

ArchiMate[®] 2

Certification Study Guide

Preparation for the ArchiMate 2 Part 1 and 2 Examinations



THE *Open* GROUP

Andrew Jasey & Bill Estam

Copyright protected. Use is for Single Users only via a VHP Approved License.
For information and printed versions please see www.vanharen.net

Study Guide
ArchiMate® 2
Certification

The Open Group Publications available from Van Haren Publishing

The TOGAF Series:

TOGAF® Version 9.1

TOGAF® Version 9.1 – A Pocket Guide

TOGAF® 9 Foundation Study Guide, 3rd Edition

TOGAF® 9 Certified Study Guide, 3rd Edition

The Open Group Series:

Cloud Computing for Business – The Open Group Guide

ArchiMate® 2.1 – A Pocket Guide

ArchiMate® 2.1 Specification

ArchiMate® 2 Certification – Study Guide

The Open Group Security Series:

Open Information Security Management Maturity Model (O-ISM3)

Open Enterprise Security Architecture (O-ESA)

Risk Management – The Open Group Guide

All titles are available to purchase from:

www.opengroup.org

www.vanharen.net

and also many international and online distributors.

Study Guide

ArchiMate® 2

Certification

Preparation for the ArchiMate 2 Part 1 and Part 2 Examinations

Prepared by Andrew Josey, The Open Group and Bill Estrem, Metaplexity Associates



Title: ArchiMate® 2 Certification Study Guide
Series: The Open Group Series
A Publication of: The Open Group
Authors: Andrew Josey and Bill Estrem
Publisher: Van Haren Publishing, Zaltbommel,
www.vanharen.net
ISBN Hard copy: 978 94 018 0002 0
ISBN eBook: 978 94 018 0505 6
ISBN ePub: 978 94 018 0506 3
Edition: First edition, first impression, January 2014
Layout and Cover design: CO2 Premedia, Amersfoort – NL
Print: Wilco, Amersfoort – NL
Copyright: © 2014 The Open Group
All rights reserved

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior permission of the copyright owner.

The views expressed in this Study Guide are not necessarily those of any particular member of The Open Group.

In the event of any discrepancy between text in this Study Guide and the official ArchiMate documentation, the ArchiMate documentation remains the authoritative version for certification, testing by examination, and other purposes. The official ArchiMate documentation can be obtained on-line at www.opengroup.org/archimate.

Study Guide
ArchiMate® 2 Certification
Document Number: B135

Published by The Open Group, January 2014.

Comments relating to the material contained in this document may be submitted to:

The Open Group
Apex Plaza
Reading
Berkshire, RG1 1AX
United Kingdom
or by electronic mail to: ogspeccs@opengroup.org

Contents

Chapter 1 Introduction	1
1.1 Key Learning Points.....	1
1.2 The ArchiMate Certification for People Program.....	1
1.2.1 Certification Document Structure	2
1.2.2 Program Vision and Principles.....	3
1.2.3 ArchiMate 2 Foundation	4
1.2.4 ArchiMate 2 Certified.....	4
1.2.5 Certification Syllabus Overview	4
1.2.6 Self-Study Paths	7
1.2.7 The Certification Process.....	8
1.2.8 Preparing for the Examination	12
1.3 Summary	13
1.4 Recommended Reading	13
1.5 Exercises	14
1.6 Test Yourself Questions	14
Chapter 2 Foundations of Enterprise Architecture and the ArchiMate Language	17
2.1 Key Learning Points.....	17
2.2 Introduction to the ArchiMate Specification	17
2.2.1 What is ArchiMate?.....	17
2.2.2 Structure of the ArchiMate Specification	18
2.3 What is an Enterprise?.....	18
2.4 What is Architecture in the Context of the ArchiMate Modeling Language?.....	19
2.5 Why do I Need Enterprise Architecture?.....	20
2.6 Key Enterprise Architecture Concepts and Terms	21
2.6.1 Stakeholders	22
2.6.2 Concerns.....	23
2.7 The ArchiMate Modeling Language and Enterprise Architecture	23
2.8 The TOGAF Standard and the ArchiMate Modeling Language.....	23
2.8.1 ArchiMate Core, Extensions, and the TOGAF ADM	24
2.9 Summary	26
2.9.1 Key Concepts	27

2.10	Recommended Reading	28
2.11	Exercise 1: Enterprise Architecture Concepts	28
2.12	Test Yourself Questions	29

Chapter 3 Enterprise Architecture Modeling using the ArchiMate

	Language	33
3.1	Key Learning Points.....	33
3.2	Structure of the ArchiMate Modeling Language	33
3.3	Core Concepts of the ArchiMate Modeling Language.....	35
3.4	Collaboration and Interaction.....	37
3.5	Relationships.....	38
3.6	Layering.....	39
3.7	The ArchiMate Framework.....	44
3.8	ArchiMate Modeling Language Extensions.....	46
	3.8.1 The Motivation Extension	46
	3.8.2 The Implementation and Migration Extension	48
3.9	Summary	50
	3.9.1 Key Concepts	50
3.10	Recommended Reading	52
3.11	Exercise 2: ArchiMate Core Concepts.....	52
3.12	Test Yourself Questions	54

Chapter 4 The Business Layer

	57	
4.1	Key Learning Points.....	57
4.2	Business Layer Metamodel	57
4.3	Active Structure Concepts	58
	4.3.1 Examples.....	60
4.4	Behavioral Concepts	63
	4.4.1 Examples.....	65
4.5	Passive Structure Concepts.....	68
	4.5.1 Examples.....	69
4.6	Business Layer Example	71
4.7	Summary	72
	4.7.1 Key Concepts	72
4.8	Recommended Reading	74
4.9	Exercise 3: Business Layer Concepts	74
4.10	Test Yourself Questions	75

Chapter 5	The Application Layer	77
5.1	Key Learning Points.....	77
5.2	The Application Layer Metamodel	77
5.3	Active Structure Concepts	78
5.3.1	Examples.....	79
5.4	Behavioral Concepts	80
5.4.1	Examples.....	82
5.5	Passive Structure Concepts.....	83
5.5.1	Examples.....	84
5.6	Application Layer Example.....	85
5.7	Summary	85
5.7.1	Key Concepts	85
5.8	Recommended Reading	86
5.9	Exercise 4: Application Layer Concepts	86
5.10	Test Yourself Questions	88
Chapter 6	The Technology Layer	91
6.1	Key Learning Points.....	91
6.2	Technology Layer Metamodel.....	91
6.3	Active Structure Concepts	91
6.3.1	Examples.....	94
6.4	Behavioral Concepts	95
6.4.1	Example	96
6.5	Passive Structure Concepts.....	96
6.5.1	Example	97
6.6	Technology Layer Example.....	97
6.7	Summary	98
6.7.1	Key Concepts	98
6.8	Recommended Reading	99
6.9	Exercise 5: Technology Layer Concepts	99
6.10	Test Yourself Questions	101
Chapter 7	Modeling Cross-Layer Dependencies	103
7.1	Key Learning Points.....	103
7.2	Business-Application-Technology Alignment	103
7.2.1	Examples.....	104
7.3	Application-Technology Alignment.....	105
7.3.1	Examples	106

7.4	Summary	107
7.5	Recommended Reading	107
7.6	Exercise 6: Cross-Layer Dependencies.....	107
7.7	Test Yourself Questions	108
Chapter 8 Modeling Relationships		111
8.1	Key Learning Points.....	111
8.2	Introduction to Relationships.....	111
8.3	Structural Relationships	111
8.3.1	Association	112
8.3.2	Access	113
8.3.3	Used by.....	114
8.3.4	Realization	115
8.3.5	Assignment.....	116
8.3.6	Aggregation	117
8.3.7	Composition	118
8.4	Dynamic Relationships	119
8.4.1	Flow	120
8.4.2	Triggering	120
8.5	Other Relationships	121
8.5.1	Grouping.....	121
8.5.2	Junction.....	122
8.5.3	Specialization	123
8.6	Relationships Example	124
8.7	Derived Relationships.....	124
8.8	Summary	126
8.8.1	Key Concepts	126
8.9	Recommended Reading	127
8.10	Exercise 7: Relationships	127
8.11	Test Yourself Questions	128
Chapter 9 ArchiMate Viewpoints		133
9.1	Key Learning Points.....	133
9.2	Architecture Viewpoints	133
9.3	Views, Viewpoints, and Stakeholders	133
9.3.1	Views	134
9.3.2	Viewpoints.....	135
9.3.3	Stakeholders and their Concerns	136

9.4	Viewpoint Classification	136
9.5	ArchiMate Viewpoints Summary	138
9.6	Example	140
9.7	Summary	141
9.7.1	Key Concepts	141
9.8	Recommended Reading	143
9.9	Exercise 8: ArchiMate Viewpoints	143
9.10	Test Yourself Questions	144
Chapter 10 Language Extension Mechanisms.....		147
10.1	Key Learning Points.....	147
10.2	Language Extension.....	147
10.3	Adding Attributes to ArchiMate Concepts and Relationships.....	148
10.4	Specialization of Concepts	149
10.5	Summary	150
10.5.1	Key Concepts	150
10.6	Recommended Reading	150
10.7	Exercise 9: Extending the ArchiMate Modeling Language.....	151
10.8	Test Yourself Questions	151
Chapter 11 The Motivation Extension.....		153
11.1	Key Learning Points.....	153
11.2	Motivation Extension Metamodel	153
11.3	Motivation Extension Concepts.....	154
11.3.1	Examples.....	156
11.4	Motivation Extension Relationships.....	159
11.4.1	Examples.....	160
11.4.2	The Relationship of Motivational Elements to Core Elements.....	161
11.5	Motivation Extension Example	162
11.6	Motivation Extension Viewpoints	163
11.7	Summary	164
11.8	Key Concepts	164
11.9	Recommended Reading	165
11.10	Exercise 10: Motivation Extension Concepts	165
11.11	Test Yourself Questions	166

Chapter 12	The Implementation and Migration Extension	169
12.1	Key Learning Points.....	169
12.2	Implementation and Migration Extension Metamodel	169
12.3	Implementation and Migration Concepts	170
12.3.1	Examples.....	171
12.3.2	Relationship of Implementation and Migration Concepts to Core Concepts.....	172
12.4	Implementation and Migration Example.....	173
12.5	Implementation and Migration Extension Viewpoints	174
12.6	Summary	174
12.6.1	Key Concepts	174
12.7	Recommended Reading	175
12.8	Exercise 11: Implementation and Migration Extension Concepts.....	175
12.9	Test Yourself Questions	176
Chapter 13	Certified Tool Support for the ArchiMate Modeling Language	177
13.1	Key Learning Points.....	177
13.2	ArchiMate 2 Tool Certification	177
13.2.1	Mandatory Conformance Requirements	179
13.2.2	Conformance Requirements – Recommended Capabilities	180
13.3	Summary	181
13.4	Recommended Reading	181
13.5	Exercises	181
13.6	Test Yourself Questions	181
Chapter 14	Using ArchiMate with Other Frameworks and Languages	183
14.1	Key Learning Points.....	183
14.2	The ArchiMate Modeling Language and the TOGAF Standard.....	183
14.2.1	The ArchiSurance Case Study.....	185
14.3	Other Languages and Frameworks	185
14.3.1	Universal Modeling Language	186
14.3.2	Business Process Model and Notation.....	186
14.4	Summary	188
14.5	Recommended Reading	188
14.6	Exercises	188
14.7	Test Yourself Questions	188

Appendix A	Answers to Test Yourself Questions and Exercises.....	191
A.1	Answers to the Test Yourself Questions	191
A.2	Answers to Exercises.....	194
Appendix B	Test Yourself Examination Paper – Part 1.....	209
B.1	Examination Paper.....	209
B.2	Questions.....	209
Appendix C	Test Yourself Examination Paper – Part 2	229
C.1	Examination Paper.....	229
C.2	Questions.....	229
Appendix D	Test Yourself Examination Paper Answers – Part 1.....	253
D.1	Scoring the Examination.....	253
D.2	Answers	253
Appendix E	Test Yourself Examination Paper Answers – Part 2.....	257
Appendix F	ArchiMate 2 Certification Syllabus.....	267
	Index	271

Preface

This Book

This book is a Study Guide for the ArchiMate® 2 People Certification program. This is based on Version 2.0.1 of the ArchiMate Certification for People Conformance Requirements.

It gives an overview of every learning objective for the ArchiMate 2 certification syllabus and in-depth coverage on preparing and taking the ArchiMate 2 Examinations. It is specifically designed to help individuals prepare for certification.

The audience for this Study Guide is:

- Individuals who require a basic understanding of the ArchiMate modeling language
- Professionals who are working in roles associated with an architecture project and who need to understand architecture artifacts developed using the ArchiMate modeling language
- Individuals who want to achieve a recognized qualification to demonstrate their knowledge of the ArchiMate modeling language

A prior knowledge of Enterprise Architecture and architecture modeling is advantageous but not required. While reading this Study Guide, the reader should also refer to the ArchiMate 2.1 documentation¹ available on-line at pubs.opengroup.org/architecture/archimate2-doc and also available in book form.

The Study Guide is structured as follows:

- Chapter 1 (Introduction) provides a brief introduction to the ArchiMate Certification Program and the ArchiMate 2 Examinations, as well as how to use this Study Guide.
- Chapter 2 (Foundations of Enterprise Architecture and the ArchiMate Language) introduces Enterprise Architecture and the ArchiMate modeling language.

¹ *ArchiMate 2.1 Specification*, The Open Group, C13L, ISBN 978 94 018 0003 7, December 2013

- Chapter 3 (Enterprise Architecture Modeling using the ArchiMate Language) describes the principles and core concepts of the ArchiMate modeling language and its extensions.
- Chapter 4 (The Business Layer) describes the Business Layer of the ArchiMate modeling language.
- Chapter 5 (The Application Layer) describes the Application Layer of the ArchiMate modeling language.
- Chapter 6 (The Technology Layer) describes the Technology Layer of the ArchiMate modeling language.
- Chapter 7 (Modeling Cross-Layer Dependencies) describes how to model the relationships between elements on different layers of ArchiMate models.
- Chapter 8 (Modeling Relationships) describes how to model relationships between model elements.
- Chapter 9 (ArchiMate Viewpoints) describes how to use the ArchiMate modeling language standard architecture viewpoints to model the concerns of stakeholders.
- Chapter 10 (Language Extension Mechanisms) describes how to create extensions to the ArchiMate modeling language.
- Chapter 11 (The Motivation Extension) describes the Motivation extension of the ArchiMate modeling language.
- Chapter 12 (The Implementation and Migration Extension) describes the Implementation and Migration extension of the ArchiMate modeling language.
- Chapter 13 (Certified Tool Support for the ArchiMate Modeling Language) describes how ArchiMate Certified Tools can be used to support Enterprise Architecture design and modeling activities.
- Chapter 14 (Using ArchiMate with Other Frameworks and Languages) describes how the ArchiMate modeling language can be used with other frameworks and languages to define and model effective Enterprise Architectures.
- Appendix A (Answers to Test Yourself Questions and Exercises) provides the answers to the Test Yourself sections provided at the end of each chapter.
- Appendix B (Test Yourself Examination Paper – Part 1) provides a Test Yourself examination to allow you to assess your knowledge of the ArchiMate modeling language and readiness to take the ArchiMate 2 Part 1 Examination.

- Appendix C (Test Yourself Examination Paper – Part 2) provides a Test Yourself examination to allow you to assess your knowledge of the ArchiMate modeling language and readiness to take the ArchiMate 2 Part 2 Examination.
- Appendix D (Test Yourself Examination Paper Answers – Part 1) provides the answers to the examination in Appendix B.
- Appendix E (Test Yourself Examination Paper Answers – Part 2) provides the answers to the examination in Appendix C.
- Appendix F (ArchiMate 2 Certification Syllabus) provides the ArchiMate 2 Certification Syllabus.

How to Use this Study Guide

The chapters in this Study Guide are arranged to provide coverage of the ArchiMate 2 certification syllabus (see Appendix F) and should be read in order. However, you may wish to use this Study Guide during review of topics with which you are already familiar, and it is certainly possible to select topics for review in any order. Where a topic requires further information from a later part in the syllabus, a cross-reference is provided.

Within each chapter are “Key Learning Points” and “Summary” sections that help you to easily identify what you need to know for each topic.

Each chapter also has a “Recommended Reading” section that indicates the relevant sections in the ArchiMate documentation that can be read to obtain a further understanding of the subject material.

Each chapter has “Exercises” and “Test Yourself Questions” sections that will help you to check your understanding of the chapter and prepare for the ArchiMate 2 Examinations. The purpose of this is to reinforce Key Learning Points (KLPs) in the chapter. These include a mix of multiple-choice format questions where you must identify one correct answer, open questions, and simple modeling exercises.

Finally, at the end of this Study Guide are two “Test Yourself” practice examination papers that you can use to test your readiness to take the official ArchiMate 2 Part 1 and Part 2 Examinations.

Conventions Used in this Study Guide

The following conventions are used throughout this Study Guide in order to help identify important information and avoid confusion over the intended meaning.

- Ellipsis (...)
 - Indicates a continuation; such as an incomplete list of example items, or a continuation from preceding text.
- Bold
 - Used to highlight specific terms.
- Italics
 - Used for emphasis. May also refer to other external documents.
- *(Syllabus reference: Unit X, Learning Outcome Y: Statement)*
 - Used at the start of a text block to identify the ArchiMate 2 certification syllabus learning outcome.

In addition to typographical conventions, the following conventions are used to highlight segments of text:



A Note box is used to highlight useful or interesting information.



A Tip box is used to provide key information that can save you time or that may not be entirely obvious.

About the ArchiMate Specification

The ArchiMate® Specification, an Open Group Standard, is an open and independent modeling language for Enterprise Architecture that is supported by different tool vendors and consulting firms. ArchiMate provides instruments to enable Enterprise Architects to describe, analyze, and visualize the relationships among business domains in an unambiguous way.

About The Open Group

The Open Group is a global consortium that enables the achievement of business objectives through IT standards. With more than 400 member organizations, The Open Group has a diverse membership that spans all

sectors of the IT community – customers, systems and solutions suppliers, tool vendors, integrators, and consultants, as well as academics and researchers – to:

- Capture, understand, and address current and emerging requirements, and establish policies and share best practices
- Facilitate interoperability, develop consensus, and evolve and integrate specifications and open source technologies
- Offer a comprehensive set of services to enhance the operational efficiency of consortia
- Operate the industry's premier certification service

Further information on The Open Group is available at www.opengroup.org. The Open Group publishes a wide range of technical documentation, most of which is focused on development of Open Group Standards and Guides, but which also includes white papers, technical studies, certification and testing documentation, and business titles. Full details and a catalog are available at www.opengroup.org/bookstore.

Readers should note that updates – in the form of Corrigenda – may apply to any publication. This information is published at www.opengroup.org/corrigenda.

About the Authors

Andrew Josey, The Open Group

Andrew Josey is Director of Standards within The Open Group. He is currently managing the standards process for The Open Group, and has led the standards development projects for the ArchiMate 2.1 Specification and the TOGAF 9.1 Standard, IEEE Std 1003.1-2008 (POSIX), and the core specifications of the Single UNIX Specification, Version 4. He is a member of the IEEE, USENIX, UKUUG, and the Association of Enterprise Architects (AEA).

Bill Estrem, Metaplexity Associates

Bill Estrem is the President of Metaplexity Associates LLC, an Enterprise Architecture education and consulting firm. Bill has several years of industrial experience, working as an Enterprise Architect at 3M and as an industry analyst. He has been active with The Open Group holding memberships in the Architecture Forum and the ArchiMate Forum. He has been an active contributor to the development of the TOGAF Standard and the ArchiMate modeling language. He served as the Chairman of the Architecture Forum and served on The Open Group Board of Governors.

Trademarks

ArchiMate®, DirecNet®, Jericho Forum®, Making Standards Work®, OpenPegasus®, The Open Group®, TOGAF®, and UNIX® are registered trademarks and Boundaryless Information Flow™, Dependability Through Assuredness™, FACE™, Open Platform 3.0™, and The Open Group Certification Mark™ are trademarks of The Open Group.

BPMN™ is a trademark and UML® is a registered trademark of Object Management Group, Inc. in the United States and/or other countries.

Java™ is a trademark of Oracle and/or its affiliates.

MSP® and PRINCE2® are registered trademarks of the AXELOS, UK.

PMBOK® is a registered trademark of the Project Management Institute, Inc.

All other brand, company, and product names are used for identification purposes only and may be trademarks that are the sole property of their respective owners.

Acknowledgements

The Open Group gratefully acknowledges The Open Group ArchiMate Forum for developing the ArchiMate 2.1 Specification.

The Open Group gratefully acknowledges the following reviewers who participated in the review of this Study Guide:

- Mike Broomhead
- Steve Else
- Paul Homan
- Henk Jonkers
- Veer Muchandi
- Dumebi Oderinde
- Simon Parker
- John Spencer
- Michéllé van den Berg
- Gerben Wierda
- Raina Wissing

References

The following documents are referenced in this Study Guide:

- ArchiMate® 2.1 Specification, Open Group Standard, C13L, ISBN: 978 94 018 0003 7, December 2013, published by Van Haren Publishing
- ArchiMate® 2.1 A Pocket Guide, G137, ISBN: 978 94 018 0001 3, December 2013, published by Van Haren Publishing
- ArchiMate® 2.1 Viewpoints Reference Card (PDF), N131, December 2013, published by The Open Group; refer to www.opengroup.org/bookstore/catalog/n131.htm.
- ArchiMate® Certification for People: Certification Policy, X113, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/x113.htm.
- ArchiMate® Certification for People: Conformance Requirements, X115, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/x115.htm.
- ArchiMate® Tool Certification: Conformance Requirements, X116, January 2012, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/x116.htm.
- Architecture Tool Certification: Certification Policy, X117, January 2012, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/x117.htm.
- ArchiMate® Language Primer, Marc Lankhorst and the ArchiMate Team, Telematica Instituut, August 2004; refer to: <https://doc.novay.nl/dsweb/Get/Document-43839>.
- ArchiSurance Case Study, Case Study by Henk Jonkers, Iver Band, and Dick Quartel, SAP, Y121, January 2012, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/y121.htm.
- Enterprise Architecture at Work, Marc Lankhorst et al, ISBN: 978 3 540 24371 7, 2005, published by Springer-Verlag.
- ISO/IEC 42010:2007: Systems and Software Engineering – Recommended Practice for Architectural Description of Software-intensive Systems, Edition 1 (technically identical to ANSI/IEEE Std 1471-2000).

- TOGAF® 9.1, Open Group Standard, G116, ISBN: 978 90 8753 679 4, December 2011, published by Van Haren Publishing.
- Why Does Enterprise Architecture Matter?, White Paper by Simon Townson, SAP, W076, December 2008, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/w076.htm.
- Using the TOGAF® 9.1 Architecture Content Framework with the ArchiMate® 2.0 Modeling Language, White Paper by Henk Jonkers (Ed.), Iver Band, Dick Quartel, Henry Franken, Mick Adams, Peter Haviland, and Erik Proper, W129, July 2012, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/w129.htm.
- Moving Enterprise Architecture forward with TOGAF® and ArchiMate®, Bas van Gils, PhD, EA Consultant, BiZZdesign, Webinar, D044, January 2012, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/d044.htm.

The following web links are referenced in this Study Guide:

- The Open Group ArchiMate 2 Certification website: www.opengroup.org/certifications/archimate
- The ArchiMate information website: www.opengroup.org/subjectareas/enterprise/archimate

Chapter 1

Introduction

1.1 Key Learning Points

This document is a Study Guide for the ArchiMate modeling language for students planning to become certified within the ArchiMate Certification for People program. It covers both ArchiMate 2 Foundation and ArchiMate 2 Certified. It will familiarize you with all the topics that you need to know in order to pass the ArchiMate 2 Examinations.

It gives an overview of every learning objective for the ArchiMate 2 certification syllabus and in-depth coverage on preparing and taking the ArchiMate 2 Examinations. It is specifically designed to help individuals prepare for certification.

This first chapter will familiarize you with the ArchiMate 2 Certification Program and its principles, as well as give you important information about the structure of the ArchiMate 2 Examinations.

The objectives of this chapter are as follows:

- To provide an understanding of the ArchiMate Certification Program and why you should become certified
- To learn key facts about the ArchiMate 2 Examinations

1.2 The ArchiMate Certification for People Program

(Syllabus Reference: Unit 9, Learning Outcome 1: You should be able to briefly explain the ArchiMate Certification Program.)

Certification is available to individuals who wish to demonstrate they have attained the required knowledge and understanding of the ArchiMate modeling language as defined in the ArchiMate 2.0 Specification or subsequent minor releases.

There are two levels defined for ArchiMate 2 People Certification:

- ArchiMate 2 Foundation
- ArchiMate 2 Certified

This Study Guide covers both of these. Studying for ArchiMate 2 Foundation can be used as a learning objective towards achieving ArchiMate 2 Certified, as the learning outcomes in ArchiMate 2 Foundation are also required in ArchiMate 2 Certified. The difference between the two certification levels is that, in addition to the requirements for ArchiMate 2 Foundation, ArchiMate 2 Certified requires passing an advanced examination.

1.2.1 Certification Document Structure

The documents available to support the program are as shown in Figure 1.

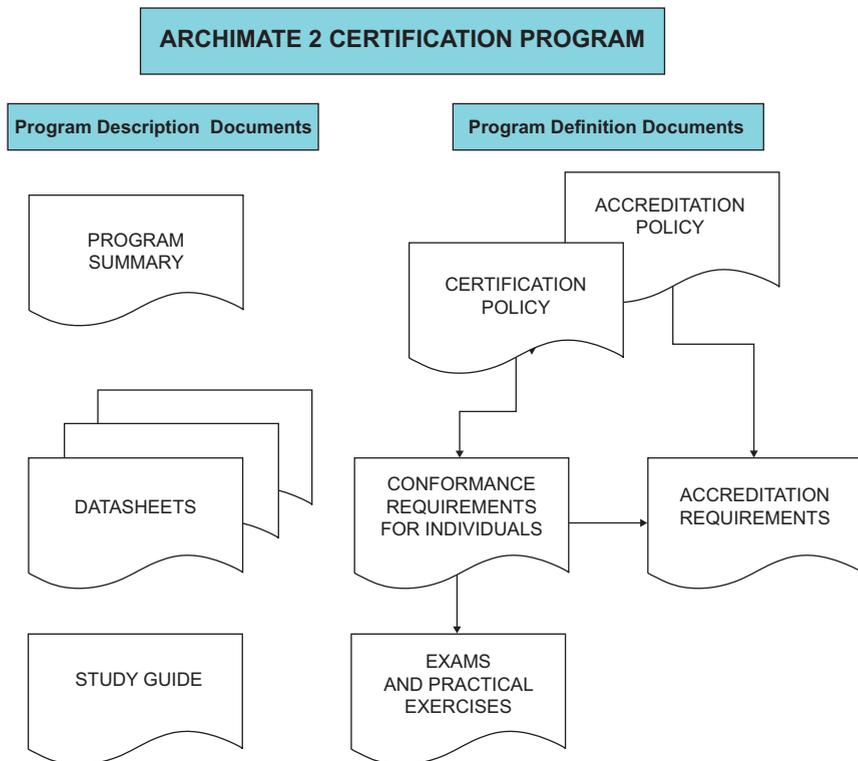


Figure 1: Certification Document Structure

Program description documents, such as this Study Guide, are intended for an end-user audience including those interested in becoming certified. The Program definition documents are intended for trainers, examination

developers, and the Certification Authority. All these documents are available from The Open Group website.²



Why become Certified?

Becoming certified demonstrates publicly that you possess a body of core knowledge about the ArchiMate modeling language as an open, industry standard modeling language for Enterprise Architecture. The Open Group publishes the definitive directory of ArchiMate Certified individuals and issues certificates.

1.2.2 Program Vision and Principles

The vision for the Program is to define and promote a market-driven education and certification program to support the ArchiMate Specification. The Program has been designed with the following principles in mind:

Table 1: ArchiMate Certification Principles

Principle	Certification Aspects
Openness	The Program is open to applicants from all countries.
Fairness	Certification is achieved only by passing an examination that is equivalent to that taken by any other candidate.
Market Relevance	The Program is structured to meet the perceived needs of the market. It includes certification at two levels. Additional levels may be introduced during the life of the Program, as may updated versions of the ArchiMate modeling language.
Learning Support	Training courses are provided by third parties, according to the needs of the market.
Quality	Training course providers may choose to seek Open Group accreditation for their courses. Accredited ArchiMate Training Courses (ATCs) are listed on The Open Group website. Only ATCs may use The Open Group logo and include the ArchiMate examinations and practical exercises within the course.
Best Practice	The Program is designed to follow industry best practice for equivalent certification programs.

² Available from the ArchiMate 2 Certification website at: www.opengroup.org/certifications/archimate or from The Open Group Bookstore at www.opengroup.org/bookstore.

1.2.3 ArchiMate 2 Foundation

The purpose of certification for ArchiMate 2 Foundation is to provide validation that the Candidate has gained knowledge of the notation, terminology, structure, and concepts of the ArchiMate modeling language. The learning objectives at this level focus on knowledge and comprehension. Certification for ArchiMate 2 Foundation is achieved by passing the ArchiMate 2 Part 1 Examination. This is a simple multiple-choice examination with 40 questions.³

1.2.4 ArchiMate 2 Certified

The purpose of certification for ArchiMate 2 Certified is to provide validation that, in addition to the knowledge and comprehension of ArchiMate 2 Foundation, the Candidate is able to analyze and apply this knowledge. The learning objectives at this level therefore focus on application and analysis. Certification for ArchiMate 2 Certified is achieved by passing the ArchiMate 2 Part 2 Examination. This is a scenario based, gradient scored examination with 8 questions.

1.2.5 Certification Syllabus Overview

Individuals certified at both levels will have demonstrated their understanding of:

- The basic concepts and key terminology of Enterprise Architecture and the ArchiMate modeling language
- The principles and core concepts underlying the ArchiMate core language and extensions
- The concepts from the ArchiMate layers and extensions
- The ArchiMate relationships
- ArchiMate views and viewpoints
- Adapting the ArchiMate modeling language
- ArchiMate Certified Tools to support modeling and analysis
- The relationship of the ArchiMate modeling language to other languages and frameworks

³ For the latest information on examinations, see the ArchiMate 2 Certification website at: www.opengroup.org/certifications/archimate.

Here is a high-level summary of the learning objectives:

Basic Concepts and Definitions

The Candidate must be able to:

- Describe what an enterprise is
- Explain the purpose of an Enterprise Architecture
- Explain what architecture is in the context of the ArchiMate modeling language
- List the different types of architecture that the ArchiMate modeling language deals with

Language Principles

The Candidate must be able to:

- Briefly explain the structure and the ideas underlying the ArchiMate modeling language
- Identify the core concepts of the ArchiMate modeling language and their relationships
- Explain the aspects and layers in the ArchiMate Framework
- Explain the basic structure of the ArchiMate Motivation extension and its relationship to the ArchiMate core concepts
- Explain the basic structure of the ArchiMate Implementation and Migration extension and its relationship to the ArchiMate core and motivation concepts

Concepts

The Candidate must be able to understand and explain the use of:

- The ArchiMate concepts from the Business Layer
- The ArchiMate concepts from the Application Layer
- The ArchiMate concepts from the Technology Layer
- The ArchiMate concepts from the Motivation extension
- The ArchiMate concepts from the Implementation and Migration extension

Relationships

The Candidate must be able to understand and explain the use of:

- The relationships between the Application Layer and the Business Layer
- The relationships between the Technology Layer and the Application Layer
- The structural relationships of the ArchiMate modeling language

- The dynamic relationships of the ArchiMate modeling language
- The Grouping, Junction, and Specialization relationships
- The additional relationships in the Motivation extension
- The concept of derived relationships

Viewpoints and Visualization

The Candidate must be able to:

- Explain the concepts of view, viewpoint, and stakeholder
- Explain the viewpoint classification of the ArchiMate modeling language
- Give examples of different types of viewpoints relating to the ArchiMate core, and explain how they can be used
- Give examples of viewpoints relating to the Motivation extension, and explain how they can be used
- Give examples of viewpoints relating to the Implementation and Migration extension, and explain how they can be used

Language Extension Mechanisms

The Candidate must be able to understand and explain:

- The principle of adding attributes to ArchiMate concepts or relationships for specific purposes
- How to define specializations of ArchiMate concepts, and give examples of specialized concepts

Tool Support for the ArchiMate Modeling Language

The Candidate must be able to briefly explain:

- How ArchiMate 2 Certified Tools can be used to support modeling and analysis with the ArchiMate modeling language

The ArchiMate Modeling Language and Other Frameworks and Languages

The Candidate must be able to briefly explain:

- How the ArchiMate modeling language (core and extensions) relates to the TOGAF Standard
- How the ArchiMate modeling language can be used in combination with detailed design languages, such as BPMN or UML

ArchiMate Certification Program

The Candidate must be able to:

- Explain the ArchiMate Certification Program



What is the relationship between ArchiMate 2 Foundation and ArchiMate 2 Certified?

The learning outcomes for ArchiMate 2 Foundation are identical to those for ArchiMate 2 Certified. The difference is that, in addition to the requirements for ArchiMate 2 Foundation, ArchiMate 2 Certified requires passing an advanced examination that demonstrates a deeper level of understanding.

1.2.6 Self-Study Paths

The self-study paths to achieve certification in the ArchiMate Certification for People program are summarized in Figure 2. The chosen path depends on whether you want to first become certified to ArchiMate 2 Foundation or proceed directly to ArchiMate 2 Certified.

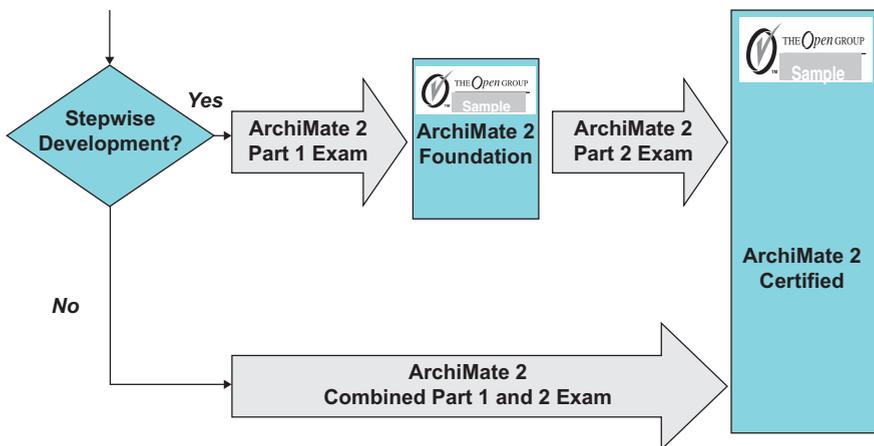


Figure 2: Paths to Certification



What is the Relationship between ArchiMate 2 Foundation and ArchiMate 2 Certified?

Candidates are able to choose whether they wish to become certified in a stepwise manner by starting with ArchiMate 2 Foundation and then at a later date ArchiMate 2 Certified, or bypass ArchiMate 2 Foundation and go directly to ArchiMate 2 Certified. For those going directly to ArchiMate 2 Certified there is a choice of taking the two examinations separately or a Combined examination. The advantage of taking the two examinations over the single Combined examination is that if you pass Part 1 but fail Part 2 you can still qualify for ArchiMate 2 Foundation.

1.2.7 The Certification Process

This Study Guide is aimed at preparing you to become certified at either certification level. An overview of the certification process is shown in Figure 3 (using a simple flowchart notation).

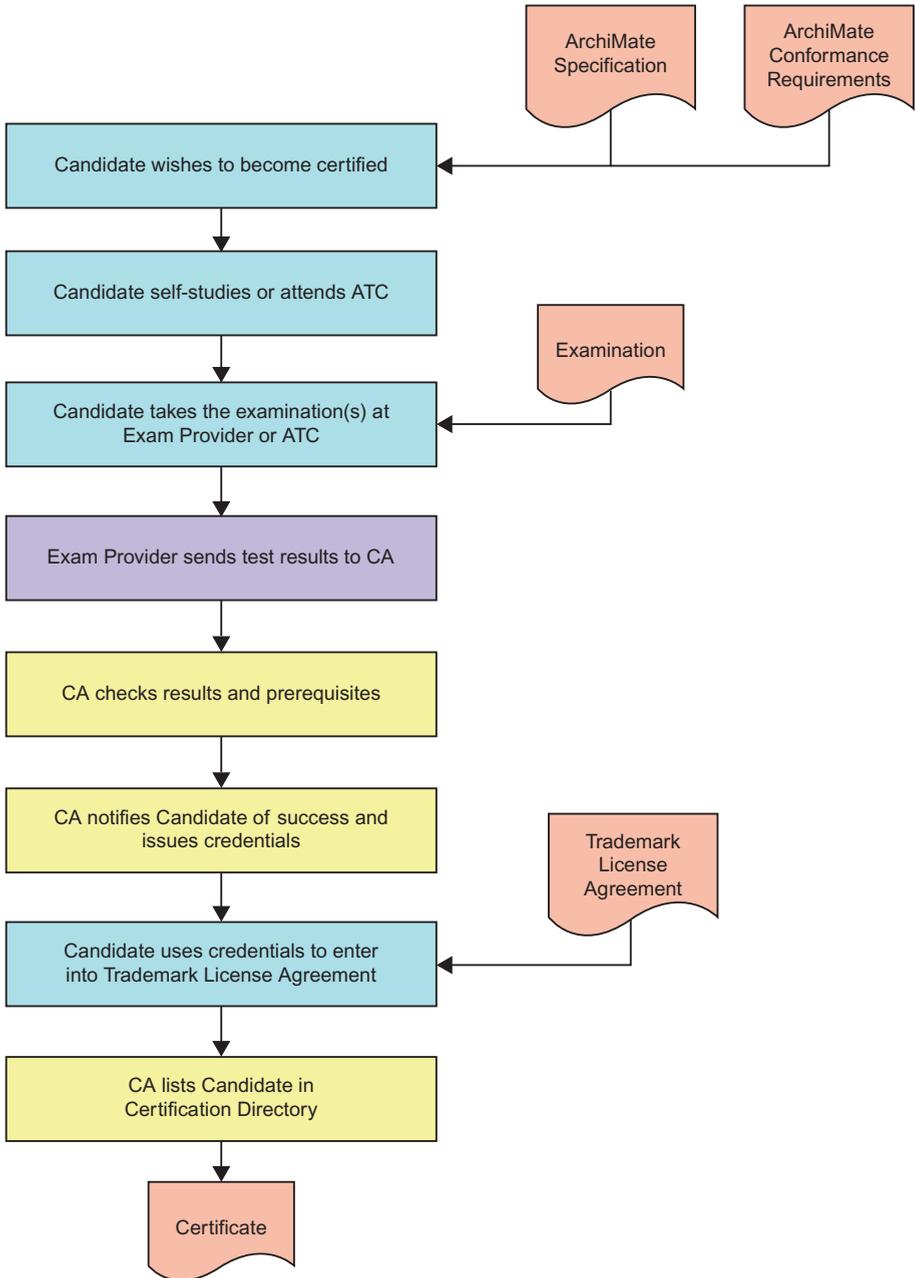


Figure 3: Certification Process

(ATC = Accredited Training Course, CA = Certification Authority)

The process for becoming certified as shown in Figure 3 is as follows:

1. Candidate wishes to become certified.
To achieve ArchiMate certification, Candidates must possess a thorough knowledge and understanding of those elements of the ArchiMate modeling language identified in the Conformance Requirements as being mandatory.
2. Candidate self-studies or attends ATC.
A Candidate can self-study or attend an ATC. The two key inputs to the learning process are the ArchiMate Specification itself and the Conformance Requirements. The Conformance Requirements identify which elements of the ArchiMate Specification must be known to achieve certification.
3. Candidate takes the examination(s) at Examination Provider or ATC.
Certification is achieved by passing the applicable examination(s) delivered either at The Open Group Examination Provider or as part of an ATC.
Candidates who fail to meet the required pass mark will be informed of this and are encouraged to undergo further study and re-sit the examination at a later date. Candidates who fail an examination are not allowed to re-sit an examination again for a period of one (1) month.
4. Certification Authority (CA) checks results and prerequisites.
Examination results of all Candidates are sent to the Certification Authority for review. The Certification Authority will check to ensure that the pass mark has been met. The Certification Authority will also ensure that Candidates have not failed an examination within the previous month.
5. CA notifies Candidate of success and issues credentials.
The Certification Authority will notify the Candidate in writing of the decision. If the decision is to accept the application for certification, the Certification Authority will also issue credentials to the successful Candidate that will enable the Candidate to access the Certification Authority's website to accept the terms of, and enter into, a Trademark License Agreement (TMLA) with the Certification Authority.
6. Candidate uses credentials to enter into Trademark License Agreement.
The Candidate then uses the credentials to access the Certification Authority's website to enter into a TMLA with the Certification Authority and to obtain the artwork of the applicable Program Logo.

7. CA lists Candidate in Certification Directory.

The Certification Authority will then make a Certificate available to the Candidate in electronic form and enter the Candidate's Certification Record into the Certification Directory. The credentials also allow the Certified Person to control to whom the Certification Record is disclosed and to update contact and employer information in the Certification Record.

1.2.7.1 ArchiMate 2 Examination Coverage by Topic

The ArchiMate 2 certification syllabus is contained in Appendix F. Certain topic areas are weighted as more important than others and thus have more questions. The topic areas covered by the examinations together with the number of questions per area in each examination are provided in Table 2 and Table 3. It should be noted that some areas of the syllabus are non-examinable (Topics 7 and 9).

Table 2: ArchiMate 2 Part 1 Examination Coverage

Unit	Topic	No. of Questions
1	Basic Concepts and Definitions	1
2	Language Principles	2
3	Concepts	16
4	Relationships	11
5	Viewpoints and Visualization	8
6	Language Extensions Mechanisms	1
7	Tool Support for ArchiMate	0
8	ArchiMate and Other Frameworks and Languages	1
9	ArchiMate Certification Program	0

Table 3: ArchiMate 2 Part 2 Examination Coverage

Area	Topics by Learning Unit Ref (LU)	No. of Questions
Business Layer	LU1 LU2.1, LU2.2, LU2.3 LU3.1 LU4.3, LU4.4, LU4.5, LU4.7 LU5.1, LU5.2, LU5.3	1
Application Layer	LU1 LU2.1, LU2.2, LU2.3 LU3.2 LU4.3, LU4.4, LU4.5, LU4.7 LU5.1, LU5.2, LU5.3	1
Technology Layer	LU1 LU2.1, LU2.2, LU2.3 LU3.3 LU4.3, LU4.4, LU4.5, LU4.7 LU5.1, LU5.2, LU5.3	1
Multiple Layers, consisting of questions involving two or three Core layers and relationships between them	LU1 LU2.1, LU2.2, LU2.3 LU3.1, LU3.2, LU3.3 LU4.1, LU4.2, LU4.3, LU4.4, LU4.5, LU4.7 LU5.1, LU5.2, LU5.3	3
Extensions, consisting of questions involving either extension with realization of Core elements, or realization of Motivation elements by Implementation and Migration elements	LU1 LU2 LU3.4, LU3.5 LU4.3, LU4.4, LU4.5, LU4.6, LU4.7 LU5.1, LU5.2, LU5.4, LU5.5	2

Format of the Examination Questions

The examination questions are multiple-choice questions. These are very similar in format to the Test Yourself practice examinations included in Appendix B and Appendix C. Note that the exact format for display is test center-specific and will be made clear on the screens when taking the examination.

**Tips when Taking the Examination**

Ensure you take the tutorial provided prior to the commencement of the examination. It explains how the examination will work and does not use any of the allotted time for the examination. Please read each question carefully before reading the answer options. Be aware that some questions may seem to have more than one right answer, but you are to look for the one that makes the most sense and is the most correct. For questions where you are unsure of an answer you can mark them and come back later if you have time. Remember to answer all questions, as leaving unanswered questions reduces your maximum possible score.

What do I need to bring with me to take the Examination?

You should consult with the test center prior to attendance regarding the forms of picture ID you are required to bring with you to verify your identification.

Can I refer to materials while I take the Examination?

This depends on the examination. The ArchiMate 2 Part 1 examination is closed book. The ArchiMate 2 Part 2 examination is open book. Where an examination is open book, a copy of the reference text is provided with the examination.

What is the pass mark?

You should check with The Open Group for the latest information on the examination. At the time of writing the pass mark for the Part 1 examination is 60% and the pass mark for the Part 2 examination is 70%.

If I fail, how soon can I retake the Examination?

You should consult the current policy on The Open Group website. At the time of this writing, the policy states that individuals who have failed the examination are not allowed to retake the examination within one (1) month of the first sitting.

1.2.8 Preparing for the Examination

You can prepare for the examination by working through this Study Guide section-by-section. A mapping of the sections of this Study Guide to the ArchiMate 2 certification syllabus is given in Appendix E. After completing

each section, you should read the referenced sections from the ArchiMate documentation together with any other recommended reading. Then you should complete the Exercises and the Test Yourself Questions. Once you have completed all the sections in this Study Guide, you can then attempt the Test Yourself practice examination papers in Appendix B and Appendix C. This is designed to give a thorough test of your knowledge. If you have completed all the prescribed preparation and can attain a pass mark for the Test Yourself examination papers, then it is likely you are ready to sit the examination(s).

1.3 Summary

The ArchiMate 2 People Certification Program is a knowledge-based certification program. It has two levels: ArchiMate 2 Foundation and ArchiMate 2 Certified, respectively.

This Study Guide will prepare you for both levels of certification.

Preparing for the examination(s) includes the following steps:

- You should work through this Study Guide step-by-step.
- At the end of each chapter, you should read the sections of the ArchiMate documentation and other references listed under Recommended Reading, and complete the Exercises and the Test Yourself Questions.
- Once you have completed all the chapters in this Study Guide, you should attempt the Test Yourself practice examination papers given in Appendix B and Appendix C.
- If you can attain the target score for the Test Yourself practice examination papers, then you have completed your preparation.

1.4 Recommended Reading

The following are recommended sources of further information for this chapter:

- ArchiMate® Certification for People: Program Summary Datasheet, February 2013, published by The Open Group; refer to www.opengroup.org/certifications/archimate.
- ArchiMate® 2 Foundation Datasheet, February 2013, published by The Open Group; refer to www.opengroup.org/certifications/archimate.
- ArchiMate® Certification for People: Certification Policy, X113, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/x113.htm.

- ArchiMate® 2 Certified Datasheet, January 2014, published by The Open Group; refer to www.opengroup.org/certifications/archimate.
- ArchiMate® Certification for People: Conformance Requirements, X115, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/x115.htm.
- The Open Group ArchiMate 2 Certification website: www.opengroup.org/certifications/archimate
- The ArchiMate information website: www.opengroup.org/subjectareas/enterprise/archimate

1.5 Exercises

There are no exercises for this chapter.

1.6 Test Yourself Questions

- Q1: How many certification levels are there in the ArchiMate 2 People Certification Program?
- A. 1
 - B. 2
 - C. 3
 - D. 4
- Q2: Which one of the following is the entry-level certification for an individual?
- A. ArchiMate 2 Certified
 - B. ArchiMate 2 Foundation
 - C. ArchiMate 2 Professional
 - D. ArchiMate 2 Architect
- Q3: Which one of the following describes three principles of the ArchiMate 2 People Certification Program?
- A. Integrity, Scalability, Flexibility
 - B. Objectivity, Robustness, Simplicity
 - C. Openness, Fairness, Quality
 - D. Knowledge-based, Valuable, Simplicity
 - E. All of these

- Q4: Which of the following topic areas is *not* included in the ArchiMate 2 certification syllabus?
- A. Architecture in the context of the ArchiMate modeling language
 - B. The different architectures that the ArchiMate modeling language addresses
 - C. The dynamic relationships of the ArchiMate modeling language
 - D. Using the ArchiMate modeling language for Architecture Governance
 - E. The relationship with the TOGAF Standard
- Q5: Which of the following statements about the retake policy for ArchiMate 2 Examinations is correct?
- A. Candidates who fail cannot take an examination again within one (1) month.
 - B. Candidates who fail cannot take an examination again within five (5) days.
 - C. Candidates who fail cannot take an examination again within seven (7) days.
 - D. Candidates who fail cannot take an examination again within three (3) months.

Foundations of Enterprise Architecture and the ArchiMate Language

2.1 Key Learning Points

This chapter provides an introduction to the basic concepts of Enterprise Architecture and the ArchiMate modeling language.

Key Points Explained

This chapter will help you to:

- Describe what an enterprise is
- Explain the purpose of an Enterprise Architecture
- Explain what architecture is in the context of the ArchiMate modeling language
- Define key terms and concepts related to Enterprise Architecture
- Describe how the TOGAF Standard and the ArchiMate modeling language are related and how they can be used together to conduct Enterprise Architecture activities

2.2 Introduction to the ArchiMate Specification

2.2.1 What is ArchiMate?

ArchiMate, an Open Group Standard, is an open and independent modeling language for Enterprise Architecture that is supported by different tool vendors and consulting firms. The ArchiMate modeling language provides a notation to enable Enterprise Architects to describe, analyze, and visualize the relationships among business domains in an unambiguous way.

Just as an architectural drawing in classical building architecture describes the various aspects of the construction and use of a building, the ArchiMate Specification offers a common language for describing the construction and operation of business processes, organizational structures, information flows, IT systems, and technical infrastructure. This insight helps stakeholders to design, assess, and communicate the consequences of decisions and changes within and between these business domains.



Study Guide References

When appropriate, this Study Guide contains references to sections within the ArchiMate Specification. The references are intended to be functional for the web version and printed version of the ArchiMate 2.1 Specification. Therefore, the format of the reference number contains both the Part and the Chapter reference, but not the page references since they exist only in the printed book.

2.2.2 Structure of the ArchiMate Specification

The ArchiMate 2.1 Specification is The Open Group Standard for the ArchiMate architecture modeling language. It contains the formal definition of the ArchiMate visual design language, together with concepts for specifying inter-related architectures, and specific viewpoints for typical stakeholders (see Section 9.2 of this book for information on viewpoints). It also includes a chapter addressing considerations regarding language extensions.

The contents of the specification include the following:

- The overall modeling framework that the ArchiMate modeling language uses
- The structure of the modeling language
- A detailed breakdown of the constituent elements of the modeling framework covering the three layers (Business/Application/Technology), cross-layer dependencies and alignment, and relationships within the framework
- Architectural viewpoints including a set of standard viewpoints
- Optional extensions to the framework
- Commentary around future direction of the specification
- Notation overviews and summaries

The ArchiMate 2.1 Specification is a maintenance update, addressing comments raised since the introduction of the ArchiMate 2.0 Specification in early 2012. It is an evolution from the ArchiMate 1.0 Specification.

2.3 What is an Enterprise?

(Syllabus Reference: Unit 1, Learning Outcome 1: You should be able describe what an enterprise is.)



Enterprise Architecture and the TOGAF Standard

In this Study Guide, we refer to the TOGAF Version 9.1 Standard for definitions of the key terminology and concepts related to Enterprise Architecture (EA). TOGAF is a standard EA framework used to improve business efficiency. It provides an Architecture Development Method (ADM), an Architecture Content Framework (ACF), and a set of tools and techniques for establishing an Enterprise Architecture Capability.

The ArchiMate Specification draws on the TOGAF 9.1 Standard for the definition of an “enterprise”. The TOGAF Standard defines an “enterprise” as any collection of organizations that has a common set of goals. For example, an enterprise could be a government agency, a whole corporation, a division of a corporation, a single department, or a chain of geographically distant organizations linked together by common ownership.

The term “enterprise” in the context of “Enterprise Architecture” can be used to denote both an entire enterprise, encompassing all of its information systems, and a specific domain within the enterprise. In both cases, the architecture crosses multiple systems and multiple functional groups within the enterprise.

An extended enterprise frequently includes partners, suppliers, and customers. If the goal is to integrate an extended enterprise, then the enterprise comprises the partners, suppliers, and customers, as well as internal business units. For example, an organization with an on-line store that uses an external fulfillment house for dispatching orders would extend its definition of the enterprise in that system to include the fulfillment house.

2.4 What is Architecture in the Context of the ArchiMate Modeling Language?

(Syllabus Reference: Unit 1, Learning Outcome 3: You should be able to explain what architecture is in the context of the ArchiMate modeling language.)

The TOGAF Standard and the ArchiMate modeling language concepts of architecture have a common foundation that is based on the ISO/IEC 42010:2007 definition of “Architecture”:

Copyright protected. Use is for Single Users only via a VHP Approved License. For information and printed versions please see www.vanharen.net

“The fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution.”



What is Enterprise Architecture?

There are many definitions of Enterprise Architecture. Most focus on structure and organization. Three definitions are given below:

Enterprise Architecture is:

1. The organizing logic for business processes and IT infrastructure reflecting the integration and standardization requirements of the firm’s operating model.
[Source: MIT Center for Information Systems Research]
2. A conceptual blueprint that defines the structure and operation of an organization. The intent of an Enterprise Architecture is to determine how an organization can most effectively achieve its current and future objectives.
[Source: SearchCIO.com]
3. The process of translating business vision and strategy into effective enterprise change by creating, communicating, and improving the key requirements, principles, and models that describe the enterprise’s future state and enable its evolution.

[Source: Gartner Group⁴, IT Glossary, 2009]

2.5 Why do I Need Enterprise Architecture?

(Syllabus Reference: Unit 1, Learning Outcome 2: You should be able to explain the purpose of an Enterprise Architecture.)

The purpose of Enterprise Architecture is to optimize across the enterprise the often fragmented legacy of processes (both manual and automated) into an integrated environment that is responsive to change and supportive of the delivery of the business strategy. Effective management and exploitation of information through IT is a key factor to business success, and an indispensable means to achieving competitive advantage. An Enterprise Architecture addresses this need, by providing a strategic context for the evolution of the IT system in response to the constantly changing needs of the business environment.

⁴ Retrieved 27 December 2012 from http://en.wikipedia.org/wiki/Enterprise_architecture. Wikipedia attributes the definition to Gartner Group who have subsequently revised their definition.

The advantages that result from a good Enterprise Architecture can bring important business benefits, including:

- A more efficient business operation:
 - Lower business operation costs
 - More agile organization
 - Business capabilities shared across the organization
 - Lower change management costs
 - More flexible workforce
 - Improved business productivity
- A more efficient IT operation:
 - Lower software development, support, and maintenance costs
 - Increased portability of applications
 - Improved interoperability and easier system and network management
 - Improved ability to address critical enterprise-wide issues, such as security
 - Easier upgrade and exchange of system components
- Better return on existing investment, reduced risk for future investment:
 - Reduced complexity in the business and IT
 - Maximum return on investment in existing business and IT infrastructure
 - The flexibility to make, buy, or out-source business and IT solutions
 - Reduced risk overall in new investments and their costs of ownership
- Faster, simpler, and cheaper procurement:
 - Simpler buying decisions, because the information governing procurement is readily available in a coherent plan
 - Faster procurement process, maximizing procurement speed and flexibility without sacrificing architectural coherence
 - The ability to procure heterogeneous, multi-vendor open systems
 - The ability to secure more economic capabilities

2.6 Key Enterprise Architecture Concepts and Terms

An Enterprise Architecture is typically developed because key people have *concerns* that need to be addressed by the business and IT systems within the organization. Such people are commonly referred to as the “*stakeholders*” in the system. The architect works to address the stakeholders’ concerns, by:

- Identifying and refining the stakeholders’ requirements

- Developing views of the architecture that show how the concerns and the requirements are going to be addressed
- Showing the trade-offs that are going to be made in reconciling the potentially conflicting concerns of different stakeholders

Without an Enterprise Architecture, it is unlikely that all the stakeholder concerns and requirements would be considered and met.

2.6.1 Stakeholders

Stakeholders are people who have key roles in, or *concerns* about, the system; for example, users, developers, etc. Stakeholders can be individuals, teams, organizations, etc.

A system has one or more stakeholders. Each stakeholder typically has interests in, or concerns relative to, that system. Figure 4⁵ shows a typical set of stakeholders for an Enterprise Architecture, with defined categories of stakeholder type.

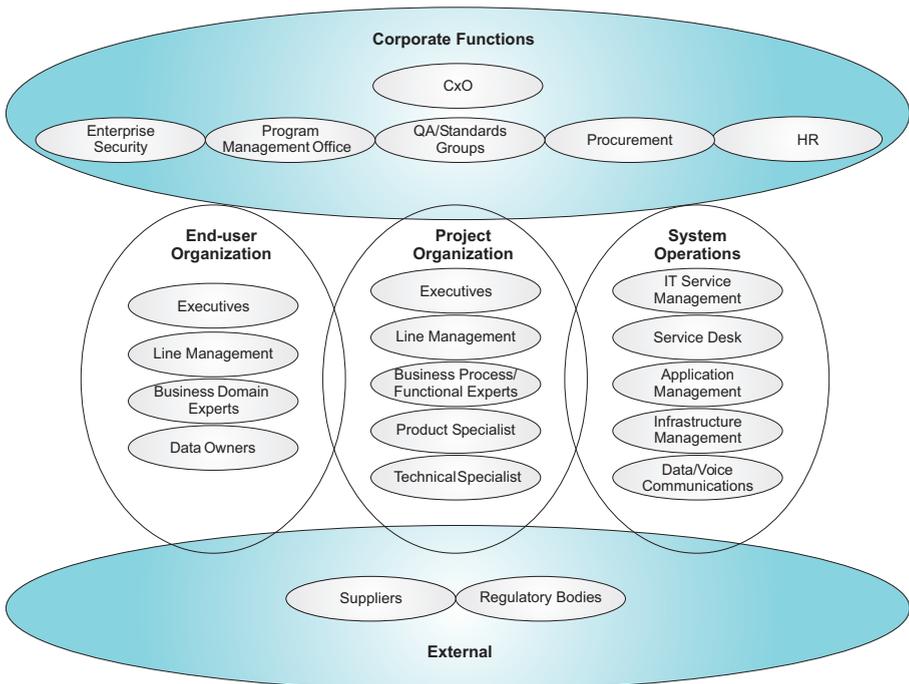


Figure 4: A Typical Set of Stakeholders for an Enterprise Architecture

5 Source: TOGAF Version 9.1, Chapter 24, Figure 24-1.

2.6.2 Concerns

Concerns are key interests that are crucially important to stakeholders, and determine the acceptability of the system.

They may include performance, reliability, security, distribution, evolvability, etc. A Security Architect could have the following concerns: authentication, authorization, audit, assurance, availability, asset protection, administration, risk management.

2.7 The ArchiMate Modeling Language and Enterprise Architecture

Architecture descriptions are formal descriptions of a system, organized in a way that supports reasoning about the structural and behavioral properties of the system and its evolution. They define the components or building blocks that make up the overall information system, and provide a plan from which products can be procured, and subsystems developed, that will work together to implement the overall system. The Enterprise Architecture enables you to manage your overall IT investment in a way that meets the needs of your business.

The role of the ArchiMate Specification is to provide a graphical language for the representation of Enterprise Architectures over time (i.e., including transformation and migration planning), as well as their motivation and rationale. The ArchiMate modeling language provides a uniform representation for diagrams that describe Enterprise Architectures, and offers an integrated approach to describe and visualize the different architecture domains together with their underlying relations and dependencies.

2.8 The TOGAF Standard and the ArchiMate Modeling Language

The TOGAF Standard and the ArchiMate modeling language complement each other with respect to process and language, as shown in Figure 5.

Enterprise Architecture frameworks vary in the aspects they cover. They may have, among others, any combination of the following components:

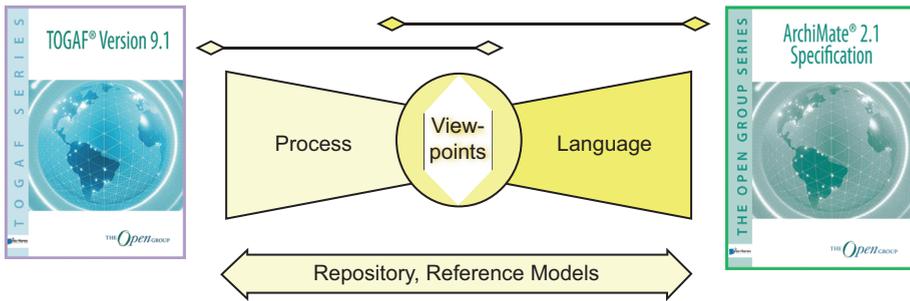


Figure 5: The TOGAF Standard and the ArchiMate Modeling Language

- A process (“way of working”) for creating architectures
- A classification for viewpoints
- A set of viewpoints
- A language for describing architectures (defining concepts and relationships, but also a notation)

The TOGAF Standard includes a process – the TOGAF Architecture Development Method (ADM) – and describes viewpoints (and also techniques, reference models) and the types of building blocks that make up an architecture, but does not prescribe the use of a specific modeling language. The ArchiMate Specification describes viewpoints and a well-defined language. Both have a firm common foundation in their use of viewpoints on a single underlying model. The TOGAF Standard defines an Architecture Repository and includes a number of reference models. Content described in the ArchiMate modeling language can be stored in a repository, and the ArchiMate modeling language notation can be used to represent reference models.

2.8.1 ArchiMate Core, Extensions, and the TOGAF ADM

(Syllabus Reference: Unit 8, Learning Outcome 1: You should be able to explain how the ArchiMate modeling language (core and extensions) relate to the TOGAF Standard.)

The ArchiMate 2.0 Specification consists of the ArchiMate Core (the core language), that focuses on the description of the four architecture domains defined by the TOGAF Standard (Business, Data, Application, and Technology Architectures, as well as their inter-relationships), and extensions to model the motivations for the architecture, and its implementation and

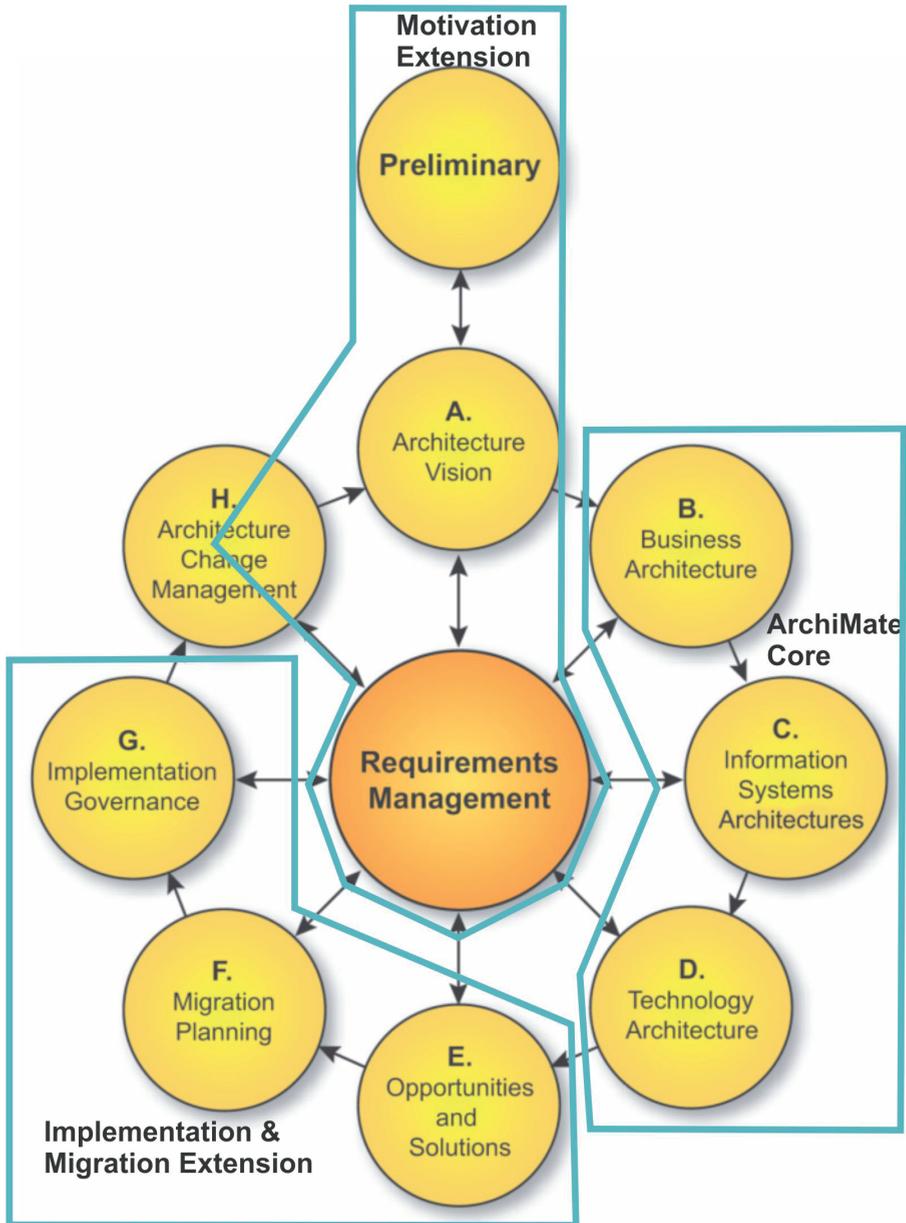


Figure 6: The Relationship between ArchiMate Core, Extensions, and the TOGAF ADM

migration planning. Figure 6 shows how the ArchiMate Core, the Motivation extension, and the Implementation and Migration extension relate to the phases of the TOGAF ADM.

The Motivation extension concepts within the ArchiMate Specification support the Requirements Management, Preliminary Phase, and Architecture Vision phases of the TOGAF ADM, which establish the high-level business goals, architecture principles, and initial business requirements. It is also relevant to the Architecture Change Management phase of the TOGAF ADM, since the phase deals with changing requirements.

The Implementation and Migration extension of the ArchiMate Specification adds concepts to support the implementation and migration of architectures through the Opportunities and Solutions, Migration Planning, and Implementation Governance phases of the TOGAF ADM.

2.9 Summary

This chapter has introduced the basic concepts of Enterprise Architecture and the ArchiMate modeling language. This has included answering questions, such as:

- “What is an enterprise?”
 - A collection of organizations that share a common set of goals, such as a government agency, part of a corporation, or a corporation in its entirety.
 - Large corporations may comprise multiple enterprises.
 - An “extended enterprise” can include partners, suppliers, and customers.
- “What is an architecture?”
 - An architecture is defined as “the fundamental organization of something, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution.”

The role of the ArchiMate Specification is to provide a language for describing Enterprise Architecture and also for visualizing Enterprise Architecture via ArchiMate models. It is a graphical modeling language with portable semantics. It also provides viewpoints tailored to different stakeholders. The TOGAF Standard and the ArchiMate modeling language complement each other with respect to process and language.

2.9.1 Key Concepts

This section contains a summary of the key concepts for this chapter together with the ArchiMate Specification reference.⁶

Concept	Reference
<p>Architecture</p> <ol style="list-style-type: none"> 1. A formal description of a system, or a detailed plan of the system at component level to guide its implementation. 2. The structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time. 	<p>TOGAF 9.1 §3.8 Architecture</p>
<p>Concerns</p> <p>The key interests that are crucially important to the stakeholders in a system, and determine the acceptability of the system. Concerns may pertain to any aspect of the system's functioning, development, or operation, including considerations such as performance, reliability, security, distribution, and evolvability.</p>	<p>TOGAF 9.1 §3.30 Concerns</p>
<p>Enterprise</p> <p>The highest level (typically) of description of an organization and typically covers all missions and functions. An enterprise will often span multiple organizations.</p>	<p>TOGAF 9.1 §3.34 Enterprise</p>
<p>Enterprise Architecture</p> <p>A description of organizational business operation and underlying IS/IT support for that operation. Use of architecture discipline at the most abstracted layers of an organization. Enterprise Architecture typically applies to ongoing communication and management of change and will typically comprise business structure, the IS/IT landscape, identification of strategic improvement opportunities, and identification of large-scale transformation activities.</p>	<p>TOGAF 9.1 §1.2 Executive Overview</p>
<p>Method</p> <p>A defined, repeatable approach to address a particular type of problem.</p>	<p>TOGAF 9.1 §3.46 Method</p>
<p>Model</p> <p>A representation of a subject of interest. A model provides a smaller scale, simplified, and/or abstract representation of the subject matter. A model is constructed as a "means to an end". In the context of Enterprise Architecture, the subject matter is a whole or part of the enterprise and the end is the ability to construct "views" that address the concerns of particular stakeholders; i.e., their "viewpoints" in relation to the subject matter.</p>	<p>TOGAF 9.1 §3.48 Model</p>

⁶ As noted in Chapter 1 of the ArchiMate Specification, the specification does not provide its own set of defined terms, but follows those provided by the TOGAF Standard. Any conflict between the concepts here and the applicable official TOGAF 9.1 definition is unintentional.

Concept	Reference
Stakeholder An individual, team, or organization (or classes thereof) with interests in, or concerns relative to, the outcome of the architecture. Different stakeholders with different roles will have different concerns.	TOGAF 9.1 § 3.68 Stakeholder

2.10 Recommended Reading

The following are recommended sources of further information for this chapter:

- *ArchiMate 2.1 Specification*, Chapter 1 (Introduction)
- *TOGAF 9.1*, Chapter 1 (Introduction)
- *Why Does Enterprise Architecture Matter?*, White Paper by Simon Townson, SAP⁷

2.11 Exercise 1: Enterprise Architecture Concepts

In your own words, provide short answers to these questions.

1. What is an architecture?

2. What is an enterprise?

3. What is the purpose of Enterprise Architecture?

4. When performing Enterprise Architecture activities, what audience are you working to satisfy?

5. When performing Enterprise Architecture activities, what are the things you are trying to address?

⁷ *Why Does Enterprise Architecture Matter?*, White Paper by Simon Townson, SAP, Wo76, December 2008, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/wo76.htm.

6. What is the relationship between the TOGAF Standard and the ArchiMate Specification?
-
-
-
7. (Refer to Chapter 2 of the ArchiMate 2.1 Specification) Complete the first column in the following table, by entering the relevant number(s) to identify the mapping of ArchiMate elements (layers and extensions) that are related to the phases of the TOGAF ADM. Each TOGAF phase may have *more than one* related ArchiMate element.

Mapping	TOGAF ADM Phase	ArchiMate Element
.....	Preliminary	1. Business Layer
.....	Architecture Vision	2. Application Layer
.....	Business Architecture	3. Technology Layer
.....	Information Systems Architecture: Application	4. Motivation Extension
.....	Information Systems Architecture: Data	5. Implementation and Migration Extension
.....	Technology Architecture	
.....	Opportunities & Solutions	
.....	Migration Planning	
.....	Implementation Governance	
.....	Architecture Change Management	
.....	Requirements Management	

2.12 Test Yourself Questions

- Q1: Which of the following best describes an enterprise?
- A. A collection of organizations with a common set of goals
 - B. A corporation with more than 10,000 employees
 - C. Any organization whose stock is traded
 - D. Any organization with an ecommerce site

- Q2: Which of the following best describes the purpose of an Enterprise Architecture?
- A. To enable an organization to exploit the latest trends in IT
 - B. To enable the CIO to provide effective control of the business units
 - C. To optimize processes into an integrated environment responsive to change and supportive of the business strategy
 - D. To provide a strict set of standards that all actors must adhere to
- Q3: Which of the following best describes the ArchiMate modeling language?
- A. It provides a uniform representation for diagrams describing Enterprise Architecture.
 - B. It includes an integrated approach for describing and visualizing different architecture domains and the relationships between them.
 - C. It represents Enterprise Architectures as they change over time.
 - D. It addresses different stakeholders.
 - E. All of the above.
- Q4: An extended enterprise might contain which of the following entities?
- A. Trading Partners
 - B. Customers
 - C. Suppliers
 - D. All of these are part of an extended enterprise.
- Q5: Which of the following is an advantage that results from Enterprise Architecture?
- A. Better return on existing investment
 - B. More efficient business operation
 - C. More efficient IT operation
 - D. All of these are advantages of Enterprise Architecture.
- Q6: Complete the sentence: One of the main benefits of Enterprise Architecture planning is that you can better understand
- A. systems and their dynamics
 - B. customers and their needs
 - C. applications and their interfaces
 - D. stakeholders and their concerns

- Q7: Complete the sentence: An architecture has who have concerns about the system being designed.
- A. architects
 - B. executives
 - C. shareholders
 - D. stakeholders
- Q8: Complete the sentence: Enterprise Architecture describes how and in what way information, information systems, and technology will support an organization's
- A. business model
 - B. business objectives and goals
 - C. strategy
 - D. IT strategy
- Q9: Which of the following phases of the TOGAF ADM does the Motivation extension of the ArchiMate modeling language address?
- A. Preliminary, Architecture Vision, Requirements Management, Architecture Change Management
 - B. Opportunities & Solutions, Migration Planning, Implementation Governance
 - C. Business Architecture, Information Systems Architectures, Technology Architecture
 - D. Preliminary, Business Architecture, Migration Planning
- Q10. Which of the following phases of the TOGAF ADM does the Implementation and Migration extension of the ArchiMate modeling language address?
- A. Preliminary, Architecture Vision, Requirements Management, Architecture Change Management
 - B. Opportunities & Solutions, Migration Planning, Implementation Governance
 - C. Business Architecture, Information Systems Architectures, Technology Architecture
 - D. Preliminary, Business Architecture, Migration Planning

Chapter 3

Enterprise Architecture Modeling using the ArchiMate Language

3.1 Key Learning Points

This chapter will help you understand and be able to explain the principles and core concepts of the ArchiMate modeling language and its extensions.

Key Points Explained

This chapter will help you to:

- Explain the structure and the ideas underlying the ArchiMate modeling language
- Identify the core concepts of the ArchiMate modeling language and their relationships
- Explain the aspects and layers in the ArchiMate Framework
- List the different types of architecture that the ArchiMate modeling language deals with
- Explain the basic structure of the ArchiMate Motivation extension and its relationship to the ArchiMate core concepts
- Explain the basic structure of the ArchiMate Implementation and Migration extension and its relationship to the ArchiMate core and motivation concepts



Attributes of an Architecture Modeling Language

An architecture modeling language should be able to provide a clear and unambiguous specification and description of an Enterprise Architecture's components and their relationships. It should be able to address the consistent alignment and facilitate a coherent modeling of Enterprise Architectures. The ArchiMate modeling language is designed to provide these capabilities.

3.2 Structure of the ArchiMate Modeling Language

(Syllabus Reference: Unit 2, Learning Outcome 1: You should be able to explain the structure and the ideas underlying the ArchiMate modeling language.)

A key challenge in the development of a general metamodel for Enterprise Architecture is to strike a balance between the specificity of languages for individual architecture domains, and a very general set of architecture concepts, which reflects a view of systems as a mere set of inter-related entities. Figure 7 shows that concepts can be described at different levels of specificity.



What is a Metamodel?

A model that describes in a structured way how and with what the architecture will be described.

[Adapted from: *TOGAF Version 9.1 Part 1, Chapter 3 (Definitions).*]

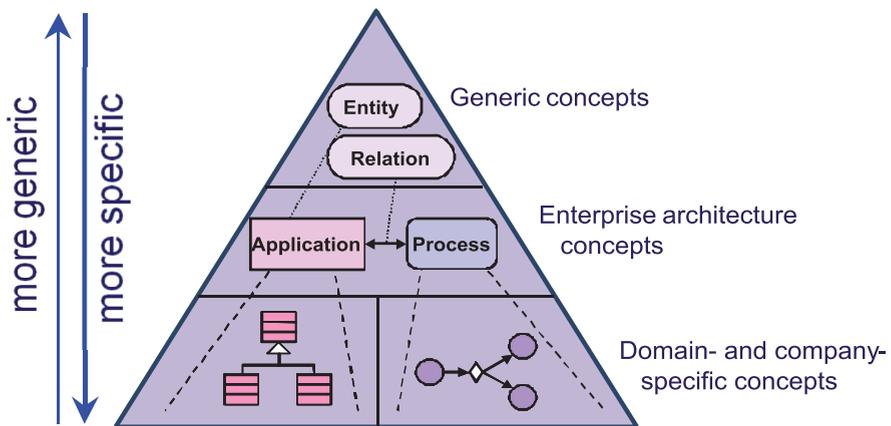


Figure 7: Metamodels at Different Levels of Specificity

At the base of the triangle we find the metamodels of the architecture modeling concepts used by specific organizations, as well as a variety of existing modeling languages and standards; UML is an example of a language in this category. At the top of the triangle we find the “most general” metamodel for system architectures, essentially a metamodel that merely comprises notions such as “entity” and “relation”.

The design of the ArchiMate modeling language started from a set of relatively generic concepts (entities and relations higher up in the pyramid), which have been specialized for application at the different architectural layers for an Enterprise Architecture.



ArchiMate Modeling Language Design

The most important design constraint on the ArchiMate modeling language is that it has been explicitly designed to be as compact as possible, yet still usable for most Enterprise Architecture modeling tasks. In the interest of simplicity of learning and use, the ArchiMate modeling language has been limited to the concepts that suffice for modeling the proverbial 80% of practical cases.

3.3 Core Concepts of the ArchiMate Modeling Language

(Syllabus Reference: Unit 2, Learning Outcome 2: You should be able to identify the core concepts of the ArchiMate modeling language and their relationships.)

The core language consists of three types of elements, as shown in Figure 8:

- Active structure elements
- Behavior elements
- Passive structure elements (objects)

These three aspects – active structure, behavior, and passive structure – are based upon natural language, where a sentence has a subject (active structure), a verb (behavior), and an object (passive structure). You can think of an ArchiMate model as conveying a narrative. This typically takes the form [subject doing action] + [verb] + [object receiving action]. Consider the following simple example. If we were to model the sentence “John reads a book”, then the verb “reads” is the behavior element. “John” (the subject) is doing the reading (the element that can act) so he is the active structure element. “A book” (the object) is the element that is consumed by the act of reading by John, so is the passive structure.

The three types of elements are as follows:

- **Active structure elements** are the elements that act (the subjects doing the action). They are the entities that are capable of performing behavior. Examples are the business actors, application components, and devices that display actual behavior; i.e., the subjects of activity as shown in the right side of Figure 8.
- **Behavior elements** are elements that represent the behavior of elements that act (the verb). They can be considered as a unit of activity performed by one or more **active structure elements**. These show who or what

performs the behavior for an **active structure element** construct as shown in the center of Figure 8. Examples are processes, functions, and services.

- **Passive structure elements** are elements that cannot act but are acted upon by the behavior elements as shown in the left side of Figure 8. They are usually information or data objects (for example, contracts and artifacts), and can also represent physical objects.

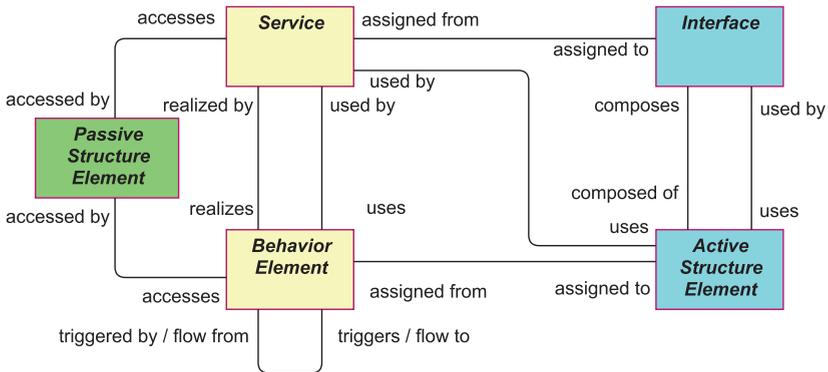


Figure 8: Generic Metamodel: The Core Concepts of the ArchiMate Modeling Language



Conventions for the Use of Labels in the Metamodel Diagrams

In the metamodel diagrams within the ArchiMate Specification and this book, elements and objects are presented by rectangles with lines between them to show the relationships. The relationships are labeled and the words closest to an object are associated with the object's relationship to the object at the far end of a line. So, in Figure 8, the Behavior Element “uses” a Service and also “realizes” a Service.

Conventions for the Use of Colors

In the metamodel diagrams within this book (and also the ArchiMate Specification), colors are used to distinguish concepts belonging to the different types of elements: green is used for passive structure, yellow for behavior, and blue for active structure (see also the ArchiMate Framework in Section 3.7).

It should be noted that this use of color differs for ArchiMate models, where in general the use of color is less formal and left down to the modeler. In some cases color can be used to distinguish between layers of the ArchiMate Framework (see Sections 3.6 and 3.7), and this approach is used within many of the models in this book. It can also be used for visual emphasis. A recommended text providing guidelines is *Enterprise Architecture at Work*, by Marc Lankhorst et al (Chapter 6).

In addition to the three aspects (active structure, behavior, and passive structure), the ArchiMate Specification makes a distinction between an external view and an internal view of a system by defining *service* and *interface*:

- A **service** is defined as a unit of functionality that a system exposes to its environment which provides a certain value. The **service** is the externally visible behavior of the providing system. For users of the service only the exposed functionality and value are relevant. **Services** are accessible through **interfaces**.
- An **interface** is defined as a point of access where one or more services are made available to the environment. **Interfaces** constitute the external view on **active structure elements**, and provide access to **services**.

3.4 Collaboration and Interaction

Going one level deeper in the structure of the language, there is a distinction between behavior that is performed by a single structure element (e.g., actor, role component, etc.), or collective behavior (interaction) that is performed by a collaboration of multiple structure elements.

A **collaboration** is defined as a (temporary) grouping (or aggregation) of two or more structure elements, working together to perform some collective behavior.

Collective behavior can be modeled as an **interaction**. An interaction is defined as a unit of behavior performed by a collaboration of two or more structure elements.

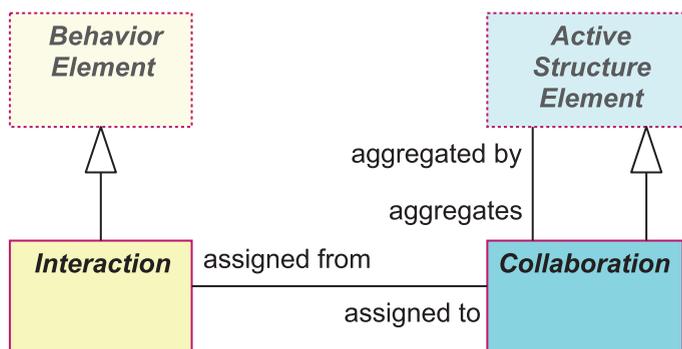


Figure 9: Collaboration and Interaction

3.5 Relationships

Along with the core concepts outlined so far in this chapter, the ArchiMate modeling language contains a core set of relationships, as shown in Table 4. A relationship shows how two or more elements of the language are connected. Several of these relationships have been adopted from corresponding relationship concepts that occur in existing standards; for example, composition, aggregation, association, and specialization are taken from UML 2.0, while triggering is used in many business process modeling languages.

Table 4: Summary of Core Relationships

Relationship	Description
Association 	Association models a relationship between objects that is not covered by another, more specific relationship.
Access 	The access relationship models the access of behavioral concepts to business or data objects.
Used by 	The used by relationship models the use of services by processes, functions, or interactions and the access to interfaces by roles, components, or collaborations.
Realization 	The realization relationship links a logical entity with a more concrete entity that realizes it.
Assignment 	The assignment relationship links units of behavior with active elements (e.g., roles, components) that perform them, or roles with actors that fulfill them.
Aggregation 	The aggregation relationship indicates that an object groups a number of other objects.
Composition 	The composition relationship indicates that an object is composed of one or more other objects.
Flow 	The flow relationship describes the exchange or transfer of, for example, information or value between processes, function, interactions, and events.
Triggering 	The triggering relationship describes the temporal or causal relationships between processes, functions, interactions, and events.

Relationship	Description
Grouping 	The grouping relationship indicates that objects, of the same type or different types, belong together based on some common characteristic.
Junction 	A junction is used to connect relationships of the same type.
Specialization 	The specialization relationship indicates that an object is a specialization of another object.

A number of relationships are introduced in the example in the next section and subsequent chapters. Detailed information on relationships provided in Chapter 8.

3.6 Layering

The ArchiMate modeling language defines three layers – Business, Application, and Technology – based on specializations of the core concepts described in Section 3.3 and 3.4. A layered view provides a natural way to look at service-oriented models. The higher layers make use of services that are provided by the lower layers as shown in the example model in Figure 10.

The following example shows a high-level overview of the systems, applications, and processes in place to handle insurance claims at the ArchiSurance company.



Example of the Use of Layers in an ArchiMate Model

The following example is primarily for illustration of the use of layers in an ArchiMate model. However, as it is also the first ArchiMate model in this book, we explore some of the elements in more detail. You are not expected to fully understand the details of the model at this stage as it uses elements and relationships that have not yet been introduced in this book.

In this example, the model has been structured and colors have been used for visual emphasis. Elements in the model have been structured in terms of layers with separate internal and external behavior identified. Colors have been used to emphasize similarity.

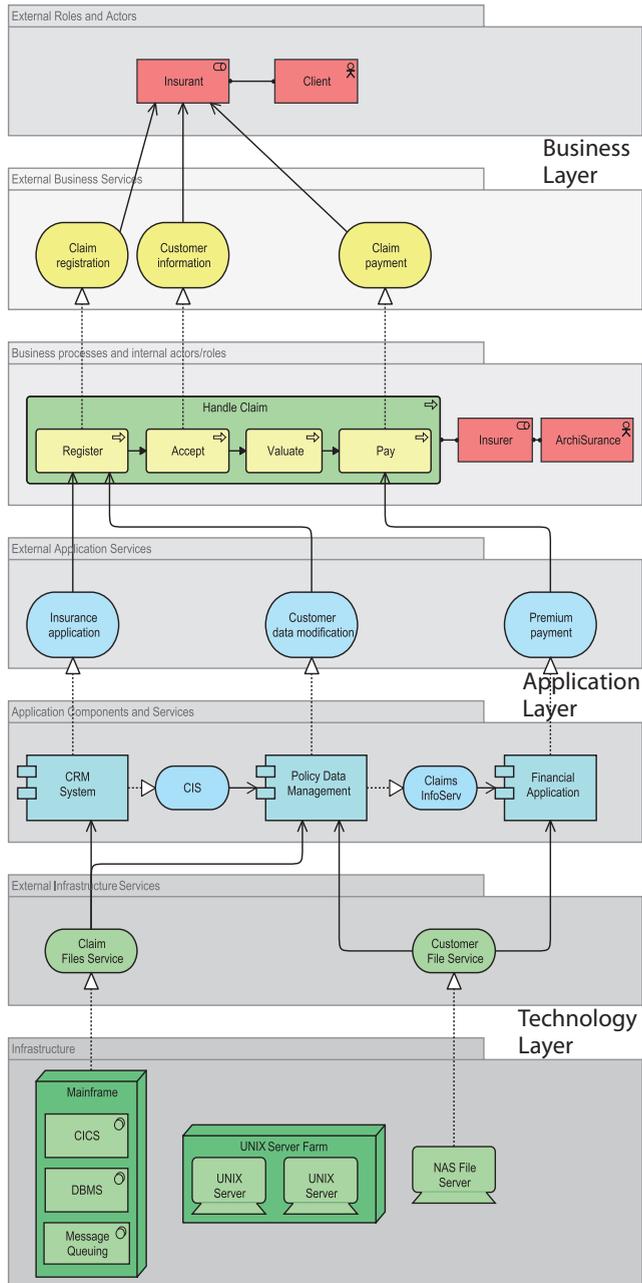


Figure 10: Example Layered Model

The **Business Layer** offers products and services to external customers, which are realized in the organization by business processes performed by business actors.

Figure 11 is a part of the Business Layer from Figure 10, showing how the business process “Handle Claim” is composed of a series of business processes that trigger each other (shown by triggering relationships). These business processes are assigned to (performed by) the role “Insurer” which is itself assigned to the business actor “ArchiSurance” (shown by assignment relationships). The Business Layer is described in detail in Chapter 4. (Red labels are used in this figure and other figures in this book as an aid to readers to highlight new and key concepts introduced into this book).

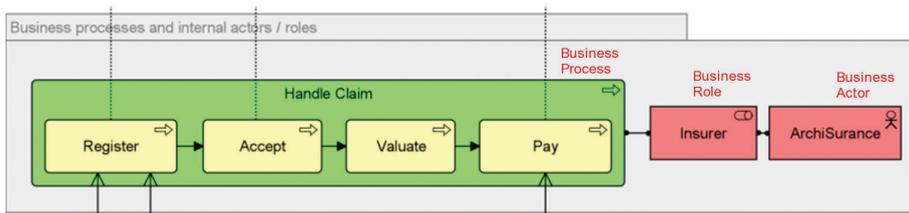


Figure 11: Example Business Layer – Processes, Role, and Actor

The **Application Layer** supports the Business Layer with application services, which are realized by (software) applications (this example uses application components). This example shows two types of application services: those that support the Business Layer (the external application services, such as the “Insurance application” service) and those that are used internally by application components (such as the “Claims InfoServ” service). The Application Layer is described in detail in Chapter 5.

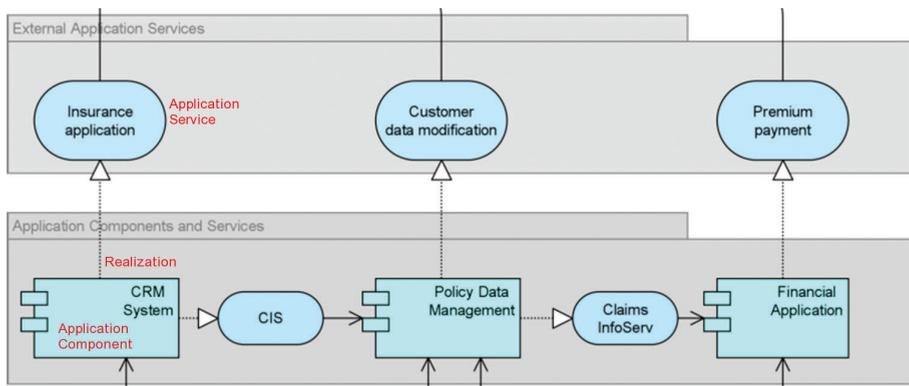


Figure 12: Example Application Layer – Application Services and Components

The **Technology Layer** offers infrastructure services (e.g., processing, storage, and communication services) needed to support applications, realized by computer and communication hardware and system software. The Technology Layer is described in Chapter 6.

In this example, the “Customer File Service” (an infrastructure service) used by the “Policy Data Management” and “Financial Application” components is realized by a NAS File Server (a device). The realization relationship shows how a logical entity such as service is given physical form, in this case by a device.

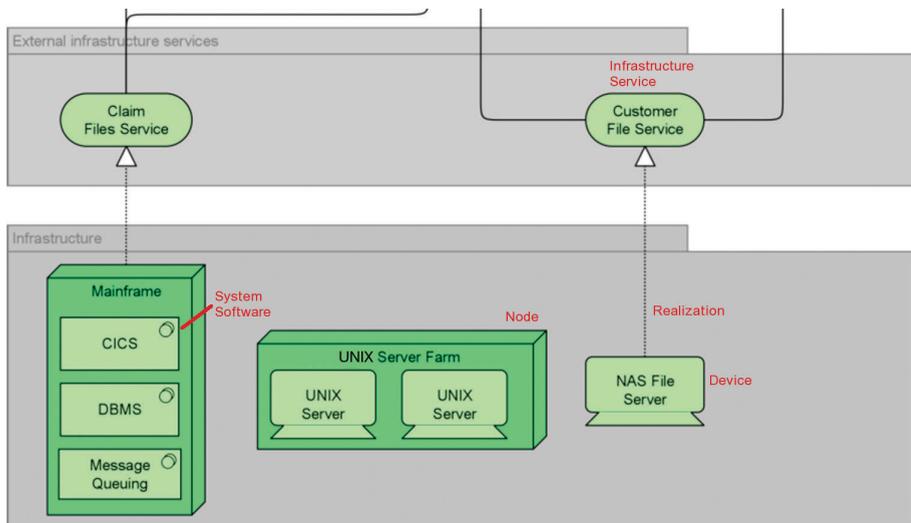


Figure 13: Example Technology Layer – Technology Services, Hardware, and Software

The general structure of models within the different layers can be similar. The same types of concepts and relationships are often used, although their exact nature and granularity differ. The two major relations between layers are “realization” by passive objects and “used by” for services and interfaces.

The “used by” relationships show how the higher layers make use of the services of lower layers. The element at the end without the arrow head is used by the element at the end with the arrow head. In Figure 14, which is an extract from the model in Figure 10, the “Customer File Service” (Technology Layer service) is used by the “Policy Data Management” and “Financial Application” components.

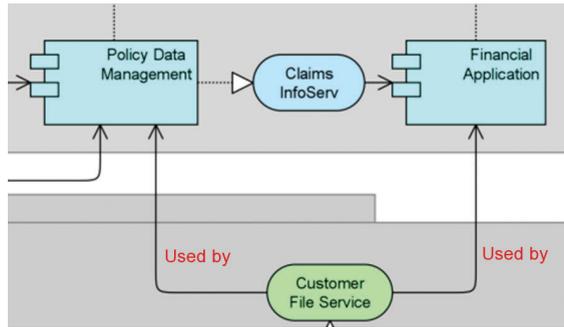


Figure 14: Example Used-By Relation – Technology to Application Layer

Figure 15 shows a separate example of a “used by” relationship, with an application interface being used by a business role.

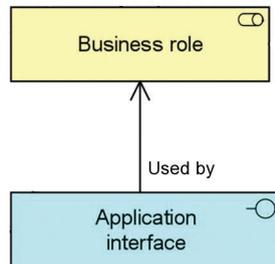


Figure 15: Example Used-By Relation – Application to Business Layer

Another common link between layers can be formed by realization relationships: elements in lower layers realize comparable elements in higher layers. For example, as shown in Figure 16 “Data object” (Application Layer) can realize a “Business object” (Business Layer); or an “Artifact” (Technology Layer) can realize a “Data object” (Application Layer).

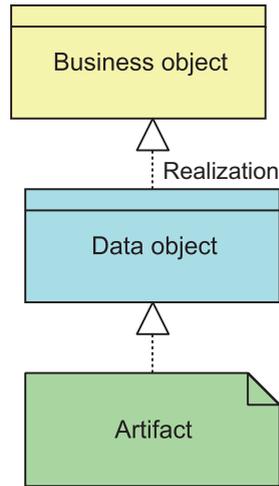


Figure 16: Example Realization Relation – Multiple Layers

3.7 The ArchiMate Framework

The aspects (passive structure, behavior, and active structure) and layers (business, application, and technology) identified in the previous sections can be organized as a framework of nine cells, as illustrated in Figure 17.

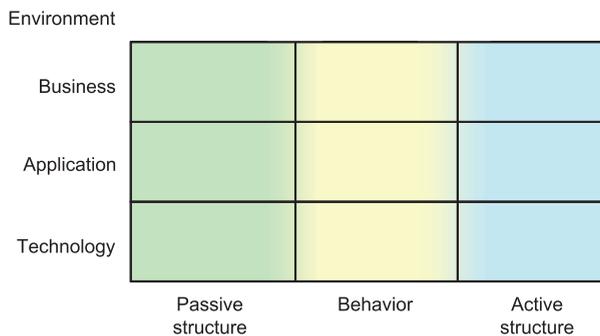


Figure 17: ArchiMate Framework

The structure of the framework allows for modeling of the enterprise from different viewpoints, where the position within the cells highlights the concerns of the stakeholder. A stakeholder typically can have concerns that cover multiple cells.

The dimensions of the framework are as described below.

- **Layers:** The three abstraction levels at which an enterprise can be modeled – Business, Application, and Technology.

- The **Business Layer** offers products and services to external customers, which are realized in the organization by business processes.
 - The **Application Layer** supports the Business Layer with application services which are realized by (software) applications.
 - The **Technology Layer** offers infrastructure services (e.g., processing, storage, and communication services) needed to support applications, realized by computer and communication hardware and system software.
- **Aspects:**
 - The **active structure** aspect represents the structural concepts (the business actors, application components, and devices that display actual behavior; i.e., the “subjects” of activity).
 - The **behavior** aspect represents the behavior (processes, functions, events, and services) performed by the actors. Behavioral concepts are assigned to structural concepts, to show who or what displays the behavior.
 - The **passive structure** aspect represents the objects on which behavior is performed. These are usually information objects in the Business Layer and data objects in the Application Layer, but they may also be used to represent physical objects.

The concepts of the three layers can be mapped to the framework, as shown in Figure 18. Details of the concepts are provided in Chapter 4, Chapter 5, and Chapter 6.

Environment			
Business	Business Object Representation Product Meaning Contract Value	Business Process Business Function Business Interaction Business Service Business Event	Business Actor Business Collaboration Location Business Role Business Interface
Application	Data Object	Application Function Application Interaction Application Service	Application Component Application Collaboration Application Interface
Technology	Artifact	Infrastructure Function Infrastructure Service	Node Device Network System Software Communication Path Infrastructure Interface
	Passive structure	Behavior	Active structure

Figure 18: ArchiMate Framework with Concepts

Besides the three aspects shown in Figure 17 (passive structure, behavior, and active structure), which are mainly operational in nature, an Enterprise Architect touches upon numerous other aspects in the course of his/her work that are not explicitly covered by the ArchiMate Framework, some of which may cross several (or all) of the layers. An example is Motivation (now addressed by the Motivation extension) which could be represented as a fourth aspect crossing the layers. Other examples include:

- Goals, principles, and requirements
- Risk and security
- Governance
- Policies and business rules
- Costs
- Performance
- Timing
- Planning and evolution

Not all of these aspects can be completely covered using the standard language extension mechanisms. In order to facilitate the work of tool vendors and methodology experts in providing support for additional aspects within the overall ArchiMate modeling language, specific extensions can be added. Modular extensions can add new language concepts, relationships, or attributes, while complying with the core design goal: to be as compact as possible.

3.8 ArchiMate Modeling Language Extensions

The ArchiMate Specification includes two extensions: the **Motivation** extension and the **Implementation and Migration** extension (see Section 2.8.1, Chapter 11, and Chapter 12).

3.8.1 The Motivation Extension

(Syllabus Reference: Unit 2, Learning Outcome 4: You should be able to explain the basic structure of the ArchiMate Motivation extension and its relationship to the ArchiMate core concepts.)

The Motivation extension of the ArchiMate Specification includes the motivational concepts such as goal, principle, and requirement. It addresses the way the Enterprise Architecture is aligned to its context, as described by motivational elements. In addition, the Motivation extension includes the concepts of stakeholders, drivers, and assessments.

**Motivational Element**

A motivational element is defined as an element that provides the context or reason lying behind the architecture of an enterprise.

The main reason to introduce motivational concepts in the ArchiMate modeling language is to support requirements management and to support the Preliminary Phase and Phase A (Architecture Vision) of the TOGAF ADM, which establish the high-level business goals, architecture principles, and initial business requirements.

Requirements management is an important activity in the process of designing and managing Enterprise Architectures. Goals from various stakeholders form the basis for any change to an organization. These goals need to be translated into requirements on the organization's architecture. This architecture should reflect how the requirements are realized by services, processes, and software applications in the day-to-day operations.

Figure 19 depicts the relationship between core and motivational elements in the ArchiMate modeling language. The upper section shows that the core elements of an architectural description are related to motivational elements via requirements. The lower section shows that a business actor may be assigned to a stakeholder, which can be seen as a motivational role (as opposed to an operational business role) that an actor may fulfill.

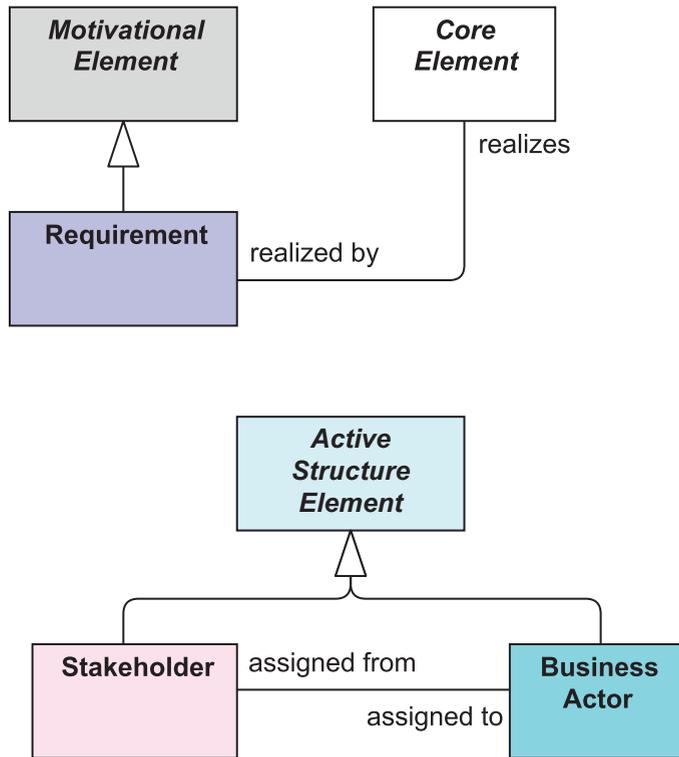


Figure 19: Relationship between Core and Motivational Elements in the ArchiMate Modeling Language

3.8.2 The Implementation and Migration Extension

(Syllabus Reference: Unit 2, Learning Outcome 5: You should be able to explain the basic structure of the ArchiMate Implementation and Migration extension and its relationship to the ArchiMate core concepts.)

The Implementation and Migration extension of the ArchiMate modeling language adds concepts to support the TOGAF ADM phases related to the implementation and migration of architectures (Phases E, F, and G). This extension includes concepts for modeling implementation programs and projects to support program, portfolio, and project management, and a plateau concept to support migration planning.

The extension aims at covering the main concepts of program and project management standards and best practices, such as MSP, PRINCE2, and *PMBOK Guide*. Concepts that are specific to one of these methods are not part of the extension, but may be defined as specialization of the generic

concepts. In this way, the set of concepts and relationships that are defined in the extension is kept at a minimum.



MSP, PRINCE2, and PMBOK Guide

MSP is the Managing Successful Programs (MSP) methodology. PRINCE2 is an acronym for Projects IN Controlled Environments, which is a standard project management method. *PMBOK Guide* is the Project Management Body of Knowledge from the Project Management Institute (PMI).

Figure 20 depicts the relationship between concepts from the Implementation and Migration extension and concepts from the ArchiMate core and Motivation extension.

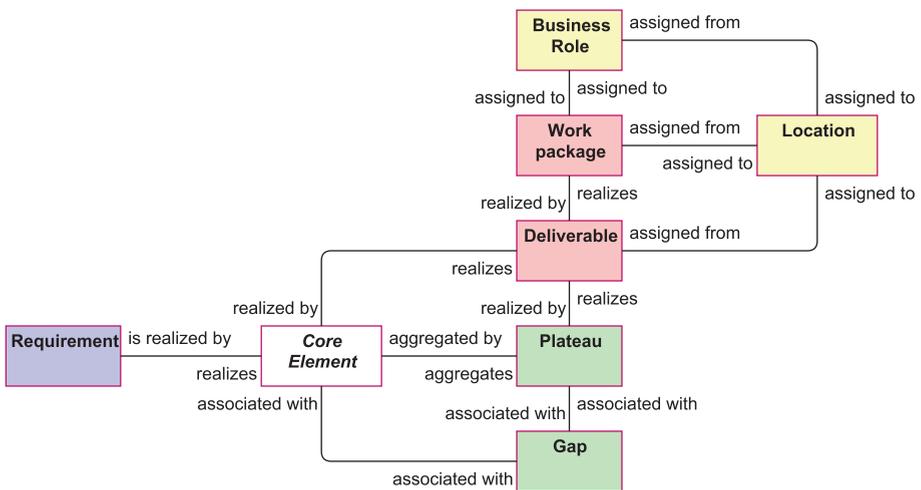


Figure 20: Relationship between Motivational, Core, and Implementation and Migration Elements in the ArchiMate Modeling Language

A *deliverable* may realize core elements within an architecture. A *gap* may be associated with any number of core elements. A *work package* realizes requirements indirectly through the realization of core elements (e.g., an application component, business process, or service). A *location* may be assigned to work packages and deliverables.

Also, core elements are linked to the other concepts of the Motivation extension by means of derived relationships. The possible relationships

among implementation and migration, core, and motivational elements are explained in more detail in Chapter 10 and Chapter 11 of the specification.

3.9 Summary

This chapter has introduced the fundamental concepts of the ArchiMate modeling language. This has included the following:

- The ArchiMate modeling language is designed to enable modeling at different levels of specificity.
- The core language models active structure elements, behavior elements, and passive structure elements.
- Elements can interact and collaborate.
- Elements have relationships of different types.
- The ArchiMate Specification defines three layers: Business, Application, and Technology.
- The ArchiMate Framework classifies the concepts of the ArchiMate modeling language.
- The ArchiMate Motivation extension can be used to model the principles, drivers, goals, and requirements of the architecture.
- The Implementation and Migration extension is used to stage the work packages that are needed to implement the architecture.

3.9.1 Key Concepts

This section contains a summary of the key concepts for this chapter together with the ArchiMate Specification reference.

Concept	ArchiMate 2.1 Specification Reference
Active Structure Element An entity that is capable of performing behavior.	§2.2 Core Concepts
Application Layer Supports the Business Layer with application services which are realized by (software) applications.	§2.5 Layering
ArchiMate Core Part of the ArchiMate modeling language that defines the concepts and relationships to model the actual architectures.	§2.2 Core Concepts

Concept	ArchiMate 2.1 Specification Reference
<p>ArchiMate Framework Framework to classify the concepts of the ArchiMate modeling language. It consists of a core framework with three layers and three aspects, and two extensions.</p>	§2.6 ArchiMate Framework
<p>Attribute Data element within a profile that describes a specific property of an ArchiMate concept or relationship.</p>	§9.1 Adding Attributes to ArchiMate Concepts and Relationships
<p>Behavior Element A unit of activity performed by one or more active structure elements.</p>	§2.2 Core Concepts
<p>Business Layer Offers products and services to external customers, which are realized in the organization by business processes performed by business actors.</p>	§2.5 Layering
<p>Collaboration A (temporary) grouping (or aggregation) of two or more structure elements, working together to perform some collective behavior.</p>	§2.3 Collaboration and Interaction
<p>Core Element Generic concept that may refer to any of the concepts in the ArchiMate Core.</p>	§2.2 Core Concepts
<p>Implementation and Migration Extension Extension of ArchiMate that adds concepts to support the phases in the architecture development cycle related to the implementation and migration of architectures.</p>	§2.8 Implementation and Migration Extension
<p>Interaction A unit of behavior performed by a collaboration of two or more structure elements.</p>	§2.3 Collaboration and Interaction
<p>Interface A point of access where one or more services are made available to the environment.</p>	§2.2 Core Concepts
<p>Metamodel A model that describes how and with what the architecture will be described in a structured way.</p>	TOGAF 9.1 §3.45 Metamodel
<p>Motivation Extension The extension of the ArchiMate modeling language that adds motivational concepts to address the way the Enterprise Architecture is aligned to its context.</p>	§2.7 Motivation Extension

Concept	ArchiMate 2.1 Specification Reference
Motivational Element An element that provides the context or reason lying behind the architecture of an enterprise.	§2.7 Motivation Extension
Passive Structure Element An object on which behavior is performed.	§2.2 Core Concepts
Profile A data structure which can be defined separately from the ArchiMate modeling language, but can be dynamically coupled with concepts or relationships.	§9.1 Adding Attributes to ArchiMate Concepts and Relationships
Service A unit of functionality that a system exposes to its environment, while hiding internal operations, which provides a certain value (monetary or otherwise).	§2.2 Core Concepts
Technology Layer Offers infrastructure services needed to run applications, realized by computer and communication hardware and system software.	§2.5 Layering

3.10 Recommended Reading

The following are recommended sources of further information for this chapter:

- ArchiMate 2.1 Specification, Chapter 2
- ArchiMate Language Primer

3.11 Exercise 2: ArchiMate Core Concepts

1. Complete the first column in the following table, by entering the relevant number to identify the mapping of ArchiMate layer concepts to ArchiMate Framework aspects. Each layer concept should map to only one framework aspect.

Mapping	ArchiMate Layer Concept	ArchiMate Framework Aspect
.....	Business Actor	1. Passive Structure
.....	Application Service	2. Behavior
.....	Artifact	3. Active Structure
.....	Contract	

Mapping	ArchiMate Layer Concept	ArchiMate Framework Aspect
.....	Device	
.....	Location	
.....	Infrastructure Service	
.....	Product	
.....	Business Object	
.....	Business Interaction	
.....	Data Object	

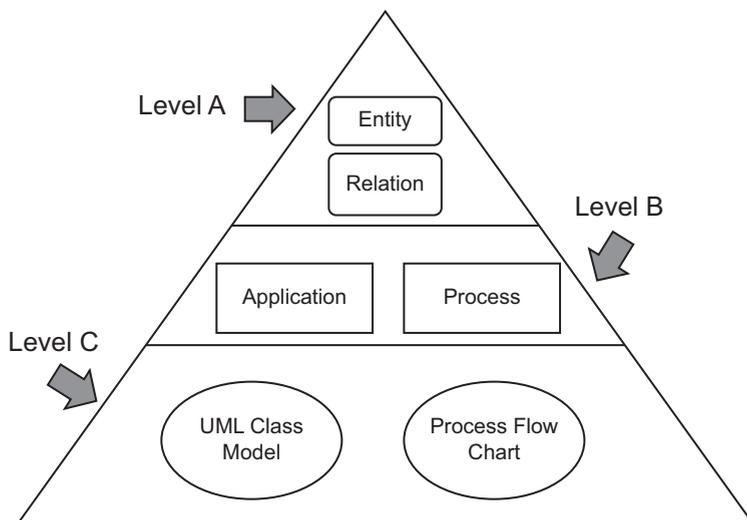
2. Refer to Sections 3.5, 4.5, 5.5, and 7.5 of the ArchiMate Specification. Match the term in column 3 to its associated concept in column 2.

Answer	Concept	Term
.....	Provides the context or reason lying behind the architecture of an enterprise.	A. Trigger
.....	A unit of activity performed by one or more active structure elements.	B. Motivation
.....	A point of access where one or more services are made available.	C. Active Structure Element
.....	Offers products and services to external customers.	D. Used By
.....	A relationship used in business process modeling to initiate events.	E. Behavior Element
.....	Shows how the higher layers make use of the services of lower layers.	F. Collaboration
.....	An entity that is capable of performing behavior.	G. Service
.....	Working together to perform some collective behavior.	H. Interface
.....	A unit of behavior performed by a collaboration of two or more structure elements.	I. Business Layer
.....	A unit of functionality that a system exposes to its environment while hiding internal operations.	J. Interaction

3.12 Test Yourself Questions

- Q1: Complete the sentence: The ArchiMate modeling language has been designed to balance
- A. complexity and simplicity
 - B. elegance and efficiency
 - C. generic concepts and specific concepts
 - D. graphical images and textual description
- Q2: Complete the sentence: If we model the sentence “Janet paints a picture”, the subject “Janet” would go into
- A. Active structure
 - B. Behavior
 - C. Passive structure
- Q3: Complete the sentence: A service is defined as
- A. the entities that are capable of performing behavior
 - B. a unit of functionality that a system exposes to its environment
 - C. a point of access
 - D. information or data objects
- Q4: Complete the sentence: In the ArchiMate modeling language collective behavior is modeled as a(n)
- A. collaboration
 - B. interaction
 - C. interface
 - D. relationship
- Q5: Which layer in the ArchiMate Framework offers infrastructure services realized by computer and communication hardware and system software?
- A. Business Layer
 - B. Application Layer
 - C. Information Layer
 - D. Technology Layer

- Q6: Which aspect of the ArchiMate Framework includes business actors, application components, and devices?
- A. Active structure
 - B. Behavior
 - C. Informational concepts
 - D. Passive structure
- Q7: Which of the following is a behavioral concept?
- A. Application Function
 - B. Business Actor
 - C. Application Component
 - D. Artifact
- Q8: Which of the following statements correctly describes a relationship between a core language and motivation element in the ArchiMate modeling language?
- A. A business actor can be assigned from a stakeholder.
 - B. A requirement realizes a core element.
 - C. A structure element can realize a stakeholder.
 - D. A stakeholder realizes a core element.
- Q9: The following diagram illustrates metamodels at different levels of specificity:



Which of the following describes the level(s) that the ArchiMate modeling language is principally aimed at?

- A. Levels A and B
- B. Levels B and C
- C. Level B only
- D. All the levels