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Software engineering — Life cycle processes — Software acquisition

Ingénierie du logiciel — Processus du cycle de vie — Acquisition des logiciels

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Institute of Electrical and Electronics Engineers, Inc
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NY 10016-5997, USA

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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 document 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 or www.iec.ch/members_experts/refdocs).

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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*, in cooperation with the Systems and Software Engineering Standards Committee of the IEEE Computer Society, under the Partner Standards Development Organization cooperation agreement between ISO and IEEE.

This second edition cancels and replaces the first edition (ISO/IEC/IEEE 41062:2019), which has been technically revised.

The main changes are as follows:

— the eight steps of software acquisition were replaced by four sub-processes of software acquisition;

— discussion of the various forms of requirements and their implications was expanded;

— additional attention was given to acquisitions of services;

— alternatives to traditional methods were described for identifying prospective suppliers, structuring requests for proposals (RFPs), evaluating proposals, and negotiating contracts;

— numerous insights and tips are provided to aid in avoiding common acquisition difficulties;

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— the acquisition of operations, maintenance and support services in conjunction with acquiring software products was added.

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Introduction

This document describes the management and execution of software acquisition activities and is intended for:

— individuals or organizations that acquire software or software services from external suppliers for operational use, including software implementation, support, and operations services;

— individuals or organizations that acquire software from external suppliers for resale to other individuals or organizations;

— individuals or organizations that influence how software and software services is acquired from suppliers or implemented, operated, and maintained by suppliers;

— suppliers interested in providing high-quality software to acquirers.

This document is designed to help organizations and individuals:

— incorporate quality considerations during the definition, evaluation, selection, implementation, acceptance, operation, and support of supplier software for operational use;

— specify how the external supply of software and software services should be specified, selected, monitored, and accepted on behalf of end users.

This document is intended to satisfy the following objectives:

— enable acquirers to more effectively acquire software that economically meets their needs;

— enable external suppliers to more effectively and economically deliver software that meets acquirers' needs;

— enable acquirers and suppliers to establish fair, understandable, suitable, and sufficient agreements for the acquisition of software;

— promote consistency within and among organizations in acquiring software from external suppliers;

— provide guidance and useful practices for enhancing the quality of acquired software and the software acquisition process;

— provide guidance and useful practices for evaluating and qualifying supplier capabilities to meet the acquirer's business and technical requirements;

— provide guidance and useful practices for evaluating, qualifying, and contracting for proposed supplier software;

— provide guidance and useful practices for evaluating and determining acceptability of software implemented by external suppliers;

— provide guidance and useful practices for specifying, evaluating, and controlling the acceptability of ongoing software services provided by external suppliers.

This document can be helpful if the software acquirer and supplier are both part of the same organization.

While many of the concepts and techniques for acquiring software from external suppliers can also be relevant for internal software development, this document is not intended to address techniques of software development, testing, or operation.

Each organization or individual using this document can identify the specific set of activities to include within the organization's acquisition process, given its legal and regulatory environment, procurement guidelines, and life cycle processes.

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Software engineering — Life cycle processes — ~~IEEE Recommended Practice for~~ Software acquisition

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~~1. Overview~~

~~This recommended practice is divided into six clauses. Clause 1 provides the scope of this recommended practice. Clause 2 lists references to other standards that are essential in applying this recommended practice. Clause 3 provides definitions that are either not found in other standards, or have been modified for use with this recommended practice. Clause 4 describes the options for acquiring software. Clause 5 describes the eight steps in a software acquisition process and the related quality practices that apply to acquiring software. Clause 6 describes how quality assurance can be applied to software acquisition.~~

~~This recommended practice also contains five annexes. Annex A provides a set of checklists that individuals or organizations may elect to adapt to their specific needs, Annex B provides software acquisition guidelines with respect to Software Safety Assurance and Software Information Security Assurance, Annex C provides guidelines with respect to rights in technical data software usage, Annex D provides acquisition plan guidelines, and Annex E is the bibliography.~~

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1 Scope

This document ~~recommended practice~~ describes a set of useful activities, tasks, methods, ~~quality considerations that can be selected~~ and practices that acquirers of ~~applied during one or more steps in a~~ software and related services from unrelated (external) suppliers can apply to help ensure an efficient and effective acquisition of software or software services. These ~~process. The recommended~~ practices can be applied in competitive and in sole source procurements, regardless of the type, size, complexity, and cost of the acquisition. The document can be applied to software that runs on any computer system regardless of its ~~the~~ size, complexity, or criticality ~~of the software~~. The software supply chain can ~~may~~ include integration of ~~commercial~~ off-the-shelf (OTS ~~COTS~~), custom, software as a service (SaaS), or ~~free and~~ open-source software. Software services can include software development and sustainment (maintenance), integration, verification (testing) and operation. ~~source software (FOSS). Each organization or individual using this recommended practice will need to identify the specific quality and activities that need to be included within the organization's acquisition process.~~ Security and safety are ~~will be~~ included as attributes to be ~~a quality attribute~~ considered during the acquisition. However, specific requirements for acquisition of information assurance (security), safety, and cloud services are not included.

~~1.2 Purpose~~

~~This recommended practice is designed to help organizations and individuals incorporate quality, including security considerations during the definition, evaluation, selection, and acceptance of supplier software for operational use. It will also help determine how supplier software should be evaluated, tested, and accepted for delivery to end users. This recommended practice is intended to satisfy the following objectives:~~

~~— Promote consistency within organizations in acquiring software from software suppliers.~~

~~— Provide useful practices on including quality, security, safety and data rights considerations during acquisition planning.~~

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— Provide useful practices on evaluating and qualifying supplier capabilities to meet user requirements.

— Provide useful practices on evaluating and qualifying supplier software.

— Assist individuals or organizations judging the quality of supplier software for referral to end users.

— Assist suppliers in understanding how the software will be evaluated, tested, and accepted for delivery to end users.

Success in acquiring high-quality software products and services from software suppliers can be achieved by doing the following things:

a) Identifying quality characteristics necessary to achieve the acquirer's objectives

b) Selecting suppliers most capable of meeting the acquisition objectives

c) Including quality considerations in the planning, evaluation, and acceptance activities

d) Developing an organizational strategy for acquiring software

e) Establishing a software acquisition process using the eight steps stated in 5.2 as a starting point

f) Putting the defined process into practice

2. Normative references

The following referenced documents are referred to in indispensable for the text in such a way that some or all of their content constitutes requirements application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

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~~IEEE Std 1228™, IEEE *Standard for Software Safety Plans*.[1], [2]~~

ISO/IEC/IEEE ~~Std~~ 12207, ~~-~~*Systems and software engineering — Software life cycle processes*~~.~~

ISO/IEC/IEEE 15289, *Systems and software engineering— Content of life-cycle information items (documentation)*

~~ISO/IEC/IEEE Std 15288, Systems and software engineering—System life cycle processes.~~

~~ISO/IEC/IEEE Std 15289, Content of life-cycle information products.~~

~~ISO/IEC/IEEE Std 24765, Systems and Software Engineering—Vocabulary.~~

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply. ~~The *International Standard ISO/IEC/IEEE 24765: Systems and Software Engineering—Vocabulary* should be referenced for terms not defined in this clause[3].~~

ISO, IEC and IEEE maintain terminology databases for use in standardization at the following addresses:

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

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

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~~[3] *The International Standard ISO/IEC/IEEE 24765: Systems and Software Engineering Vocabulary* is available at www.computer.org/sevocab.~~

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— IEEE Standards Dictionary Online: available at: http://dictionary.ieee.org

NOTE Definitions for other systems and software engineering terms typically can be found in ISO/IEC/IEEE 24765, available at www.computer.org/sevocab.

3.1.1

acquirer

stakeholder that acquires or procures a product or service from *a supplier* (3.1.19)

Note 1 to entry: Other terms commonly used for an acquirer are buyer, customer, owner, purchaser or internal/ organizational sponsor.

[SOURCE: ISO/IEC/IEEE 12207:2017, 3.1.1]

3.1.2

acquisition

process of obtaining a system, product or service

[SOURCE: ISO/IEC/IEEE 12207:2017, 3.1.2]

3.1.3

agile development

software development approach based on iterative development, frequent inspection and adaptation, and incremental deliveries in which requirements and solutions evolve through collaboration in cross-functional teams and through continuous stakeholder feedback

[SOURCE: ISO/IEC/IEEE 26515:2018, 3.1, modified — "software" has been added at the beginning of the definition.]

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3.1.4

business objective

strategy designed by senior management to help ensure an organization's continued existence and enhance its profitability, market share, and other factors influencing the organization's success

Note 1 to entry: Capability, performance level or *process outcome* (3.1.13) to be achieved to solve a problem, take advantage of an opportunity, or meet a challenge and thereby provide benefit or value.

Note 2 to entry: Identifying business objective(s) is an integral part of the business or mission analysis process described in ISO/IEC/IEEE 12207:2017, 6.4.1.

Note 3 to entry: Business objectives are not the same as *business requirements* 3.1.5); business objectives are accomplished by satisfying business requirements.

[SOURCE: ISO/IEC TR 29110-5-1-4:2018, 3.5, modified — "help" has been added; notes to entry has been added.]

3.1.5

business requirement

requirement that describes in business terms what needs to be delivered or accomplished

Note 1 to entry: The business requirement is a means to achieve *business objectives* (3.1.4) and thereby provide value.

Note 2 to entry: A product, system, or item of software is not and does not determine the business requirements; rather, a product, system or item of software can be used to satisfy the business requirements.

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Note 3 to entry: The term "business" here is used broadly and generically, without implying a commercial venture, and can pertain to both personal and work, for-profit and not-for-profit, and production and administrative situations.

[SOURCE: ISO 29481-1:2016, 3.4, modified — Notes to entry have been added.]

3.1.6

COTS

~~3.1 Definitions~~

~~**acquisition:** Process of obtaining a system, product, or service.~~

commercial-off-the-shelf

~~(COTS):~~ ~~A~~ product available for purchase and use without the need to conduct development activities ~~[ISO/IEC/IEEE 15289:2011].~~

[SOURCE: ISO/IEC/IEEE 90003:2018, 3.4]

~~**modified-off-the-shelf (MOTS):** Software product that is already developed and available, usable either "as is" or with modification, and provided by the supplier, acquirer, or a third party.~~

3.1.7

defect

fault or deviation from the intended level of performance of a system or software

[SOURCE: ISO/IEC 23643:2020, 3.4]

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3.1.8

functional requirement

requirement that specifies a function that a system or system component performs

[SOURCE: IEEE Std 730-2014, 3.2]

3.1.9

hazard

source or situation with a potential for harm in terms of human injury or ill health (both short and long term), damage to property, damage to the environment, or a combination of these

[SOURCE: IEEE 7000:2021]

3.1.10

IT asset management

ITAM

coordinated activity of an organization to realize value from IT assets

[SOURCE: ISO/IEC 19770-1:2017, 3.3, modified — "IT" has been added in the term and the definition; the abbreviated term "ITAM" has been added.]

3.1.11

non-functional requirement

any requirement for a software-intensive system or for a software product, including how it should be developed and maintained, and how it should perform in operation, except any functional user requirement for the software

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[SOURCE: ISO/IEC/IEEE 32430:—[1], 3.1.25, modified — The abbreviated term "NFR" has been removed.]

3.1.12

off-the-shelf ~~(~~ OTS~~):~~

product or system already developed and available ~~[ISO/IEC/IEEE 15289:2011].~~

3.1.13

process outcome

observable result of the successful achievement of the *process purpose* (3.1.14)

[SOURCE: ISO/IEC/IEEE 12207:2017, 3.1.34]

3.1.14

process purpose

high-level objective of performing the process and the likely outcomes of effective implementation of the process

Note 1 to entry: The purpose of implementing the process is to provide benefits to the stakeholders.

[SOURCE: ISO/IEC/IEEE 12207:2017, 3.1.35]

1) Under preparation. Stage at the time of publication: ISO/IEC/IEEE PRF 32430:2024.

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3.1.15

product requirement

requirement that describes how a product, system, or item of software will satisfy a *business requirement* (3.1.5) and thereby provide value

3.1.16

safety

expectation that a system does not, under defined conditions, lead to a state in which human life, health, property, or the environment is endangered

[SOURCE: ISO/IEC/IEEE 12207:2017, 3.1.48]

3.1.17

software acquisition

process that begins with the decision to obtain a software product or service with the outcome of acceptance of the software

3.1.18

software requirement

software capability needed by a user to solve a problem or to achieve an objective

Note 1 to entry: A software requirement is a form of *product requirement* (3.1.15).

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3.1.19

supplier

organization or an individual that enters into an agreement with the *acquirer* (3.1.1) for the supply of a product or service

Note 1 to entry: Other terms commonly used for supplier are contractor, producer, seller, or vendor.

Note 2 to entry: The acquirer and the supplier sometimes are part of the same organization.

[SOURCE: ISO/IEC/IEEE 12207:2017, 3.1.60]

3.1.20

technical requirement

requirement relating to the technology and environment for the development, maintenance, support and execution of the software

3.2 Abbreviated terms

FOSS free and open-source software

LOU letter of understanding

MOU memo of understanding

NDA non-disclosure agreement

QA quality assurance

RFI request for information

RFQ request for quote

RFP request for proposal

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RPP request for prototype proposals

SaaS software as a service

SLA service level agreement

SOI system of interest

SOW statement of work

T&M time and materials

V&V verification and validation

software-intensive system: A system for which software is a major technical challenge and is perhaps the major factor that affects system schedule, cost, and risk [IEEE Std 1362-1998 (Reaff 2007)] and [ISO/IEC/IEEE 24765:2010].

NOTE—In the most general case, a software-intensive system is comprised of hardware, software, people, and manual procedures.[4]

3.2 Use of should, may, and can

In this document, the word *should* is used to indicate a recommendation. The word *may* is used to indicate a permissible action. The word *can* is used for statements of possibility and capability.

[4] Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

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4 Software acquisition process

4.1 General

The acquirer shall perform software acquisition as specified in the process outcomes, activities, and tasks of the acquisition process required in ISO/IEC/IEEE 12207, with additional requirements as specified in Clauses 6 through 10 and Annexes B and C. Information items (output) shall conform to the required content of ISO/IEC/IEEE 15289.

For convenience in this document, requirements quoted from these normative standards are shown in boxes.

Quoted requirements include the acquisition process purpose, outcomes, activities and tasks.

4.2 Purpose

> The purpose of the Acquisition process is to obtain a product or service in accordance with the acquirer's requirements.
>
> [ISO/IEC/IEEE 12207:2017, 6.1.1.1]

This document applies primarily to the software acquisition process, for the acquisition of software products and services from external suppliers.

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4.3 Outcomes

The following outcomes shall apply to the acquisition of software and software-related services:

~~As a result of the successful implementation of the acquisition process~~

a) A request for supply is prepared.

b) One or more suitable suppliers are selected.

c) An agreement is established between the acquirer and supplier.

d) A product or service complying with the agreement is accepted.

e) Acquirer obligations defined in the agreement are satisfied.

[ISO/IEC/IEEE 12207:2017, 6.1.1.2]

Operation and maintenance of the supplied software or consumption of the supplied services consistent with the contract are examples of delivered software and services. Some or all of such activities can be performed by the acquirer, by the supplier of the acquired software and services, or by a subsequently and separately engaged third-party supplier.

4.4 Structure of the software acquisition process

4.4.1 Software acquisition sub-processes

The software acquisition process consists of four major sub-processes within which relevant activities may be performed in a more flexible, less sequential manner:

a) planning and request for proposals (RFP);

b) evaluation, selection, and contracting;

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c) implementation and acceptance;

d) acquisition of operations, maintenance, and support.

NOTE 1 The acquisition of operations, maintenance, and support sub-process pertain only to essentially an additional acquisition of such services in conjunction with acquisition of an executable software product to which such services pertain. Operations, maintenance, and support services that are obtained in their own right separately from acquiring the executable software product(s) to which the services pertain are treated like any acquisition of software services and are not addressed in the associated operations, maintenance, and support sub-process.

Each sub-process includes its purpose, outcomes, and activities and tasks in addition to activities for security, risk management, process improvement, and verification and validation (V&V).

Figure 1 illustrates the four sub-processes of the software acquisition process, along with supporting life cycle processes.

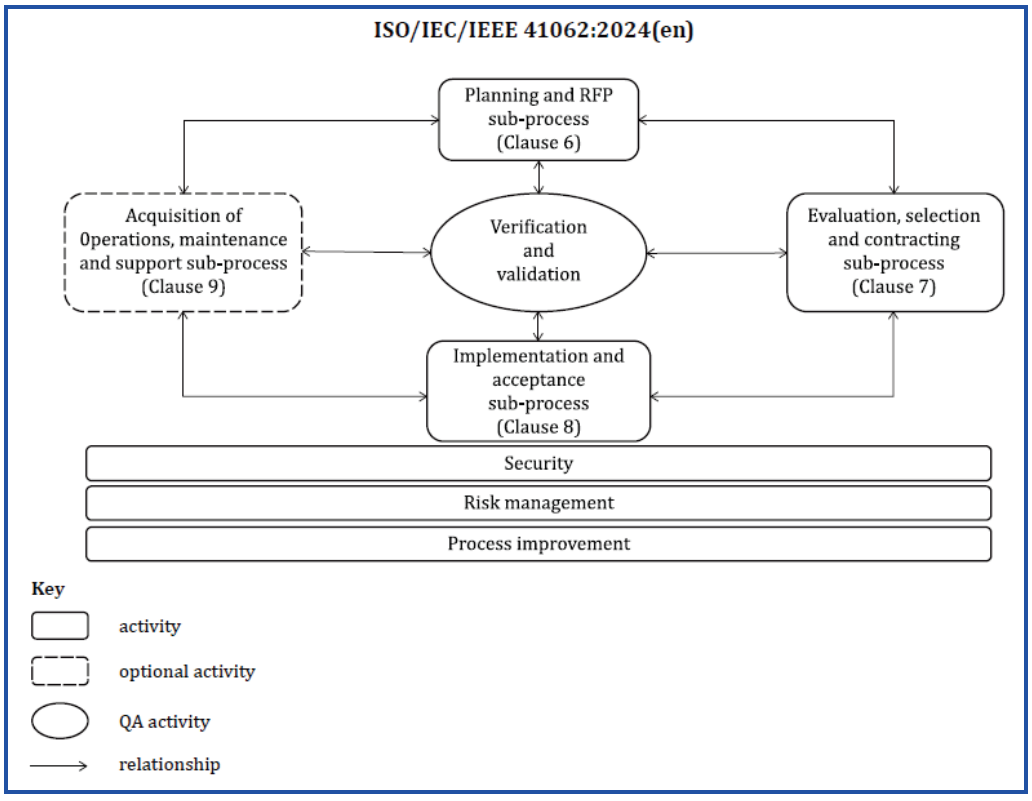

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Figure 1 — Software acquisition sub-processes

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Table 1 illustrates the alignment of the four sub-processes described in this clause to ISO/IEC/IEEE 12207.

Table 1 — Alignment with the acquisition activities in ISO/IEC/IEEE 12207

ISO/IEC/IEEE 12207 acquisition activities	Sub-processes in this document
a) Prepare for the acquisition	Planning and RFP
b) Advertise the acquisition and select the supplier	Evaluation, selection and contracting
c) Establish and maintain an agreement	
d) Monitor the agreement	Implementation and acceptance
e) Accept the product or service	
a) Prepare for the acquisition b) Advertise the acquisition and select the supplier c) Establish and maintain an agreement d) Monitor the agreement e) Accept the product or service	Acquisition of operations, maintenance and support

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NOTE 2 The operations, maintenance and support sub-process pertains to the acquisition of such services for an executable software product or SaaS.

4.4.2 Defining the acquisition process

A software acquisition's effectiveness and efficiency generally are enhanced by following an explicit and well-conceived acquisition process. Many organizations already have and thus can readily apply a defined software acquisition process. Other organizations may define their software acquisition process, which may include formalizing existing but undocumented or informal processes, before proceeding with a particular acquisition. In either case, the acquirer should regularly review its software acquisition process and revise it as appropriate.

A software acquisition process may include the following tasks.

a) Identify the need for software or services.

b) Define relevant top-level requirements to meet the need.

c) Identify alternative ways to obtain software or services meeting the requirements.

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d) Estimate the capability, effort, time, cost, and risk of each alternative.

e) If an acquisition is to be pursued, develop a request for proposals (RFP) or request for prototype proposals (RPP) for the software or services with the chosen alternatives.

f) Publish and distribute the RFP or RPP to interested prospective suppliers.

g) Respond to questions and comments, clarifying or amending the RFP or RPP as needed.

h) Receive and evaluate proposals from prospective suppliers, including requesting clarifications and additional information from them. Clarify or amend the RFP or RPP as needed, giving prospective suppliers the opportunity to modify their proposals as needed.

i) Identify the supplier whose final proposal is responsive and most advantageous overall to the acquirer and finalize execution of a formal contract for the proposed software.

j) If a formal contract cannot be executed within a reasonable time with the identified supplier, pursue execution of a formal contract with the next most advantageous responsive supplier for their proposed software and so forth as needed until either a satisfactory formal contract has been executed or the acquisition is terminated for lack of a suitable supplier or other business reasons.

k) Monitor and assist the supplier's implementation of the contracted software or services.

l) Perform relevant evaluation of the delivered software or acceptability of services, providing the supplier reasonable opportunity to address deficiencies.

m) Pay agreed-upon amounts to the supplier, usually in response to full or partial accepted software or services delivery. Declare the contract completed upon final delivery and payment.

n) If the supplier also has been engaged to perform continuing operation, maintenance, or support services of the acquired software, assist the supplier to assume such roles and oversee the acceptability of the supplier's ongoing performance.

o) As appropriate, transition or end the supplier's role, paying amounts due.

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~~5.1.2 Activities and tasks~~

~~Software can be acquired as a stand-alone product, as a service, or embedded in a system consisting of a single processor or a large, complex system with many hardware items. This clause describes the activities in the software acquisition process and is applicable to the acquisition of developed software, non-developmental software (COTS, reuse, or FOSS), and software services.~~

~~5.1.3 Principal acquisition roles~~

~~There are three principal roles involved: acquirer, supplier, and end user. These roles may be performed by a single individual in a small business or by multiple people representing organizations in a large corporate or government environment. The acquirer develops the method to satisfy the identified need and the supplier provides the required product or service to the end user.~~

4.4.3 Tailoring the acquisition process

~~5.2 Eight steps in acquiring quality software~~

A software acquisition involves two parties: acquirer and supplier. ~~The software acquisition process can be described by eight steps. The activities in each step support the acquisition of high quality software products, services or systems that meet~~ The acquirer's ~~requirements and expectations, including on-time and on-budget delivery. The~~ software acquisition process may ~~should~~ be tailored or streamlined to fit the acquirer's specific needs and circumstances, ~~the maximum extent possible~~ taking risk into consideration. The process should be consistent with the acquirer's technical maturity and ~~,~~validated requirements~~,~~ and expected level of effort and funding. ~~The tailoring process is presented in Annex A of ISO/IEC/IEEE 12207.~~

NOTE The tailoring process is further explained in ISO/IEC/IEEE 12207:2017, Annex A.

~~Figure 1 illustrates the eight-step process described in this clause and Table 2 summarizes the process steps, along with their inputs and outputs.~~

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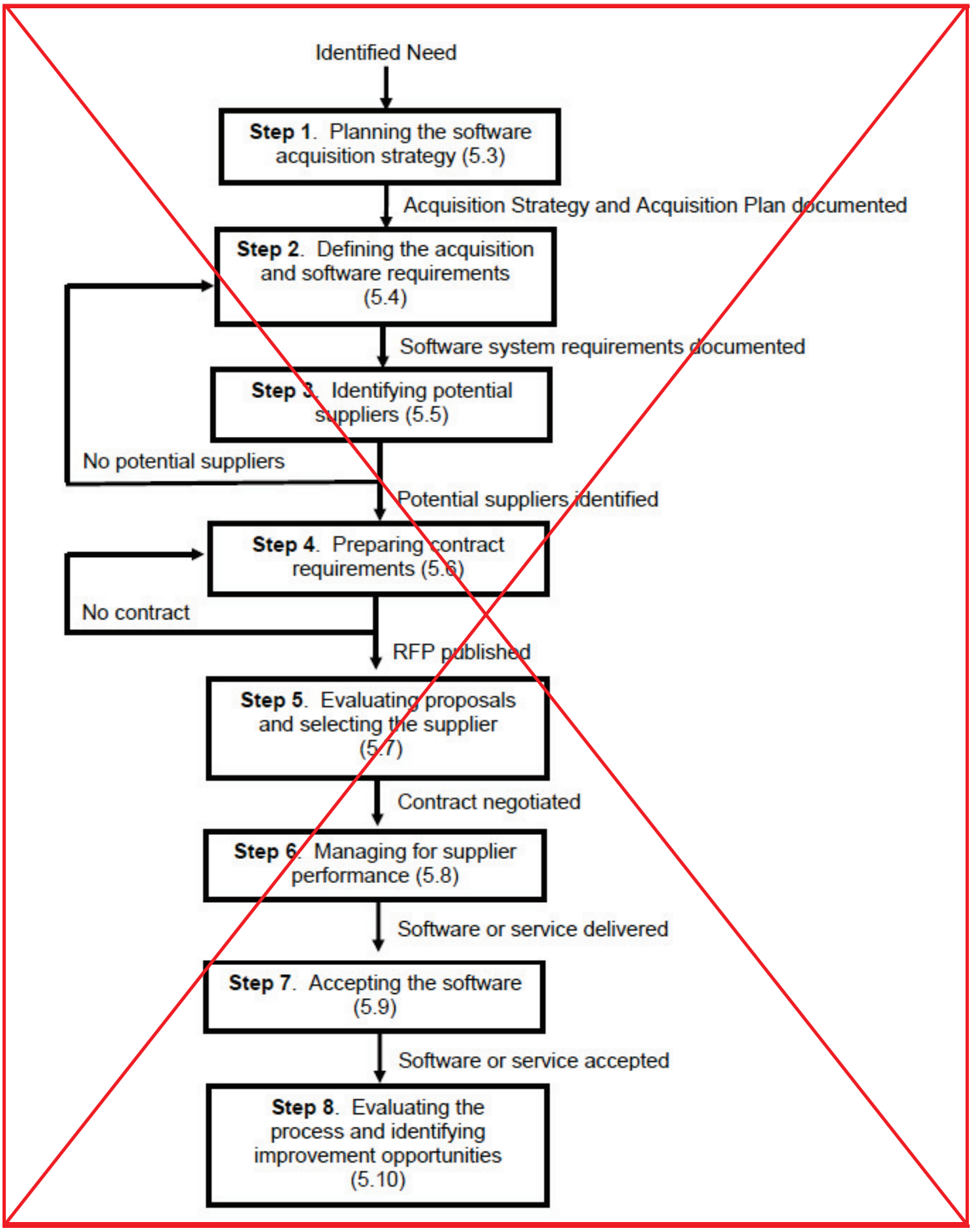

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~~**Figure 1 — Eight steps in acquiring software**~~

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~~Table 2—Eight steps in acquiring software~~

Steps in software acquisition process	Activities and Tasks	Outcomes
Step 1. Planning the software acquisition strategy (5.3)	1. Initiate a planning process. 2. Develop an acquisition strategy. 3. Develop an acquisition plan. 4. Include contracting practices. 5. Obtain acquisition services from other organizations. 6. Tailor the process.	1. High level specification of functional and non-functional requirements to confirm need for a system and guide acquisition planning is produced. 2. Acquisition plan is specified and deliberated on. 3. Acquisition plan is approved.
Step 2. Defining the acquisition and software requirements (5.4)	1. Define the software being acquired. 2. Establish supplier evaluation criteria. 3. Establish acquirer and supplier obligations. 4. Develop plans to evaluate and accept software and services. 5. Develop contingency plans.	1. The software to be acquired is defined in detail. 2. The Statement of Work (SOW) is defined and approved. 3. Software requirements are specified and approved. 4. A detailed RFP which includes acquirer and supplier obligations is produced and approved. 5. Evaluation and acceptance criteria for the software to be acquired are produced. 6. Contingency plan is drawn up and approved.
Step 3. Identifying potential suppliers (5.5)	1. Gather software supplier's information. 2. Review software supplier's information. 3. Survey uses of the supplier's software.	1. Potential supplier information is gathered and a detailed RFI report produced for each supplier visited. 2. Review report based on potential supplier's information is produced. 3. A limited number of supplier candidates are shortlisted based on the acquisition organization's policy.
Step 4. Preparing contract requirements (5.6)	1. Determine the required quality of the work. 2. Determine how payment is to be made. 3. Determine nonperformance remedies. 4. Prepare contract provisions. 5. Review contract provisions with legal counsel.	1. The desired level of quality of work is determined. 2. Payment terms are determined. 3. Remedies for non-performance are determined. 4. Contract for engaging a supplier is produced and approved. 5. Legal review opinion including caveats and limitations documented.
Step 5. Evaluating proposals and selecting the supplier (5.7)	1. Evaluate supplier proposals. 2. Visit supplier facilities. 3. Select a qualified supplier. 4. Negotiate the contract.	1. An evaluation report on proposals submitted is produced. 2. A qualified and preferred supplier is selected. 3. A contract between acquirer and supplier is negotiated and signed.
Step 6. Managing for supplier performance (5.8)	1. Manage the contract during execution. 2. Monitor the supplier's progress.	1. Performance measures or assessment results are available. 2. Adequacy of roles and accountabilities is assessed. 3. Agreement objectives are achieved. 4. Accountability in carrying out project activities and tasks. 5. Issues (including problems) in project execution are managed.
Step 7. Accepting the software (5.9)	1. Review and update the acceptance criteria. 2. Conduct a review and test of the software. 3. Manage the testing process. 4. Document the test results.	1. An acceptance testing report on delivered software solution is produced. 2. Decision to accept, reject or make changes to the delivered software solution is made.
Step 8. Evaluating the process and identifying improvement opportunities (5.10)	1. Evaluate contracting practices. 2. Evaluate software product quality. 3. Evaluate supplier performance.	1. Contracting practices evaluated and reviewed. 2. Acquired software product is evaluated. 3. Supplier performance is evaluated. 4. A detailed evaluation report is produced.

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~~5.3.3.6 Tailor the process~~

The extent to which the acquisition process is tailored depends on the nature and risk of the underlying acquisition. ~~The process may be tailored to perform these tasks at a level appropriate for the complexity of the software to be acquired.~~. For example, procurement of a proven standard ~~an~~ off-the-shelf product typically does ~~may~~ not require extensive requirements documentation; some acquisitions ~~, but~~ may require a support or training agreement with additional suppliers; and ~~.~~ ~~Likewise,~~ a large development project with many requirements may require more extensive documentation and specification. ~~will likely require all of the topics listed above to be addressed.~~

~~The processes that both the acquirer and supplier are required to implement may be tailored as appropriate. The amount of tailoring permissible for the supplier should be included in contract documents.~~

Reference to relevant internal policies and practices may be used for additional guidance on implementing a process for acquiring high-quality software. A knowledge base ~~reference list~~ of information currently available within the organization should be maintained.

After completing the acquisition process, lessons learned should be collected and reviewed to identify potential process improvements to meet the changing needs and objectives of the organization.

~~5.4 Step 2: Defining the acquisition and software requirements~~

~~5.4.1 Purpose~~

~~The purpose of defining the software requirement is to specify detailed functional and non-functional requirements for the software to be procured and use these to produce the request for proposal (RFP) and statement of work (SOW).~~

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5.4.2 Outcomes

The outcomes of Step 2 are as follows:

- The software to be acquired is defined in detail.
- The SOW is defined and approved.
- Software requirements are specified and approved.
- A detailed RFP that includes acquirer and supplier obligations is produced and approved.
- Evaluation and acceptance criteria for the software to be acquired are produced.
- Contingency plan is drawn up and approved.

5.4.3 Activities and tasks

5.4.3.1 Define the software being acquired

The objective is to develop the requirements for the software, including functional, performance, and nonfunctional requirements and to obtain from the supplier(s) realistic assessments of the size, scope, and cost of the effort required for the software.

Functional requirements specify what the software should do. Performance requirements specify the performance attributes for the software, such as computational load, algorithm timing, precision, or accuracy. Non-functional requirements specify the quality attributes required for the software, such as dependability, reliability, availability, or maintainability.

The needed software, deliverables, and software support should be described as completely as possible in the RFP so that the supplier can understand and address the scope of work in the proposal. The example questions in Annex A, Checklist 2 may be used as a starting point.

IEEE Std 830™ [B5] should be used to document the requirements.

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Depending upon the type of software being acquired, a request for quote or other acquisition document may be used in place of the RFP.

5.4.3.2 Establish supplier evaluation criteria

The objective is to confirm that the supplier most suited to do the work is selected.

Evaluation criteria should be developed to use in reviewing supplier proposals, identifying nonresponsive suppliers, and selecting a qualified supplier. The supplier's management qualifications, technical approach, quality assurance program, and proposed cost should be considered. The questions in Annex A, Checklist 3, may be used.

A provision should be included in the RFP requiring inspections of supplier facilities to investigate and evaluate various factors, including financial position, technical capability, experience, and quality practices.

5.4.3.3 Establish acquirer and supplier obligations

The objective is to establish and clearly state the obligations of both the acquirer and the supplier. Annex A, Checklist 4, may be used.

5.4.3.4 Develop plans to evaluate and accept software and services

Quality and maintenance plans should be developed to use in evaluating and accepting the software and services provided by the supplier. Annex A, Checklist 5, may be used.

5.4.3.5 Develop contingency plans

Contingency plans should be developed to use in the event the supplier fails to satisfy contract requirements and the contract is then terminated. The complexity of the project and the risk in achieving the contract requirement should be considered.

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5.5 Step 3: Identifying potential suppliers

5.5.1 Purpose

The purpose is to identify potential suppliers of the required software through a request for information (RFI) followed by site visits to those potential suppliers.

Contact potential suppliers and schedule the itinerary for facilities visiting. Facilities visiting participants should be selected and meeting agenda should be prepared in advance. A comparison chart to record observations made during the supplier facility visit should be created. Annex A, Checklist 3, may be used. The purpose of the visiting is to verify the RFI responses matched with suppliers' operation practices, to validate products demonstration, and to review document and quality system. A presentation of the RFI response should be conducted by suppliers for critical points clarification and a management or executive level meeting will be helpful for mutual understanding of further cooperation possibility.

Identify a group of suppliers whose offers are likely to be acceptable to receive an RFP for further evaluation. Also, evaluate if a non-disclosure agreement (NDA) is required for the RFP to secure both acquirer's and supplier's confidential information.

It is important that the acquirer establishes "valid supplier" criteria and that these are shared with the supplier community. This can reduce the possibility of protests against any final supplier selection.

Custom-developed vs OTS vs SaaS can be summarized as follows:

a) Custom-developed: If custom built software is an option, then determining the past performance of a potential supplier in the domain (e.g., communications, spacecraft, IT) is important.

b) OTS/SaaS: If OTS or SaaS is an option, determining the satisfaction of the user community of the product/service is important. This can sometimes be accomplished by interacting with product/service user groups for a given product/service.

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5.5.2 Outcomes

The outcomes of Step 3 are as follows:

— Potential supplier information is gathered and a detailed RFI report produced for each supplier visited.

— Review report based on potential supplier's information is produced.

— A limited number of supplier candidates (e.g., 3) are shortlisted based on the acquisition organization's policy.

5.5.3 Activities and tasks

5.5.3.1 Gather software supplier's information

Prepare an RFI/market survey and/or user survey form to collect software suppliers' information. Collect any information to assist further evaluation and mitigate the acquisition risk.

The RFI should consist of general company and domain specific information.

a) General company information includes company size, founder/executives, location(s), subsidiaries, product roadmap, service cost, financial information (capital and/or statements), and quality process/system. Annex A, Checklist 3 may be helpful.

b) Domain specific information such as domain specific technology/knowledge, expertise, development resources, patent list, and test equipment is required for further evaluation. Information from Annex A, Checklist 2 may be helpful.

The RFI and user survey needs to be managed to determine who should receive it. The supplier list may be obtained from technical alliance membership lists, exhibition and/or trade publications, consultants, supplier chain management (refer to ISO/IEC/IEEE 12207). The user list can be obtained from suppliers' website, consultant, or other stakeholders' recommendation.

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A task owner should be assigned to distribute the RFI and/or user survey form to appropriate suppliers or users. She/he should also be responsible for collecting the RFI and user survey response. The RFI and user survey form should define the deadline for response submission.

5.5.3.2 Review software supplier's information

Review the general company information and filter out those are not appropriate for the software to be acquired. The criteria, especially security and/or financial, should be defined according to organization's acquisition strategy, information from Annex A, Checklist 3 may be helpful.

Review domain specific information and user survey responses. The acquirer's project team should define criteria for the technical related thresholds such as quality process maturity level, person-years of expertise team experience, domain knowledge scope, patent(s) protection coverage, etc.

If a supplier has been contracted with before, review the suppliers' performance and commitment fulfillment.

The suppliers identified with capability insufficiency and/or bad user experience should be eliminated from the potential suppliers list. Suppliers without the capability to handle a large effort on their own may be awarded a portion of a project, as an encouragement to small businesses or to apply specific expertise.

5.5.3.3 Survey users of the supplier's software

One indicator of the quality and effectiveness of a software product is the number of satisfied companies currently using the software. Users can provide information on volume throughput planning and system degradation, and important insights on correcting software failures. The nature, quality, speed, and reliability of maintenance may be determined by exploring other users' experiences. The following should be considered:

a) Establishing functional and performance requirements.

b) Evaluating software product against the functional and performance requirements of item a).

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c) Evaluating the adequacy of the development process including the activities of quality assurance, configuration management, verification and validation, reliability measurement, documentation, and maintenance.

When preparing to contact users about a product, the questions suggested in Annex A, Checklist 6, may be used. This checklist can be easily modified to fit the acquirer's needs.

5.6 Step 4: Preparing contract requirements

5.6.1 Purpose

The purpose is to prepare a detailed contract for the engagement of the chosen supplier.

5.6.2 Outcomes

The outcomes of Step 4 are as follows:

- The desired level of quality of work is determined.
- Payment terms are determined.
- Remedies for non-performance are determined.
- Contract for engaging a supplier is produced and approved.
- Legal review opinion including caveats and limitations documented.

5.6.3 Activities and tasks

5.6.3.1 Determine the required quality of the work

The objective is to prepare a contract that describes the expected quality level of the finished work. The following should be included:

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a) Describe in the contract's statement of work the relationship between the supplier and acquirer, and who has responsibility for each task. The list of supplier and acquirer obligations developed from Annex A, Checklist 4, may be used (see 5.5.3).

b) Describe in the contract what will be delivered, and what constitutes satisfactory and timely performance by the supplier (see Annex A, Checklist 7.).

c) Specify who is authorized to make changes in the contract and to answer supplier questions.

d) Consider providing in the contract means to monitor the supplier's progress. To do this, divide the development effort into logical work steps. The more undefined the software is, the closer the steps should be at the outset. The acquirer's approval should be required for each step before the development is allowed to continue to the next step. Identify performance as well as functional specifications.

e) Specify what measures will be used to determine the acceptability of the product or service. Service contracts often include service level agreements (SLA) that define an acceptable level of service. Agreements for developed software can require acceptance testing in the acquirer's environment.

f) Specify the measures of reliability and quality by which the supplier's work will be evaluated. The list of quality objectives developed from Annex A, Checklist 5, may be used.

g) Specify the criteria for software evaluation. The list of criteria developed from Annex A, Checklist 10, may be used.

5.6.3.2 Determine how payment is to be made

The objective is to create a contract that ties supplier payments to contract deliverables (see Annex A, Checklist 8).

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5.6.3.3 Determine nonperformance remedies

An objective of this step is to prepare a contract that provides the acquirer the right to terminate the contract if the supplier cannot perform according to the contract's terms. The satisfactory performance and acceptance testing criteria developed from Annex A, Checklist 7, can be used to identify work that does not meet contract requirements.

Include a provision requiring the supplier to deliver, at contract termination, all agreed deliverables.

Complex projects where there is significant risk in achieving the contract requirements should include a provision that requires the supplier to deposit with an escrow agent source code, documentation and other material deemed appropriate by the acquirer.

5.6.3.4 Prepare contract provisions

Contract provisions should be developed according to the acquirer's needs. Consideration should be given to the following when preparing the contract:

- Review the objectives previously described in 5.5.1. Select those provisions that represent the acquirer's business practices that influence or contribute to obtaining a high-quality product.
- Identify the contracting method most appropriate for acquiring software products or services from suppliers.
- Incorporate in the agreement the acquirer selected provisions. Review existing agreements and consider including favorable contract provisions used successfully in the past.
- Incorporate in the agreement appropriate contract exhibits describing the work required, deliverables, support, and training (see Annex A, Checklist 2) and the acceptance requirements (see Annex A, Checklist 7, Checklist 10, and Checklist 12).

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5 Software acquisition alternatives

5.1 General

Acquiring software from an external supplier is an alternative to developing the software internally or continuing without new or changed software. As shown in Figure 2, acquirers may acquire custom software, off-the-shelf (OTS) software, open-source software (OSS) which often is free (FOSS), software as a service (SaaS), or related services, including analysis, design, development/implementation, testing, maintenance, support, and operations. Moreover, acquirers may acquire custom software by having software developed from scratch, or by having off-the-shelf software, or their own software, modified in a material fashion. Similarly, software as a service can be acquired and implemented without modification or subject to modification. Modifications can include other off-the-shelf and open-source software. Acquirers can themselves modify acquired software; however, modifications by the acquirer are not considered part of the acquisition. This document does not address acquisition of contract staff, where the contracted staff members function as extensions of the acquirer's internal staff.

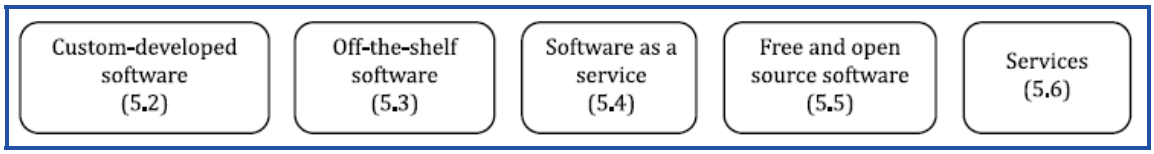

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Figure 2 — Software acquisition alternatives

~~4.1 Introduction~~

~~Software can be acquired in three different ways or a combination of the three. It is acknowledged that any combination of these three alternatives will make the overall software project more complex and likely to be different from each other. This document does not attempt to address the combinations of these three basics software acquisition options. The software acquisition alternatives include contracting custom-developed software, obtaining the right to use off-the-shelf (OTS) software and renting software as a service (SaaS). The advantages and disadvantages of each option are summarized in Table 1.~~

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5.2 Custom-developed software-

5.2.1 General

An acquirer seeking a custom approach to meeting its needs can develop the software internally or acquire the software by contracting with an external supplier to develop it, either from scratch or by modifying existing software. Custom development can combine a variety of custom software components and approaches, often in conjunction with acquiring existing software products, in which case characteristics of custom-developed software pertain to the parts of acquired existing software products affected by custom development.

Custom development is likely to be performed in accordance with one or more software development methodologies or life cycles, which may be specified in the contract. When methodology is not so specified, it is left to the discretion of the supplier, for whom having control over development practices can impact the supplier's productivity and overall performance. The contract also usually requires that the supplier deploy the identified methodologies in accordance with the acquirer's or supplier's policies or identified standards.

A well-structured development agreement should provide that the developer is responsible for all work required to complete the development other than enumerated tasks specifically retained by the acquirer. Importantly, the acquirer should retain only those responsibilities that it is better positioned to perform than is the supplier, such as defining its business requirements and performing user acceptance testing. An acquirer may engage a supplier's assistance defining the acquirer's business requirements; and in general, to avoid conflicts of interest, such a supplier of requirements definition services often is precluded from proposing to deliver software to meet the acquirer's business requirements.

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~~Reaching an agreement, often a formal contract for the custom development is an acquisition approach where the solution to an acquirer's need is provided via hiring a supplier (outsourcing) or using an internal team to custom develop a software solution that is built to a specification or set of requirements. Following software development standards and known methods, the acquirer oversees the development, test activities, and products performed by the supplier. At acceptance, the acquirer takes ownership of the solution and possibly some of the supporting tools/methods in order to support ops/maintenance of the solution. This option includes software built from scratch and/or integrated from other existing components (e.g., reuse, modified FOSS).~~

5.2.2 Advantages of custom-developed software

The advantages of custom-developed software are as follows.

— The acquirer can achieve capabilities which cannot be achieved as effectively by internal development or by using existing software, such as off-the-shelf products. Such capabilities can include unique functionality, ease of integration with current business and development processes, meeting performance levels and other quality factors (often called "non-functional requirements" or "ilities"), and integration with other systems and software.

— A particular supplier can have specific knowledge, skills, or technology not available internally to the acquirer.

— The acquirer can have greater control over the software development, can monitor the course of development/test and, depending on the terms of the development agreement, more flexibly change its requirements or other aspects of development – though often at additional cost.

— The acquirer installs the software on its own infrastructure or controls the decision regarding the infrastructure on which the software is deployed, giving the acquirer greater control over operations and access to its data.

~~— The solution should match the need exactly, no more or no less.~~

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~~— The acquirer can require that flexibility and maintainability be supported by the solution and by the supplier of the solution.~~

~~— The acquirer can monitor and influence the course of development/test in case changes are deemed appropriate.~~

~~— The acquirer can control and influence the related topics to the executable software solution (e.g., size, performance, information protection, authorization security, capacity) and the software development environment (language, tools, etc.).~~

~~— If a problem is reported, the acquirer can determine if the problem legitimately violates the specifications and if it does, the supplier should be responsible for fixing that problem, typically at no additional cost to the acquirer.~~

~~— Changes after acceptance are typically still under control of the acquirer via an ops/maintenance agreement with a possibly different ops/maintenance supplier.~~

5.2.3 Disadvantages of custom-developed software~~.~~

The disadvantages of custom development include that it typically ~~developed software are as follows~~:

— increases the risk that the implementation is not successful, especially with regard to areas requiring specialized skills and knowledge, including newer technologies, security, and compliance with laws, regulations, and standards;

— ~~Typically~~ costs more than the alternatives; ~~other options.~~

— ~~Typically~~ takes more time ~~(sometimes much more)~~ than the alternatives; ~~other options.~~

— can incur intellectual property rights issues, including when open-source or other third-party software is incorporated within the customized software or where the supplier applies possibly proprietary techniques or resources in the custom development.

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5.3 Off-the-shelf (OTS) software

5.3.1 General

An acquirer may satisfy some or all of its requirements, including security and other non-functional requirements, by acquiring and implementing existing (OTS) software on assets owned by it or on a third-party's infrastructure. OTS software can be acquired directly from the software's owner/author or sometimes from a third-party supplier, vendor, or system integrator which the software's owner/author has authorized to supply to acquirers.

Existing software is typically licensed in 'as is' condition, although many OTS software products include capabilities for built-in 'tailoring' of the product to choose from limited sets of predefined capabilities variations. In addition, the supplier of OTS software often provides some maintenance changes to all users of the product, typically for an additional annual charge. Some OTS software includes source code which enables more extensive customization by the acquirer or suppliers. Such customization runs the risk of conflicting with the product's capabilities that its supplier supports and can result in more effort and time than initially planned.

The preponderance of OTS software acquisition involves "shrink wrapped" software or "apps" where the acquirer ordinarily has no direct relationship with the supplier. Thus, the acquirer takes the entire burden of responsibility for determining whether the product satisfies their needs, often without adequate information. The producer of the software makes no promises to the acquirer that the product meets the acquirer's specific needs. Therefore, the acquirer should clearly and accurately identify their needs. This document's treatment of OTS software pertains to products warranting a more explicit and conscious acquisition process than consumer products and usually involves the acquirer's more direct interactions with the supplier.

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~~This is an acquisition approach where the solution to an acquirer's need is provided via purchasing and taking possession of an already built solution from a software supplier. The acquirer agrees to the seller's license agreement to use the "executable" version of the solution but typically does not have access to the source code or other information about the solution or the processes used to produce that product. In addition, the acquirer typically takes possession of the software solution and installs in on assets owned by the acquirer. In addition, the solution is typically acquired in "as is" condition, unless the supplier offers built in tailoring of the product (and this more common than not). This option includes commercial off theshelf (COTS), free and open source software (FOSS) products acquired in "as is" condition, and other non-developmental items (NDI).~~

5.3.2 Advantages of OTS software

The typical advantages of OTS software are as follows:

— is less costly to acquire and implement than to develop and implement custom software;

— can be implemented and elevated to production more rapidly than custom developed software (although this can take more time to implement and elevate than SaaS);

— has less risk that the software will not satisfy requirements because the acquirer can observe and evaluate the software prior to agreeing to acquire it;

— compared to SaaS, gives the acquirer greater control over the decision regarding the infrastructure on which the software is deployed, control over operations and access to its data.

~~— Cost is less than the custom-developed option but similar to the SaaS option.~~

~~— Time to initial operations is less than the custom-developed option and can be greater than the SaaS option.~~

~~— Since the acquirer takes possession of the solution, the control over data and access is greater than the SaaS option and about the same as the custom-developed option.~~

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5.3.3 Disadvantages of OTS software

The disadvantages of OTS software are as follows.

— Depending on the parties' relative leverage, it can be difficult for the acquirer to negotiate favourable license terms, and the negotiated license terms can limit the acquirer's use of the software.

— The software can partly satisfy the acquirer's needs, so that additional solutions, or modifications to the acquired solution, are needed to fill these gaps. Moreover, the software can provide features or capabilities that are not required or desired and that add cost and complexity to the solution. The acquirer can be unable to modify the OTS software accordingly to address differences from the acquirer's needs or can incur extra costs, delays, and risks attempting to do so.

— The acquirer often decides to make changes to its business processes and other systems to realize the benefits of the OTS software. Such changes, or failing to make such changes, can take time, be costly, and increase risks to business effectiveness, especially where users resist such changes.

— Maintaining software written by someone else is inherently risky.

— Typically, support for the software comes from the supplier or a third-party familiar with the software for installation, maintenance, and operational support. Realization of the benefits of the software depends in part on the quality of such services, which in turn rely on the supplier or other third party's capability and capacity, and the terms negotiated by the acquirer, on the one hand, and the supplier or other third party, on the other hand.

— Upgrades, new releases, and new versions are controlled by the supplier and determined by marketplace needs. Such changes can be inconsistent with the acquirer's needs. Moreover, supplier maintenance can be dependent on the acquirer implementing such upgrades, new releases and new versions which can be incompatible with the acquirer's then current environment.

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— Because the acquirer usually is dependent on the supplier of OTS software for the software's support, maintenance, and upgrades, the acquirer is continually at risk of no longer receiving suitable support, maintenance, and upgrades necessary for the continued successful use of the software. In some such instances, the acquirer can lose access to its data. Such risks often are realized when the OTS supplier changes business directions or ceases to operate. Contractual provisions, such as software escrow, may in some cases mitigate such risks. However, an acquirer can find itself in the unexpected position of having to support software which it had acquired in part because of the anticipated availability of supplier support at reasonable rates.

5.4 Software as a service (SaaS)

5.4.1 General

An acquirer can satisfy some or all of its requirements by acquiring software as a service (SaaS) which provides the acquirer remote access to an operational version of the software on the supplier's infrastructure or on infrastructure of a third-party under contract with the supplier. Inputs to the remote software product are transmitted to the supplier and outcomes/results/products from using the software product are transmitted back to the acquirer typically using external networks or the internet. This acquisition option is not limited to but frequently is part of the cloud computing approach (the ISO/IEC 22123 series) to software (i.e. renting access to products, services, infrastructure, etc.).

~~Software as a service (SaaS) is an acquisition approach where the solution to an acquirer's need is provided via an agreement with a supplier for access to a software product for a fixed amount of time and to use that software product remotely, via connection (wired, wireless, etc.) to the supplier's assets. Inputs to the remote software product are transmitted to the supplier and outcomes/results/products from using the software product are transmitted back to the acquirer. This acquisition option is part of the Cloud Computing approach (NIST Special Publication 800-145 [B12]) to software (aka renting access to products, services, infrastructure, etc.) and is frequently referred to as software as a service (SaaS).~~

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5.4.2 Advantages of software as a service (SaaS)

The advantages of SaaS are as follows.

— As with OTS, there is less risk that the software will not satisfy requirements than custom software because it can be observed in operation prior to acquisition.

— Typically, SaaS can be implemented more rapidly than OTS or custom software.

— Typically, there is no need for the acquirer to provide internal computing assets to support developing, operating, maintaining, and supporting the equivalent products or services, thus reducing costs and time in preparation for using the solution, as compared to both custom-developed and OTS.

— Typically, implementation of SaaS is less risky than is implementation of OTS or custom software. The SaaS supplier assumes more of the risk compared to in-house operations.

~~— Rapid access to products and services via Service Level Agreement (SLA) and ready to use solutions, more so than custom-developed or OTS.~~

~~— No need to provide internal computing assets to support "building or buying" the equivalent products or services, thus reducing costs and time in prep for using solution, as compared to both custom-developed and OTS.~~

~~— Typically is cheaper than custom-developed option and can be cheaper than the OTS option.~~

~~— No need to take permanent ownership of the software solution, thus reducing impacts associated with such ownership (e.g., sustainment, hardware to host solution), as in the custom-developed and OTS options.~~

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4.4.2 Disadvantages of SaaS

The disadvantages of SaaS are as follows:

- The terms of the generally non-negotiable license agreement constrain how the solution may be used by the acquirer, possibly to the acquirer's detriment. The solution typically includes features that attempt to enforce specific agreement terms, adding cost and complexity to the solution.

- The solution may not satisfy all of the acquirer's needs (sometimes called gaps) and it may also provide features/capabilities that are not required, not desired or even tolerable to the acquirer. The acquirer may need additional solutions, or modifications to the acquired solution, to fill these gaps. In addition, the acquirer may also need to identify and deactivate or prevent the extraneous code from activating itself.

- The location of where the data is stored is not controlled by the acquirer; therefore the data (personal data, sensitive data, etc.) could be subject to the rules and regulations of the locality of the supplier.

- In the event the supplier is no longer a case of e.g., bankruptcy of supplier, potentially the acquirer's data could be lost.

- The user interface to the solution may be different from the way an acquirer is currently offering a user interface to their current users. This can sometimes/often be solved via product tailoring.

- Protection of data, being transmitted in both directions due to dependency on supplier's capabilities. This may require internal protections or legal agreements if this protection should ever fail or be compromised.

- Problem reporting and problem correction of a solution, if it does not work as desired: Supplier may not agree with nature of the problem or may not be able to fix in a timely manner. Similar to OTS and more problematic than custom developed.

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- ~~Assured access to solution due to dependency on external assets. Again, backup/alternative paths to supplier's assets may be required or legal recourse in case of loss of access. This is typically a bigger risk than for custom-developed or OTS options.~~

- ~~Recovery from loss of access to or other failures of the solution may be dependent on the supplier's abilities and sometimes out of the control of the acquirer.~~

- ~~Product changes, both fixes and upgrades, are controlled mostly by the supplier and determined by marketplace needs. Such changes may not be consistent with the acquirer's ongoing needs or timeframe.~~

- ~~It is possible for the vendor to go out of business resulting in a possible loss of data.~~

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