

4 WRITING IN A NATURAL LANGUAGE

course “software requirements and architecture”

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contents

- ① Template for the requirements document
- ② Guidelines for writing
 - Issues to consider
 - Issues to avoid
- ③ Ambiguity

contents

1 Template for the requirements document

2 Guidelines for writing

- Issues to consider
- Issues to avoid

3 Ambiguity

need for a structure

- The project team is responsible for the edition of the requirements document.
- It is an activity that demands a great care, namely with respect to all the details of the document.
- The definition of a **generic template** for the documents that specify the requirements is an important aspect, since there is a great diversity of engineering systems and projects.
- Without that template, the degrees of freedom are excessive, making the documents quite different from case to case.
- The existence of a pre-defined structure is very useful, specially for highly-complex systems.

voluminous documentation

“Voluminous documentation is part of the problem, not part of the solution.”

Tom DeMarco (1940–), software engineer



generic structure for the requirements documents

Project triggers	13. operational 14. maintenance and support 15. security 16. cultural and political 17. legal
Restrictions of the project	18. open issues 19. immediate solutions 20. new problems 21. tasks 22. migration to the new system
Functional requirements	23. risks 24. costs 25. user manual 26. waiting room 27. ideas for solutions
Non-functional requirements	
10. appearance 11. usability 12. performance	

contents

1 Template for the requirements document

2 Guidelines for writing

- Issues to consider
- Issues to avoid

3 Ambiguity

writing of the requirements

- Writing requirements in a natural language is inescapable.
- It is not expectable that all stakeholders are able to interpret formal requirements specifications.
- Engineers must be able to write requirements in a natural language.
- The engineer, in general, must know how to communicate with any common person.
- Writing in an effective way is a task prone to errors.



- Writing requirements, according to a set of principles and recommendations, is important.
- Writing requirements requires continuous enhancement, through training and practice.

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writing of the requirements



writing of the requirements

- There are no magical formulas to write well, since writing is an art.
- The option for writing requirements in a natural language without any restriction presents several advantages:
 - ① there are no limits to expressiveness,
 - ② it is understandable by all literate persons,
 - ③ it does not require any specific training.
- Free writing presents normally many ambiguities.
- The final quality varies from case to case.
- It is crucial to find some principles that aid in writing good requirements.

technical writing



- Writing requirements for engineering systems must obey the basic rules of technical writing.
- The language must be simple, clear, and precise.
- Figures of speech, like metaphors or similes, should not be used.
- The words should be adopted in their denotative meanings, with no space for possible alternative interpretations.
- Technical writing must be done in an impersonal, objective, clear, humble, and polite style.

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standardised format for user requirements

- a subject that indicates the type of **users** that benefit from that requirement;
- an intended result to achieve with the requirement (using a predicate):
 - verb (i.e., **functionality** to be performed),
 - other sentence elements to complete the predicate: (direct, indirect, prepositional) objects, predicatives, and adjuncts,
- a mechanism to allow a **test** for the requirement to be defined.

(users)
(functionality)
(object/concept)
(test)

The hotel receptionist
should visualise
the room number of a guest,
2 s after making the request.

user stories

- Some agile methods propose the adoption of a different format.
- A **user story** is a simple and short description of a functionality, made in the perspective of the person that needs it.
- It is materialised through a set of sentences that describe what the users do or need.

format

As a <type of user>, I want to <objective> for <reason>.

As a hotel receptionist, I want to visualise the room number of a guest for calling him if someone wants to contact him.

- This format puts the **user** as the focus of attention and eases the identification of the sources.

standardised format for system requirements

- A subject, either the **system** under development or a design **entity** that is related to the requirement.
- an intended result to achieve with the requirement (using a predicate):
 - verb (i.e., **functionality** to bring about),
 - other sentence elements to complete the predicate: (direct, indirect, prepositional) objects, predicatives, and adjuncts.

(system/entity)	The signal of the battery
(functionality)	must turn on,
(description)	when the charge is lower than 20 mA h.

standardised format for non-functional requirements

- the **system** under development or a design entity that is related to the requirement.
- a **quality** to be achieved with the requirement:
 - verb (in some cases, a verbal form of “to be” or “to have”, or something equivalent);
 - object (i.e., a description).

The product shall be easy to use for illiterate persons.

The product must continue to function at 30 metres under water.

The product must be prepared to be translated to any language.

The source code of the product programs should contain comments.

short and simple sentences

- Each requirement must be represented by one sentence and each sentence should just represent one requirement.
- The objective is to have the requirements written clearly and this presupposes short and simple sentences.
- The sentences must be affirmative and written in the active voice.
- One must avoid negative sentences or written in the passive voice.
- References to other documents should be limited, especially those with restricted and limited access.

short and simple sentences

“Make everything as simple as possible, but not simpler.”
Albert Einstein (1879–1955), physicist

short and simple sentences

Simplify the following sentences:

It is a device that allows the client to record and store his favourite programming to watch whenever he wishes, in addition to pause, go forward and backward. Additionally, it allows different programs to be recorded and viewed at the same time, so the client will always be able to continue to watch a program that for some reason he could not finish at that moment.



short and simple sentences

Simplify the following sentences:

It is a device that allows the client to record and store his favourite programming to watch whenever he wishes, in addition to pause, go forward and backward. Additionally, it allows different programs to be recorded and viewed at the same time, so the client will always be able to continue to watch a program that for some reason he could not finish at that moment.



The user records a TV program.

The user watches a previously recorded TV program.

...

limited vocabulary

- Utilising limited vocabulary must constitute a concern.
- Avoid the use of terms that may create confusion, especially synonyms of words that represent important concepts.
- student: undergraduate, postgraduate, scholar, tutee, freshman, freshwoman, finalist, sophomore.
- Acronyms and abbreviations must be used with great care.
- It is difficult not to resort to expressions already established: BIOS, ERP, GNU, JPEG, MP3, PDF, RAM, SMTP.
- One should avoid using synonyms just to make the text less repetitive.

ambiguity

- Ambiguity is an important question to handle when writing requirements.
- Its occurrence means that there are two or more possible interpretations for a sentence.
- The situations of ambiguity must be corrected, with the objective of making a sentence clearer.
- The sentences can be complemented with other materials (tables, figures, schemes), to make the meaning clearer.
- Ambiguity is manifested also when two or more conflicting requirements are defined.
- The resolution can be solved through negotiation techniques.

vague terminology

- Many words, used informally to indicate desirable characteristics for a given system, are too vague.
- Examples: easy to use/learn, versatile, flexible, intuitive, modern, improved, efficient, approximately, more possible, minimal impact.

The e-mail application must have an intuitive user interface.

- Complement the writing of the requirement with the definition of verifiable criteria.
- The interface is intuitive if, in the first utilisation of the application, with no help, 85% of the users are able to perform the most basic tasks after 25 minutes.

illusions and fantasies

- In engineering, there are no perfect components.
- One should avoid any sort of wishful thinking, in which one is trying to reach the impossible.
- The project team must have a realistic attitude, rejecting any requirement that has an illusory or unrealistic idea.
- Do not use: 100% reliable, totally safe, never fails, satisfies all users, handle all unforeseen situations.

The printer shall be always operational.

The software application shall handle all unexpected errors.

The biometric authentication system shall be 100% reliable.

multiple requirements

- Requirements that contain coordinating conjunctions are especially susceptible to create ambiguity situations.
- avoid the use of coordinators like: for, and, nor, but, or, yet, and so (FANBOYS).
- The solution in these cases consists in dividing one requirement into simpler ones.

The guest shall pay the bill with money or credit card.

The system shall produce a beep or visual signal to be sent to the director or secretary.

beep	●	●	●				●	●	●
visual signal				●	●	●	●	●	●
director	●		●	●		●	●	●	●
secretary		●	●		●	●		●	●

design

- One should avoid indicating how the system will be able to satisfy a given requirement.
- This implies that the requirement has too much detail and that design decisions are taken prematurely.
- It may mean that one is losing the opportunity to consider more adequate technical solutions.
- The focus of the writing process should be on functionalities that the system will provide to its users.
- The reference to component names, materials, database fields, or technological aspects should be avoided.

The clock shall present the current civil local time, by receiving code time signals from a radio station.

The guest shall complain about the hotel services through a form available in the web.

project plans

- Project plans and the way the project is scheduled are important aspects to consider.
- They should not be included in the requirements document.
- One should avoid the inclusion of dates, phases and project activities in the requirements.
- That type of information must be available in a different document (project plan).



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definition

- Whenever one writes a requirements document, the principal objective is not highlighting the writing abilities of the author.
- The aim in general with a technical document is fundamentally clarity.
- It is important to avoid ambiguous sentences, since they cause difficulties and doubts in the interpretation.
- Ambiguity characteristics of the words, expressions, or sentences that express more than one possible understanding.
- It is widely used in poetry, publicity or jokes, but it must be banned from technical texts.

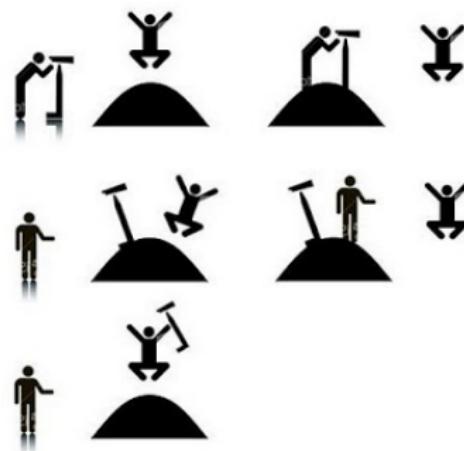
ambiguous sentences

Look at the dog with one eye.

They are hunting dogs.

Those prosecutors have been trying to lock him up for ten years.

I saw a man on a hill with a telescope.



homonymy and polysemy

- Homonymy and polysemy constitute possible causes of lexical ambiguity.
- **Homonymy:** occurs when two or more distinct and unrelated meanings accidentally share the same lexical form.
- **Polysemy:** occurs when the same lexical unit supports two or more distinct meanings, but somehow semantically related.
- The difference between homonymy and polysemy is not always easy to establish.

The secretary of the director is tall.

The secretary of the director is unsympathetic.



possessive pronouns

- Some forms of ambiguity are related to the use of possessive pronouns in the third person (in the singular or plural).
- This occurs after referring to more than one subject.

The director call the doctor about his problems.

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The director calls the doctor
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conjunctions

The managers inform the directors and the secretaries, because they are responsible for editing the document.

conjunctions

The managers inform the directors and the secretaries, because they are responsible for editing the document.

The managers inform the directors and the secretaries, because the latter are responsible for editing the document.

The managers inform the directors and the secretaries, because both of them are responsible for editing the document.

- A problem of interpretation exists when, after an enumeration, one writes something that can be applied to all the elements enumerated or just to the last one.
- The enumerations are responsible for various ambiguity situations, so they need to be handled with especial attention.

conjunctions

- In the common language, the terms ‘and’ and ‘or’ have often identical practical effects.
- Their use must be well analysed.
- Both are conjunctions and in the case of ‘or’ its value can be either inclusive or exclusive.
- This situation differs from what happens in mathematics, where the Boolean operator AND is distinct from the Boolean operator OR.
- A term that should not be employed in technical documentation is ‘and/or’, since it is a source of ambiguity.
- It is always preferable to use only ‘or’ than ‘and/or’.

conjunctions

The club accepts, as members, men and women.

- ... men or women.
- ... tall and thin men.
- ... tall or thin men.
- ... tall men and thin men.
- ... any tall and thin man.

Anthony and Barbara shall call Charles.

- ... shall each call Charles.
- ... , acting collectively, shall call Charles.

This law is valid in Angola, São Tomé and Príncipe and Mozambique.

- ... (1) Angola, (2) São Tomé and Príncipe and (3) Mozambique.
- ... (1) Angola, (2) São Tomé and (3) Príncipe and Mozambique.

Summary

- The use of requirements written in a natural language is common in engineering projects.
- It fosters communication among the various stakeholders.
- Writing is a task prone to errors and problems, since what is written often is interpreted in a different way than intended.
- A set of practical recommendations for writing good requirements in English was described.
- Having the requirements written in a clear and standardised way results in advantages for all participants in a given project.
- The structure of a standard template for documenting requirements, with 27 possible sections, was discussed.
- Ambiguity-related issues in natural languages are discussed.
- Ambiguity happens when there are two or more possible interpretations for a sentence.
- Ambiguity is addressed for highlighting some aspects to be taken into account when writing requirements.

bibliography

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