

A set of Common Service Quality Assurance Baseline Criteria for Research Projects



A DOI-citable version of this manuscript is available at <http://hdl.handle.net/>.

This manuscript was automatically generated on 29-04-2020.

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Abstract

The purpose of this document is to define a set of quality standards, procedures and best practices to conform a Service Quality Assurance plan to serve as a reference within the European research ecosystem related projects for the adequate development, deployment, operation and integration of services into production research infrastructures.

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Acknowledgements

The EOSC-Synergy project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 857647.



Document Log

Issue	Date	Comment
v0.1	27/04/2020	First draft version
v0.2	28/02/2020	Second draft version
v1.0-beta03	09/06/2020	beta03 draft version
v1.0	12/06/2020	v1.0 release

Introduction

The Open Science realization in Europe is already taking its first steps by means of the implementation of the European Open Science Cloud (EOSC). The EOSC aims at providing researchers with a unique, federated and inclusive view of fit-for-purpose services, developed and operated by the diverse European research infrastructures, including the underlying e-Infrastructures. Consequently, the ultimate success of the EOSC heavily relies on the quality aspects of those services, such as their stability or functional suitability.

The meaning of **Service** can be regarded from different perspectives. From an IT Service Management (ITSM) standpoint, such as the EOSC Service Management System (SMS) process model, a **Service** is devised as a means to “provide value to the customer”. The same goal is shared by the DevOps paradigm, but in this case there is a more pragmatic vision that the customer satisfaction is achieved through the continuous delivery of quality-assured **Services**, with a shorter life cycle, as the final outcome of a comprehensive software development process.

The ITSM model has a broader focus. A **Service** is an “intangible asset” that also includes additional activities such as customer engagement and support. Consequently, it is a much heavier process that might not be appropriate to be applicable for all types of **Services**. The DevOps model, on the other hand, narrows down the scope to meet the user expectations by acting exclusively on the quality features of the **Service**, which is seen as an aggregate of software components in operation.

Purpose

This document provides an initial approach to **Service Quality Assurance**, meant to be applied in the integration process of the **Services** existing under the EOSC-Synergy project, which eventually will be accessible as part of the EOSC offerings.

The criteria compiled in this document favours a pragmatic and systematic approach that puts emphasis on the programmatic assessment of the quality conventions. To this end, the criteria herein compiled builds on the DevOps culture already established in the preceding Software Quality Assurance baseline document [1] to outline the set of good practices that seek the usability and reliability of **Services**, and meet the user expectations in terms of functional requirements.

Contextualization of a Service

As a result, a **Service**, as conceived in this document, represents the following:

- **Web Service** [2]:
 - A **Web Service** is an application or data source that is accessible via a standard web protocol (HTTP or HTTPS).
 - **Web Services** are designed to communicate with other programs, rather than directly with users.
 - Most **Web Services** provide an API, or a set of functions and commands, that can be used to access the data.
- **Web Application** [3]:
 - A **Web Application** or “Web App” is a software program that is delivered over the Internet and is accessed through a web browser.
- **Platform or Service Composition** [4]:
 - Aggregation of multiple small services into larger services, according to a service-oriented (SOA) and/or microservices architecture.
 - An integrated set of **Web Services**, **Web Applications** and software components.

Examples are: Web portals, Scientific portals and gateways, data repositories.

Goals

The herein proposed baseline harnesses the capabilities of the quality factors in the underlying software to lay out the principles for attaining quality in the enabled services within the EOSC context. According to this view, service quality is the foundation to shape user-centric, reliable and fit-for-purpose services.

The Service Quality baseline aims at fulfilling the following goals:

- Complement with a DevOps approach the existing approaches to assess and assure the quality and maturity of services within the EOSC, i.e. Technology Readiness Levels (TRLs) and EOSC Service Management System (SMS).

- Build trust on the users by strengthening the reliability and stability of the services, with a focus on the underlying software, thus ensuring a proper realization of the verification and validation processes.
- Ensure the functional suitability of the service by promoting testing techniques that check the compliance with the user requirements.
- Improve the usability by identifying the set of criteria that fosters the service adoption.
- Promote the automated validation of the service quality criteria.

Notational Conventions

The keywords “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in RFC 2119 [5].

Quality Criteria

The following sections describe the quality conventions and best practices that apply to the development, operation and integration phases of a **Service** with a production infrastructure for research, such as the EOSC ecosystem. These guidelines rule the **Service** development and operation process within the framework of the EOSC-Synergy project.

Some of the criteria in this document is similar or based on the document “Software Quality Assurance baseline” [1]. For such cases the following tag is added to the criteria: [SQA-QC.XyNN] where QC.XyNN is the codename of the criteria in that document.

API Testing [SvcQC.Api]

Web services commonly use application programming interfaces (APIs) to expose the available features to external consumers, which can be either oriented to the end-user or suitable for machine-to-machine communications.

An accurate implementation of a publicly-accessible API is driven by a clearly defined specification. The OpenAPI Specification (OAS) [6] provides the most suitable way to describe, compose, consume and validate APIs. The following requirements assume the presence of such an API specification.

- **[SvcQC.Api01]** API testing MUST cover the validation of the features outlined in the specification (aka *contract testing*).
 - **[SvcQC.Api01.1]** Any change in the API not compliant with the OAS MUST NOT pass contract testing.
 - **[SvcQC.Api01.2]** The use of OAS SHOULD narrow down the applicable set of test cases to the features described in the specification, avoiding unnecessary assertions.
- **[SvcQC.Api02]** API testing MUST include the assessment of the security-related criteria outlined in [SvcQC.Sec] section.
- **[SvcQC.Api03]** API testing SHOULD involve the use of test doubles, such as mock servers or stubs, that act as a validation layer for the incoming requests.

Integration Testing [SvcQC.Int]

Integration testing refers to the evaluation of the interactions among coupled **Services** or parts of a system that cooperate to achieve a given functionality.

- **[SvcQC.Int01]** Whenever a new functionality is involved, integration testing **MUST** guarantee the operation of any previously-working interaction with external **Services**. [SQA-QC.Int01].
 - When using APIs, contract testing **MUST** detect any disruption in the communication between provider and consumer endpoints, through the validation of the API specification [SvcQC.Api01].
- **[SvcQC.Int02]** Integration testing **SHOULD** be automated.
- **[SvcQC.Int03]** Ad-hoc pilot **Service** infrastructures and/or local testbeds **MAY** be used to cope with the integration testing requirements. [SQA-QC.Int04].

Functional tests [SvcQC.Fun]

Functional testing is a type of black-box testing. It involves the verification of the **Service** identified functionality, based on requested requirements and agreed design specifications. This type of **Service** testing focuses on the evaluation of the functionality that the **Service** exposes, leaving apart any internal design analysis or side-effects to external systems.

- **[SvcQC.Fun01]** Functional testing **SHOULD** tend to cover the full scope –e.g. positive, negative, edge cases– for the set of functionality that the **Service** claims to provide. [SQA-QC.Fun01].
 - **[SvcQC.Fun01.1]** When using APIs, contract testing **MUST** detect any disruption in the features exposed by the provider to the consumer, through the validation of the API specification. [SvcQC.Api01].
 - **[SvcQC.Fun01.2]** Functional tests **SHOULD** include the Web interface of the **Service**.
- **[SvcQC.Fun02]** Functional tests **SHOULD** be checked automatically.
- **[SvcQC.Fun03]** Functional tests **SHOULD** be provided by the developers of the underlying software. [SQA-QC.Fun04].

Performance tests [SvcQC.Per]

Performance testing verifies that the software meets the specified performance requirements and assesses performance characteristics - for instance, capacity and response time [7].

Stress or Load testing, exercises software at the maximum design load, as well as beyond it, with the goal of determining the behavioral limits, and to test defense mechanisms in critical systems [7]. *Stress testing is a subset of Performance testing* [8].

Scalability testing is a test methodology in which an application's or **Service** performance is measured in terms of its ability to scale up *and/or* scale out the number of user requests or other such performance measure attributes, through an increase in the amount of available resources. The definition is based on [9]. *Scalability testing is a subset of Performance testing*.

Elasticity is based on how quickly **Services** in an infrastructure are able to adapt [9], in response to variable demand or workload for those service(s) [10]. *Elasticity testing is a subset of Performance*

testing.

- **[SvcQC.Per01]** Performance testing SHOULD be carried out to check the **Service** performance under varying loads.
- **[SvcQC.Per02]** Stress testing SHOULD be carried out to check the **Service** to determine the behavioral limits under sudden increased load.
- **[SvcQC.Per03]** Scalability testing MAY be carried out to check the **Service** ability to scale up *and/or* scale out when its load reaches the limits.
- **[SvcQC.Per04]** Elasticity testing MAY be carried out to check the **Service** ability to scale out or scale in, depending on its demand or workload.

Documentation [SvcQC.Doc]

Documentation is an integral part of any Software or Service. For example, it describes how and what users can use and interact with it, or how operators can deploy, configure and manage a given Software or Service.

- **[SvcQC.Doc01]** Documentation MUST be available online, easily findable and accessible. [SQA-QC.Doc03].
- **[SvcQC.Doc02]** Documentation SHOULD have a Persistent Identifier (PID).
- **[SvcQC.Doc03]** Documentation MUST be version controlled. [SQA-QC.Doc01.1].
- **[SvcQC.Doc04]** Documentation MUST be updated on new **Service** versions involving any change in the installation, configuration or behaviour of the **Service**. [SQA-QC.Doc04].
- **[SvcQC.Doc05]** Documentation MUST be updated whenever reported as inaccurate or unclear. [SQA-QC.Doc05].
- **[SvcQC.Doc06]** Documentation MUST have a non-software license.
- **[SvcQC.Doc07]** Documentation MUST be produced according to the target audience, varying according to the **Service** specification. The identified types of documentation and their RECOMMENDED content are:
 - **[SvcQC.Doc07.2]** Deployment and Administration. [SQA-QC.Doc06.3]:
 - Installation and configuration guides.
 - Service Reference Card, with the following RECOMMENDED content:
 - Brief functional description.
 - List of processes or daemons.
 - Init scripts and options.
 - List of configuration files, location and example or template.
 - Log files location and other useful audit information.
 - List of ports.
 - Service state information.
 - List of cron jobs.
 - Security information.
 - FAQs and troubleshooting.
 - **[SvcQC.Doc07.3]** User. [SQA-QC.Doc06.4]:

- Detailed User Guide for the **Service**.
- Public API documentation (if applicable).
- Command-line (CLI) reference (if applicable).

Security [SvcQC.Sec]

Security assessment is essential for any production **Service**. While an effective implementation of the security requirements applies to every stage in the software development life cycle (SDLC) –especially effective at the source code level, as discussed in [SQA-QC.Sec]–, the security testing of a **Service** is also –similarly to the diverse testing strategies previously covered– a black-box type of testing. Hence, this section focuses on the runtime analysis of security-related requirements, as part of the *Dynamic Application Security Testing (DAST)*.

Additionally, the compliance with security policies and regulations complements the analysis, which can be implemented, continuously validated and monitored through the *Security as Code (SaC)* capabilities. SaC is a particularly suitable tool for endorsing security of **Service Composition** deployments.

- [SvcQC.Sec01] The **Service** public endpoints and APIs MUST be secured with data encryption.
 - [SvcQC.Sec01.1] The **Service** MUST use strong ciphers for data encryption.
- [SvcQC.Sec02] The **Service** SHOULD have an authentication mechanism.
 - [SvcQC.Sec02.1] Whenever dealing with a **Service Composition**, such as microservice architectures, the **Services** SHOULD be managed by a centralized authentication mechanism.
 - [SvcQC.Sec02.2] In publicly-accessible APIs, **Service** authentication SHOULD be handled through an API gateway in order to control the traffic and protect the backend services from overuse.
- [SvcQC.Sec03] The **Service** SHOULD implement an authorization mechanism.
 - [SvcQC.Sec03.1] In **Service Composition** environments, the authorization mechanism SHOULD uniquely grant the essential access permissions for each **Service** according to the principle of least privilege (PoLP).
- [SvcQC.Sec04] The **Service** MUST validate the credentials and signatures.
 - [SvcQC.Sec04.1] Credentials used in the **Service** MUST be signed by a recognized and trusted certification authority.
- [SvcQC.Sec05] The **Service** MUST handle personal data in compliance with the applicable regulations, such as the General Data Protection Regulation (GDPR) within the European boundaries.
- [SvcQC.Sec06] The **Service** SHOULD be audited in accordance with the black-box testing criteria identified by de-facto (cyber)security standards and good practices.
 - [SvcQC.Sec06.1] DAST checks MUST be executed, through the use of ad-hoc tools, directly to an operational **Service** in order to uncover runtime security vulnerabilities and any other environment-related issues (e.g. SQL injection, cross-site scripting or DDOS). The latest release of OWASP's Web Security Testing Guide [11] and the NIST's Technical Guide to Information

Security Testing and Assessment [[12](#)] MUST be considered for carrying out comprehensive **Service** security testing.

- **[SvcQC.Sec06.2]** Penetration testing (manual or automated) MAY be part of the application security verification effort. [SQA-QC.Sec04].
- **[SvcQC.Sec06.3]** The security assessment of the target system configuration is particularly important to reduce the risk of security attacks. The benchmarks delivered by the Center for Internet Security (CIS) [[13](#)] and the NIST's Security Assurance Requirements for Linux Application Container Deployments [[14](#)] MUST be considered for this task.
- **[SvcQC.Sec07]** IaC testing, from [SvcQC.Aud02] criterion, MUST cover the security auditing of the IaC templates (SaC) in order to assure the deployment of secured **Services**. For all the third-party dependencies used in the IaC templates (including all kind of software artefacts, such as Linux packages or container-based images):
 - **[SvcQC.Sec07.1]** SaC MUST perform vulnerability scanning of the artefact versions in use.
 - **[SvcQC.Sec07.2]** SaC SHOULD verify that the artefacts are trusted and digitally signed.
 - **[SvcQC.Sec07.3]** SaC MUST scan IaC templates to uncover misalignments with widely-accepted security policies from [SvcQC.Sec06] criteria, such as non-encrypted secrets or disabled audit logs.
 - **[SvcQC.Sec07.4]** SaC MAY be used to seek, in the IaC templates, for violations of security requirements outlined in the applicable regulations from criterion [SvcQC.Sec05].

Policies [SvcQC.Pol]

Policy documents describe what are the user's expected behaviour when using the **Service**, how they can access it and what they can expect regarding privacy of their data.

- **[SvcQC.Pol01]** The **Service** MUST include the following policy documents:
 - **[SvcQC.Pol01.1]** Acceptable Usage Policy (AUP): Is a set of rules applied by the owner, creator or administrator of a network, **Service** or system, that restrict the ways in which the network, **Service** or system may be used and sets guidelines as to how it should be used. The AUP can also be referred to as: Acceptable Use Policy or Fair Use Policy.
 - **[SvcQC.Pol01.2]** Access Policy or Terms of Use: represent a binding legal contract between the users (and/or customers), and the Provider of the **Service**. The Access Policy mandates the users (and/or customers) access to and the use of the Provider's **Service**.
 - **[SvcQC.Pol01.3]** Privacy Policy: Data privacy statement informing the users (and/or customers), about which personal data is collected and processed when they use and interact with the **Service**. It states which rights the users (and/or customers) have regarding the processing of their data.

Support [SvcQC.Sup]

Support is the formal way by which users and operators of the **Service** communicate with other operators and/or developers of the **Service**, in case of problems, be it operational problems or bugs in the **Service** or underlying Software. Reporting of enhancements, improvements and even documentation issues.

- **[SvcQC.Sup01]** The **Service** MUST have a tracker or helpdesk for operational and users issues.
- **[SvcQC.Sup02]** The **Service** SHOULD have a tracker for the underlying software issues. [SQA-QC.Man01].

- **[SvcQC.Sup03]** The **Service** SHOULD include an Operational Level Agreement (OLA) with the infrastructure where it is integrated.
- **[SvcQC.Sup04]** The **Service** MAY include Service Level Agreement (SLA) with user communities.

Automated Deployment [SvcQC.Aud]

The automated deployment of **Services** implies the use of code to install and configure them in the target infrastructures. Infrastructure as Code (IaC) templates allow operations teams to treat service provisioning and deployment in a similar fashion as developers manage the software code.

Consequently, IaC enables the paradigm of immutable infrastructure deployment and maintenance, where **Services** are never updated, but deprovisioned and redeployed. An immutable infrastructure simplifies maintenance and enhances repeatability and reliability.

- **[SvcQC.Aud01]** A production-ready **Service** SHOULD be deployed as a workable system with the minimal user or system administrator interaction leveraging IaC templates.
- **[SvcQC.Aud02]** Any future change to a deployed **Service** SHOULD be done in the form of a new deployment, in order to preserve immutable infrastructures.
- **[SvcQC.Aud03]** IaC SHOULD be validated by specific (unit) testing frameworks for every change being done.
 - **[SvcQC.Aud03.1]** IaC (unit) tests MUST be idempotent.

Monitoring [SvcQC.Mon]

Monitoring is a periodic testing of the **Service**. It requires a monitoring service from where tests are executed or sent and results of those tests are shown. The tests can be the same, in part or in total of the Functional, Security and Infrastructure tests. The technology used for the monitoring is left to the developers of the underlying software to decide eventually with input from the infrastructure(s), where the **Service** is foreseen to be integrated.

- **[SvcQC.Mon01]** The **Service** in an operational production state SHOULD be monitored for functional-related criteria:
 - **[SvcQC.Mon01.1]** The **Service** public endpoints MUST be monitored.
 - **[SvcQC.Mon01.2]** The **Service** public APIs MUST be monitored. Use functional tests of criteria [SvcQC.Fun01.2].
 - **[SvcQC.Mon01.3]** The **Service** Web interface MAY be monitored. Use functional tests of criteria [SvcQC.Fun01.3].
- **[SvcQC.Mon02]** The **Service** MUST be monitored for security-related criteria:
 - **[SvcQC.Mon02.1]** The **Service** MUST be monitored for public endpoints and APIs secured and strong ciphers for encryption. Use Security tests of criteria [SvcQC.Sec02] and [SvcQC.Sec05].
 - **[SvcQC.Mon02.2]** The **Service** SHOULD be monitored with DAST checks. Use Security tests of criteria [SvcQC.Sec06].
- **[SvcQC.Mon03]** The **Service** MUST be monitored for infrastructure-related criteria:
 - **[SvcQC.Mon03.1]** IaC (unit) tests [SvcQC.Aud02] SHOULD be reused as monitoring tests, thus avoiding duplication.

Metrics [SvcQC.Met]

A metric is a quantifiable measure that is used to track and assess the status of a specific process.

In the case of **Services**, some relevant metrics are the number of users registered in the **Service**, or using it actively. Also accounting is important to track resource usage per user or group of users, either or both computing and storage resources.

Although the metrics may be published in external services managed by the infrastructure, this is a common case in federated infrastructures such as EOSC.

- **[SvcQC.Met01]** The **Service** SHOULD implement the collection of metrics.
 - **[SvcQC.Met01.1]** The collection of metrics SHOULD be cumulative over time and timestamped, so that the values can be queried per time interval.
 - **[SvcQC.Met01.2]** The metric *Number of registered users* SHOULD be collected.
 - **[SvcQC.Met01.3]** The metric *Number of active users over a given period of time* MAY be collected.
 - **[SvcQC.Met01.4]** The metric *Amount of computing resources per user or per group* MAY be collected. The metric unit depends on the type of service and infrastructure. An example is CPU x hours.
 - **[SvcQC.Met01.5]** The metric *Amount of storage resources per user or per group* MAY be collected. The metric unit depends on the type of service and infrastructure. An example is GByte x hours.

Glossary

API

Application Programming Interface

AUP

Acceptable Usage Policy

CLI

Command Line Interface

DAST

Dynamic Application Security Testing

EOSC

European Open Science Cloud

GDPR

General Data Protection Regulation

IaC

Infrastructure as Code

ITSM

IT Service Management

NIST

National Institute of Standards and Technology

OAS

OpenAPI Specification

OLA

Operational Level Agreement

OWASP

Open Web Application Security Project

PID

Persistent Identifier

PoLP

Principle of Least Privilege

SaC

Security as Code

SDLC

Software Development Life Cycle

SLA

Service Level Agreement

SMS

Service Management System

SOA

Service Oriented Architecture

VCS

Version Control System

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