A Reference Architecture captures the essence of the architecture of a collection of systems. The purpose of a Reference Architecture is to provide guidance for the development of architectures for new versions of the system or extended systems and product families.

We provide guidelines for the content of a Reference Architecture and the process to create and maintain it. A Reference Architecture is created by capturing the essentials of existing architectures and by taking into account future needs and opportunities, ranging from specific technologies, to patterns to business models and market segments.
1. general introduction

2. level of abstraction

3. content

4. summary
Why Reference Architectures?

When to Use Reference Architectures?

What do Reference Architectures contain?

How to use Reference Architectures?

What are inputs of a Reference Architecture?

Criteria for a good Reference Architecture.
Increased complexity, scope, size

Facilitate multi-site, multi-organization, multi-vendor, multi-* system creation and life-cycle support

Increased dynamics, integration

Effectively create new: products, product lines, product portfolio

Managing synergy

Providing guidance, e.g., architecture principles, best practices

Providing an architecture baseline and an architecture blueprint

Capturing and sharing (architectural) patterns

Providing a common lexicon and taxonomy

Providing a common (architectural) vision

Providing modularization and the complementary context

Articulation of domain and realization concepts

Explicit modeling of functions and qualities above systems level

Explicit decisions about compatibility, upgrade and interchangeability.
When to Use Reference Architectures

Reference Architectures facilitate the step towards product family architecting and evolvability; this often coincides with multi-* problems.

Reference Architectures facilitate the step towards product family architecting and evolvability; this often coincides with multi-* problems.
RA Elaborates Mission, Vision and Strategy

- Mission
- Vision
- Strategy

Multiple organizations

Reference Architecture

Elaborated in guidance for future
RA = Business Arch. + Technical Arch. + Customer Context

customer context

technical architecture

relations

guidance

requirements

black box view

customer enterprise

users

design patterns

technology

business model

life cycle

business architecture
Instantiation of a RA in few Transformations

architect

reference architecture

extracting essentials

system architecture

design and engineer

family architecture

build and test

shared asset architecture

field feedback

constraints and opportunities

shared assets

extracting essentials

product family

evaluation

system A

system B

actual systems

design and engineer

build and test

field feedback

refactoring

reference architecture

architectures

crossfamily

engineering documentation

actual systems
Inputs of a Reference Architecture

existing architectures

mining

essence architecture patterns

proven concepts & known problems

Reference Architecture

customer needs business needs

exploration & analysis

product portfolio future requirements

vision

guides evolution

triggers new changes
Criteria for a good Reference Architecture

understandable for broad set of stakeholders

accessible and actually read/seen by majority of the organization

addresses the key issues of the specific domain

satisfactory quality

acceptable

up-to-date and maintainable

adds value to the business
Challenge: Appropriate Level of Abstraction

Single System
Product Family in Context
Capturing the Essence
Size Considerations:
What is the appropriate level of abstraction?
How many details?
Decomposition of Large Documents

or

Reference
Architecture
Product Family in Context

- **enterprise context**
- **enterprise**
- **stakeholders**
- **systems**
- **multidisciplinary design**
- **parts, connections, lines of code**

![Diagram showing the relationship between enterprise context, enterprise, stakeholders, systems, multidisciplinary design, and parts, connections, lines of code.]
RA: level of abstraction, number of details

$10^3$ level of abstraction

$10^6$ number of details

compact reference architecture
few diagrams only

extensive reference architecture
many documents

market
process flow
key drivers
key performance indicators
information model
concurrency & synchronization

high end market
value chain
industry roadmap
key drivers
strategic partners
business models
process descriptions
map of systems
standards

Cost of Ownership
function flow
key performance indicators
interoperability
function descriptions

Cost of Ownership
key performance indicators

resource management
exception handling
security
supplier policy
API's
shared assets

decomposition
behavior

 Cost of Ownership
key performance indicators

resource management
exception handling
security
supplier policy
API's
shared assets

A Reference Architecture Primer
Gerrit Muller

version: 0.6
September 9, 2018
RAPsizeSpectrum
Size Considerations

10^3

level of abstraction

10^6

number of details

compact reference architecture
few diagrams only

low effort to create
maintain
read
easy to share

limited guidance
anchor value

extensive reference architecture
many documents

high end market
value chain
industry roadmap
key drivers
strategic
partner
business
models

process flow
interoperability
function flow
key performance
indicators
process descriptions
standards
map of systems

resource management
exception handling
security
supplier
policy

concurrency & synchronization
API's
shared assets

concurrency & synchronization

low effort to create
maintain
read
difficult to share
great
guidance
anchor value

significant effort to create
maintain
read
difficult to share

great

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RAPsizeConsiderations
Decomposition of Large Documents

atomic document

compound document

overview

document
structure

recursion

frontpage
title
identification
author
distribution
status
review

history
changes

diagrams

tables

meta information
max 2 pages

contents
2..18 pages

atomic document

1. aap
2. noot
3. mies
lists
and ca 50%
text

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RAPdocumentDesign
What should be in Reference Architectures?

Guidance from Best Practices

Visualizations

Structure

What content should be in Reference Architectures?
1.1 One of several prerequisites for architecture creative synthesis is the definition of **5-7 specific key drivers** that are critical for success, along with the rationale behind the selection of these items.

2.1. The essence of a system can be captured in about **10 models/views**.

2.2. A **diversity** of architecture descriptions and models is needed: languages, schemata and the degree of formalism.

2.3. The level of **formality** increases as we move closer to the implementation level.

from http://www.architectingforum.org/bestpractices.shtml
Possible useful visualizations

Actual figures and references to their use at http://www.gaudisite.nl/figures/<name>.html
Ideal Structure does not exist
1. Functional Decomposition

2. Construction Decomposition

3. Allocation

4. Infrastructure

5. Choice of integrating concepts
Checklist for RA content

customer context
- business
- financials
- stakeholders
- benefits, concerns
- concept of operations

key performance parameters
- product features, functions

technical architecture
- core technologies
- critical resources
- design issues
- dominant patterns

relations guidance

business architecture
- business model
- life cycle
- stakeholders
- benefits, concerns
Summary of the role of Reference Architectures

- **Mission**
- **Vision**
- **Strategy**

- **Customers**
- **Market**

- **Needs**
- **Opportunities**

- **Elaboration**

- **Technology**

- **Reference Architecture**

- **Existing Architectures**

- **Multiple Organizations**

- **New or Evolved Architectures**

- **Knowledge**

- **Guidance**