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BCS Intermediate Certificate in Enterprise and Solution Architecture Syllabus

**Version 4.4
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This qualification is not regulated by the following United Kingdom Regulators - Ofqual, Qualification in Wales, CCEA or SQA

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Change History

Any changes made to the syllabus shall be clearly documented with a change history log. This shall include the latest version number, date of the amendment and changes made. The purpose is to identify quickly what changes have been made.

Version Number and Date	Changes Made
Version 4.4 December 2016	Strapline regarding regulated statement has been added
Version 4.3 March 2015	Updated language requirements for additional time and use of dictionaries. Changed the format of the syllabus so that it reflects the standard format. Standardised the trainer requirements
Version 4.2 October 2013	Trainer requirements added to show minimum pass rate
V4.1 July 2012	Added in details of extra time for foreign language candidates
V4.0 January 2012	Updated Page 9 pre-requisites for Practitioner entry level – previously stated candidates needed to have attended the ‘course’ should say candidates have passed the Intermediate exam prior to taking the Practitioner. Changed ISEB for BCS logos and removed ISEB from syllabus.
V3.0 October 2010	Added more information to Data Classification Category. Changed the pass rate on Practitioner level from 60% (24/40) to 26/40. Changed Distinction level on Practitioner level from 80% to N/A. Added Change Log in the main body of the syllabus.
V2.0 July 2010	Added in trainer criteria for new trainers. This is not a retrospective requirement. Effective July 2010.
V1.1 January 2010	Signed off and approved.

Background

This document is the syllabus for the BCS Practitioner Certificate in Enterprise and Solution Architecture, as administered by the BCS, The Chartered Institute for IT. The syllabus in this document defines the scope of BCS examinations in Enterprise and Solution Architecture.

It is designed to help:

- Candidates to understand terms and concepts in examination questions
- Accredited Training Organisations to scope training courses that lead to the exams
- Examiners to scope examination questions

Examination questions and associated training are based on the terms that are listed in one syllabus and defined in the companion reference model. Each term is classified as Foundation, Intermediate or Practitioner level. Each level of certification embraces the level below. So, while there is no foundation level examination, there are many foundation level concepts, and these may appear in intermediate and practitioner level examinations. It is expected that candidates will understand most if not all the foundation-level concepts before attending a training course. And that Accredited Training Organisations may cover foundation-level concepts - relatively briefly.

Objectives

The primary aims of the BCS examinations and associated training are to give enterprise and solution architects a broad framework that covers the range of architecture work that precedes and steers system development, and to focus attention on areas where the architect is responsible for effective design and risk management.

A secondary aim is to provide architects with generally applicable knowledge and training. General here means independent of any specific architecture framework (Gartner, TOGAF, etc.). This enables Accredited Training Organisations to teach general knowledge and skills, rather than framework-specific terms, concepts, structures and processes.

Holders of the Intermediate Certificate will have demonstrated their knowledge and understanding of:

- different kinds of architecture and the roles architects play in the IT/IS industry
- the business context, and the importance of business-IT alignment
- architecture precursors: goals, directives and constraints
- architecture development process and description frameworks
- business architecture concepts and techniques
- data architecture concepts and techniques
- applications architecture concepts and techniques
- solution design to meet non-functional requirements
- infrastructure architecture as a process to support applications architecture.

Intermediate level training and examinations cover the most of the syllabus at a remembering and understanding level.

Eligibility for the Examination

It is recommended that candidates have 3 years or more experience of IS/IT work including some contact with architects and architecture descriptions.

Duration and Format of the Course

Candidates can study for this certificate in two ways: by attending a training course provided by an Accredited Training Organisation or by self-study. An accredited training course will require a minimum of 19 hours of study run over a minimum of 3 days.

The course can be delivered a number of different ways from traditional class-room based training to online e-learning.

Duration and Format of the Examination

The format for the examination is a one-hour multiple-choice examination. The examination is closed book i.e.no materials can be taken into the examination room. The pass mark is 26/40.

Additional time for candidates requiring Reasonable Adjustments due to a disability

Candidates may request additional time if they require reasonable adjustments. Please refer to the [reasonable adjustments policy](#) for detailed information on how and when to apply.

Additional time for candidates whose language is not the language of the examination

If the examination is taken in a language that is not the candidate's native / official language then they are entitled to 25% extra time.

If the examination is taken in a language that is not the candidate's native / official language then they are entitled to use their own **paper** language dictionary (whose purpose is translation between the examination language and another national language) during the examination. Electronic versions of dictionaries will **not** be allowed into the examination room.

The candidate registration form asks for the candidate's business language, if this is not English then BCS will automatically allocate additional time.

Reference Model

The reference model associated with the syllabus defines terms in just sufficient detail to help:

- Candidates to understand terms and concepts in examination questions
- Accredited Training Organisations to be consistent with the syllabus and each other
- Examiners to phrase examination questions and answers

Accredited Training Organisation Guidance

Each major subject heading in the syllabus is assigned an allocated time. The purpose of this is to give both guidance on the relative proportion of time to be allocated to each section of an accredited course and an approximate minimum time for the teaching of each section. Accredited Training Organisations may spend more time than is indicated and candidates may spend more time again in reading and research.

The course may be delivered as a series of modules with gaps between them, as long as it meets all other constraints. Courses do not have to follow the same order as the syllabus.

The syllabus contains references to established standards. The use of referenced standards in the preparation of training material is mandatory. Each standard used must be the version quoted in the current version of this syllabus.

Training materials should be consistent with the terms and definitions contained in the syllabus and reference model. Accredited Training Organisations may use sources that use the same terms with different meanings, but should in this case explain any terminology clashes to candidates.

Accredited Training Organisations are free to decide:

- the "process" that candidates are taught at the Intermediate level and apply to the case study in the practitioner level, and
- the notations used in architecture models and descriptions.

An Intermediate training course should lightly introduce the topics in Sections 10 and 11, but no exam questions will be set.

On the breadth of an architect's role

Architect roles are broad, and the enterprise or solution architect must be a generalist. No syllabus, training course or examination can be enough to make an architect. The role requires extensive experience on a variety of projects.

In this document, the terms "architect" and "architecture" apply principally to Enterprise and Solution Architects working in relation to Information Systems and Technologies. The role played by architects in these roles is broad – spanning the spectrum from business concerns to information technologies.

Note especially that while most sections of the syllabus are divided into Foundation, Intermediate or Practitioner levels, each level of certification embraces the level below. So, while there is no foundation level examination, there are many foundation level concepts, and these may appear in intermediate and practitioner level examinations. It is expected that candidates will understand most if not all the foundation-level concepts before attending a training course. And that Accredited Training Organisations may cover foundation-level concepts – relatively briefly.

This means they remember and understand all the terms defined in the syllabus, at all levels. In addition:

- **3 ARCHITECTURE PRECURSORS:** The Practitioner should be able to define SMART goals and business cases, and identify risks relating to non-functional requirements.
- **4 ARCHITECTURE FRAMEWORKS:** The Practitioner should be aware of alternative frameworks and comprehend one framework in more depth.
- **5 BUSINESS ARCHITECTURE:** The Practitioner should be able to describe business architecture building blocks, models and views.
- **6 DATA ARCHITECTURE:** The Practitioner should be able to describe data architecture building blocks, models and views.
- **7 APPLICATIONS ARCHITECTURE:** The Practitioner should be able to describe an applications architecture.
- **8 SOLUTION DESIGN FOR NFRS:** The Practitioner should be able to design or redesign a solution to meet non-functional requirements.
- **9 INFRASTRUCTURE ARCHITECTURE:** The Practitioner should be able to outline an infrastructure in sufficient detail for technical/infrastructure architects to complete.
- **10 MIGRATION PLANNING:** The Practitioner should be able to plan an architecture migration, alongside managers using standard management planning processes.
- **11 ARCHITECTURE MANAGEMENT:** The Practitioner should be able to govern the implementation of an architecture.

Levels of Knowledge / SFIA Levels

This course will provide candidates with the levels of difficulty / knowledge skill highlighted within the following table, enabling them to develop the skills to operate at the levels of responsibility indicated.

The levels of knowledge and SFIA levels are explained in on the website www.bcs.org/levels

The levels of knowledge above will enable candidates to develop the following levels of skill to be able to operate at the following levels of responsibility (as defined within the SFIA framework) within their workplace:

Level	Levels of Knowledge	Levels of Skill and Responsibility (SFIA)
K7		Set strategy, inspire and mobilise
K6	Evaluate	Initiate and influence
K5	Synthesise	Ensure and advise
K4	Analyse	Enable
K3	Apply	Apply
K2	Understand	Assist
K1	Remember	Follow

Question Weighting and Course Timings

Section Number	Section Title	Training Hours	Avg. target number of questions per paper
1	Architecture and Architects	2.5	4
2	Architecture and Precursors	3	6
3	Architecture Frameworks	2.5	5
4	Business Architecture	2.5	5
5	Data Architecture	1	3
6	Component Architecture	2	5
7	Applications Architecture	2	4
8	Design for NFRs	1.5	3
9	Infrastructure Architecture	1.5	5
10	Migration Planning	0.25	
11	Architecture Management	0.25	
	Total Number of Questions	19	40

Mapping the Intermediate Level to Bloom's taxonomy

The relevant levels in Bloom's taxonomy are Level 1 - Remembering and 2 Understanding. An Intermediate Enterprise or Solution Architect should be at Bloom Level 2 for all Sections 1 to 9. This means they remember and understand all the terms defined in the syllabus at Foundation and Intermediate Levels.

Syllabus

1. Architecture and Architects

Recognise the work and roles involved in describing the architecture (the high-level design) of business systems and the information systems that support them. (Not, in this context, work and roles related to buildings).

Foundation Learning Objectives

Recognise the ways base terms like architecture, system, structure, behaviour, interface, service and function are used in the BCS reference model (and so, examination question wording).

Intermediate Learning Objectives

Architecture granularity

Distinguish the following three levels of granularity in architecture definition: Enterprise, Solution(s) and Software.

Architecture domains

Recognise the need for separation of concerns. Recognise that architecture descriptions are sliced into high-level views to address the separate concerns of different stakeholders. Distinguish the following four broad perspectives: Business, Information/Data, Applications and Technology/Infrastructure.

Hierarchical or layered architecture

Recognise division into layers as a fundamental and widely-used technique of architecture and design. Recognise how the architecture domains (above) may be regarded as layers.

Architect roles, goals and skills

List a variety of architect roles. Distinguish the goals of enterprise architects and solution architects. List some knowledge and skills required for those roles.

2. Architecture Precursors

Recognise the various inputs, statements of requirements and constraints that guide an architect as to the nature and shape of solutions to be built. Recognise the information that may be needed in a statement of architecture work.

Foundation Learning Objectives

Stakeholders

Identify stakeholders and their concerns. Apply stakeholder management techniques.

Elaboration of inputs to become deliverables

Recognise that architecture involves hierarchical decomposition inputs into outputs, so the outputs at one level are inputs to the level below.

Intermediate Learning Objectives

Drivers, aims and directives

Distinguish drivers, aims and directives. Recognise the hierarchical decomposition of both aims and directives. Define SMART aims.

Solution descriptions and plans

Distinguish business from IT. Recognise the hierarchical decomposition of solutions and the plans to deliver them.

Standards

Identify several standard bodies. Recognise the need for the enterprise to have a Standards Information Base, and to define the standards profile of solution components.

Scope of architecture work

Recognise ways to define the scope of architecture work, and the scope of an enterprise or system. Draw a context diagram showing interfaces to external systems). Distinguish the concepts of external entity, actor, role.

Requirements

Recognise the difference between functional and non-functional requirements. List ten kinds of non-functional requirement. Distinguish requirements, Service Level Agreements and Service Level Requirements.

Regulatory requirements

Recognise several kinds of regulatory requirement relevant to architecture definition.

Business case

Recognise the contents of a business case; notably RoI, cost-benefit analysis, solution options and risk analysis. Recognise in this connection the nature and purposes of gap analysis (between options), trade-off analysis, and business scenarios.

3. Architecture Frameworks

Recognise methodologies designed to help people create architecture descriptions and use them to good effect. Distinguish a development process (a process framework) from a classification of architecture descriptions (a description framework).

Intermediate Learning Objectives

Architecture process frameworks

Recognise the phases of an architecture process framework that helps architects to describe a baseline architecture, a target architecture and the transformation between them.

Recognise the ten phases of the method for enterprise architecture development (ADM) in the Open Group Architecture Framework (TOGAF) Recognise that a process for solution architecture involves similar activities but with different goals and a different level of detail.

Architecture descriptions

Distinguish the key concepts of architecture description (system, view, view point, concern, and stakeholder) and the relationships between them, as described in the standard popularly known as ANSI 1471. Identify building blocks used in architecture descriptions.

Architecture models

Recognise that models are abstractions composed of instances of artefact types and mappings between them.

Distinguish three kinds of abstraction: by composition, generalisation and idealisation.

Distinguish three levels in an idealisation hierarchy: conceptual, logical and physical. Recognise the possible transformations involved in Model-Driven Architecture (MDA).

Recognise the relationship (line) symbols shared by the Unified Modelling Language (UML) and ArchiMate.

Architecture description frameworks

Identify the rows and columns of the architecture description framework known as the Zachman framework. Recognise the meta model of an architecture repository. Recognise the two dimensions of the Enterprise Continuum in TOGAF.

4. Business Architecture

Recognise ways to describe the structure and behaviour of a business system (not necessarily related to computers), covering business functions or capabilities, business processes and the roles of the actors involved.

Recognise how to map business functions and business processes to each other, to the business goals and business services they support, and to the applications and data they need.

Foundation Learning Objectives

Distinguish the physical and logical structures of a business (organisation units and business functions or capabilities). Recognise several synonyms in this area.

Distinguish business services and business processes. Recognise synonyms in this area, and the use of the terms value stream and value chain.

Recognise mappings of the above to place and time.

Intermediate Learning Objectives

Business architecture structure and behaviour

Recognise ways to model a business system, including business process structures, business function (or capability) structures, business data models and business rules.

Business process decomposition and automation

Recognise three levels of business process granularity: workflow, use case and automated service.

Recognise the benefits of implementing a process as an ACID transaction and the need for compensating transactions where this is not possible.

Distinguish business services from data services.

Design for business security

Identify several features in design for human and organisational security.

5. Data Architecture

Recognise ways to describe the data structures used by a business and/or its applications, including meta data: that is, descriptions of data in storage, data in motion, data structures and data items. Recognise mappings of data objects to data qualities, applications, technologies etc.

Recognise information architecture can embrace not only data architecture but also knowledge/content management.

Foundation Learning Objectives

Recognises how the data stored in and transmitted between information systems is a model of entities and events in the external environment, or real world.

Recognise how data is described using meta data, data structures, data types and data dictionaries.

Intermediate Learning Objectives

Knowledge and/or content management

Distinguish knowledge and/or content management from data management.

Data architecture structure

Understand how to describe data in storage using data models. Recognise the issues in storing state outside of a database in a cache. Recognise the functions of database management system and concept of a federated transaction across a distributed database.

Understand how to describe data in motion, data flow definitions, regular expression, message formats and canonical data models.

Data qualities and integration

Recognise how the three primary data qualities (CIA) may be measured at three or more levels.

Distinguish data store integrity from data flow (or message) integrity.

Recognise the dimensions of a data dissemination view.

Recognise the way denormalisation is used to optimise output from a data warehouse,

Recognise the concept of master data management, and ways to implement it.

Design for data security

Recognise key concepts in data security: security protection, security feature, security policy, information domain, identity, encryption, checksum and digital signature.

6. Software Architecture

Recognise ways to modularise the internal structure of an application, and ways to connect components, ranging from tightly coupled to loosely-coupled.

Foundation Learning Objectives

Recognise system modeling techniques including at least context diagrams, data flow diagrams, use case diagrams, process flow charts (activity diagrams), interaction diagrams (sequence diagrams) and state charts.

Recognise the core concepts of modular design including: encapsulation, façade, aggregation by cluster or affinity analysis, stateful and stateless components.

Recognise the core elements of a service contract and principles of service-oriented design.

Recognise the concepts of transactional processing.

Recognise the concept of delegation from clients to servers. Distinguish cyclic dependency from hierarchical (non-cyclic) dependency. Recognise several service qualities and service-oriented design challenges.

Intermediate Learning Objectives

Component structures and patterns

Recognise the essential ideas in component structures and patterns: client versus server, loosely-coupled versus tightly-coupled.

Recognise basic design patterns: hierarchical and peer-to-peer structures, fork and chain structures. model-view controller (MVC).

Recognise a few common OO design patterns.

Component interfaces

Recognise the concepts of an Application Programming Interface (API) and Interface Description Language (IDL). Recognise how an interface is realised by a component.

Distinguish asynchronous from synchronous communication, from both client and server perspectives.

Component interoperation styles

Recognise how the following component interoperation styles are successively more loosely-coupled: Distributed Objects style (DO): Service-Oriented Architecture style (SOA): Representational State Transfer style (REST): Event-Driven Architecture style (EDA).

Component communication styles

Recognise how the following component communication styles increasingly decouple client/sender from server/receiver: point-to-point communication, introduction agent (direct broker) and mediator (indirect broker). Recognise at least one middleware technology used for each style.

Publish and subscribe distribution

Distinguish different kinds of publish and subscribe distribution.

7. Applications Architecture

Recognise ways to describe the structure and behaviour of applications used in a business, with a focus on how they interact with each other and with business users or actors. Recognise the need for enterprise and solution architects to focus on data consumed and produced by applications rather than their internal structure. Recognise mappings of applications to business functions they support and to application platform technologies they need.

Foundation Learning Objectives

Distinguish three kinds of application: user application, infrastructure application, platform application.

Recognise the main purposes of Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) systems.

Intermediate Learning Objectives

Applications architecture structure and behaviour

Recognise the goals and concepts of application portfolio management.

Distinguish structural and behavioural models of applications architecture.

Recognise a variety of approaches to application integration: screen scrapers, ETL, application consolidation. Distinguish point-to-point from hub and spoke application integration. Recognise the TOGAF concepts of Boundaryless Information Flow and Integrated Information Infrastructure Reference Model (III-RM).

Design for applications security

Distinguish the steps in applications security: identification, authentication, authorisation and access. Recognise the concept of three-factor authentication. Recognise different security controls needed in different layers of an enterprise application.

Application platform

Recognise the purposes of application platform technologies: notably component distribution middleware, database and transaction middleware (remote database access, transaction processing and distributed transaction manager).

8. Design for NFRs

Recognise a selection of common techniques used in design for NFRs.

Foundation Learning Objectives

None.

Intermediate Learning Objectives

Recognise four designs for performance techniques: Database optimization (normalisation, denormalisation, index, and access path analysis), cache, scale up, scale out (aka clustering).

Recognise two design for resilience techniques: Fail over, Defensive design.

Recognise two design for recoverability techniques: Back up, Backup site.

Recognise two design for integrity techniques.

Recognise two design for serviceability techniques.

Recognise design for security techniques mentioned in other sections of the syllabus and identify relevant standards [ISO/IEC 27001: 2013](#) and [ISO/IEC 27002:2013](#).

9. Infrastructure Architecture

Recognise ways to describe the structure and behaviour of the technology platform that underpins user applications: covering the client and server nodes of the hardware configuration, the platform applications that run on them, the platform services they offer to applications, and the protocols and networks that connect applications and nodes.

Foundation Learning Objectives

Computers

Recognise the basic units of computer network: computer, processor, operating system, peripheral, router, bridge.

Connecting computers to networks

Distinguish physical and logical network addresses: MAC address, IP address.

Recognise the use by a process of a socket of a port to send and receive data of a service type.

Topologies

Distinguish four topology shapes: hub and spoke, point to point, bus and ring. Recognise these terms have different meanings in different areas of computing.

Recognise different shapes may apply at different topology levels.

Networks and protocols

Distinguish four levels of network geography: PAN, LAN, MAN, and WAN.

Recognise the convergence of telecommunications media, and Voice Over IP.

Distinguish the seven layers of the OSI model of communication protocols. Distinguish the TCP/IP 5 layer stack from the OSI 7 layer model. Recognise the protocols used in the web services stack.

Recognise the division of an IP address by a network administrator to identify a subnet.

Intermediate Learning Objectives

Infrastructure architecture structure and behaviour

Recognise why TOGAF recommends listing platform services under a logical hierarchical structure, known as a Technical Reference Model.

Recognise the building blocks commonly shown in a hardware configuration diagram, and the process of infrastructure architecture design.

Recognise the concepts of virtualisation and server consolidation.

Design for infrastructure security

Recognise techniques for infrastructure security used to protect client devices, web sites and services, including https, firewalls and a De-Militarised Zone (DMZ).

Format of the Intermediate Examination

Type	Multiple choice, 40 Questions.
Duration	1 Hour. Candidates are entitled to an additional 15 minutes if they are sitting an examination in a language that is not their native/official language.
Pre-requisites	Accredited training is strongly recommended but is not a pre-requisite. Recommended 3 years' experience of IS/IT work including some contacts with architects and architecture descriptions
Supervised/Invigilated	Yes
Open Book	No
Pass Mark	26/40 (65%)
Calculators	Calculators are not permitted in this examination
Delivery	Paper based examination only via an BCS Accredited Training Organisation

Trainer Criteria

Criteria	<ul style="list-style-type: none"> • Hold the BCS Enterprise and Solution Architecture Intermediate Certificate • Have 10 days training experience or hold a train the trainer qualification • Have a minimum of 3 years practical experience in enterprise and solution architecture
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Relevant Standards

- [ISO/IEC 42010:2011](#) Systems and software engineering — Architecture description
- [ISO/IEC 24762:2008](#) Information technology Security techniques Guidelines for information
- [ISO/IEC 27001: 2013](#) Information technology Security techniques and Information security management systems Requirements
- [ISO/IEC 20000-5:2013](#) IT Service Management System (based on BS15000)
- [ISO9000:2014](#) Quality management systems (currently in draft)

Relevant Websites

- [Architectural styles and the design of network based software architectures by Roy Thomas Fielding](#)
- [IBM patterns for e-business resources \(Red Books\)](#)
- Object Management Group (OMG) specifications and standards:
 - [Business Motivation Model](#)
 - [Business Process Modelling Notation \(BPMN\)](#)
 - [Unified Modeling Language](#) Specification
 - [Model Driven Architecture \(MDA\)](#) Specification
 - [Common Object Request Broker Architecture \(CORBA\)](#)
 - [IT Portfolio Management Facility \(ITPMF\)](#) Specification
- [Federal Enterprise Architecture Framework \(FEAF\)](#)
- [Practical Guide to Federal Enterprise Architecture](#)

- [The Open Group Architecture Framework \(TOGAF\)](#)
- [The Zachman Institute for Framework Advancement \(ZIFA\)](#)
- Governance and principles:
 - [OECD Principles of Corporate Governance, Organisation for Economic Co-Operation and Development](#)
 - [Control Objectives for Information and Related Technology \(COBIT\)](#)
 - [The Information Technology Governance Institute](#)

Recommended Reading List

None of the books listed below is required reading, but an architect is expected to have a breadth of knowledge, which reading some of these documents will help to provide.

Title [Enterprise Architecture as Strategy: Creating a Foundation for Business Execution](#)
Author Jeanne Ross, Peter Weill, & David C. Robertson
Publisher Harvard Business School Press
Publication Date August 2006
ISBN 978 15913 98394

Architectural styles and patterns:

Title [SOA in Practice: The art of distributed system design](#)
Author Nicolai M. Josuttis
Publisher O'Reilly Media
Publication Date August 2007
ISBN 978 059 6529550

Title [Patterns for e-business](#)
Author Jonathan Adams
Publisher IBM Press
Publication Date October 2001
ISBN 978 19311 82027

Title [Design Patterns: Elements of Reusable Object Oriented Software](#)
Author Erich Gamma, Richard Helm, Ralph Johnson, & John Vlissides
Publisher Addison Wesley
Publication Date October 1994
ISBN 978-0201633610

Title [Patterns of Enterprise Application Architecture](#)
Author Martin Fowler
Publisher Addison Wesley
Publication Date November 2002
ISBN 978-0321127426