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Systems and software engineering — Information technology project performance benchmarking framework —

Part 1:
Concepts and definitions

Ingénierie des systèmes et du logiciel — Cadre de conduite de tests de performance de projet de technologies de l'information —

Partie 1: Concepts et définitions

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and systems engineering*.

This second edition cancels and replaces the first edition (ISO/IEC 29155-1:2011), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— the introduction was restructured and updated to add descriptions for ISO/IEC 29155-2, -3, and -4, which were published after the publication of the first edition;

— Clause 2 (Normative references) was added following the new requirements of ISO/IEC Directives, Part 2 (Seventh edition);

— definitions were added to include major terms and definitions of other parts of ISO/IEC 29155;

— abbreviations of names of benchmarking activities were added;

— minor editorial improvements were made to increase understandability and readability throughout the document; and

— Clause 5 of the first edition was restructured to Clauses 5 to 9.

Introduction

Benchmarking consists of comparing "objects of interest" to each other, or against a benchmark, to evaluate characteristic(s). In the context of the ISO/IEC 29155 series, the "object of interest" is the performance of information technology (IT) projects, and the characteristic is a particular aspect of an IT project such as productivity.

Benchmarking is one of the fastest-growing techniques in the area of IT project management. Instances of IT project performance benchmarking are initiated and conducted for various reasons. Among the most common reasons are:

— the need to compare project productivity between similar industries;

— the need to compare productivity between different project types and technologies;

— the need to find the most effective targets for IT development process improvement;

— the need to compare productivity between different suppliers;

— the need to improve project management maturity;

— the need to improve project estimation capability.

Much has been written regarding the trials of establishing IT project performance benchmarking, and statistics bear witness to the high failure rate of measurement and benchmarking programs. The most likely causes for failure have been disappointment in the benchmarking outcomes due to a lack of alignment between the selected measurements and business goals, and the misunderstanding of project level measurements in relation to program and portfolio management levels. When there is no alignment between executed measurements and provided outcomes, unnecessary effort is required from the IT project teams collecting the project data. This results in decreased motivation to continue and institutionalize benchmarking.

As is shown in Figure 1, the ISO/IEC 29155 series contains multiple parts:

— Part 1 provides the overall framework model for IT project performance benchmarking. It consists of activities and components that are necessary to successfully identify, define, select, apply, and improve benchmarking. It also provides definitions for IT project performance benchmarking terms;

— Part 2 describes the required tasks in individual benchmarking activities that are necessary to execute various activities to conduct and/or support successful benchmarking in an organization;

— Part 3 provides general requirements and guidance for reporting processes and contents of typical reports;

— Part 4 provides general requirements and guidance for the activities to collect data of IT project to be entered into and maintained in a benchmarking repository.

It is possible that further parts follow in the future.

This document is intended to provide a framework about issues and considerations for data selection and comparison in IT project performance benchmarking.

The starting point for this document and the ISO/IEC 29155 series was the concept outlined by the draft ISBSG (International Software Benchmarking Standards Group) benchmarking standard. IT project performance benchmarking is a combination of several different advanced technologies and practices in the area of quantitative analysis and management. Thus, the framework introduced in this document can be built on the basis of various standardized key technologies such as:

— project management (e.g. PMBOK Guide and ISO 10006);

— systems and software measurements (e.g. ISO/IEC/IEEE 15939);

— software life cycle process (e.g. ISO/IEC 12207);

— system life cycle process (e.g. ISO/IEC/IEEE 15288);

— functional size measurement (e.g. ISO/IEC 14143 series and related methods);

— systems and software quality evaluations (e.g. the ISO/IEC 25000 family and ISO/IEC 9126 series).

This document is designed to conform to the concepts of ISO/IEC 12207 (Software life cycle processes), ISO/IEC/IEEE 15288 (Systems life cycle processes), the ISO/IEC 14143 series (Functional size measurement), the ISO/IEC 15504 series and the ISO/IEC 33000 family (Process assessment), ISO/IEC/TR 12182 (Categorization of systems and software products), or ISO/IEC 14764 (Software life cycle processes — Maintenance).
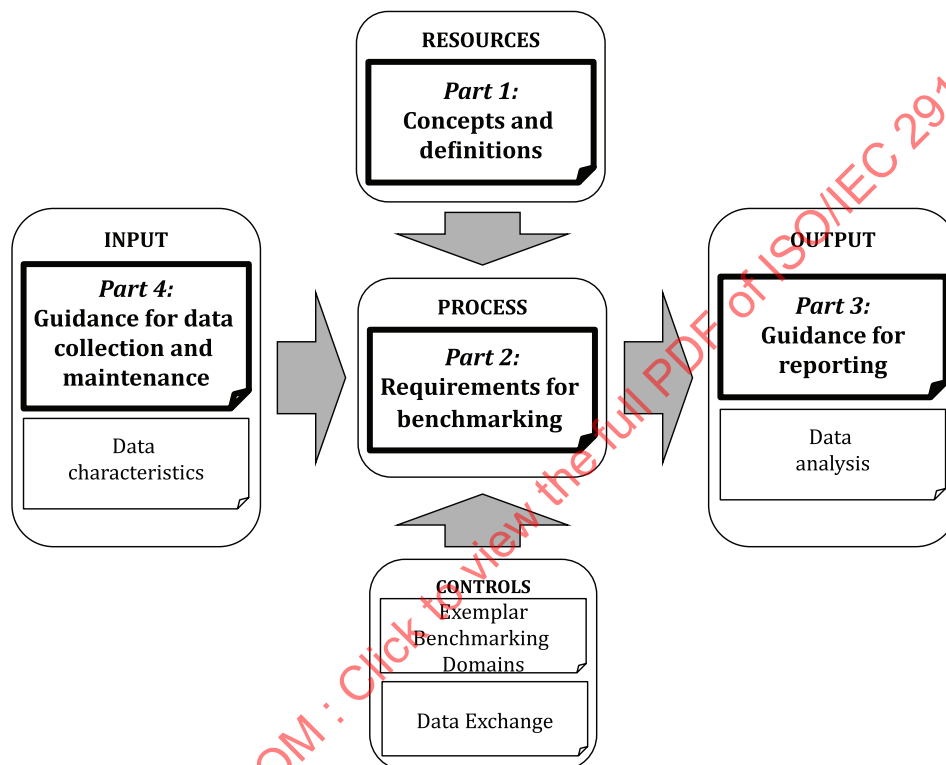
Figure 1 — IT project performance benchmarking framework overview

Systems and software engineering — Information technology project performance benchmarking framework —

Part 1:
Concepts and definitions

1 Scope

This document identifies a framework for information technology (IT) project performance benchmarking (e.g. development or maintenance productivity) and related aspects (e.g. data collection and software classification).

The framework consists of activities and components that are necessary to successfully identify, define, select, apply, and improve benchmarking for IT project performance. It also provides definitions for IT project performance benchmarking terms, which are also applicable to other parts of the ISO/IEC 29155 series.

The target audience of this document are stakeholders of IT project performance benchmarking.

NOTE   The following are examples of how this document can be used:

— by a benchmarking service provider who wants to align their benchmarking process to be consistent with this document;

— by a benchmarking user (or third-party agents) for evaluating the performance of an IT project;

— by an organization internally to answer specific information needs.

This document does not cover how to organize benchmarking. It is out of the scope of this document to prescribe the name, format, or explicit content of the documentation to be produced from the benchmarking process.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
attribute
property or characteristic of an entity that can be distinguished quantitatively or qualitatively by human or automated means

[SOURCE: ISO/IEC/IEEE 15939:2017, 3.2]

3.2
benchmark
reference point against which comparisons can be made

Note 1 to entry: In the context of the ISO/IEC 29155 (all parts), IT project performance(s) is the object of comparison.

3.3
benchmarking
activity of comparing objects of interest to each other or against a *benchmark* (3.2) to evaluate characteristic(s)

Note 1 to entry: In the context of the ISO/IEC 29155 (all parts), the object of interest is IT project performance, and the characteristic is a particular aspect of an IT project such as productivity.

3.4
benchmarking analyst
person or organization that conducts *benchmarking* (3.3) activities

3.5
benchmarking experience base
information store that contains the evaluation of the information products and the *benchmarking* (3.3) activity as well as any lessons learned during *benchmarking* and analysis

Note 1 to entry: ISO/IEC/IEEE 15939:2007 defines "information product" as "one or more indicators and their associated interpretations that address an information need". For example, information product can include templates, graphs, statistical algorithms, and interpretation guidelines.

3.6
benchmarking method
logical sequence of general steps to describe the process of comparing one or more *attributes* (3.1) against a reference *attribute* with respect to a specified scale

3.7
benchmarking report
document showing the results of an *instance of benchmarking* (3.15)

Note 1 to entry: Document usually consists of various formats (e.g. textual descriptions, numeric values, statistical charts and tables), and is exchanged via various media (e.g. electronic documents, electronic dataset, printed documents, and embedded data within specific computer software).

3.8
benchmarking repository
organized and persistent data storage which is designated for *benchmarking* (3.3)

3.9
benchmarking user
person or organization that utilizes the outcome of *benchmarking* (3.3)

3.10
core report
document for providing descriptions of the process and outcomes of the *benchmarking* (3.3) activity

Note 1 to entry: Two kinds of core reports (executive summary and detailed report) are often produced for reporting results of an instance of benchmarking activity.

3.11
data element
smallest unit of data of an IT project

Note 1 to entry: Data element is usually implemented to be a data cell in a benchmarking repository and/or an "IT project data",

Note 2 to entry: Data element is defined by a responsible person who plans data collection or benchmarking.

3.12
data record
defined group of related data elements, in which all the necessary data elements are included to represent *attributes* (3.1) of interest

Note 1 to entry: One data record usually corresponds to a specific IT project with in IT project performance benchmarking framework.

3.13
data submitter
person or organization that provides *IT project* (3.16) data to be included into a *benchmarking repository* (3.8)

3.14
explanatory report
document attached to a product and which provides complementary information in order to assist understanding and avoid inappropriate usage of the product

Note 1 to entry: Examples of an explanatory report are data element definitions, data demographics, data source information which are attached to benchmarking repositories or benchmarks.

Note 2 to entry: Examples of the product are benchmarking repository, benchmark(s), or software tools to support benchmarking activities.

3.15
instance of benchmarking
set of operations, described specifically, used in the execution of a particular *benchmarking* (3.3) according to a given method

3.16
IT project
information technology project
temporary endeavor undertaken to create or change a unique information technology product, system, or service

Note 1 to entry: The PMBOK Guide defines "project" as "a temporary endeavor undertaken to create a unique product, service or result". "IT project" is a specified subset of projects.

3.17
IT project dataset
classified group of data records, into which collected data records are selected by pre-defined criteria

Note 1 to entry: Classification criteria for an IT project dataset can be based on the information needs of the owner and/or users of data.

3.18
project performance
derived measure that gives an indication of some *attribute* (3.1) associated with how well, how quickly, how effectively or how efficiently a project is carried out

3.19
repository owner
person or organization that owns and maintains a benchmarking repository

Note 1 to entry: Also called repository administrator.

3.20
task
smallest unit of work subject to management accountability; a well-defined work assignment for one or more project members

Note 1 to entry: Related tasks are usually grouped to form activities.

[SOURCE: IEEE 829-2008 IEEE Standard for Software and System Test Documentation, 3.1.38]

4   Abbreviated terms

CBa   "conduct benchmarking" activity

IBa   "issue benchmarks" activity

IT   information technology

MBLa   "manage benchmarking business level" activity

MPa   "measure IT project" activity

MPLa   "manage benchmarking program level" activity

MRa   "maintain repository" activity

PIa   "provide instruments" activity

SDa   "submit data" activity

URa   "utilize benchmarking results" activity

5   Overview of the framework

5.1   General

This clause presents an overview of the IT project performance benchmarking framework. The objective is to orient the users of this document so that they can apply benchmarking properly within context.

5.2   Concepts of IT project performance benchmarking

5.2.1   Overall framework

This clause outlines the overall framework of IT project performance benchmarking.

As shown in Figure 2, the framework consists of the following categories of components:

— [C1] "Core benchmarking activities", which collectively illustrate an instance of benchmarking;

— [C2] "Supporting activities", which provides the base and instruments for benchmarking information for use in an instance of benchmarking;

— [C3] "Benchmarking instruments", used by stakeholders to conduct an instance of benchmarking;

— [C4] "Benchmarking information base", which contains data for use during an instance of benchmarking;

— [C5] "External reference base", which provides alternative or additional external data (e.g. repository and/or benchmarks) for an instance of benchmarking;

— [C6] "Benchmarking experience base", which contains knowledge and lessons learned from present and/or past benchmarking experiences.

Diagram

External repository — Import data

External benchmarks

External reference base [C5]

Maintain repository [MRa] — Submit data

Maintain data

Submit data [SDa]

Measure IT project [MPa]

Extract data — Retain/refer data

Benchmarking repository

Refer benchmark

IT project data — Extract data

Refer data

Issue benchmarks [IBa] — Supply

Internal benchmarks — Extract benchmark

Benchmarking information base [C4]

Refer benchmark

Use/refer

Tools

Methods

Guides

Provide instruments [PIa] — Supply

Use/refer

Conduct bench-marking [CBa] — Report results

Utilize bench-marking results [URa]

Core benchmarking activities [C1]

Supporting activities [C2]

Benchmarking instruments [C3]

Maintain/refer

Benchmarking experience base [C6]

Key

☐	activity
📖	benchmark
🛢	organized data store
▱	generic data store

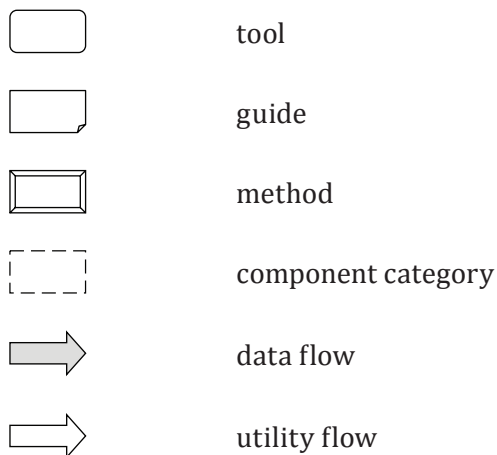|	
tool	
guide	
method	
component category	
data flow	
utility flow	

Figure 2 — IT project performance benchmarking framework

5.2.2 Core benchmarking activities

The core benchmarking activities mainly address information needs of the benchmarking users. Each activity has one or more processes to initiate, plan, execute, review and improve the activity. The activities can be grouped as follows:

— The "conduct benchmarking" activity, which initiate and execute an instance of benchmarking [CBa];

— The "utilize benchmarking results" activity, which utilizes benchmarking results for various business purposes [URa].

There are two approaches for conducting benchmarking:

— extracting benchmark from benchmarking repository and comparing it to data of specific IT project(s);

— referring a benchmark (internal benchmarks or external benchmarks) and comparing it to data of specific IT project(s).

NOTE   Examples of the usage are estimating, comparing, evaluating and managing performance of a specific IT project.

5.2.3 Supporting activities

The supporting activities provide the framework to assist benchmarking users. Each activity has one or more processes to initiate, plan, execute, review and improve the activity. The activities can be grouped as follows:

— the "measure IT project" activity, which measures IT project artifacts and maintains data [MPa];

— the "submit data" activity, which selects and provides data of IT projects to be included into the benchmarking repository [SDa];

— the "maintain repository" activity, which accepts, verifies, and stores data of IT projects into the benchmarking repository, and later manages the benchmarking repository [MRa];

— the "issue benchmarks" activity, which analyzes data of IT projects within the benchmarking repository and provides internal benchmarks [IBa];

— the "provide instruments" activity, which develops and provides tools, methods, and guides to support every activity in the benchmarking framework [PIa].

In this framework, the activity of measuring IT project can be planned and conducted as an existing routine task of a project, or be done as an ad hoc task in support of an instance of benchmarking.

The activity of submitting data usually includes tasks to select and review data before submission.

The management of a benchmarking repository usually includes different tasks for different purposes, e.g. to assure data quality, control data security, ensure data anonymity (i.e. protect privacy of data submitter), back up data, etc.

The activity of issuing internal benchmarks provides pre-determined benchmarks which are authorized and shared by benchmarking users.

5.2.4   Benchmarking information base

Three types of components exist in this category:

— the benchmarking repository, which is a data store to maintain reliable data of IT projects used to produce a benchmark;

— the IT project data, which is a data store to maintain data related to various IT projects;

— the internal benchmarks, which provide a group of commonly usable and authorized pre-determined benchmarks.

The benchmarking repository is the organized and persistent data store to maintain verified data related to IT projects. Data in the benchmarking repository are extracted in order to derive a benchmark in an instance of benchmarking.

The IT project data, in Figure 2, is the data store in which data related to various IT project are stored. This data store in this framework is a conceptual collection of all available information, and it is possible that it is neither organized nor persistent. Data are not always stored in electronic storage in systematic forms. Data in IT project data within this framework can be:

— collected in a variety of formats for different business purposes such as project tracking, time recording for payment, its existence;

— stored in a variety of media including electronic or paper copy;

— independently maintained by individual IT project teams.

Some measured data can be temporarily stored for a specific purpose e.g. project management, quality management, etc. Such data may be deleted when the purpose has been achieved or data have become obsolete.

The third component of benchmarking information base is the internal benchmark. An internal benchmark can be:

— a pre-extracted dataset;

— a set of data extraction conditions; or

— documented results of an instance of benchmarking.

Such a pre-determined benchmark is created by analyzing a specific benchmarking repository and usually issued as white papers, data books, technical reports, study papers, research papers, academic articles, etc.

A pre-determined benchmark can only be an internal benchmark if it is authorized by the benchmarking user.

Created internal benchmarks can be:

— published in public (across organizations);

— distributed within an organization; or

— built-in into specific tools.

Internal benchmarks enable benchmarking users to prepare reliable benchmarks without needing to extract benchmarks from the benchmarking repository.

5.2.5 Benchmarking instruments

Three types of components exist in benchmarking instruments category:

— thetools, which provide means to support stakeholders;

— the methods, which provide procedures;

— the guides, which provide instructive information.

The tools can support various activities, e.g. to measure, collect, maintain, extract and analyze data, as well as to report results. These tools are not necessarily automated or computer-supported.

A method in this framework is a pre-defined procedure to conduct activities. Examples of methods are statistical analyses which are applied and utilized to conduct an instance of benchmarking.

Guides give instructive information for stakeholders to establish and operate within benchmarking framework. Guides can be directives, implemented as textbooks, handbooks, comment boxes, or tooltips, for example.

5.2.6 External reference base

Two types of components exist in the external reference base category:

— the external repository, which is a repository maintained by an external organization;

— the external benchmarks, which are issued in some external organizations by analyzing external repositories.

An external repository is the dataset which is maintained as a repository in external organization. This repository is included in this benchmarking framework to model activity to import a dataset from external organization.

NOTE   An external benchmark can also be adopted to be an internal benchmark by the authorization of benchmarking user.

5.2.7 Benchmarking experience base

The benchmarking experience base is an archive of benchmarking outcomes and lessons learned.

NOTE   Information in the benchmarking experience base will facilitate effectiveness of future benchmarking process. Those experiences will also be incorporated into benchmarking instruments.

5.3 Stakeholders

Various stakeholders can be involved in IT project performance benchmarking. In this clause, activities of benchmarking in the framework of this document (see Figure 2) are broken down into roles and tasks.

From the viewpoints of roles, stakeholders can logically be classified into the following groups:

— benchmark provider, which collects data and maintains benchmarking repository, and provides benchmarks;

— benchmarking service provider, which develops and provides instruments of benchmarking, and conducts benchmarking at the request of benchmarking users;

— benchmarking user, which utilizes outcomes of benchmarking;

— IT project team, which measures IT projects, and in some cases submits data to benchmark provider.

NOTE 1   Any person or organization can fulfill one or more of the above roles. For example, a benchmarking user can also be benchmarking service provider.

NOTE 2   In the context of this document, tasks of an IT project team include measurement-related tasks.

Figure 3 illustrates a basic role-sharing scheme among the four stakeholder groups of the framework of this document. There can be various role-sharing schemes in practice.

NOTE 3   For example, many benchmark providers also provide benchmarking services; many academic researchers do not maintain repository by themselves but publish various benchmarks; and the IT project team can be a potential benchmarking user.

For each activity (shown as a box in Figure 3), five types of actors, either individuals or organizations, can be assigned:

— activity sponsor, who authorizes and supports the establishment of the activity;

— activity owner, who is responsible for the activity;

— activity planner (designer), who is responsible for planning the activity;

— activity developer, who is responsible for implementing the activity;

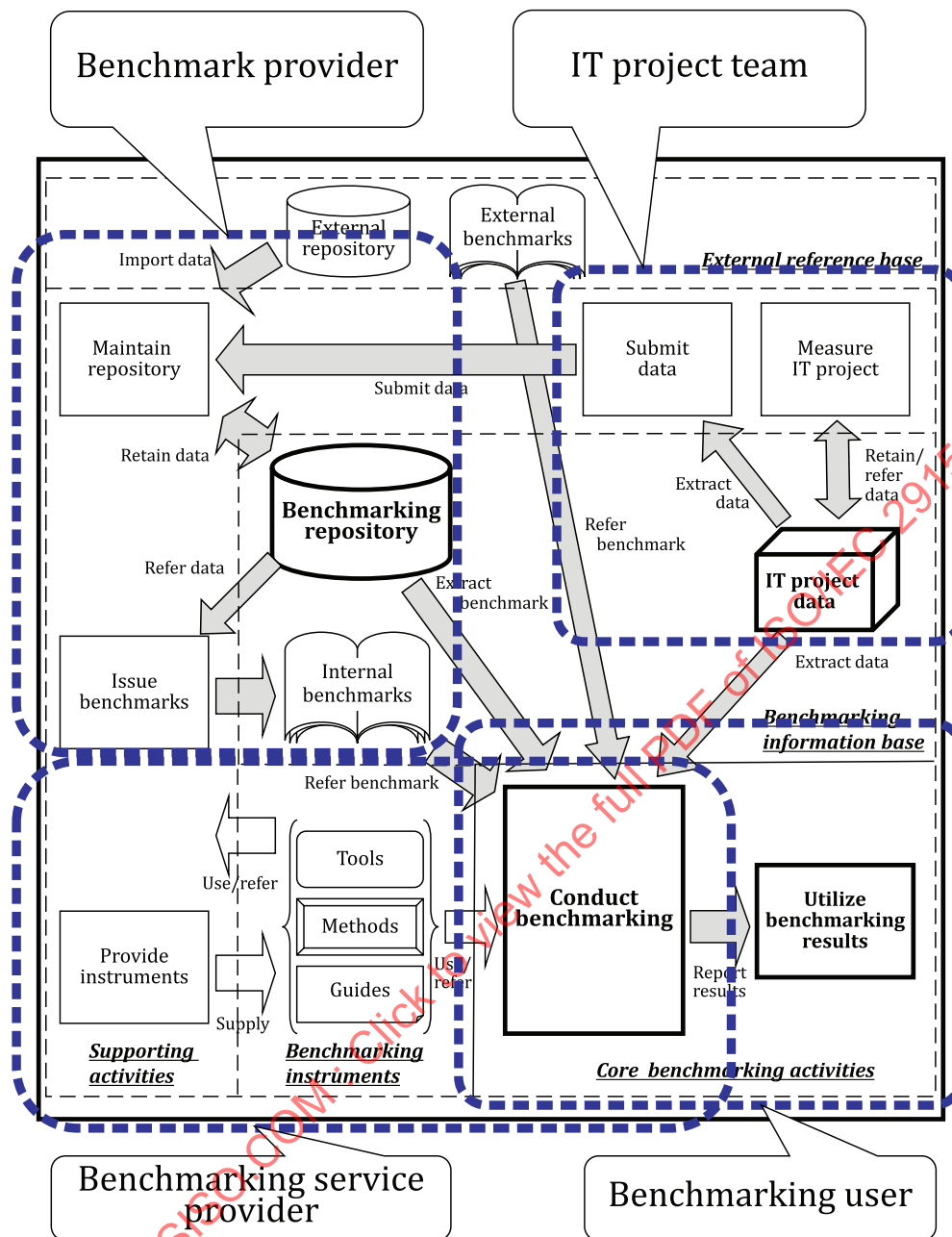— activity operator, who is responsible for executing the activity.

Figure 3 — Example of stakeholders and their roles

5.4 Types of benchmarking methods

The type of benchmarking method means the nature of the operations used to quantify an attribute. Two types are distinguished:

— qualitative – quantification involving human judgement or comparison. An example would be rating some aspect in line with a model. While often expressed numerically, these are ordinal measures derived by subjective judgement.

— quantitative – based on numerical rules. It can be subjected to arithmetic processes.

5.5 IT project categories

Not all IT projects are similar to each other by nature, and it is possible that they are not directly comparable for all benchmarking purposes. For these reasons, it is important to specify the project category. An IT project (for software, system, service) can be performed as:

— Customer-specific new development: a project to create completely new customer specific IT product.

— Commercial product new development: a project to create a new commercial or embedded IT product.

An IT product is always developed to be used by more than one customer. The product can be either standalone package or an embedded part of any other product.

— Version enhancement: a project to create a new version of existing IT product.

The existing product can be either customer-specific or commercial.

— IT service development: a project to create a contract-based continuous or temporary IT service.

The service can be either software- or hardware-related, and encompasses maintenance, support, help desk or operating services, for example.

— Package configuration: a project where the result is an installed, parameterized and, user-configured IT product package.

— Data conversion: a project where data are moved from data storage of one information system to data storage of another information system.

NOTE 1   The software developed in a data conversion project is often "thrown away" in that it is only used once. Even so, the pieces of conversion software can reside on one or more hardware platforms.

— Integration development: a project to create interface services between two or more information systems.

Maintenance and support of systems and software are continuous activities in general. In the context of the ISO/IEC 29155 series, benchmarking of maintenance and support is specified in terms of some (agreed) maintenance and support time period.

NOTE 2   Categories of IT projects are defined in.[17] Category and process of maintenance are defined in ISO/IEC 14764.

6   Requirements for benchmarking

ISO/IEC 29155-2 defines requirements for benchmarking and introduces a three-layered benchmarking management process model (see Figure 4) that consists of:

— a business layer, which takes responsibility for organizational business decision making and commitment;

— a program layer, which controls all benchmarking activities in the organization and supervises projects;

— a project and operational layer, which consists of various projects and/or operations to perform one or more allocated activities.

NOTE 1   The project and operational layer corresponds to the IT project performance benchmarking framework introduced in Figure 2.

NOTE 2   Depending on the maturity of the organization, IT project performance benchmarking can include only the activities in the project and operational layer. For example, an organization can choose to pilot a benchmarking activity as a single instance of benchmarking.

Each activity at project and operational layer consists of several tasks. The number of tasks per activity varies from 10 to 40. All the tasks are defined in detail in ISO/IEC 29155-2.
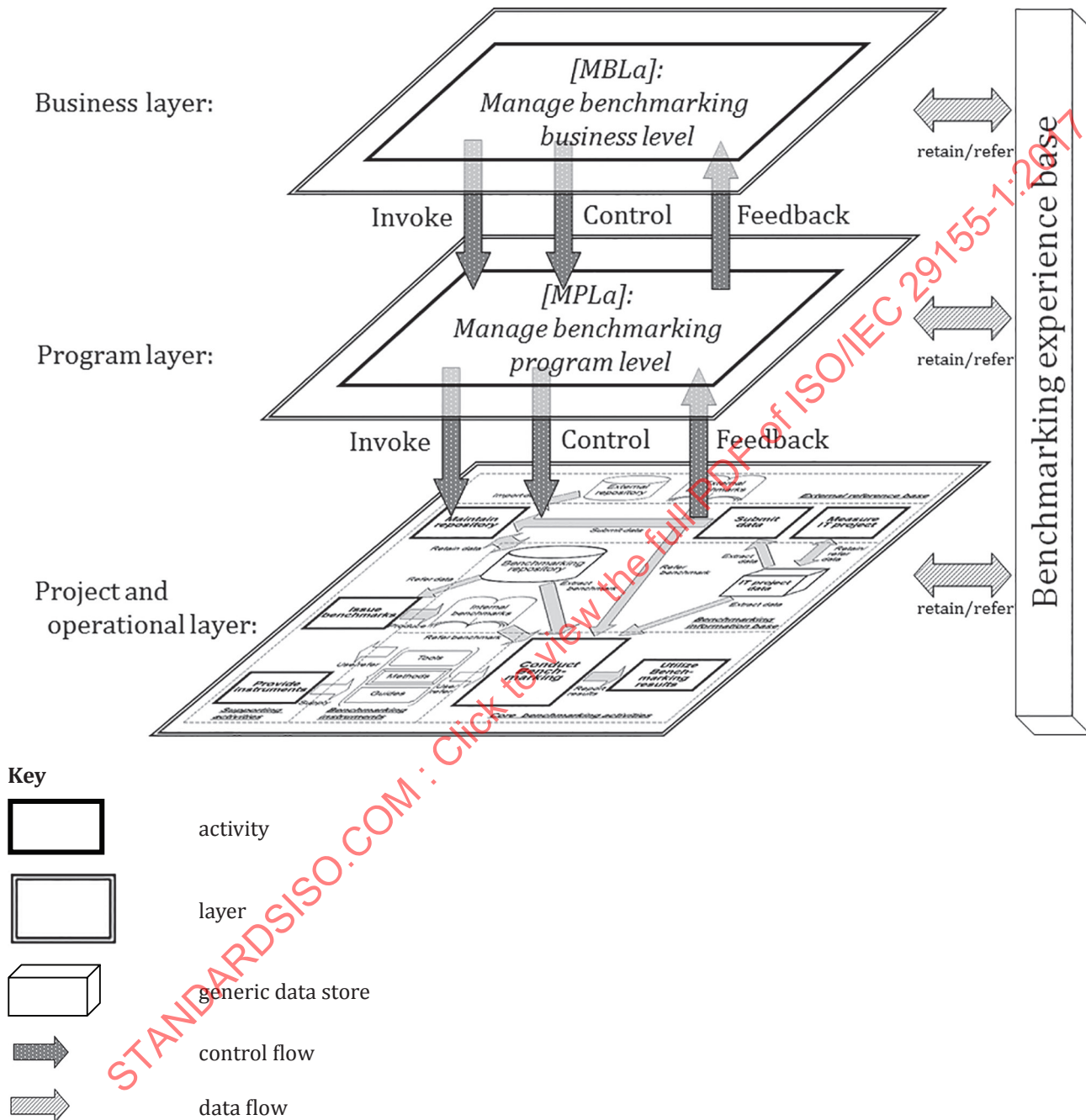

Figure 4 — Benchmarking process model

7   Benchmarking reporting

ISO/IEC 29155-3 provides general requirements and guidance for reporting processes and contents of typical reports within benchmarking activities by prescribing: requirements and guidance for the reporting processes, and contents of reports.

The most important reporting tasks and reports within benchmarking framework are related to three major activities, which are "conduct benchmarking", "maintain repository", and "issue benchmarks" activities.

ISO/IEC 29155-3 focuses on two types of reports:

— benchmarking reports, which describe results of an instance of benchmarking;

— explanatory reports, which provide complementary information about the released benchmarking products (e.g. benchmarking repository or benchmarks).

8 Data collection and maintenance

ISO/IEC 29155-4 provides general requirements and guidance for collecting and maintaining data of IT projects, and for delivering the benchmarking repository. It provides requirements and guidance for:

— data definition;

— data collection processes;

— maintenance and support processes;

within the benchmarking framework.

ISO/IEC 29155-4 mainly focuses on three major activities, which are "maintain repository", "submit IT project data", and "measure IT project" activities. It introduces a data model where benchmarking data consists of "benchmarking repository" and "IT project data". They are the major data stores in the framework of the ISO/IEC 29155 series (See Figure 2). Figure 5 illustrates the overall data structure of these data stores.