Measure Process Maturity for Quality Management Systems

COBIT 5 PAM for ISO 9001:2015 Maturity Measurement

Master Thesis in MSc Business Information Systems

Pascal Bürgy
(08-650-350)

University of Applied Sciences and Arts Northwestern Switzerland // MSc Business Information Systems // 5. Semester PT. // Prof. Dr. Petra Maria Asprion // V1.0 – 21. January 2016

University of Applied Sciences and Arts
Northwestern Switzerland

University of Applied Sciences and Arts

Northwestern Switzerland

School of Business

Abstract

Keywords Process, Maturity Measurement, Quality Management, ISO 9001:2015, COBIT 5 PAM, Small and Mid-Sized Enterprises (SME), Swiss based, Glaux Soft AG, Master Thesis, Design Science Research

ISO 9001:2015 is a widespread standard for quality management – also and especially within the IT industry. As with every standard or best practice, quality management systems require a continuous improvement whose characteristics are defined on a high-level basis within ISO 9001:2015. Respectively, companies develop individual improvement approaches, which makes comparison and industry benchmarking impossible.

Therefore, this study establishes a COBIT 5 PAM based maturity measurement instrument for ISO 9001 based process models, wherewith ISO 9001 certified companies will be able to assess their individual process models along the standardized maturity measurement instruments of COBIT 5 PAM. This study analyses, based on a design science research approach, the current scientific and practical literature about quality management and process maturity measurement as well as that about respective combination approaches of these fields. With this foundation, a comprehensive mapping of ISO 9001:2015 and COBIT 5 PAM needs to be defined. This mapping then is the baseline for a prototype that allows process maturity measurement for ISO 9001 certified process models. Finally, this prototype need to be validated within a qualitative case study.

Based on the combination of ISO 9001:2015 and COBIT 5 PAM on process level, the Process Improvement Prototype (PIP) is developed. This prototype covers two activities, which participating companies need to perform. On the one hand, the PIP supports its users when mapping their individual process maps with a generic ISO 9001:2015 process map (GPM-IT). This generalization, on the other hand, allows the execution of the PIPs second activity, whereas the measurement tools of COBIT 5 PAM are applied to define the capability level of individual ISO 9001:2015 processes and establish respective process improvement initiatives.

The PIP has been validated within a practical environment together with Glaux Soft AG, a Swiss-based software development SME. Thereby, its overall usability is approved by mapping Glaux Softs individual ISO 9001 processes with the generic processes of the GPM-IT and furthermore, by performing a process maturity measurement iteration with the PIPs tools and techniques. Thereby, certain limitations and improvement ideas are identified and either directly addressed within the study or highlighted as possible prospective research activities.

I. Content Overview

1 Introduction 13

This chapter contains preliminary information about the study topic and its background. Furthermore, the framework of the study, containing study purpose, thesis statement and other aspects, is defined.

2 Theoretical Foundation 18

Within the second chapter, theoretical and scientific aspects of the topic are analysed. Thereby, both the topics quality management and process maturity measurement as well as respective combination approaches are in focus.

3 Research Methodology 35

Chapter number three highlights the relevant research corner stones for the study as well as, in more detail, the different steps and activities of the design science research framework of Hevner & Chatterjee (2010).

4 Components of a Measurement Framework 38

This chapter focuses on the definition of necessary components that allow a target-aimed combination of ISO 9001:2015 and COBIT 5 PAM.

5 ISO 9001:2015 Process Improvement Prototype 47

The Process Improvement Prototype is defined within chapter 5, whereas every aspect of the respective measurement tool invented within this study is explained.

6 Prototype Validation 70

Chapter 6 contains the validation of the Process Improvement Prototype, wherefore a company is selected along defined criteria. Within the practical setup of this company, the potential of the prototype is analysed.

7 Conclusion 80

Within the conclusion, the coverage of the research objectives defined within chapter one are evaluated. Furthermore, lessons learned and ideas for prospective research initiatives are provided.

8 Bibliography 84

Chapter 8 contains the detailed bibliography of the study, categorized along internal, scientific, practice-oriented and graphics-only resources.

9 Appendix 88

The ninth and last chapter of the study contains six appendixes, which substantiate different contents of the study.

II. Table of Contents

1 Introduction 13

1.1 Background 13
1.2 Purpose of the Study 14
1.3 Thesis Statement and Research Objectives 15
1.4 Limitations and Scope 15
1.5 Relevance 16
1.6 Research Methodology 17

2 Theoretical Foundation 18

2.1 Literature Review Process 18
2.2 Standards and Instruments 19
2.2.1 Perceptions 19
2.2.2 Opportunities 20
2.2.3 Risks 21
2.3 Quality Management 22
2.3.1 Quality 22
2.3.2 Quality Management 24
2.3.3 Quality Management System 26
2.3.4 Quality Management Standard 27
2.3.5 Quality Management in Software Development 29
2.4 Process Maturity Measurement 29
2.4.1 Process 29
2.4.2 Process Reference Models 29
2.4.3 Process Maturity 32
2.4.4 Process Maturity Measurement 33
2.5 Combinations 34

3 Research Methodology 35

3.1 Research Corner Stones 35
3.2 Design Research Steps 36
3.2.1 Awareness 36
3.2.2 Suggestion 36
3.2.3 Development 37
3.2.4 Evaluation 37
3.2.5 Conclusion 37

4 Components of a Measurement Framework 38

4.1 Combining Standards & Frameworks 38
4.1.1 Combination Dimensions 38
4.1.2 Combination Level 38
4.2 Specific Combination Levels 39
4.2.1 Methodology 39
4.2.2 Process 40
4.2.3 Indicator 40
4.2.4 Maturity Level 40
4.3 Mapping on Process Level 41
4.4 Generic Process Landscape for IT SMEs 41
4.4.1 IT Process Map of the Swiss Federal Administration 41
4.4.2 Extensions to the Swiss Federal IT Process Map 42
4.4.3 Generic ISO 9001:2015 Process Model for IT SMEs (GPM-IT) 43
4.5 ISO 9001:2015 versus COBIT 5 PAM Mapping Approach 44

5 ISO 9001:2015 Process Improvement Prototype 47

5.1 Overview 47
5.2 Process Model Mapping 48
5.2.1 Process Model 48
5.2.2 Comparison 49
5.2.3 Connection 50
5.3 Process Maturity Measurement 51
5.3.1 Process 51
5.3.2 Scope 52
5.3.3 Measurement 53
5.3.4 Level 54
5.3.5 Improvement 54
5.4 Process Maturity Levels 55
5.4.1 Level 1 – Performed Process 55
5.4.2 Level 2 – Managed Process 61
5.4.3 Level 3 – Established Process 63
5.4.4 Level 4 – Predictable Process 65
5.4.5 Level 5 – Optimising Process 67
5.5 Rating System 69

6 Prototype Validation 70

6.1 Company Selection Criteria 70
6.2 Participating Company – Glaux Soft AG 71
6.2.1 Facts and Figures of Glaux Soft AG 71
6.2.2 An Outline on evidence – Glaux Softs Product Baseline 71
6.2.3 ISO 9001:2015 Process Map of Glaux Soft AG 71
6.3 Process Model Mapping in Practice 73
6.4 Process Maturity Measurement in Practice 74
6.4.1 Defining and Scoping Processes with the PIP 74
6.4.2 Measuring Process Maturity with the PIP 76
6.4.3 Defining Process Improvements with the PIP 77
6.5 Analysis of Generated Results and Insights 78

7 Conclusion 80

7.1 Research Question Coverage 80
7.1.1 ISO 9001:2015 and COBIT 5 Mapping 80
7.1.2 Prototyping a Process Measurement Model 81
7.1.3 Validating the Usability of the Developed Measurement Model 81
7.2 Lessons Learned 82
7.3 Prospective Research 83

8 Bibliography 84

8.1 Internal university-related resources 84
8.2 Scientific papers & nonfictions 84
8.3 Practice-oriented literature & resources 86
8.4 Used Graphics (not directly mentioned in text) 87

9 Appendix 88

9.1 Appendix A – Structured Literature Review 89
9.2 Appendix B – Generic Process Map for IT SMEs in Detail 92
9.2.1 Process 01 – IT Management 93
9.2.2 Process 04 – IT Steering 94
9.2.3 Process 08 – Maintain IT-Processes 95
9.2.4 Process 10 – Strategic Marketing 95
9.2.5 Process 05 – Solution Development & Deployment 96
9.2.6 Process 06 – Operate IT-Infrastructure & -Services 97
9.2.7 Process 07 – User Support 99
9.2.8 Process 11 – Sales 100
9.2.9 Process 02 – Skills Development 101
9.2.10 Process 03 – Procurement 101
9.2.11 Process 09 – Support Financial Management 102
9.3 Appendix C – Generic Process Map and COBIT 5 Detailed Process Mapping 103
9.3.1 Process 01 – IT Management 103
9.3.2 Process 04 – IT Steering 107
9.3.3 Process 08 – Maintain IT-Processes 109
9.3.4 Process 10 – Strategic Marketing 111
9.3.5 Process 05 – Solution Development & Deployment 112
9.3.6 Process 06 – Operate IT-Infrastructure & -Services 116
9.3.7 Process 07 – User Support 120
9.3.8 Process 11 – Sales 121
9.3.9 Process 02 – Skills Development 122
9.3.1 Process 03 – Procurement 123
9.3.2 Process 09 – Support Financial Management 124
9.4 Appendix D – Glaux Soft's Process Map in Detail 125
9.5 Appendix E – Generic Process and Glaux Soft's Detailed Process Mapping 126
9.6 Appendix F – Process Improvement Prototype (PIP) 127
9.6.1 Tool No. 1 – Process Model Mapping 127
9.6.2 Tool No. 2 – Process Definition & Scoping 127
9.6.3 Tool No. 3 – Process Maturity Measurement 127

III. List of Figures

Figure 1 Limitation & Scope of the Planned Study 16
Figure 2 Rigor vs. Relevance of the Planned Study 16
Figure 3 Design Science Research Framework (adapted from Hevner & Chatterjee (2010)) 17
Figure 4 Upcoming Chapters & Contents 17
Figure 5 Literature Review Process (according to Hart (1998)) 18
Figure 6 Framework Introduction – Opportunities (adapted from Repp et al. (2008)) 20
Figure 7 Framework Introduction – Risks (adapted from Repp et al. (2008)) 21
Figure 8 Quality (adapted from Schmitt (2015)) 22
Figure 9 Economic Quality (adapted from Schmitt (2015)) 23
Figure 10 Quality Target (own illustration - adapted from Benes & Groh (2014)) 25
Figure 11 Quality Management Disciplines (adapted from Müller (2004)) 25
Figure 12 Quality Management Disciplines (adapted from Thom & Ritz (2000)) 26
Figure 13 Functional Chain of a QMS (adapted from KMU Portal des Bundes (2015)) 27
Figure 14 ISO 9001:2015 Process Model (adapted from Hermann (2009)) 27
Figure 15 COBIT 5 Process Model (adapted from ISACA (2013c)) 30
Figure 16 COBIT 5 Principles (adapted from ISACA (2013c)) 31
Figure 17 COBIT 5 Enablers (adapted from ISACA (2013c)) 31
Figure 18 COBIT 5 PAM Capability Levels (adapted from ISACA (2013b)) 32
Figure 19 COBIT 5 PAM Maturity Measurement 33
Figure 20 Mapping of ISO 9001:2000 and CMMI (from Mutafelija and Stromberg (2003)) 34
Figure 21 Research Corner Stones (adapted from Saunders et al. (2009)) 35
Figure 22 Design Science Research Framework (adapted from Hevner & Chatterjee (2010)) 36
Figure 23 Design Science Research Cycles (adapted from Hevner & Chatterjee (2010)) 37
Figure 24 Generic Levels of Combination (own visualisation) 38
Figure 25 Different Mapping Levels (own visualisation) 39
Figure 26 Combination on “Methodology”-Level 39
Figure 27 Combination on “Process”-Level 40
Figure 28 Combination on “Indicator”-Level 40
Figure 29 Combination on “Maturity Level”-Level 40
Figure 30 Map ISO 9001:2015 and COBIT 5 PAM 41
Figure 31 Swiss Federal IT Process Map (from ISB (2015)) 42
Figure 32 Generic ISO 9001:2015 Process Model for IT SMEs (GPM-IT) (adapted from ISB (2015)) 43
Figure 33 Process Improvement Prototype (PIP) 47
Figure 34 PIP ISO 9001:2015 Process Model Mapping Steps 48
Figure 35 Generic ISO 9001:2015 Process Model for IT SMEs (GPM-IT) (adapted from ISB (2015)) 48
Figure 36 Generic & Specific ISO 9001:2015 Process Mapping Tool 50
Figure 37 PIP Maturity Measurement Procedure (adapted from ISACA (2013a)) 51
Figure 38 PIP Targeted Capability Level Definition (adapted from ISACA (2013a)) 52
Figure 39 PIP Process Maturity Measurement (adapted from ISACA (2013a)) 53
Figure 40 PIP process Capability Level Calculation (adapted from ISACA (2013a)) 54
Figure 41 COBIT 5 PAM Capability Levels (adapted from ISACA (2013b)) 55
Figure 42 COBIT 5 PAM Maturity Measurement 69
Figure 43 Company Selection Criteria 70
Figure 44 Glaux Soft’s ISO 9001 Process Model (adapted from Glaux Soft AG (2015c)) 72
Figure 45 Glaux Soft’s Targeted Process Capability Levels 75
Figure 46 Glaux Soft’s Process Maturity Measurement 76
Figure 47 Glaux Soft’s Resulting Process Capability Levels 76
Figure 48 Insight Importance & Categories 79
Figure 49 Generic ISO 9001:2015 Process Model for IT SMEs (GPM-IT) (adapted from ISB (2015)) 92

IV. List of Tables

Table 1 Five Perspectives of Quality of David A. Garvin (according to Paul (2009)) 23
Table 2 The Four Absolutes of Quality (according to Crosby (1979)) 24
Table 3 The Five Quality Management Disciplines (according to Müller (2004)) 25
Table 4 Eight Quality Management Principles (from International Standardisation Organisation (2012)) 28
Table 5 Additional Process Description Terms (from ISACA (2013c)) 30
Table 6 COBIT 5 PAM & ISO/IEC 15504 Capability Levels (from ISACA (2013b)) 32
Table 7 COBIT 5 PAM & ISO/IEC 15504 Rating Stages (from ISACA (2013b)) 34
Table 8 Combination Dimensions 38
Table 9 Mapping Generic ISO 9001:2015 and COBIT 5 Processes 46
Table 10 PIP Weighting Aspects 49
Table 11 PIP Mapping Statuses 49
Table 12 COBIT 5 Enterprise Goals (adapted from ISACA (2013a)) 51
Table 13 COBIT 5 IT-related Goals (from ISACA (2013a)) 52
Table 14 Generic Process Improvement Measures 54
Table 15 PIP process Outcomes Filtration 55
Table 16 PA1.1 Process Performance 60
Table 17 PA2.1 Performance Management (from ISACA (2013b)) 61
Table 18 PA2.2 Work Product Management (from ISACA (2013b)) 62
Table 19 PA3.1 Process Definition (from ISACA (2013b)) 63
Table 20 PA3.2 Process Development (from ISACA (2013b)) 64
Table 21 PA4.1 Process Measurement (from ISACA (2013b)) 65
Table 22 PA4.2 Process Control (from ISACA (2013b)) 66
Table 23 PA5.1 Process Innovation (from ISACA (2013b)) 67
Table 24 PA5.2 Process Optimization (from ISACA (2013b)) 68
Table 25 COBIT 5 PAM & ISO/IEC 15504 Rating Stages (from ISACA (2013b)) 69
Table 26 Mapping Glaux Softs and Generic ISO 9001:2015 Processes 74
Table 27 Enterprise goal selection of Glaux Soft AG 74
Table 28 Defined Process Improvement Initiatives 77
Table 29 Generated Results and Insights 79
Table 30 Structured Literature Review 91
Table 31 ISB Process 01 – IT Management (from ISB (2015)) 93
Table 32 ISB Process 04 – IT Steering (from ISB (2015)) 94
Table 33 ISB Process 08 – Maintain IT-Processs (from ISB (2015)) 95
Table 34 Adapted Process 10 – Strategic Marketing (adapted from Glaux Soft AG (2015c)) 95
Table 35 ISB Process 05 – Solution Development & Deployment (from ISB (2015)) 96
Table 36 ISB Process 06 – Operate IT-Infrastructure & -Services (from ISB (2015)) 98
Table 37 ISB Process 07 – User Support (from ISB (2015)) 99
Table 38 Adapted Process 11 – Sales (adapted from Glaux Soft AG (2015c)) 100
Table 39 ISB Process 02 – Skills Development (from ISB (2015)) 101
Table 40 ISB Process 03 – Procurement (from ISB (2015)) 101
Table 41 ISB Process 09 – Support Financial Management (from ISB (2015)) 102
Table 42 Detailed Mapping: Process 01 <> EDM01 103
Table 43 Detailed Mapping: Process 01 <> EDM03 104
Table 44 Detailed Mapping: Process 01 <> APO01 104
Table 45 Detailed Mapping: Process 01 <> APO02 105
Table 46 Detailed Mapping: Process 01 <> APO03 105
Table 47 Detailed Mapping: Process 01 <> MEA01 106
Table 48 Detailed Mapping: Process 01 <> MEA03 106
Table 49 Detailed Mapping: Process 04 <> EDM04 107
Table 50 Detailed Mapping: Process 04 <> APO05 107
Table 51 Detailed Mapping: Process 04 <> APO09 108
Table 52 Detailed Mapping: Process 04 <> APO12 108
Table 53 Detailed Mapping: Process 08 <> APO11 109
Table 54 Detailed Mapping: Process 08 <> DSS06 109
Table 55 Detailed Mapping: Process 08 <> MEA02 110
Table 56 Detailed Mapping: Process 10 <> EDM05 111
Table 57 Detailed Mapping: Process 10 <> APO08 111
Table 58 Detailed Mapping: Process 05 <> EDM02 112
Table 59 Detailed Mapping: Process 05 <> APO04 112
Table 60 Detailed Mapping: Process 05 <> BAI01 113
Table 61 Detailed Mapping: Process 05 <> BAI02 113
Table 62 Detailed Mapping: Process 05 <> BAI05 114
Table 63 Detailed Mapping: Process 05 <> BAI06 114
Table 64 Detailed Mapping: Process 05 <> BAI07 115
Table 65 Detailed Mapping: Process 05 <> BAI08 115
Table 66 Detailed Mapping: Process 06 <> APO13 116
Table 67 Detailed Mapping: Process 06 <> BAI03 116
Table 68 Detailed Mapping: Process 06 <> BAI04 117

Table 69 Detailed Mapping: Process 06 <> BAI10 117
Table 70 Detailed Mapping: Process 06 <> DSS01 118
Table 71 Detailed Mapping: Process 06 <> DSS03 118
Table 72 Detailed Mapping: Process 06 <> DSS04 119
Table 73 Detailed Mapping: Process 06 <> DSS05 119
Table 74 Detailed Mapping: Process 07 <> DSS02 120
Table 75 Detailed Mapping: Process 11 <> No COBIT 5 Process Available 121
Table 76 Detailed Mapping: Process 02 <> APO07 122
Table 77 Detailed Mapping: Process 03 <> APO10 123
Table 78 Detailed Mapping: Process 03 <> BAI09 123
Table 79 Detailed Mapping: Process 09 <> APO06 124

V. Document Information

Purpose of document

This document contains a master thesis, written in the scope of the eponymous module at the University of Applied Sciences Northwestern Switzerland, FHNW. The objective of the paper is to develop a process maturity measurement approach for ISO 9001:2015 certified quality management systems of Swiss-based SME IT companies.

Change Management

The following steps were necessary to create the current document.

Version	Date	Person	Remarks
D0.1	24. August 2015	Pascal Bürgy	Document initiated / Take-over of MTRP document
D0.2	24. August 2015	Pascal Bürgy	Document structure extended
D0.3	12. September 2015	Pascal Bürgy	MTRP document elements adapted and extended
D0.4	18. September 2015	Pascal Bürgy	Theory “Combination Standards and Frameworks” added
D0.5	20. September 2015	Pascal Bürgy	Combination levels described
D0.6	29. September 2015	Pascal Bürgy	Process level mapping described
D0.7	05. October 2015	Pascal Bürgy	Preparation generic process model & process mapping
D0.8	20. October 2015	Pascal Bürgy	Optimisation according to supervisor feedback
D0.9	31. October 2015	Pascal Bürgy	Generic ISO 9001:2015 process map for IT SMEs added
D0.10	16. November 2015	Pascal Bürgy	ISO 9001:2015 and COBIT 5 process mapping (incl. appendix C)
D0.11	23. November 2015	Pascal Bürgy	ISB process map description added (appendix B)
D0.12	25. November 2015	Pascal Bürgy	Glaux Soft and ISO 9001:2015 process mapping (incl. appendix E)
D0.13	27. November 2015	Pascal Bürgy	Glaux Soft process map description added (incl. appendix D)
D0.14	29. November 2015	Pascal Bürgy	PIP process landscape & mapping steps defined
D0.15	30. November 2015	Pascal Bürgy	PIP maturity level descriptions added
D0.16	02. December 2015	Pascal Bürgy	PIP rating system added
D0.17	03. December 2015	Pascal Bürgy	Glaux Soft company description added
D0.18	05. December 2015	Pascal Bürgy	PIP process maturity measurement added
D0.19	06. December 2015	Pascal Bürgy	Master Thesis keywords defined
D0.20	07. December 2015	Pascal Bürgy	Structure of chapter 6 (Evaluation) refined
D0.21	08. December 2015	Pascal Bürgy	Optimisation according to supervisor feedback
D0.22	18. December 2015	Pascal Bürgy	Evaluation documented
D0.23	20. December 2015	Pascal Bürgy	Conclusion and research objective coverage added
D0.24	21. December 2015	Pascal Bürgy	Prospective research described
D0.25	28. December 2015	Pascal Bürgy	Corrections due to internal review
RC0.26	29. December 2015	Pascal Bürgy	Corrections & adaptions / Abstract added
RC0.27	07. January 2016	Pascal Bürgy	Optimisation according to supervisor feedback
RC0.28	20. January 2016	Pascal Bürgy	Optimisation according to spell check
RC0.29	21. January 2016	Pascal Bürgy	Final corrections & adaptions

D = Draft , RC = Release Candidate , V = Release / Ready for Assessment

Approvals

This document has been approved by the following people.

Version	Date	Person	Remarks
D0.6	20. October 2015	Petra M. Asprion	Review the current state of the document
D0.17	07. December 2015	Petra M. Asprion	Review the current state of the document
D0.24	25. December 2015	Pascal Bürgy	Internal review of entire document
RC0.26	31. December 2015	Petra M. Asprion	Review of entire document
RC0.27	20. January 2016	Douglas Andrews	Spell Check
RC0.28	21. January 2016	Pascal Bürgy	Internal review of entire document
V1.0	21. January 2016	Pascal Bürgy	Release / Ready for Assessment

Basic Document Parameters

Document title Measure Process Maturity for Quality Assurance Systems	**File name** MT_5_BuergyPascal_MeasureProcessMaturityForQMS.docx
Remarks This document was generated during the module "Master Thesis" at FHNW and contains the entire master thesis of Pascal Bürgy.	**File size** 1785 Kilobytes * * This value correlates to the Word document.
Author / Editor Bürgy Pascal	**Version** V1.0
Creation Date 24. August 2015	**Status** Release / Ready for Assessment

Statement of Justification

This project is submitted in partial fulfilment of the fifth semester's requirements of the Degree of Master in Business Information Systems at the University of Applied Sciences and Arts Northwestern Switzerland. All the supporting literature referred to on this report has been properly referenced according to the Harvard referencing guide. The complete work was exclusively created for this particular subject reaching the academic limitations, without any plagiarism**.**

Olten, in January 2016

1 Introduction

Within this chapter, relevant and scientific essentials of the planned study are provided including a detailed problem derivation as well as the definition of the thesis statement, research questions and objectives.

1.1 Background

Regarding the evolution within information technology (among others highlighted by Quack (2014) and Rüter et al. (2010)) and the resulting increased IT-dependency of most businesses (stated by Andenmatten (2012a)), the management of quality within information technology became an important aspect. However, developing organisational capabilities that ensure a comprehensive alignment towards qualitative effectiveness and efficiency is a complex and occasionally cost-intensive endeavour (Pfeifer & Schmitt (2010)). Therefore, industries and organisations developed tool sets that should facilitate the implementation of the necessary disciplines, so-called quality management systems.

According to the British Department of Trade & Industry (2015), a quality management system can be defined as follows:

> **"A set of co-ordinated activities to direct and control an organisation in order to continually improve the effectiveness and efficiency of its performance."**

Beside this short and concise definition, other formulations highlight special aspects of quality management. For example, the aim of being compliant with laws and regulations as well as the idea of strictly focussing on customer needs (Business Dictionary (2015)) whereas other sources (ISO 9000 Store (2015)) highlight the specific process orientation of all key activities within a quality management system.

Along these aspects, various quality management system standards and reference models were developed during the last decades. Thereby, as stated by Schroll (2006), the Capability Maturity Model Integration (CMMI), the European Foundation for Quality Management (EFQM) model, ISO 9001, ISO 15504 as well as the IT Infrastructure Library (ITIL) are the five approaches with the highest importance within the IT industry. All these approaches cover essential elements of common quality management systems. Thereby ISO 9001 is still the most widespread approach for quality management in Europe according to Gvoic (2013). This standard, initially published in 1987 and currently available in the latest released version 2015, defines minimal requirements for organisations, which need to be fulfilled in order to transform a certain input into an added value output in form of products and services that are compliant with customer and / or legal expectations. Furthermore, ISO 9001:2015 clearly asks for continual improvement based on the well-known PDCA-cycle of Walter Deming (International Standardisation Organisation (2012)), but without defining concrete measures and approaches to determine and improve maturity of systems and processes. As ISO 9001:2015 is a standard and should be applicable for various industry sectors, its definitions are formulated on a generic high-level basis.

Due to this focus, the standard is too generic to apply directly in practice. Companies and entire industries usually enlarge the ISO 9001:2015 process model with an adequate amount of (sub-) processes. The result of that is that most certified companies using ISO 9001 have completely different process models. Nonetheless, some best practice approaches have been established within certain industry branches as needs and mechanics of companies within the same industry are usually quite similar.
Beside ISO 9001, which is very well known and applicable within many branches and industries, other best practices such as EFQM or COBIT have been developed with an exclusive focus on IT (Rohloff (2003)). Their descriptions and instructions are much more concrete, what means that COBIT 5, a widespread example of IT governance frameworks, provides a standardized process model that needs to be adapted.

COBIT 5 does not only provide a detailed process model, but also a specific model that allows the measurement of process maturity. This model is a supplement of COBIT 5 and is called Process Assessment Model (PAM). Thereby PAM provides six maturity levels with related measurement instruments along which the establishment and anchoring of every process within a company can be measured.

An adaption of COBIT 5 PAM best practices within the well-known ISO 9001:2015 standard may lead to a powerful IT governance and a high quality management instrument for IT enterprises by combining ISO 9001's external marketing and flexibility power with COBIT 5's best practices for internal improvement. This concept is the focus of the planned study.

1.2 Purpose of the Study

ISO 9001:2015 is, as described within the previous chapter, an industrial standard. This means it is addressed to a wide variety of different industry sectors and enterprises, which makes a certain high-level focus necessary.

ISO 9001:2015 only provides a rough process model, composed of four processes, that according to SAI Global Limited (2015) needs to be fulfilled in order to reach a respective certification. In fact, the corporate reality of most enterprises is much more difficult so that more detailed processes are necessary to be able to operate in daily business. Accordingly, industries and enterprises usually split the four basic processes into a detailed process model. This leads to the situation that, at least in theory, every certified enterprise may have a completely individual process model.

As superficial as its process model, ISO 9001:2015 defines its efforts towards continuous improvement of a quality management system. The standard generally only asks for continuous improvement as a black box and state the PDCA-cycle of Walter Deming to be a possibility to achieve (International Standardisation Organisation (2015a)). Concrete approaches of how a current state of a quality management system should be measured and how the maturity of a single process should be classified in order to identify the virtue of undertaken improvement measures are not provided. Thus, companies and industry branches are asked to develop individual approaches for the maturity measurement of ISO 9001:2015 processes.

Although the elementary definition of the ISO 9001:2015 standard and the concomitant flexibility of how to adapt it in practice can be considered as an advantage, the related uncertainty has two major disadvantages.

First, due to the missing guidelines, the possibility and necessity of designing one's own process models and individual improvement mechanics usually leads to a non-circumstantial increase in cost and needed time to achieve a quality management system that is fit for use. As increased costs based on a fixed improvement potential within a company lead to a longer return on investment period, the endeavour of establishing an ISO 9001 quality management system loses a certain part of its allure.

Another disadvantage is that individual approaches within process models and continuous improvement efforts, for example in how to measure and classify the maturity of a process with a given objective, do not allow the benchmarking of measurement results in comparison with other companies or industries. With that, a huge potential of common best practices, which usually state a "learn from the best"-approach (Angermeier 2015), is lost.

Both of these disadvantages may lead a given enterprise to invest only into its process model and establish only rudimentary improvement mechanics, which may be enough to achieve the respective certification. According to Repenning & Sterman (2002), the practice has showed that process models without a strong continuous improvement tend to erode over time, which, in the long term, may lead to a loss of the ISO 9001 certification.

None of these insights are new to the establishment of an ISO 9001 certified quality management system. Therefore efforts have already been undertaken to combine the characteristics of ISO 9001 with best practices which

provide a fixed process model and which are in possession of a respective improvement and maturity measurement instrument. Thereby CMMI (Capability Maturity Model Integration) has usually been used as the best practice approach to combine with ISO 9001. However, as Yoo et al. (2006) has highlighted, the different focuses of ISO 9001 and CMMI is a problem for a target-aimed combination in practice.

1.3 Thesis Statement and Research Objectives

The potential of combining ISO 9001:2015 with IT governance best practice approaches was identified. To address the described problems and focus on the related challenges when targeting such a combination, this research is going to establish a COBIT 5 PAM based maturity measurement instrument for ISO 9001 based process models. Respectively, the thesis statement is as follows:

The continuous improvement mechanics of the ISO 9001:2015 standard can be enhanced by adapting the COBIT 5 PAM reference model.

Based on this statement, relevant research questions can be derived. These questions accumulate the thesis statement and guide the research in the desired direction.

- How can COBIT 5 domains and processes be mapped with respective elements of the ISO 9001:2015 process model in order to adapt COBIT 5 PAM?
- How can COBIT 5 PAM be used for ISO 9001:2015 based business processes such as marketing, sales or facility management?
- How is COBIT 5 and the related PAM framework capable of ensuring maturity measurement and (industry) benchmarking within common ISO 9001:2015 process landscapes?

According to the identified problem as well as to the thesis statement and the derived research questions, the following research objectives have been defined:

- Modelling relevant relationships between ISO 9001:2015 and COBIT 5 and developing a generic mapping table to align the respective processes.
- Prototyping a process measurement model applicable for ISO 9001:2015 based on the COBIT 5 PAM capability indicators.
- Validating the usability of the developed measurement model (qualitative case study approach).

Those objectives will guide the planned study. This study can be considered successful as soon as these objectives are achieved.

1.4 Limitations and Scope

In order to keep a clear focus as well as to balance the planned study within the relevant temporal and contextual borders, some limitations and restrictions need to be defined. Therefore, the intention of this study is to support process maturity measurement only for ISO 9001 certified process models that follow the basic rule set of the standard. Furthermore, the focus is set on process models of software development companies that are categorized as small or mid-sized enterprises in Switzerland. This limitation allows a clear focus on process models, which are influenced by governmental restrictions of only one single country. Together with the decision to leave out explicit processes and disciplines which only large companies are faced with, the planned study gains a clear focus towards a qualitative case study within the desired field (see figure 1).

Regarding the defined scope, process models that do not follow the ISO 9001 standard are not within the scope of the planned study. Process models of others than SME software development companies in Switzerland are also not relevant for this study. Finally, this study will not deal with any quantitative attempts.

Figure 1 Limitation & Scope of the Planned Study

1.5 Relevance

The measurement of process maturity within ISO 9001 process models is a topic with both theoretical and practical relevance.

From a scientific point of view, the combination of the ISO 9001:2015 standard with common best practices such as CMMI or EFQM provides major benefits in measuring and classifying process maturity within ISO 9001 process models. The planned study will provide a similar approach using COBIT 5 PAM as measurement instrument. As COBIT 5 PAM and the respective combination with ISO 9001:2015 are relatively new, not much scientific work has been done so far in this area. This study will try to eliminate essential drawbacks from former studies such as Yoo et al. (2006) had.

From the practical point of view, this planned study is addressing a challenge ISO 9001 certified companies have to deal with in daily business. With this approach, a toolset can be developed and established to allow such companies to benefit from the best practices of COBIT 5 and the related PAM framework without losing the ability to adapt this measurement framework to an individual ISO 9001 certified process model.

Based on these outlines, the planned study may be positioned as shown in figure 2 according to Dilger (2012) and Riehle (2011).

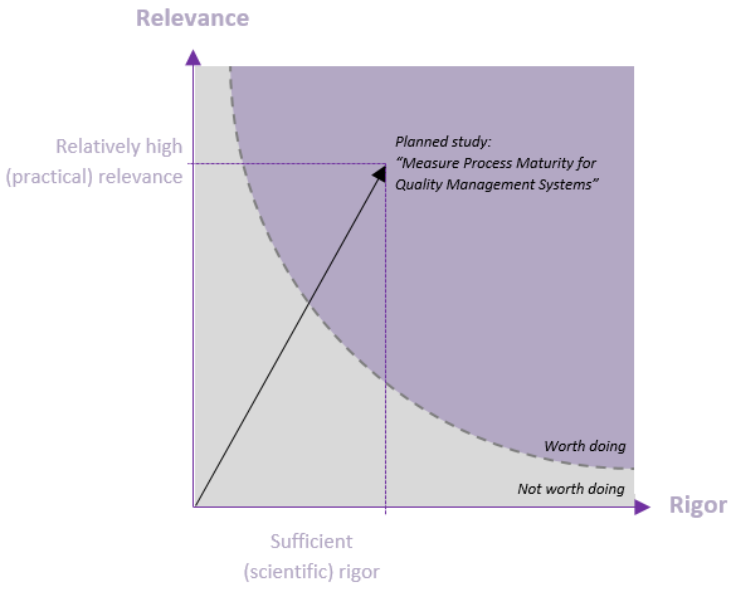


Figure 2 Rigor vs. Relevance of the Planned Study

1.6 Research Methodology

The study is inspired by an interpretivist research philosophy including an inductive research approach to achieve the research objectives defined within chapter 1.3. Furthermore, the study is guided by an exploratory purpose as well as by the design science research framework (see figure 3) as the underlying research strategy.

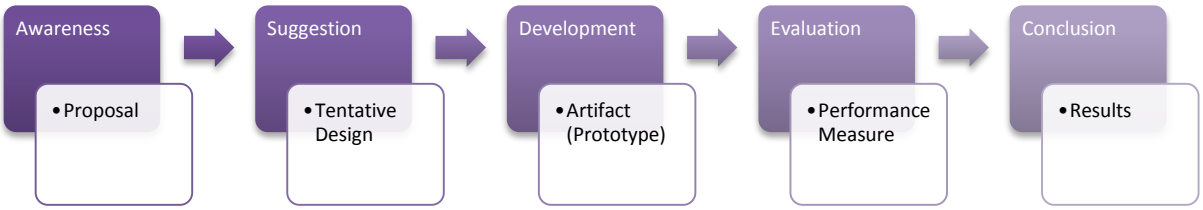


Figure 3 Design Science Research Framework (adapted from Hevner & Chatterjee (2010))

With this strategy in mind, in the study a triangulated approach is used. Together with a cross-sectional, limited time horizon, this research framework leads to various techniques and procedures such as in depth literature research and investigations along qualitative data samples. Thereby this literature is not only used for securing the awareness of the problem but as well for the formulation of the suggestive tentative design and even more it is the baseline for the development of the prototype model.

Based on the described research approach, the chapters of the master thesis are as pictured in figure 4.

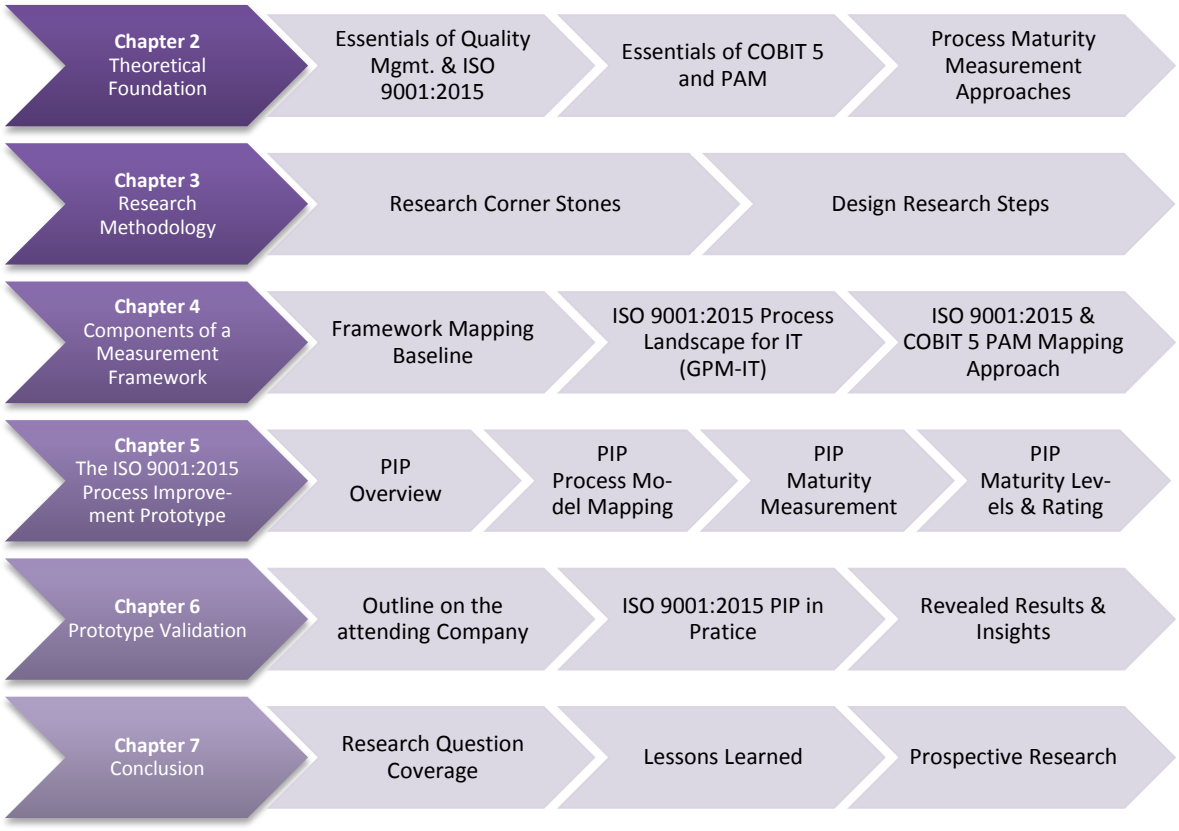


Figure 4 Upcoming Chapters & Contents

The study is situated within the field of action research what means that the author is performing research within a concrete field of activity, in which he is himself active (Adelman (1993)). Therefore, the author states its own independence from outer influences in order to keep a clear and neutral focus for the present study.

2 Theoretical Foundation

Based on the introduction and the defined research objectives, this chapter is going to analyse the theoretical foundation within the field of study. Thereby in a first step, the process of literature review is described. Afterwards, the basic theory along quality management and process maturity measurement is analysed. Finally, an overview about former studies along the combination of both topics is given.

2.1 Literature Review Process

According to Hart (1998), a clearly defined process is necessary in order to be able to perform a sustainable and target-oriented literature review. Therefore, to prepare a rigor scientific basis for the planned study, the used procedure is visualized in figure 5.

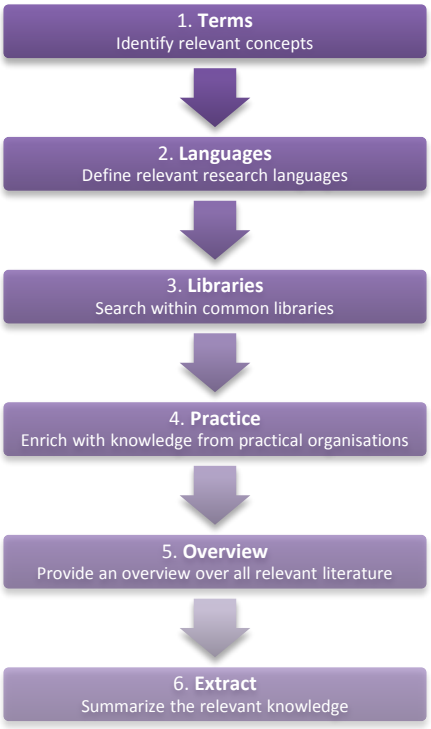


Figure 5 Literature Review Process (according to Hart (1998))

First, the planned study and its surrounding fields need to be categorized into several terms of knowledge - based on keywords. Therefore, a number of global and for each of them, various subordinate concepts have been explored. Along those structured keywords, further research can be guided. Within a second step, the relevant languages for research must be defined. Because the planned study is focused on Swiss based companies, English literature as well as German and probably even French or Italian literature may be relevant. Therefore, the search for the keywords defined within step 1 will be extended by translating the keywords into the above-mentioned languages.

Based on that, common scientific libraries such as NEBIS, Springer Link, Hanser e-Library, IEEE or Google Books will be analysed within a third step. Then, the identified scientific literature will be enriched by adapting practical knowledge out of standards and best practices from sources such as the International Standardisation Organisation (ISO) or ISACA.

Afterwards, all relevant scientific and practical literature found will be categorized within a structured literature overview during a fifth step. This list can be found within Appendix A (Structured Literature Review). Finally, a concentrated extract of relevant knowledge will be provided. This extract can be found within the subsequent sub chapters of this chapter 2.

2.2 Standards and Instruments

As mentioned in chapter 1.1 of this study, encroachments within a company's strategy, structure and organisation may cause extensive cost and essential risks. Not only for this reason, but also because of a certain similarity in challenges and boundaries different companies are faced with, industries have looked for normalized approaches that allow a single company to benefit from experiences of others. The result of this aspiration are standards and best practices, which are defined for many business aspects.

2.2.1 Perceptions

According to Strompen (2015), a standard is defined as a set of rules that has the objective of unifying a tangible good or an intangible procedure. Thereby various elements such as products (paper, screws, …), laws (legal norms), ethical and social merits or working processes and organisational forms may be standardized. In every case, the main objective of a standard is to facilitate reusability and comparability of the unified element across different stakeholders such as people, companies, industries or even countries.

Due to the versatility of standardized elements, establishment and maintenance of standards is a complex endeavour. Therefore, this task can be organized on three levels (Deutsches Institut für Normierung (2015)). On the lowest level, there are national norming institutes such as SN (Schweizerische Normenvereinigung) in Switzerland or DIN (Deutsches Institut für Normierung) in Germany. Standards released by these associations are valid only within the respective country. On a second level, there are transnational, European institutions such as CEN (Comité Européen de Normalisation) or ETSI (European Telecommunications Standards Institute) and on the top level, international institutes such as ISO (International Standardisation Organisation) or IEC (International Electrotechnical Commission) exist. Over these three levels, the adaption of superior standards is mandatory for all associated institutions and countries. Thereby the name of the standard indicates the initial publisher even if a standard is now valid on a higher level.

A common characteristic of every standard is its description on a very high-level basis and its focus strictly on results but not how the result is achieved. For example, the standard DIN A4 only defines the size of a respective paper. Its diameter and even more the way it is produced are not part of the standard (Kuhn (1996)).

In contrast, a best practice (sometimes as well called good practice, industry standard or de-facto standard) describes an attempt of unifying a certain topic by adapting an approved procedure of another company that is usually a leading player within the respective industry branch (Angermeier (2015)). Thereby, best practices have been developed over time and are usually described and maintained by the propagating company or a third party contractor.

Different from a standard, a best practice is a complete set of rules, guidelines and documentations that describes the respective topic in detail (Rohloff 2003)). Because a best practice is in fact a documentation of the as-is-state of the propagating company, best practices usually contain fine-grained process models with clearly defined inputs and outputs as well as specific guidelines for implementation and further improvement of the practice. This detailed documentation may help in understanding the concrete idea behind, but it is often an obstacle in adapting the complete best practice. This because a full implementation would mean adapting the entire company along the industry leader which is not possible due to cultural and other boundaries. This means that best practices first are a recommendation on how to address a certain business challenge.

As a contrast to best practices, sometimes as well "worst practices" are provided which highlight a practice that was not useful. Thereby other companies may benefit as well when preventing errors others already have made.

Best practices are most widespread in industry in order to adapt production procedures. Also in IT, best practices such as COBIT or ITIL are widespread.

2.2.2 Opportunities

Both standards and best practices, as they have similar objectives, are often titled under the term “Framework”. According to Repp et al. (2008), the introduction of a framework within a company generates various opportunities, which are visualized in figure 6.

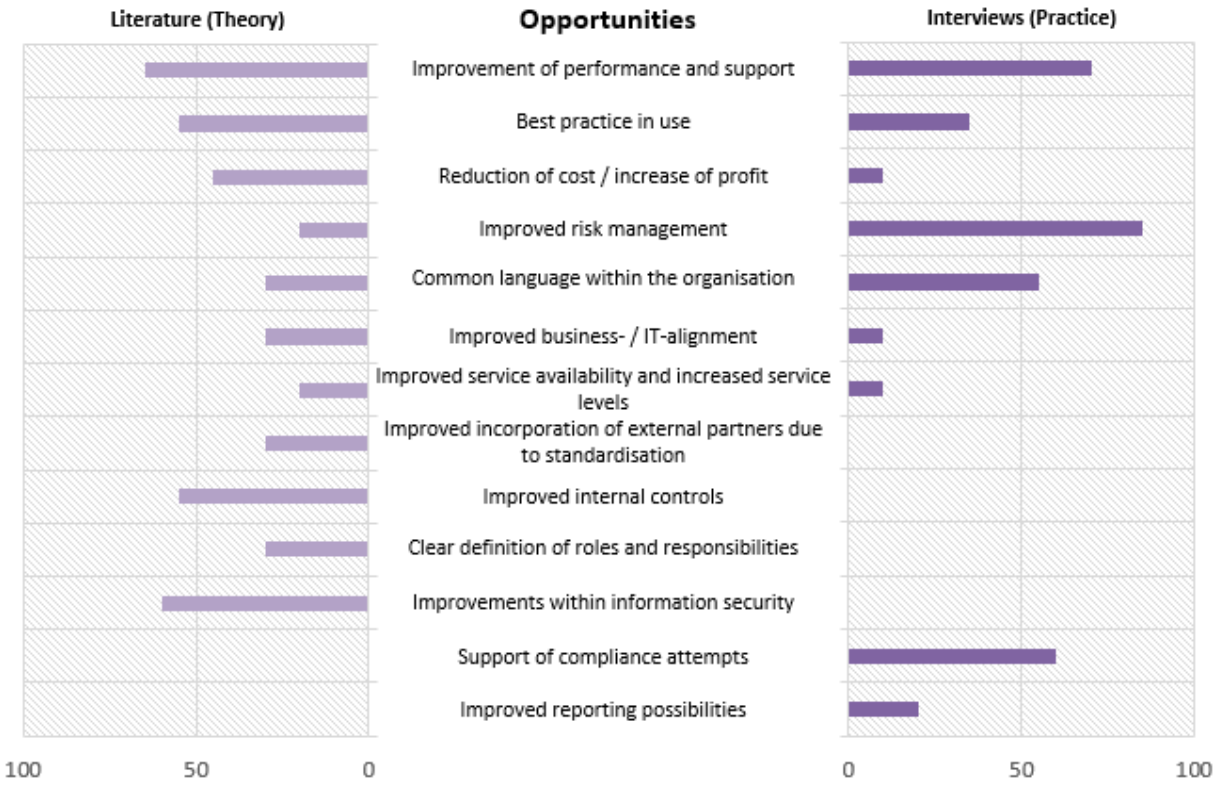


Figure 6 Framework Introduction – Opportunities (adapted from Repp et al. (2008))

Repp et al. (2008) states that scientific literature as well as expert interviews highlight an improvement of performance and support capabilities as an important opportunity when introducing an IT governance framework. Besides that, experts state that an improved risk management, the support of compliance attempts as well as the common language within the organisation are further possible opportunities when introducing a framework. The literature highlights the best practice use, improved internal controls and an improvement in information security as positive aspects. Therefore, a certain difference between theory and practice is evident. Nonetheless, the study from Repp (2008) has showed that companies can benefit from the introduction of an IT governance framework.

2.2.3 Risks

The introduction of standards and / or best practices is a complex organisational project, meaning that there are many potential risks, visualized within figure 7, that need to be handled.

Figure 7 Framework Introduction – Risks (adapted from Repp et al. (2008))

An important risk when introducing a framework is the resistance against organisational or cultural changes what is highlighted by literature as well as interviews. Furthermore and according to practical experience, missing knowledge and experience, the missing inclusion within existing risk management systems as well as the carelessness of employees are important risks. In contrast, scientific resources state a missing management commitment, the overlapping introduction of frameworks and insufficient implementation instructions as major introduction risks of IT governance frameworks. Once again, differences between literature and practice are recognizable.

As Repp et al. (2008) have investigated various IT governance frameworks, which means standards and best practices, with different focuses, the mentioned benefits and risks may be transferred to quality management. Therefore, the respective theoretical baseline is provided within the next chapter.

2.3 Quality Management

The management and controlling of quality are important fields within the activity of IT. Therefore, this chapter is going to shine on its basic elements (quality and its management) and specific topics (e.g. quality management systems, standards and their relevance) around quality in IT and related standards.

2.3.1 Quality

According to the Gabler Business Dictionary (2015), the term quality can be defined along two different meanings. On the one hand, in a neutral definition interprets quality as the sum of all characteristics of a given object. On the other hand, quality can be defined in a valued way, whereas the term defines the goodness of all characteristics of an object.

Within the present study, the second, interpretation of the term "quality" is mainly in focus. Respectively, the common definition of quality from the International Standardisation Organisation (2015d), which is stated within the ISO 9000:2015 standard, enriches the attempt of the Gabler Business Dictionary (2015):

> **"Quality is the degree to which a set of inherent characteristics fulfils requirements."**

Related to the definition stated above, quality can be seen as the level of superposition of market requirements and company achievements (see figure 8).

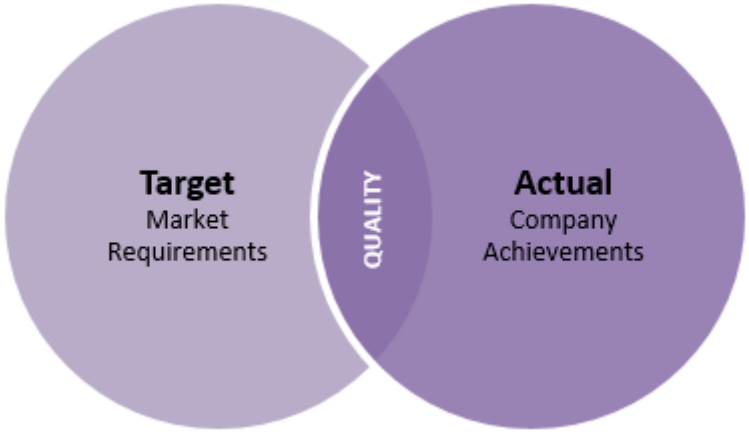


Figure 8 Quality (adapted from Schmitt (2015))

However, according to Schmitt (2015), the comprehension of quality should be extended. Thereby the aspect of market requirements is unaltered but the aspect of company achievements should be divided into company alignment and company abilities. This because quality should consider economic aspects such as resource optimization and profitability in order to ensure long-term company success. In a visualized form, this way of interpreting economic quality can be shown as in figure 9.

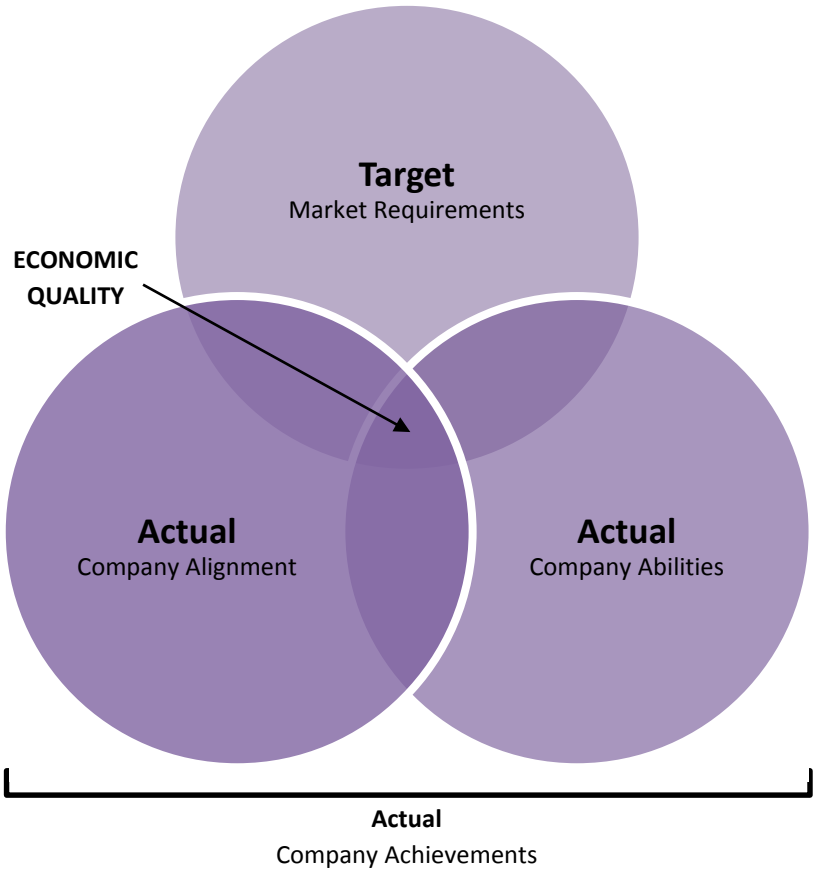


Figure 9 Economic Quality (adapted from Schmitt (2015))

Nevertheless, quality is not only categorized along its contribution to the economic success of a company. According to Paul (2009), quality may also be structured along different perspectives, which were initially defined by David A. Garvin. According to these perspectives, quality is perceived and interpreted in five different ways as in table 1.

Perspective	Description
Transcendental quality	This perspective perceives quality as an absolute and universally recognizable, not finally definable measure. This perspective states that quality is only sensible with a given amount of experience. It interprets quality as a non-measurable perfection.
Product-related quality	In comparison, the product-related perspective states that quality is measurable at any time. Furthermore, this approach states that qualitative differences can be quantitatively visualized.
User-related quality	User-related quality includes the necessary ability of products to meet individual customer requirements. This means that the chosen option is not the best one but those that fits best for the designated purpose.
Process-related quality	This perspective defines quality as the satisfaction of specification and regulations. It means that good quality can only be reached if specific requirements are met.
Worth-related quality	Finally, worth-related quality describes the fulfilment of an achievement at acceptable cost. The idea behind is that over fulfilment is accepted but not rewarded by customers.

Table 1 Five Perspectives of Quality of David A. Garvin (according to Paul (2009))

Based on the different interpretations of quality, it becomes clear that this field of activity is very dynamic. Therefore and because quality is a topic that affects every business, Philipp B. Crosby has defined four basic absolutes for quality which are common for every endeavour within this field.

Absolute	The idea behind
Quality is conformance to the requirements.	In order to be able to do "it" right, people within an organisation need to know what is meant with "it". Therefore, it is necessary that all actions, which are relevant to run a company or produce a product or a service, are defined and agreed.
The system of quality is prevention.	The best way to achieve quality is to prevent errors. Therefore, a quality management system should prevent doing things wrong. To achieve that, Crosby states regular trainings, examples and discipline to be good instruments. Finally, the entire company must commit to a prevention-oriented culture.
The performance standard is "Zero Defects".	The third absolute is set against the "close enough" mentality that must not be tolerated. According to Crosby, errors are simply too costly to ignore. Therefore, the entire company needs to transform towards the so-called "Zero Defects" culture.
The measurement of quality is the price of non-conformance.	The fourth and last of Crosby's absolutes states that non-conformance can be used as a measure of efficiency and effectiveness of a company.

Table 2 The Four Absolutes of Quality (according to Crosby (1979))

Based on these absolutes mentioned in table 2 as well as based on a concise interpretation of the term quality, the establishment of a quality-oriented culture is possible. However, as such attempts need a constant maintenance in order not to erode over time, continuous management of quality is inevitable.

2.3.2 Quality Management

The management of quality is an ongoing topic almost every company is faced with. As companies and businesses are conquered by constant change, quality management also has to react to such changes in order to provide a constant or even improved level of quality. Thereby the discipline of quality management may be examined from two different points of view – a hierarchical and a functional.

First looking at the hierarchical aspects of quality management, this management discipline covers three related management areas, which are allocated on different levels (adapted from Benes & Groh (2014)). Thereby the first and lowest management area is test management. Within this section, usually allocated in a company's operative level, the focus is on the quality of products (or services), thus answering the question "What should be qualitatively managed?".

One level above, process management is located. This management area is often a task allocated to the management level. Thereby process management focuses on the quality of processes, where the bold question "How should it (meaning the product defined on level 1) be qualitatively managed?" should be answered.

Finally, on the third and highest level, the area of strategy management is located. Focusing on the quality of systems, which means the entire company and even its surrounding stakeholders, this quality management level answers the question "Who is responsible for quality management?". Thereby strategy management is usually a task allocated to the board of directors.

According to Benes & Groh (2014), all three levels of quality management need to enforce each other in order to achieve quality as it is defined in the previous chapter. The typical mode of operation is top-down, meaning first defining strategic quality aspects, which lead to respective processes, which finally lead to qualitatively excellent products or services.

This collaboration is shown in figure 10 using the metaphor of a target disk. It is easy to hit the biggest circle of test management (by initiating operative test and quality endeavours), but achieving this circle alone is not sufficient to win. Therefore, a consequent aim toward the quality bull's eye (as well as on all other smaller circles) is necessary to gain enough points in time. In the end the game will be won on outermost circle (the operational test management) as low points, are need, at the end to hit the exact number of points in order to win.

Figure 10 Quality Target (own illustration - adapted from Benes & Groh (2014))

Beside this hierarchical view, quality management can be considered on a functional view as well. This includes, according to Müller (2004), that quality management consists of different disciplines (see figure 11).

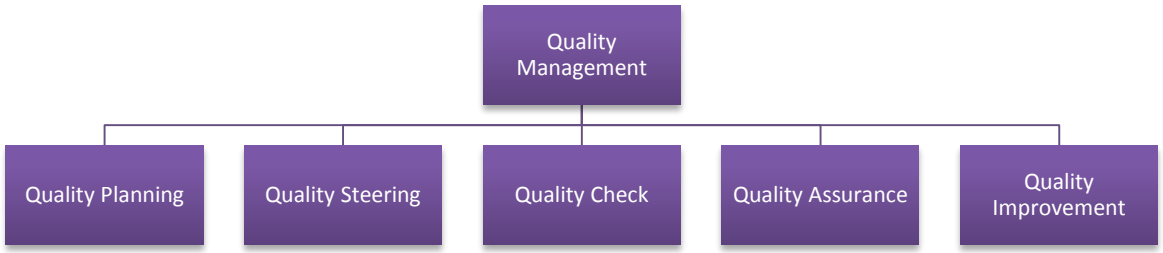


Figure 11 Quality Management Disciplines (adapted from Müller (2004))

Thereby, every discipline has its specific "raison d'être" that is described in table 3, down below.

Quality Management Discipline	Description
Quality Planning	Focuses on external quality requirements of markets and customers. Based on that, planning of internal quality objectives with respect to boundaries such as resources is performed.
Quality Steering	The implementation of elements planned within quality planning. This discipline focuses on the fulfilment of quality requirements.
Quality Check	Contains the concrete examination of the quality of products and services.
Quality Assurance	This discipline focuses on the indemnity of defined quality requirements.
Quality Improvement	The generation of a culture of continuous improvement of processes and other factors of quality. This discipline is the engine of every quality management.

Table 3 The Five Quality Management Disciplines (according to Müller (2004))

All these disciplines together are able to form "quality management" as an initiative to guide a company towards quality. Thereby, every discipline has its specific task within the overall system.

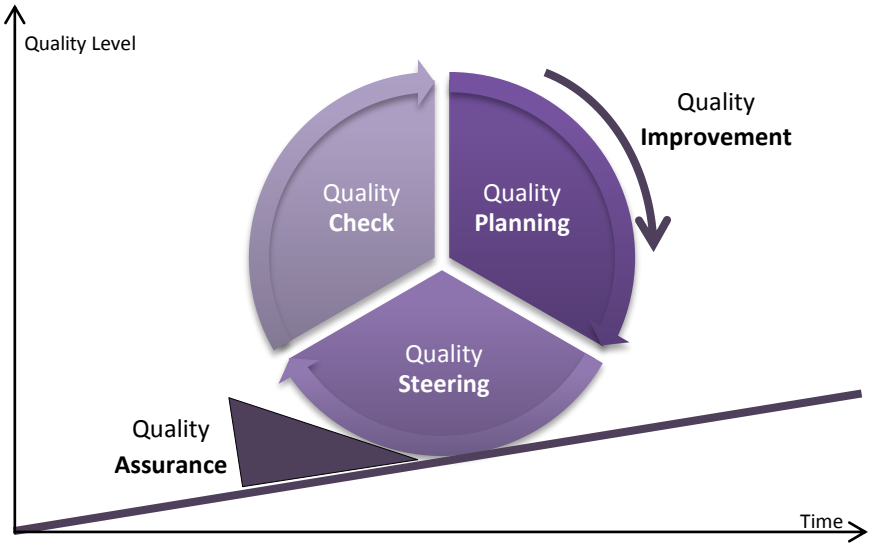


Figure 12 Quality Management Disciplines (adapted from Thom & Ritz (2000))

The quality management disciplines visualized in figure 12 can be used on every hierarchical level previously introduced. Vice-versa, every hierarchical level of quality management has direct influence on the single quality management disciplines. Therefore, quality management needs to be viewed as one big endeavour of a company, independent from hierarchical or function.

2.3.3 Quality Management System

Based on the deliberations within the previous chapters, it becomes clear that the management of quality is a challenging task for companies. Therefore and because of the fact that quality management generates equal challenges for companies out of different branches and of different sizes, specific quality management systems were developed.

According to the KMU Portal des Bundes (2015), a quality management system should allow a company to provide products and services on a constant and defined level of quality. Thereby quality management systems usually provide a set of processes as well as defined roles and functionalities, which are based on the theoretical insights on quality and its management.

Contrary to the concrete approach, a quality management system is not primarily focused on short-term improvements. Even more, it evolves its full economic potential only in the mid- and long-term. This is on the one hand because the establishment of a QMS generates high efforts and cost. On the other hand, quality management affects people what leads to cultural changes when introducing a QMS. Such changes need time until they provide the desired improvements.

Nonetheless, the introduction of a quality management system may launch a functional chain that supports the long-term success of a company. Thereby, according to the KMU Portal des Bundes (2015), both an increase in productivity (due to an improvement in process and system quality) as well as in quality of a company's output (due to an improvement in product quality) can be reached. Basis for such positive effects is a close involvement of the company's employees as they are finally in charge when it comes to the transformation of a quality management system into daily practice (see figure 13).

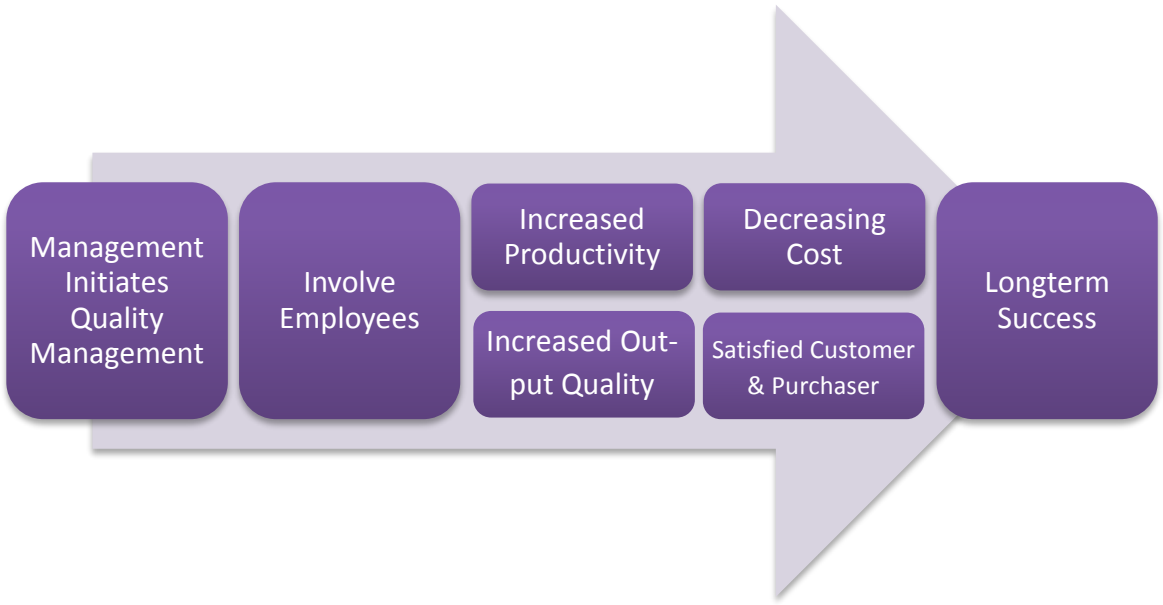


Figure 13 Functional Chain of a QMS (adapted from KMU Portal des Bundes (2015))

During the last years, various standards and best practice for quality management systems were developed. Thereby, EFQM (European Foundation of Quality Management) as well as ISO 9001:2015 are the most widespread approaches for quality management in Europe (Schroll (2006)).

2.3.4 Quality Management Standard

Based on the clear focus of the present study on ISO 9001:2015, this chapter focuses on the related and well-known standard in version 2015. The standards basic process model is shown in figure 14:

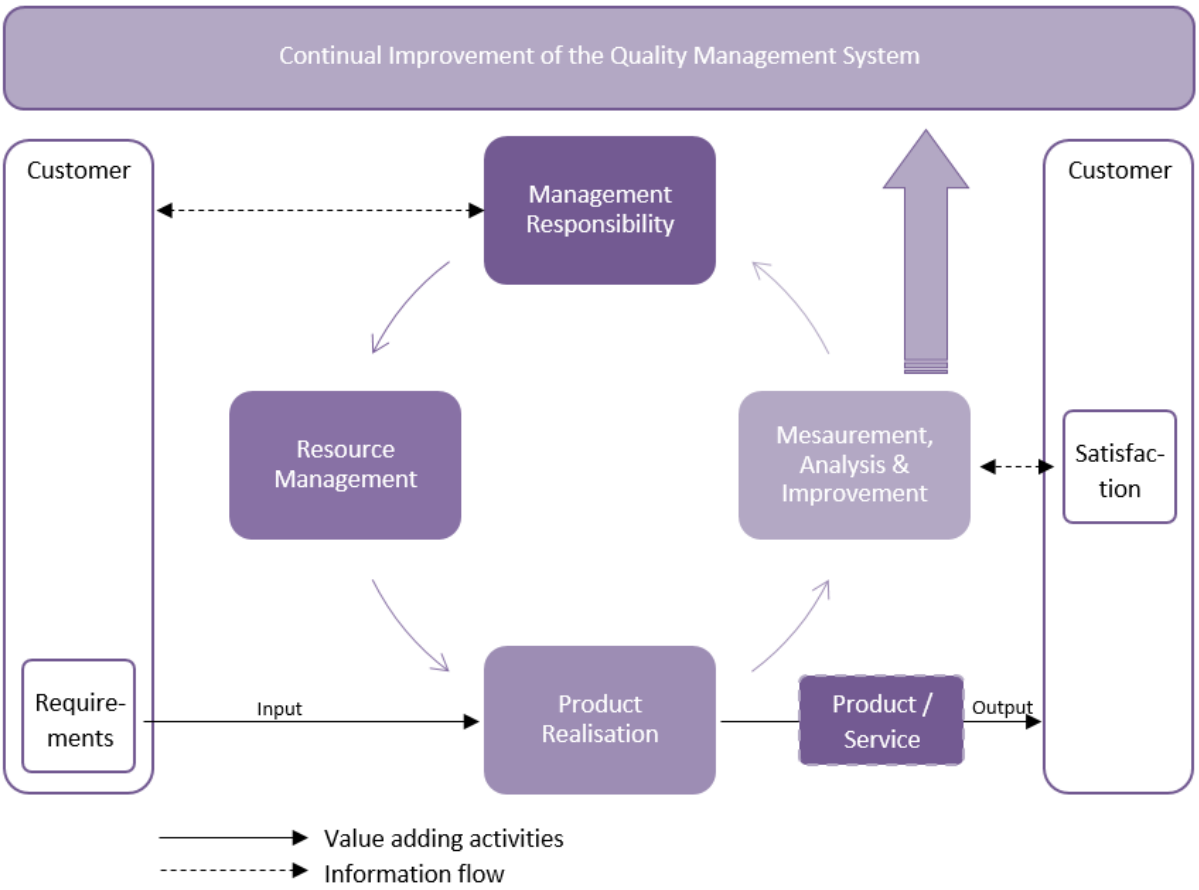


Figure 14 ISO 9001:2015 Process Model (adapted from Hermann (2009))

Based on the process model in figure 14, the standard allows the development of company specific process landscapes. Thereby ISO 9001:2015 strictly focuses on a value added and efficient transformation of requirements into a measurable benefit for the customer on the one hand. On the other hand, the ISO 9001:2015 standard also puts a focal point on the continuous improvement of a company. Therefore and according to the International Standardisation Organisation (2015a), the well-known PDCA-life cycle of Walter Deming (Deming (1982)) is an essential part of the present process model.

Beside the process model defined within the standard of ISO 9001:2015, the entire rule set provided by the International Standardisation Organisation contains further assistance for companies, which focuses on qualitative effectiveness. For example, the standard ISO 9000 contains a set of eight quality management principles, which are listed within table 4.

Principle	Official Description
1. Customer focus	Organizations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations.
2. Leadership	Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.
3. Involvement of people	People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit.
4. Process approach	A desired result is achieved more efficiently when activities and related resources are managed as a process.
5. System approach to management	Identifying, understanding and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives.
6. Continual improvement	Continual improvement of the organization's overall performance should be a permanent objective of the organization.
7. Factual approach to decision making	Effective decisions are based on the analysis of data and information.
8. Mutually beneficial supplier relationships	An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value.

Table 4 Eight Quality Management Principles (from International Standardisation Organisation (2012))

Based on these principles, the development and the long-term maintenance of a quality management system within a company become possible. Thereby, the ISO 9000 family and especially the standard ISO 9001:2015 have been established as the leading guideline along quality management (Gvoic (2013)) which means that they are the most widespread approach compared to other relevant quality management systems. These are, according to Schroll (2006), the Capability Maturity Model Integration (CMMI), the European Foundation for Quality Management (EFQM) model, ISO 9001, ISO 15504 as well as the IT Infrastructure Library (ITIL).

In Switzerland, over 12'000 companies received an ISO 9001 certification until the end of 2013 whereas overall in Europe, around 485'000 are certified according to the International Standardisation Organisation (2015b). This means that, compared to the overall population (where Swiss people contributed around 1.10 % to the European population in 2013) Switzerland has a factor 2.25 higher propagation of ISO 9001 certified companies compared to the European average. Thereby and according to Schmutz (2013), most of the certified companies in Switzerland are SME companies.

Finally when establishing an ISO 9001:2015 compatible quality management system in a Swiss based company, the KMU Portal des Bundes (2015) estimates the cost of implementation as being around 30'000 to 50'000 Swiss francs depending on the concrete starting point / compatibility of existing processes of the respective company. In general, this means that an adequate return on investment (ROI) is achievable when taking into account the potential benefits mentioned in this chapter.

2.3.5 Quality Management in Software Development

As mentioned in the introduction chapter, quality management has become a very important topic within software development. This fact becomes visible when taking a look at the ISO Survey of Management System Standard Certifications (International Standardisation Organisation (2015b)). These statistics show that the IT industry, as a relatively young industry sector, is already ranked 12 out of 39 regarding the number of certified companies within the field. The number of approximately 27'000 worldwide certificates is of course quite small compared with the leading metal industry with almost 117'000 issued certificates by the end of 2013. However, taking a closer look highlights that the increase of certified companies in IT exceeds the increase in metal industry by more than 15% since 1998.

Summing up, these digits underline the fact that IT companies around the globe are considering quality management as an important topic / management activity.

2.4 Process Maturity Measurement

Beside quality management, process maturity measurement is the second major field of activity within the present study. Respectively, this chapter is going to highlight the essential elements within this topic along a theoretical baseline.

2.4.1 Process

The basic element of process maturity measurement is the organisational construct "process" itself. According to Schmelzer & Sesselmann (2010), it can be defined as follows:

> **A process consists of a sequence of activities, which generate a certain output out of a set of inputs.**

This generic definition is true for every form of process. In fact, various forms of processes such as value creation processes, business processes or classical working processes can be distinguished. Thereby the focus of common maturity models is mainly set on business processes, which are defined by Schmelzer & Sesselmann (2010) as follows:

> **A business process consists of a cross-functional and cross-organisational intersection of value added activities which generate a performance expected by the customer and which implement process goals derived from business strategy.**

According to this more concrete definition, the keyword "process" is going to be used within the present study.

2.4.2 Process Reference Models

In daily practice, companies and organisations consist of a set of various business processes by which long-term success is ensured. As these sets of processes are usually very similar for companies in the same industry sector, certain reference models have been developed to provide a standard and comparable process landscape. For IT, ITIL V3, CMMI as well as COBIT 5 are the most widespread process reference models. Due to the specific focus of this study, COBIT 5 is analysed in more detail.

The COBIT 5 process model (see figure 15) is split into five different areas called EDM (Evaluate, Direct and Monitor), APO (Align, Plan and Organise), BAI (Build, Acquire and Implement), DSS (Deliver, Service and Support) and MEA (Monitor, Evaluate and Assess). Thereby one of these areas (EDM) focuses on strategic governance while the four other areas are used for operational management of IT. Furthermore, each of these areas is designed to cover a management topic companies out of information technology are faced with. Overall and according to ISACA (2013), 37 single processes are allocated to these five areas.

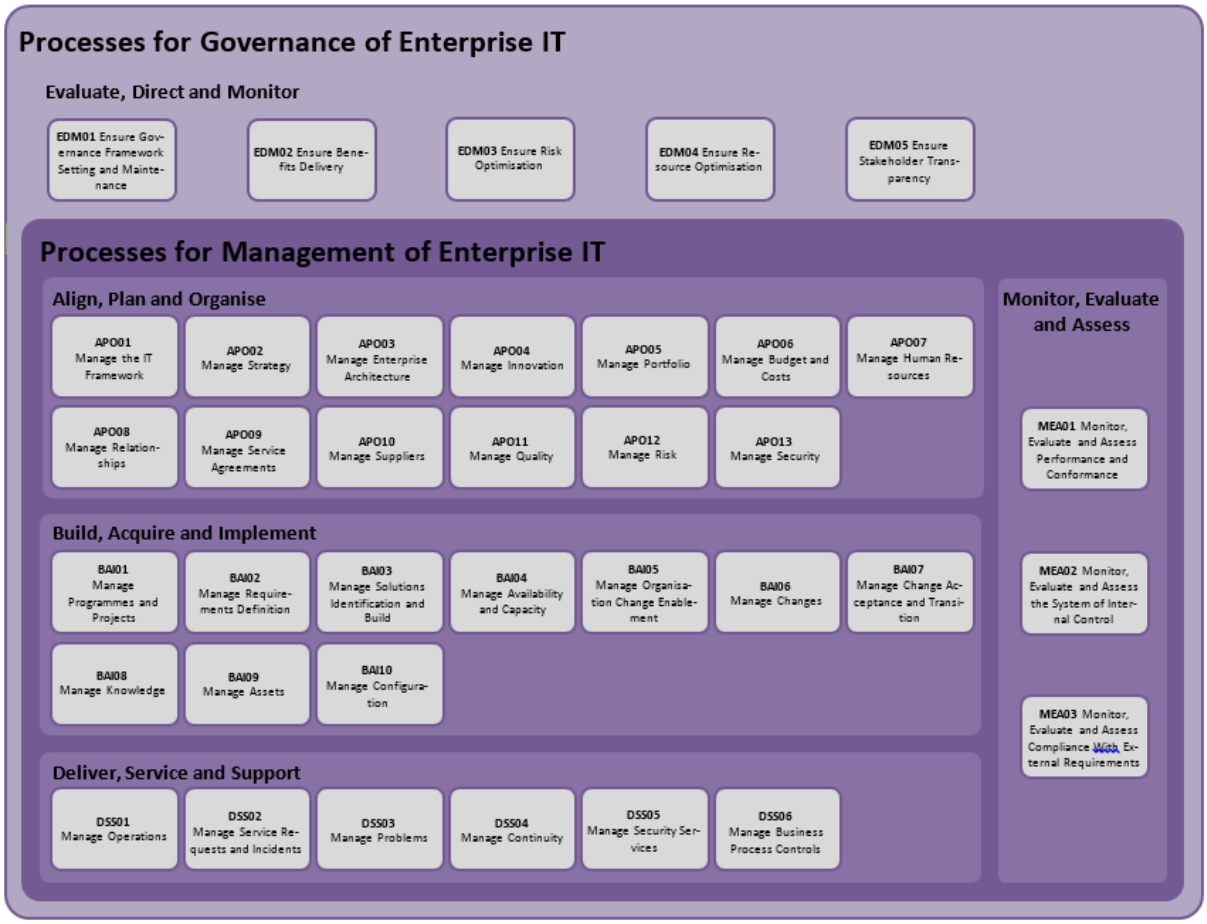


Figure 15 COBIT 5 Process Model (adapted from ISACA (2013c))

Beside a categorized landscape along these 37 processes, COBIT 5 provides even more, detailed information about every single process. Thereby, the following areas listed in table 5 are covered:

Terms	Description
Process Description	The description of a process is enriching its name provided within the process model with additional information.
Process Purpose Statement	Within the purpose statement, the exact goal of the process related to the entire process landscape is described.
Outcomes (Os)	This section provides a list of process outcomes.
Best Practices (BPs)	Best practices are linked to a specific outcome and provide guidelines in order to generate the defined outcome as well as to fulfil the process purpose.
Work Products (WPs) Inputs Outputs	Work products are concrete results, which can be figured either as an input or as an output of a process. As well as best practices, they are linked with a respective outcome.
Characteristics	This section defines special aspects of a certain work product.

Table 5 Additional Process Description Terms (from ISACA (2013c))

But COBIT 5, as an IT-governance reference model, does not only provide process-related information and guidelines, but also a detailed set of information and best practices along which the introduction of a respective process model may be successful for a company. One important part within this section are COBIT 5 so-called principles visualized in figure 16.

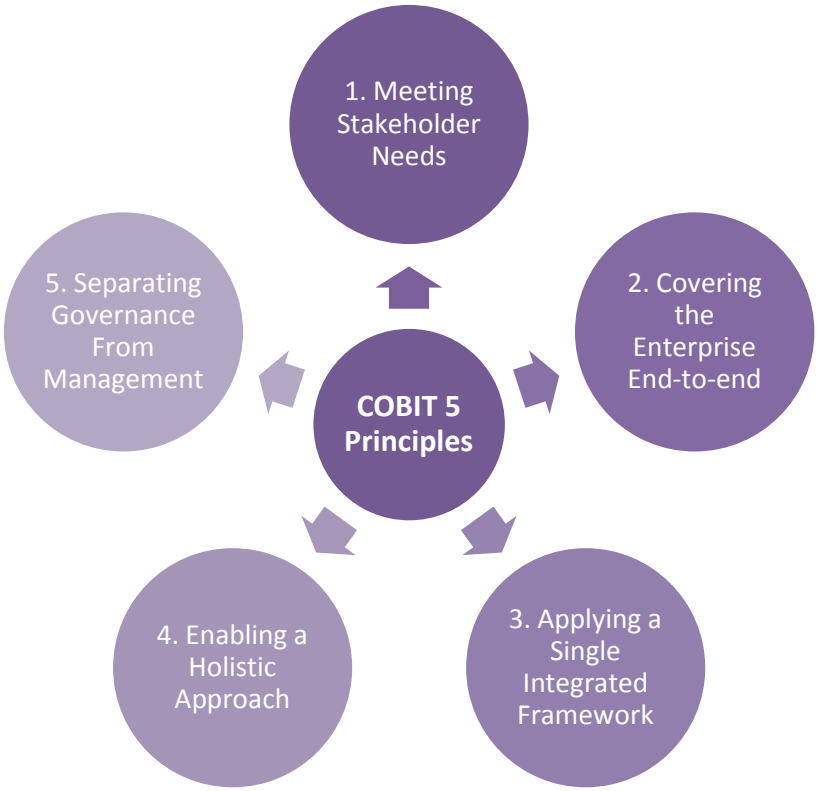


Figure 16 COBIT 5 Principles (adapted from ISACA (2013c))

However, according to ISACA (2013c) as well as based on Malzahn (2009), processes themselves are not the only critical success factor when defining a process landscape. There are many other factors of influence that determine, whether such an implementation will be successful or not. COBIT 5 is considers this proven fact by defining the so-called seven enablers (see figure 17).

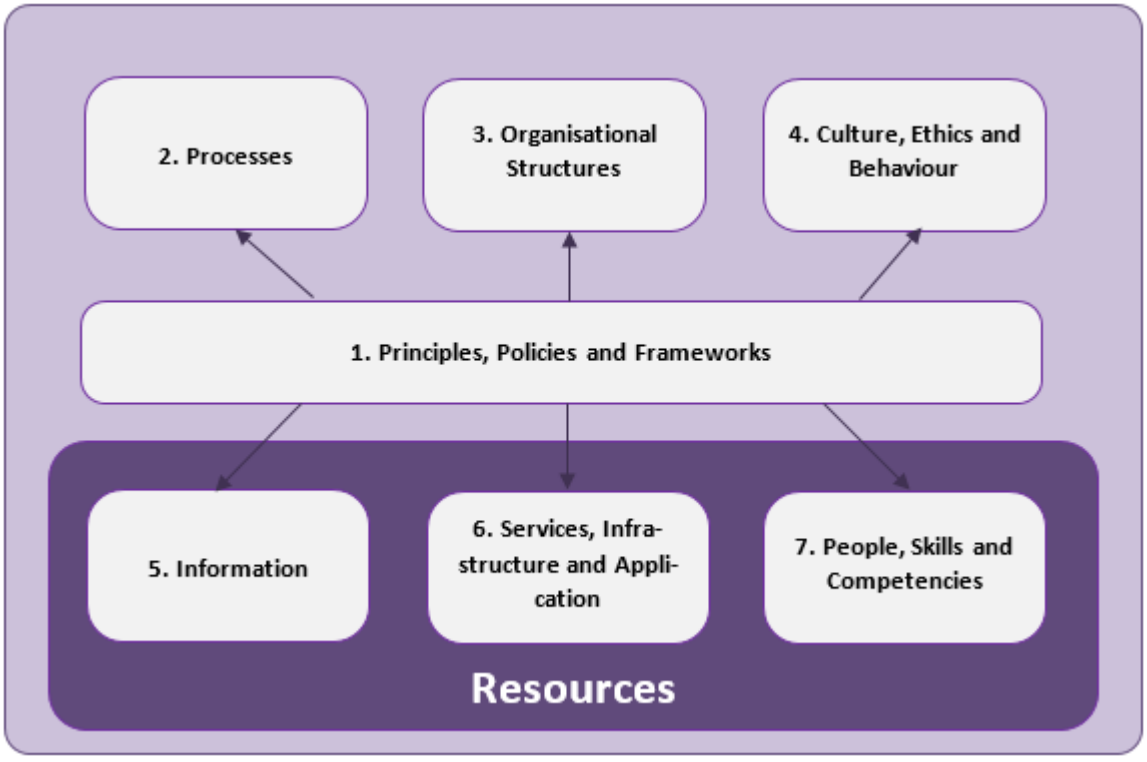


Figure 17 COBIT 5 Enablers (adapted from ISACA (2013c))

Finally, when combining the process model mentioned in figure 15 together with all the additional information and guidelines, IT companies are able set up a standardized and effective organisational structure. However, once initialized, every process model needs to be maintained.

2.4.3 Process Maturity

According to Repenning & Sterman (2002), the long-term success of any organisational structure needs to be maintained by strong and ongoing improvement measures. Process landscapes, which are not continuously questioned and adapted along economic developments, are going to erode over time.

In order to ignite the continuous improvement of processes, processes needs to be classified according to how good this process is at the current moment. Thereby various aspects such process performance, controlling and others are analysed. Based on such analyses, each process is classified within a model usually containing different levels of process maturity.

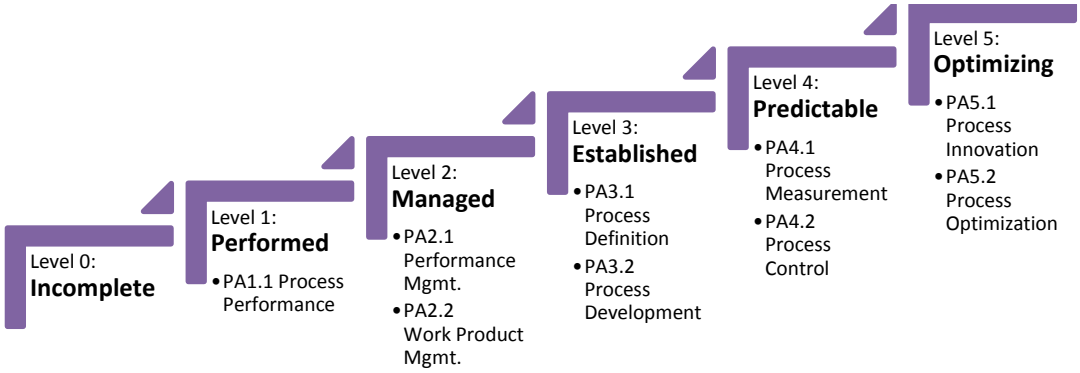


Figure 18 COBIT 5 PAM Capability Levels (adapted from ISACA (2013b))

As seen in figure 18 and described within table 6, COBIT 5's process assessment model, called PAM, contains six different levels of process maturity, starting from level 0 assigned for completely incomplete processes and moving up to level 5 for comprehensively optimized processes (ISACA (2013b)).

Level	Official Description
0 Incomplete	The process is not implemented or fails to achieve its process purpose. At this level, there is little or no evidence of any systematic achievement of the process purpose.
1 Performed	The implemented process achieves its process purpose.
2 Managed	The previously described performed process is now implemented in a managed fashion (planned, monitored and adjusted) and its work products are appropriately established, controlled and maintained.
3 Established	The previously described managed process is now implemented using a defined process that is capable of achieving its process outcomes.
4 Predictable	The previously described established process now operates within defined limits to achieve its process outcomes.
5 Optimized	The previously described predictable process is continuously improved to meet relevant current and projected business goals.

Table 6 COBIT 5 PAM & ISO/IEC 15504 Capability Levels (from ISACA (2013b))

These so-called COBIT 5 PAM capability levels are closely related to the respective standard ISO/IEC 15504, which contains exactly the same capability levels. This standard, also called SPICE for **s**oftware **p**rocess **i**mprovement and **c**apability d**e**termination, was initially developed in 1993, for CMM (Capability Maturity Model), another process maturity measurement model. Nonetheless, the successor of CMM – CMMI – today uses a slightly different maturity model containing five levels from 1 to 5 (International Standardisation Organisation (2003)).

Along these maturity levels, processes within a company's process landscape can be categorized according to their specific strengths and weaknesses. Therefore, the task of categorizing processes according to their maturity levels should be initiated by a company's management. However, according to COBIT 5's principle number five mentioned within figure 16, the execution of process governance, what includes maturity categorization, should be clearly divided from the management of the process model.

2.4.4 Process Maturity Measurement

Along the capability levels introduced within the previous chapter, processes can be categorized. However, the concrete measurement itself is a complicated endeavour as companies are different and their interpretation of reference model guidelines may vary. Even more, according to Andenmatten (2012b), wrong measuring or measuring process maturity with wrong objectives can lead to inadequate incentives within a company. This means that a company process and its involved employees probably delivers desired results, a measurement too close to theoretical baselines may result in a low maturity level, what of course may cause frustration within a actually well running part of a company.

To address such challenges, process maturity models like COBIT 5 PAM as well as the respective international standard ISO/IEDC 33001:2015 (International Standardisation Organisation (2015c)) contain measurement architectures that respect the company and process specific conditions.

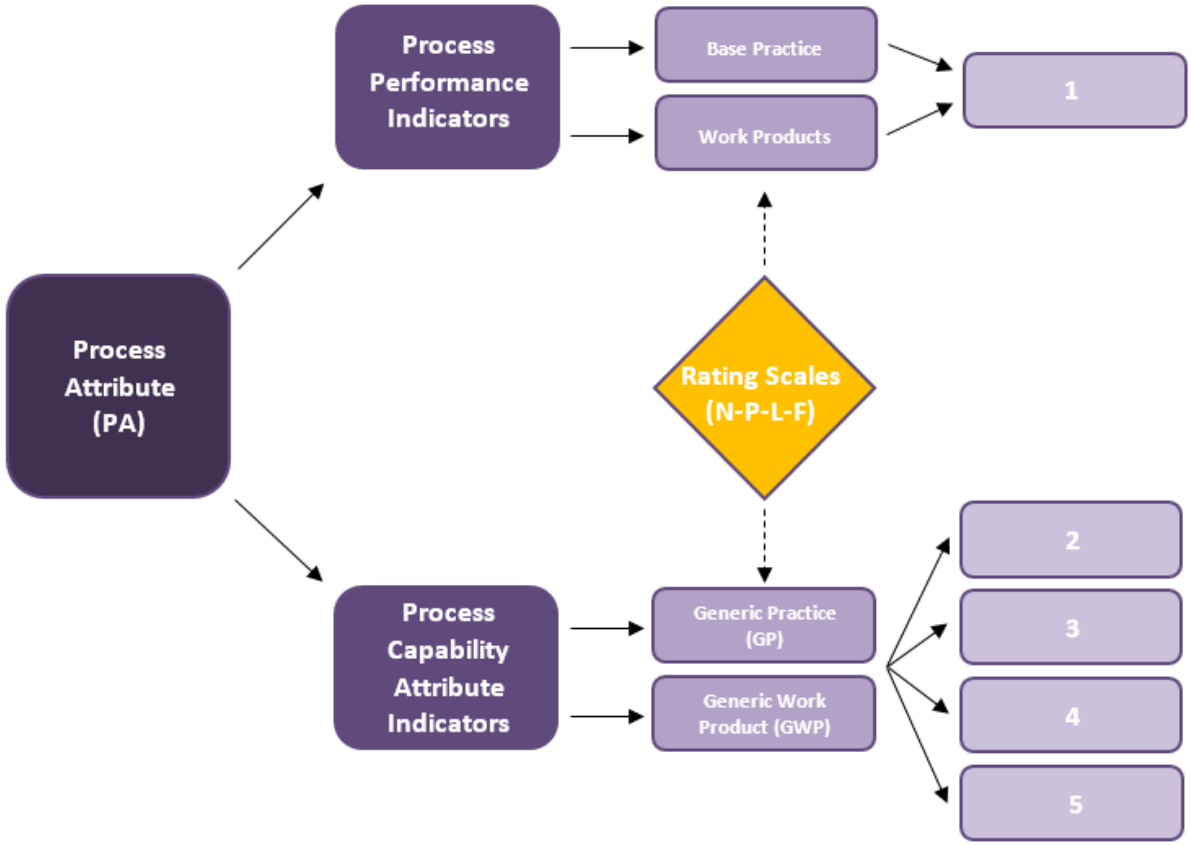


Figure 19 COBIT 5 PAM Maturity Measurement

As shown within figure 19, maturity measurement in COBIT 5 PAM is based on so-called process attributes (PA), which are divided into process performance indicators (adapted only on level 1) and process capability attribute indicators (used on level 2 to 5). Thereby every process attribute is directly allocated to a capability level.

While performance indicators are individual for every single process and are used to determine whether a process has reached level 1 or not, process capability attribute indicators are generic for all processes. Thereby, process capability attribute indicators contain generic practices (GP) and generic work products (GWP), which should be present within a process in order to reach a certain level.

Finally, every attribute can be measured along a four-stage classification model; this model is a part of ISO/IEC 15504. The classification stages are described within table 7.

Stage	Official Description
N (Not achieved / 0 – 15%)	There is little or no evidence of achievement of the defined attribute in the assessed process.
P (Partially achieved / >15 – 50%)	There is some evidence of an approach to, and some achievement of, the defined attribute in the assessed process. Some aspects of achievement of the attribute may be unpredictable.
L (Largely achieved / >50 – 85%)	There is evidence of a systematic approach to, and significant achievement of, the defined attribute in the assessed process. Some weakness related to this attribute may exist in the assessed process.
F (Fully achieved / >85 – 100%)	There is evidence of a complete and systematic approach to, and full achievement of, the defined attribute in the assessed process. No significant weaknesses related to this attribute exist in the assessed process.

Table 7 COBIT 5 PAM & ISO/IEC 15504 Rating Stages (from ISACA (2013b))

In conclusion, by combining a detailed process model with additional information and guidelines as well as with a maturity measurement model, the use of process reference models, such as COBIT 5, allow for the establishment and maintenance of a goal-oriented and value added process landscape.

2.5 Combinations

The theoretical elaboration in the area of quality management and process maturity measurement has shown that a combination of ISO 9001:2015 standard for quality management systems with a process reference model can be worthy. Respectively, the awareness for the advantages of such a combination is not a new insight.

A first attempt, described by Paulk (1995), tried to combine ISO 9001 with in that time the well-known, Capability Maturity Model (CMM). Focusing primarily on similarities and differences of both ISO 9001 and CMM, Paulk (1995) stated that a sensible co-existence of both approaches providing mutual reinforcements is possible. The paper also identified huge challenges concerning the completely different focus of both approaches related to granularity level (standard versus best practice) and subject (quality versus process improvement). Finally, Paulk (1995) stated that ISO 9001 and CMM have significant overlapping, but that a concrete mapping will not lead to success.

With the detachment of CMM by its successor CMMI, further analyses according the combination with ISO 9001:2000 have been done. For example, Yoo et al (2004) and Yoo et al (2006) have propagated a mapping model (see figure 20) which guide the implementation of CMMI for ISO 9001 certified companies.

ISO 9001:2000		CMMI PA	CMMI practice	Strength	Comments
7.0	Product realization				
7.1	Planning product realization				
	Develop needed processes	OPD	SP 1.1, 1.2, 1.2	S	
	Planning is consistent with other processes	OPD ALL	SP 1.1 GP 2.2, 3.1	S	
	Address objectives and verification	QPM PP	SP 1.1 SP 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7	S	SP 3.1–3.3 are not specifically required
	Plans in appropriate format	PP IPM	SP 2.7 SP 1.1, 1.3, 1.4	S	

S—strong match; M—medium match; W—weak match.

Figure 20 Mapping of ISO 9001:2000 and CMMI (from Mutafelija and Stromberg (2003))

Beside the combination with CMMI, further analyses of e. g. Bayo-Moriones (2011) highlights the combination potential of ISO 9001 and EFQM, while Aldowaisan & Youssef (2004) concretely focuses on the implementation of an incremental ISO 9001 quality management system within small enterprises. All these studies mention the necessity of strong continuous improvement measures within ISO 9001 QMS. These studies also mention difficulties regarding different focuses and contexts of the single standards and best practices.

3 Research Methodology

This chapter describes the appropriate research strategy of the study. Thereby the research cornerstones as well as the concrete research chronology are determined in detail.

3.1 Research Corner Stones

According to Saunders et al. (2009), every research project is guided and defined by a specific research methodology. Thereby, this methodology consists of various aspects, which are usually organized and visualized within a so-called research onion. For this study, the adapted form of this onion is shown in figure 21.

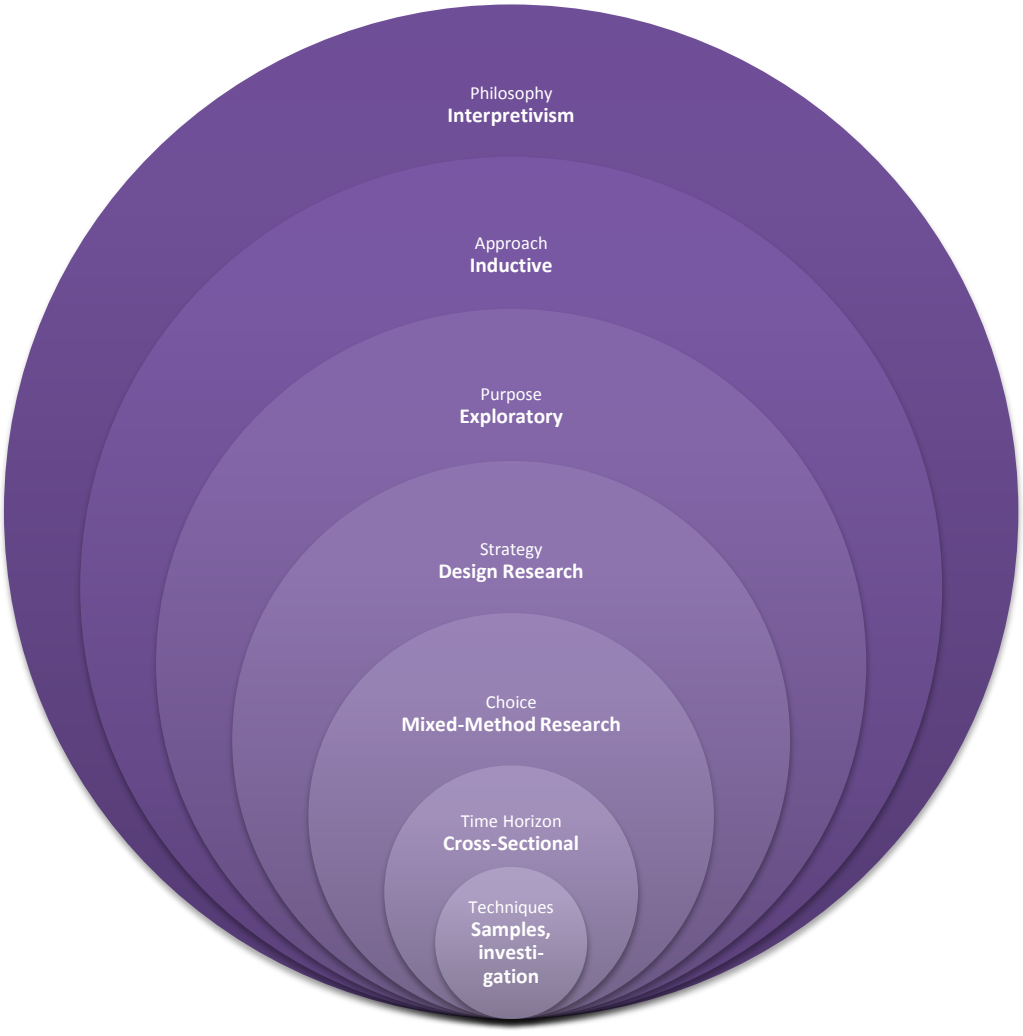


Figure 21 Research Corner Stones (adapted from Saunders et al. (2009))

On the outermost sphere of the research methodology, the basic philosophy is defined. Thereby this study is arranged around an interpretivist research philosophy. This because, according to Saunders et al. (2009), an interpretivist study is well suited for research topics around organisational behaviour. Furthermore, Walsham (1993) defines interpretivism as a form of study that generally attempts to understand a certain topic along the meaning a society assigns to it. Thereby the understanding of the entire context of a topic relishes a high importance, what is true for the present study.

Beside the philosophy, a research project is also guided by a specific research approach. This approach is clearly inductive for the present study as an advanced problem understanding is the basis for the development of a process maturity measurement model for quality management systems. Furthermore, an inductive research approach allows a flexible structure to be able to react on changing boundaries during research which is necessary

due to the imminent release of ISO 9001:2015, which could directly influence the present study. In addition, according to Saunders et al. (2009), inductive research has a focus on qualitative, rather small samples of data, which is true for this study as well.

Regarding the research purpose, this study is guided by an exploratory purpose, as the aim is to explore new insights by allowing QMS process maturity measurement through the combination of two well-known standards and best practices. This main objective also guides the present study towards the so-called design science research strategy of Hevner & Chatterjee (2010) (see figure 22). This because the resolution of a problem and the generation of a new model or artefact is in focus (Hinkelmann & Witschel (2014)).

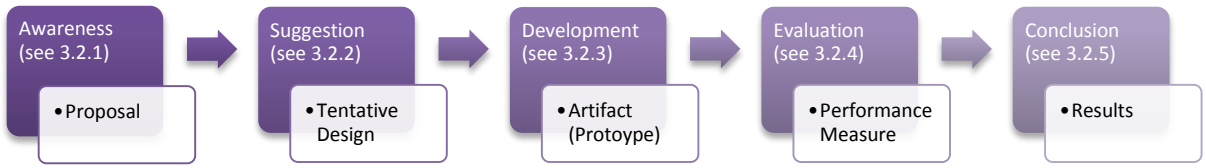


Figure 22 Design Science Research Framework (adapted from Hevner & Chatterjee (2010))

Based on the defined purpose and strategy, research choices can be defined. The present study is following a mixed-method research choice. The reason is the fact that the study has, due to its research purpose, a qualitative focus, which is aggregated by quantitative data collected during the review of relevant literature (Saunders et al. (2009)).

Taking into focus the temporal aspect of the planned study, its time horizon is cross sectional. According to Saunders et al. (2009), this means the study highlights the defined topic during a given and limited period. Throughout the fixed length of a master thesis, this limitation is clearly true.

Finally, all these research aspects lead to the selection of a certain set of research techniques and procedures. As for the planned study, a huge amount of well-documented literature and practical samples are available, these techniques are mainly focused on such samples and further investigations along the literature. Further research techniques such as interviews or questionnaires (Hinkelmann & Witschel (2014)) are not used.

3.2 Design Research Steps

According to the design science research framework of Hevner & Chatterjee (2010), every single step within this process is guided by specific objectives, which focus on target-aimed research. Thereby, the overall objective is to generate a competitive advantage by adapting scientific knowledge along a practical problem which is defined, according to Beckman & Barry (2007), as design thinking. Therefore, every step in the study is described.

3.2.1 Awareness

This very first step contains the development of the scientific baseline. It includes the definition of relevant research attributes such as thesis statement and research objectives as well as the detailed investigation of the literature as described within chapter 2.1. Additionally, the appropriate research methodology is determined.

3.2.2 Suggestion

Within this part of the research process, the literature compiled and analysed in the previous research will be used to determine possible solutions for approaches in order to develop a maturity measurement prototype for ISO 9001 certified process models. As various solutions are conceivable, this step will also include a weighting of specific strengths and weaknesses of every single approach. By the end of this step, the preferred solution approach needs to be defined along the theoretical baseline.

3.2.3 Development

The development of the prototype is based on the revealed insights of the suggestion phase. Thereby, a concrete model to measure process maturity in ISO 9001 process models will be defined. For this, the design science research cycles defined by Hevner & Chatterjee (2010) need to be taken into focus.

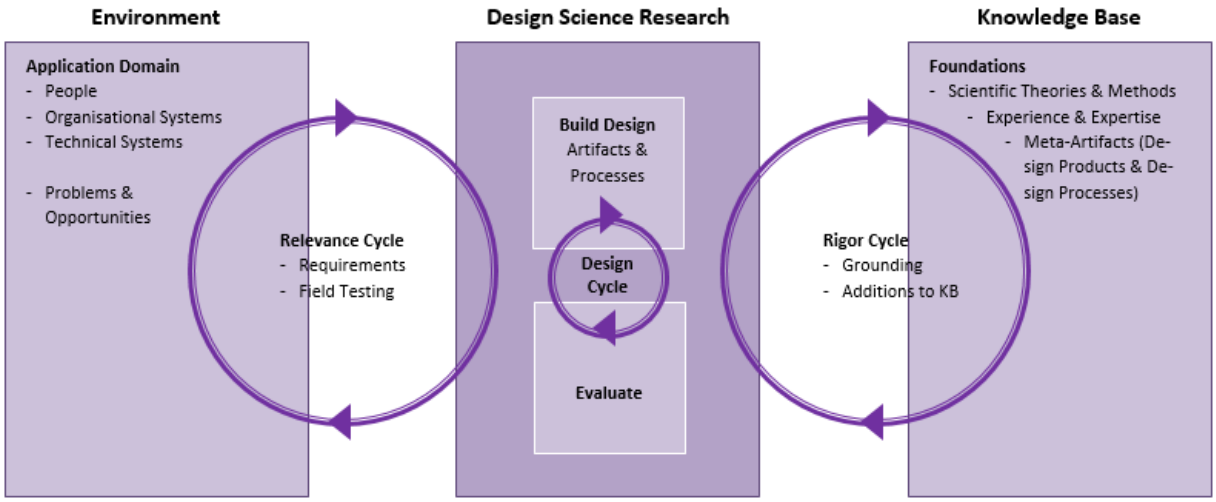


Figure 23 Design Science Research Cycles (adapted from Hevner & Chatterjee (2010))

As figure 23 illustrates, the research work along the design science approach is about balancing the environment and the theoretical knowledge base. On the one hand, research activities collect practice-oriented requirements and test fulfilment by performing field trials within a so-called relevance cycle. On the other hand, design science research is influenced by a theoretical knowledge base (see chapter 2 of this study) which is grounding the performed research. Thereby, new insights provided by research activities may lead to an adaption of the knowledge base.

The research activities themselves are performed within an iterative sequence of building new artefacts and evaluating them along theory and practice. The orientation along the design science research strategy of Hevner & Chatterjee (2010) means that both perspectives need to be taken into account. On the one hand practical requirements represented in a qualitative form by Glaux Soft AG, the supporting company within the qualitative case study (see chapter 6).

On the other hand, theoretical baselines when developing a prototype that allows the measurement of process maturity within ISO 9001 process models. According to Hess et al. (2014), this procedure is typical for design- and practice-oriented research endeavours in Europe.

3.2.4 Evaluation

Within the evaluation step, the previous developed prototype will be tested alongside the current ISO 9001 certified process model of the selected unit of analysis (Glaux Soft AG). Thereby on the one hand, maturity levels should result for Glaux Soft's processes, which allow the company to set priorities along further improvement measures. As Glaux Soft AG will be faced with a full ISO 9001:2015 recertification by the end of 2016, this evaluation should help setting the right priorities in order to regain the respective ISO 9001:2015 certification at that given point. On the other hand, the practical adaption of the prototype should allow further improvement of the process maturity measurement model towards a target-aimed instrument deliverable in daily practice.

3.2.5 Conclusion

Within the last step of the design science research strategy, the entire research project will be concluded regarding its specific potential at that given time. At the same time, still existing limitations will be described in order to classify the performed work from both a practical as well as a theoretical point of view. Finally, an outline of possible next steps should be provided.

4 Components of a Measurement Framework

Based on the insights described within the previous chapters, a relevant approach of measuring process maturity for quality management systems is to combine both ISO 9001:2015 and COBIT 5 PAM.

4.1 Combining Standards & Frameworks

A combination between different standards and / or frameworks has to be performed in a structured way (Alter & Goeken (2009)). Based on this combination, various aspects of a target-aimed combination could be derived. This led to the individual development of the following mapping approach for two different standards and / or frameworks.

4.1.1 Combination Dimensions

When combining two different standards or frameworks within the field of IT governance, their mapping is influenced by two dimensions: The similarity potential, meaning the grade of how many elements from one methodology can be adapted within another one, needs to be taken into account. The second dimension is the aspect of mapping granularity, describing how good a single element of one methodology can be mapped with a similar element of another. In Table 8, the two dimensions are described in detail.

Combination Dimension	Low Level	High Level
Similarity Potential	A low similarity potential means a combination of two standards or frameworks where only few elements of the one methodology can be used within the other. Respectively most concepts need to be individually developed or adapted.	A high similarity potential describes a combination of standards or frameworks that allows the reuse of many elements of one methodology within the other. In consequence, none or only few elements need to be individually developed or adapted.
Mapping Granularity	A low level of mapping granularity describes a combination of two standards or frameworks on a rough level. Respectively, similar elements of both methodologies cannot be mapped with each other or only on a vague level what makes such a combination difficult to comprehend.	A high level of mapping granularity means a combination of two standards or frameworks where similar elements of both methodologies can be mapped within detail. Respectively, such a mapping is comprehensible and clear.

Table 8 Combination Dimensions

Regardless of the field of activity, the concrete standards, or frameworks that should be mapped with each other, these two combination dimensions mentioned within table 8 always act in the same way. Thereby, similarity potential and mapping granularity interact with one other meaning that, the higher the similarity potential of a certain combination, the lower the mapping granularity and vice versa. Therefore, a trade-off needs to be defined for every specific combination of two standards or frameworks.

4.1.2 Combination Level

Another aspect of the combination of different standards and frameworks is the level on which a respective combination is performed. In general, as described by ISACA (2010), these levels can be rather high-, meaning a maximised similarity potential and minimal mapping granularity, or low-level whereas the mapping granularity is maximised and similarity potential is low. These levels are visualised within figure 24.

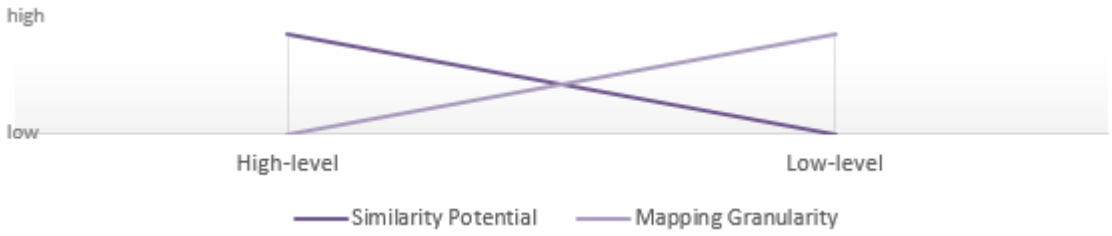


Figure 24 Generic Levels of Combination (own visualisation)

Different from for the combination dimensions, certain levels of combination need to be defined specifically for each desired combination, meaning that individual aspects and characteristics of the standards and frameworks need to be taken into account. Within the following chapters, these technologies will be used toward the achievement of the defined study objectives.

4.2 Specific Combination Levels

Based on the combination procedure explained within the previous chapter, the specific levels for the desired combination of ISO 9001:2015 and COBIT 5 PAM need to be defined. Thereby, the four levels presented in figure 25 are relevant.

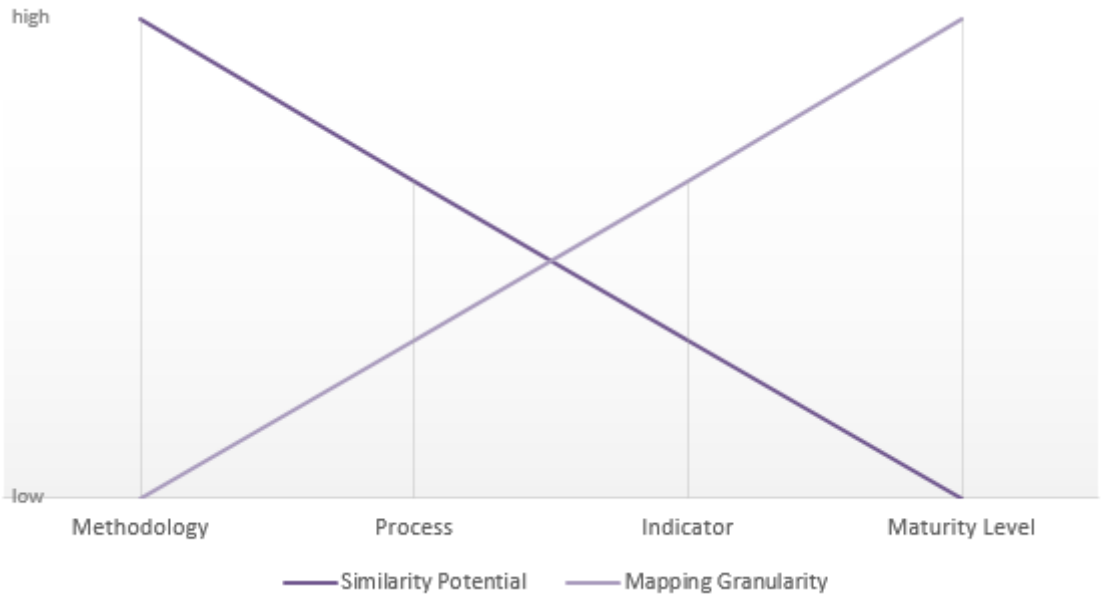


Figure 25 Different Mapping Levels (own visualisation)

Each level has a specific similarity potential and a given mapping granularity. On the highest level, a combination of the methodology level is conceivable whereas on the lowest level, a mapping on maturity levels is possible. In between, the more balanced combination approaches on process and indicator level are situated. All of these four levels need to be investigated in order to be able to select the right level of combination for the desired combination of ISO 9001:2015 and COBIT 5 PAM. Respectively, they are described in detail in the following text.

4.2.1 Methodology

A combination of ISO 9001:2015 and COBIT 5 PAM on methodology level describes a mapping of both entire methodologies with each other. This is, due to the different characteristics and focuses of both ISO 9001:2015 and COBIT 5 PAM, not possible. Respectively, this hypothetic combination level has a granularity mapping of zero (see figure 25) which indicates the lack of mapping possibilities.

Adapting such a combination in practice would lead to the usage of both methodologies independent from each other. ISO 9001:2015 would still have no comparable maturity measurement methodologies (see figure 26). Therefore, no synergies can be generated which finally leads to a non-optimal operation in daily business.

Figure 26 Combination on "Methodology"-Level

4.2.2 Process

One level below, a mapping of ISO 9001:2015 and COBIT 5 PAM on process level is conceivable. The basic idea behind this is to map the processes of ISO 9001:2015 and COBIT 5 PAM which have similar characteristics such as purpose, input & outputs and others. By doing that, all aspects of COBIT 5 PAM such as indicators, practices and maturity levels, which are allocated along a specific COBIT 5 process, can be reused within the desired prototype (see figure 27). Respectively, the similarity potential is quite high (see figure 25).

Regarding the mapping granularity, both methodologies are process-oriented which in general makes a mapping possible. However, the different focuses of both methodologies may lead to a missing mapping of for example sales and marketing processes in ISO 9001:2015 that are not present in COBIT 5. Therefore, the mapping granularity is even low (see figure 25).

Figure 27 Combination on "Process"-Level

4.2.3 Indicator

Furthermore, a mapping of the desired standards and frameworks on indicator level is possible. This means that specific indicators and practices need to be developed along the ISO 9001:2015 process model (see figure 28) which drives the similarity potential to an even lower level (see figure 25).

On the other hand, the mapping granularity is quite high because a mapping on such a low level generates many more contact points (meant by every single indicator and practice). Respectively, a mapping on indicator-level will be much easier to realize than on the previous levels.

Figure 28 Combination on "Indicator"-Level

4.2.4 Maturity Level

On the lowest level, a combination on maturity levels is another hypothetic possibility. Hypothetic because such a combination in fact is an ISO 9001:2015 specific replica of COBIT 5 PAM (see figure 29) what leads to a similarity potential of zero (see figure 25). However, the mapping granularity is maximised in this case because it is possible to redesign the elements of COBIT 5 PAM with direct focus on the requirements of an ISO 9001:2015 related process model. However, as for a mapping on methodology level, such a combination is not a mapping of both approaches at all.

Figure 29 Combination on "Maturity Level"-Level

4.3 Mapping on Process Level

Based on the performed analyses in previous chapters, the most useful mapping for ISO 9001:2015 and COBIT 5 PAM will result by a combination on the process level. This because all elements of COBIT 5 PAM can be reused while having a suitable mapping granularity.

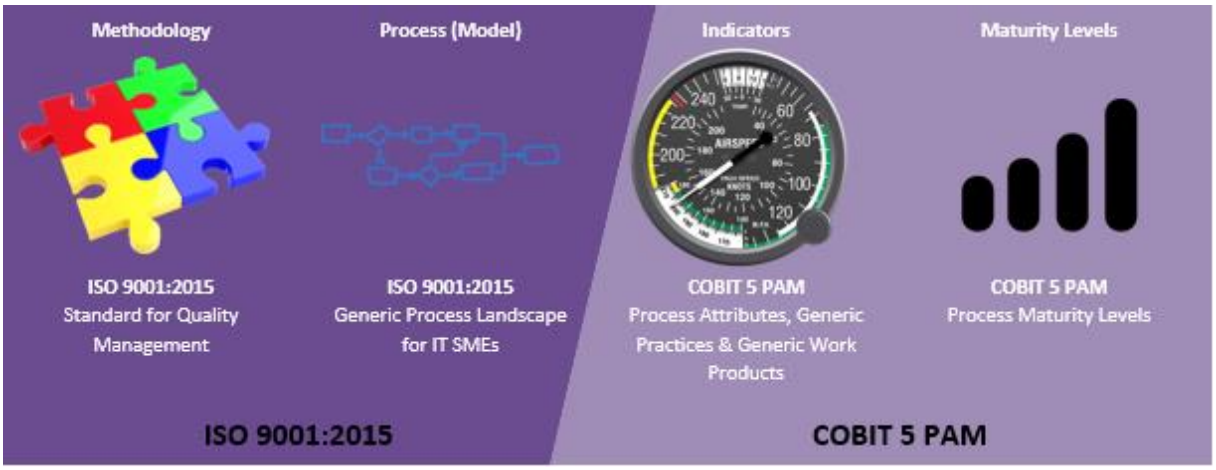


Figure 30 Map ISO 9001:2015 and COBIT 5 PAM

By mapping both standards / frameworks on the process level, it is on the one hand possible to reuse the entire maturity measurement expertise of COBIT 5 PAM. Therewith a lowering of the specific analysis and measurement potential of COBIT 5 PAM can be prevented. This because, different from with a mapping on indicator-level, most of its given elements and functionalities are reused as a whole (see figure 30).

On the other hand, the process model of ISO 9001:2015 can be used as a common entering point into the Process Improvement Prototype (see chapter 5). As it is common to adapt and refine the high-level process model of the ISO-standard (see figure 14), a usage of the prototype will generate a certain recognition value.

Furthermore, a combination of two standards and / or frameworks on process level is a common approach within the field of IT-governance. While Glenfis AG (2011) is performing a respective mapping between COBIT 5 and ITIL Edition 2011, ISACA (2010) is operating in the a very similar manner when mapping COBIT 4.1 with the FFIEC (US Federal Financial Institutions Examination Council) IT Examination Handbook.

4.4 Generic Process Landscape for IT SMEs

The decision to combine ISO 9001:2015 and COBIT 5 PAM on process level is an essential baseline for the generation of the Process Improvement Prototype. However, by combining ISO 9001:2015 and COBIT 5 PAM on process level, the necessity of a generic, ISO 9001:2015-adapted process map is obvious. This process map generalizes individual aspects of the ISO 9001 certified process models, which will be assessed with the Process Improvement Prototype.

4.4.1 IT Process Map of the Swiss Federal Administration

While dealing with SME IT companies in Switzerland, it became clear that almost all of these companies are handling information about their processes and internal organisation confidentially. Therefore, the development of a generic ISO 9001:2015 process map from examples of different companies within the target audience has become a non-realistic endeavour. Respectively, a different solution approach had to be developed.

As some of the contacted companies mentioned the generic IT process landscape of the Swiss federal administration as the starting point of their individual process maps (among others Lemberg (2015)), further analyses of this process model have showed a close interlinkage with the cornerstones defined by the ISO 9001:2015 standard (ISB (2015)). Therefore, the present study defines this process model as the central element of the generic ISO 9001:2015 process landscape.

The Swiss federal IT process map (see figure 31) is a process framework consisted of nine different processes, which are in close cooperation with each other and are categorized within three process categories.

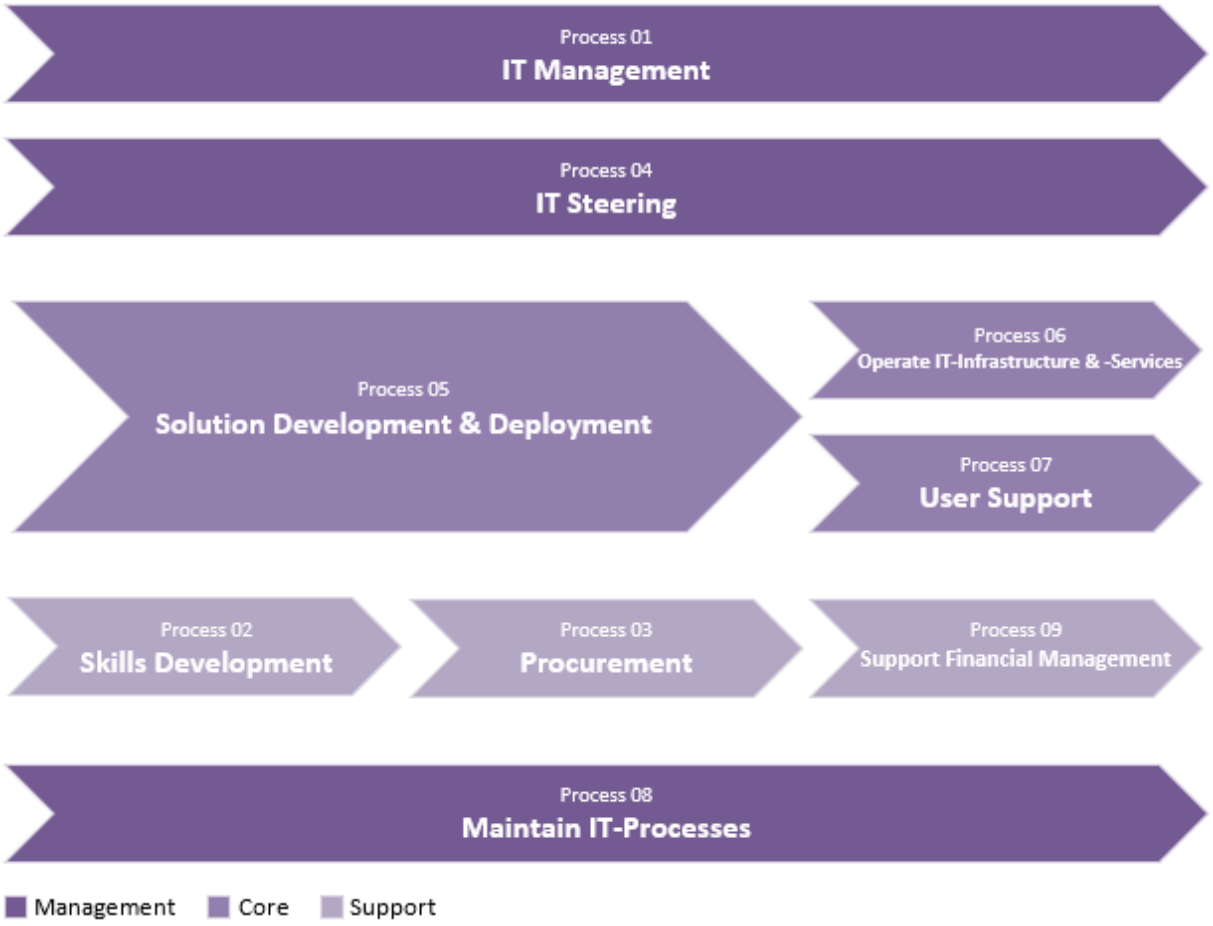


Figure 31 Swiss Federal IT Process Map (from ISB (2015))

Three management processes are focused on strategic challenges within the IT whereas three core processes are covering daily activities within information technology. Finally, three support processes encourage the six management and core processes with specific services and solutions.

Every single process has its specific activities, objectives, input, outputs and roles that are necessary to perform the process in its desired way. For further details, please see Appendix B (Generic Process Map for IT SMEs in Detail).

4.4.2 Extensions to the Swiss Federal IT Process Map

The Swiss federal IT process map, as mentioned within the previous chapter, covers most of the organisational topics Swiss based SME companies are faced with. However, as this process model is focused on IT departments within the federal administration, two important fields of activity, which are focused on external interaction with customers, are not covered within this process model – marketing and sales. Therefore, the Swiss federal IT process map must be expanded with two additional processes in order to meet the requirements of the generic ISO 9001:2015 process model for IT SMEs (GPM-IT).

On the one hand, a strategic management process called "Strategic Marketing" has been added to the process model. The objective of this process is to ensure an adequate external and internal communication with all stakeholders. This includes the management and maintenance of communication channels as well as the definition of respective CI/CD-regulations and best practices.

On the other hand, an additional core process called "Sales" is added to the process model. Within this process, sustainable customer relationships should be established in order to ensure the long-term survival of the company. Thereby, this new process is an upstream process for all other core processes.
Both new processes are linked with the existing nine processes mentioned within the Swiss federal IT process map. Details along these specific in- and outputs as well as along the defined roles for these processes are as well available within Appendix B (Generic Process Map for IT SMEs in Detail).

4.4.3 Generic ISO 9001:2015 Process Model for IT SMEs (GPM-IT)

Based on the Swiss federal IT process map and combined with the necessary extensions, a generic ISO 9001:2015 process model for small and mid-sized IT companies in Switzerland (GPM-IT) can be defined.

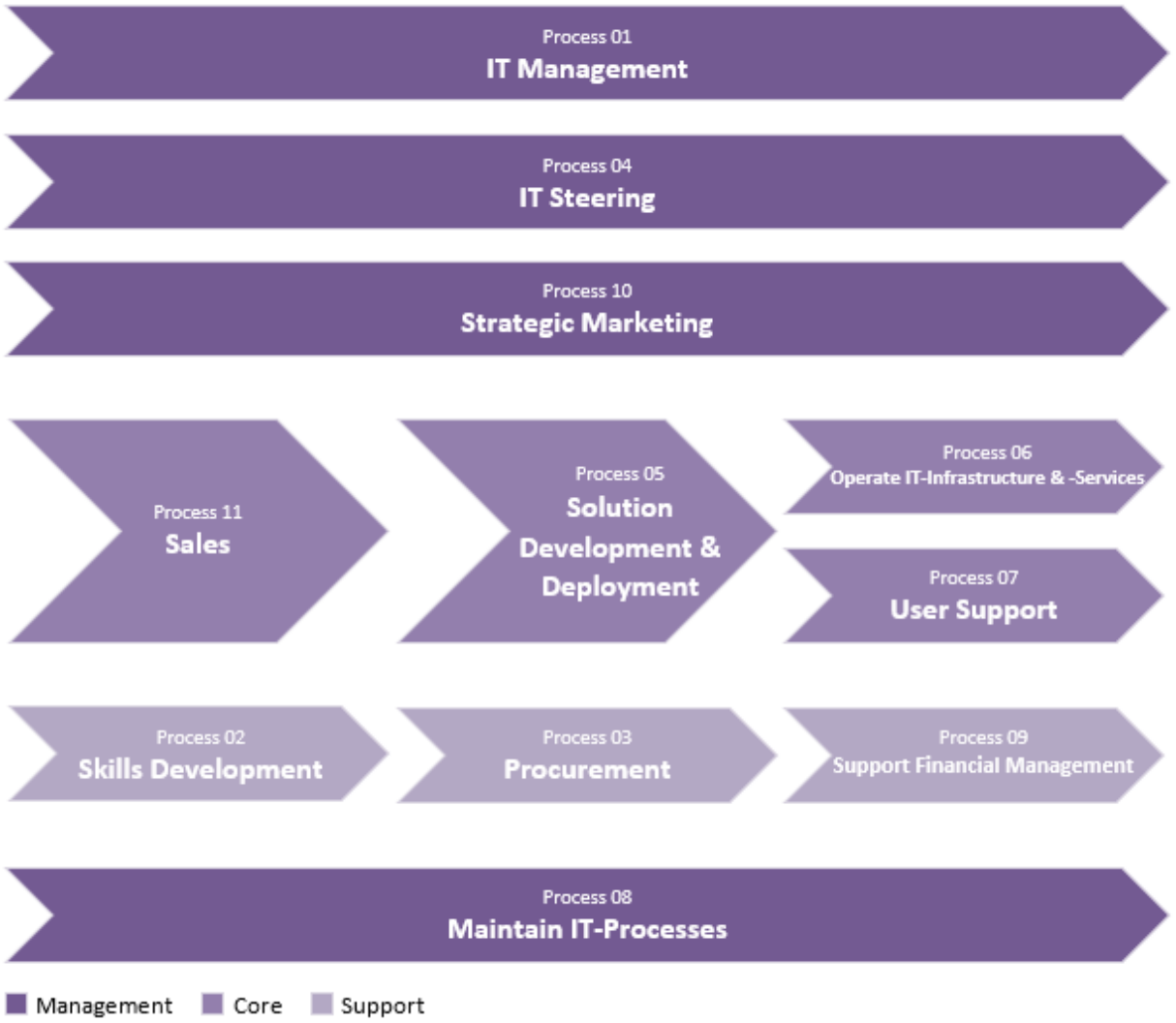


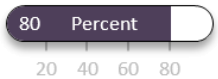
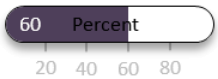
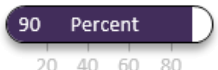
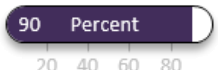
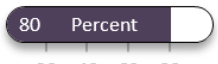
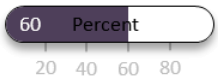
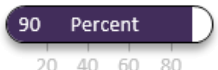
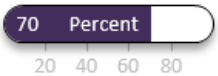
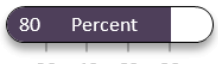
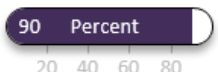
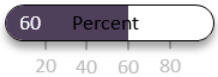
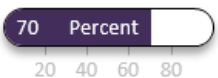
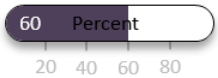
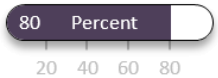
Figure 32 Generic ISO 9001:2015 Process Model for IT SMEs (GPM-IT) (adapted from ISB (2015))

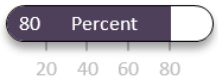
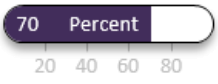
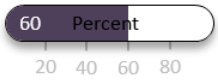
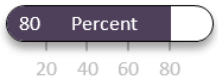
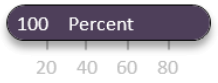
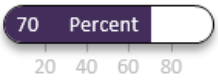
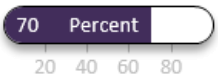
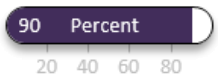
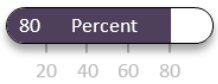
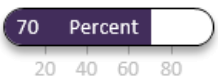
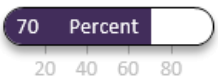
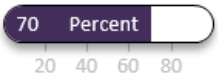
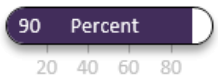
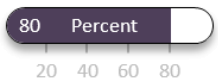
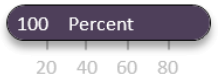
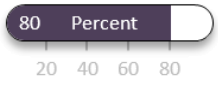
As visualized within figure 32, the generic ISO 9001:2015 process model consists of 11 processes. Based on these processes, every single IT company should be able to match its specific ISO 9001:2015 processes with one of these generic processes. Respectively the process improvement prototype (see chapter 5) becomes usable.

Within a next step, each of these 11 generic processes needs to be mapped with one or more processes out of the COBIT 5 framework in order to be able to use the defined maturity measurement technologies, which are allocated to every COBIT 5 process within COBIT 5 PAM framework.

4.5 ISO 9001:2015 versus COBIT 5 PAM Mapping Approach

Based on the GPM-IT (figure 32), each process is mapped with one or more of the COBIT 5 processes (see table 9). Along this mapping, the relevant process maturity measurement capabilities of COBIT 5 PAM can be derived. Within the table below, the left column indicates the process of the GPM-IT that is mapped with the COBIT 5 processes presented in the right column. The mapping accuracy of the two processes is can be seen in the middle column. A higher accuracy means processes that are more congruent.

Generic ISO 9001:2015 Process	Mapping Accuracy	COBIT 5 Process
Management Process 01 IT Management		**Evaluate, Direct and Monitor (EDM)** EDM01 Ensure Governance Framework Setting and Maintenance
		**Evaluate, Direct and Monitor (EDM)** EDM03 Ensure Risk Optimization
		**Align, Plan and Organise (APO)** APO01 Manage the IT Management Framework
		**Align, Plan and Organise (APO)** APO02 Manage Strategy
		**Align, Plan and Organise (APO)** APO03 Manage Enterprise Architecture
		**Monitor, Evaluate and Assess (MEA)** MEA01 Monitor, Evaluate and Assess Performance and Conformance
		**Monitor, Evaluate and Assess (MEA)** MEA03 Monitor, Evaluate and Assess Compliance With External Requirements
Management Process 04 IT Steering		**Evaluate, Direct and Monitor (EDM)** EDM04 Ensure Resource Optimization
		**Align, Plan and Organise (APO)** APO05 Manage Portfolio
		**Align, Plan and Organise (APO)** APO09 Manage Service Agreements
		**Align, Plan and Organise (APO)** APO12 Manage Risk
Management Process 08 Maintain IT-Processes		**Align, Plan and Organise (APO)** APO11 Manage Quality
		**Deliver, Service and Support (DSS)** DSS06 Manage Business Process Controls
		**Monitor, Evaluate and Assess (MEA)** MEA02 Monitor, Evaluate and Assess the System of Internal Control

Generic ISO 9001:2015 Process	Mapping Accuracy	COBIT 5 Process
Management Process 10 Strategic Marketing		**Evaluate, Direct and Monitor (EDM)** EDM05 Ensure Stakeholder Transparency
		**Align, Plan and Organise (APO)** APO08 Manage Relationships
Core Process 05 Solution Development & Deployment		**Evaluate, Direct and Monitor (EDM)** EDM02 Ensure Benefits Delivery
		**Align, Plan and Organise (APO)** APO04 Manage Innovation
		**Build, Acquire and Implement (BAI)** BAI01 Manage Programmes and Projects
		**Build, Acquire and Implement (BAI)** BAI02 Manage Requirements Definition
		**Build, Acquire and Implement (BAI)** BAI05 Manage Organisational Change Enablement
		**Build, Acquire and Implement (BAI)** BAI06 Manage Changes
		**Build, Acquire and Implement (BAI)** BAI07 Manage Change Acceptance and Transitioning
		**Build, Acquire and Implement (BAI)** BAI08 Manage Knowledge
Core Process 06 Operate IT-Infrastructure & -Services		**Align, Plan and Organise (APO)** APO13 Manage Security
		**Build, Acquire and Implement (BAI)** BAI03 Manage Solutions, Identification and Build
		**Build, Acquire and Implement (BAI)** BAI04 Manage Availability and Capacity
		**Build, Acquire and Implement (BAI)** BAI10 Manage Configuration
		**Deliver, Service and Support (DSS)** DSS01 Manage Operations
		**Deliver, Service and Support (DSS)** DSS03 Manage Problems

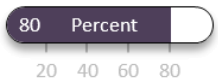
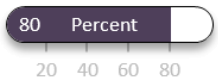
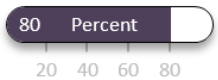
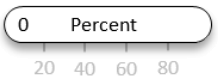
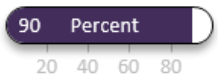
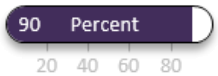
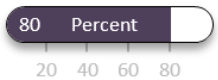
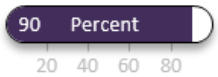
Generic ISO 9001:2015 Process	Mapping Accuracy	COBIT 5 Process
Core Process 06 Operate IT-Infrastructure & -Services		**Deliver, Service and Support (DSS)** DSS04 Manage Continuity
		**Deliver, Service and Support (DSS)** DSS05 Manage Security Services
Core Process 07 User Support		**Deliver, Service and Support (DSS)** DSS02 Manage Service Requests and Incidents
Core Process 11 Sales		No comparable COBIT 5 process is available.
Support Process 02 Skills Development		**Align, Plan and Organise (APO)** APO07 Manage Human Resources
Support Process 03 Procurement		**Align, Plan and Organise (APO)** APO10 Manage Suppliers
		**Build, Acquire and Implement (BAI)** BAI09 Manage Assets
Support Process 09 Support Financial Management		**Align, Plan and Organise (APO)** APO06 Manage Budget and Costs

Table 9 Mapping Generic ISO 9001:2015 and COBIT 5 Processes

Table 9 shows that all generic processes except process 11 (Sales) are covered by at least one COBIT 5 process. Respectively, individual processes allocated around the sales topic and mapped with process 11 will not be assessed within the planned prototype. This because COBOT 5 does not address the sales topic. For all other individual processes, this mapping, described in detail within Appendix C (Generic Process Map and COBIT 5 Detailed Process Mapping), allows the usage of specific maturity measurement elements of COBIT 5 PAM in order to assess a certain ISO 9001:2015 process, which allows the categorization and future optimization of such processes.

5 ISO 9001:2015 Process Improvement Prototype

The Process Improvement Prototype (PIP) is based on the previous chapters. Respectively, the prototype contains methodologies that allow the mapping of individual ISO 9001:2015 processes with a process of the GPM-IT. Furthermore, various process maturity measurement tools, which allow the analysis and categorisation of typical ISO 9001:2015 processes in IT, are provided.

5.1 Overview

The PIP covers two major fields of activity, which continuously interact with each other as outputs of the one activity become inputs of the other and vice versa. This linkage as well as particular processes of those two fields are visualized in figure 33.

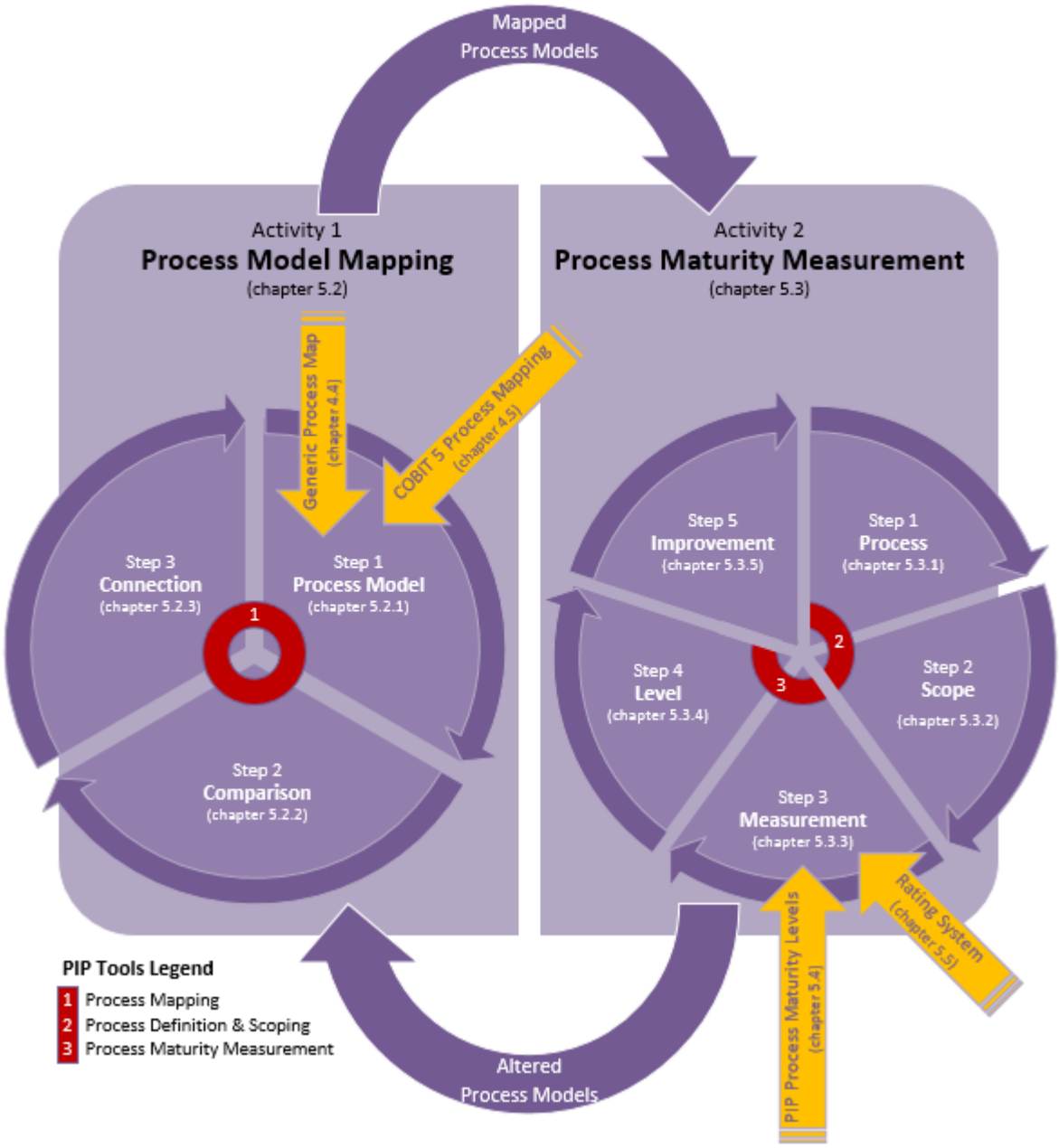


Figure 33 Process Improvement Prototype (PIP)

The elements of the Process Improvement Prototype (PIP) are described in further details within the following chapters.

5.2 Process Model Mapping

One major activity of the PIP allows the allocation of company-specific ISO 9001:2015 processes with the given processes of the GPM-IT. The necessary steps are shown in figure 34.

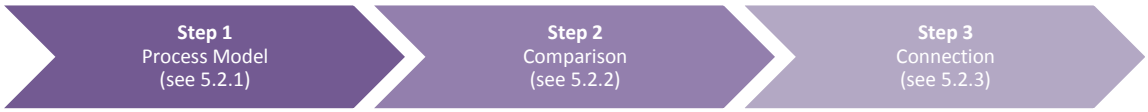


Figure 34 PIP ISO 9001:2015 Process Model Mapping Steps

Along these three steps, the mapping of the two process models, the basis for all other maturity measurement tasks, are possible.

5.2.1 Process Model

The PIP operates based on the GPM-IT (figure 35) which is described in detail in Appendix B (Generic Process Map for IT SMEs in Detail) of the study.

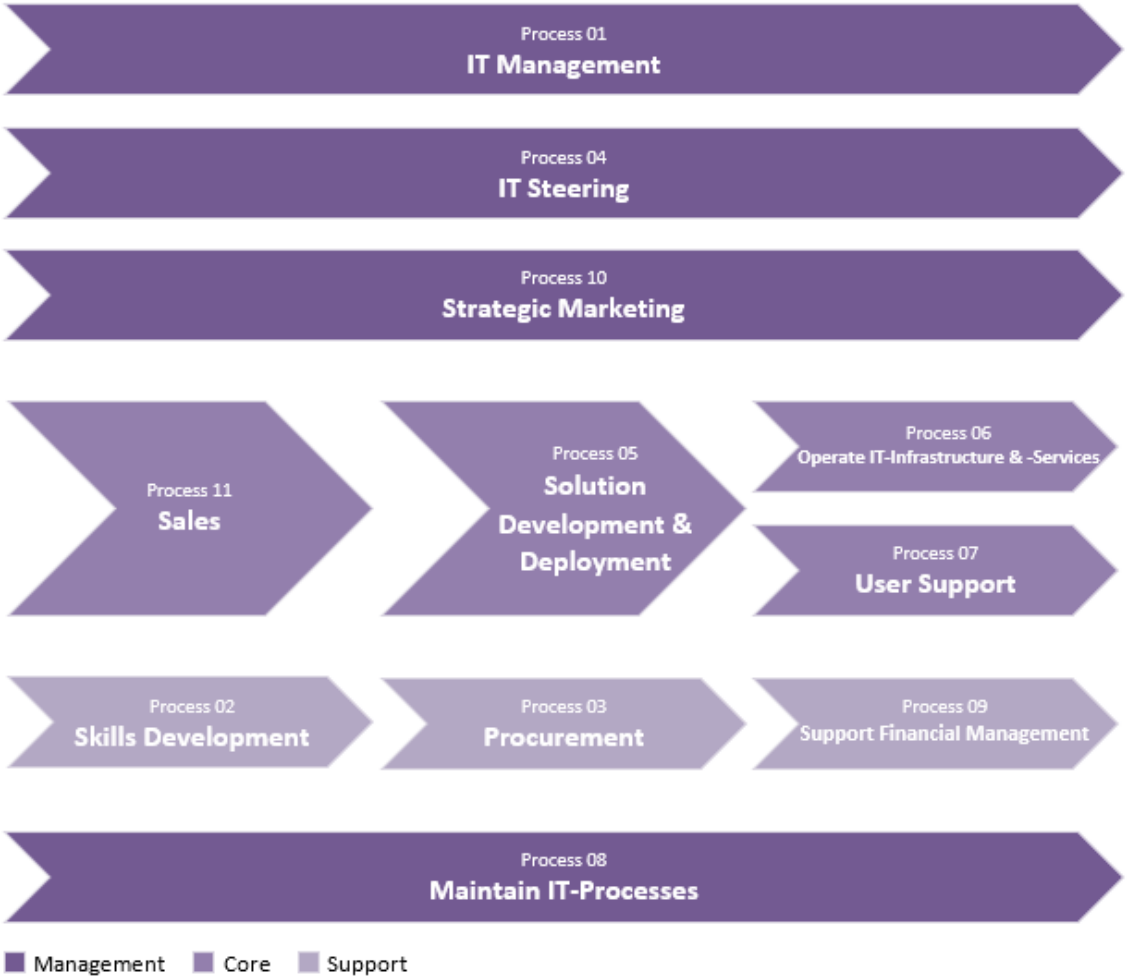


Figure 35 Generic ISO 9001:2015 Process Model for IT SMEs (GPM-IT) (adapted from ISB (2015))

Based on this process model, users of the PIP need to allocate their individual ISO 9001:2015 processes by performing the activities described within the next subchapters.

5.2.2 Comparison

The mapping of an individual ISO 9001:2015 process with one of the eleven processes of the GPM-IT needs to be performed in a structured way. Therefore, the PIP provides an instrument, which allows the analysis and comparison of two given processes along five different aspects. This comparison is described within table 10.

Aspect	Description	Weighting
Process Inputs	This aspect focuses on the inputs a given process consumes from its environment. The more similar process inputs are, the more equal are two processes in general.	For every aspect, the individual, subjective coverage of the two selected processes is defined in a percentage way. To detect the overall mapping accuracy, the average of each of the five compared aspects is calculated.
Process Outputs	Every process should provide a given work result that is defined as an output to its environment as well as to other processes (where such a work product is an input). Similar outputs therefore are an evidence for related processes.	
Process Objectives	Every process is performed with a given objective in mind. Therefore, comparable process objectives may lead to very comparable processes.	
Process Activities	Within every process, one or more activity is performed that support the reach of the objectives as well as the production of the defined outputs. Again, similar activities usually lead to similar processes.	
Process Roles	Within every process, certain roles are involved. Therefore, similar roles and responsibilities may be an evidence for a high mapping potential of two processes.	

Table 10 PIP Weighting Aspects

With these five weighting aspects, combined within an overall mapping accuracy, a very detailed categorisation of a given process combination can be defined. However, these detailed results need to be categorized in a more general way in order to be able to determine whether a performed comparison is adequate or not. Therefore, the PIP provides as a second instrument a three-step status concept (see table 11) that allows a general categorisation of a given comparison.

Status	Description	Overall Mapping Accuracy
Green	Process mappings with this status have a high overall mapping accuracy. Their usage within the PIP needs no further action.	>= 80 %
Yellow	Process mappings with a yellow mapping status can be used for the PIP, but further analyses should be done in order to identify the present differences. Probably, a better mapping with another process of the GPM-IT can be achieved.	>= 50 % - < 80 %
Red	Process mappings with status red cannot be used within the PIP as their differences are too fundamental. Therefore, the usage of the standardized process maturity measurement components may lead to wrong results.	< 50 %

Table 11 PIP Mapping Statuses

Based on these two supporting instruments, a mapping of every individual ISO 9001:2015 process with one of the eleven processes of the GPM-IT should be achievable.

5.2.3 Connection

Both the GPM-IT and the instruments defined within the previous chapter are adapted within the following mapping tool. This tool, listed as tool number 1 within the overview of the PIP (see figure 33) as well as within Appendix F (Process Improvement Prototype (PIP)), supports the definition of a proper process mapping necessary for the usage of the PIP in practice.

Company-specific ISO 9001:2015 Process Map

Generic ISO 9001:2015 Process Map for IT SMEs

	Process Mapping	11	12	13	14	15	16	17	21	22	23	24	25	27	31	32	33	34	35	36
	Best Process	01	01	01	02	10	08	05	04	11	05	05	07	07	11	03	09	06	06	06
	Overall Mapping Accu	0.90	0.80	0.70	0.60	1.00	0.90	1.00	0.60	1.00	0.70	0.80	0.90	0.80	1.00	1.00	0.70	0.80	0.60	0.60
	Status																			
01	Inputs	0.60	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Outputs	0.80	1.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Objectives	1.00	0.60	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Activities	1.00	0.60	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Roles	1.00	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.90	**0.80**	**0.70**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
04	Inputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Outputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Objectives	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Activities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Roles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
08	Inputs	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Outputs	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Objectives	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Activities	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Roles	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.90**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
10	Inputs	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Outputs	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Objectives	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Activities	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Roles	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	**0.00**	**0.00**	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
05	Inputs	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Outputs	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Objectives	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.60	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Activities	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.60	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Roles	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.60	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**0.00**	**0.00**	**0.70**	**0.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
06	Inputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	1.00	0.40	0.60
	Outputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.80	0.60	0.60
	Objectives	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.80	0.60	0.80
	Activities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.80	0.40	0.60
	Roles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.60	0.80	0.60
		0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.80**	**0.60**	**0.60**
07	Inputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00
	Outputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00
	Objectives	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00
	Activities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00
	Roles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.90**	**0.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
11	Inputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
	Outputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
	Objectives	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
	Activities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
	Roles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
		0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
02	Inputs	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Outputs	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Objectives	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Activities	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Roles	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	**0.00**	**0.00**	**0.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
03	Inputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
	Outputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
	Objectives	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
	Activities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
	Roles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00
		0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**
09	Inputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00
	Outputs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00
	Objectives	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00
	Activities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00
	Roles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00
		0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.70**	**0.00**	**0.00**	**0.00**

Figure 36 Generic & Specific ISO 9001:2015 Process Mapping Tool

5.3 Process Maturity Measurement

Within the Process Improvement Prototype, the second major component is to measure process maturity. This is organised along a five step procedure (see figure 37) which is closely related to the COBIT 5 self-assessment process (ISACA (2013a)).

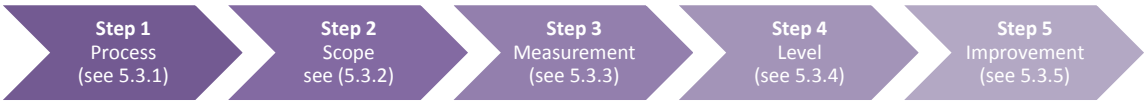


Figure 37 PIP Maturity Measurement Procedure (adapted from ISACA (2013a))

Once generic and specific ISO 9001:2015 process maps are combined (see chapter 5.2), the sequential execution of the PIP maturity measurement procedure guides its users towards a structured process maturity measurement that allows target-aimed improvements within the process landscape. Thereby, the five necessary steps are described within the following subchapters.

5.3.1 Process

As a first step, the processes that should be assessed within the individual, specific ISO 9001:2015 process map need to be defined. This is done along the defined enterprise and IT-related goals hierarchy of the COBIT 5 assessment scoping tool (ISACA (2013a)). Therein, 17 common enterprise goals, shown in table 12, are defined and categorized along the four perspectives of the Balanced Scorecard.

BSC Perspective	Enterprise Goal	IT-related Goals (ITRG)	Relevant Generic ISO 9001:2015 Processes
Financial	1. Stakeholder value of business investments	01, 03, 05, 06, 07, 08, 09, 11, 12, 13, 14, 16, 17	01, 02, 03, 04, 05, 06, 07, 08, 09, 10
	2. Portfolio of competitive products and services	01, 03, 05, 07, 08, 09, 11, 12, 13, 14, 16, 17	01, 02, 03, 04, 05, 06, 07, 08, 09, 10
	3. Managed business risk (safeguarding of assets)	01, 04, 06, 07, 08, 09, 10, 12, 13, 14, 15, 16	01, 02, 03, 04, 05, 06, 07, 08, 09, 10
	4. Compliance with external laws and regulations	02, 04, 07, 10, 14, 15	01, 03, 04, 05, 06, 07
	5. Financial transparency	06	01, 03, 04, 05, 06, 09, 10
Customer	6. Customer-oriented service culture	01, 05, 07, 08, 09, 12, 13, 16, 17	01, 02, 03, 04, 05, 06, 07, 08, 09, 10
	7. Business service continuity and availability	01, 04, 07, 08, 10, 14	01, 03, 04, 05, 06, 07
	8. Agile responses to a changing business environment	01, 03, 04, 05, 07, 09, 11, 12, 16	01, 02, 03, 04, 05, 06, 07, 08, 09, 10
	9. Information-based strategic decision making	01, 03, 06, 07, 08, 09, 14, 17	01, 02, 03, 04, 05, 06, 07, 08, 09, 10
	10. Optimisation of service delivery costs	01, 05, 06, 08, 11, 12, 13	01, 02, 03, 04, 05, 06, 08, 09, 10
Internal	11. Optimisation of business process functionality	01, 03, 07, 08, 09, 11, 12, 14, 17	01, 02, 03, 04, 05, 06, 07, 08, 10
	12. Optimisation of business process costs	01, 05, 06, 07, 08, 11, 12, 13	01, 02, 03, 04, 05, 06, 07, 08, 09, 10
	13. Managed business change programmes	01, 03, 04, 07, 09, 11, 12, 13, 17	01, 02, 03, 04, 05, 06, 07, 08, 10
	14. Operational and staff productivity	05, 08, 09, 11, 12, 16	01, 02, 03, 04, 05, 06, 08, 09, 10
	15. Compliance with internal policies	02, 04, 10, 15	01, 03, 04, 05, 06, 07, 08
Learning	16. Skilled and motivated people	01, 03, 04, 07, 08, 09, 16, 17	01, 02, 03, 04, 05, 06, 07, 08, 10
	17. Product and business innovation culture	05, 07, 08, 09, 11, 12, 16, 17	01, 02, 03, 04, 05, 06, 07, 08, 09, 10

Table 12 COBIT 5 Enterprise Goals (adapted from ISACA (2013a))

Additionally, and as mentioned within the above table, every enterprise goal is expanded with one or more IT-related goal (ITRG). Thereby, the following 17 IT-related goals (see table 13) are defined.

IT-related Goal	Official Description
ITRG 01	Alignment of IT and business strategy
ITRG 02	IT compliance and support for business compliance with external laws and regulations
ITRG 03	Commitment of executive management for making IT-related decisions
ITRG 04	Managed IT-related business risk
ITRG 05	Realised benefits from IT-enabled investments and services portfolio
ITRG 06	Transparency of IT costs, benefits and risk
ITRG 07	Delivery of IT services in line with business requirements
ITRG 08	Adequate use of applications, information and technology solutions
ITRG 09	IT agility
ITRG 10	Security of information, processing infrastructure and applications
ITRG 11	Optimisation of IT assets, resources and capabilities
ITRG 12	Enablement and support of business processes by integrating applications and technology into business processes
ITRG 13	Delivery of programmes delivering benefits, on time, on budget, and meeting requirements and quality standards
ITRG 14	Availability of reliable and useful information for decision making
ITRG 15	IT compliance with internal policies
ITRG 16	Competent and motivated business and IT personnel
ITRG 17	Knowledge, expertise and initiatives for business innovation

Table 13 COBIT 5 IT-related Goals (from ISACA (2013a))

Along the combination of enterprise and IT-related goals, the user of the PIP can derive relevant processes (see table 12) for his assessment by choosing those enterprise goals that are relevant for his specific situation and his objectives. This because every IT-related goal is linked with one or more COBIT 5 processes and through the process mapping described in chapter 4.5 as well with one or more processes of the GPM-IT.

Thereby the linkage between enterprise and IT-related goals as well as the linkage between IT-related goals and COBIT 5 processes are separated in two different priorities (ISACA (2013a)). The Process Improvement Prototype respects this fact by considering only linkages of high priority in order to support its users in setting their assessment focus on the most valuable or challengeable areas of their individual process map.

5.3.2 Scope

Once step 1 is finished, the PIP highlights all processes out of the individual ISO 9001:2015 process map of the user that will be assessed. For each of these, the targeted capability level that should be achieved needs to be defined. This is done within the second tool of the PIP which is show in figure 38 below:

	Generic ISO 9001:2015 Processes	Relevance	Relevant, Specific ISO 9001:2015 Processes	Taregeted Level
01	IT Management	yes	Process(es) 11, 12 & 13	3
02	Skills Development	yes	Process(es) 14	2
03	Procurement	yes	Process(es) 32	2
04	IT Steering	yes	Process(es) 21	3
05	Solution Development & Deployment	yes	Process(es) 17, 23 & 24	3
06	Operate IT-Infrastructure & -Services	yes	Process(es) 34, 35 & 36	2
07	User Support	yes	Process(es) 25 & 27	3
08	Maintain IT Processes	yes	Process(es) 16	3
09	Support Finanical Management	yes	Process(es) 33	2
10	Strategic Marketing	yes	Process(es) 15	2
11	Sales	-	-	-

Figure 38 PIP Targeted Capability Level Definition (adapted from ISACA (2013a))

In order to be able to define the targeted capability level for every process, the specific situation of the company as well as other influences from the company's environment need to be taken into account. Therefore, every targeted process capability level reflects a subjective analysis and decision.

5.3.3 Measurement

With the baseline of defined processes and targeted capability levels, the actual process maturity measurement can be performed. Therefore, the PIP provides another helpful instrument (mentioned as tool number 3) which is shown below in figure 39.

Process Maturity Measurement			11	12	13	14	15	16	17	21	22	23	24	25	27	31	32	33	34	35	36
			01	01	01	02	10	08	05	04	11	05	05	07	07	11	03	09	06	06	06
Level 0 Incomplete	The process is not implemented, or fails to achieve its process purpose.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Level 1 Performed	PA 1.1 Process Performance	As a result of full achievement of this attribute:																			
		a) The process achieves ist defined outcomes.	F	F	F	F	F	F	F	L	N	F	F	L	F	N	L	F	L	L	L
Level 2 Managed	PA 2.1 Performance Management	As a result of full achievement of this attribute:																			
		a) Objectives for the performance of the process are identified.	F	F	F	F	F	F	F	F	N	F	F	F	F	N	F	F	F	F	F
		b) Performance of the process is planned and monitored.																			
		c) Performance of the process is adjusted to meet plans.																			
		d) Responsibilities and authorities for performing the process are defined, assigned and communicated.																			
		e) Resources and information necessary for performing the process are identified, made available, allocated and used.																			
		f) Interfaces between the involved parties are managed to ensure both effective communication and also clear assignment of responsibility.																			
	PA 2.2 Work Product Management	As a result of full achievement of this attribute:																			
		a) Requirements for the work products of the process are defined.	L	L	L	F	F	F	L	P	N	L	L	L	P	N	L	L	L	P	L
		b) Requirements for documentation and control of the work products are defined.																			
		c) Work products are appropriately identified, documented, and controlled.																			
		d) Work products are reviewed in accordance with planned arrangements and adjusted as necessary to meet requirements.																			
Level 3 Established	PA 3.1 Process Definition	As a result of full achievement of this attribute:																			
		a) A standard process, including appropriate tailoring guidelines, is defined that describes the fundamental elements that must be incorporated into a defined process.	P	P	P	P	P	P	P	P	N	P	P	P	P	N	P	P	P	P	P
		b) The sequence and interaction of the standard process with other processes is determined.																			
		c) Required competencies and roles for performing a process are identified as part of the standard process.																			
		d) Required infrastructure and work environment for performing a process are identified as part of the standard process.																			
		e) Suitable methods for monitoring the effectiveness and suitability of the process are determined.																			
	PA 3.2 Process Deployment	As a result of full achievement of this attribute:																			
		a) A defined process is deployed based upon an appropriately selected and/or tailored standard process.	P	P	P	P	P	P	P	P	N	P	P	P	P	N	P	P	P	P	P
		b) Required roles, responsibilities and authorities for performing the defined process are assigned and communicated.																			
		c) Personnel performing the defined process are competent on the basis of appropriate education, training, and experience.																			
		d) Required resources and information necessary for performing the defined process are made available, allocated and used.																			
		e) Required infrastructure and work environment for performing the defined process are made available, managed and maintained.																			
		f) Appropriate data are collected and analysed as a basis for understanding the behaviour of, and to demonstrate the suitability and effectiveness of the process, and to evaluate where continuous improvement of the process can be made.																			
Level 4 Predictable	PA 4.1 Process Measurement	As a result of full achievement of this attribute:																			
		a) Process information needs in support of relevant defined business goals are established.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		b) Process measurement objectives are derived from process information needs.																			
		c) Quantitative objectives for process performance in support of relevant business goals are established.																			
		d) Measures and frequency of measurement are identified and defined in line with process measurement objectives and quantitative objectives for process performance.																			
		e) Results of measurement are collected, analysed and reported in order to monitor the extent to which the quantitative objectives for process performance are met.																			
		f) Measurement results are used to characterise process performance.																			
	PA 4.2 Process Control	As a result of full achievement of this attribute:																			
		a) Analysis and control techniques are determined and applied where applicable.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		b) Control limits of variation are established for normal process performance.																			
		c) Measurement data are analysed for special causes of variation.																			
		d) Corrective actions are taken to address special causes of variation.																			
		e) Control limits are re-established (as necessary) following corrective action.																			
Level 5 Optimizing	PA 5.1 Process Innovation	As a result of full achievement of this attribute:																			
		a) Process improvement objectives for the process are defined that support the relevant business goals.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		b) Appropriate data are analysed to identify common causes of variations in process performance.																			
		c) Appropriate data are analysed to identify opportunities for best practice and innovation.																			
		d) Improvement opportunities derived from new technologies and process concepts are identified.																			
		e) An implementation strategy is established to achieve the process improvement objectives.																			
	PA 5.2 Process Optimisation	As a result of full achievement of this attribute:																			
		a) Impact of all proposed changes is assessed against the objectives of the defined process and standard process.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		b) Implementation of all agreed changes is managed to ensure that any disruption to the process performance is understood and acted upon.																			
		c) Based on actual performance, effectiveness of process change is evaluated against the defined product requirements and process objectives to determine whether results are due to common or special causes.																			

Figure 39 PIP Process Maturity Measurement (adapted from ISACA (2013a))

Process maturity measurement within the Process Improvement Prototype is defined based on the techniques of COBIT 5 PAM (ISACA (2013a)) and ISO 33001:2015 (International Standardisation Organisation (2015c)). Therefore, every specific process need to fulfil its defined outcomes as listed within chapter 5.4.1 to reach level 1 while for level 2 – 5, the respective generic practices and generic work products listed within chapters 5.4.2 to 5.4.5 have to be achieved. Thereby, the COBIT 5 rating system described within chapter 5.5 builds the baseline to answer the question whether an outcome or a generic practice / work product is achieved or not.

5.3.4 Level

As soon as all relevant, individual processes are assessed, the PIPs tool number 3 (see figure 40) automatically calculates the reached capability level for every single process.

Process Maturity Measurement	11	12	13	14	15	16	17	21	22	23	24	25	27	31	32	33	34	35	36
Resulting Process Capability Level	2	2	2	2	2	2	2	1	0	2	2	1	1	0	1	2	1	1	1
Targeted Process Capability Level	3	3	3	2	2	3	3	3	-	3	3	3	3	-	2	2	2	2	2
Process Capability Status																			

Figure 40 PIP process Capability Level Calculation (adapted from ISACA (2013a))

Together with the respective targeted capability levels, users of the PIP can perform a gap analysis that highlights valuable room for improvement within their individual process maps.

5.3.5 Improvement

Based on achieved and targeted capability level analyses for every process, users of the PIP in a last step are able to define respective improvement measures for their most valuable or most divergent processes. Thus, all process improvement measures need to be individually adjusted for the respective process, its current state, as well as it specific objectives. Nonetheless, various generic process improvement measures are listed within table 14 below.

Improvement Measure	Description
Training	A potential improvement measure may be an additional and / or advanced training session for the users of a process.
Adjust TAR	Sometimes, involved roles are not able to operate a process in the desired way due to missing or incorrect TAR (tasks, authorities and responsibilities). Therefore, a redesign of respective profiles may lead to an improvement of a certain process.
Redesign Process	In case that a process is no longer reflecting the practice within a company, a redesign of the process becomes necessary. Thereby the process and its aspects can be adjusted to the changed environment.
Redefine Process Owner	In certain circumstances, a process needs a new or another process owner. This may lead to new initiatives within the given process environment what may result in an improved process performance within the scope of a future maturity measurement run.
Process Automation	Often, the performance and especially the stability of a process can be improved by automating repetitive parts of the process. This usually leads to lowering of errors and temporal disruptions.

Table 14 Generic Process Improvement Measures

Once the defined process improvement measures are completed, the process maturity measurement procedure may be performed again in order to visualize a potential increase in process capability levels.

5.4 Process Maturity Levels

As the PIP is based on COBIT 5 PAM, its specific process maturity levels (see figure 41) are directly reused without any further adaptions within step 3 of the process maturity measurement activity (see chapter 5.3.3).

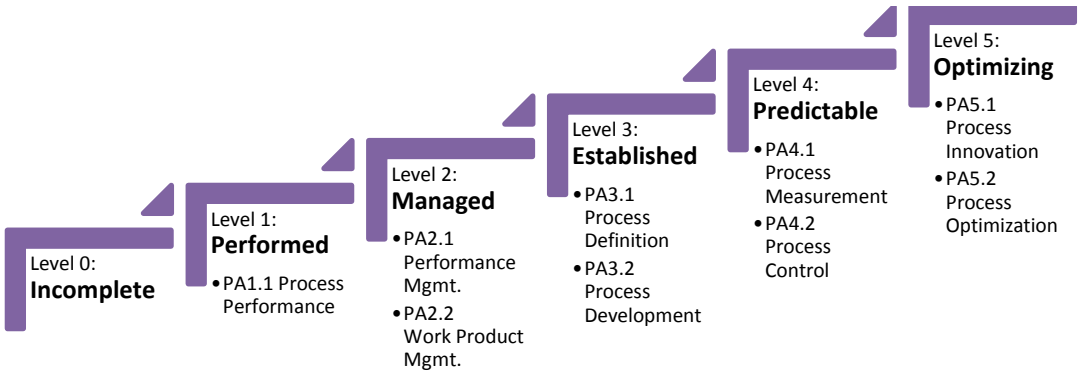


Figure 41 COBIT 5 PAM Capability Levels (adapted from ISACA (2013b))

Respectively, every single process is levelled between zero and five. These levels, used within ISO/IEC 15504 as well, are described in detail within chapter 2.4.3 of this study. For every level, COBIT 5 PAM defines concrete measurements, which need to be fulfilled. These levels are described within the following subchapters.

5.4.1 Level 1 – Performed Process

The achievement of level 1 is assessed along so-called process performance indicators. Different from the indicators for level 2 – 5, these indicators are specific for every single process within the reference model. Thereby level 1 only focuses on the performance of a process in general. This is done by the following process attribute.

PA1.1 Process Performance

Within this process attribute, the achievement of the specific process outcomes for every process is measured. Thereby, the standardized COBIT 5 process outcomes are grouped along the generic ISO 9001:2015 process map for IT SMEs and the respective mapping described in chapter 4.5.

Generic ISO 9001:2015 process	Number of Process Outcomes (without filtration)	Number of Process Outcomes (with filtration)
01 IT Management	24	16
04 IT Steering	16	9
08 Maintain IT-Processes	10	4
10 Strategic Marketing	6	3
05 Solution Development & Deployment	34	17
06 Operate IT-Infrastructure & -Services	25	17
07 User Support	3	3
11 Sales	0	0
02 Skills Development	2	2
03 Procurement	5	5
09 Support Financial Management	4	4

Table 15 PIP process Outcomes Filtration

With this baseline in mind (see table 15), the amount of achievable outcomes is quite high for various generic processes. Therefore, the Process Improvement Prototype only requires the fulfilment of high priority outcomes to reach a level 1 capability level. Within this context, high priority outcomes are those which are linked with a COBIT 5 process that has a green mapping status, meaning an overall mapping accuracy of 80 percent or higher. With this filtration, the amount of outcomes per process is lowered as in table 15. Based on this, the achievable process outcomes per process are shown in table 16:

Process	COBIT 5 Process Outcomes	
	Process	**Outcome**
Management Process 01 IT Management	**Evaluate, Direct and Monitor (EDM)** EDM01 Ensure Governance Framework Setting and Maintenance	**EDM01-01** Strategic decision-making model for IT is effective and aligned with the enterprise's internal and external environment and stakeholder requirements.
		EDM01-02 The governance system for IT is embedded in the enterprise.
		EDM01-03 Assurance is obtained that the governance system for IT is operating effectively.
	Align, Plan and Organise (APO) APO01 Manage the IT Management Framework	**APO01-01** An effective set of policies is defined and maintained.
		APO01-02 Everyone is aware of the policies and how they should be implemented.
	Align, Plan and Organise (APO) APO02 Manage Strategy	**APO02-01** All aspects of the IT strategy are aligned with the enterprise strategy.
		APO02-02 The IT strategy is cost-effective, appropriate, realistic, achievable, enterprise-focused and balanced.
		APO02-03 Clear and concrete short-term goals can be derived from, and traced back to, specific long-term initiatives, and can then be translated into operational plans.
		APO02-04 IT is a value driver for the enterprise.
		APO02-05 There is awareness of the IT strategy and a clear assignment of accountability for delivery.
	Align, Plan and Organise (APO) APO03 Manage Enterprise Architecture	**APO03-01** The architecture and standards are effective in supporting the enterprise.
		APO03-02 A portfolio of enterprise architecture services supports agile enterprise change.
		APO03-03 Appropriate and up-to-date domain and/or federated architectures exist that provide reliable architecture information.
		APO03-04 A common enterprise architecture framework and methodology as well as an integrated architecture repository are used to enable re-use efficiencies across the enterprise.
	Monitor, Evaluate and Assess (MEA) MEA03 Monitor, Evaluate and Assess Compliance With External Requirements	**MEA03-01** All external compliance requirements are identified.
		MEA03-02 External compliance requirements are adequately addressed.

Process	COBIT 5 Process Outcomes	
	Process	**Outcome**
Management Process 04 IT Steering	**Align, Plan and Organise (APO)** APO05 Manage Portfolio	**APO05-01** An appropriate investment mix is defined and aligned with enterprise strategy.
		APO05-02 Sources of investment funding are identified and available.
		APO05-03 Programme business cases are evaluated and prioritised before funds are allocated.
		APO05-04 A comprehensive and accurate view of the investment portfolio performance exists.
		APO05-05 Investment programme changes are reflected in the relevant IT service, asset and resource portfolios.
		APO05-06 Benefits have been realised due to benefit monitoring.
	Align, Plan and Organise (APO) APO09 Manage Service Agreements	**APO09-01** The enterprise can effectively utilise IT services as defined in a catalogue.
		APO09-02 Service agreements reflect enterprise needs and the capabilities of IT.
		APO09-03 IT services perform as stipulated in service agreements.
Management Process 08 Maintain IT-Processes	**Monitor, Evaluate and Assess (MEA)** MEA02 Monitor, Evaluate and Assess the System of Internal Control	**MEA02-01** Processes, resources and information meet enterprise internal control system requirements.
		MEA02-02 All assurance initiatives are planned and executed effectively.
		MEA02-03 Independent assurance that the system of internal control is operational and effective is provided.
		MEA02-04 Internal control is established and deficiencies are identified and reported.
Management Process 10 Strategic Marketing	**Evaluate, Direct and Monitor (EDM)** EDM05 Ensure Stakeholder Transparency	**EDM05-01** Stakeholder reporting is in line with stakeholder requirements.
		EDM05-02 Reporting is complete, timely and accurate.
		EDM05-03 Communication is effective and stakeholders are satisfied.

Process	COBIT 5 Process Outcomes	
	Process	**Outcome**
Core Process 05 Solution Development & Deployment	**Align, Plan and Organise (APO)** APO04 Manage Innovation	**APO04-01** Enterprise value is created through the qualification and staging of the most appropriate advances and innovations in technology, IT methods and solutions.
		APO04-02 Enterprise objectives are met with improved quality benefits and/or reduced cost as a result of the identification and implementation of innovative solutions.
		APO04-03 Innovation is promoted and enabled and forms part of the enterprise culture.
	Build, Acquire and Implement (BAI) BAI01 Manage Programmes and Projects	**BAI01-01** Relevant stakeholders are engaged in the programmes and projects.
		BAI01-02 The scope and outcomes of programmes and projects are viable and aligned with objectives.
		BAI01-03 Programme and project plans are likely to achieve the expected outcomes.
		BAI01-04 The programme and project activities are executed according to the plans.
		BAI01-05 There are sufficient programme and project resources to perform activities according to the plans.
		BAI01-06 The programme and project expected benefits are achieved and accepted.
	Build, Acquire and Implement (BAI) BAI06 Manage Changes	**BAI06-01** Authorised changes are made in a timely manner and with minimal errors.
		BAI06-02 Impact assessments reveal the effect of the change on all affected components.
		BAI06-03 All emergency changes are reviewed and authorised after the change.
		BAI06-04 Key stakeholders are kept informed of all aspects of the change.
	Build, Acquire and Implement (BAI) BAI07 Manage Change Acceptance and Transitioning	**BAI07-01** Acceptance testing meets stakeholder approval and takes into account all aspects of the implementation and conversion plans.
		BAI07-02 Releases are ready for promotion into production with stakeholder readiness and support.
		BAI07-03 Releases are promoted successfully, are stable and meet expectations.
		BAI07-04 Lessons learned contribute to future releases.

Process	COBIT 5 Process Outcomes	
	Process	**Outcome**
Core Process 06 Operate IT-Infrastructure & -Services	**Build, Acquire and Implement (BAI)** BAI04 Manage Availability and Capacity	**BAI04-01** The availability plan anticipates the business expectation of critical capacity requirements.
		BAI04-02 Capacity, performance and availability meet requirements.
		BAI04-03 Availability, performance and capacity issues are identified and routinely resolved.
	Build, Acquire and Implement (BAI) BAI10 Manage Configuration	**BAI10-01** Configuration repository is accurate, complete and up to date.
	Deliver, Service and Support (DSS) DSS01 Manage Operations	**DSS01-01** Operational activities are performed as required and scheduled.
		DSS01-02 Operations are monitored, measured, reported and remediated.
	Deliver, Service and Support (DSS) DSS03 Manage Problems	**DSS03-01** IT-related problems are resolved so that they do not reoccur.
	Deliver, Service and Support (DSS) DSS04 Manage Continuity	**DSS04-01** Business-critical information is available to the business in line with minimum required service levels.
		DSS04-02 Sufficient resilience is in place for critical services.
		DSS04-03 Service continuity tests have verified the effectiveness of the plan.
		DSS04-04 An up-to-date continuity plan reflects current business requirements.
		DSS04-05 Internal and external parties have been trained in the continuity plan.
	Deliver, Service and Support (DSS) DSS05 Manage Security Services	**DSS05-01** Networks and communications security meet business needs.
		DSS05-02 Information processed on, stored on and transmitted by endpoint devices is protected.
		DSS05-03 All users are uniquely identifiable and have access rights in accordance with their business role.
		DSS05-04 Physical measures have been implemented to protect information from unauthorised access, damage and interference when being processed, stored or transmitted.
		DSS05-05 Electronic information is properly secured when strored (sic!), transmitted or destroyed.
Core Process 07 User Support	**Deliver, Service and Support (DSS)** DSS02 Manage Service Requests and Incidents	**DSS02-01** IT-related services are available for use.
		DSS02-02 Incidents are resolved according to agreed-on service levels.
		DSS02-03 Service requests are dealt with according to agreed-on service levels and to the satisfaction of users.
Core Process 11 Sales	-	-
Support Process 02 Skills Development	**Align, Plan and Organise (APO)** APO07 Manage Human Resources	**APO07-01** The IT organisational structure and relationships are flexible and responsive.
		APO07-02 Human resources are effectively and efficiently managed.

Process	COBIT 5 Process Outcomes	
	Process	**Outcome**
Support Process 03 Procurement	**Align, Plan and Organise (APO)** APO10 Manage Suppliers	**APO10-01** Suppliers perform as agreed.
		APO10-02 Supplier risk is assessed and properly addressed.
		APO10-03 Supplier relationships are working effectively.
	Build, Acquire and Implement (BAI) BAI09 Manage Assets	**BAI09-01** Licences are compliant and aligned with business need.
		BAI09-02 Assets are maintained at optimal levels.
Support Process 09 Support Financial Management	**Align, Plan and Organise (APO)** APO06 Manage Budget and Costs	**APO06-01** A transparent and complete budget for IT accurately reflects planned expenditures.
		APO06-02 The allocation of IT resources for IT initiatives is prioritised based on enterprise needs.
		APO06-03 Costs for services are allocated in an equitable way.
		APO06-04 Budgets can be accurately compared to actual costs.

Table 16 PA1.1 Process Performance

5.4.2 Level 2 – Managed Process

Different from level one, level 2 is analysed along so-called process capability attribute indicators, which are generic for every COBIT 5 process. Thereby, level 2 processes are managed in a way that are planned, monitored and adjusted as well as their work products which are established, controlled and maintained (ISACA (2013b)). To ensure these management aspects, COBIT 5 PAM defines two process attributes (PAs).

PA2.1 Performance Management

The first process attribute focuses on the management of the performance of a certain process. Thereby, the following six elements (see table 17) need to be fulfilled:

Result of Full Achievement	Generic Practices (GPs)	Generic Work Products (GWPs)
a. Objectives for the performance of the process are identified.	**GP 2.1.1 Identify the objectives** for the performance of the process. The performance objectives, scoped together with assumptions and constraints, are defined and communicated.	**GWP 1.0 Process documentation** should outline the process scope. **GWP 2.0 Process plan** should provide details of the process performance objectives.
b. Performance of the process is planned and monitored.	**GP 2.1.2 Plan and monitor the performance** of the process to fulfil the identified objectives. Basic measures of process performance linked to business objectives are established and monitored. They include key milestones, required activities, estimates and schedules.	**GWP 2.0 Process plan** should provide details of the process performance objectives. **GWP 9.0 Process performance records** should provide details of the outcomes.
c. Performance of the process is adjusted to meet plans.	**GP 2.1.3 Adjust the performance** of the process. Action is taken when planned performance is not achieved. Actions include identification of process performance issues and adjustment of plans and schedules as appropriate.	**GWP 4.0 Quality record** should provide details of action taken when performance is not achieved.
d. Responsibilities and authorities for performing the process are defined, assigned and communicated.	**GP 2.1.4 Define responsibilities and authorities** for performing the process. The key responsibilities and authorities for performing the key activities of the process are defined, assigned and communicated. The need for process performance experience, knowledge and skills is defined.	**GWP 1.0 Process documentation** should provide details of the process owner and who is responsible, accountable, consulted and/or informed (RACI). **GWP 2.0 Process plan** should include details of the process communication plan as well as process performance experience, skills requirement.
e. Resources and information necessary for performing the process are identified, made available, allocated and used.	**GP 2.1.5 Identify and make available** resources to perform the process according to plan. Resources and information necessary for performing the key activities of the process are identified, made available, allocated and used.	**GWP 2.0 Process plan** should provide details of the process training plan and process resourcing plan.
f. Interfaces between the involved parties are managed to ensure effective communication and clear assignment of responsibility.	**GP 2.1.6 Manage the interfaces** between involved parties. The individuals and groups involved with the process are identified, responsibilities are defined and effective communication mechanisms are in place.	**GWP 1.0 Process documentation** should provide details of the individuals and groups involved (suppliers, customers and RACI). **GWP 2.0 Process plan** should provide details of the process communication plan.

Table 17 PA2.1 Performance Management (from ISACA (2013b))

PA2.2 Work Product Management

While PA2.1 is focusing on the management of the process performance, this PA2.2 is analysing the management of respective work products. Thereby the following four elements (see table 18) are important:

Result of Full Achievement	Generic Practices (GPs)	Generic Work Products (GWPs)
a. Requirements for the work products of the process are defined.	**GP 2.2.1 Define the requirements for the work products,** including content structure and quality criteria.	**GWP 3.0 Quality plan** should provide details of quality criteria and work product content and structure.
b. Requirements for documentation and control of the work products are defined.	**GP 2.2.2 Define the requirements for documentation and control** of the work products. This should include identification of dependencies, approvals and traceability of requirements.	**GWP 1.0 Process documentation** should provide details of controls (control matrix).
		GWP 3.0 Quality plan should provide details of work product, quality criteria, documentation requirements and change control.
c. Work products are appropriately identified, documented and controlled.	**GP 2.2.3 Identify, document and control** the work products. Work products are subject to change control, versioning and configuration management as appropriate.	**GWP 3.0 Quality plan** should provide details of work product, quality criteria, documentation requirements and change control.
d. Work products are reviewed in accordance with planned arrangements and adjusted as necessary to meet requirements.	**GP 2.2.4 Review and adjust work products** to meet the defined requirements. Work products are subject to review against requirements in accordance with planned arrangements and any issues arising are resolved.	**GWP 4.0 Quality records** should provide an audit trail of reviews undertaken.

Table 18 PA2.2 Work Product Management (from ISACA (2013b))

5.4.3 Level 3 – Established Process

As for maturity level 2, level 3 is analysed along generic process capability attribute indicators. Whereas level 2 focuses in on process management, level 3 has a focus on definition and establishment of processes. Again, two PAs are available.

PA3.1 Process Definition

The first PA of level 3 analyses the extent to which a process that supports the deployment of the defined COBIT 5 process is established and maintained. Thereby, five different elements (see table 19) need to be analysed:

Result of Full Achievement	Generic Practices (GPs)	Generic Work Products (GWPs)
a. A standard process, including appropriate tailoring guidelines, is defined that describes the fundamental elements that must be incorporated into a defined process.	**GP 3.1.1 Define the standard** process that will support the deployment of the defined process. A standard process is defined that identifies the fundamental process elements and provides guidance and procedures to support implementation and guidance on how it can be tailored when needed.	**GWP 5.0 Policies and standards** should provide details of the organisational objectives for the process, minimum standards of performance, standard procedures, and reporting and monitoring requirements. The evidential requirement at this level is not just that policies and standards exist, but that they are applied across the organisation.
b. The sequence and interaction of the standard process with other processes are determined.	**GP 3.1.2 Determine the sequence and interaction between processes** so that they work as an integrated system of processes. The standard process sequence and interaction with other processes are determined and maintained when a process is implemented in different parts of the organisation.	**GWP 5.0 Policies and standards** should provide a process mapping with details of standard processes and expected sequences and interaction. The evidential requirement at this level is not just that policies and standards exist, but that they are applied across the organisation.
c. Required competencies and roles for performing a process are identified as part of the standard process.	**GP 3.1.3 Identify the roles and competencies** for performing the standard process.	**GWP 5.0 Policies and standards** should provide details of roles and competencies for performing. The evidential requirement at this level is not just that policies and standards exist, but that they are applied across the organisation.
d. Required infrastructure and work environment for performing a process are identified as part of the standard process.	**GP 3.1.4 Identify the required infrastructure and work environment** for performing the standard process. The infrastructure (facilities, tools, methods, etc.) and work environment for performing the standard process are identified.	**GWP 5.0 Policies and standards** should identify minimum required infrastructure and work environment for performing the process. The evidential requirement at this level is not just that policies and standards exist, but that they are applied across the organisation.
e. Suitable methods for monitoring the effectiveness and suitability of the process are determined.	**GP 3.1.5 Determine suitable methods** to monitor the effectiveness and suitability of the standard process, including ensuring that appropriate criteria and data needed to monitor the effectiveness and suitability of the process are defined, and establishing the need to conduct internal audit and management review.	**GWP 5.0 Policies and standards** should provide details of the organisational objectives for process, minimum standards of performance, standard procedures, and reporting and monitoring requirements. The evidential requirement at this level is not just that policies and standards exist, but that they are applied across the organisation.
		GWP 4.0 Quality records and **GWP 9.0 Process performance records** should provide evidence of reviews undertaken.

Table 19 PA3.1 Process Definition (from ISACA (2013b))

PA3.2 Process Deployment

A second PA on level 3 is focuses on the ability of a process to support the achievement of its outcomes by ensuring an efficient deployment. This is achieved by the following six elements (see table 20).

Result of Full Achievement	Generic Practices (GPs)	Generic Work Products (GWPs)
a. A defined process is deployed based on an appropriately selected and/or tailored standard process.	**GP 3.2.1 Deploy a defined process** that satisfies the context. When the same process is used within different areas of the organisation, it is based on a standard process, tailored as appropriate, with conformance to the requirements of the defined process verified.	**GWP 5.0 Policies and standards** should define the standards to be followed across all implementations of the process. The evidential requirement at this level is not just that policies and standards exist, but that they are applied across the organisation.
b. Required roles, responsibilities and authorities for performing the defined process are assigned and communicated.	**GP 3.2.2 Assign and communicate roles, responsibilities and authorities** for performing the defined process. When the same process is used within different areas of the organisation, the authorities and roles for performing the activities of process are assigned and communicated.	**GWP 5.0 Policies and standards** should provide details, responsibilities and authorities for performing the activities of process. The evidential requirement at this level is not just that policies and standards exist, but that they are applied across the organisation.
c. Personnel performing the defined process are competent on the basis of appropriate education, training and experience.	**GP 3.2.3 Ensure necessary competencies** for performing the defined process. When the same process is used within different areas of the organisation, the appropriate competencies for assigned personnel are identified and suitable training is available for those deploying the defined process.	**GWP 1.0 Process documentation** should provide details of competencies and training requirements. **GWP 2.0 Process plan** should include details of the process communication plan, training plan and resourcing plan for each instance of the process.
d. Required resources and information necessary for performing the defined process are made available, allocated and used.	**GP 3.2.4 Provide resources and information** to support the performance of the defined process. When the same process is used within different areas of the organisation, the required human resources and information to perform the process are made available, allocated and used.	**GWP 2.0 Process plan** should include details of the resourcing plan for each instance of the process.
e. Required infrastructure and work environment for performing the defined process are made available, managed and maintained.	**GP 3.2.5 Provide adequate process infrastructure** to support the performance of the defined process. When the same process is used within different areas of the organisation, the required organisational support, infrastructure and work environment are made available, allocated and used.	**GWP 2.0 Process plan** should include details of the process infrastructure and work environment for each instance of the process.
f. Appropriate data are collected and analysed as a basis for understanding the behaviour of the process to demonstrate its suitability and effectiveness, and to evaluate where continuous improvement of the process can be made.	**GP 3.2.6 Collect and analyse data** about performance of the process to demonstrate its suitability and effectiveness. Data required to monitor the effectiveness and suitability of the process across the organisation are defined, collected and analysed as a basis for continual improvement.	**GWP 4.0 Quality records** and **GWP 9.0 Process performance records** should provide evidence of reviews undertaken tools for each instance of the process.

Table 20 PA3.2 Process Development (from ISACA (2013b))

5.4.4 Level 4 – Predictable Process

COBIT 5 PAM's maturity level 4 is measured along the following, generic process capability attribute indicators. Thereby the focus is set on process operation within previously defined limits. As for the other maturity levels, two process attributes (PAs) ensure the achievement of this level.

PA4.1 Process Measurement

This PA measures the extent to which performance measurement guides process performance towards the achievement of process performance and business objectives. This is achieved by the six elements in table 21:

Result of Full Achievement	Generic Practices (GPs)	Generic Work Products (GWPs)
a. Process information needs in support of relevant defined business goals are established.	**GP 4.1.1 Identify process information needs,** in relation with business goals. The business goals and process stakeholder information needs have been established as a basis for determining the process performance measurement objectives.	**GWP 6.0 Process improvement plan** should provide process improvement objectives and proposed Improvement actions.
b. Process measurement objectives are derived from process information needs.	**GP 4.1.2 Derive process measurement objectives** from process information needs. Measurement objectives are based on the defined process measurement objectives.	**GWP 7.0 Process measurement plan** should provide details of proposed measurement objectives.
c. Quantitative objectives for process performance in support of relevant business goals are established.	**GP 4.1.3 Establish quantitative objectives** for the performance of the defined process, according to the alignment of the process with the business goals Quantitative measurement objectives are established that explicitly reflect business goals and have been verified as realistic and useful with organisational management and process owner(s).	**GWP 7.0 Process measurement plan** should provide details of proposed measurement measures and indicators.
d. Measures and frequency of measurement are identified and defined in line with process measurement objectives and quantitative objectives for process performance.	**GP 4.1.4 Identify product and process measures** that support the achievement of the quantitative objectives for process performance. Detailed measures for products and process are identified, together with the frequency of data collection and measurement as well as verification mechanisms.	**GWP 7.0 Process measurement plan** should provide details of proposed measures and indicators together with data collection procedures and analytical procedures.
e. Results of measurement are collected, analysed and reported in order to monitor the extent to which the quantitative objectives for process performance are met.	**GP 4.1.5 Collect product and process measurement results** through performing the defined process. Product and process measurement results are collected, analysed and reported according to a defined plan.	**GWP 7.0 Process measurement plan** should provide details of proposed analytical procedures. **GWP 9.0 Process performance records** should provide details of measurements collected and analysed.
f. Measurement results are used to characterise process performance.	**GP 4.1.6 Use the results of the defined measurement** to monitor and verify the achievement of the process performance objectives. The results of the defined measurement are analysed to verify achievement against the process performance objectives. Appropriate techniques are used to understand process performance and capability within defined control limits.	**GWP 9.0 Process performance records** should provide details of measurements collected and analysed.

Table 21 PA4.1 Process Measurement (from ISACA (2013b))

PA4.2 Process Control

The second PA is focusing on the quantitative management a process in order to operate this process stable, capable and predicable within defined limits. Five elements (see table 22) need to be taken into account for that:

Result of Full Achievement	Generic Practices (GPs)	Generic Work Products (GWPs)
a. Analysis and control techniques are determined and applied where applicable.	**GP 4.2.1 Determine analysis** and control techniques appropriate to control the process performance. Methods of measuring the effectiveness of process control are defined and validated.	**GWP 1.0 Process documentation** should provide details of controls (control matrix). **GWP 8.0 Process control plan** should exist that specifies for each process the measurement approach.
b. Control limits of variation are established for normal process performance.	**GP 4.2.2 Define parameters** suitable to control the process performance. The standard process definition is modified to include methods for process control and control limits are established.	**GWP 8.0 Process control plan** should exist that specifies for each control limits for normal performance.
c. Measurement data are analysed for special causes of variation.	**GP 4.2.3 Analyse process and product measurement results** to identify variations in process performance. The results of process control measurements are analysed to determine issues of concern and forwarded for action.	**GWP 9.0 Process performance record** should provide details of measurements collected and analysed.
d. Corrective actions are taken to address special causes of variation.	**GP 4.2.4 Identify and implement corrective actions** to address assignable causes. Corrective action is taken to address process control concerns and results are monitored and evaluated.	**GWP 9.0 Process performance record** should provide details of measurements collected and analysed and corrective action taken.
e. Control limits are re-established (as necessary) following corrective action.	**GP 4.2.5 Re-establish control** limits following corrective action. Process control limits are appropriately modified after corrective action is taken.	**GWP 8.0 Process control plan** should exist that specifies control limits for normal performance.

Table 22 PA4.2 Process Control (from ISACA (2013b))

5.4.5 Level 5 – Optimising Process

Generic process capability attribute indicators are used as well to determine maturity level 5 for a specific process. Thereby, such a process is continuously improved in order to meet current and future business goals. Two PAs are established to measure the fulfilment of level 5.

PA5.1 Process Innovation

The first PA focuses on the ability to identify changes to a process due to the analysis of variances on process performance as well as due to the analysis of new and innovative approaches to the definition and deployment of the process. Five elements (see table 23) are important:

Result of Full Achievement	Generic Practices (GPs)	Generic Work Products (GWPs)
a. Process improvement objectives for the process are defined that support the relevant business goals.	**GP 5.1.1 Define the process improvement objectives for the process** that supports the relevant business goals. Directions to process innovations are set. Quantitative and qualitative process improvement objectives—based on the potential for process innovation as well as business vision and goals— have been defined and documented.	**GWP 7.0 Process improvement plan** should provide process improvement objectives and proposed improvement actions.
b. Appropriate data are analysed to identify common causes of variations in process performance.	**GP 5.1.2 Analyse measurement data of the process** to identify real and potential variations in process performance. Process performance data are analysed to identify variations in process performance together with the root cause of common process performance issues.	**GWP 9.0 Process performance records** should provide details of measurements collected and analysed.
c. Appropriate data are analysed to identify opportunities for best practice and innovation.	**GP 5.1.3 Identify improvement opportunities of the process** based on innovation and best practices. Process improvement opportunities are identified based on comparison with industry best practices.	**GWP 6.0 Process improvement plan** should provide details of analysis against best practice.
d. Improvement opportunities derived from new technologies and process concepts are identified.	**GP 5.1.4 Derive improvement opportunities of the process from new technologies and process concepts.** Process improvement opportunities are identified based on review and analysis of emerging technological and process concept innovations, taking into account business environment changes including emerging business risks.	**GWP 6.0 Process improvement plan** should provide details of analysis of technology improvement opportunities.
e. An implementation strategy is established to achieve the process improvement objectives.	**GP 5.1.5 Define an implementation strategy** based on long-term improvement vision and objectives. A process improvement strategy is defined and validated based on long-term improvement goals and objectives. Commitment to improvement is demonstrated by organisational management and process owner(s).	**GWP 6.0 Process improvement plan** should provide details of the implementation strategy for process improvement.

Table 23 PA5.1 Process Innovation (from ISACA (2013b))

PA5.2 Process Optimization

The second PA of level 5 focuses on the ability to perform changes to process definition, management and performance in an effective way in order to achieve given improvement objectives. Thereby, three elements (see table 24) are relevant:

Result of Full Achievement	Generic Practices (GPs)	Generic Work Products (GWPs)
a. Impact of all proposed changes is assessed against the objectives of the defined process and standard process.	**GP 5.2.1 Assess the impact of each proposed change** against the objectives of the defined and standard process. The impact of proposed changes is assessed against the objectives of the process and to determine the impact on product quality and process performance as well as other related processes.	**GWP 6.0 Process** improvement plan should provide details of the required process improvement project quality approach.
b. Implementation of all agreed changes is managed to ensure that any disruption to the process performance is understood and acted on.	**GP 5.2.2. Manage the implementation of agreed changes** to selected areas of the defined and standard process according to the implementation strategy. The implementation of agreed changes is managed in accordance with defined change management and change enablement processes.	**GWP 6.0 Process improvement plan** should provide details of the implementation strategy for process improvement and evidence of changes in: - **GWP 1.0 Process documentation** - **GWP 3.0 Quality plan** - **GWP 5.0 Policies and standards**
c. Based on actual performance, effectiveness of process change is evaluated against the defined product requirements and process objectives to determine whether results are due to common or special causes.	**GP 5.2.3 Based on actual performance, evaluate the effectiveness of process change** against process performance, capability objectives and business goals. The effectiveness of the changes made to the process is measured, evaluated and reported after implementation.	**GWP 6.0 Process improvement plan** should provide details of the required process improvement project quality approach.

Table 24 PA5.2 Process Optimization (from ISACA (2013b))

5.5 Rating System

The measurement and rating of processes and maturity levels within the PIP, as described in step 3 of the process maturity measurement activity (see chapter 5.3.3), is performed along the defined instruments of COBIT 5 PAM. These instruments and their connections are shown in figure 42.

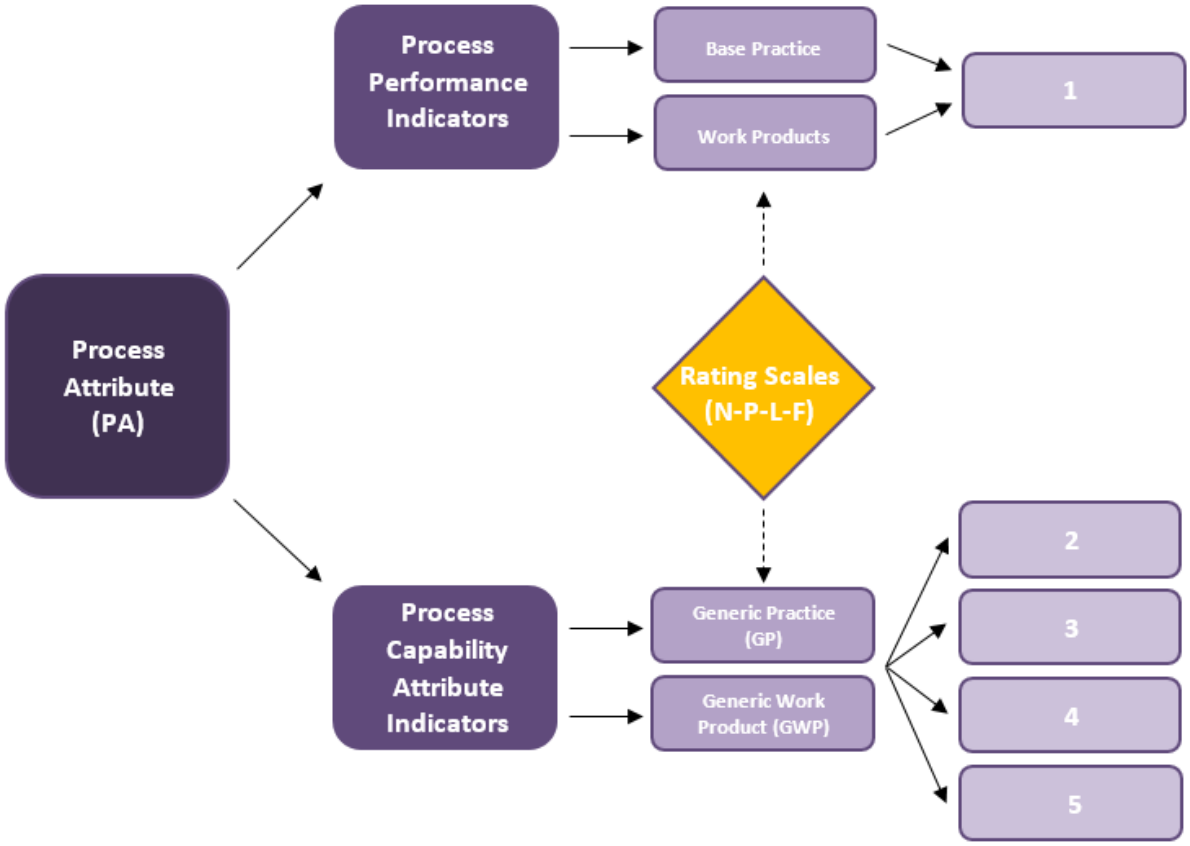


Figure 42 COBIT 5 PAM Maturity Measurement

As mentioned in the previous chapter and within chapter 2.4.4 of the theoretical foundation of the study, both process performance and process capability attribute indicators are categorized along four rating stages (see table 25) which show the amount of fulfilment of defined process requirements.

Stage	Official Description
N (Not achieved / 0 – 15%)	There is little or no evidence of achievement of the defined attribute in the assessed process.
P (Partially achieved / >15 – 50%)	There is some evidence of an approach to, and some achievement of, the defined attribute in the assessed process. Some aspects of achievement of the attribute may be unpredictable.
L (Largely achieved / >50 – 85%)	There is evidence of a systematic approach to, and significant achievement of, the defined attribute in the assessed process. Some weakness related to this attribute may exist in the assessed process.
F (Fully achieved / >85 – 100%)	There is evidence of a complete and systematic approach to, and full achievement of, the defined attribute in the assessed process. No significant weaknesses related to this attribute exist in the assessed process.

Table 25 COBIT 5 PAM & ISO/IEC 15504 Rating Stages (from ISACA (2013b))

In order to achieve a certain maturity level, every rated process attribute (PA) of the given level needs to be largely (L) or fully (F) achieved. Furthermore, all PAs of below maturity levels need to be fully (F) achieved. So for example, to reach a maturity level 3, both PAs 3.1 and 3.2 need to be largely (L) or fully (F) achieved and PAs 1.1, 2.1 and 2.2 all need to be fully (F) achieved.

6 Prototype Validation

After the definition of the PIP, its potential needs to be validated within a practice-oriented environment. Therefore, this chapter presents the respective company providing the practical framework as well as the systematic usage of the PIP.

6.1 Company Selection Criteria

In order to be able to setup a realistic, practice-oriented and target-aimed evaluation scenario, a respective company needs to be selected. Thereby, the following criteria, visualized within figure 43, are relevant.

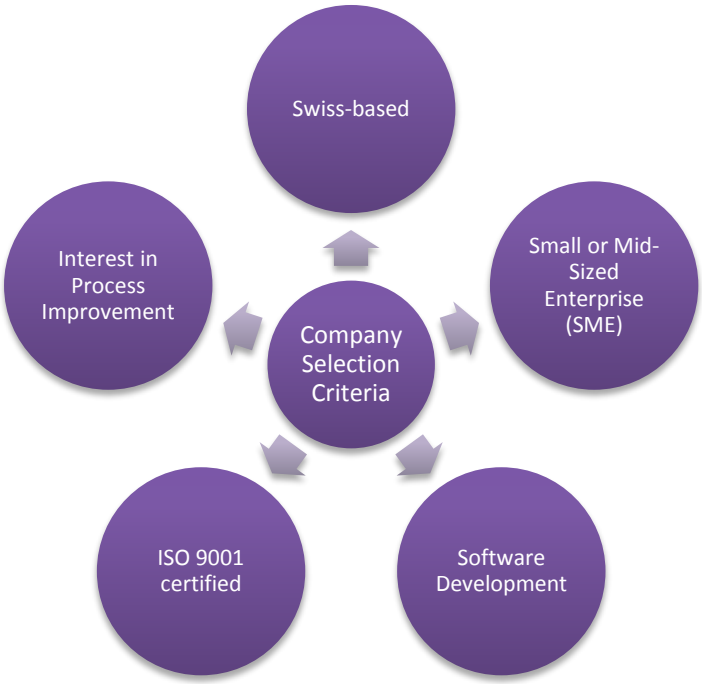


Figure 43 Company Selection Criteria

A company that fits into the study limitations (see chapter 1.4) is necessary. This means, the evaluating company must be a Swiss-based and SME software development company which has an ISO 9001 certified quality management system and a respective process model. Additionally, the respective company should be actively interested in improving its own processes.

This because the evaluating company is not only asked to provide its documented process model and further material resources but also temporal resources as its management and process owners need to be directly involved into the evaluation of the Process Improvement Prototype (PIP) and the company's process measurement process.

With all these requirements in mind and the potential deliverables of the PIP as compensation for the company prepared, potential companies were contacted.

6.2 Participating Company – Glaux Soft AG

According to the outlines of the previous chapter, the evaluation of the Process Improvement Prototype (PIP) was performed within the practical environment of a concrete company. This company is Glaux Soft AG.

6.2.1 Facts and Figures of Glaux Soft AG

Glaux Soft AG is a Swiss based SME-company located in Bern. The company, founded in 1996, focuses on specification, development and operation of complex information technology solutions (Glaux Soft AG (2015a)). The optimization of their customer's business processes is usually the central aspect of these systems. With 51 employees, Glaux Soft serves a variety of customers in all industrial sectors. Beside various governmental institutions, huge multinational companies (e.g. Swatch, Thales) and important Swiss based companies (such as Swisscom and Post), Glaux Soft is also a key partner to many small and mid-sized companies all over the German-speaking area of Switzerland. As of 2014, Glaux Soft AG was certified for its ISO 9001 quality management system.

6.2.2 An Outline on evidence – Glaux Softs Product Baseline

An important part of Glaux Soft's strategy and daily business is a standardized XRM-platform (XRM stands for **any**thing **r**elationship **m**anagement) called Evidence. Evidence is a business application platform that provides various standard functions for software applications, such as user and role management, and a wide set of common interfaces (Glaux Soft AG (2015b)). With its modular based architecture and extensions, it can easily be run as a CRM-, service or case management system. Most of the Evidence applications, which cover nearly 100% of all Glaux Soft software projects, are more than just isolated address and data management systems. They are usually integrated in an existing IT environment in order to obtain and provide business critical data from and to other systems. Software projects involving Evidence often cover topics such as analysing a customer's enterprise architecture and existing business processes to maximize benefits of automated processes.

6.2.3 ISO 9001:2015 Process Map of Glaux Soft AG

As described within the previous sections, Glaux Soft AG operates based on a certified ISO 9001 quality management system. The respective process map was developed in 2013 and certified at the beginning of 2014. Since then, the process map and every single process has been continuously improved and adapted to the changing environment of the company.

Still today, the company struggles with setting the right priorities for these improvement measures as its processes cannot be measured and compared to objectives in detail. Therefore, the company was willing to participate within the evaluation phase of the present study.

By the end of 2015, the ISO 9001 process map of Glaux Soft AG contained 19 processes in total whereas they are divided into the well-known three process groups of management-, core and support processes. Every process is defined by various inputs and outputs as well as by described objectives and concrete activities. Furthermore, every process is managed by a process owner. While in the execution of the process, one or more further roles may be involved (Glaux Soft AG (2015c)).

Based on these cornerstones, the visualization of Glaux Soft's process map can be shown as in figure 44.

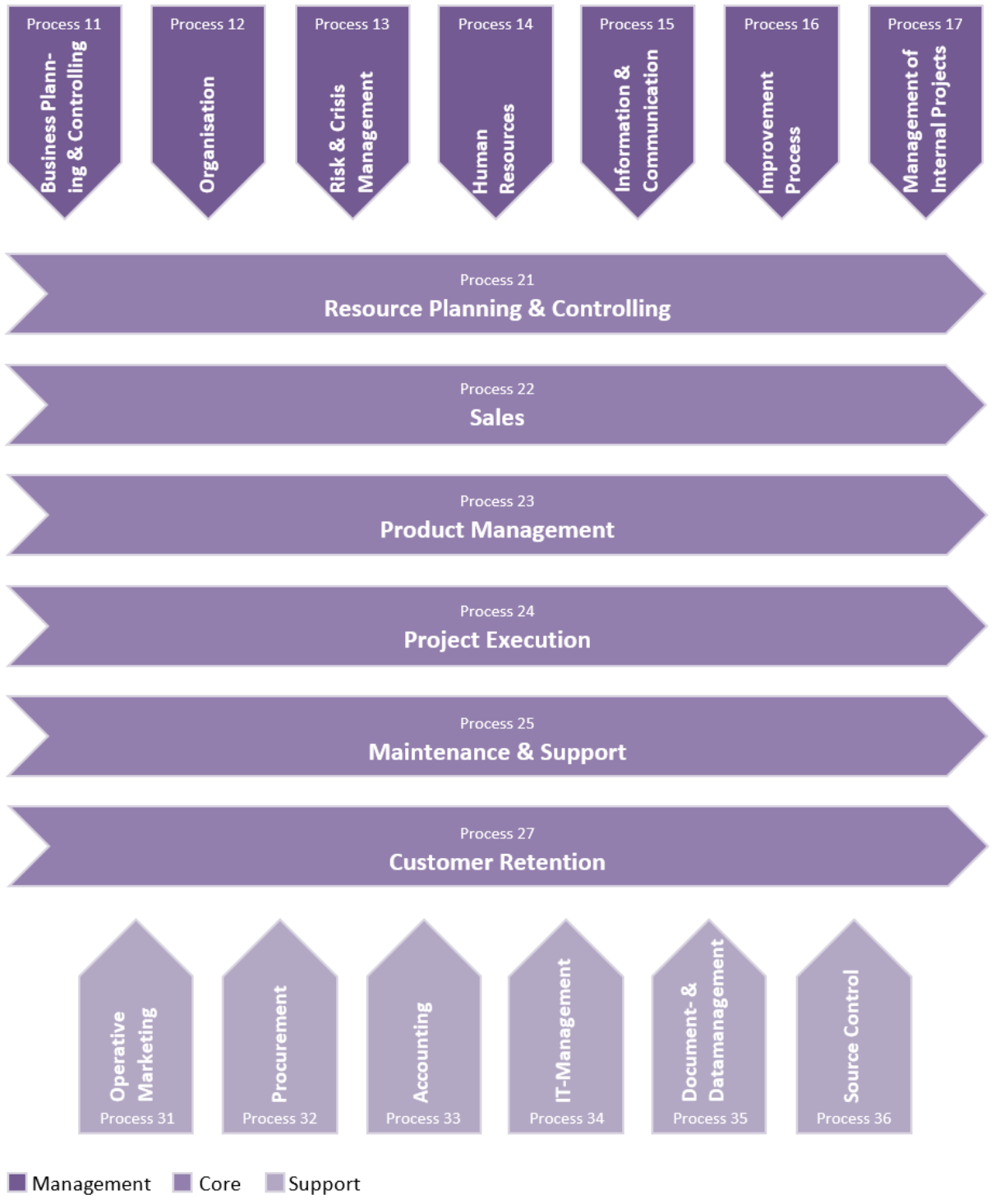
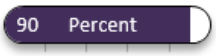
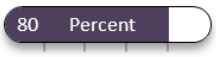
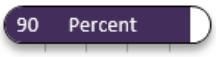
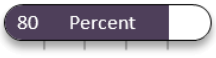
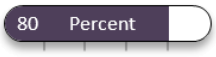


Figure 44 Glaux Soft's ISO 9001 Process Model (adapted from Glaux Soft AG (2015c))

For further information of these processes and their detailed aspects, please see Appendix D (Glaux Soft's Process Map in Detail).

6.3 Process Model Mapping in Practice

Based on the company's process map described within the previous chapter, the Process Improvement Prototype is set into practice. As a first step, Glaux Soft's individual ISO 9001 processes are mapped with the generic ISO 9001:2015 process map for IT SMEs. Along the outlines described in chapter 5.2 and by using the respective tool number 1 of the PIP, the following process mapping (see table 26) was derived.

Glaux Soft Process	Mapping Accuracy	Generic ISO 9001:2015 Process
Management Process 11 Business Planning & Controlling		**Management Process** 01 IT Management
Management Process 12 Organisation		**Management Process** 01 IT Management
Management Process 13 Risk & Crisis Management		**Management Process** 01 IT Management
Management Process 14 Human Resources		**Support Process** 02 Skills Development
Management Process 15 Information & Communication		**Management Process** 10 Strategic Marketing
Management Process 16 Improvement Process		**Management Process** 08 Maintain IT-Processes
Management Process 17 Management of Internal Projects		**Core Process** 05 Solution Development & Deployment
Core Process 21 Resource Planning & Controlling		**Management Process** 04 IT Steering
Core Process 22 Sales		**Core Process** 11 Sales
Core Process 23 Product Management		**Core Process** 05 Solution Development & Deployment
Core Process 24 Project Execution		**Core Process** 05 Solution Development & Deployment
Core Process 25 Maintenance & Support		**Core Process** 07 User Support
Core Process 27 Customer Retention		**Core Process** 07 User Support
Support Process 31 Operative Marketing		**Core Process** 11 Sales

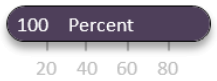
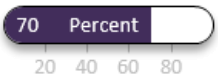
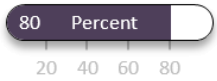
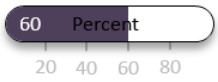
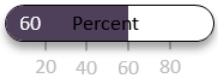
Glaux Soft Process	Mapping Accuracy	Generic ISO 9001:2015 Process
Support Process 32 Procurement		**Support Process** 03 Procurement
Support Process 33 Accounting		**Support Process** 09 Support Financial Management
Support Process 34 IT-Management		**Core Process** 06 Operate IT-Infrastructure & -Services
Support Process 35 Document- & Data-Management		**Core Process** 06 Operate IT-Infrastructure & -Services
Support Process 36 Source Control		**Core Process** 06 Operate IT-Infrastructure & -Services

Table 26 Mapping Glaux Softs and Generic ISO 9001:2015 Processes

6.4 Process Maturity Measurement in Practice

Based on the mapping provided in the previous chapter, which is as well described in detail within Appendix E (Generic Process and Glaux Soft's Detailed Process Mapping), the specific maturity measurement elements of the PIP (see chapter 5.3) can now be used for Glaux Softs individual ISO 9001:2015 processes.

6.4.1 Defining and Scoping Processes with the PIP

Based on the performed process mapping (see chapter 6.3), Glaux Soft's management, together with the respective process owners, has defined the relevant COBIT 5 enterprise goals (see chapter 5.3.1) for Glaux Soft as in table 27.

BSC Perspective	Enterprise Goal	Selected by Glaux Soft AG
Financial	1. Stakeholder value of business investments	
	2. Portfolio of competitive products and services	x
	3. Managed business risk (safeguarding of assets)	x
	4. Compliance with external laws and regulations	x
	5. Financial transparency	
Customer	6. Customer-oriented service culture	x
	7. Business service continuity and availability	
	8. Agile responses to a changing business environment	x
	9. Information-based strategic decision making	
	10. Optimisation of service delivery costs	x
Internal	11. Optimisation of business process functionality	x
	12. Optimisation of business process costs	
	13. Managed business change programmes	
	14. Operational and staff productivity	x
	15. Compliance with internal policies	
Learning	16. Skilled and motivated people	x
	17. Product and business innovation culture	x

Table 27 Enterprise goal selection of Glaux Soft AG

With these enterprise goals as the baseline, the Process Improvement Prototype automatically has calculated the relevant processes for Glaux Soft's specific situation. In this case, the generic processes 01 – 10 are in focus, what means that all of Glaux Soft's processes except number 22 and 31 need to be evaluated.

Based on this calculation, Glaux Soft's executives have defined the targeted process capability levels by analysing the defined COBIT 5 process attributes in chapter 5.4. Thereby the following targeted capability levels were defined (see figure 45):

	Generic ISO 9001:2015 Processes	Relevance	Relevant, Specific ISO 9001:2015 Processes	Taregeted Level
01	IT Management	yes	Process(es) 11, 12 & 13	3
02	Skills Development	yes	Process(es) 14	2
03	Procurement	yes	Process(es) 32	2
04	IT Steering	yes	Process(es) 21	3
05	Solution Development & Deployment	yes	Process(es) 17, 23 & 24	3
06	Operate IT-Infrastructure & -Services	yes	Process(es) 34, 35 & 36	2
07	User Support	yes	Process(es) 25 & 27	3
08	Maintain IT Processes	yes	Process(es) 16	3
09	Support Finanical Management	yes	Process(es) 33	2
10	Strategic Marketing	yes	Process(es) 15	2
11	Sales	-	-	-

Figure 45 Glaux Soft's Targeted Process Capability Levels

Within the defined targeted capability levels, there is a regularity discernible. Glaux Softs executives have defined a targeted level three for all core processes and the most important management and support processes. However, level two is targeted for remaining management and support processes. The basic idea behind is the settled conviction that every defined process is at least performed, whereas the company's objectives should be defined even higher. On the other hand, the general maturity of Glaux Softs management system that was established at the beginning of 2014 makes targeted capability levels higher than level three unrealistic.

6.4.2 Measuring Process Maturity with the PIP

With the targeted capability levels in mind, the maturity measurement for all relevant processes of Glaux Soft was performed by involving the respective process owners. In order to gather the relevant practical influence for the prototype evaluation, the measurement took place in December 2015 right before the annual external adherence audit of Glaux Soft's ISO 9001 management system. The respective results are shown in figure 46.

Process Maturity Measurement			11	12	13	14	15	16	17	21	22	23	24	25	27	31	32	33	34	35	36
			01	01	01	02	10	08	05	04	11	05	05	07	07	11	03	09	06	06	06
Level 0 Incomplete	The process is not implemented, or fails to achieve its process purpose.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Level 1 Performed	PA 1.1 Process Performance	As a result of full achievement of this attribute:																			
		a) The process achieves ist defined outcomes.	F	F	F	F	F	F	F	L	N	F	F	L	F	N	L	F	L	L	L
Level 2 Managed	PA 2.1 Performance Management	As a result of full achievement of this attribute:																			
		a) Objectives for the performance of the process are identified.	F	F	F	F	F	F	F	F	N	F	F	F	F	N	F	F	F	F	F
		b) Performance of the process is planned and monitored.																			
		c) Performance of the process is adjusted to meet plans.																			
		d) Responsibilities and authorities for performing the process are defined, assigned and communicated.																			
		e) Resources and information necessary for performing the process are identified, made available, allocated and used.																			
		f) Interfaces between the involved parties are managed to ensure both effective communication and also clear assignment of responsibility.																			
	PA 2.2 Work Product Management	As a result of full achievement of this attribute:																			
		a) Requirements for the work products of the process are defined.	L	L	L	F	F	F	L	P	N	L	L	L	P	N	L	L	L	P	L
		b) Requirements for documentation and control of the work products are defined.																			
		c) Work products are appropriately identified, documented, and controlled.																			
		d) Work products are reviewed in accordance with planned arrangements and adjusted as necessary to meet requirements.																			
Level 3 Established	PA 3.1 Process Definition	As a result of full achievement of this attribute:																			
		a) A standard process, including appropriate tailoring guidelines, is defined that describes the fundamental elements that must be incorporated into a defined process.	P	P	P	P	P	P	P	P	N	P	P	P	P	N	P	P	P	P	P
		b) The sequence and interaction of the standard process with other processes is determined.																			
		c) Required competencies and roles for performing a process are identified as part of the standard process.																			
		d) Required infrastructure and work environment for performing a process are identified as part of the standard process.																			
		e) Suitable methods for monitoring the effectiveness and suitability of the process are determined.																			
	PA 3.2 Process Deployment	As a result of full achievement of this attribute:																			
		a) A defined process is deployed based upon an appropriately selected and/or tailored standard process.	P	P	P	P	P	P	P	P	N	P	P	P	P	N	P	P	P	P	P
		b) Required roles, responsibilities and authorities for performing the defined process are assigned and communicated.																			
		c) Personnel performing the defined process are competent on the basis of appropriate education, training, and experience.																			
		d) Required resources and information necessary for performing the defined process are made available, allocated and used.																			
		e) Required infrastructure and work environment for performing the defined process are made available, managed and maintained.																			
		f) Appropriate data are collected and analysed as a basis for understanding the behaviour of, and to demonstrate the suitability and effectiveness of the process, and to evaluate where continuous improvement of the process can be made.																			
Level 4 Predictable	PA 4.1 Process Measurement	As a result of full achievement of this attribute:																			
		a) Process information needs in support of relevant defined business goals are established.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		b) Process measurement objectives are derived from process information needs.																			
		c) Quantitative objectives for process performance in support of relevant business goals are established.																			
		d) Measures and frequency of measurement are identified and defined in line with process measurement objectives and quantitative objectives for process performance.																			
		e) Results of measurement are collected, analysed and reported in order to monitor the extent to which the quantitative objectives for process performance are met.																			
		f) Measurement results are used to characterise process performance.																			
	PA 4.2 Process Control	As a result of full achievement of this attribute:																			
		a) Analysis and control techniques are determined and applied where applicable.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		b) Control limits of variation are established for normal process performance.																			
		c) Measurement data are analysed for special causes of variation.																			
		d) Corrective actions are taken to address special causes of variation.																			
		e) Control limits are re-established (as necessary) following corrective action.																			
Level 5 Optimizing	PA 5.1 Process Innovation	As a result of full achievement of this attribute:																			
		a) Process improvement objectives for the process are defined that support the relevant business goals.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		b) Appropriate data are analysed to identify common causes of variations in process performance.																			
		c) Appropriate data are analysed to identify opportunities for best practice and innovation.																			
		d) Improvement opportunities derived from new technologies and process concepts are identified.																			
		e) An implementation strategy is established to achieve the process improvement objectives.																			
	PA 5.2 Process Optimisation	As a result of full achievement of this attribute:																			
		a) Impact of all proposed changes is assessed against the objectives of the defined process and standard process.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		b) Implementation of all agreed changes is managed to ensure that any disruption to the process performance is understood and acted upon.																			
		c) Based on actual performance, effectiveness of process change is evaluated against the defined product requirements and process objectives to determine whether results are due to common or special causes.																			

Figure 46 Glaux Soft's Process Maturity Measurement

The maturity measurement of Glaux Soft's processes, which were defined within chapter 6.4.1, has showed that, as expected by Glaux Soft's executives, all measured processes at least reach a level one capability level, which means that the COBIT 5 process outcomes, which are relevant for the PIP, are all largely or fully achieved. Furthermore, many processes have reached even higher capability levels (see figure 47).

Process Maturity Measurement	11	12	13	14	15	16	17	21	22	23	24	25	27	31	32	33	34	35	36
	01	01	01	02	10	08	05	04	11	05	05	07	07	11	03	09	06	06	06
Resulting Process Capability Level	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**0**	**2**	**2**	**1**	**1**	**0**	**1**	**2**	**1**	**1**	**1**
Targeted Process Capability Level	3	3	3	2	2	3	3	3	-	3	3	3	3	-	2	2	2	2	2
Process Capability Status																			

Figure 47 Glaux Soft's Resulting Process Capability Levels

Overall, three out of 17 measured processes have reached their targeted capability levels. For the majority of the remaining processes, the gap in maturity is one level whereas for three processes, a gap of two maturity levels was identified.

6.4.3 Defining Process Improvements with the PIP

Based on the performed process maturity measurement and the identified gaps in process maturity, various process improvement initiatives were defined by Glaux Softs executives. For every process the desired initiative as well as a timeline for its fulfilment have been defined as shown in Table 28.

Glaux Soft Process	Improvement Initiative	Deadline
11	In order to improve work product management for all three processes, further supporting tools such as checklists, definitions of done (DOD) and others should be established. Additionally, the involved staff will run a further, specific training.	30.06.2016
12		
13		
14	The process already reaches its targeted capability level 2.	-
15	The process already reaches its targeted capability level 2.	-
16	This process should further be established within the company. Therefore, a slight process redesign (in order to even better meet the changed ISO 9001:2015 requirements) as well as additional training is planned.	30.06.2016
17	Due to close interlinkage with process 24 and the defined improvement initiatives for this process, process 17 will not be improved at the current moment. After finishing process improvement of P24, synergies for P17 and based on that, potential further P17-specific improvements will be analysed.	-
21	The measurement has showed that P21 is closely caught between strategic influences of P11 – P13 and operative boundaries out of product and project management. Therefore, P21 and its roles should become a more solid hierarchical foundation by adjusting relevant TAR (tasks, authorities and responsibilities).	30.06.2016
22	The process cannot be measured with the PIP and is therefore not in focus.	-
23	The process measurement and even before practical influences have showed a changed environment within product management. Therefore, the process need to be readapted to practice, wherefore an interdisciplinary process improvement team was designated.	30.06.2016
24	Already before the process measurement, an improvement team was set up with the objective to redesign the process for more practical relevance. This team will continue with its task be considering the insights of the process measurement.	31.03.2016
25		30.06.2016
27	Customer retention is a topic that is covered by P27, but as well by processes 22, 24 and 25. This distribution of responsibilities makes the proper performance of P27 difficult. As both P23 and P24 are currently redesigned, an individual improvement of P27 is deferred until the influences of the changed P23 and P24 are foreseeable.	-
31	The process cannot be measured with the PIP and is therefore not in focus.	-
32	The process is currently not in focus for concrete improvement initiatives as higher prioritized initiatives of other processes need to be performed first.	-
33	The process already reaches its targeted capability level 2.	-
34	The process should be further enforced by performing additional staff training especially for disciplines related to IT-security. Therefore, isolated process changes may be necessary.	30.06.2016
35	Both processes are currently not in focus for concrete improvement initiatives as higher prioritized initiatives of other processes need to be performed first.	-
36		

Table 28 Defined Process Improvement Initiatives

Overall, Glaux Soft's management system, metered on its age of two years, is very well established. Nonetheless, concrete improvement initiatives were defined for many processes. All these initiatives, independent from their complexity and elaborateness, have the objective to further improve the benefit of the single process as well as of the complete management system.

6.5 Analysis of Generated Results and Insights

Within the previous chapter of the evaluation, the Process Improvement Prototype (PIP) was set into practice and the concrete activities and results for Glaux Soft AG were described. However, this chapter is focused on the PIP itself and the insights, problems and challenges its usage within the environment of Glaux Soft has generated. Therefore, personal opinions of the involved staff at Glaux Soft were collected and analysed. Based on that, the following insights, listed within table 29, were generated.

No.	Insight	Category
1	After a basic training and with some instant support, the PIP in its current setup is usable for people with a respective background in (business) process management.	Potential
2	The PIP addresses Glaux Softs practical requirements of process measurement and maturity categorization in an appropriate way. The generated measurements lead to concrete improvement initiatives, whose may lead to improved processes in future.	Potential
3	Within the context of the annual external adherence audit, both external auditors showed their interest for the PIP and the generated results.	Potential
4	Although with some limitations (see below), the combination of COBIT 5 PAM and ISO 9001:2015 works in practice. Process outcomes and generic practices as well as work products of COBIT 5 are applicable and recognizable within certified ISO 9001:2015 process models.	Potential
5	As already mentioned within chapter 4.5, the Process Improvement Prototype (PIP) provides no measurement methodology for processes that are allocated within the field of sales. This due to fact, that COBIT 5 does not cover the respective discipline. According to that, Glaux Soft's processes 22 and 31 could not have been analysed as they are mapped to the generic ISO 9001:2015 process number 11.	Limitation
6	The interpretation of "company IT", meaning IT as a department of a company, by COBIT 5 is different from the "IT company" character of Glaux Soft AG, describing an IT only company in the respective industry sector. Respectively, a certain adaption of COBIT 5 aspects such as process outcomes or work products is necessary, what makes the measurement more inaccurate.	Limitation
7	The PIP aggregates process outcomes of various COBIT 5 processes within one generic IT process. In the situation of Glaux Soft, the content of one such generic process is again split within multiple specific processes. This unitization of outcomes and processes exacerbates the measurement of capability level one as necessary outcomes of one generic process in some cases are provided by various specific processes. In these cases, the process model as a whole reaches level 1, while every single process measured for itself shows missing outcomes, what must lead to a level zero capability level.	Limitation
8	The mapping of 37 COBIT 5 processes with 11 generic processes represents a major generalization of the process model. This leads to the situation that most COBIT 5 enterprise goals, which are indirectly mapped with the COBIT 5 processes, demand the evaluation of almost all generic processes. Therefore as in the case of Glaux Soft, the selection of only one single enterprise goal requires the evaluation of the entire process model.	Limitation
9	Based on insight number 8, Glaux Softs executives tend to the definition of rather low targeted capability levels as they had in mind the quantitative amount of process measurements to be performed. This conclusion, based on the awaited workload, negatively influences the practical usage of the PIP.	Limitation
10	In its current state, the PIP and the respective Microsoft Excel tool need to be adapted for every participating company. This leads to a sophisticated reutilization.	Limitation
11	During the measurement of Glaux Softs process 25 (Maintenance & Support), it became clear that the initial mapping to the generic process number 6 (Operate IT-Infrastructure & -Services) was suboptimal. Therefore, the mapping of P25 was changed to the generic process number 7 (User Support).	Optimization
12	While using the PIP, the process maturity measurement element was extended with the visualization of the respective generic process for every specific process. As for the measurement of capability level one specific outcomes need to be assessed, this visualization simplifies the usage of the PIP.	Optimization

No.	Insight	Category
13	To simplify the comparison of targeted and resulting capability levels for every process, the PIP was extended with a coloured status display. This status is green as long as the resulting level is equal or higher than the targeted capability level. In case the resulting level undercuts the targeted level, the status is red. Again, such a visualization increases the usability of the PIP in practice.	Optimization
14	The descriptive structure of Glaux Softs management system directly covers the process attribute 2.1 (Performance Management) and its requirements. As Glaux Softs description of processes is based on common best practices in the field of ISO 9001:2015, this PA coverage may be true for other certified company as well.	Practical Finding

Table 29 Generated Results and Insights

Every result and insight, already categorized within the above table, has its specific importance for the practical usage of the Process Improvement Prototype (PIP). Therefore, the following figure 48 defines the relative importance of every insight.

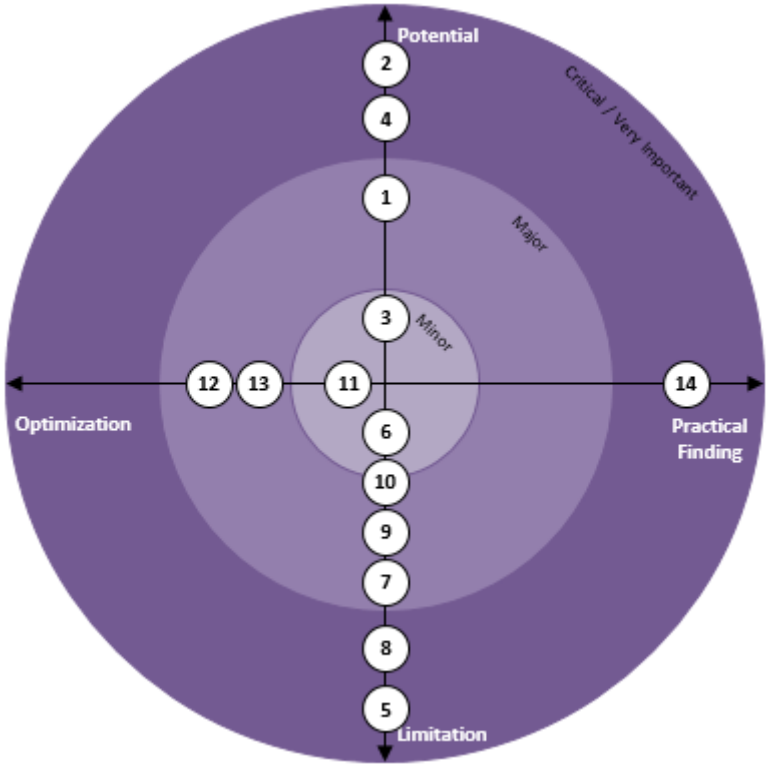


Figure 48 Insight Importance & Categories

Based on the defined importance, two potentials and one practical finding are stated as very important, meaning that their positive influence actively supports the deployment of the PIP in practice. Respectively, these aspects may be further carved out. On the other hand, two limitations are critical, which means that those insights are massively lower the PIP's practical relevance.

Furthermore, various insights of all categories are stated as major, what means that they should be further improved or used, whereas as minor insights cover "nice to have"-details, which may be interesting in future, but are not further relevant for the practical setup of the PIP.

7 Conclusion

This conclusive chapter focuses on the coverage of the defined research questions as well as on revealed lessons learned. Additionally, further useful fields of activity for future research and optimization of the PIP are designated.

7.1 Research Question Coverage

Does the Process Improvement Prototype (PIP) and the related study have the ability to fulfil the defined expectations? To answer this question, the present chapter analyses the individual attainment of the three research goals defined initially in chapter 1.3 of the study.

7.1.1 ISO 9001:2015 and COBIT 5 Mapping

The first research objective has focused on the study cornerstone of combining both standards / methodologies ISO 9001:2015 and COBIT 5 PAM. The detailed formulation of the objective is as follows:

Modelling relevant relationships between ISO 9001:2015 and COBIT 5 and developing a generic mapping table to align the respective processes.

Initial research within this study has proven that a combination of quality management systems (such as ISO 9001:2015) and maturity measurement frameworks (such as COBIT 5 PAM) can work. Within chapter 2.5, various attempts are documented and analysed.

Based on the potential and problems of these earlier endeavours, this study first has analysed possible ways of combining two different standard and / or methodologies (see chapter 4.1, 4.2 and 4.3). With the resulting decision to combine ISO 9001:2015 and COBIT 5 PAM on process level, a detailed mapping of both standards and methodologies, available within appendix C (Generic Process Map and COBIT 5 Detailed Process Mapping), was created and summarized within chapter 4.5.

As a further baseline for this mapping, a generic process model attempt for ISO 9001 certified, Swiss-based software development SMEs was defined in advance. Therefore, the common IT process map of the Swiss federal administration was reused and extended to create the generic ISO 9001:2015 process map for IT SMEs (see chapter 4.4).

Additionally, the process mapping of ISO 9001:2015 and COBIT 5 PAM is based on a specific policy that is now an essential part of the Process Improvement Prototype (PIP) and is documented within chapter 5.2.2.

Overall, the feasibility of a mapping between ISO 9001:2015 and COBIT 5 PAM with the intention to measure maturity of certified ISO 9001:2015 processes is approved. Identified limitations, especially the non-coverage of the sales discipline within COBIT 5, are delimited and documented (see chapter 6.5) with the idea of being a prospective study topic in chapter 7.3.

7.1.2 Prototyping a Process Measurement Model

The second research objective has governed the creation of a prototype that is able to measure the maturity of ISO 9001:2015 process models by using the instruments and tools of COBIT 5 PAM. In detail:

> **Prototyping a process measurement model applicable for ISO 9001:2015 based on the COBIT 5 PAM capability indicators.**

With this research objective in mind and the previously described process mapping between ISO 9001:2015 and COBIT 5 PAM in hand, the development of a respective prototype with the name Process Improvement Prototype (PIP) was started. Therefore, the process model mapping approach, which has already been used for the mentioned mapping between ISO 9001:2015 and COBIT 5 PAM, was refined and documented (see chapter 5.2.2). Furthermore, a respective tool (see Appendix F (Process Improvement Prototype (PIP))), together with a three step mapping process was developed that allows users of PIP the mapping of their individual ISO 9001:2015 processes with one of the generic ISO 9001:2015 processes for IT SMEs of the PIP.

As a second aspect of the prototype, the essentials of COBIT 5 regarding process definition and scoping, including the given enterprise and IT related goals of COBIT 5, were adapted for a target-aimed usage within the PIP. This means that mentioned goals have been relinked to the relevant processes of the generic ISO 9001:2015 process map for IT SMEs, which now allows a user of the PIP to select assessable processes by selecting enterprise goals, which are relevant within the specific situation of the users company (see chapter 5.3.1). Furthermore, this second element of the PIP contains helpful instruments, which guides the user towards proper defined targeted capability level for its own, specific processes (see chapter 5.3.2).

The third element of the PIP is the measurement tool itself, which is again closely linked with the respective COBIT 5 tools. This tool, described within chapter 5.3.3 and available within Appendix F (Process Improvement Prototype (PIP)), allows the definition of a resulting capability level for all assessed processes by using metrics and rating systems of COBIT 5 (see chapter 5.3, 5.4 and 5.5). Finally, the PIP as well guides the user along the definition of potential improvement initiatives.

By taking these three elements of the PIP in account, the respective research question is fulfilled. Nonetheless, further optimization potential (see chapter 6.5) was revealed during the evaluation of the PIP, which leads to respective prospective research endeavours described within chapter 7.3.

7.1.3 Validating the Usability of the Developed Measurement Model

The last research objective has asked for a qualitative evaluation of the study perceptions, the formulation of which is detailed as follows:

> **Validating the usability of the developed measurement model (qualitative case study approach).**

After finishing the Process Improvement Prototype (PIP), the selection of an appropriate company was started. Therefore, the study scope (see chapter 1.4 and 6.1) was used to generate respective selection criteria. Therewith, Glaux Soft AG (chapter 6.2) was selected, whereas first the mapping of the company's processes (see chapter 6.2.3) along the generic ISO 9001:2015 processes (see chapter 6.3) was performed by using the respective tool number 1 of the PIP.

Once its processes were mapped, the company, meaning its executives and process owners, has defined enterprise goals, assessable processes and respective targeted capability levels by using the second instrument of the PIP (described in chapter 6.4.1). During this process, various improvement potential for the PIP was identified and adaptions, as described in chapter 6.5, were performed.

Finally, a process assessment was performed (as in chapter 6.4.2) and different improvement initiatives (see chapter 6.4.3) have been defined by using the baseline of the PIP. Thereby, again some adaptions have been made on the PIP and its tools and instruments.
Overall, the performed qualitative case study has highlighted the potential of the PIP to become a worthy instrument within the areas of process maturity measurement and continuous improvement for ISO 9001:2015 certified companies. Notwithstanding the various limitations, which are addressed directly during the study or are highlighted as prospective research elements (see chapter 7.3), the prototype and therewith the study have reached its defined goals.

7.2 Lessons Learned

During the development of this study, several superior insights were generated. For example, scientific resources (among others Gvoic (2013)) and practical observations (see chapter 6.2) have showed the importance of quality management for software development companies in Switzerland. Respectively, literature and practice hold available various different approaches for quality management along the ISO 9001 standard. Thereby, this individualisation is both boon and bane at the same time. Bane because companies have plenty of possibilities to meet their own, specific requirements within the boundaries of the respective standard, which of course is one major reason for the international and cross-industrial success of the ISO 9001 standard for quality management. Boon in contrary because the wealth of different approaches and characteristics makes the development of generic tools such as the Process Improvement Prototype (PIP) even more difficult.

Another, more procedure-oriented insight is that companies handle information related to their quality management systems much more confidentially than initially expected. Respectively, the procedure for this study had to be redesigned during its development, as the initial plan of collecting various companies' process models in order to develop the generic ISO 9001:2015 process map for IT SMEs was not realistic. However, by using the Swiss federal IT process map, an adequate alternative was found.

Furthermore, an important insight concerning COBIT 5 is that the respective methodology is clearly focused on IT departments within bigger companies. This fact led to multiple challenges and problems, among others the missing sales processes, which are currently the most serious limitation of the Process Improvement Prototype (PIP). However, other consequences of this insight such as the need for interpretation of COBIT 5 outcomes are considerable as well.

Finally and protruding, it became clear that both the combination of different standards and methodologies on process level as well as the reuse of elements of the one within the other framework is suitable to generate practical benefits. Respectively, the development of the PIP within the present study can be stated as a successful intermediate goal. Nonetheless of several limitations and future improvement potential, the PIP in its current state has proved its operability within a qualitative case study.

7.3 Prospective Research

Based on the result of the qualitative case study as well as on the conclusive reflection, several prospective research fields for further improvement of the Process Improvement Prototype (PIP) are identified and described.

First, as highlighted at various points of the study, assessment of sales processes is currently not possible with the PIP, as COBIT 5 does not cover the respective topic within its process model. However, almost every Swiss-based software development SME has such processes within its process model. Therefore, further research activities should be performed in order to identify a possibility as to how to extend the existing prototype with additional sales measures. Thereby, one possible approach is to use other methodologies such as ValIT, which has a more generic focus and is not as IT specific as COBIT 5 or ITIL V3.

Another worthy field of prospective research is the further optimization of the PIPs tools and techniques. In its current state, the PIP is defined within a Microsoft Excel sheet, what allows on the one hand automated calculations of various elements. However, on the other hand, the necessary formulas are currently closely related to Glaux Soft's number and structure of processes. Respectively, work that is more comprehensive needs to be done to adapt the PIP to another company and to their specific process model. Therefore, the further generalization of excel sheet and formulas or even the development of an own application may be useful.

Finally, as a third potential field of activity, investments into the further generalization of the PIP within the IT sector should be done. Currently, the PIP only fits for SME software development companies, whereas only a qualitative case study has been done to approve the respective fit. Therefore, further quantitative analyses and / or an extension in scope towards other company types and sizes within the IT sector are necessary. Moreover, as a long-term endeavour, the PIP may be adapted for other industry sectors as well as for companies outside Switzerland. However, both of these extensions will generate massive adaptions to the PIP due to the current underlying IT process model of the Swiss federal administration.

8 Bibliography

8.1 Internal university-related resources

Hinkelmann, Knut; Witschel, Hans Friedrich (2014): How to choose a research methodology?, Course theory in module PORP (Practice-oriented Research Project), University of Applied Sciences Northwestern Switzerland, School of Business, Olten (Switzerland).

8.2 Scientific papers & nonfictions

Adelman, Clem (1993): Kurt Lewin and the Origins of Action Research, Educational Action Research, University of Reading, Reading (Great Britain).

Aldowaisan, Tariq A.; Youssef, Ashraf S. (2004): An ISO 9001:2000-based framework for realizing quality in small businesses, Department of Industrial and Management Systems Engineering, College of Engineering and Petroleum, Kuwait University, Safat (Kuwait).

Alter, Stefanie; Goeken, Matthias (2009): Konzeptionelle Metamodelle von IT-Governance-Referenzmodellen als Basis der Kombination und Integration in einer Multi-Modell-Umgebung, Frankfurt School of Finance & Management, Frankfurt (Germany).

Bayo-Moriones, Alberto; Merino-Diaz-de-Cerio, Javier; Escamilla-de-León, Sergio Antonio, Selvam, Rejina Mary (2011): The Impact of ISO 9000 and EFQM on the Use of Fexible Work Practices, Universidad Pública de Navarra, Departamento de Gestión de Empresas, Campus de Arrosadía, Pamplona (Spain).

Beckmann, Sara L.; Barry, Michael (2007): Innovation as a Learning Process, Embedding Design Thinking, University of California, Berkeley (USA).

Benes, Georg M. E.; Groh, Peter E. (2014): Grundlagen des Qualitätsmanagement, 3rd Edition, Carl Hanser Verlag GmbH & Co. KG, Munich (Germany).

Crosby, Philip B. (1979): Quality is free, the art of making quality certain, McGraw-Hill, New York (United States).

Deming, Walter E. (1982): Out of the Crisis, Massachusetts Institute of Technology (MIT), Cambridge (United States).

De Vries, M. (2012): A Process Reuse Identification Framework Using an Alignment Model, PhD Thesis, University of Pretoria, Pretoria (South Africa).

Dilger, Alexander (2012): Rigor, wissenschaftliche und praktische Relevanz, Discussion Paper, Institute for Organisational Economics, Westfälische Wilhelms-Universität Münster, Münster (Germany).

Ellis, Timothy J.; Levy, Yair (2008): Framework of Problem-Based Research, A Guide for Novice Researchers on the Development of a Research-Worthy Problem, Graduate School of Computer and Information Sciences, Nova Southeastern University, Fort Lauderdale (USA).

Fischer, Nikolaus; Smolnik, Stefan (2013): The Impact of Mobile Computing on Individuals, Organizations, and Society, Synthesis of Existing Literature and Directions for Future Research, 46th Hawaii International Conference on System Sciences, IEEE Computer Society, Washington DC (USA).

Hart, Chris (1998): Doing a Literature Review, Releasing the Social Science Research Imagination, SAGE Publications, Thousand Oaks (USA).

Hermann, Joachim (2009): Ein Qualitätsmanagementsystem (QMS) für Lehre und Studium an der TU Berlin, Technische Universität Berlin, Berlin (Germany).

Hess, Thomas; Matt, Christian; Hilbers, Konrad (2014): Bekannte und weniger bekannte Wege zu praxisrelevanter Forschung in der Wirtschaftsinformatik, Ludwig-Maximilians-Universität München (LMU), Institut für Wirtschaftsinformatik und Neue Medien, Munich (Germany).

Hevner, Alan R.; Chatterjee, Samir (2010): Design Research in Information Systems, Theory & Practice, 1st Edition, Springer Science + Business Media LLC, New York (USA).

Kahl, Timo (2009): Das Information Modeling Maturity Model, Ein Reifegradmodell für die Informationsmodellierung, Logos Verlag Berlin GmbH, Berlin (Germany).

Kuhn, Markus (1996): International Standard Paper Sizes, Computer Laboratory, University of Cambridge, Cambridge (United Kingdom).

Lebek, Benedikt; Uffen, Jörg; Breitner, Michael H.; Neumann, Markus; Hohler, Bernd (2013): Employees' Information Security Awareness and Behavior, A Literature Review, 46th Hawaii International Conference on System Sciences, IEEE Computer Society, Washington DC (USA).

Lee, Ming-Chang; Chang, to (2006): Applying TQM, CMM and ISO 9001 in Knowledge Management for software development process improvement, Department of Information Management, Taiwan (Taiwan).
Malzahn, Dirk (2009): Assessing – Learning – Improving, An Integrated Approach for Self-Assessment and Process Improvement Systems, 4th International Conference on Systems, IEEE Computer Society, Washington DC (USA).

Mutafelija, Boris; Stromberg, Harvey (2003): Exploring CMMI-ISO 9001:2000 Synergy when Developing a Process Improvement Strategy, SEPG 2003 Conference, BearingPoint Inc. & Hughes Network Systems, Boston (USA).

Müller, Christian (2004): Grundlagen des Qualitätsmanagement, MPA Abschlussworkshop, Barbara Bredner, Statistische Beratung & Lösungen, Unna (Germany).

Paul, Philipp (2009): Vom Qualitätsmanagement zum Total Quality Management, Ullrich Präzisionstechnik, Benshausen (Germany).

Paulk, Mark C. (1995): How ISO 9001 Compares with the CMM, Institute for Software Research, School of Computer Science, Carnegie Mellon University, Pittsburgh (USA).

Pfeifer, Tilo; Schmitt, Robert (2010): Qualitätsmanagement, Strategien Methoden Techniken, 4nd Edition, Carl Hanser Verlag GmbH & Co. KG, Munich (Germany).

Repenning, Nelson P.; Sterman, John D. (2002): Capability Traps and Self-Confirming Attribution Errors in the Dynamics of Process Improvement, Sloan School of Management Massachusetts Institute of Technology, Cambridge (USA).

Repp, Nicolas; Mauthe, Andreas U., Steinmetz, Ralf (2008): Chancen und Risiken bei der Einführung von IT-Governance-Frameworks, Ergebnisse einer qualitativen Untersuchung in Grossbritannien, Fachgebiet Multimedia kommunikation, Technische Universität Darmstadt, Darmstadt (Germany).

Riehle, Dirk (2011): Software research and the Industry, Rigor vs. Relevance, or: What is the size of a Dissertation?, Available: http://dirkriehle.com/2011/04/20/rigor-vs-relevance-or-what-is-the-size-of-a-dissertation/ (Access: 21. April 2015).

Rohloff, Michael (2003): IT-Governance: Modell und ausgewählte Beispiele für die Umsetzung, Siemens AG, Munich (Germany).

Russell, Steve (2010): ISO 9000:2000 and the EFQM Excellence Model: Competition or co-operation?, Business Improvement & Total Quality, Lloyds Register Quality Assurance Limited, Coventry (England).

Rüter, Andreas; Schröder, Jürgen; Göldner, Axel; Niebuhr, Jens (Hrsg.) (2010): IT-Governance in der Praxis, Erfolgreiche Positionierung der IT im Unternehmen, 2nd Edition, Springer-Verlag GmbH, Heidelberg (Germany).

Saunders, Mark N. K.; Rojon, Céline (2011): On the Attributes of a Critical Literature Review, School of Management, University of Surrey, Guildford (United Kingdom).

Saunders, Mark N. K.; Lewis, Philip; Thornhill, Adrian (2009): Research Methods for Business Students, 5th Edition, Pearson Education Limited, Harlow (England).

Schmelzer, Hermann J.; Sesselmann, Wolfgang (2010): Geschäftsprozessmanagement in der Praxis, Carl Hanser Verlag GmbH & Co. KG, Munich (Germany).

Schmitt, Robert (2015): Unternehmerisches Qualitätsmanagement, Das unternehmerische Qualitätsverständnis, Available: http://www.aachener-qualitaetsmanagement-modell.de/das-unternehmerische-qualitatsverstand-nis/ (Access: 11. May 2015).

Schroll, Johann (2006): Qualitätsmanagement im IT-Bereich, ISO 9001 und ITIL® im Vergleich, GRIN Verlag GmbH, Munich (Germany).

Strompen, Norbert (2015): Definition Normen – Standards, Begriffsbestimmung und Erläuterungen, IHK Koblenz, Koblenz (Germany).

Thaller, Georg E. (1997): Der individuelle Software-Prozess, DIN EN ISO 9001 für Klein- und Mittelbetriebe, BHV Software GmbH, Kaarst (Germany).

Thom, N.; Ritz, A. (2000): Public Management, Innovative Konzepte zur Führung im öffentlichen Sektor, GWV, Wiesbaden (Germany).

Walsham, Geoff (1993): Interpreting Information Systems in Organizations, John Wiley & Sons, Chichester (Great Britain).

Yoo, Chanwoo; Yoon, Junho; Lee, Byungjeong; Lee, Chongwon; Lee, Jinyoung; Hyun, Seunghun; Wu, Chisu (2004): An Integrated Model of ISO 9001:2000 and CMMI for ISO Registered Organizations, 11th Asia-Pacific Software Engineering Conference, IEEE Computer Society, Washington DC (USA).

Yoo, Chanwoo; Yoon, Junho; Lee, Byungjeong; Lee, Chongwon; Lee, Jinyoung; Hyun, Seunghun; Wu, Chisu (2006): A unified model for the implementation of both ISO 9001:2000 and CMMI by ISO-certified organizations, SE Lab, School of Computer Science and Engineering, Seoul National University, Seoul (South Korea).

Zelt, Saskia; Uebernickel, Falk; Brenner, Walter (2013): Managing Global IT Delivery Networks, A Literature Review from the Supplier's Perspective, 46th Hawaii International Conference on System Sciences, IEEE Computer Society, Washington DC (USA).

8.3 Practice-oriented literature & resources

Andenmatten, Martin (2012a): Erfolg durch Serviceorientierung, Swiss IT Magazine, Available: http://www.itmagazine.ch/Artikel/49275/Erfolg_durch_Serviceorientierung.html, Swiss IT Media, Thalwil (Switzerland).

Andenmatten, Martin (2012b): Prozess Assessment, Wer misst, misst Mist, Available: https://blog.itil.org/2012/10/cobit/prozess-assessment-wer-misst-misst-mist (Access: 18. June 2015).

Angermeier, Dr. Georg (2015): Best Practice Approach, Definition, Available: https://www.projektmagazin.de/glossarterm/best-practice (Access: 18. April 2015).

British Department of Trade & Industry (2015): Quality Management Systems, Definition, Available: http://www.businessballs.com/dtiresources/quality_management_systems_QMS.pdf (Access: 30. March 2015).

Business Dictionary (2015): Definition of Quality Management System, Available: http://www.businessdictionary.com/definition/quality-management-system-QMS.html (Access: 30. March 2015).

Deutsches Institut für Normierung (2015): Koordinierung der Normungsarbeit, Ziele der Normungsarbeit, Available: http://www.din.de/cmd?level=tpl-unterrubrik&languageid=de&cmssubrubid=ziele (Access: 11. May 2015).

Gabler Business Dictionary (2015): Definition of the term quality, Available: http://wirtschaftslexikon.gabler.de/Archiv/55799/qualitaet-v6.html (Access: 01. June 2015).

Glaux Soft AG (2015a): Company Webpage – About Us, Online: https://www.glauxsoft.com/ueber-uns.html (Access: 07. December 2015).

Glaux Soft AG (2015b): Company Webpage – evidence, Online: https://www.glauxsoft.com/evidence.html (Accessed: 07. December 2015).

Glaux Soft AG (2015c): Glaux Soft AG – Description of the ISO 9001:2015 Quality Management System, Internal Documentation, Glaux Soft AG, Bern (Switzerland).

Glenfis AG (2011): ITIL Edition 2011 - COBIT 5 Mapping, Glenfis AG, Zurich (Switzerland).

Gvoic, Marina (2013): Der aktuelle ISO-Survey 2013 stellt die Daten zur Verbreitung der ISO-Zertifizierungen vor, Arbeitswohlfahrt Bundesverband e.V., Berlin (Germany).

International Standardisation Organisation (2003): ISO 15504-2:2003, Information technology, Process assessment, Part 2: Performing an assessment, 1st Edition, ISO, Vernier (Switzerland).

International Standardisation Organisation (2012): Quality Management Principles, ISO, Vernier (Switzerland).

International Standardisation Organisation (2015a): ISO 9001:2015, Quality Management Systems – Requirements, 5th Edition, ISO, Vernier (Switzerland).

International Standardisation Organisation (2015b): The ISO Survey, Available: http://www.iso.org/iso/iso-survey (Access: 16. June 2015).

International Standardisation Organisation (2015c): ISO/IEC 33001:2015, Process Assessment, Concepts and Terminology, 1st Edition, ISO, Vernier (Switzerland).

International Standardisation Organisation (2015d): ISO 9000:2015, Quality Management, 4th Edition, ISO, Vernier (Switzerland).

ISACA (2013a): COBIT 5, Using COBIT 5 – Self Assessment Guide, ISACA, Rolling Meadows (USA).

ISACA (2013b): Process Assessment Model (PAM), Using COBIT 5, ISACA, Rolling Meadows (USA).

ISACA (2013c): COBIT 5, A Business Framework for the Governance and Management of Enterprise IT, ISACA, Rolling Meadows (USA).

ISACA (2010): COBIT Mapping, Mapping of FFIEC with COBIT 4.1, ISACA, Rolling Meadows (USA).

ISB (2015): Prozesslandkarte, Informatikprozesse in der Bundesverwaltung, Release 3 vom 12.08.2015, Informatiksteuerungsorgan des Bundes, Bern (Switzerland).

ISO 9000 Store (2015): Definition of Quality Management System, Available: http://the9000store.com/what-is-iso-9001-quality-management-system.aspx (Access: 30. March 2015).

KMU Portal des Bundes (2015): Qualitätsmanagementsysteme (QMS) nach ISO 9001, Available: http://www.kmu.admin.ch/kmu-betreiben/03293/03294/03295/index.html?lang=de (Access: 27. April 2015).

Lemberg, Sabine (2015): Clarifications about the provision of information about ISO 9001:2015 process models (Interview / Discussion from 22. October 2015).

Quack, Karin (2014): IT-Kompass 2014, IT und Fachbereiche nähern sich an, Available: http://www.computerwoche.de/a/it-und-fachbereiche-naehern-sich-an,2555787 (Access: 20. June 2015).

SAI Global Limited (2015): Certification along ISO 9001:2008, Available: http://www.saiglobal.com/Assurance/quality-business-management/ISO9001.htm (Access: 18. April 2015).

Schmutz, Christoph G. (2013): Ein Massstab für konstante Qualität, Warum Unternehmen sich zertifizieren lassen, Available: http://www.nzz.ch/ein-massstab-fuer-konstante-qualitaet-1.18106375 (Access: 16. June 2015).

8.4 Used Graphics (not directly mentioned in text)

Illustration Quality Assurance (Page 1): title image of the paper, http://wordsrevealed.com/wp-content/uploads/2014/02/aaaa.jpg, Words revealed, Rome (Italy).

9 Appendix

This chapter contains various appendixes, which substantiate different contents of the study that are provided in a summarized form within the previous chapters. In order to ensure a comprehensive overview of the different appendixes, the following list summarizes each appendix.

Appendix A – Structured Literature Review 89

The structured literature review contains a list of all resources used within the study. It contains a fine granular categorization of the resources as described within chapter 2.1.

Appendix B – Generic Process Map for IT SMEs in Detail 92

This appendix provides further information concerning the GPM-IT defined in chapter 4.4. All processes are described in detail regarding the common process aspects of inputs, outputs, objectives, activities, process owners and roles.

Appendix C – Generic Process Map and COBIT 5 Detailed Process Mapping.....103

The mapping between the GPM-IT and COBIT 5 introduced in chapter 4.5 is enriched with further information within this appendix. Along common process aspects of inputs, outputs, objectives, activities, process owners and roles, the respective mapping accuracy is calculated and justified.

Appendix D – Glaux Soft's Process Map in Detail.....125

This appendix provides further information concerning Glaux Softs ISO 9001 process model introduced in chapter 6.2.3. All processes are described in detail regarding the common process aspects of inputs, outputs, objectives, activities, process owners and roles.

Appendix E – Generic Process and Glaux Soft's Detailed Process Mapping 126

The mapping between the GPM-IT and Glaux Softs ISO 9001 process model introduced in chapter 6.3 is enriched with further information within this appendix. Along common process aspects of inputs, outputs, objectives, activities, process owners and roles, the respective mapping accuracy is calculated and justified.

Appendix F – Process Improvement Prototype (PIP) 127

The last appendix contains further information and clarifications about the PIP and its three specific tools, which are provided within a separate Microsoft Excel file.

Important Notice:
This master thesis is available in two different versions – an internal and external one. Within the external, published version, appendixes D and E are removed due to the confidentiality of the respective contents.

9.1 Appendix A – Structured Literature Review

The structured literature review (see table 27) provides an overview over all relevant literature that was used in order to generate the present study. Thereby every source is categorized along the keywords defined during the process of literature review.

Reference (for detailed references see chapter 8)		Quality			IT Governance			Process Maturity				Mapping				Research			
	Framework & Standard	ISO/IEC 9001	EFQM	Quality Management System	Business- / IT-Alignment	IT Governance Model	COBIT 5 (incl. COBIT 4.1)	Process Improvement	Self-Assessment	COBIT 5 PAM	CMMI	ISO/IEC 9001	CMMI	COBIT 5 PAM (incl. COBIT 4.1)	EFQM	Literature Review	Research Methodology	Research Design	Other Resources
Adelman (1993)																	x	x	
Aldowaisan & Youssef (2004)	x	x										x							
Alter & Goeken (2009)												x		x					
Andenmatten (2012a)					x														
Andenmatten (2012b)								x	x										
Angermeier (2015)	x																		
Crosby (1979)				x															
Bayo-Moriones et al. (2011)	x	x	x	x															
Beckman & Barry (2007)																		x	
Benes & Groh (2014)				x															
British Department of Trade & Industry (2000)				x															
Business Dictionary (2015)				x															
Deutsches Institut für Normierung (2015)	x																		
Deming (1982)	x																		
De Vries (2012)																		x	
Dilger (2012)																	x		
Ellis & Levy (2008)																	x		
Fischer & Smolnik (2013)																x	x		
Gabler Business Dictionary (2015)				x															
Glaux Soft AG (2015a)																			x
Glaux Soft AG (2015b)																			x
Glaux Soft AG (2015c)	x			x								x							x
Glenfis AG (2011)														x					
Gvoic (2013)		x																	
Hart (1998)																x			
Hevner & Chatterjee (2010)																	x	x	
Hermann (2009)		x																	
Hess et al. (2014)																	x		
Hinkelmann & Witschel (2014)																	x	x	
International Standardisation Organisation (2003)								x	x										
International Standardisation Organisation (2012)		x		x															
International Standardisation Organisation (2015a)		x		x															
International Standardisation Organisation (2015b)		x		x															

Reference (for detailed references see chapter 8)		Quality			IT Governance			Process Maturity				Mapping				Research			
	Framework & Standard	ISO/IEC 9001	EFQM	Quality Management System	Business- / IT-Alignment	IT Governance Model	COBIT 5 (incl. COBIT 4.1)	Process Improvement	Self-Assessment	COBIT 5 PAM	CMMI	ISO/IEC 9001	CMMI	COBIT 5 PAM (incl. COBIT 4.1)	EFQM	Literature Review	Research Methodology	Research Design	Other Resources
International Standardisation Organisation (2015c)								x	x										
International Standardisation Organisation (2015d)		x		x															
ISACA (2013a)								x	x	x									
ISACA (2013b)								x		x									
ISACA (2013c)							x												
ISACA (2010)							x							x					
ISB (2015)	x				x	x													
ISO 9000 Store (2015)		x		x															
Kahl (2009)								x											
KMU Portal des Bundes (2015)				x															
Kuhn (1996)	x																		
Lebek et al. (2013)																x			
Lee & Chang (2006)												x	x						
Lemberg (2015)				x								x							x
Malzahn (2009)								x	x										
Mutafelija & Stromberg (2003)												x	x						
Müller (2004)				x															
Paul (2009)				x															
Paulk (1995)												x	x						
Pfeifer & Schmitt (2010)				x															
Quack (2014)					x														
Repenning & Sterman (2002)								x											
Repp et al. (2008)	x				x	x													
Riehle (2011)																	x		
Rohloff (2003)	x		x		x		x												
Russell (2010)												x			x				
Rüter et al. (2010)						x													
SAI Global Limited (2015)		x																	
Saunders & Rojon (2011)																x			
Saunders et al. (2009)																x	x	x	
Schmelzer & Sesselmann (2010)					x			x											
Schmitt (2015)				x															
Schmutz (2013)		x		x															
Schroll (2006)	x	x	x				x				x								
Strompen (2015)	x																		
Thaller (1997)		x		x															
Thom & Ritz (2000)				x															
Walsham (1993)																	x		
Yoo et al. (2004)												x	x						
Yoo et al. (2006)												x	x						

Reference (for detailed references see chapter 8)	Framework & Standard	Quality			IT Governance			Process Maturity				Mapping				Research			Other Resources
		ISO/IEC 9001	EFQM	Quality Management System	Business- / IT-Alignment	IT Governance Model	COBIT 5 (incl. COBIT 4.1)	Process Improvement	Self-Assessment	COBIT 5 PAM	CMMI	ISO/IEC 9001	CMMI	COBIT 5 PAM (incl. COBIT 4.1)	EFQM	Literature Review	Research Methodology	Research Design	
Zelt et al. (2013)																x	x		

Table 30 Structured Literature Review

9.2 Appendix B – Generic Process Map for IT SMEs in Detail

The generic ISO 9001:2015 process map for IT SMEs (as in figure 49) contains eleven different processes, which are categorized in management, core and support processes. Thereby the resulting process model looks as follows:

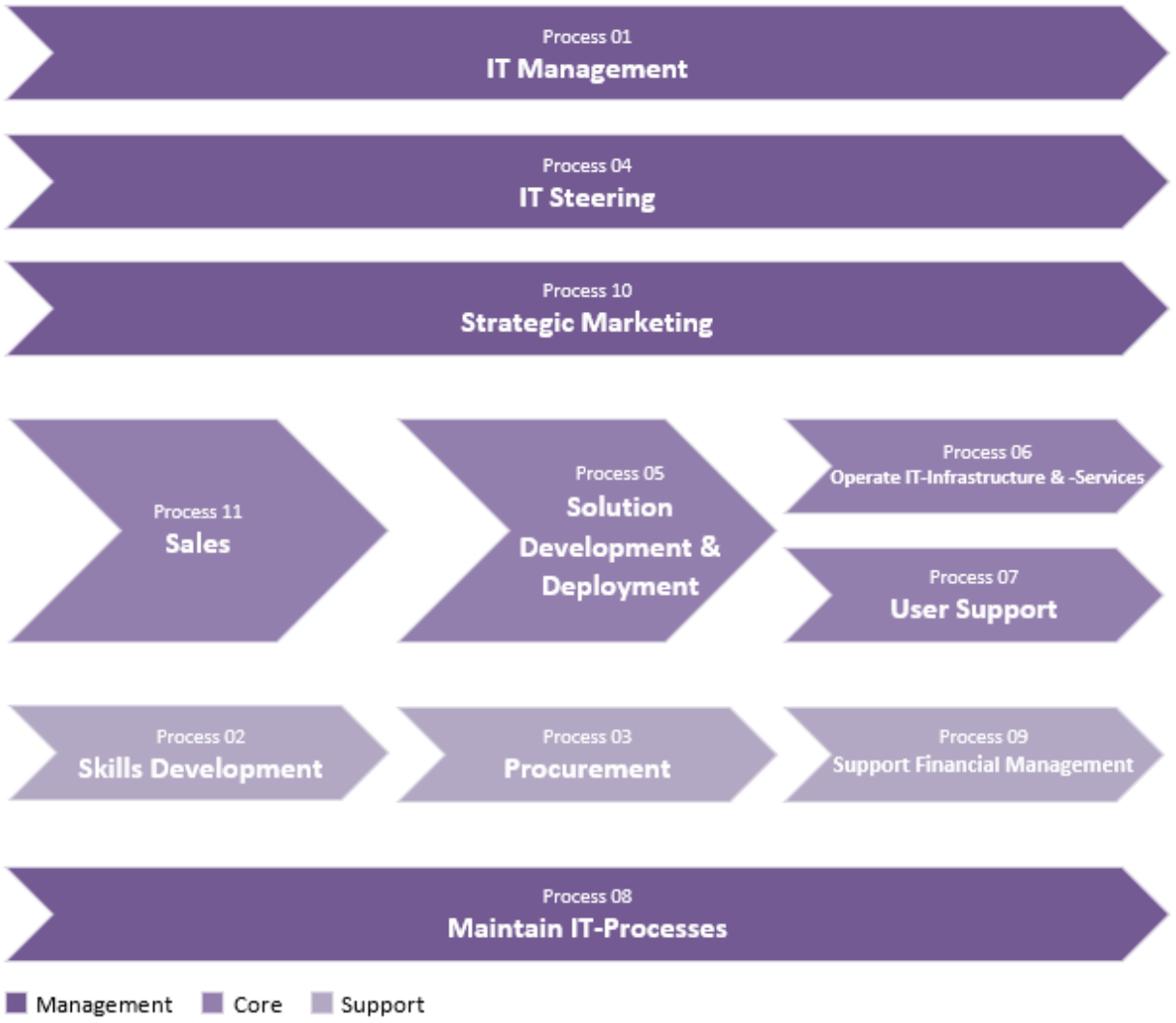


Figure 49 Generic ISO 9001:2015 Process Model for IT SMEs (GPM-IT) (adapted from ISB (2015))

Within this appendix, which is based on ISB (2015) and in parts adapted from Glaux Soft (2015c), the single processes and their individual attributes are described in detail. As the cited resources are written in German only, the process details are provided in the respective language.

9.2.1 Process 01 – IT Management

Aspect	Official Description
Inputs	- Ausnahmebedarf (04, 05, 06) - Controllingberichte (04) - Finanz- & Kostendaten (09) - freigegebenes Informatikportfolio (04) - Geschäftsprozess-Anforderungen (01) - Geschäftsstrategien (01) - Legislaturziele des Bundesrates (01) - SCO-Bericht (04)
Outputs	- Ausnahmeentscheid (04) - IKT-Prüfbericht (04) - IKT-Vorgaben aus P01 (02, 03, 04, 05, 06, 07, 08, 09) - Masterplan aus IKT-Strategie (04) - Messdaten (08) - Programm-Handbuch (05) - Programm-Informationen (04) - Studienbedarf (04)
Objectives	- Eine optimale Informatikunterstützung der Geschäftsprozesse in der Bundesverwaltung ist sichergestellt. - IKT-Vorgaben sind aktualisiert und IKT-Standards sind eingehalten. - IKT-Programme sind umgesetzt.
Activities	01.01 Strategische Informatikplanung (SIP) - IKT-Strategie entwickeln - IKT-Strategie nachführen 01.02 IKT-Standards festlegen - IKT-Standard entwickeln - IKT-Standard pflegen - IKT-Standard ausser Kraft setzen 01.03 Einhaltung von IKT-Vorgaben überprüfen - Einhaltung von IKT-Vorgaben überprüfen 01.04 Ausnahmen von IKT-Vorgaben gewähren - Ausnahmen von IKT-Vorgaben gewähren 01.05 Unternehmensarchitektur-Planung - Unternehmensarchitektur entwickeln - Unternehmensarchitektur nachführen 01.06 IKT-Programme umsetzen - IKT Programm - Programm identifizieren - IKT Programm - Programm definieren - IKT Programmumsetzung führen - IKT Programm - Programm abschliessen
Process Owner	n. a.
Roles	- Auftraggeber/in (AG) - Geschäftsprozess-Verantwortliche/r (GPV) - IKT-Auditor/in - Informatiksicherheitsbeauftragte/r (ISB) - Lösungsarchitekt/in (ARCH) - Programm-Delegierte/r (PDL) - Programm-Manager/in (PGM) - Projektleiter/in (PL) - Standard-Administrator/in (STA) - Strategieverantwortliche/r (STV) - Unternehmensarchitekt/in (UA)

Table 31 ISB Process 01 – IT Management (from ISB (2015))

9.2.2 Process 04 – IT Steering

Aspect	Official Description
Inputs	- Änderungsantrag (RFC) & Änderungsauftrag (MAC) (07) - Ausnahmeentscheid (01) - Auswertungen über erbrachte IKT-Leistungen (06) - Bedarf nach IKT-Service (05) - Bedarfserfüllung (03) - Betriebsanforderungen für SLA (05) - Finanzkennzahlen und Reports (09) - Geschäftsprozess-Anforderungen (01) - IKT-Prüfbericht (01) - IKT-Vorgaben aus P01 (01) - Konsolidierte Inventarinformationen (06) - Konsolidierter Changeplan (05) - Masterplan aus IKT-Strategie (01) - Plankostenkalkulation für LV (09) - Programm-Informationen (01) - Projektstatus (05) - Servicekatalog (06) - Serviceverbesserungsplan (06) - Stand Zahlungs- und Verpflichtungskredite (09) - Studienbedarf (01) - verfügbare Zahlungs- und Verpflichtungskredite (09)
Outputs	- abgeschlossene DLV & SLA (09) - ACO-, SCO-, PCO-Bericht (09) - Änderungsantrag (RFC) (05) - Änderungsauftrag (MAC) (05) - Ausnahmebedarf (01) - Bedarfsanforderung (03) - Controllingberichte (01) - freigegebenes Informatikportfolio (AG, 01, 09) - genehmigter Serviceverbesserungsplan (06) - ICO-Vorgaben (05) - Informationen über Kundenzufriedenheit (07) - Informationen über Trends (06) - Kundenzufriedenheit (04) - Messdaten (08) - nachgeführter Servicekatalog (06) - Projektanmeldung oder SCO-Bericht (05) - Projektentscheide (05) - Projektvereinbarung (AG) - SCO-Bericht (01) - SLA (04, 05, 06, 07)
Objectives	- Unterstützung und Optimierung der Geschäftsprozesse durch den Einsatz von IKT-Mitteln.
Activities	04.02 Informatikportfolio führen - Informatikportfolio führen 04.04 Studien führen - Studien führen 04.05 Projekte führen - Projekte führen 04.06 Anwendungen und IKT-Services führen - SLA für IKT-Services aus Servicekatalog abschliessen - SLA für individuelle IKT-Services abschliessen - Erbrachte Leistungen periodisch überprüfen
Process Owner	n. a.
Roles	- Accountmanager/in (AM) - Anwendungs-Verantwortliche/r (AV) - Auftraggeber/in (AG) - Geschäftsprozess-Verantwortliche/r (GPV) - Informatikcontrollingbeauftragte/r (ICB) - Informatiksicherheitsbeauftragte/r (ISB) - Integrationsmanager/in (IM) - Lösungsarchitekt/in (ARCH) - Produktverantwortliche/r (PRV) - Projektleiter/in (PL) - Servicekatalog-Verantwortliche/r (SKV) - Serviceverantwortliche/r (SRV) - Unternehmensarchitekt/in (UA)

Table 32 ISB Process 04 – IT Steering (from ISB (2015))

9.2.3 Process 08 – Maintain IT-Processes

Aspect	Official Description
Inputs	- Freigabe Prozessrelease (08) - IKT-Vorgaben aus P01 (01) - Messdaten (01, 02, 03, 04, 05, 06, 07, 08, 09) - Prozessanregungen (Prozessanwender) - Verbesserungsvorschläge (Prozessanwender)
Outputs	- Änderungsmitteilungen (08) - Änderungsmitteilungen (Prozessanwender) - Ausbildung (Prozessanwender) - Ausbildungsunterlagen (Ausbildungsunterlagen) - Messdaten (08) - Prozessänderungen (Prozessdokumentation) - Prozessindex (08) - Verbesserungsanträge (08)
Objectives	- Der Prozess ' P08 IKT-Prozesse pflegen' definiert das Prozessmanagementsystem und stellt die kontinuierliche Verbesserung der IKT-Prozesse sicher.
Activities	08.01 Prozess messen - Individuelles Prozessassessment durchführen - Periodisches Prozessassessment durchführen - Prozess messen 08.02 Prozess verbessern - Prozess verbessern 08.03 Prozessänderung einführen - Prozessänderung einführen
Process Owner	n. a.
Roles	- Prozesseigner/in (PE) - Prozessverantwortliche/r Bund (PVB) - Prozessverantwortliche/r Departement (PVD)

Table 33 ISB Process 08 – Maintain IT-Processs (from ISB (2015))

9.2.4 Process 10 – Strategic Marketing

Aspect	Official Description
Inputs	- IKT-Vorgaben aus P01 (01) - verfügbare Zahlungs- und Verpflichtungskredite (09)
Outputs	- Zielgerichtete Kommunikation (07) - Marketinginformationen (01) - Messdaten (08)
Objectives	- Sicherstellen einer stufen- und zielgruppengerechten, rechtzeitigen, kontinuierlichen und verlässlichen Kommunikation.
Activities	10.01 Management von Informations- & Kommunikationsplattformen 10.02 Definition CI-/CD-Vorgaben
Process Owner	n. a.
Roles	- Marketing Manager

Table 34 Adapted Process 10 – Strategic Marketing (adapted from Glaux Soft AG (2015c))

9.2.5 Process 05 – Solution Development & Deployment

Aspect	Official Description
Inputs	- Änderungsantrag (RFC) (04, 06, 07) - Änderungsauftrag (MAC) (07) - Bedarfserfüllung (02, 03) - Betriebsanforderungen (06) - Betriebsanforderungen und Informationen für Lösung (06) - Einkaufsinformation (03) - Existierende Konfigurationsinformationen (06) - ICO-Vorgaben (04) - IKT-Vorgaben aus P01 (01) - individueller IKT-Ausbildungsbedarf (02) - Inventarinformationen (06) - Programm-Handbuch (01) - Projektanmeldung oder SCO-Bericht (04) - Projektentscheide (04) - SLA (04) - Stand Zahlungs- und Verpflichtungskredite (09) - Supportanforderungen und Informationen für Lösung (07)
Outputs	- aktivierte Lösung (06) - Ausnahmebedarf (01) - Bedarf nach IKT-Service (04) - Bedarfsanforderung (03) - Betriebsanforderungen für SLA (04) - Changestatus (07) - Konsolidierter Changeplan (04, 06, 07) - Lösungsbeschreibung für Betrieb (06) - Lösungsbeschreibungen für Support (07) - Messdaten (08) - Pflichtenheft (03) - projektspezifische Ausbildungsanforderungen (02, 05) - Projektstatus (04) - Projektvereinbarung (09) - Veränderte Konfigurationsinformationen (06)
Objectives	- Der Prozess 'P05 Lösungen entwickeln und einführen' definiert Abläufe, um IKT-Vorhaben und IKT-Changes bezüglich Qualität, Dauer, Kosten und Funktion zur vollsten Zufriedenheit des Auftraggebers abzuwickeln und zum Betreiben in die produktive Umgebung einzuführen.
Activities	05.01 IKT-Vorhaben initialisieren 05.02 Lösungsvorschläge skizzieren 05.03 Lösung designen 05.04 Lösung realisieren 05.05 Lösung einführen 05.06 IKT-Vorhaben abschliessen IKT-Change abwickeln (ohne Projekt) - IKT-Change einführen - IKT-Change initialisieren (Koordination und Planung)
Process Owner	n. a.
Roles	- Accountmanager/in (AM) - Auftraggeber/in (AG) - Change Manager/in - Geschäftsprozess-Verantwortliche/r (GPV) - Informatiksicherheitsbeauftragte/r (ISB) - Integrationsmanager/in (IM) - ISDS-Verantwortliche/r (ISDSV) - Lösungsarchitekt/in (ARCH) - Projektleiter/in (PL) - Qualitätsverantwortliche/r (QV) - Servicekatalog-Verantwortliche/r (SKV) - Serviceverantwortliche/r (SRV)

Table 35 ISB Process 05 – Solution Development & Deployment (from ISB (2015))

9.2.6 Process 06 – Operate IT-Infrastructure & -Services

Aspect	Official Description
Inputs	- aktivierte Lösung (05) - Auftrag für Sicherstellung und Wiederherstellung (07) - Bedarfserfüllung (03) - Finanzkennzahlen und Reports (09) - genehmigter Serviceverbesserungsplan (04) - IKT-Vorgaben aus P01 (01) - Informationen über Trends (04) - Konsolidierter Changeplan (05) - Lösungsbeschreibung für Betrieb (05) - nachgeführter Servicekatalog (04) - Referenznummer Anlagebuchhaltung (09) - SLA (04) - Status Problemlösung (07) - Unterstützungsplan (07) - Veränderte Konfigurationsinformationen (05)
Outputs	- Analysierte Informationen und Problemmeldungen (07) - Änderungsantrag (RFC) (05) - Ausnahmebedarf (01) - Auswertungen über erbrachte IKT-Leistungen (04) - Bedarfsanforderung (03) - Betriebsänderungen (07) - Betriebsanforderungen (05) - Betriebsinformationen (07) - Existierende Konfigurationsinformationen (05) - IKT-Leistung (Kunde) - Inventarinformationen (09) - Inventarinformationen (05) - Konsolidierte Inventarinformationen (04) - Messdaten (08) - Problemmeldung (07) - Reports über Leistungen, Kapazitäten (09) - Servicekatalog (04) - Serviceverbesserungsplan (04) - Status Problemlösung (07)
Objectives	- Erbringung (planen, durchführen und steuern) von operationellen IKT-Dienstleistungen im Rahmen der festgelegten Service Level Agreements und unter Einhaltung des Budgets. - Erreichung der vorgegebenen Kundenzufriedenheit. - Liefern der Grundlagen und Empfehlungen damit die Verfügbarkeitsanforderungen aller IKT-Services gemäss den Service Level Agreements wirtschaftlich und nachhaltig erfüllt sind. - Definieren und Einführen von den notwendigen Datenschutz- und Sicherheitsmassnahmen gemäss den Weisungen des Bundes zur Gewährleistung der Sicherheit von Personen, Informatikobjekten und Infrastruktur. - Planung und Durchführung aller Massnahmen welche nach Sicherstellung und Wiederherstellung konsistente Zustände aller erforderlichen Objekten (Betriebssysteme, Anwendungen, Daten und Geschäftsfunktionen) gewährleisten. - Erfüllung der Sicherstellungs- und Wiederherstellungsanforderungen aller erforderlichen Objekte gemäss Service Level Agreements. - Erfüllung der Anforderungen aus der Katastrophenvorsorge bezüglich Sicherstellung und Wiederherstellung. - Systematische Inventarisierung von IKT-Objekten gemäss Vorgaben. - Konsistente und aktuelle Konfigurationsinformationen werden zur Verfügung gestellt. - Änderungen der Konfigurationsinformationen aus dem Prozess P05 Lösungen entwickeln werden laufend nachgeführt. - Einhaltung der vereinbarten Zeit- und Durchsatzanforderungen. - Wirtschaftliche und rechtzeitige Sicherstellung der Leistung- und Kapazität der IKT-Infrastruktur.
Activities	06.01 Konfigurationsinformationen erstellen und unterhalten - Anforderungen an Konfigurationsinformationen definieren - Konfigurationsinformationen erfassen und pflegen - Konfigurationsinformationen verwalten und verifizieren 06.02 Verfügbarkeit steuern - Verfügbarkeit analysieren und rapportieren - Verfügbarkeit messen und überwachen - Verfügbarkeit planen 06.03 Sicherstellung und Wiederherstellung steuern - Bedürfnisse identifizieren - Plan und Prozeduren realisieren - Resultate analysieren und rapportieren - Sicherstellung und Wiederherstellung verbessern - Sicherstellung durchführen

Aspect	Official Description
	- Wiederherstellung durchführen 06.04 Leistung und Kapazität steuern - Leistung & Kapazität analysieren und rapportieren - Leistung und Kapazität messen und überwachen - Leistung und Kapazität planen 06.05 Betrieb steuern und aufrecht erhalten - Ressourcen mit Verpflichtungen abstimmen - Erbringung der Dienstleistungen ermöglichen - Dienstleistungen ausführen - Dienstleistungen aufrecht erhalten 06.06 IKT-Inventar bewirtschaften - Inventarverfahren definieren - Hardware erfassen (Direktlieferung an Kunden) - Hardware erfassen (Lieferung über Inventarlager) - Software erfassen - Inventarinformationen auswerten - Inventarinformationen unterhalten und verifizieren
Process Owner	n. a.
Roles	- Auftraggeber/in (AG) - Beschaffungskoordinator/in - Change Manager/in - Informatiksicherheitsbeauftragte/r (ISB) - Integrationsmanager/in (IM) - Produktverantwortliche/r (PRV) - Serviceverantwortliche/r (SRV)

Table 36 ISB Process 06 – Operate IT-Infrastructure & -Services (from ISB (2015))

9.2.7 Process 07 – User Support

Aspect	Official Description
Inputs	- Analysierte Informationen und Problemmeldungen (06) - Anliegen (Kunde) - Betriebsänderungen (06) - Betriebsinformationen (06) - Changestatus (05) - IKT-Vorgaben aus P01 (01) - Informationen über Kundenzufriedenheit (04) - Konsolidierter Changeplan (05) - Lösungsbeschreibungen für Support (05) - Meldung (Kunde) - Problemmeldung (06) - SLA (04) - Status Problemlösung (06)
Outputs	- Änderungsantrag (RFC) (04, 05) - Änderungsauftrag (MAC) (04, 05) - Auftrag für Sicherstellung und Wiederherstellung (06) - Auswertungen über erbrachte IKT-Leistungen (04) - Information über problemverursachende Komponenten (03) - Messdaten (08) - Reports über Leistungen, Kapazitäten (09) - Status der Anliegen, Probleme oder Störungen (Kunde) - Status Problemlösung (06) - Supportanforderungen und Informationen für Lösung (05) - Unterstützungsplan (06)
Objectives	- Sicherstellung der Benutzerunterstützung gemäss Service Level Vereinbarungen und schnellstmögliche Wiederherstellung der IKT-Services bei Störungen. - Betrieb eines Kommunikationszentrums mit qualitativ hochstehender und kompetenter Auskunftsbereitschaft und hoher Erreichbarkeit. - Etablierung von klaren Kommunikationsschnittstellen zum Leistungsbezüger und den internen und externen Service-Anbietern. - Strukturierte, effiziente und termingerechte Problembehandlung unter optimaler Nutzung der Ressourcen. - Schaffen der besten Voraussetzungen für eine eindeutige Zuweisung der Probleme zur Ausarbeitung von Lösungen. - Reduktion der auftretenden Störungen durch Ermitteln der Ursachen und Auswirkungen der Probleme (reaktiv und proaktiv).
Activities	07.01 Leistungsbezüger unterstützen - Unterstützungsdienste planen und vorbereiten - Störungen bearbeiten - Informations- und Serviceanliegen bearbeiten - MAC-Anliegen bearbeiten - Unterstützungsdienste messen, auswerten & überwachen 07.02 Probleme behandeln - Probleme bearbeiten
Process Owner	n. a.
Roles	- Benutzer-Unterstützer/in (BU)

Table 37 ISB Process 07 – User Support (from ISB (2015))

9.2.8 Process 11 – Sales

Aspect	Official Description
Inputs	- Verkaufschance (11) - Kundenentscheid - IKT-Vorgaben aus P01 (01)
Outputs	- Angebot (Kunde) - Auftrag für Change (04) - Infrastruktur bereitstellen (06) - Messdaten (08)
Objectives	- Vertragsabschluss mit langfristig profitablen und auf unser Portfolio passenden Kunden
Activities	11.01 Verkauf
Process Owner	n. a.
Roles	- Accountmanager/in (AM) - Vertriebsleiter - Administration - Projektleiter/in (PL) - Service Desk

Table 38 Adapted Process 11 – Sales (adapted from Glaux Soft AG (2015c))

9.2.9 Process 02 – Skills Development

Aspect	Official Description
Inputs	- allgemeine Ausbildungsanforderungen (02) - IKT-Ausbildungsanforderungen (02) - IKT-Vorgaben aus P01 (01) - projektspezifische Ausbildungsanforderungen (05) - Rollenträgerprofil (Stellendaten, Personaldaten) - Stellenbeschreibung (Stellendaten, Personaldaten)
Outputs	- aktualisierte IKT-Ausbildungsempfehlungen (02) - Bedarfserfüllung (05) - individueller IKT-Ausbildungsbedarf (05) - individueller IKT-Ausbildungsbedarf (Prozessanwender) - Messdaten (08)
Objectives	- Der Prozess P02 "Fähigkeiten entwickeln" unterstützt die Linienvorgesetzten bei der Entwicklung der Fähigkeiten der IKT-Rollenträger.
Activities	02.01 Ausbildungsempfehlungen ausarbeiten 02.02IKT-Gap-Analyse ausführen
Process Owner	n. a.
Roles	- Prozessverantwortliche/r Bund (PVB)

Table 39 ISB Process 02 – Skills Development (from ISB (2015))

9.2.10 Process 03 – Procurement

Aspect	Official Description
Inputs	- Angebot (Lieferant) - Bedarfsanforderung (05, 06) - Bedarfsanforderung (04) - IKT-Vorgaben aus P01 (01) - Information über problemverursachende Komponenten (07) - Pflichtenheft (05)
Outputs	- Bedarfserfüllung (04, 05, 06) - Bestellung (Lieferant) - Einkaufsinformation (05) - Messdaten (08) - Vertrag (Lieferant) - Zahlungsanweisung (09)
Objectives	- Übergeordnetes Ziel des Prozesses P03 'Güter und Dienstleistungen beschaffen' ist die bedarfsgerechte und effiziente Versorgung aller Verwaltungseinheiten der Bundesverwaltung mit Informatikgütern und Dienstleistungen.
Activities	03.01 Bedarfsanforderung 03.02 Angebotsabwicklung 03.03 Bestellabwicklung 03.04 Lieferung / Leistungserbringung 03.05 Rechnungsabwicklung 03.06 Auftragskontrolle
Process Owner	n. a.
Roles	- Auftraggeber/in (AG) - Beschaffungskoordinator/in - Integrationsmanager/in (IM) - Zentrale/r Beschaffer/in

Table 40 ISB Process 03 – Procurement (from ISB (2015))

9.2.11 Process 09 – Support Financial Management

Aspect	Official Description
Inputs	- abgeschlossene DLV (04) - abgeschlossene SLA (04) - ACO-, SCO-, PCO-Bericht (04) - freigegebenes Informatikportfolio (04) - IKT-Vorgaben aus P01 (01) - Inventarinformationen (06) - Projektvereinbarung (05) - Reports über Leistungen, Kapazitäten (06, 07) - Zahlungsanweisung (03)
Outputs	- Finanz- & Kostendaten (01) - Finanzkennzahlen und Reports (04, 06) - Messdaten (08) - Plankostenkalkulation für LV (04) - Referenznummer Anlagebuchhaltung (06) - Stand Zahlungs- und Verpflichtungskredite (04, 05) - verfügbare Zahlungs- und Verpflichtungskredite (04)
Objectives	- Die benötigten IT-Ressourcen können bei den IT-LE sowie LB geplant, gesteuert und transparent dargestellt werden. - Der wirtschaftliche Einsatz der Informatikmittel wird u.a. mit einer KLR sowie einem Verrechnungspreissystem instrumentell unterstützt. - Der finanzielle Supportprozess unterstützt umfassend die IT-Geschäftsprozesse (Kernprozesse).
Activities	09.01 Finanzplanung & Budgetierung 09.02 Haushaltsvollzug 09.03 Jahresrechnung
Process Owner	n. a.
Roles	- Accountmanager/in (AM) - Finanzchef/in (FCV) - Finanzcontroller/in (FCOV) - Informatikcontrollingbeauftragte/r (ICB) - Integrationsmanager/in (IM) - Kostenobjekt-Verantwortliche/r (KOV)

Table 41 ISB Process 09 – Support Financial Management (from ISB (2015))

9.3 Appendix C – Generic Process Map and COBIT 5 Detailed Process Mapping

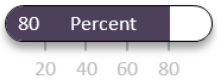
An essential part of the Process Improvement Prototype (PIP) is the mapping of every process of the generic ISO 9001:2015 process map for IT SMEs with one or more respective CPOBIT 5 processes in order to be able to adapt the corresponding process maturity measurement instruments. Therefore, this appendix provides a detailed mapping between the mentioned reference models that is aggregated within chapter 4.5. Thereby, this mapping was generated by analysing and comparing ISACA (2013c) and ISB (2015).

Important: Every mapping attempt has a header with basic information and a body with the detailed mapping. Within the header, the compared COBIT 5 process, a status (green = mapping accuracy is ≥ 80 %; yellow 50 % - 79 %; red < 50 %) and the overall mapping accuracy (average of the compared process aspects) is mentioned. Within the body, the two processes are compared along the process aspects inputs, outputs, objectives, activities and roles. For every aspect, a subjective percentage value of interference is defined.

9.3.1 Process 01 – IT Management

COBIT 5 Process EDM01 Ensure Governance Framework Setting and Maintenance

Status **Green**

Overall Mapping Accuracy 

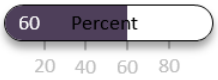
Aspect	Generic ISO 9001:2015 Process -> Process 01	Percentage	COBIT 5 Process -> EDM01
Inputs	Expected are mainly strategic inputs (from business) including defined compliance borders.	60 %	The process explicitly asks for compliance baselines as an input. The ambient strategy is not directly mentioned.
Outputs	The process provides an IT-strategy baseline for other processes including regulations and other instructions.	80 %	Governance guiding principles as well as other regulations are provided.
Objectives	The strategic management of IT, the fulfilment of compliance requirements as well as the support of business processes are in focus.	80 %	The purpose is: "Provide a consistent approach integrated and aligned with the enterprise governance approach."
Activities	Overall, the focus is set on strategic IT management with all its included tasks and responsibilities.	80 %	The management of the governance system is in focus.
Roles	Involved are typical management roles as well as creative operational IT roles such as solutions architects.		
TOTAL		**80 %**	

Table 42 Detailed Mapping: Process 01 <> EDM01

COBIT 5 Process EDM03 Ensure Risk Optimization

Status Yellow

Overall Mapping Accuracy



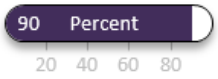
Aspect	Generic ISO 9001:2015 Process -> Process 01	Percentage	COBIT 5 Process -> EDM03
Inputs	Expected are mainly strategic inputs (from business) including defined compliance borders.	40 %	The process only asks for inputs towards its risk management discipline.
Outputs	The process provides an IT-strategy baseline for other processes including regulations and other instructions.	60 %	This process provides risk management related baselines for all other processes.
Objectives	The strategic management of IT, the fulfilment of compliance requirements as well as the support of business processes are in focus.	60 %	The purpose is: "Ensure that IT-related enterprise risk does not exceed risk appetite and risk tolerance, the impact of IT risk to enterprise value is identified and managed, and the potential for compliance failures is minimised."
Activities	Overall, the focus is set on strategic IT management with all its included tasks and responsibilities.	60 %	The process covers strategic risk management disciplines.
Roles	Involved are typical management roles as well as creative operational IT roles such as solutions architects.		
TOTAL		**60 %**	

Table 43 Detailed Mapping: Process 01 <> EDM03

COBIT 5 Process APO01 Manage the IT Management Framework

Status Green

Overall Mapping Accuracy

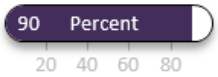


Aspect	Generic ISO 9001:2015 Process -> Process 01	Percentage	COBIT 5 Process -> APO01
Inputs	Expected are mainly strategic inputs (from business) including defined compliance borders.	80 %	Various strategic plans, resources, principles and policies are needed.
Outputs	The process provides an IT-strategy baseline for other processes including regulations and other instructions.	80 %	Organisational data security related regulations are provided.
Objectives	The strategic management of IT, the fulfilment of compliance requirements as well as the support of business processes are in focus.	100 %	The purpose is to provide a consistent management approach for the governance system.
Activities	Overall, the focus is set on strategic IT management with all its included tasks and responsibilities.	80 %	The process covers activities concerning organisation and structure of the system.
Roles	Involved are typical management roles as well as creative operational IT roles such as solutions architects.		
TOTAL		**90 %**	

Table 44 Detailed Mapping: Process 01 <> APO01

COBIT 5 Process APO02 Manage Strategy
Status **Green**

Overall Mapping Accuracy

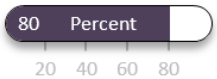


Aspect	Generic ISO 9001:2015 Process -> Process 01	Percentage	COBIT 5 Process -> APO02
Inputs	Expected are mainly strategic inputs (from business) including defined compliance borders.	80 %	Various strategic plans, resources, principles and policies are needed.
Outputs	The process provides an IT-strategy baseline for other processes including regulations and other instructions.	80 %	Strategic outcomes such as IT-related goals and others are provided.
Objectives	The strategic management of IT, the fulfilment of compliance requirements as well as the support of business processes are in focus.	100 %	The purpose is to align strategic IT plans with business goals.
Activities	Overall, the focus is set on strategic IT management with all its included tasks and responsibilities.	100 %	The process covers activities concerning the strategic IT planning.
Roles	Involved are typical management roles as well as creative operational IT roles such as solutions architects.		
TOTAL		**90 %**	

Table 45 Detailed Mapping: Process 01 <> APO02

COBIT 5 Process APO03 Manage Enterprise Architecture
Status **Green**

Overall Mapping Accuracy



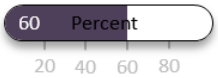
Aspect	Generic ISO 9001:2015 Process -> Process 01	Percentage	COBIT 5 Process -> APO03
Inputs	Expected are mainly strategic inputs (from business) including defined compliance borders.	80 %	Various strategic plans, resources, principles and policies are needed.
Outputs	The process provides an IT-strategy baseline for other processes including regulations and other instructions.	60 %	The process provides different architecture models regarding information, processes and others.
Objectives	The strategic management of IT, the fulfilment of compliance requirements as well as the support of business processes are in focus.	80 %	The purpose is to define and maintain the different aspects of a system within a consistent architecture.
Activities	Overall, the focus is set on strategic IT management with all its included tasks and responsibilities.	80 %	The process covers activities to define and maintain the (strategic) architecture of a company.
Roles	Involved are typical management roles as well as creative operational IT roles such as solutions architects.		
TOTAL		**80 %**	

Table 46 Detailed Mapping: Process 01 <> APO03

COBIT 5 Process MEA01 Monitor, Evaluate and Assess Performance and Conformance

Status Yellow

Overall Mapping Accuracy



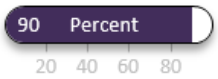
Aspect	Generic ISO 9001:2015 Process -> Process 01	Percentage	COBIT 5 Process -> MEA01
Inputs	Expected are mainly strategic inputs (from business) including defined compliance borders.	60 %	Inputs are various strategic measures and indicators as well as strategic baselines.
Outputs	The process provides an IT-strategy baseline for other processes including regulations and other instructions.	40 %	The process provides various monitoring deliverables such as reports, requirements and others.
Objectives	The strategic management of IT, the fulfilment of compliance requirements as well as the support of business processes are in focus.	60 %	The purpose is: "Provide transparency of performance and conformance and drive achievement of goals."
Activities	Overall, the focus is set on strategic IT management with all its included tasks and responsibilities.	60 %	The process organises the monitoring within the system and generates respective reports and analyses.
Roles	Involved are typical management roles as well as creative operational IT roles such as solutions architects.		
TOTAL		**60 %**	

Table 47 Detailed Mapping: Process 01 <> MEA01

COBIT 5 Process MEA03 Monitor, Evaluate and Assess Compliance With Ext. Requirements

Status Green

Overall Mapping Accuracy



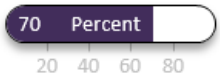
Aspect	Generic ISO 9001:2015 Process -> Process 01	Percentage	COBIT 5 Process -> MEA03
Inputs	Expected are mainly strategic inputs (from business) including defined compliance borders.	80 %	Inputs are internal and external compliance requirements and respective audit results.
Outputs	The process provides an IT-strategy baseline for other processes including regulations and other instructions.	80 %	The process provides actions and other measures within the field of compliance.
Objectives	The strategic management of IT, the fulfilment of compliance requirements as well as the support of business processes are in focus.	100 %	The purpose is: "Ensure that the enterprise is compliant with all applicable external requirements."
Activities	Overall, the focus is set on strategic IT management with all its included tasks and responsibilities.	80 %	The process analyses external compliance regulations and the company's fulfilment of these requirements.
Roles	Involved are typical management roles as well as creative operational IT roles such as solutions architects.		
TOTAL		**90 %**	

Table 48 Detailed Mapping: Process 01 <> MEA03

9.3.2 Process 04 – IT Steering

COBIT 5 Process EDM04 Ensure Resource Optimization
Status Yellow

Overall Mapping Accuracy

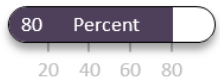


Aspect	Generic ISO 9001:2015 Process -> Process 04	Percentage	COBIT 5 Process -> EDM04
Inputs	The process receives strategic baselines as well as operational influences from project, operation as well as from finance.	80 %	The process needs information about resource needs, available skills and supplier capabilities.
Outputs	SLAs, projects, data about customer satisfaction and other operational IT steering elements are provided.	60 %	The process provides information about resources, architecture, capabilities and others.
Objectives	The objective is to support and optimise business processes by using IT.	80 %	The purpose is to meet resource requirements while monitoring IT cost.
Activities	Various activities related to the operational IT management such as portfolio management and others.	60 %	The process covers all aspects towards a target-aimed resource management.
Roles	Various leading IT roles such as principals, operation responsibles, account manager and others.		
TOTAL		**70 %**	

Table 49 Detailed Mapping: Process 04 <> EDM04

COBIT 5 Process APO05 Manage Portfolio
Status Green

Overall Mapping Accuracy



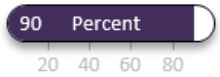
Aspect	Generic ISO 9001:2015 Process -> Process 04	Percentage	COBIT 5 Process -> APO05
Inputs	The process receives strategic baselines as well as operational influences from project, operation as well as from finance.	100 %	The process needs information about the strategic road map, service topics and other operational elements.
Outputs	SLAs, projects, data about customer satisfaction and other operational IT steering elements are provided.	60 %	The process provides programme information and reports.
Objectives	The objective is to support and optimise business processes by using IT.	80 %	The purpose is: "Optimise the performance of the overall portfolio of programmes in response to programme and service performance and changing enterprise priorities and demands."
Activities	Various activities related to the operational IT management such as portfolio management and others.	60 %	The process covers portfolio and investment management.
Roles	Various leading IT roles such as principals, operation responsibles, account manager and others.		
TOTAL		**80 %**	

Table 50 Detailed Mapping: Process 04 <> APO05

COBIT 5 Process APO09 Manage Service Agreements

Status Green

Overall Mapping Accuracy



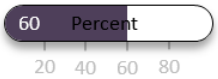
Aspect	Generic ISO 9001:2015 Process -> Process 04	Percentage	COBIT 5 Process -> APO09
Inputs	The process receives strategic baselines as well as operational influences from project, operation as well as from finance.	80 %	The process needs information resources, the architecture, budgets, programmes and others.
Outputs	SLAs, projects, data about customer satisfaction and other operational IT steering elements are provided.	60 %	The process provides actions, audits and other elements in order to meet SLAs.
Objectives	The objective is to support and optimise business processes by using IT.	100 %	The purpose is: "Ensure that IT services and service levels meet current and future enterprise needs."
Activities	Various activities related to the operational IT management such as portfolio management and others.	100 %	Activities related to service management (including agreements, levels and other aspects).
Roles	Various leading IT roles such as principals, operation responsibles, account manager and others.		
TOTAL		**90 %**	

Table 51 Detailed Mapping: Process 04 <> APO09

COBIT 5 Process APO12 Manage Risk

Status Green

Overall Mapping Accuracy



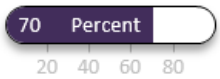
Aspect	Generic ISO 9001:2015 Process -> Process 04	Percentage	COBIT 5 Process -> APO12
Inputs	The process receives strategic baselines as well as operational influences from project, operation as well as from finance.	80 %	The process consumes strategic risk guidelines as well as information along business impacts and others.
Outputs	SLAs, projects, data about customer satisfaction and other operational IT steering elements are provided.	40 %	The process provides risk scenarios and other measures to reduce risks.
Objectives	The objective is to support and optimise business processes by using IT.	60 %	The purpose to manage risk on an IT operational level.
Activities	Various activities related to the operational IT management such as portfolio management and others.	60 %	The process covers the discipline of risk management with its different tasks and responsibilities.
Roles	Various leading IT roles such as principals, operation responsibles, account manager and others.		
TOTAL		**60 %**	

Table 52 Detailed Mapping: Process 04 <> APO12

9.3.3 Process 08 – Maintain IT-Processes

COBIT 5 Process APO11 Manage Quality
Status Yellow

Overall Mapping Accuracy

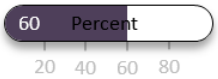


Aspect	Generic ISO 9001:2015 Process -> Process 08	Percentage	COBIT 5 Process -> APO11
Inputs	The process needs information about strategic baselines as well as data of process performance of other processes.	80 %	The process requires strategic quality aspects as well as review results and plans.
Outputs	Outputs are process optimization ideas, changes processes as well as training sequences for process users.	60 %	Quality management outcomes are provided.
Objectives	The process maintains the process model and ensures the continuous improvement of the model.	60 %	The purpose is to ensure constant quality of solutions and services.
Activities	Activities are to measure, optimise and document processes and changes.	80 %	Aspects of quality management including continuous improvement and others.
Roles	Organisational roles such as process owners and management responsibles.		
TOTAL		**70 %**	

Table 53 Detailed Mapping: Process 08 <> APO11

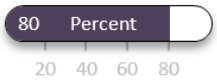
COBIT 5 Process DSS06 Manage Business Process Controls
Status Yellow

Overall Mapping Accuracy



Aspect	Generic ISO 9001:2015 Process -> Process 08	Percentage	COBIT 5 Process -> DSS06
Inputs	The process needs information about strategic baselines as well as data of process performance of other processes.	40 %	The process requires information about data classification, resources and other elements of the system.
Outputs	Outputs are process optimization ideas, changes processes as well as training sequences for process users.	60 %	The process provides information about process effectiveness and other aspects.
Objectives	The process maintains the process model and ensures the continuous improvement of the model.	60 %	The purpose is to maintain information integrity within business processes.
Activities	Activities are to measure, optimise and document processes and changes.	60 %	The process covers the analysis of information processing regarding processes, roles and other aspects.
Roles	Organisational roles such as process owners and management responsibles.		
TOTAL		**60 %**	

Table 54 Detailed Mapping: Process 08 <> DSS06

COBIT 5 Process	MEA02 Monitor, Evaluate and Assess the System of Internal Control
Status	**Green**
Overall Mapping Accuracy	

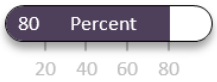
Aspect	**Generic ISO 9001:2015 Process -> Process 08**	**Percentage**	**COBIT 5 Process -> MEA02**
Inputs	The process needs information about strategic baselines as well as data of process performance of other processes.	80 %	Various audit results from internal and external disciplines.
Outputs	Outputs are process optimization ideas, changes processes as well as training sequences for process users.	80 %	The process provides information about current system state as well as plans and practices for improvement.
Objectives	The process maintains the process model and ensures the continuous improvement of the model.	60 %	The purpose is: "Obtain transparency for key stakeholders on the adequacy of the system of internal controls and thus provide trust in operations, confidence in the achievement of enterprise objectives and an adequate understanding of residual risk."
Activities	Activities are to measure, optimise and document processes and changes.	80 %	The process covers the analyses of the system as well as the ignition of initiatives for improvement.
Roles	Organisational roles such as process owners and management responsibles.		
TOTAL		**60 %**	

Table 55 Detailed Mapping: Process 08 <> MEA02

9.3.4 Process 10 – Strategic Marketing

COBIT 5 Process EDM05 Ensure Stakeholder Transparency
Status **Green**

Overall Mapping Accuracy

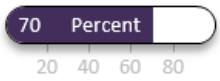


Aspect	Generic ISO 9001:2015 Process -> Process 10	Percentage	COBIT 5 Process -> EDM05
Inputs	The process requires strategic baselines as well as information from financial management.	40 %	The process receives information about value delivers, risk management and others.
Outputs	Outputs are target-aimed communication endeavours as well as strategic inputs.	80 %	The process provides communication principles and reporting requirements.
Objectives	The objective is to ensure a stakeholder-aimed, continuous and stable communication.	100 %	The purpose is to make the communication with stakeholder effective.
Activities	The process covers activities allocated within communication (channel management, CI/CD-management and others).	80 %	Activities cover the management of stakeholders and communication.
Roles	The process is performed by a marketing manager.		
TOTAL		**80 %**	

Table 56 Detailed Mapping: Process 10 <> EDM05

COBIT 5 Process APO08 Manage Relationships
Status **Green**

Overall Mapping Accuracy



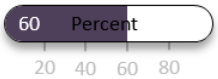
Aspect	Generic ISO 9001:2015 Process -> Process 10	Percentage	COBIT 5 Process -> APO08
Inputs	The process requires strategic baselines as well as information from financial management.	80 %	The process receives strategic and operational information.
Outputs	Outputs are target-aimed communication endeavours as well as strategic inputs.	80 %	The process provides communication plans and other internal analyses towards relationship management.
Objectives	The objective is to ensure a stakeholder-aimed, continuous and stable communication.	60 %	The purpose is: "Create improved outcomes, increased confidence, and trust in IT and effective use of resources."
Activities	The process covers activities allocated within communication (channel management, CI/CD-management and others).	60 %	Activities cover the management of relationship between business and IT.
Roles	The process is performed by a marketing manager.		
TOTAL		**70 %**	

Table 57 Detailed Mapping: Process 10 <> APO08

9.3.5 Process 05 – Solution Development & Deployment

COBIT 5 Process EDM02 Ensure Benefits Delivery
Status Yellow

Overall Mapping Accuracy

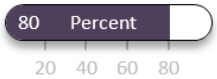


Aspect	Generic ISO 9001:2015 Process -> Process 05	Percentage	COBIT 5 Process -> EDM02
Inputs	The process requires various strategic and operational management information as well as financial baselines.	80 %	Required are information about strategy, programmes, portfolios and other aspects of the system.
Outputs	The process provides project information as well as information about service requirements and other aspects.	40 %	The process provides strategic actions along value delivery.
Objectives	The objective is to manage IT projects along time, cost, resources and quality.	60 %	The purpose is: "Secure optimal value from IT-enabled initiatives, services and assets."
Activities	The process covers typical project management disciplines such as conception, realisation and others.	60 %	The process covers disciplines along value optimization.
Roles	Typical project roles such as project manager and other creative IT roles are involved.		
TOTAL		**60 %**	

Table 58 Detailed Mapping: Process 05 <> EDM02

COBIT 5 Process APO04 Manage Innovation
Status Green

Overall Mapping Accuracy

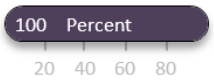


Aspect	Generic ISO 9001:2015 Process -> Process 05	Percentage	COBIT 5 Process -> APO04
Inputs	The process requires various strategic and operational management information as well as financial baselines.	80 %	The process asks for enterprise SWOT and technology baselines.
Outputs	The process provides project information as well as information about service requirements and other aspects.	80 %	The process provides innovation plans and other aspects.
Objectives	The objective is to manage IT projects along time, cost, resources and quality.	80 %	The process ensures a competitive advantage for the company.
Activities	The process covers typical project management disciplines such as conception, realisation and others.	60 %	The process covers disciplines along innovation and technology management.
Roles	Typical project roles such as project manager and other creative IT roles are involved.		
TOTAL		**80 %**	

Table 59 Detailed Mapping: Process 05 <> APO04

COBIT 5 Process BAI01 Manage Programmes and Projects
Status Green

Overall Mapping Accuracy

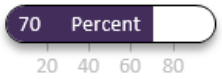


Aspect	Generic ISO 9001:2015 Process -> Process 05	Percentage	COBIT 5 Process -> BAI01
Inputs	The process requires various strategic and operational management information as well as financial baselines.	80 %	Various information about programmes, portfolios, skills and other aspects are needed.
Outputs	The process provides project information as well as information about service requirements and other aspects.	100 %	Project and programme information is provided.
Objectives	The objective is to manage IT projects along time, cost, resources and quality.	100 %	The objective is to realise business benefits in order to perform projects.
Activities	The process covers typical project management disciplines such as conception, realisation and others.	100 %	Typical project management disciplines are covered within the process.
Roles	Typical project roles such as project manager and other creative IT roles are involved.		
TOTAL		**100 %**	

Table 60 Detailed Mapping: Process 05 <> BAI01

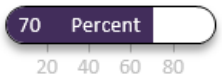
COBIT 5 Process BAI02 Manage Requirements Definition
Status Yellow

Overall Mapping Accuracy



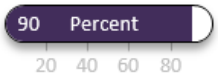
Aspect	Generic ISO 9001:2015 Process -> Process 05	Percentage	COBIT 5 Process -> BAI02
Inputs	The process requires various strategic and operational management information as well as financial baselines.	60 %	The process needs information about data classification, architecture principles and other elements.
Outputs	The process provides project information as well as information about service requirements and other aspects.	60 %	Information about requirements definition are provided.
Objectives	The objective is to manage IT projects along time, cost, resources and quality.	80 %	The purpose is: "Create feasible optimal solutions that meet enterprise needs while minimising risk."
Activities	The process covers typical project management disciplines such as conception, realisation and others.	60 %	Aspects of requirements management are covered.
Roles	Typical project roles such as project manager and other creative IT roles are involved.		
TOTAL		**70 %**	

Table 61 Detailed Mapping: Process 05 <> BAI02

COBIT 5 Process	BAI05 Manage Organisational Change Enablement
Status	Yellow
Overall Mapping Accuracy	

Aspect	Generic ISO 9001:2015 Process -> Process 05	Percentage	COBIT 5 Process -> BAI05
Inputs	The process requires various strategic and operational management information as well as financial baselines.	60 %	The process needs information about stakeholders, requirements and other organisational aspects.
Outputs	The process provides project information as well as information about service requirements and other aspects.	60 %	The process provides change management and acceptance elements.
Objectives	The objective is to manage IT projects along time, cost, resources and quality.	60 %	The purpose is: "Prepare and commit stakeholders for business change and reduce the risk of failure."
Activities	The process covers typical project management disciplines such as conception, realisation and others.	80 %	Covered are typical (project) marketing activities and others.
Roles	Typical project roles such as project manager and other creative IT roles are involved.		
TOTAL		**70 %**	

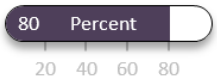
Table 62 Detailed Mapping: Process 05 <> BAI05

COBIT 5 Process	BAI06 Manage Changes
Status	Green
Overall Mapping Accuracy	

Aspect	Generic ISO 9001:2015 Process -> Process 05	Percentage	COBIT 5 Process -> BAI06
Inputs	The process requires various strategic and operational management information as well as financial baselines.	80 %	The process needs information about solutions, problems and desired changes and adaptions.
Outputs	The process provides project information as well as information about service requirements and other aspects.	80 %	Provided are change plan and documentations as well as other aspects of (project) change management.
Objectives	The objective is to manage IT projects along time, cost, resources and quality.	80 %	The purpose is to enable the system to be able to deliver changes fast and reliable.
Activities	The process covers typical project management disciplines such as conception, realisation and others.	100 %	The process covers change and project management activities.
Roles	Typical project roles such as project manager and other creative IT roles are involved.		
TOTAL		**90 %**	

Table 63 Detailed Mapping: Process 05 <> BAI06

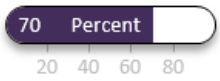
COBIT 5 Process BAI07 Manage Change Acceptance and Transitioning
Status Green

Overall Mapping Accuracy 

Aspect	Generic ISO 9001:2015 Process -> Process 05	Percentage	COBIT 5 Process -> BAI07
Inputs	The process requires various strategic and operational management information as well as financial baselines.	60 %	Required are change plans, test results and other implementation aspects.
Outputs	The process provides project information as well as information about service requirements and other aspects.	80 %	The process provides release plans and other respective elements.
Objectives	The objective is to manage IT projects along time, cost, resources and quality.	80 %	The purpose is the safe implementation of solutions into operation.
Activities	The process covers typical project management disciplines such as conception, realisation and others.	80 %	The process covers test and release management activities.
Roles	Typical project roles such as project manager and other creative IT roles are involved.		
TOTAL		**80 %**	

Table 64 Detailed Mapping: Process 05 <> BAI07

COBIT 5 Process BAI08 Manage Knowledge
Status Yellow

Overall Mapping Accuracy 

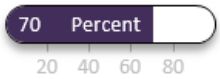
Aspect	Generic ISO 9001:2015 Process -> Process 05	Percentage	COBIT 5 Process -> BAI08
Inputs	The process requires various strategic and operational management information as well as financial baselines.	60 %	Required is information about existing knowledge, solutions and operation.
Outputs	The process provides project information as well as information about service requirements and other aspects.	80 %	The process provides structured and documented knowledge.
Objectives	The objective is to manage IT projects along time, cost, resources and quality.	60 %	The purpose is to maintain and extend knowledge in order to be able to support solution development.
Activities	The process covers typical project management disciplines such as conception, realisation and others.	60 %	The process covers typical knowledge management tasks and responsibilities.
Roles	Typical project roles such as project manager and other creative IT roles are involved.		
TOTAL		**80 %**	

Table 65 Detailed Mapping: Process 05 <> BAI08

9.3.6 Process 06 – Operate IT-Infrastructure & -Services

COBIT 5 Process APO13 Manage Security
Status Yellow

Overall Mapping Accuracy

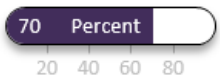


Aspect	Generic ISO 9001:2015 Process -> Process 06	Percentage	COBIT 5 Process -> APO13
Inputs	The process requires strategic and operational management guidelines as well as information out of projects, user support and financial management.	60 %	The process needs information about the enterprise security approach and other related aspects.
Outputs	The process provides information about IT operation and its influences on projects, users and others.	80 %	The process provides security policies and other measures towards an improved security.
Objectives	The objective is to operate, manage and maintain IT services.	80 %	The purpose is: "Keep the impact and occurrence of information security incidents within the enterprise's risk appetite levels."
Activities	All activities along operation, configuration and security management are covered within the process.	60 %	Typical IT security management activities are covered within the process.
Roles	Structured IT roles such as service, product or change manager are involved.		
TOTAL		**70 %**	

Table 66 Detailed Mapping: Process 06 <> APO13

COBIT 5 Process BAI03 Manage Solutions, Identification and Build
Status Yellow

Overall Mapping Accuracy

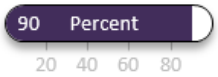


Aspect	Generic ISO 9001:2015 Process -> Process 06	Percentage	COBIT 5 Process -> BAI03
Inputs	The process requires strategic and operational management guidelines as well as information out of projects, user support and financial management.	80 %	Required are various information along risk, architecture, development, quality and other areas.
Outputs	The process provides information about IT operation and its influences on projects, users and others.	60 %	The process provides test plans, specifications, service definitions and other aspects.
Objectives	The objective is to operate, manage and maintain IT services.	60 %	The purpose is: "Establish timely and cost-effective solutions capable of supporting enterprise strategic and operational objectives."
Activities	All activities along operation, configuration and security management are covered within the process.	60 %	Solution and component management are covered within this process.
Roles	Structured IT roles such as service, product or change manager are involved.		
TOTAL		**70 %**	

Table 67 Detailed Mapping: Process 06 <> BAI03

COBIT 5 Process BAI04 Manage Availability and Capacity
Status **Green**

Overall Mapping Accuracy

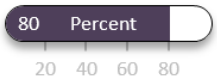


Aspect	Generic ISO 9001:2015 Process -> Process 06	Percentage	COBIT 5 Process -> BAI04
Inputs	The process requires strategic and operational management guidelines as well as information out of projects, user support and financial management.	80 %	The process needs information about risk, specifications and solutions.
Outputs	The process provides information about IT operation and its influences on projects, users and others.	80 %	The process provides information about availability and capacity.
Objectives	The objective is to operate, manage and maintain IT services.	100 %	The purpose is to maintain the service availability.
Activities	All activities along operation, configuration and security management are covered within the process.	80 %	Availability and capacity management activities including respective monitoring tasks are covered.
Roles	Structured IT roles such as service, product or change manager are involved.		
TOTAL		**90 %**	

Table 68 Detailed Mapping: Process 06 <> BAI04

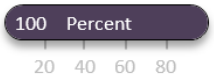
COBIT 5 Process BAI10 Manage Configuration
Status **Green**

Overall Mapping Accuracy



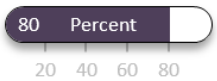
Aspect	Generic ISO 9001:2015 Process -> Process 06	Percentage	COBIT 5 Process -> BAI10
Inputs	The process requires strategic and operational management guidelines as well as information out of projects, user support and financial management.	80 %	The process needs information about release plans, change status and inventories.
Outputs	The process provides information about IT operation and its influences on projects, users and others.	80 %	The process provides information about the current configuration.
Objectives	The objective is to operate, manage and maintain IT services.	60 %	The purpose is: "Provide sufficient information about service assets to enable the service to be effectively managed, assess the impact of changes and deal with service incidents."
Activities	All activities along operation, configuration and security management are covered within the process.	80 %	The process covers activities around the establishment and maintenance of various configuration elements.
Roles	Structured IT roles such as service, product or change manager are involved.		
TOTAL		**80 %**	

Table 69 Detailed Mapping: Process 06 <> BAI10

COBIT 5 Process	DSS01 Manage Operations
Status	**Green**
Overall Mapping Accuracy	

Aspect	Generic ISO 9001:2015 Process -> Process 06	Percentage	COBIT 5 Process -> DSS01
Inputs	The process requires strategic and operational management guidelines as well as information out of projects, user support and financial management.	100 %	The process needs information about SLAs, operation plans and service definitions.
Outputs	The process provides information about IT operation and its influences on projects, users and others.	80 %	Logs, incident tickets, policies, schedules and other operational elements are provided.
Objectives	The objective is to operate, manage and maintain IT services.	100 %	The purpose is: "Deliver IT operational service outcomes as planned."
Activities	All activities along operation, configuration and security management are covered within the process.	100 %	The process covers activities around the operation of services, infrastructure and environments.
Roles	Structured IT roles such as service, product or change manager are involved.		
TOTAL		**100 %**	

Table 70 Detailed Mapping: Process 06 <> DSS01

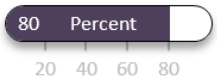
COBIT 5 Process	DSS03 Manage Problems
Status	**Green**
Overall Mapping Accuracy	

Aspect	Generic ISO 9001:2015 Process -> Process 06	Percentage	COBIT 5 Process -> DSS03
Inputs	The process requires strategic and operational management guidelines as well as information out of projects, user support and financial management.	60 %	The process needs incident descriptions, root causes, logs and other inputs.
Outputs	The process provides information about IT operation and its influences on projects, users and others.	80 %	The process provides resolved problems and other, related elements.
Objectives	The objective is to operate, manage and maintain IT services.	80 %	The purpose is to increase availability, improve service levels, prevent problems and reduce cost.
Activities	All activities along operation, configuration and security management are covered within the process.	80 %	The process covers problem management tasks and responsibilities.
Roles	Structured IT roles such as service, product or change manager are involved.		
TOTAL		**80 %**	

Table 71 Detailed Mapping: Process 06 <> DSS03

COBIT 5 Process DSS04 Manage Continuity
Status **Green**

Overall Mapping Accuracy

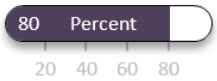


Aspect	Generic ISO 9001:2015 Process -> Process 06	Percentage	COBIT 5 Process -> DSS04
Inputs	The process requires strategic and operational management guidelines as well as information out of projects, user support and financial management.	80 %	The process needs information about SLAs and risk profiles.
Outputs	The process provides information about IT operation and its influences on projects, users and others.	80 %	The process provides guidelines, regulations and requirements along the continuity of IT assets.
Objectives	The objective is to operate, manage and maintain IT services.	80 %	The purpose is to continue critical business operations.
Activities	All activities along operation, configuration and security management are covered within the process.	80 %	The process covers activities along the identification of critical assets as well as the definition and maintenance of respective assets.
Roles	Structured IT roles such as service, product or change manager are involved.		
TOTAL		**80 %**	

Table 72 Detailed Mapping: Process 06 <> DSS04

COBIT 5 Process DSS05 Manage Security Services
Status **Green**

Overall Mapping Accuracy



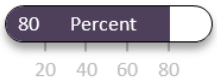
Aspect	Generic ISO 9001:2015 Process -> Process 06	Percentage	COBIT 5 Process -> DSS05
Inputs	The process requires strategic and operational management guidelines as well as information out of projects, user support and financial management.	60 %	The process needs information about SLAs, data classifications and other information architecture aspects.
Outputs	The process provides information about IT operation and its influences on projects, users and others.	80 %	The process provides security policies and other operational security elements.
Objectives	The objective is to operate, manage and maintain IT services.	80 %	The purpose is: "Minimise the business impact of operational information security vulnerabilities and incidents."
Activities	All activities along operation, configuration and security management are covered within the process.	80 %	The process covers various operational security management tasks and responsibilities.
Roles	Structured IT roles such as service, product or change manager are involved.		
TOTAL		**80 %**	

Table 73 Detailed Mapping: Process 06 <> DSS05

9.3.7 Process 07 – User Support

COBIT 5 Process DSS02 Manage Service Requests and Incidents
Status **Green**

Overall Mapping Accuracy



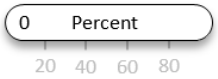
Aspect	Generic ISO 9001:2015 Process -> Process 07	Percentage	COBIT 5 Process -> DSS02
Inputs	The process needs information out of customer requests, operation and project and change management as well as about strategic IT aspects.	80 %	The process requires information about SLAs, current configuration and other operational aspects.
Outputs	The process provides information about customer requirements and other operational aspects.	80 %	Provided is information about the status of requests and incidents.
Objectives	The objective of the process is to support users as well as to manage problems and incidents.	80 %	The purpose is: "Achieve increased productivity and minimise disruptions through quick resolution of user queries and incidents."
Activities	The activities of the process cover the aspects of user support and problem management.	80 %	The process covers activities around request fulfilment and user support.
Roles	User supporter and service desk employees perform the process.		
TOTAL		**80 %**	

Table 74 Detailed Mapping: Process 07 <> DSS02

9.3.8 Process 11 – Sales

COBIT 5 Process No comparable COBIT 5 process is available

Status Red

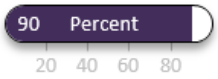
Overall Mapping Accuracy 

Aspect	Generic ISO 9001:2015 Process -> Process 11	Percentage	COBIT 5 Process -> n. a.
Inputs	This process uses inputs directly from customers such as sales offers and buying decisions. Additionally strategic IT aspects are consumed.	0 %	No comparable COBIT 5 process is available.
Outputs	Provided are offers for customers, change requests and needs for infrastructure services.	0 %	
Objectives	The objective is to generate profitable long-term contracts and portfolios with customers.	0 %	
Activities	The process covers all relevant sales activities.	0 %	
Roles	Important roles for this process are the Head of Distribution as well as account managers.		
TOTAL		**0 %**	

Table 75 Detailed Mapping: Process 11 <> No COBIT 5 Process Available

9.3.9 Process 02 – Skills Development

COBIT 5 Process APO07 Manage Human Resources
Status **Green**

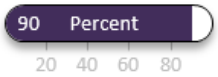
Overall Mapping Accuracy 

Aspect	Generic ISO 9001:2015 Process -> Process 02	Percentage	COBIT 5 Process -> APO07
Inputs	The process needs information about strategic IT baselines as well as about current projects.	80 %	The process consumes information about the resource situation, the documented knowledge as well as of other organisational sources.
Outputs	Provided are adapted training routines as well as fulfilled requirements out of projects and operation.	100 %	The process provides HR plans, skills development plans and other aspects of skills management.
Objectives	The objective of the process is to develop and monitor the skills of the IT staff.	100 %	The purpose is: "Optimise human resources capabilities to meet enterprise objectives."
Activities	Activities cover the analysis and development of IT skills within a company.	80 %	The process covers activities around HR and skills management.
Roles	A HR manager performs the process.		
TOTAL		**90 %**	

Table 76 Detailed Mapping: Process 02 <> APO07

9.3.1 Process 03 – Procurement

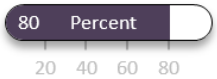
COBIT 5 Process APO10 Manage Suppliers
Status **Green**

Overall Mapping Accuracy 

Aspect	Generic ISO 9001:2015 Process -> Process 03	Percentage	COBIT 5 Process -> APO10
Inputs	The process consumes quotes of suppliers as well as internal needs, strategic baselines and financial inputs.	100 %	The process consumes acquisition plans and supplier contracts.
Outputs	The process provides purchase information, data about contracts and payments.	80 %	The process provides various supplier and procurement information.
Objectives	The process is focused on target-aimed supply with external goods and services for the entire company.	80 %	The purpose is: "Minimise the risk associated with non-performing suppliers and ensure competitive pricing."
Activities	The process covers activities around procurement, management of purchases and others.	100 %	The process covers typical supplier management tasks and responsibilities.
Roles	Procurement managers and other management roles perform the process.		
TOTAL		**90 %**	

Table 77 Detailed Mapping: Process 03 <> APO10

COBIT 5 Process BAI09 Manage Assets
Status **Green**

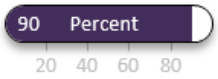
Overall Mapping Accuracy 

Aspect	Generic ISO 9001:2015 Process -> Process 03	Percentage	COBIT 5 Process -> BAI09
Inputs	The process consumes quotes of suppliers as well as internal needs, strategic baselines and financial inputs.	60 %	The process consumes asset inventories and configuration repositories.
Outputs	The process provides purchase information, data about contracts and payments.	80 %	The process provides asset registers and updated inventories.
Objectives	The process is focused on target-aimed supply with external goods and services for the entire company.	80 %	The purpose is: "Account for all IT assets and optimise the value provided by these assets."
Activities	The process covers activities around procurement, management of purchases and others.	80 %	The process covers typical asset management tasks and responsibilities.
Roles	Procurement managers and other management roles perform the process.		
TOTAL		**80 %**	

Table 78 Detailed Mapping: Process 03 <> BAI09

9.3.2 Process 09 – Support Financial Management

COBIT 5 Process APO06 Manage Budget and Costs
Status **Green**

Overall Mapping Accuracy 

Aspect	Generic ISO 9001:2015 Process -> Process 09	Percentage	COBIT 5 Process -> APO06
Inputs	The process consumes financial information from different processes as well as strategic baselines.	60 %	The process needs information about service and investment portfolios.
Outputs	The process provides information about financial indicators.	100 %	The process provides budget and cost plans as well as information for financial management.
Objectives	The objective of the process is to manage financial resources and to support the management with respective data.	100 %	The objective is to ensure transparent and efficient financial management of IT elements.
Activities	The process covers financial planning and budgeting as well as other financial activities.	80 %	The activities within the process cover cost management, budgeting and accounting.
Roles	Involved roles are the CFO, account manager and other similar roles.		
TOTAL		**80 %**	

Table 79 Detailed Mapping: Process 09 <> APO06

9.4 Appendix D – Glaux Soft's Process Map in Detail

Within this external and published version of the study, this appendix is removed due to the confidentiality its content.

9.5 Appendix E – Generic Process and Glaux Soft's Detailed Process Mapping

Within this external and published version of the study, this appendix is removed due to the confidentiality its content.

9.6 Appendix F – Process Improvement Prototype (PIP)

The Process Improvement Prototype (PIP) is arranged within a separate Microsoft Excel document with name "Appendix F - Process Improvement Prototype.xlsx ". This document is available as an independent part of this study and contains the following three worksheets, which all represent a tool of the PIP.

9.6.1 Tool No. 1 – Process Model Mapping

This tool guides the users of the PIP when mapping its own, specific ISO 9001:2015 process model with the generic ISO 9001:2015 process map for IT SMEs.

9.6.2 Tool No. 2 – Process Definition & Scoping

The second tool of the PIP supports its users when selecting the processes to be assessed as well as when defining targeted capability levels for the respective processes.

9.6.3 Tool No. 3 – Process Maturity Measurement

The third PIP-tool is the maturity measurement tool itself that supports the users of the PIP when running a process maturity measurement iteration.

Acknowledgement

Special thanks to the following individuals and institutions, without whose help this present master thesis would not have been realized:

Prof. Dr. Petra M. Asprion	Supervisor & Support
Andreas Martin	Module Coordination
Glaux Soft AG	Mandate
Andreas Ressnig	Company Representative
Douglas Andrews	Editing & Spell Check
Manuela Blaser	Comprehension Check