Table 3.2.: The reasons to employ EAM KPIs

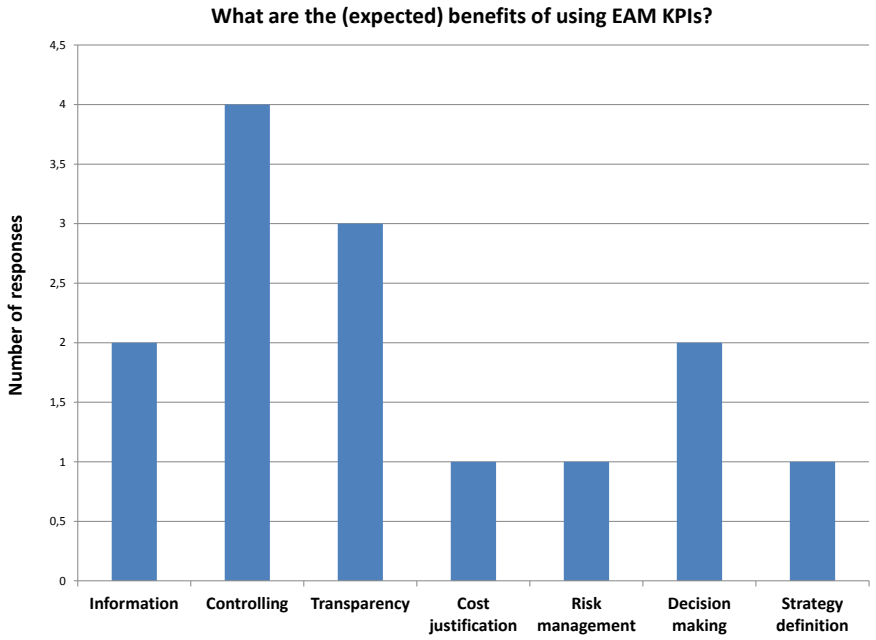


Figure 3.7.: Benefits of using EAM KPIs

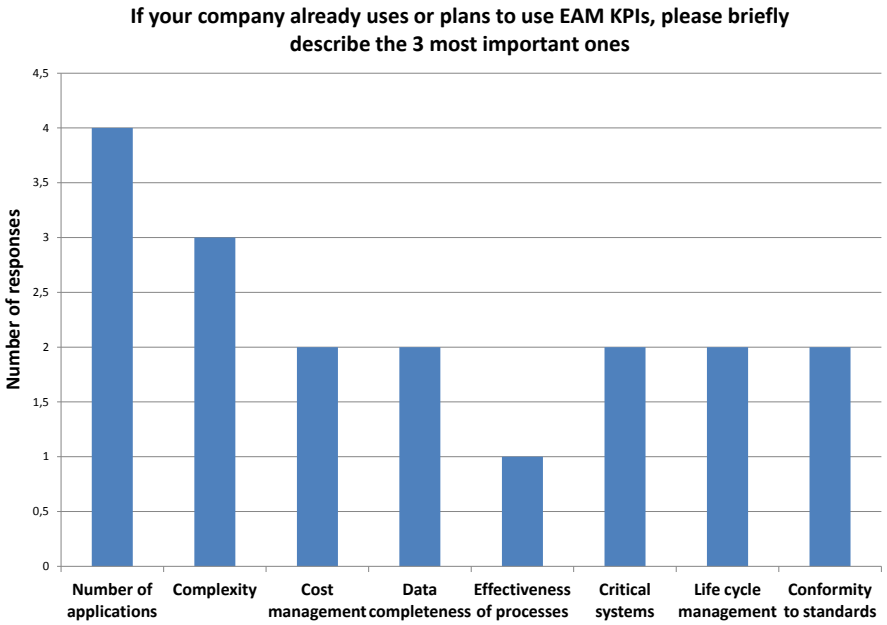


Figure 3.8.: The most important EAM KPIs

3.3. Risk prioritization

As described in Section 3.2, the reasons to employ EAM KPIs in an organization are manifold. Apparently, as the results of the survey show, also the importance that stakeholders give to these reasons is almost equally spread. Therefore, it can be assumed that all the risks affecting these aspects are to be considered. However, we focus on the risk prioritization, to further depict which risks are absolutely required and which have a more optional nature.

In order to further evaluate with which risks the organizations are faced mostly while employing EAM KPIs, the participants of the survey were asked to specify the risks that they have encountered more frequently during the definition and implementation precesses of EAM KPIs. Since all the risks provided in the list are prone to happen in a real life setting, we asked the participants to limit their answers in five risks, in order to assess the most problematic ones. All participants (100%) marked their top five risks from the provided collection. The resulting data are shown in Figure 3.9.
An excerpt of these results, depicting the five most important risks is illustrated in Table **??**.

According to 12% (8 participants) of our respondents, the most frequent risk that the organization faces is related to the *defective data*. Inconsistent, conflicting, uncomplete and/or distributed data apparentely are a source of a considerable degree of risks in an organization. Therefore, countermeasures that ensure the data quality are to be given a high priority.

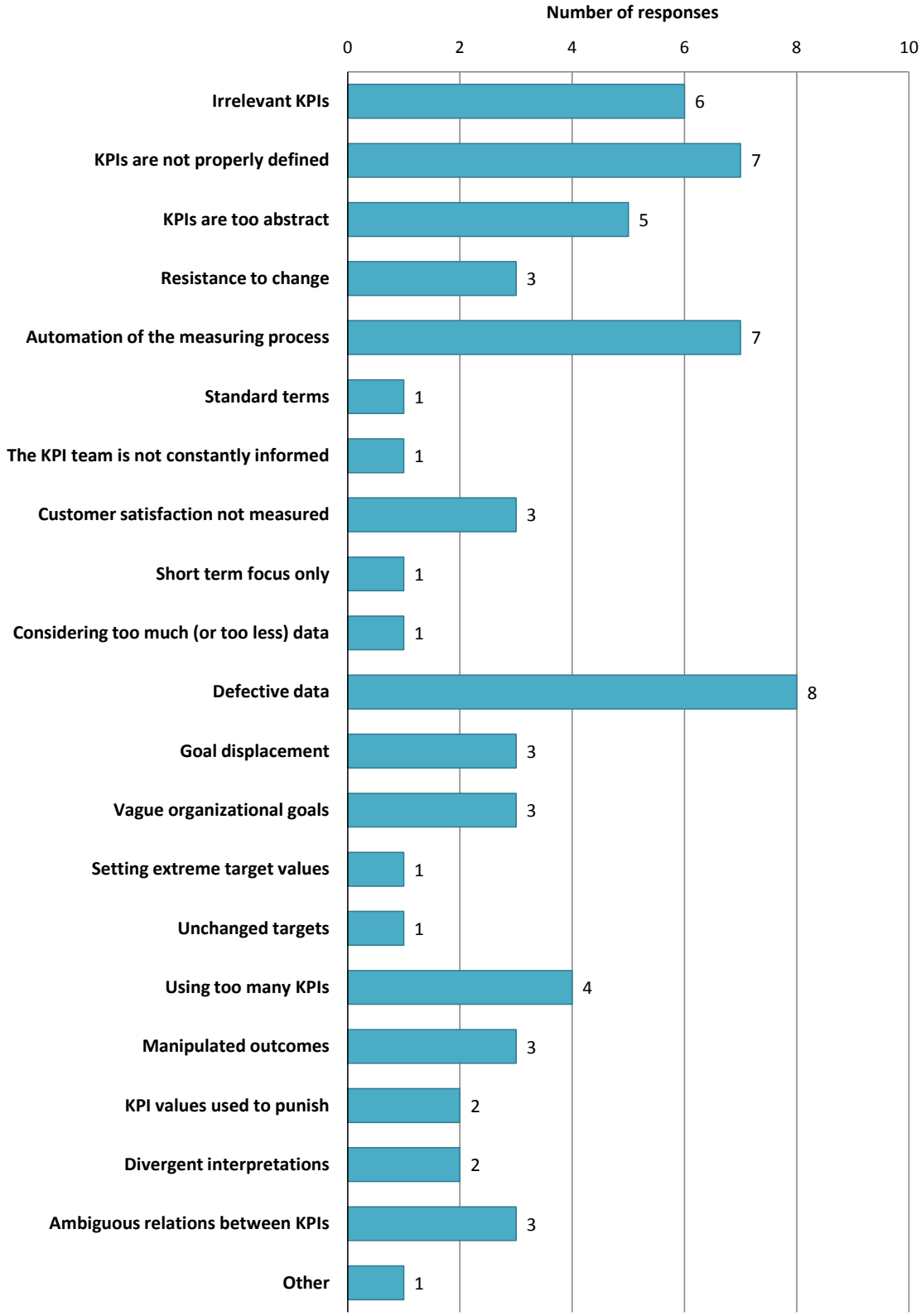


Figure 3.9.: Risk prioritization

Top five KPI risks in the field of EAM	% of respondents
Defective data	12%
Automation of the measuring process	11%
KPIs are not properly defined	11%
Irrelevant KPIs	9%
KPIs are too abstract	8%

Table 3.3.: Top five KPI risks

Almost equally important are two other risks: *KPIs are not properly defined* (11%) and *the automation of the measuring process* (11%). The proper definition of the KPIs and the standardization of the related terminology is an issue that is considered important also in the previous reasearch in the SEBIS chair. The implementation of a template-based method (c.f. Section 4.5) to design KPIs, provides a concrete suggested solution to this issue, presenting concrete steps towards well-defined KPIs.

Completeness of results

To evaluate the completeness of the identified risks and countermeasures, the participants of the survey were asked whether some relevant issues, success factors or countermeasures regarding the design and implementation of EAM KPIs were missing. 94% of the respondents agreed on the accurancy of the presented data. This result demonstrates the validity of the literature review presented in detail in chapter 2.

Is is also important to point out that, 100% of the participants provided a response about the risk prioritization. Therefore the data collected on the most relevant risks, as experienced in practice by our respondent, is relevant and reliable.

One of the participants provided also a very useful insight on the fact that also the aggregation of KPIs should be considered a possible risk. This concrete risk is to be evaluated in the future research and possibly added in a more refined list of risks and countermeasures.

Risk	Prioritization score	Number of sources
Standard terms	1	7
Goal displacement	3	5

Table 3.4.: Risks with low priority but high consideration in literature

3.4. Summary

In this chapter risks and countermeasures listed in the related literature were evaluated. The survey-based evaluation brought into our attention some facts that impact current work and future research.

1. The high correlation between the reasons to employ EAM KPIs leads to the conclusion that the risks that danger the benefits related to each of the specific reason are almost equally important. Therefore considerable attention should be given to risks and countermeasures in every category of risks (c.f. Section 2.4).

2. The results of the risk prioritization provided a thorough insight on risks that frequently affect real organizations. These results allow KPI stakeholders to focus on those countermeasures that deal precisely with these risks.

3. Surprisingly, a number of risks that were discussed in many literature sources, did not received the expected consideration by the participating practitioners. The two most noticeable risks are depicted in Table 3.4.

   Firstly, standard terms are considered a key aspect for the definition of KPIs by at least 7 literature sources. However, the score that this risk got is only 1. Secondly, the goal displacement, related directly with the alignment of the KPIs with respective organizational goals, has only a priority 3.

4. The completeness of the results, leads us to the conclusion that the list of risks and countermeasures provided in this thesis can guide the KPI stakeholders to a risk-aware process of definition, design and implementation of KPIs and KPI systems.

5. However, only one participant provided some comments about the listed countermeasures. The feedback on the countermeasures was optional, but we were expecting more attention. On the one hand, the fact that there are no comments can be interpreted positively, as the respondents did not feel that something was missing or it needed to change. On the other hand, the lack of comments, does not help in the improvement and refinement of the literature findings in the next research iterations.

In the next chapter, these results are assembled and combined with the literature findings, to generate a concrete guidelines checklist, that can be used by KPI stakeholders in different phases of the measuring process.

4. Risk consideration

In this chapter, the findings from the literature review and the results of the expert survey are collected to produce a summary in the form of a guidelines checklist. Moreover, a method for designing organization-specific EAM KPIs is introduced and the mapping of the specified guidelines to the method is described.

4.1. Designing a guidelines checklist

To guide the KPI stakeholders through the measuring process while considering the possible risks that can occur during this process, a guidelines checklist is created. The objective of this checklist is to apply the previously examined countermeasures suggested by the related literature.
The guidelines list is designed in alignment with the countermeasures for the risks of all categories, as presented in Section 2.4. The list is formated in the form of a checklist. This layout guarantees a compact form of representation and a straightforward way of control (checked or not checked). Moreover, each item of the list is, in our understanding, self-descriptive, so no additional glossary has to be provided for the KPI stakeholder.

The guidelines are developed in alignment with the countermeasures for all risks, as presented in Section 2.4. Some of the guidelines are an adaptation of a concrete countermeasure (i.e., a guideline is often longer than the title of the countermeasure, to ensure the self-descriptive nature of the former). The other countermeasures are depicted from the description of the countermeasures and formated as a possible guideline.

In this thesis, we subdivide the guidelines in logical groups, following three possible modes of representation:

1. map the guidelines to the risk categorization
2. map the guidelines to the evaluation results
3. map the guidelines to the design method

Each of these representations is described in detail in the following sections.

4.2. Checked guidelines

The research group of the SEBIS chair, has developed artifacts to guide organizations through the design and implementation of EAM KPIs. As previously mentioned 1.2.3, a template containing a uniform structure to document EA management KPIs is already

available. Moreover, a design method for the definition of organization-specific KPIs is introduced (c.f. Section 4.5). These artifacts already ensure a number of the guidelines in two possible ways:

- by the structure of the template, as some suggested guidelines are already part of the template's body.
- by the design method, as some suggested guidelines are directly incorporated in the method.

Therefore, if the organization is employing KPIs based on this documentation structure, these guidelines are already fulfilled. The stakeholders can just check them, and move on to examine the remaining guidelines.

The already ensured guidelines, by the template structure and the design method provided by SEBIS, are:

☑ Use standard terms and definitions for each KPI to assure consistency (T)
☑ Define the KPIs in a simple and understandable way (T)
☑ Use a template for KPI design and fill the template with all the necessary data (T)
☑ Test KPIs in advance to assure that all stakeholders share common understandings (T)
☑ Keep the stakeholders involved through the whole measuring process(M)
☑ Choose KPIs in alignment with organizational goals (T)
☑ Review, revise and update the KPIs frequently (M)
☑ Use standard terms when presenting KPI values (T)
☑ Train all stakeholders to lead to common interpretations (T)
☑ Inform all stakeholders when introducing changes (M)
☑ Inform all stakeholders about the KPI owner (M)
☑ Delegate authority to the KPI team (T)
☑ Determine and communicate the data collection needed for the measurement of each KPI (T)
☑ Interview executives and managers to set proper target values (M)
☑ Communicate to all stakeholders how the targets are set (M)
☑ Use prototypes to pretest if all stakeholders share the same understandings (T)

The guidelines that are ensured by the template are marked with (T) and the ones ensured by the design method are marked with (M).
In the remaining of this thesis, the already ensured guidelines will be always displayed as checked, for consistency reasons.

4.3. Alignment of the guidelines to the risk categories

Following this design, the guidelines are divided into subgroups and aligned with each of the eight risk categories, introduced in Section 2.4.

Checks for category "General"

☐ Select KPIs that provide added value
☑ Use standard terms and definitions for each KPI to assure consistency
☑ Define the KPIs in a simple and understandable way
☐ Communicate the definitions, terms and related glossary to all stakeholders
☑ Use a template for KPI design and fill the template with all the necessary data
☑ Test KPIs in advance to assure that all stakeholders share common understandings
☐ Inform all stakeholders when new KPIs are introduced
☑ Keep the stakeholders involved through the whole measuring process
☐ Use related tools for the automation of the measuring process
☑ Train all stakeholders to lead to common interpretations
☑ Inform all stakeholders when introducing changes
☑ Inform all stakeholders about the KPI owner
☑ Delegate authority to the KPI team
☐ Measure customer satisfaction

Checks for category "Data"

☑ Determine and communicate the data collection needed for the measurement of each KPI
☐ When the data collection is difficult to be identified, delegate the task of scouting data sources to a data analyst
☐ When using external consultants, make sure that the knowledge is transfered to the internal employees
☐ Ensure data quality

Checks for category "Organizational goals"

☑ Choose KPIs in alignment with organizational goals
☐ Update KPIs when the organizations's strategy or goals change
☐ While selecting KPIs do not focus only on measuring financial outcomes
☑ Review, revise and update the KPIs frequently

Checks for category "Targets"

☑ Interview executives and managers to set proper target values
☐ Use last year's targets to set base target values
☐ Revise targets continuously
☑ Communicate to all stakeholders how the targets are set

Checks for category "Number of KPIs"

☐ Measure a minimal set of KPIs

Checks for category "Ethical issues"

☐ Inform people and ask for their consent when using confidential data
☐ Inform all stakeholders when data resulting from KPI measurements are to be published
☐ Do not use KPI values to punish the employees

Checks for category "Rewards"

☐ Reward employees as soon as appropriate, when satisfactory results are reached
☐ When satisfactory results are reached, communicate the news to all stakeholders

Checks for category "Presentation of KPIs"

☑ Use standard terms when presenting KPI values
☐ Define clearly the relationships between related KPIs
☐ Present KPIs in a way that the results provide a common understanding for all stakeholders
☐ Keep KPI presentations as simple as possible
☑ Use prototypes to pretest if all stakeholders share the same understandings
☐ Design dynamic structures

4.4. Alignment of the guidelines to the evaluation results

Following this design, the guidelines are divided into two subgroups: required and optional.
The allocation of a guideline in one of the two subgroups depends on:

- the risk (category) with which the guideline is associated (c.f. Section 4.3)
- the score that the risk received in the evaluation (c.f. Section 3.3)

In this thesis, we consider a guideline as required, if the risk (category) with which the guideline is associated has received a score not lower than three in the evaluation. Following this philosophy, the guidelines are categorized as in the following:

Required checks

☐ Select KPIs that provide added value
☑ Use standard terms and definitions for each KPI to assure consistency
☑ Define the KPIs in a simple and understandable way
☑ Use a template for KPI design and fill the template with all the necessary data
☑ Test KPIs in advance to assure that all stakeholders share common understandings
☐ Inform all stakeholders when new KPIs are introduced
☑ Keep the stakeholders involved through the whole measuring process
☐ Use related tools for the automation of the measuring process
☐ Measure customer satisfaction
☐ Ensure data quality
☑ Choose KPIs in alignment with organizational goals
☐ Update KPIs when the organizations's strategy or goals change
☐ While selecting KPIs do not focus only on measuring financial outcomes
☑ Review, revise and update the KPIs frequently
☐ Measure a minimal set of KPIs
☑ Use standard terms when presenting KPI values
☐ Define clearly the relationships between related KPIs

Optional checks

☐ Communicate the definitions, terms and related glossary to all stakeholders
☑ Train all stakeholders to lead to common interpretations
☑ Inform all stakeholders when introducing changes
☑ Inform all stakeholders about the KPI owner
☑ Delegate authority to the KPI team
☑ Determine and communicate the data collection needed for the measurement of each KPI
☐ When the data collection is difficult to be identified, delegate the task of scouting data sources to a data analyst
☐ When using external consultants, make sure that the knowledge is transfered to the internal employees
☑ Interview executives and managers to set proper target values
☐ Use last year's targets to set base target values
☐ Revise targets continuously
☑ Communicate to all stakeholders how the targets are set
☐ Inform people and ask for their consent when using confidential data
☐ Inform all stakeholders when data resulting from KPI measurements are to be published
☐ Do not use KPI values to punish the employees
☐ Reward employees as soon as appropriate, when satisfactory results are reached
☐ When satisfactory results are reached, communicate the news to all stakeholders
☐ Present KPIs in a way that the results provide a common understanding for all stakeholders
☐ Keep KPI presentations as simple as possible
☑ Use prototypes to pretest if all stakeholders share the same understandings
☐ Design dynamic structures

4.5. A design method for the definition of organization-specific KPIs

Matthes et. al. [28] propose a design method to define organization-specific EAM KPIs. This artifact is based on a template structure, designed for the documentation of EAM KPIs. The template is described in detail in Section 1.2.3.
The evaluation of the method is based on expert interviews, conducted in April 2012. The interviews confirmed the comprehensibility of the method and its benefits, as a artifact that provides a high level of detail and support for the configuration of organization-specific KPIs.

The method is designed in four steps, as illustrated in Figure 4.1. Each step presents the activities and the different actors involved in the process.

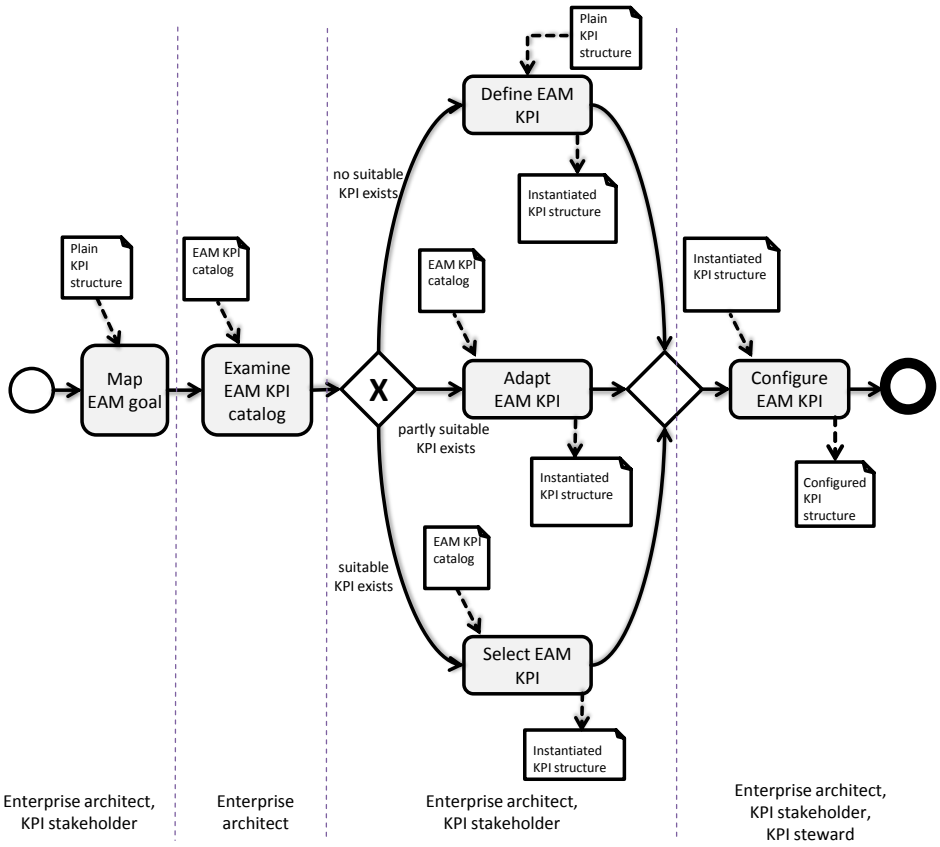


Figure 4.1.: A design method for defining EAM KPIs

Step 1 - Initialize KPI design and map EAM goal
The method starts when an organizational goal needs to be measured. The organizational goal could be a new goal that is being introduced in the organization as part of changes in the organizational strategy, or an existing goal that currently is not measured by any existing KPIs. The mapping of the goal with the one of the ten EAM KPI goals is done in the first activity *"Map EAM goal"*. The actors involved are the enterprise architect and the KPI stakeholders.

Step 2 - Examine the EAM KPI catalog
In this step the enterprise architect examines the EAM KPI catalog, to find the most adequate KPI that measures the organizational goal defined in step 1. The enterprise architect can select KPIs from the list of 52 KPIs based on the structured information that is provided for each KPI such as: goals, title, description, information model and calculation.

Step 3 - Instantiate EAM KPI
During the third step an EAM KPI is instantiated. If a suitable KPI is found, then the KPI is already instantiated. If a KPI is partially suitable, then it needs to be adapted to the organizational needs by changing the content of one or more of its general structure elements. Alternatively, if there is no suitable KPI in the catalog, a new KPI is to be defined by filling the respective elements of the template. The new information is entered in the template by an enterprise architect and the stakeholder, who are also responsible to assure the consistency of the KPI system.

Step 4 - Configure EAM KPI
Finally, the specified KPI is configured to match the requirements of a specific organization. This is achieved by filling out the organization-specific elements of the KPI template with content. Also in this step, the consistency of the KPI system has to be maintained. This activity is performed by the enterprise architect, the KPI stakeholder and the KPI steward.

This method provides a structured means to design EAM KPIs. However, the risks that can occur during the measurement process are to be considered. Therefore we extend the design method to incorporate the guidelines introduced previously. The extended method is described in detail in Section 4.6.

4.6. Adaptation of the checklist for the design method

To incorporate the guidelines in the design method, we distribute the guidelines into the four steps of the method, in alignment with the activities that each step holds. Therefore, the list of guidelines introduced previously, is divided into four categories, respectively for each of the steps of the design method. The guidelines are also aligned with the categorization in required and optional subgroups. To ensure the consistency, in the remaining of this thesis, the required guidelines are marked with (R) and the optional guidelines with (O).
Thereby, the guidelines are distributed as in the following:

Checks for Step 1

☐ Select KPIs that provide added value (R)
☑ Choose KPIs in alignment with organizational goals (R)
☐ Update KPIs when the organizations's strategy or goals change (R)

Checks for Step 2

☑ Define the KPIs in a simple and understandable way (R)
☑ Use a template for KPI design and fill the template with all the necessary data (R)
☑ Inform all stakeholders about the KPI owner (O)
☐ Measure customer satisfaction (R)

Checks for Step 3

☑ Test KPIs in advance to assure that all stakeholders share common understandings (R)
☑ Determine and communicate the data collection needed for the measurement of each KPI (O)
☐ When the data collection is difficult to be identified, delegate the task of scouting data sources to a data analyst (O)
☐ Ensure data quality (R)
☐ Inform people and ask for their consent when using confidential data (O)
☑ Use prototypes to pretest if all stakeholders share the same understandings (O)

Checks for Step 4

☐ Inform all stakeholders when new KPIs are introduced (R)
☐ Use related tools for the automation of the measuring process (R)
☑ Train all stakeholders to lead to common interpretations (O)
☑ Delegate authority to the KPI team (O)
☑ Determine and communicate the data collection needed for the measurement of each KPI (O)
☑ Interview executives and managers to set proper target values (O)
☐ Use last year's targets to set base target values (O)
☐ Revise targets continuously (O)
☑ Communicate to all stakeholders how the targets are set (O)
☐ Inform all stakeholders when data resulting from KPI measurements are to be published (O)
☑ Use standard terms when presenting KPI values (R)
☐ Define clearly the relationships between related KPIs (R)
☐ Present KPIs in a way that the results provide a common understanding for all stakeholders (O)
☐ Keep KPI presentations as simple as possible (O)
☐ Design dynamic structures (O)

The advantage of this distribution is that the stakeholders that are involved in a specific step of the method, are responsible for controlling the guidelines aligned to that specific step. Therefore they do not have to check the whole checklist over and over again.

4.6.1. General guidelines

Since the design method is implemented precisely for EAM KPIs and it describes the design of one KPI at a time, potential guidelines related to the implementation of the whole KPI system are enclosed in a specific category: *general guidelines*. The guidelines of this category are to be checked and communicated regardless the steps of the design method. For example, the guideline "Use standard terms and definitions for each KPI to assure consistency" is to be ensured during the whole process. Standard terms and definitions are a requirement that has to be fulfilled during all the activities of the design method. The guidelines belonging to this category are:

☑ Use standard terms and definitions for each KPI to assure consistency (R)
☐ Communicate the definitions, terms and related glossary to all stakeholders (O)
☑ Keep the stakeholders involved through the whole measuring process (R)
☑ Inform all stakeholders when introducing changes (O)
☐ When using external consultants, make sure that the knowledge is transfered to the internal employees (O)
☐ While selecting KPIs do not focus only on measuring financial outcomes (R)
☑ Review, revise and update the KPIs frequently (R)
☐ Do not use KPI values to punish employees (O)
☐ Reward employees as soon as appropriate, when satisfactory results are reached (O)
☐ When satisfactory results are reached, communicate the news to all stakeholders (O)

4.7. Summary

In this chapter a guidelines checklist for KPI-related risks was developed. The objective of checklist is to ensure that the stakeholders have a general overview of what they should consider important during the definition and implementation of KPIs. The checklist was presented in three possible designs: in alignment to the risk categories, in alignment to the evaluation results, and in alignment to a design method for the definition of KPIs.
An important outcome of this chapter is the list of the guidelines that are ensured by a structured template or a design method for the definition of KPIs. As pointed out in Section 4.4, the ensured guidelines that are also marked as required are 8 out of 17. This fact leads to the conclusion that, the definition of KPIs based on a structured template and the employment of the design method already ensures half of the suggested guidelines. Hence, we can assume that, by all means the organizations will be shielded by many possible KPI-related risks if they make proper use of these artifacts.

5. Summary and Outlook

In this chapter, the thesis is finalized by summarizing the results and subjecting them to critical examination. In section 5.1 the contribution of the work presented in the previous chapters is described. Thereafter, in Section 5.2, possible suggestions for future research are discussed.

5.1. Results of the thesis

Chapter 1 introduced the main motivation for this research. In Section 1.1 the existing gap in research is discussed, hence motivating the need for this research and its objective. Moreover, the arisen research question were defined. In Section 1.2, three different approaches that support the controlling dimension of EA management are presented.

Chapter 2 presented the core contribution of this thesis. The research method used for the literature review was described (Section 2.1). In Section 2.2 the terminology regarding KPIs and other related concepts was analyzed. This section addressed **RQ1**. Afterwards, in Section 2.4, literature sources were interpreted (Section 2.3) following a hermeneutic method to produce a resulting set of eight risk categories: *General*, *Data*, *Organizational goals*, *Targets*, *Number of KPIs*, *Ethics*, *Rewards*, and *KPI presentation*. Each one of these categories contains specific risks and respective countermeasures, as suggested in the literature. Hence, this section addresses the **RQ2**.

In Chapter 3 the literature findings were evaluated through a survey. The collected results provided important insights about the identified risks. The core contribution was the risk prioritization (Section 3.3). Based on the feedback from EAM practitioners we could identify the most relevant risks in practice. Therefore, in this chapter, **RQ3** was answered.

In Chapter 4 we combined the results from the evaluation with the literature findings to create a guidelines checklist. The list's item were identified by analyzing the countermeasures and their description. The guidelines were thereafter classified into required and optional based on the risk prioritization. Two other views of the checklist were based on the risk categorization and on their state (checked or not checked) when a design method for the definition of KPIs is employed. Hence, this chapter addresses the **RQ4** and **RQ5**.

5.2. Future research

The research for this thesis was founded on the available literature regarding risks in the design and implementation of KPIs (and other related concepts). The body of knowledge constructed from the collected literature sources was limited by the time constraints and by the lack of literature sources that specifically deal with risks. In future research, the analysis could be based on more literature sources, if more time ought to be invested in improving the collection of findings. Moreover, KPIs in the area of EAM, but also in other fields, are gaining attention from practitioners and academia. Therefore more publications, that introduce best practices for KPI-risks could be available.

The literature findings were evaluated for correctness and completeness by a survey. Due to time constraints the survey was handed-out only in one conference. Nevertheless, 17 full responses could be received from EAM practitioners. However, only a few of them provided also feedback regarding the suggested countermeasures. Future research could approach a more extensive number of responses, and maybe publish the online survey in a prolongated time-span. Moreover, as the participants were mostly active in the field of EAM, it would be beneficial to collect feedback also from practitioners and experts from other fields e.g., IT management or business management.

The literature findings and the evaluation results were combined to produce a guidelines checklist. The checklist was afterwards adapted to a design method for the definition of EAM KPIs. As future work, the design method with the incorporated guidelines for each step could be evaluated.

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Appendix

A. Risk prioritization survey

In this appendix, the risk prioritization survey is described. The survey was conducted between April 3, 2013 and April 21, 2013. A detailed description of this survey and the result analysis can be found in Chapter 3.
The following sections contain all the questions as presented in the risk prioritization survey.

A.1. Cover page

Prioritization survey on risks, problems, issues and suggested countermeasures on the development and implementation of EAM KPIs (systems)

Dear reader,

please take a few moments to complete our survey. We are very interested in understanding the typical risks, problems and issues aswell as suggested countermeasures on the development and implementation of EAM KPIs (systems). Your responses will help us to prioritize these risks as well as to refine the provided countermeasures.

This survey comprises 12 mostly closed questions. Its completion takes less than 17 mins.

Please complete the survey until 21th of April 2013.

For any questions do not hesitate to contact us: ivan.monahov@tum.de.

Thank you for your effort and time in advance.

Kind regards,

Ivan Monahov

A.2. Background information

1. What industry branch are you working in?
   - ○ Aerospace / defense
   - ○ Consulting
   - ○ Education (e.g. professor, PhD. student, etc.)
   - ○ Finance (e.g. banking, insurance, etc.)
   - ○ Government
   - ○ Healthcare
   - ○ IT products and tools
   - ○ IT services
   - ○ Manufacturing (e.g. automotive)
   - ○ Telecommunication
   - ○ Transportation / logistics
   - ○ Other _____
2. Which of the following describes your current professional occupation best?
   - ○ Academic and educational occupation
   - ○ Business architect
   - ○ Consultant
   - ○ Enterprise architect
   - ○ Managing position
   - ○ IT architect
   - ○ Scientific position in an enterprise
   - ○ Other _____
3. For how long have you already been working in the area of EAM?
   - ○ Less than 1 year
   - ○ 1-5 years
   - ○ 6-10 years
   - ○ More than 10 years
4. For how long have you already been working with KPIs in general?
   - ○ Less than 1 year
   - ○ 1-5 years
   - ○ 6-10 years
   - ○ More than 10 years

5. Why does your organization need EAM KPIs? (Please mark multiple options if appropriate)

   ☐ To measure the achievement of predefined EAM goals
   ☐ To measure the benefits (added value) of the EAM initiative
   ☐ To improve EAM processes
   ☐ To support EAM decision making
   ☐ To justify the need for architectural projects
   ☐ Other _____

6. Which stakeholders in your organization are interested in EAM KPIs?

   _____

7. What are the (expected) benefits of using EAM KPIs?

   _____

8. If your company already uses or plans to use EAM KPIs, please briefly describe the 3 most important ones

   _____

A.3. Risks and countermeasures

1. Please select the top 5 risks you experienced / expect to face on the definition and implementation of EAM KPIs.

   ☐ Irrelevant KPIs
   ☐ KPIs are not properly defined
   ☐ KPIs are too abstract
   ☐ Resistance to change
   ☐ Automation of the measuring process
   ☐ Standard terms
   ☐ The KPI team is not constantly informed
   ☐ Customer satisfaction not measured
   ☐ Short term focus only
   ☐ Considering too much (or too less) data
   ☐ Defective data (inconsistent, conflicting, unnecessary, distributed)
   ☐ Goal displacement
   ☐ Vague organizational goals
   ☐ Negotiated goals
   ☐ Setting extreme target values
   ☐ Unchanged targets
   ☐ Using too many KPIs
   ☐ Access of confidential data
   ☐ Manipulated outcomes
   ☐ KPI values used to punish
   ☐ Legal limits
   ☐ Delaying rewards
   ☐ Rewards attached to KPIs too soon
   ☐ Divergent interpretations
   ☐ Ambiguous relations between KPIs
   ☐ Static KPI structure

2. In the following you can find the respective countermeasures of the risks introduces previously.
   Feel free to give us your feedback regarding the identified countermeasures in the comment fields.

   Irrelevant KPIs

   - Measure what is truly important not just what is easy to measure _____

   KPIs are not properly defined

   - Provide clear, unambiguous and understandable definitions _____
   - Use a template for KPI design and provide all the necessary data _____

KPIs are too abstract

- Measure well-defined and well-designed KPIs _____
- Test KPIs in advance _____
- Provide clear, unambiguous and understandable definitions _____

Resistance to change

- Make sure that the employees are not threatened by the implementation of new KPIs (inform the team and keep them involved) _____

Automation of the measuring process

- Use related tools to compute KPIs automatically to lower the employee frustration _____

Standard terms

- Provide clear, unambiguous and understandable definitions _____
- Pretest KPIs _____
- Training of the staff _____

The KPI team is not constantly informed

- Inform the team about changes _____
- Inform the team about KPI owner _____
- Delegate authority to the team _____

Customer satisfaction not measured

- Define KPIs that measure the satisfaction of the customer _____

Short term focus only

- Identify KPIs that target the organization's long-term goals _____

Considering too much (or too less) data

- Appoint a system analyst to scout data sources for potential KPIs _____

Defective data (inconsistent, conflicting, unnecessary, distributed)

- Ensure data quality _____

Goal displacement

- Choose KPIs in alignment with the organizational goals
- Measure KPIs, not only outcomes
- Review, revise and update KPIs frequently

Vague organizational goals

- Align the KPI structure with the goal structure

Setting extreme target values

- Interview executives and managers
- Use last year's targets

Unchanged targets

- Revise targets continuously, especially when the organizational strategy changes

Using too many KPIs

- Select a minimal set of KPIs (aligned with organizational goals)
- Review, revise and update KPIs frequently

Access of confidential data

- Inform people and ask for their consent when using confidential data
- Design a special agreement when the data are to be published

Manipulated outcomes

- Ensure data quality
- Test KPIs in advance

KPI values used to punish

- Use KPI values to empower, not to punish employees

Delaying rewards

- Reward staff as soon as appropriate _____
- Look for KPIs measuring future outcomes _____

Rewards attached to KPIs too soon

- Do not promise rewards too soon in the process _____

The presentation causes divergent interpretation

- Use standard terms _____
- Recruit design experts and train staff _____
- Test effects of the presentation by using prototypes _____

Ambiguous relations between KPIs

- Use standard and consistent names for each relation between KPIs _____

Static KPI structure

- Make sure to design dynamic KPIs so that authorized stakeholders can personalize the interface _____

3. Are some relevant issues, success factors or countermeasures regarding the design and implementation of EAM KPIs missing?

_____