GECO: USER MANUAL

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Acronyms:

ARB  Anomaly Review Board
CD   Conceptual Design
CRB  Configuration change Review Board
DD   Detailed Design
MTBF Mean Time Between Failures
MTTF Mean Time To Failure
MTTR Mean Time To Repair
NRB  Non-conformity Review Board
PD   Preliminary Design
PRD  PRoDuction Phase
PT   Product Tree
RAMS Reliability, Availability, Maintainability, Safety
XML  eXtensible Markup Language
## Change Control

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1. SUMMARY

This is the User Manual of Fractal GEneral COngfiguration Management Tool (GECO).

In this manual, you will learn:

➢ GECO functionality
➢ How to use the application step by step and
➢ How to handle the problems that could arise.

2. GECO OVERVIEW

The goal of GECO is twofold: firstly, to assist the System Engineering Group to control and maintain the configuration items of a system, both in the development phase and in the operation and maintenance phase; secondly, to make this information available to the other groups within the organization or the consortium in charge of developing and operating the System.

Developing a proper System Engineering Plan is a distinctive advantage for leading a project to success. During the implementation of such plan, the system configuration data are generated: Product Tree (PT) elements, requirements, interfaces, specification documents, procedures, reports, etc. The amount of information keeps growing in size and complexity along the project’s lifetime, to such an extent that it becomes virtually impossible to manage all that information without the aid of specific computer-based tools.

Specifically, the system information that can be stored and controlled through this tool is:

- The Product Tree elements and the parts
- The table of interfaces.
- The requirements, interface requirements and the relationships between parent and child requirements.
- The requirement verification matrix
- The configuration changes
- Non-conformities
- Verification and operation anomalies
- RAMS components of repairable systems
- RAMS components of systems without repair
- The project documentation, i.e. specification documents (at the system and subsystem level); interface specification documents; tests, analysis and assessment documents; etc.
2.1 GECO Functionality: A quick look

The configuration information is hierarchically distributed following the Product Tree of the system. This provides an intuitive view of the system’s breakdown structure, and thus allows the user to access, with a few mouse clicks, to a Product Tree element, its requirements, interfaces, associated documents, etc.

Each Product Tree element shall have a code that identifies it uniquely. Using a consistent, manageable coding convention is paramount, as this code shall be the base for assigning codes to the rest of the configuration items: documents, requirements, interfaces, etc. The user defines the PT element code, and then the Configuration Management Tool shall generate automatically the codes of the remaining configuration items; the user can either accept or modify such codes, but the tool shall check that the codes are not duplicated or inconsistent.

The General Configuration Management Tool provides the following functionalities, which we describe as displayed in the tool corresponding to the different folders on the top bar (underscored and bold letter is used to press on the keyboard to execute the command):

❖ File utilities: the commands included here are:
  o Print view, for printing the selected view
  o Exit for closing the tool

❖ Views: the Data Views screens (see section 4.2) allow the user to visualize as a table all the relevant information stored for a PT element. Once a PT element is selected on the screen, the following views are available:
  o Anomalies View
  o Configuration changes View
  o Documentation View
  o PT elements View
  o Interfaces View
  o Non-conformities View
  o Parts View
  o RAMS components of repairable systems View
  o RAMS components of systems without repair View
  o Requirements View
  o Verification matrix View

❖ Forms: Data input form screens provide forms for adding or modifying the data associated to each configuration item. Once a PT element is selected, any of the forms described below can be opened. The form provides access to all the records associated to the element, and allows the user to search or filter information based on the fields contained in the specific form.
- **Anomalies Form** (see section 13): this form allows the user to start new anomalies or to add information to the already existing ones. As in the case of configuration changes and non-conformities, the tool shall send notifications to the users in charge of the anomaly.

- **Configuration changes Form** (see section 11): it allows the user to start new configuration changes and to add information to the changes that already are in course (conducted actions, changes of status, affected documents, etc.). The process associated to the configuration changes may range from very simple (when the change considered does not affect other elements of the system) to rather complex (when other elements or different working groups are involved). In any case, the application helps to coordinate this process by sending the necessary notifications to the users affected by the change, as the configuration change goes through its lifecycle (approved, rejected or finalized), i.e. it guides the user through the lifecycle defined for a configuration change.

- **Documentation Form** (see section 10): this form allows the user to enter or to modify the documents associated to the project by connecting them with PT elements. They may be requirement specification documents, analyses, reports, procedures, etc. It is essential that the Configuration Management Tool contains the project documents, or at least it can link them from another database, as the requirements are usually traced to documents (analysis documents, reports, etc.) that contain the rationale for the requirement, and therefore they help to understand the consequences of a configuration change.

- **PT elements Form** (see section 5): where the definition of the elements of the PT can be introduced and be modified, for example the related documents, etc.

- **Interfaces Form** (see section 7): this form allows the user to define and to modify the interfaces among the PT elements, thus showing which elements are related to each other.

- **Non-conformities Form** (see section 12): this form allows the user to start a new Non-conformity, as well as to add new bits of information to the already existing non-conformities. As in the case of the configuration changes, the tool sends notifications to the users affected by the Non-conformity as it goes through its lifecycle (approved, rejected or fixed), i.e. it guides the user through the lifecycle defined for a Non-conformity.

- **Parts Form** (see section 6): where the definition of the Parts can be introduced and modified (for example the related documents, etc.)

- **Requirements Form** (see section 8): this form allows the user to enter new requirements, or to modify the already existing requirements, associated to a certain PT element. A major functionality of this form is the ability to track down this requirement to other requirements or to documents, what is crucial for identifying what a configuration change or a non-conformity actually involves. This utility is used for assessing the impact of the proposed change in terms of scope, schedule and price, and it is one of the major goals of the Configuration Management Tool.

- **RAMS components for repairable systems Form** (see section 14): this form allows the user to create or modify RAMS components and their relationships. RAMS components are not necessarily linked to PT elements. The functionality
of this form is to calculate the global availability (in terms of percentage) and reliability (global MTBF and MTTR) of the set of components and subsystems created with the tool.

- **RAMS components for systems without repair Form** (see section 15): this form allows the user to create or modify RAMS components and their relationships. RAMS components are not necessarily linked to PT elements. The functionality of this form is to calculate the global system MTTF in order to verify the compliance of the reliability requirement are performed with the aid of a mathematical model that we call “Reliability model”, of the set of components and subsystems created with the tool.

- **Users Form** (see section 16): this form allows the administrator to enter or to modify the users authorized in the system.

- **Verification matrix Form** (see section 9): this form allows the user to enter and to modify the results of the verification tests.

**Tools:** The Configuration Management Tool provides a set of built-in utilities that are described below:

- **Consult requirement’s children** (see section 8.7): the tool shall display the requirements that are affected by a change in a higher level requirement. To do so, the parent-child relationships (traceability) that were introduced in the Requirements Form are considered.

- **Consult requirement’s parents** (see section 8.6): the tool shall display the requirements that are affected by a change in a lower level requirement.

- **Export requirements to XML** (see section 10.6): Automatic generation of the requirements document: the tool gathers the requirements of the selected PT element and then generates the document section where the requirements are specified; such section can be imported into the definitive formal specification document, as it is described in the corresponding chapter. The format of the generated document section is XML.

- **Export interfaces to XLS** (see section 7.6): all the interfaces of one subsystem and lower level elements will be exported to an XLS document.

- **Export PT elements to XLS** (see section 5.6): all the PT elements of one subsystem and lower level elements will be exported to an XLS document.

- **Export parts to XLS** (see section 6.6): all the parts of one subsystem and lower level elements will be exported to an XLS document.

- **Export Verification Matrix to XLS** (see section 9.7): all the verification matrix elements of one subsystem and lower level elements or of a document will be exported to an XLS document.

- **Import Verification Matrix from XLS** (see section 9.8): all the verification matrix elements of one subsystem and lower level elements or of a document will be imported to the application from an XLS document.

- **Export RAMS repairable system and system without repair calculations to XLS** (see section 14.6 and 15.6): all the RAMS components of one subsystem and lower level elements will be exported to a XLS document.
Export requirements to XLS (see section 8.8): all the requirements of a document will be exported to an XLS document.

Import requirements from XLS (see section 8.9): the requirement of a document will be imported to the application from an XLS document.

Filter data (see section 4.2.3): this allows the user to search or filter information based on the fields contained in the specific form or view.

Insert requirements into the Verification matrix automatically (see section 9.2): all the technical requirement of one subsystem can be automatically introduced in the verification matrix when the user decides that such subsystem is ready for being verified.

Verification Matrix summary view (see section 9.6): a summary view of the verification matrix elements of one subsystem and lower level elements will be exported to a pdf document.

The General Configuration Management Tool contains a database and a user-friendly graphical interface. The application uses a popular database, whereas the user interface is developed in Java, what makes it platform independent, i.e. it runs on Unix, Linux and MS-Windows operating systems.

**Help:** to give support while using GECO.

- About contains the application description
- User manual contains this manual in PDF format
3. INSTALLING GECO

3.1 Software requirements

The minimum software requirements to install GECO on your computer are the following:

- Windows XP/Vista or Linux 2.4 or greater
- The Java Runtime Environment 8.0 or greater
- MySQL Server v5.0 or greater (only needed in the server installation)

(For more information to download and install Java Runtime Environment and MySQL Server see the page [http://www.fractal-es.com/en/GECO.html](http://www.fractal-es.com/en/GECO.html))

3.2 MySQL Server configuration

After MySQL Server is installed (only needed in the server installation), there are a couple of parameters to be modified at my.ini MySQL options file in order to have working properly GECO database.

The options to add or modify are described in the following lines:

- **Character set and collation.**

  Add the following lines in the options file:

  ```
  [mysql]
  default-character-set=utf8
  [mysqld]
  default-character-set=utf8
  default-collation=utf8_general_ci
  ```

- **max_allowed_packet**

  Add the following lines in the options file:

  ```
  [mysqld]
  max_allowed_packet=100M
  ```

Note: When a MySQL client or the mysqld server receives a packet bigger than max_allowed_packet bytes, it issues a Packet too large error and closes the connection. If it happens, the max_allowed packet value can be increased from 100 MB to as much as 1GB.
3.3 GECO Installation

After the GECO software is downloaded and unzipped in your machine, launch GECO following the instructions in the file README-GECO.txt.

The installation wizard permits the user to perform the following two different installations:

- GECO Server installation to install GECO application and the database using the MySQL server running in this machine as described in section 3.3.1.
- GECO User installation to install only GECO application as described in section 3.3.2.

3.3.1 Server Installation

Once the installation wizard is executed:

1. The following license dialog will appear

   ![License dialog](image1)

   \(\Rightarrow\) Introduce the license number,
   \(\Rightarrow\) click Accept.

   If the license number is not correct, the installation will be cancelled and the following dialog will be shown:

   ![License error dialog](image2)

2. Once the license number is accepted, the following “working dir” dialog will be opened.
Figure 3: GECO Working dir dialog

→ Introduce the working dir or select it from an Open dialog by clicking the … button.

Figure 4: Open dir dialog

→ click Accept

3. The wizard will open the following GECO configuration wizard dialog.

Figure 5: GECO configuration wizard dialog

→ Select GECO Server option,

→ Click Continue.
4. The wizard will open GECO configuration wizard: Step 1 dialog, where the information about the MySQL server as well as GECO server name (networking name or IP) must be introduced.

![Figure 6: GECO configuration wizard Step 1 dialog](image)

- Introduce the **MySQL Server workdir** (path to the MySQL binary files) or select it from an Open dialog by clicking the … button,
- Introduce the **Server name**,
- Introduce the **MySQL port**,
- Introduce the **MySQL root user**,
- Introduce the **MySQL root password**
- Click **Continue**.

The wizard will install GECO Database and will also create the users needed by GECO application in the MySQL server.

If the information is not right or there is any problem with the MySQL Server, the installation will be cancelled and the following dialog will appear:

![Figure 7: Cancel installation dialog](image)
5. The wizard will open GECO configuration wizard Step 2 dialog, where the information that GECO application needs to send e-mails to GECO users must be introduced.

![GECO configuration wizard: Step 2 dialog](image)

*Figure 8: GECO configuration wizard Step 2 dialog*

- Introduce the **SMTP server name**,  
- Introduce the **e-mail account** (account created to send GECO e-mails, for example name@company.com),  
- Introduce the **e-mail account password**,  
- If the SMTP server needs authentication, select the checkbox *Authentication required by the server*,  
- If the SMTP server requires SSL, select the checkbox *SMTP server requires authentication*,  
- If the SMTP server requires SSL, introduce the SMTP port,  
- Click *Continue*.

6. The wizard will finish GECO installation and will start GECO application.
3.3.2 User Installation

Once the installation wizard is executed:

1. The following license dialog will appear

   ![License dialog](image)

   Figure 9: GECO License dialog

   ⇒ Introduce the license number,

   ⇒ click Accept,

   If the license number is not correct, the installation will be cancelled and the following dialog appears:

   ![Licence error](image)

   Figure 10: GECO license Error dialog

2. Once the license number is accepted, the following working dir dialog will be opened

   ![Installation wizard](image)

   Figure 11: GECO Working dir dialog
⇒ Introduce GECO *working dir* or select it from an Open dialog by clicking the … button,

![Open dialog](image)

*Figure 12: Open dir dialog*

⇒ click *Accept*

3. The wizard will open the following GECO configuration wizard dialog.

![GECO configuration wizard](image)

*Figure 13: GECO configuration wizard dialog*

⇒ Select the *User* option,

⇒ Click *Continue*.

4. The wizard will open GECO configuration wizard: Step 1 dialog, where the information about GECO server name (networking name or IP) and MySQL port must be introduced.
Figure 14: GECO configuration wizard Step 1 dialog

- Introduce GECO server name,
- Introduce the MySQL port,
- Introduce the MySQL database name,
- Introduce the MySQL database write username,
- Introduce the MySQL database write user password
- Introduce the MySQL database read username,
- Introduce the MySQL database read user password,
- Click Continue.

The wizard will configure GECO application according to the introduced data.

5. The wizard will open the following GECO configuration wizard: Step 2 dialog, where the information that the application needs to send e-mails to GECO users must be introduced.
3.4 GECO configuration file

The file geco.props is the GECO configuration file.

The parameter to configure are (the file path is $GECO_WOKRDIR/geco.props):

- **mySQLPort** -> MySQL port (for example 3306).

  ```
  mySQLPort=3306
  ```

- **mySQLHost** -> MySQL host name (for example localhost).
mySQLHost=localhost

- dbName -> MySQL database name (by default geco).
  dbName=geco

- userAdmin -> It’s the database MySQL user with the needs rights to can read/write the database.
  userAdmin=USERADMIN

- userRead -> It’s the database MySQL user with only read rights in the database.
  userRead=USERREAD

- passwordAdmin -> It’s the database MySQL userAdmin password.
  passwordAdmin=USERADMINPASSWORD

- passwordRead-> -> It’s the database MySQL userRead password.
  passwordRead=USERREADPASSWORD

- keyword-> -> It’s the keyword licence.
  keyword=KEYWORD

- mail.smtp.host -> Mail SMTP Host name of the company (for example mail.fractal-es.com).
  mail.smtp.host@mail.fractal-es.com

- mail.smtp.auth -> TRUE if the SMTP Mail Server need authentication, FALSE if not.
  mail.smtp.auth=TRUE

- mail.smtp.user -> e-mail user to manage the GECO e-mail service (for example docma@company.com).
  mail.smtp.user=docma@company.com

- mail.smtp.password -> e-mail user password to manage the GECO e-mail service.
  mail.smtp.password=password

- mail.from -> e-mail user to manage the GECO e-mail service (for example docma@company.com).
  mail.from=docma@company.com
In the case the mail SMTP server is secure (SSL), you have these other parameters:

- `mail.smtp.port` -> Mail SMTP port (for example 465).
  ```
  mail.smtp.port=465
  ```

- `mail.smtp.socketFactory.port` -> Mail SMTP socketFactory port (for example 465).
  It is the same that in the parameter `mail.smtp.port`.
  ```
  mail.smtp.socketFactory.port=465
  ```

- `mail.smtp.socketFactory.class` -> Mail SMTP socketFactory class. The value for this parameter has to be `javax.net.ssl.SSLSocketFactory`.
  ```
  mail.smtp.socketFactory.class=javax.net.ssl.SSLSocketFactory
  ```

**Note:** If you change the user and/or password of the generic userAdmin and userRead users in the MySQL server, you have to change the username and/or the password values in the geco.props parameter `userAdmin/userRead` and/or `passwordAdmin/passwordAdmin`.

**Note 1:** If you change the database name in the MySQL server, you have to change the `dbName` value in the geco.props parameter `dbName`. 

4. STARTING GECO

4.1 Logging into GECO

Once GECO is executed (see 3.3), the following Login window will appear:

![GECO Login Window](image)

*Figure 16: GECO. Login window*

- Introduce the *Username*,
- Introduce the *Password*,
- Select in the *View combo box* which view is going to be displayed whenever the logging in is successful (by default, the *Documents View* is selected).
- Click *Accept*.

If the login information is correct, the Main window will be opened.
4.2 Accessing the data

As it was described in the overview of the application (section 2), all the data are hierarchically distributed following the Product Tree of the systems. It allows the user to find quickly all the information existing in GECO associated with a particular Product Tree Element.

4.2.1 Changing Views

In the Main window application, the different views can be changed by selecting Views Menu → xxxx View or pressing ALT+V+x.

Where, xxxx can be any of the following:

- Anomalies (x: A)
- Configuration changes (x: C)
- Documentation (x: D)
- Product Tree elements (x: E)
- Interfaces (x: I)
- No-conformities (x: N)
Parts ($x: P$)
- RAMS components for repairable system
- RAMS components of systems without repair
- Requirements ($x: R$)
- Verification Matrix ($x: V$)

Whenever the view is changed, the Product Tree element selection comes back to the highest-level element of the tree.

Therefore, all records existing in GECO corresponding with the selected view will be displayed in the left part of the application.

4.2.2 Moving through the PT elements

In the Main window application, select a Product Tree element by clicking the desired element with the left button of the mouse.

The selected Product Tree element will be highlighted.

All records corresponding to the view previously selected and belonging to this Product Tree element (and, also, to the low-level Product Tree elements under the selected one) will be displayed in the left part of the application.

Those elements with lower level subsystems in the PT appear with a symbol (like a key). The horizontal / closed position indicates that the low-level subsystems exist but they are not currently shown while the vertical / open position indicates that the subsystems are being shown.

![Figure 18: Selected PT element (left) and its corresponding view shown at the right](image-url)
4.2.3 Filtering the data

The number of records to be displayed can be constrained by using the filtering option.

In order to filter the records, in the Main window of the application, select Tools Menu ⇒ Filter table … or press ALT+T+F.

A new window will appear,

⇒ Select in the Field combo box the desired field to filter the data. All the fields of the corresponding view will be displayed in the combo box.

⇒ Write in the Value text field the text that is going to be used to filter the previously selected field step, (upper and lower cases are not distinguished).

⇒ Define as many filters as wanted (by adding new lines),

⇒ Click Accept.

![Filter Dialog](image)

*Figure 19: Filter Dialog. Any field can be selected for any value*

In the Main window, the records displayed will have been filtered according to the criteria selected in the filter window.

4.2.4 Printing the data

The current view (i.e., the records that are currently displayed) can be printed using the printing option.

In order to print the records, in the Main window of the application, select File Menu ⇒ Print view or press ALT+F+P. The application will look for the printers connected to your computer and the print menu will be opened.

A new window will appear,

⇒ select in the Name combo box the printer to be used,

⇒ define the desired properties for this job,

⇒ click Accept,
4.2.5 Editing the data

In order to edit the data, the corresponding Form View of the record to be modified must be opened (see sections from 5 to 14 for a detailed explanation).

Whenever editing the data in the Forms, you have to take into account that:

The mouse cannot be used to copy or paste the fields, but to select part of the text inside a field. Then you can use the DEL key to delete the selected text. Also, you can use the key CTRL+C to copy a field and CTRL-V to paste a field.

4.3 Exit from GECO

In the Main window, select File Menu ⇒ Exit or press ALT+F+E.

The application will end.

4.4 Update GECO

Each time that the tool is launched it will connect to the Fractal server to check if there is a new version of GECO tool. If there is the case, a new window will appear,

⇒ The user can follow the instructions to update the tool and click OK, or

⇒ Click Cancel and launch the GECO tool without update it (it is not the recommended option).
5. PRODUCT TREE ELEMENTS

5.1 What is a Product Tree?

The product tree (PT, Product Tree) describes the hierarchic breaking up of a complex system into the necessary levels to be able to define the system completely. An example of a Product Tree is shown in the following figure:

![Product Tree Diagram]

Figure 22: Product Tree: a hierarchical organization of subsystems

From the project point of view, the Product Tree provides a representation of the whole system and breaks the system up into the subsystem levels that are going to be designed and procured independently.

Each Product Tree element (i.e., system, subsystems or components) must be uniquely identified by a Product Tree element code. These codes can be used as a base to uniquely identify other elements of the project such as interfaces, requirements, documents, etc.

5.2 Creating a new Product Tree Element

Starting at the Main Window of the application,
The following steps must be executed in order to create a new Product Tree element:

**A. Open the Configuration Elements Form.**

In the Main window, the Product Tree elements Form can be opened in two different ways:

**A.I. Going through the Forms Menu.**

In the Main window, select **Forms Menu ⇒ PT elements Form** or press **ALT+O+E**.

The PT Elements Form will be opened with all available records selected.

**A.II. Selecting a Product Tree element in the Product Tree elements View.**

In the Main window, click the **Views Menu ⇒ PT elements View** or press **ALT+V+E**.
Select a Product Tree element among the ones listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Product Tree Elements Form will be opened only with the selected record available.

**B. Add a new record.**

In the PT Elements form, new Product Tree elements can be created in two different ways:

**B.I. Starting an empty Product Tree element.**
In the PT Elements form (Figure 26), click the _Add button_ to add a new record.

A new PT elements Form will be opened empty and ready to be filled.

![Figure 27: PT Elements Form ready to introduce a new PT element without re-using information from other configuration elements already recorded in the database](image)

**B.II. Cloning an already existing Product Tree element.**

In the PT Elements Form (Figure 26), click the _Copy button_ to clone the Product Tree element that is currently selected in the form,

A new PT Elements Form will be opened with several fields cloned from the previous record and ready to be completed.

![Figure 28: Configuration Elements Form ready to introduce a new PT element by cloning an existing configuration element (an existing record). In this case we are cloning record #1 (see Figure 24)](image)
C. Fill in the new record.

In the PT Elements Form, the mandatory fields that must be filled in are the following ones:

- **Code.** Indicate the Product Tree element Code. The Code must be unique for each Product Tree element, because it is going to be used as the base to automatically generate other codes in the application, such as Requirements and Documents. If a code is defined equal to another already assigned to the database, the tool gives a warning and the record cannot be saved. This is a text field with a maximum length of 50 characters.

  The code pattern is as follows:

  **AA-AA-AA-AA**

  where:

  - **AA:** Product Tree Element acronym to be defined as any combination of alphanumeric characters (excluding the “%”). The length of this acronym is not fixed.

  The PT element code convention is defined before starting to use GECO. More information about it can be found in section 18.

  **It is very important** to define correctly the PT Elements Codes because the Product Tree structure (i.e., the dependency among the different levels of the PT elements) is established according to the Codes. GECO takes into account where the separator (in this case, “-“) is, to decide in which PT level each element is and, also, from which PT high level element this element is hanging.

  **AA-AA-AA-AA**

  1st level - 2nd level - 3rd level - 4th level

  ▪ **Name.** Describe the element in a short and concise way as possible. This is a text field with a maximum length of 200 characters.

  ▪ **Sub-subject.** Indicate which subsystem (or group inside the organization) is responsible for this Product Tree element. This is a text field with a maximum length of 20 characters.
- **Status combo box.** Select the status of the Product Tree element among the options offered in the Status combo box, which includes the following ones:
  - CD (Conceptual Design)
  - PD (Preliminary Design)
  - DD (Detailed Design)
  - PRD (PRoDuction Phase)

  By default, the reference line is “CD”.

If any of the mandatory fields are not filled, then the tool gives an alert and the record cannot be saved until all the mandatory fields have been introduced.

The rest of the fields that can be optionally filled are:

- **Date.** Indicate the creation date of the Product Tree element. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.

- **Description.** Describe the Product Tree element providing all the information that can be useful. This is a text field and it does not have a maximum length limit.

- **Document codes related to the Configuration Element combo box.** Select the code of the documents that are related to the Product Tree Element. In the combo box, all documents existing in the application can be selected and the user can select as many documents as required.

**D. Save the new record.**

In the Product Tree elements Form, click the **Save button** to save the record,

If the current record is not saved, the new record will not be created.

**E. Close the Product Tree elements Form**

In the Product Tree elements Form, click the **Exit button** to exit the form,

If the record has been saved, the Configuration Elements Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

*Figure 29: Warning Window reporting that changes have not been saved.*
5.3 Selecting a particular Product Tree Element

In the Main window, the form view of a particular Product Tree element can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select Forms Menu ⇒ PT elements Form or press ALT+O+E.

In order to find a particular Product Tree element, the following actions can be done:

⇒ Use the arrows for moving among the Product Tree elements currently selected in the form,

- To go to the first record of the selected ones,
- To go to the previous record to the current one,
- To go to the next record to the current one and
- To go to the last record among the selected ones

⇒ Use the Filter button to filter/un-filter the set of Product Tree elements currently selected in the form,

A new window will appear:

⇒ Click Data filter activated box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the Field combo box the desired field to filter the data,

⇒ select in the Op combo box how the previously selected field must match the defined Value (i.e., “starting with”, “contains”, “is”, and “ending by”)

⇒ write in the Value text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as required (by adding new lines),

⇒ click Accept,
B. Selecting the Product Tree elements in the Product Tree elements View.

In the Main window, click the Views Menu ⇒ PT elements View or press ALT+V+E.

In order to constrain (by Product Tree Element or by filtering) the number of Product Tree elements listed in the view, see the steps to be followed in section 4.2.

Select the desired Product Tree element among the Product Tree elements listed in the table at the right side of the window by double-clicking with the left button of the mouse.

5.4 Modifying existing Product Tree Elements

The Product Tree element to be modified must be already selected, which will be done by following the steps described in section 5.3.

In the Product Tree elements Form, the following steps must be completed in order to modify the selected Product Tree element.

A. Modify the desired fields.

Make the desired changes in the Product Tree element fields, taking into account all constrains identified in section 5.2, numbered item C).

All the fields in the Product Tree elements Form can be modified.

B. Save the modified record.

In the Product Tree elements Form, click the Save button to save the record,

If the record is not saved, the changes will not be applied.

C. Close the Product Tree elements form

In the Product Tree elements Form, click the Exit button to exit the form,

If the record has been saved, the Product Tree elements Form will be closed.
If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window reporting that changes have not been saved.](image)

- Click *YES* to exit without saving
- Click *NO* to come back to the Product Tree Form.

### 5.5 Deleting a Product Tree Element

The Product Tree element to be deleted must be already selected, which will be done by following the steps described in section 5.3.

In the Product Tree elements Form, the following steps must be done in order to delete the selected Product Tree element.

**A. Delete the record.**

In the Product Tree elements Form, click the *Delete button* to delete the record,

![Delete button](image)

A new window will appear to ask the user if he/she really wants to delete the record.

![Warning Window to check if the user wants to delete a record](image)

- Click *YES* to delete the record.
- Click *NO* to exit without deleting.

### 5.6 Export PT elements to XLS

In the Main window, click the *Tools Menu ⇒ Export PT elements to XLS.*

A new window will appear where the user must, first, introduce the subsystem and the file name and path to save the xls file, then, click *Accept.*
A new window (it is necessary to have any xls viewer installed) will show a list of the PT elements of the subsystem and lower level elements that has been just introduced.

![Figure 33: Window to insert the subsystem and filename/path to generate the xls file](image)

**Figure 33: Window to insert the subsystem and filename/path to generate the xls file**

After entering the subsystem, this window will show the result of the search of all the PT elements of this subsystem and lower level elements found in the database.

![Figure 34: After entering the subsystem, this window will show the result of the search of all the PT elements of this subsystem and lower level elements found in the database.](image)
6. PARTS

6.1 What is a Part?

A Part is the lowest level that can be reached in a system breakdown.

In order to maintain a complete inventory of the system, it is important to correctly identify all the system’s parts.

The information about parts will be also needed to define in detail the maintenance activities of the whole system.

6.2 Creating a new Part

Starting at the Main Window of the application,

![Figure 35: Main window of the application](image)

The following steps must be executed in order to create a new Part:

A. Open the Parts form.

In the Main window, the Parts form can be opened in two different ways:

A.I. Going through the Forms Menu.

In the Main window, select Forms Menu → Parts Form or press ALT+O+P.

The Parts Form will be opened with all available records selected.
A.II. Selecting a Part in the Parts View

In the Main window, click the Views Menu ⇒ Parts View or press ALT+V+P.

Select a Part among the Parts listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Parts Form will be opened only with the selected record available.
B. Add a new record.

In the Parts Form, new Parts can be created in two different ways:

B.I. Starting an empty Part.

In the Parts Form, click the Add button to add a new record,

A new Part element form will be opened empty and ready to be filled.

B.II. Cloning an already existing Part.

In the Parts Form, click the Copy button to clone the Part that is currently selected in the form,

A new Parts Form will be opened with several fields cloned from the previous record and ready to be completed.
C. Fill in the new record.

In the Part Form, the mandatory fields that must be filled in are the following ones:

- **Code.** Indicate the Part Code. The Code must be unique for each Part. This is a text field with a maximum length of 80 characters. If a code already in use is entered in the field, at the time of exit the form, the tool will send a warning message (saying that the code already exists in the database and it is not allowed to save the record).

- **Name.** Describe the Part in a short and concise way as possible. This is a text field with a maximum length of 100 characters.

- **PT element combo box.** Select which PT element is on top of the Part. In the combo box, all Product Tree elements existing in the application can be selected.

If any of the mandatory fields are not filled, then the tool gives an alert and the record cannot be saved until all the mandatory fields have been introduced.

The rest of the fields that can be optionally filled are:

- **Serial#.** Indicate the production serial number of the Part. This is a text field with a maximum length of 50 characters.

- **Date.** Indicate the creation date of the Part. This is a date field with the following format: *dd-mm-yyyy*, where *dd*: day, *mm*: month and *yyyy*: year.

- **Comments.** Describe any additional information that can be useful. This is a text field with a maximum length of 400 characters.

D. **Save the new record.**

In the Parts Form, click the *Save button* to save the record,

If the current record is not saved, the new record will not be created.

E. **Close the Parts Form**

In the Parts Form, click the *Exit button* to exit the form,
If the record has been saved, the Parts Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window reporting that changes have not been saved.](image)

**Figure 41:** Warning Window reporting that changes have not been saved.

- Click **YES** to exit without saving
- Click **NO** to come back to the Parts Form.

### 6.3 Selecting a particular Part

In the Main window, the form view of a particular Part can be opened in two different ways:

#### A. Going through the Forms Menu.

In the Main window, select *Forms Menu ⇒* Parts Form or press **ALT+O+P**.

In order to find a particular Part, the following actions can be done:

- Use the arrows for moving among the Parts currently selected in the form,
  - To go to the first record of the selected ones,
  - To go to the previous record to the current one,
  - To go to the next record to the current one and
  - To go to the last record of the selected ones

- Use the **Filter button** to filter/un-filter the set of Parts currently selected in the form,

A new window will appear:

- Click **Data filter activated box** to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be record),
- select in the **Field combo box** the desired field to filter the data,
- select in the **Op combo box** how the previously selected field must match the defined **Value** (i.e., “starting with”, “contains”, “is”, “ending by”)


write in the Value text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

define as many filters as wanted (by adding new lines),

click Accept,

Figure 42: Form to filter the parts

B. Selecting the Parts in the Parts View.

In the Main window, click the Views Menu ⇒ Parts View or press ALT+V+P.

In order to constrain (by Product Tree Element or by filtering) the number of Parts listed in the view, see the steps to be followed in section 4.2.

Select the desired Part among the Parts listed in the table at the right side of the window by double-clicking with the left button of the mouse.

6.4 Modifying existing Parts

The Part to be modified must be already selected, which will be done by following the steps described in section 6.3.

In the Parts Form, the following steps must be done in order to modify the selected Part.

A. Modify the desired fields.

Make the desired changes in the Part fields, taking into account all constrains identified in section 6.2, numbered item C).

All the fields in the Parts form can be modified.

B. Save the modified record.

In the Parts Form, click the Save button to save the record,

If the record is not saved, the changes will not be applied.
C. Close the Parts form

In the Parts Form, click the Exit button to exit the form,

If the record has been saved, the Parts Form will be closed.
If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window reporting that changes have not been saved.]

> Click YES to exit without saving.
> Click NO to come back to the Parts Form.

6.5 Deleting a Part

The Part to be deleted must be already selected, which will be done by following the steps described in section 6.3.

In the Parts Form, the following steps must be done in order to delete the selected Part.

A. Delete the record.

In the Parts Form, click the Delete button to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

![Warning Window to check if the user wants to delete the record]

> Click YES to delete the record.
> Click NO to exit without deleting.
6.6 Export Parts to XLS

In the Main window, click the Tools Menu → Export Parts to XLS.

A new window will appear where the user must, first, introduce the subsystem and the file name and path to save the xls file, then, click Accept.

![Figure 45: Window to insert the subsystem and filename/path to generate the xls file](image)

A new window (it is necessary to have any xls viewer installed) will show a list of the parts of the subsystem and lower level elements that has been just introduced.

![Figure 46: After entering the subsystem, this window will show the result of the search of all the parts of this subsystem and lower level elements found in the database.](image)
7. INTERFACES

7.1 What is an Interface?

An Interface is defined as the border between two subsystems (hardware or software). Interfaces among subsystems that are under the responsibility of different working groups are especially important to be controlled.

The interfaces must be identified and introduced in the application during the system design in order to avoid any problems during the integration of the system.

7.2 Creating a new Interface

Starting at the Main Window of the application,

![Figure 47: Main window of the application](image)

The following steps must be executed in order to create a new Interface:

A. Open the Interface form.

In the Main window, the Interfaces form can be opened in two different ways:

A.I. Going through the Forms Menu.

In the Main window, select *Forms Menu ➔ Interfaces Form* or press *ALT+O+I*.

The Interfaces Form will be opened with all available records selected.
A.II. Selecting an Interface in the Interfaces View.

In the Main window, click the Views Menu ⇒ Interfaces View or press ALT+V+I.

Select an Interface among the Interfaces listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Interfaces Form will be opened only with the selected record available.
B. Add a new record.

In the Interfaces Form, new Interfaces can be created in two different ways:

B.I. Starting an empty Interface.

In the Interface Form, click the Add button to add a new record,

A new Interface element form will be opened empty and ready to be filled.
B.II. Cloning an already existing Interface.

In the Interfaces Form, click the Copy button to clone the Interface that is currently selected in the form,

A new Interfaces Form will be opened with several fields cloned from the previous record and ready to be completed.

![Image of Interface Form]

*Figure 52: Interface Form ready to introduce a new part by cloning an existing record*

C. Fill in the new record.

In the Interface Form, the mandatory fields that must be filled in are:

- **Code.** Indicate the Interface Code. The Code must be unique for each Interface, since it is going to be used as a base to automatically generate other codes in the application, such as Requirements and Documents. This is a text field with a maximum length of 110 characters. Be aware that the IF code is not automatically generated to give the user flexibility to use their own codes but it should be connected to the related PT elements codes. Also, it is possible to define several interfaces between the same configuration elements; although this is not a common practice, it could be used by some organizations.

- **Name.** Describe the Interface in the shortest and most concise way possible. This is a text field with a maximum length of 80 characters.

- **Sub-subject.** Indicate which subsystem (or group inside the organization) is responsible for this Interface. This is a text field with a maximum length of 20 characters.

- **Element 1 combo box.** The interface is defined in the border between two PT elements. Select the first one of this two PT element. In the combo box, all Product Tree elements existing in the application can be selected.

- **Element 2 combo box.** The interface is defined in the border between two PT elements. Select the second one of this two PT element. In the combo box, all Product Tree elements existing in the application will be accessible.
If any of the mandatory fields are not filled, then the tool gives an alert and the record cannot be saved until all the mandatory fields have been introduced.

The rest of the fields that can be optionally filled are:

- **Date.** Indicate the creation date of the Interface. This is a date field with the following format: *dd-mm-yyyy*, where *dd*: day, *mm*: month and *yyyy*: year.

- **Description.** Describe any additional information that can be useful. This is a text field and it does not have a maximum length limit.

- **Interface-related documents combo box.** Select the code of the documents that are related to the Interface. In the combo box, all documents existing in the application can be selected and the user can select as many documents as required.

**D. Save the new record.**

In the Interfaces Form, click the *Save button* to save the record,

If the current record is not saved, the new record will not be created.

**E. Close the Interfaces Form**

In the Interfaces Form, click the *Exit button* to exit the form,

If the record has been saved, the Interfaces Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window](image)

*Figure 53: Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Interfaces Form.

### 7.3 Selecting a particular Interface

In the Main window, the form view of a particular Interface can be opened in two different ways:

**A. Going through the Forms Menu.**

In the Main window, select *Forms Menu ⇒ Interfaces Form* or press *ALT+O+I*.

In order to find a particular Interface, the following actions can be done:
Use the arrows for moving among the Interfaces currently selected in the form,

- To go to the first record of the selected ones,
- To go to the previous record to the current one,
- To go to the next record to the current one and
- To go to the last record of the selected ones

Use the *Filter button* to filter/un-filter the set of Interfaces currently selected in the form.

A new window will appear:

- Click *Data filter activated box* to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be reset),
- select in the *Field combo box* the desired field to filter the data,
- select in the *Op combo box* how the previously selected field must match the defined *Value* (i.e., “starting with”, “contains”, “is”, “ending by”)
- write in the *Value* text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,
- define as many filters as wanted (by adding new lines),
- click *Accept*.

![Interface Filter](image)

*Figure 54: Interface Filter to select the desired interface records by different fields*

**B. Selecting the Interfaces in the Interfaces View.**

In the Main window, click the *Views Menu ⇒ Interfaces View* or press *ALT+V+I*.

In order to constrain (by Product Tree Element or by filtering) the number of Interfaces listed in the view, see the steps to be followed in section 4.2.
Select the desired Interface among the Interfaces listed in the table at the right side of the window by double-clicking with the left button of the mouse.

7.4 Modifying existing Interfaces

The Interface to be modified must be already selected, which will be done by following the steps described in section 7.3.

In the Interfaces Form, the following steps must be done in order to modify the selected Interface.

A. Modify the desired fields.

Make the desired changes in the Interface fields, taking into account all constrains identified in section 7.2, numbered item C).

All the fields in the Interfaces Form can be modified.

B. Save the modified record.

In the Interfaces Form, click the Save button to save the record,

If the record is not saved, the changes will not be applied.

C. Close the Interfaces form

In the Interfaces Form, click the Exit button to exit the form,

If the record has been saved, the Interfaces Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window reporting that changes have not been saved.](image)

Figure 55: Warning Window reporting that changes have not been saved.

⇒ Click YES to exit without saving.
⇒ Click NO to come back to the Interfaces Form.
7.5 Deleting an Interface

The Interface to be deleted must be already selected, which will be done by following the steps described in section 7.3.

In the Interfaces Form, the following steps must be done in order to delete the selected Interface.

A. Delete the record.

In the Interfaces Form, click the Delete button to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

![Warning Window](image)

**Figure 56:** Warning Window to check if the user wants to delete the record

⇒ Click YES to delete the record.
⇒ Click NO to exit without deleting.

7.6 Export Interfaces to XLS

In the Main window, click the Tools Menu ⇒ Export Interfaces to XLS.

A new window will appear where the user must, first, introduce the subsystem and the file name and path to save the xls file, then, click Accept.

![Export window](image)

**Figure 57:** Window to insert the subsystem and filename/path to generate the xls file

A new window (it is necessary to have any xls viewer installed) will show a list of the interfaces of the subsystem and lower level elements that has been just introduced.
Figure 58: After entering the subsystem, this window will show the result of the search of all the interfaces of this subsystem and lower level elements found in the database.
8. REQUIREMENTS

8.1 What is a Requirement?

A requirement is defined as the capacity or condition that a system, subsystem or component must fulfil to satisfy the specification or contract that has been formally imposed to this system, subsystem or component.

GECO is thought to manage all the requirements that must be produced during the design of a system, which comprise the Functional Requirements and the Technical Requirements.

- At the beginning of a design, the Functional Requirements are defined to describe the needs of the system, subsystem or component that is going to be designed.
- After a solution is found for the system, subsystem or component, the Technical Requirements are defined to describe this solution.

Elsewhere, Functional and Technical Requirements are named as Requirements and Specifications.

The requirements for a system, subsystem or component are normally grouped in a Requirement or Specification document. The user must define the requirements paying attention that the set of requirements is coherent, consistent and without conflicts among them.

Thinking in how to organize the requirements inside the documents, GECO has been implemented to allow the user organizing the requirements in two levels: sections and subsections. More information about the generation of requirement document can be found in section 10.6.

8.2 Creating a new Requirement

Starting at the Main Window of the application,
The following steps must be executed in order to create a new Requirement:

A. **Open the Requirements Form.**

In the Main window, the Requirements Form can be opened in two different ways:

A.I. **Going through the Forms Menu.**

In the Main window, select *Forms Menu ⇒ Requirements Form* or press *ALT+O+R*.

The Requirements Form will be opened with all available records selected.

![Figure 60: Requirements Form showing all the selected records](image)

A.II. **Selecting a Requirement in the Requirements View.**

In the Main window, click the *Views Menu ⇒ Requirements View* or press *ALT+V+R*. 
Figure 61: Requirements View (right panel) showing all the selected requirements associated to the selected PT element (left panel)

Select a Requirement among the Requirements listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Requirements Form will be opened only with the selected record available.

Figure 62: Requirements Form showing only the selected record
B. Add a new record.

In the Requirements form, new requirement can be created in two different ways:

B.I. Starting an empty requirement.

In the Requirements Form, click the Add button to add a new record,

A new window will appear,

- select the requirement type in the Requirement Type combo box,
- select the Product Tree or Interface code in the PT Element or interface combo box,
- click Accept,

![New requirement](image)

**Figure 63: Requirements Form**

The new Requirement Code will be automatically generated as the first one available for the Requirement type and Product Tree or Interface code selected.

All requirement Codes follow the same pattern as described below:

**TT/PT/nnn**

where,

- **TT**: FR (Functional Requirement) or TR (Technical Requirement)
- **PT**: Product Tree Element or Interface code
- **nnn**: Sequence number that will be automatically generated by the application

The Requirement Code is unique for each requirement.

The user can change of this Code the Product Tree or Interface and/or the number.

The Requirement code convention is defined before starting to use GECO. More information about it can be found in section 18.
Figure 64: Requirements Form once the PT element or interface and the requirement type has been chosen as shown in Figure 63.

B.II. Cloning an already existing Requirement.

In the Requirements Form, click the *Copy button* to clone the requirement that is currently selected in the form,

![Requirements Form](image)

The new Requirement *Code* will be automatically generated as the first one available for the same Requirement type and Product Tree or Interface code of the Requirement that has been cloned.

Figure 65: Requirements Form ready to introduce a new requirement by cloning an existing record
C. Fill in the new record.

In the Requirements Form, the mandatory fields that must be filled in are the following ones:

- **Code.** The requirement code is automatically generated by the application, but it can be modified by the user. If so, the application will check that there is no other requirement with the same code before saving the record. This is a text field with a maximum length of 60 characters.

- **Title.** Describe the objective of the requirement in the shortest and more concise way possible. This is a text field with a maximum length of 150 characters.

- **Valid.** Indicate if the requirement is still applicable or not. This means that the requirement can be migrated to the corresponding document or not. By default, all requirements are applicable.

- **Reference line combo box.** Select the reference line of the requirement among the options offered in the Reference line combo box, which are the following ones:
  
  - CD (Conceptual Design)
  - PD (Preliminary Design)
  - DD (Detailed Design)
  - PRD (PRoDuction Phase)

  By default, the reference line is “CD”.

- **Document combo box.** Select the code of the Requirement or Specification document that is going to include this requirement. In the combo box, all Requirement (REQ/…) and Specification (SPE/…) documents existing in the application will be accessible.

- **Type combo box.** Select the requirement type among the options offered in the Type combo box, which includes the following ones:
  
  - Functional Requirement
  - Performance Requirement
  - Physical Requirement
  - Environmental Requirement
  - Operation Requirement
  - Personnel Requirement
  - Production Requirement
  - Handling Requirement
  - RAMS Requirement
  - Configuration Requirement
Standardization Requirement
Design Requirement
Functional Interface Requirement
Thermal Interface Requirement
Electrical Interface Requirement
Physical Interface Requirement
Software Interface Requirement

The requirement type will be used later to define the subsection of the requirement whenever it is exported to a document (see section 10.6). By default, the requirement type is “Functional requirement”.

- **Section combo box.** Select or introduce the requirement section. That is, the user can select any of the options already included into the combo box (that offers all the sections previously defined for the document of the requirement) or, alternatively, introduce manually a new section; in this case, the section will be added to the combo box list for the next time this option is used. By default, the section is “General requirements”. When a new section is introduced, it must be taken into account that the maximum length of this field is 80 characters.

If any of the mandatory fields are not filled, then the tool gives an alert and the record cannot be saved until all the mandatory fields have been introduced.

The rest of the fields that can be optionally filled are:

- **Source.** Indicate the origin of the requirement, i.e., which person, organism or document is responsible for this requirement. It is important to mention that all requirements should be justified either by a Source or by one or several Parent Requirements, or by both. This is a text field and it does not have a maximum length limit.

- **Auxiliary file.** Introduce an auxiliary file, if desired, for this requirement. Select the auxiliary file from the File Manager when clicking in the Add Button.

- **Parent Requirements combo box.** Select as many Parent Requirements as necessary to indicate what already defined requirements are the origins of the current Requirement. It is important to mention that all requirements should be justified either by a Source or by one or several Parent Requirements. In the combo box, all requirements already existing in the application will be accessible.

- **Description.** Describe the content of the Requirement. It is convenient to follow the System Engineering practice rules as summarized in the following lines:
  
  - A requirement must be unique and not a combination of several requirements.
  
  - A requirement must not reference others requirements inside its text.
  
  - A requirement must be brief and easy to read and to understand. Explanations about the requirement could be in an analysis document which can be referenced in the Source of the requirement.
- A requirement must not be ambiguous. So, wording like “and/or”, “etc”, “maximize”, “minimize”, “as much as possible”, etc., must be avoided.

- Technical requirements must be reachable and verifiable.

This is a text field and it does not have a maximum length limit.

- **Images combo box.** Introduce as many images as needed to complete the content of the Requirement (i.e., all information that does not suit in a text paragraph, such as equations, tables, figures, etc., must be converted into image format to be included in the requirement). When a new combo box row is selected, a new window will appear,

  ⇒ introduce the *Title* of the image,

  ⇒ select the image *Path*, by writing it directly in the text line or opening the File Manager when clicking in the *File Explorer Button*,

  ⇒ select if the image is going to be stored in the Database or only the reference to it by clicking in the *File by reference box*,

  ⇒ click *Accept*,

![Image](image.png)

*Figure 66: Window to include an image associated to a requirement*

**D. Save the new record.**

In the Requirements Form, click the *Save button* to save the record,

![Save button](save.png)

If the current record is not saved, the new record will not be created.

**E. Close the Requirements Form**

In the Requirements Form, click the *Exit button* to exit the form,

![Exit button](exit.png)

If the record has been saved, the Requirements Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.
Figure 67: Warning Window reporting that changes have not been saved.

⇒ Click YES to exit without saving
⇒ Click NO to come back to the Requirements Form.

8.3 Selecting a particular Requirement

In the Main window, the form view of a particular Requirement can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select Forms Menu ⇒ Requirements Form or press ALT+O+R.

In order to find a particular requirement, the following actions can be done:

⇒ Use the arrows for moving among the Requirements currently selected in the form,

To go to the first record of the selected ones,
To go to the previous record to the current one,
To go to the next record to the current one and
To go to the last record of the selected ones

⇒ Use the Filter button to filter/un-filter the set of Requirements currently selected in the form,

A new window will appear:

⇒ Click Data filter activated box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the Field combo box the desired field to filter the data,

⇒ select in the Op combo box how the previously selected field must match the defined Value (i.e., “starting with”, “contains”, “is”, “ending by”)

⇒ write in the Value Text Field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,
– define as many filters as wanted (by adding new lines),
– click Accept,

![Requirements Filter](image)

*Figure 68: Requirements Filter to select the desired requirements by different fields*

**B. Selecting the Requirement in the Requirements View.**

In the Main window, click the *Views Menu ⇒ Requirements View* or press *ALT+V+R*.

In order to constrain (by Product Tree Element or by filtering) the number of requirements listed in the view, see the steps to be followed in section 4.2.

Select the desired Requirement among the requirements listed in the table at the right side of the window by double-clicking with the left button of the mouse.

**8.4 Modifying existing Requirements**

The Requirement to be modified must be already selected, which will be done by following the steps described in section 8.3.

In the Requirements Form, the following steps must be done in order to modify the selected Requirement.

**A. Modify the desired fields.**

Make the desired changes in the Requirement fields, taking into account all constrains identified in section 8.2, numbered item C).

All the fields in the Requirements Form can be modified.

**B. Save the modified record.**

In the Requirements Form, click the *Save button* to save the record,

![Save](image)

If the record is not saved, the changes will not be applied.

**C. Close the Requirements Form**

In the Requirements Form, click the *Exit button* to exit the form,
If the record has been saved, the Requirements Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window reporting that changes have not been saved.](image)

- Click YES to exit without saving
- Click NO to come back to the Requirements Form.

### 8.5 Deleting a Requirement

The Requirement to be deleted must be already selected, which will be done by following the steps described in section 8.3.

In the Requirements Form, the following steps must be done in order to delete the selected Requirement.

**A. Delete the record.**

- In the Requirements Form, click the *Delete button* to delete the record,

![Delete button](image)

A new window will appear to ask the user if he/she really wants to delete the record.

![Warning Window to check if the user wants to delete the record](image)

- Click YES to delete the record.
- Click NO to exit without deleting.

### 8.6 Searching of Requirement’s Parents

In the Main window, click the *Tools Menu ⇒ Consult requirement’s parents* or press ALT+T+P.

A new window will appear where the user must, first, introduce the Requirement Code (i.e., the Code of the Requirement whose Parents are going to be searched) and, then, click *Accept.*
A new window will show the Parents Requirements of the Requirement that has been just introduced.

![Figure 71: Window to insert the child requirement whose parent requirements have to be found](image1)

**Figure 71:** Window to insert the child requirement whose parent requirements have to be found

![Figure 72: The child requirement code has to be inserted in the field](image2)

**Figure 72:** The child requirement code has to be inserted in the field

8.7 Searching of Requirement’s Children

In the Main window, click the Tools Menu ⇒ Consult requirement’s children or press ALT+T+C.

A new window will appear where the user must, first, introduce the Requirement Code (i.e., the Code of the Requirement whose Childs are going to be search).

![Figure 73: After entering the child requirement whose parents have to be found, this Window will show the result of the search with all the parent requirements found in the database.](image3)

**Figure 73:** After entering the child requirement whose parents have to be found, this Window will show the result of the search with all the parent requirements found in the database.
In the case the user wants the result in xls file, click Generate xls button.

A new window will appear where the user must introduce the file name and path to save the xls file, then, click Accept.

In other case, click Accept button.

A new window will show the Children Requirement of the Requirement that has been just introduced. Be aware that only the direct children of the parent requirement will be shown.
Figure 77: After entering the parent requirement whose children have to be found, this window will show the result of the search with all the children requirements found in the database.

### 8.8 Export requirements to XLS

In the Main window, click the **Tools Menu → Export requirements to XLS**.

A new window will appear where the user must, first, introduce the document, the file name and the path to save the xls file and, then, click **Accept**.

Figure 78: Window to insert the document and filename/path to generate the xls file

A new window (it is necessary to have any xls viewer installed) will show a list of all requirements at the document selected.

Figure 79: After entering the document, this window will show the result of the search of all requirements of the selected document found in the database.
8.9 Import requirements from XLS

The first step to import the requirements of a document is to prepare the xls file that contains the requirement information.

To produce a template of this xls file you only need to export the requirements of the document as explained in the section 8.8. After producing it, follow the instructions included in the template file to fill it in correctly.

In the Main window, click the Tools Menu ⇒ Import requirements from XLS.

A new window will appear where the user must, first, select the file to be imported and, then, click Accept.

![Import requirements from XLS](image)

**Figure 80:** Window to insert the xls file to import the requirements

If the requirements import is finished without any error a help window will appear as follow:

![All the requirements from the xls file have been imported](image)

**Figure 81:** Import requirement help window

In any other case, an error window will appear explaining what requirements have not been imported and why.

![Import requirement error window](image)

**Figure 82:** Import requirement error window
9. VERIFICATION MATRIX

9.1 What is the Verification Matrix?

The Verification Matrix collects all the information that is going to be generated during the process of verifying the requirements, which includes information such as the planning of the verification tests and the result of these activities.

The Verification Matrix must include all Technical requirements. The Technical requirements describe the design solution of the system, which means that, as soon as the Technical Requirements have been approved, these requirements are going to be implemented and, therefore, they must be verified.

The Verification Matrix provides the status of the system. The user can easily check what requirements have been fulfilled and which ones could compromise the system objectives.

9.2 Exporting Requirements to the Verification Matrix

In the Main window, click the Tools Menu ⇒ Insert requirements into the Verification Matrix or press ALT+T+E.

A new window will appear,

⇒ select in the Subsystem combo box the desired Product Tree element Code (i.e., the Code of the Product Tree element which Technical requirements are going to be exported to the Verification Matrix); or in the Document combo box the desired Document (i.e., the Code of the requirement document which Technical requirements are going to be exported to the Verification Matrix),

⇒ click Accept,

![Figure 83: Window to select the subsystem or requirement document whose requirements have to be inserted into the Verification Matrix.](image)

The user can check that the desired requirements have been correctly exported in the Verification Matrix View (see section 4.2.1). Please note that the application is exporting all the Technical Requirements of the PT element selected as well as of the lower levels of the PT elements hanging of the one selected, or of the requirement document.
9.3 Selecting a particular Requirement in the Verification Matrix

The Requirement Code and Title are displayed in the Verification Matrix Form.

In the Main window, the form view of a particular Requirement in the Verification Matrix can be opened in two different ways:
A. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *Verification Matrix Form* or press *ALT+O+V*.

In order to find a particular requirement, the following actions can be done:

⇒ Use the arrows for moving among the Requirements currently selected in the Verification Matrix Form,

- To go to the first record of the selected ones,
- To go to the previous record to the current one,
- To go to the next record to the current one and
- To go to the last record of the selected ones

⇒ Use the *Filter button* to filter/un-filter the set of Requirements currently selected in the Verification Matrix Form,

A new window will appear:

⇒ Click *Data filter activated box* to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the *Field combo box* the desired field to filter the data,

⇒ select in the *Op combo box* how the previously selected field must match the defined *Value* (i.e., “starting with”, “contains”, “is”, “ending by”)

⇒ write in the *Value Text Field* the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

![Requirements Filter Window](image)
B. Selecting the Requirement in the Verification Matrix View.

In the Main window, click the Views Menu ⇒ Requirements View or press ALT+V+E.

In order to constrain (by Product Tree Element or by filtering) the number of requirements listed in the view, see the steps to be followed in section 4.2.

Select the desired requirement among the requirements listed in the table at the right side of the window by double-clicking with the left button of the mouse.

9.4 Modifying existing information in the Verification Matrix

The Requirement in the Verification Matrix to be modified must be already selected, which will be done by following the steps described in section 9.3.

In the Verification Matrix Form, the following steps must be done in order to modify the selected Requirement.

A. Modify the desired fields.

Make the desired changes in the Requirement fields:

- **Responsible combo box.** Identify the person responsible to verify the requirements. The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 16).
- **Doer combo box.** Identify the person responsible to execute the test procedure and verify the requirement. The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 16).
- **Planned date.** Indicate the date that has been planned to verify the requirement. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Execution date.** Indicate the date when the requirement has been verified. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Test procedure combo box.** Identify the procedure (if any) that has been previously defined to be followed during the verification of the requirement. In the combo box, all Procedures (PRO/…) documents existing in the application will be accessible.
- **Test report combo box.** Identify the report (if any) that has been generated after the test that has been executed to verify the requirement. In the combo box, all Reports (RPT/…) documents existing in the application will be accessible.
- **Non-conformity combo box.** If the requirement has not been verified, a non-conformity could be raised to track and analyze the problem. In the combo box, all Non-conformities existing in the application will be accessible.
- **Conform.** Indicate if the requirement has been verified or not, which means that the requirement complies or not with the requirement text. By default, the requirements have not been verified yet and, therefore, they do not appear as “Conform”.

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*Figure 86: Requirements Filter to select the desired requirements by different fields*
- **Verification method.** Describe the method that is going to be used to verify the requirement. This is a text field with a maximum length of 3000 characters.

- **Verification result.** Describe the result of the test that has been executed to verify the requirement. This is a text field with a maximum length of 3000 characters.

- **Verification milestones.** Describe the milestones to verify the requirement. This is a text field with a maximum length of 255 characters.

- **Comments box.** Describe any additional comments related to the verification test to be done or already executed. This is a text field with a maximum length of 255 characters.

**B. Save the modified record.**

In the Verification Matrix Form, click the **Save button** to save the record,

![Save button]

If the record is not saved, the changes will not be applied.

**C. Close the Verification Matrix Form**

In the Verification Matrix Form, click the **Exit button** to exit the form,

![Exit button]

If the record has been saved, the Verification Matrix Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window]

*Figure 87: Warning Window reporting that changes have not been saved.*

- Click **YES** to exit without saving.
- Click **NO** to come back to the Verification Matrix Form.

**9.5 Deleting a Requirement in the Verification Matrix**

The Requirement to be deleted must be already selected, which will be done by following the steps described in section 9.3.

In the Verification Matrix Form, the following steps must be done in order to delete the selected Requirement.
A. Delete the record.

In the Verification Matrix Form, click the *Delete button* to delete the record.

A new window will appear to ask the user if he/she really wants to delete the record.

![Warning Window](image)

**Figure 88**: Warning Window to check if the user wants to delete the record

⇒ Click **YES** to delete the record.

⇒ Click **NO** to exit without deleting.

9.6 Verification Matrix Summary View

In the Main window, click the *Tools Menu ⇒ Verification Matrix summary view* or press *ALT+T+V*.

A new window will appear where the user must, first, introduce the subsystem or the requirement document, and the file name and path to save the pdf file, then, click **Accept**.

![Summary View Window](image)

**Figure 89**: Window to insert the subsystem or requirement document, and filename/path to generate the pdf file

A new window (it is necessary to have installed any pdf viewer) will show a summary view of the verification matrix elements of the subsystem and lower level elements or of the requirement document that has been just introduced.
After entering the subsystem, this window will show the result of the search with all the verification matrix elements of this subsystem and lower level elements or of requirement document found in the database.

### 9.7 Export Verification Matrix to XLS

In the Main window, click the **Tools Menu** ⇒ **Export Verification Matrix to XLS**.

A new window will appear, where the user must, first, introduce the subsystem or requirement document, the file name and path to save the xls file and, then, click **Accept**.

A new window (it is necessary to have installed a xls viewer) will show the verification matrix elements of the subsystem (and lower level elements below this subsystem) or of the requirement document that has been just introduced.
Figure 92: After entering the subsystem or requirement document, this window will show the result of the search, which will include all verification matrix elements found in the database for the selected subsystem (and lower level elements below this subsystem) or for the selected requirement document.

9.8 Import Verification Matrix from XLS

The first step to import the verification matrix is to prepare the xls file that provides the verification matrix template and contains verification matrix information.

To produce a template of this xls file you only need to export the verification matrix as explained in the section 9.7. After producing it, follow the instructions included in the template file to fill it in correctly.

In the Main window, click the Tools Menu ⇒ Import verification matrix from XLS.

A new window will appear where the user must, first, select the file to be imported and, then, click Accept.

Figure 93: Window to insert the xls file to import the verification matrix

If the requirements import is finished without any error a help window will appear as follow:

Figure 94: Import verification matrix help window
In any other case, an error window will appear explaining what requirements have not been imported and why.

*Figure 95: Import verification matrix error window*
10. DOCUMENTS

10.1 What is a Document?

A Document is commonly defined as a writing that contains information.

In any organization, there are a lot of different documents that must be generated and kept. Not only technical documents such as Requirement or Specification documents, Drawings, Reports, Analysis, Procedures, etc. but, also, formal documents such as Contracts, Intentions to Tender, Statement of Work documents, etc.

GECO provides the means to organize, to classify and to access all these documents.

10.2 Creating a new Document

Starting at the Main Window of the application,

![Figure 96: Main window of the application](image)

The following steps must be executed in order to create a new Document:

A. Open the Documents Form.

In the Main window, the Documents Form can be opened in two different ways:

---

1 It is important to mention that the documents themselves are not stored in the Database, only the information about them, including the link. So, the Database back-ups do not manage the documents back-ups, that must be done independently.
Going through the Forms Menu.

In the Main window, select Forms Menu ⇒ Documents Form or press ALT+O+D.

The Documents Form will be opened with all available records selected.

Figure 97: Documents Form showing all the selected records

A.I. Selecting a Document in the Documents View.

In the Main window, click the Views Menu ⇒ Documents View or press ALT+V+D.

Figure 98: Documents View (right panel) showing all the selected document associated to the selected PT element (left panel)
Select a Document among the Documents listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Documents Form will be opened only with the selected record available.

![Figure 99: Documents Form showing only the selected record](image)

B. Add a new record.

In the Documents Form, new Documents can be created in two different ways:

B.I. Starting an empty Document.

In the Documents Form, click the Add button to add a new record,

A new window will appear,

⇒ select the document type in the Document Type combo box,

⇒ select the Product Tree or Interface code in the PT Element or interface combo box,

⇒ click Accept,
Figure 100: Documents Form

The new Document Code will be automatically generated as the first one available for the Document type and Product Tree or Interface code selected.

All Document Codes follow the same pattern as described below:

**TT/PT/nnn**

where,

**TT**: Document type, which include the following options:

- Analysis (ANA)
- Drawing (DR)
- Interface (INT)
- Minutes of Meeting (MOM)
- Procedure (PRO)
- Report (RPT)
- Requirement document (RQ)
- Specification document (SP)
- Technical note (TEN)

**PT**: Product Tree Element or Interface code

**nnn**: Sequence number that will be automatically generated by the application.

The Document Code is unique for each document.

The Document Code convention is defined before starting to use GECO. More information about it can be found in section 18.
Figure 101: Documents Form once the PT element or interface and the document type has been chosen as shown in Figure 100

B.II. Cloning an already existing Document.

In the Documents Form, click the Copy button to clone the document that is currently selected in the form,

![Copy button](image)

The new Document Code will be automatically generated as the first one available for the same Document type and Product Tree or Interface code of the Document that has been cloned.
C. Fill in the new record.

In the Document Form, the mandatory fields that must be filled in are the following ones:

- **Code.** The Document code is automatically generated by the application, but it can be modified by the user. If so, the application will check that there is no other document with the same code before the record is saved. This is a text field with a maximum length of 60 characters.

- **Title.** The title of the document should describe in the shortest and more concise way possible the objective of the document. This is a text field with a maximum length of 255 characters.

- **Sub-subject.** Indicate what subsystem (or group inside the organization) is in charge of creating and maintaining the document. This is a text field with a maximum length of 20 characters.

- **Keywords.** Include the main keywords of the document (i.e., the words that best describe the content of the documents). This field could help whenever the user is looking for this document or looking for documents applicable to a certain concept. This is a text field with a maximum length of 250 characters.

- **Creation date.** Indicate the date when the document has been initially created. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.

- **Version.** Indicate the version number of the document. This is a text field with a maximum length of 5 characters.
- **Issue.** Indicate the issue number of the document. This is a text field with a maximum length of 5 characters.

- **Access level combo box.** Select the access level policy associated with the document among the options offered in the access level combo box, which includes the following ones:
  - R (Restricted access)
  - P (Public access)
  - L (Limited access)

  By default, the access level is defined as “R”.

- **Status.** Indicate the current situation of the document. This is a text field with a maximum length of 20 characters. By default, the status is always “Created”. This field has been introduced to make GECO compatible with other tools of the Fractal Projects Suite, in particular with the Documentation Management Tool, DOCMA.

- **Type combo box.** This field has been defined at the document creation and cannot be modified.

- **Author.** Identify the authors of the document (as many as desired). The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 16).

The rest of the fields that can be optionally filled are:

- **Review date.** Indicate the date when the revision of the document has been finished. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.

- **Reference line combo box.** Select the reference line of the document among the options offered in the Reference line combo box, which includes the following ones:
  - CD (Conceptual Design line)
  - PD (Preliminary Design line)
  - DD (Detailed Design line)
  - PDR (Product line)

  By default, the privacy is defined as “CD”.

- **Conf.** Indicate if the document is a configuration document or not. By default, all documents are not “configuration document” (i.e., the tick is not marked).

- **Approval date.** Indicate the date when the document has been finally approved. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.

- **Summary.** Describe briefly the content of the document. This is a text field with a maximum length of 300 characters.
- **Comments**: Introduce any additional comment related to the document. This is a text field with a maximum length of 60 characters.

- **Location**: Indicate where the document is physically stored. This is a text field with a maximum length of 100 characters.

- **Link**: It is possible to create a link to the directory where the electronic copy of the document is stored. This is a text field with a maximum length of 255 characters.

- **Reviewer**: Identify the reviewers of the document (you can select as many persons as desired). The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 16).

- **Approver**: Identify the approvers of the document (you can select as many persons as desired). The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 16).

- **Distribution**: Identify to which persons the document must be distributed (you can select as many persons as desired). The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 16).

- **Notification**: Identify the persons that must be notified of the creation or new versions of the document (you can select as many persons as desired). The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 16).

**D. Save the new record.**

In the Documents Form, click the *Save button* to save the record,

If the current record is not saved, the new record will not be created.

**E. Close the Requirements Form**

In the Documents Form, click the *Exit button* to exit the form,

If the record has been saved, the Documents Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window](image)

*Figure 103: Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving
10.3 Selecting a particular Document

In the Main window, the form view of a particular Document can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select Forms Menu ⇒ Documents Form or press ALT+O+D.

In order to find a particular document, the following actions can be done:

⇒ Use the arrows for moving among the documents currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the Filter button to filter/un-filter the set of documents currently selected in the form,

A new window will appear:

⇒ Click Data filter activated box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the Field combo box the desired field to filter the data,

⇒ select in the Op combo box how the previously selected field must match the defined Value (i.e., “starting with”, “contains”, “is”, “ending by”)

⇒ write in the Value Text Field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click Accept,
B. Selecting the Document in the Documents View.

In the Main window, click the Views Menu ➔ Documents View or press ALT+V+D.

In order to constrain (by Product Tree Element or by filtering) the number of documents listed in the view, see the steps to be followed in section 4.2.

Select the desired document among the documents listed in the table at the right side of the window by double-clicking with the left button of the mouse.

10.4 Modifying existing Document

The document to be modified must be already selected, which will be done by following the steps described in section 10.3.

In the Documents Form, the following steps must be done in order to modify the selected Document.

A. Modify the desired fields.

Make the desired changes in the Document fields, taking into account all constrains identified in section 10.2, numbered item C).

All the fields in the Documents Form can be modified.

B. Save the modified record.

In the Documents Form, click the Save button to save the record,

If the record is not saved, the changes will not be applied.

C. Close the Documents Form

In the Documents Form, click the Exit button to exit the form,

If the record has been saved, the Documents Form will be closed.
If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window](image)

Figure 105: Warning Window reporting that changes have not been saved.

- Click **YES** to exit without saving.
- Click **NO** to come back to the Documents Form.

### 10.5 Deleting a Document

The Document to be deleted must be already selected, which will be done by following the steps described in section 10.3.

In the Documents Form, the following steps must be done in order to delete the selected Document.

**B. Delete the record.**

In the Documents Form, click the *Delete button* to delete the record,

![Delete Button](image)

A new window will appear to ask the user if he/she really wants to delete the record.

![Warning Window](image)

Figure 106: Warning Window to check if the user wants to delete the record

- Click **YES** to delete the record.
- Click **NO** to exit without deleting.

### 10.6 Exporting Requirements into a Document

All requirements have as a mandatory field the Requirements or Specifications Document where they are going to be grouped. Therefore, the Requirement or Specification Document must have been already created even before entering a requirement and, of course, before trying to export the requirements to the Document.

Whenever the user wants to export the requirements to the Document, the following steps must be done.

**A. Select a Document.**
In the Main window, click the Views Menu ⇒ Documents View or press ALT+V+D.

Select the Document whose requirements are going to be exported (i.e., all Requirements that has this particular document in their Document field will be selected).

Once the Document is selected, click the Tools Menu ⇒ Exporting Requirements to XML or press ALT+T+E.

If the Document selected is a Requirement or Specification Document, the following window will appear:

![Figure 107: Exporting Requirements Window](image)

If the Document is not a Requirement or Specification Document, an error message will indicate it to the user.

**B. Organize the Requirements.**

The sections, subsections and requirements order in the document will be as shown in the window tree (click the small blue key to open the section and subsections). The order can be changed by doing the actions indicated in the following steps:

- Select the section, subsection or requirement whose relative position in the Tree is going to be changed by clicking with the left button of the mouse.
- Use the corresponding arrows (in the right side of the window) to move the selected item up and down as shown in the figure.
Figure 108: Sections and Subsections are opened in the Exporting Requirements Window, the order of the sections, subsections and requirements can be modified

⇒ Repeat the previous steps as many times as needed in order to organize the sections, subsections and requirements order.

C. Save the changes done in the requirements organization.

In order to save the changes done in the section, subsections and requirements order, click the Save button.

D. Export the Requirements to the document.

In order to export the requirements to the document, click the Export button.

The following window will appear:

Figure 109: Generating the XML Files Window
⇒ Indicate the name of the document in the *Output file* field.

⇒ Select the Folder to save the document using the *Browse…* button.

⇒ Select the Format of the output file in the *Format* combo box, which offers two options:

- **MS-Word ML**: The output file is an MS-Word XML file, which can be inserted in the Requirements section of the corresponding Requirement or Specification Document.

- **Req ML**: The output file is an XML file, which follows a pattern as shown in the example below:

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<RequirementSet>
  <Section Name="General Requirements">
    <Subsection Name="Performance Requirement">
      <Requirement Code="FR/IC/001" Title="Wavelength Range">
        <Source>Instrumentation Group</Source>
        <Description>The wavelength range shall be from 1 to 2.5 microns</Description>
      </Requirement>
    </Subsection>
    <Subsection Name="Environmental Requirement">
      <Requirement Code="FR/IC-CR/001" Title="Operating Temperature">
        <ParentReqSet>
          <PR Code="FR/IC/001"/>
        </ParentReqSet>
        <Source>Instrumentation Group</Source>
        <Description>The operating temperature of the cryostat shall be 77K</Description>
      </Requirement>
    </Subsection>
  </Section>
</RequirementSet>
```

⇒ Select the language of the output file in *Language* combo box. The options are: English and Spanish. The language is only applicable if the file to be created is an MS-Word ML file. According to the language selected, the labels *Source* and *Parent requirements* shall be included in the xml file in English or Spanish.

⇒ Select *Accept*.

**E. Close the Exporting Requirements to XML window.**

In order to exit of the Exporting Requirement to XML window, click the *Exit* button.

If the changes have not been saved, the changes will not be applied.
11. CONFIGURATION CHANGES

11.1 What is a Configuration Change?

A Configuration Change is a formal request to modify the current configuration of the system. The current configuration of the system, which can also be referred as the configuration baseline, is defined by the approved status of the design of the system at a particular project milestone.

The Product Tree elements, Interfaces, Requirements and Drawings are all part of the system configuration. So, any change to these elements, once they have been approved whenever a particular project milestone (i.e., Conceptual Design Review, Preliminary Design Review …) has been successfully reached, cannot be done before a Configuration Change is requested and approved.

The Configuration Changes follow a life-cycle as shown in the figure:

- In the first place, the Configuration Change must be introduced in the application. All relevant information related to this particular Configuration Change must be identified to allow the CRB (Configuration change Review Board) evaluates correctly the implications of the change. At that point, the Configuration Change status is “Started”.

- In the CRB meeting, the Configuration Change is analyzed and the Configuration Change state can be changed to “Approved” or “Rejected” depending of the board decision. Alternatively, if any lack of information is found, the Configuration Change Board can decide to classify the change as “Suspended” and to wait for the Initiator to clarify the doubts before evaluating the Configuration Change again.

This life-cycle can be briefly summarized in the following steps:

- In the first place, the Configuration Change must be introduced in the application. All relevant information related to this particular Configuration Change must be identified to allow the CRB (Configuration change Review Board) evaluates correctly the implications of the change. At that point, the Configuration Change status is “Started”.

- In the CRB meeting, the Configuration Change is analyzed and the Configuration Change state can be changed to “Approved” or “Rejected” depending of the board decision. Alternatively, if any lack of information is found, the Configuration Change Board can decide to classify the change as “Suspended” and to wait for the Initiator to clarify the doubts before evaluating the Configuration Change again.
If the Configuration Change were approved, the people who has initiated the Configuration Change must carry out the corresponding actions and inform the Configuration Management Team if the Configuration Change can be “Closed” or “Withdrawn” (if, for any reason, the Configuration Change cannot be finally implemented):

GECO provides the support to manage and archive the Configuration Changes. In this sense, all the relevant information generated during the Configuration Change life-cycle, can be introduced and maintained in the application. GECO will also help in the Configuration Change coordination and information distribution by sending emails at the most important Configuration Change life-cycle transitions.

Finally, in order to understand the importance of having the Configuration Change information easily accessible, it is useful to mention that the current configuration of a system is composed by the approved Configuration Elements and the Configuration Changes.

11.2 Creating a new Configuration Change

Starting at the Main Window of the application,

![Figure 110: Main window of the application](image)

The following steps must be executed in order to create a new Configuration Change:

A. **Open the Configuration Changes Form.**

In the Main window, the Configuration Changes Form can be opened in two different ways:
A.I. Going through the Forms Menu.

In the Main window, select Forms Menu ⇒ Configuration Changes Form or press ALT+O+C.

The Configuration Changes Form will be opened with all available records selected.

![Configuration Changes Form](image)

**Figure 111: Configuration Changes Form showing all the selected records**

A.II. Selecting a Configuration Change in the Configuration Changes View.

In the Main window, click the Views Menu ⇒ Configuration Changes View or press ALT+V+C.

![Configuration Changes View](image)

**Figure 112: Configuration Changes View (right panel) showing all the selected Configuration Changes associated to the selected PT element (left panel)**

Select a Configuration Change among the Configuration Changes listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Configuration Changes Form will be opened with the selected record available only.
B. Add a new record.

In the Configuration Changes Form, new Configuration Changes can be created in two different ways:

B.I. Starting an empty Configuration Change.

In the Configuration Changes Form, click the Add button to add a new record,

A new window will appear,

⇒ select the System PT element code in the System combo box (only the PT elements at system level are accessible),

⇒ click Accept,
The new Configuration Change **Code** will be automatically generated as the first one available for the Configuration Change Product Tree element code selected.

All Configuration Changes Codes follow the same pattern as described below:

\[
\text{CC/PT/nnn}
\]

where,

- **CC**: Configuration Change (these characters are always the same for all Configuration Changes)
- **PT**: Product Tree Element code
- **nnn**: Sequence number that will be automatically generated by the application

The Configuration Change Code is unique for each Configuration Change.

The Requirement code convention is defined before starting to use GECO. More information about it can be found in section 18.

**Figure 115**: Configuration Changes Form once the PT System has been chosen as shown in Figure 114

### B.II. Cloning an already existing Configuration Change.

In the Configuration Changes Form, click the *Copy button* to clone the Configuration Change that is currently selected in the form,

The new Configuration Change **Code** will be automatically generated as the first one available for the same Configuration Change Product Tree element code of the Configuration Change that has been cloned.
C. Fill in the new record.

In the Configuration Changes Form, the mandatory fields that must be filled in are the following ones:

- **Code.** The Configuration Change code is automatically generated by the application and cannot be modified.

- **Sub-subject.** Indicate which subsystem (or group inside the organization) is affected by the Configuration Change. This is a text field with a maximum length of 20 characters.

- **Classification combo box.** Select the Configuration change type among the options offered in the Classification combo box, which includes the following ones:
  
  - *System* (the Configuration change affects to more than one particular subsystem)
  
  - *Subsystem* (the Configuration change affects to one subsystem only)

  By default, the classification is “Subsystem”.

- **Initiator.** Identify the person that is creating the Configuration Change. All persons in the organization that have been previously introduced as Users in the application (see section 16) can be selected from the combo box.

- **Starting date.** Indicate the date when the Configuration Change is being created. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Priority combo box.** Select the Configuration change priority among the options offered in the Priority combo box, which includes the following ones:
  - **High**
  - **Medium**
  - **Low**

  By default, the classification is “Low”.

- **Current status combo box.** Select the Configuration Change status among the options offered in the Status combo box, that includes the following ones:
  - **Started**
  - **Approved**
  - **Rejected**
  - **Suspended**
  - **Closed**
  - **Withdrawn**

  When the Configuration Change is created, the default status is “Started”.

- **Description.** Describe the change that must be done in the system. This is a text field and it does not have a maximum length limit.

The rest of the fields that can be optionally filled are:

- **Comments.** Introduce any additional comment related to the Configuration Change. This is a text field with a maximum length of 300 characters.

- **Affected.** Identify the persons that can be affected by the Configuration Change (as many persons as desired can be selected). The affected persons will receive a notification email related to the Configuration Change modifications. All persons in the organization that have been previously introduced as Users in the application (see section 16) can be selected from the combo box.

- **CC-affected elements.** Identify the PT elements that are affected by the Configuration Change (as many elements as wanted can be selected). In the combo box, all PT elements existing in the application can be selected.

- **CC-affected interfaces.** Identify the Interfaces that are affected by the Configuration Change (as many Interfaces as wanted can be selected). In the combo box, all Interfaces existing in the application can be selected.

- **CC-affected documents.** Identify the Documents that are affected by the Configuration Change (as many Documents as wanted can be selected). In the combo box, all Documents existing in the application can be selected.

The fields **Assigned to** and **Modification date** should not be filled at the creation of the Configuration Change. These fields must be filled at the CRB where the Configuration Change is reviewed.
D. Save the new record.

In the Configuration Changes Form, click the Save button to save the record,

If the current record is not saved, the new record will not be created.

Once the Configuration Change is saved, the application will send an email to notify that the Configuration Change has been created.

“The current status of the Configuration Change (Code) is (new status)” to be sent to the Initiator, the person assigned to do it (if exits) and the affected persons (if exits).

E. Close the Configuration Changes Form

In the Configuration Changes Form, click the Exit button to exit the form,

If the record has been saved, the Configuration Changes Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window reporting that changes have not been saved.]

⇒ Click YES to exit without saving
⇒ Click NO to come back to the Configuration Changes Form.

11.3 Selecting a particular Configuration Change

In the Main window, the form view of a particular Configuration Change can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select Forms Menu ⇒ Configuration Changes Form or press ALT+O+C.

In order to find a particular Configuration Change, the following actions can be done:

⇒ Use the arrows for moving among the Configuration Changes currently selected in the form,
To go to the first record of the selected ones,
To go to the previous record to the current one,
To go to the next record to the current one and
To go to the last record of the selected ones

⇒ Use the Filter button to filter/un-filter the set of Configuration Changes currently selected in the form.

A new window will appear:

⇒ Click Data filter activated box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the Field combo box the desired field to filter the data,

⇒ select in the Op combo box how the previously selected field must match the defined Value (i.e., “starting with”, “contains”, “is”, “ending by”)

⇒ write in the Value Text Field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click Accept,

![Configuration Change Filter](image)

*Figure 118: Configuration Change Filter to select the desired documents by different fields*
B. Selecting the Configuration Change in the Configuration Changes View.

In the Main window, click the Views Menu ➔ Configuration Changes View or press ALT+V+C.

In order to constrain (by Product Tree Element or by filtering) the number of Configuration Changes listed in the view, see the steps to be followed in section 4.2.

Select the desired Configuration Change among the Configuration Changes listed in the table at the right side of the window by double-clicking with the left button of the mouse.

11.4 Modifying existing Configuration Changes

The Configuration Change to be modified must be already selected, which will be done by following the steps described in section 11.3.

In the Configurations Change Form, the following steps must be done in order to modify the selected Configuration Change.

A. Modify the desired fields.

Make the desired changes in the Configurations Change fields, taking into account the constrains identified in section 11.2, numbered item C) and, also, that the Code, Initiator and Starting date fields cannot been modified once the Configuration Change has been already created.

All the rest of the fields can be modified and, in particular, the following fields must be filled after the CRB meeting where the Configuration Change is presented:

- **Assigned to.** Identify the person that is going to do the Configuration Change actions. All persons in the organization that have been previously introduced as Users in the application (see section 16) can be selected from the combo box.

- **Modification date.** Indicate the date when the Configuration Change is being modified. This is a date field with the following format: dd-mm-yyyy, where dd: day, mm: month and yyyy: year.

B. Save the modified record.

In the Configuration Changes Form, click the Save button to save the record,

If the record is not saved, the changes will not be applied.

Once the Configuration Change is saved, the application will send an email to notify that a modification has been done to the Configuration Change. This notification could be the following ones depending of the modification done

“The current status of the Configuration Change (Code) is (new status)” to be sent to the Initiator, the person assigned to do it and the affected persons whenever the status is changed.
“*The Assigned person to the Configuration Change (Code) has been changed*” to be sent to the initiator, to the previous people assigned and to the new one.

C. Close the Configuration Changes Form

In the Configurations Changes Form, click the *Exit button* to exit the form,

If the record has been saved, the Configuration Changes Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window reporting that changes have not been saved.](image)

Figure 119: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Configuration Changes Form.

11.5 Printing a Configuration Change

The Configuration Change to be printed must be already selected, which will be done by following the steps described in section 11.3.

In the Configurations Change Form, the following step must be done in order to print the selected Configuration Change.

A. Print the record.

In the Configuration Changes Form, click the *Print button* to print the record,

A preview of the record to be printed will appear.
Select the Print button to print the record,
or,
Select Cancel button to come back to the Configuration Change form without printing.

If the Print button is selected, the application will look for the printers connected to your computer and the print menu will be opened.

A new window will appear,
select in the Name combo box the printer to be used,
define the desired properties for this job,

⇒ click Accept,

![Print Dialog](image)

*Figure 121: Print Dialog. The selected record will be printed*

### 11.6 Deleting a Configuration Change

The Configuration Change to be deleted must be already selected, which will be done by following the steps described in section 11.3.

In the Configuration Changes Form, the following steps must be done in order to delete the selected Configuration Change.

**A. Delete the record.**

In the Configuration Changes Form, click the *Delete button* to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

![Warning Window](image)

*Figure 122: Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.

⇒ Click *NO* to exit without deleting.
12. NON-CONFORMITIES

12.1 What is a Non-conformity?

A Non-conformity is defined as the non-fulfilment of a specified requirement.

A Non-conformity is normally raised by the Contractor (or the group that is developing a system) of a system after realizing that they cannot achieve a particular requirement.

The Non-conformities follow a life-cycle as shown in the figure:

This life-cycle can be briefly summarized in the following steps:

- In the first place, the Non-conformity request must be introduced in the application. It is important that all relevant information related to this particular Non-conformity is identified to allow the NRB (Non-conformity Review Board) to evaluate the Non-conformity implication. At that point, the Non-conformity status is “Started”.

- At the NRB meeting, the Non-conformity is analyzed and the Non-conformity state can be changed to “Under analysis” or “Rejected” depending on the board decision. If the Non-conformity is classified as “Under Analysis” then the people in charge (Assigned to) to analyze it in more detail, shall be appointed.

- After the necessary analysis is performed, the Non-conformity responsible can request to change the state of the Non-conformity to “Accept” (i.e., the item is found to be useful as it is), “Repair” (i.e., the item must be repaired to fulfil the requirements), “Repair with conditions” (i.e., the item must be repaired although a change in the scope of the requirements is accepted), “Discard” (i.e., the item is not usable as it is) or “Back to the provider” (i.e., the item cannot be accepted and it is returned to the provider, who must provide another one).

- Finally, the NRB must take into account the analysis made by the responsible in order to decide if the Non-conformity is ending as “Closed”, as “Limitation” (i.e., the Non-conformity is not going to be solved and it must be accepted as a Limitation of the system) or as “Obsolete”. One of the actions that could be performed during the Non-
conformity life is to raise a Configuration Change to request a modification of the requirements according to the Non-conformity analysis.

GEKO provides the support to manage and archive the Non-conformities. In this sense, all the relevant information generated during the Non-conformity life-cycle can be introduced and maintained in the application. GEKO will also help in the Non-conformity coordination and information distribution by sending emails at the most important Non-conformity life-cycle transitions.

12.2 Creating a Non-conformity

Starting at the Main Window of the application,

![Figure 123: Main window of the application](image)

the following steps must be executed in order to create a new Non-conformity:

**A. Open the Non-conformities Form.**

In the Main window, the Non-conformities Form can be opened in two different ways:

**A.I. Going through the Forms Menu.**

In the Main window, select *Forms Menu* ⇒ *Non-conformities Form* or press *ALT+O+N*.

The Non-conformities Form will be opened with all available records selected.
A.II. Selecting a Non-conformity in the Non-conformities View.

In the Main window, click the Views Menu ⇒ Non-conformities View or press ALT+V+N.

Select a Non-conformity among the Non-conformities listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Non-conformities Form will be opened with the selected record available only.
B. Add a new record.

In the Non-conformities Form, new Non-conformities can be created in two different ways:

B.I. Starting an empty Non-conformity.

In the Non-conformities Form, click the Add button to add a new record,

A new window will appear,

⇒ select the System PT element code in the System combo box (only the PT elements at system level can be selected),

⇒ click Accept,
The new Non-conformity Code will be automatically generated as the first one available for the Non-conformity Product Tree element code selected.

All Non-conformities Codes follow the same pattern as described below:

**NC/PT/nnn**

where,

- **NC**: Non-conformity (these characters are always the same for all Non-conformities)
- **PT**: Product Tree Element code
- **nnn**: Sequence number that will be automatically generated by the application

The Non-conformity Code is unique for each Non-conformity.

The Requirement code convention is defined before starting to use GECO. More information about it can be found in section 18.

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**Figure 128**: Non-conformities Form once the PT System has been chosen as shown in Figure 127

**B.II. Cloning an already existing Non-conformity.**

In the Non-conformity Form, click the *Copy button* to clone the Non-conformity that is currently selected in the form,

The new Non-conformity Code will be automatically generated as the first one available for the same Non-conformity Product Tree element code of the Non-conformity that has been cloned.
Figure 129: Non-conformities Form ready to introduce a new Non-conformity by cloning an existing record

C. Fill in the new record.

In the Non-conformity Form, the mandatory fields that must be filled in are:

- **Code.** The Non-conformity code is automatically generated by the application and cannot be modified.

- **Sub-subject.** Indicate what subsystem (or group inside the organization) is affected by the Non-conformity. This is a text field with a maximum length of 20 characters.

- **Initiator.** Identify the person that is creating the Non-conformity. All persons in the organization that have been previously introduced as Users in the application (see section 16) can be selected from the combo box.

- **Starting date.** Indicate the date when the Non-conformity is being created. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.

- **Priority combo box.** Select the Non-conformity priority among the options offered in the Priority combo box, that includes the following ones:
  - **High**
  - **Medium**
  - **Low**

  By default, the classification is “Low”.

- **Status combo box.** Select the Non-conformity status among the options offered in the Status combo box, that includes:
When the Non-conformity is created, the default status is “Started”.

- **Description.** Describe the Non-conformity in detail, identifying the requirements that are not met and the consequences of the Non-conformity in meeting the objectives of the system. This is a text field and it does not have a maximum length limit.

The rest of the fields that can be optionally filled are:

- **Comments.** Introduce any additional comment related to the Non-conformity. This is a text field and it does not have a maximum length limit.

- **Affected.** Identify the persons that can be affected by the Non-conformity (you can select as many persons as required). The affected persons will receive a notification email related to the Non-conformity modifications. All persons in the organization that have been previously introduced as Users in the application (see section 16) can be selected from the combo box.

- **NC-affected Elements.** Identify the PT elements that are affected by the Non-conformity (you can select as many elements as required). In the combo box, all PT elements existing in the application can be selected.

- **NC-affected Interfaces.** Identify the Interfaces that are affected by the Non-conformity (you can select as many interfaces as required). In the combo box, all Interfaces existing in the application can be selected.

- **NC-affected Documents.** Identify the Documents that are affected by the Non-conformity (you can select as many documents as required). In the combo box, all Documents existing in the application can be selected.

The fields **Assigned to** and **Modification date** should not be filled at the creation of the Non-conformity. These fields must be filled at the NRB where the Non-conformity is reviewed.

**D. Save the new record.**

In the Non-conformities Form, click the **Save** button to save the record,
If the current record is not saved, the new record will not be created.

Once the Non-conformity is saved, the application will send an email to notify that the Non-conformity has been created.

“The current status of the Non-conformity (Code) is (new status)” to be sent to the Initiator, the person assigned to do it (if exits) and the affected persons (if exits).

E. Close the Non-conformities Form

In the Non-conformities Form, click the Exit button to exit the form,

If the record has been saved, the Non-conformities Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Figure 130: Warning Window reporting that changes have not been saved.]

⇒ Click YES to exit without saving
⇒ Click NO to come back to the Non-conformities Form.

12.3 Selecting a particular Non-conformity

In the Main window, the form view of a particular Non-conformity can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *Non-conformities* Form or press *ALT+O+N*.

In order to find a particular Non-conformity, the following actions can be done:

⇒ Use the arrows for moving among the Non-conformities currently selected in the form,

  - To go to the first record of the selected ones,

  - To go to the previous record to the current one,
To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the Filter button to filter/un-filter the set of Non-conformities currently selected in the form,

A new window will appear:

⇒ Click Data filter activated box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the Field combo box the desired field to filter the data,

⇒ select in the Op combo box how the previously selected field must match the defined Value (i.e., “starting with”, “contains”, “is”, “ending by”)

⇒ write in the Value Text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click Accept,

![Non-conformities filter](image)

**Figure 131:** Non-conformities Filter to select the desired documents by different fields

B. Selecting the Non-conformity in the Non-conformities View.

In the Main window, click the Views Menu ⇒ Non-conformities View or press ALT+V+N.

In order to constrain (by Product Tree Element or by filtering) the number of Non-conformities listed in the view, see the steps to be followed in section 4.2.

Select the desired Non-conformity among the Non-conformities listed in the table at the right side of the window by double-clicking with the left button of the mouse.
12.4 Modifying existing Non-conformities

The Non-conformity to be modified must be already selected, which will be done by following the steps described in section 12.3.

In the Non-conformities Form, the following steps must be done in order to modify the selected Non-conformity.

A. Modify the desired fields.

Make the desired changes in the Non-conformity fields, taking into account the constrains identified in section 12.2, numbered item C) and, also, that the Code, Initiator and Starting date fields cannot been modified once the Non-conformity has been already created.

All the rest of the fields can be modified and, in particular, the following fields must be filled after the NRB meeting where the Non-conformity is presented:

- **Assigned to.** Identify the person that is going to do the Non-conformity evaluation. All persons in the organization that have been previously introduced as Users in the application (see section 16) can be selected from the combo box.

- **Modification date.** Indicate the date when the Non-conformity is being modified. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.

B. Save the modified record.

In the Non-conformities Form, click the **Save** button to save the record,

If the record is not saved, the changes will not be applied.

Once the Non-conformity is saved, the application will send an email to notify that a modification has been done to the Non-conformity. This notification could be the following ones depending of the modification done

- “**The current status of the Non-conformity (Code) is (new status)”** to be sent to the Initiator, the person assigned to do it and the affected persons whenever the status is changed.

- “**The Assigned person to the Non-conformity (Code) has been changed**” to be sent to the Initiator, to the previous responsible and to the new one.

C. Close the Non-conformities Form

In the Non-conformities Form, click the **Exit** button to exit the form,

If the record has been saved, the Non-conformities Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.
Click YES to exit without saving.

⇒ Click NO to come back to the Non-conformities Form.

### 12.5 Printing a Non-conformity

The Non-conformity to be printed must be already selected, which will be done by following the steps described in section 12.3.

In the Non-conformity Form, the following step must be done in order to print the selected Non-conformity.

#### B. Print the record.

In the Non-conformity Form, click the *Print button* to print the record,

A preview of the record to be printed will appear.
Figure 133: Preview window for the Non-conformity to be printed.

⇒ Select the Print button to print the record,

or,

⇒ Select Cancel button to come back to the Non-conformity form without printing.

If the Print button is selected, the application will look for the printers connected to your computer and the print menu will be opened.

A new window will appear,

⇒ select in the Name combo box the printer to be used,

⇒ define the desired properties for this job,

⇒ click Accept,
12.6 Deleting a Non-conformity

The Non-conformity to be deleted must be already selected, which will be done by following the steps described in section 12.3.

In the Non-conformities Form, the following steps must be done in order to delete the selected Non-conformity.

A. Delete the record.

In the Non-conformities Form, click the Delete button to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

⇒ Click YES to delete the record.
⇒ Click NO to exit without deleting.
13. ANOMALIES

13.1 What is an Anomaly?

An Anomaly is any abnormal behavior of the system that must be recorded and investigated. The Anomalies follow a life-cycle as shown in the figure:

- In the first place, all relevant information related to the Anomaly must be introduced in the application to allow the ARB (Anomaly Review Board) to evaluate the Anomaly consequences. At that point, the Anomaly status is “Started”.

- At the ARB meeting, the Anomaly is evaluated and the Anomaly state can be changed to “Under analysis” or “Rejected” depending on the board decision. If the Anomaly is classified as “Under Analysis” then a responsible (Assigned to) must be appointed, in charge to analyze it in more detail.

- After the necessary analysis is performed, the Anomaly’s responsible can request to change the state of the Anomaly to “Monitorize” (i.e., the Anomaly must be maintained opened to monitorize any reoccurrences during a certain period), “Closed” (i.e., the Anomaly has been solved or the analysis made by the responsible indicates that it is not going to reoccur) or “Limitation” (i.e., the Anomaly cannot be solved and must be accepted as a Limitation of the system).

- Finally, the ARB must take into account the analysis made by the Anomaly’s responsible and has to decide if the Anomaly is ending as “Closed” or as a “Limitation”. One of the actions that could be performed during the Anomaly life is to
raise a Configuration Change to request a modification of the system in order to solve the Anomaly or to raise a Non-conformity if the Anomaly is a consequence of the System requirements not having been correctly fulfilled.

GECO provides the support to manage and archive the Anomalies. In this sense, all the relevant information generated during the Anomaly life-cycle can be introduced and maintained in the application. GECO will also help in the Anomaly coordination and information distribution by sending emails at the most important Anomaly life-cycle transitions.

13.2 Creating a new Anomaly

Starting at the Main Window of the application,

![Figure 136: Main window of the application](image)

The following steps must be executed in order to create a new Anomaly:

**A. Open the Anomalies Form.**

In the Main window, the Anomalies Form can be opened in two different ways:

**A.I. Going through the Forms Menu.**

In the Main window, select *Forms Menu ➔ Anomalies Form* or press *ALT+O+A*. The Anomalies Form will be opened with all available records selected.
A.II. Selecting an Anomaly in the Anomalies View.

In the Main window, click the Views Menu ⇒ Anomalies View or press ALT+V+A

Select an Anomaly among the Anomalies listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Anomalies Form will be opened only with the selected record available.
Figure 139: Anomalies Form showing only the selected record

B. Add a new record.

In the Anomalies Form, new Anomalies can be created in two different ways:

B.I. Starting an empty Anomaly.

In the Anomalies Form, click the Add button to add a new record,

A new window will appear,

⇒ select the System PT element code in the System combo box (only the PT elements at system level can be selected.),

⇒ click Accept,
The new Anomaly **Code** will be automatically generated as the first one available for the Anomaly Product Tree element code selected.

All Anomalies Codes follow the same pattern as described below:

\[ \text{AN/PT/nnn} \]

where,

**AN**: Anomaly (these characters are always the same for all Anomalies)

**PT**: Product Tree Element code

**nnn**: Sequence number that will be automatically generated by the application

The Anomaly Code is unique for each Anomaly.

The Requirement code convention is defined before starting to use GECO. More information about it can be found in section 18.

![Anomaly Form](image)

**Figure 141**: Anomalies Form once the PT System has been chosen as shown in Figure 140

**B.II. Cloning an already existing Anomaly.**

In the Anomalies Form, click the **Copy** button to clone the Anomaly that is currently selected in the form,

The new Anomaly **Code** will be automatically generated as the first one available for the same Anomaly Product Tree element code of the Anomaly that has been cloned.
Figure 142: Anomalies Form ready to introduce a new Anomaly by cloning an existing record

C. Fill in the new record.

In the Anomalies Form, the mandatory fields that must be filled in are the following ones:

- **Code.** The Anomaly code is automatically generated by the application and cannot be modified.

- **Sub-subject.** Indicate what subsystem (or group inside the organization) is affected by the Anomaly. This is a text field with a maximum length of 20 characters.

- **Initiator.** Identify the person that is creating the Anomaly. All persons in the organization that have been previously introduced as Users in the application (see section 16) can be selected from the combo box.

- **Starting date.** Indicate the date when the Anomaly is being created. This is a date field with the following format: `dd-mm-yyyy`, where dd: day, mm: month and yyyy: year.

- **Anomaly date.** Indicate the date when the Anomaly has occurred. This is a date field with the following format: `dd-mm-yyyy`, where dd: day, mm: month and yyyy: year.

- **Severity combo box.** Select the Anomaly severity (i.e., the impact that the occurrence of the anomaly has had in the system) among the options offered in the Severity combo box, that include:
  - **High**
  - **Medium**
By default, the classification is “Low”.

- **Criticality combo box.** Select the Anomaly criticality (i.e., the impact that the anomaly or the reoccurrence of the anomaly can have in the system) among the options offered in the Criticality combo box, that include:
  - **High**
  - **Medium**
  - **Low**

  By default, the classification is “Low”.

- **Status combo box.** Select the Anomaly status among the options offered in the Status combo box, that include:
  - **Started**
  - **Under analysis**
  - **Rejected**
  - **Closed**
  - **Limitation**

  When the Anomaly is created, the default status is “Started”.

- **Description.** Describe the Anomaly in detail: what happened, what actions were performed, etc. This is a text field with a maximum length of 300 characters.

- **Impact.** Describe the impact that the Anomaly has had in the system functionality. This is a text field with a maximum length of 250 characters.

The rest of the fields that can be optionally filled are:

- **Analysis.** If any analysis of the Anomaly has already been done, introduce a description of it in this box. This is a text field with a maximum length of 300 characters.

- **Recommended actions.** Describe what actions are recommended to investigate the anomaly. This is a text field with a maximum length of 300 characters.

- **Affected.** Identify the persons that can be affected by the Anomaly (select as many as required). The affected persons will receive a notification email related to the Anomaly modifications. All persons in the organization that have been previously introduced as Users in the application (see section 16) can be selected from the combo box.

The fields **Assigned to**, **Estimated date**, **Action to close the Anomaly** and all the fields under **Taken actions** should not be filled at the creation of the Anomaly. The first two fields must be filled at the ARB where the Anomaly is reviewed. The **Taken Actions** fields must be filled by the users (if the “Assigned to” field changes) who are doing actions to investigate the Anomaly. Eventually, the Action to close the Anomaly must be filled at the ARB where the Anomaly is ended (i.e., **Status** changed to “Closed” or “Limitation”).
D. Save the new record.

In the Anomalies Form, click the Save button to save the record,

If the current record is not saved, the new record will not be created.

Once the Anomaly is saved, the application will send an email to notify that the Anomaly has been created.

“The current status of the Anomaly (Code) is (new status)” to be sent to the Initiator, the person assigned to do it (if exits) and the affected persons (if exits).

E. Close the Anomalies Form

In the Anomalies Form, click the Exit button to exit the form,

If the record has been saved, the Anomalies Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window reporting that changes have not been saved.](image)

⇒ Click YES to exit without saving.

⇒ Click NO to come back to the Anomalies Form.

13.3 Selecting a particular Anomaly

In the Main window, the form view of a particular Anomaly can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select Forms Menu ⇒ Anomalies Form or press ALT+O+A.

In order to find a particular Anomaly, the following actions can be done:

⇒ Use the arrows for moving among the Anomalies currently selected in the form,

![Arrow to go to the first record of the selected ones.](image)

To go to the first record of the selected ones,

![Arrow to go to the previous record to the current one.](image)

To go to the previous record to the current one,
To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the Filter button to filter/un-filter the set of Anomalies currently selected in the form,

A new window will appear:

⇒ Click Data filter activated box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the Field combo box the desired field to filter the data,

⇒ select in the Op combo box how the previously selected field must match the defined Value (i.e., “starting with”, “contains”, “is”, “ending by”)

⇒ write in the Value text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click Accept,

Figure 144: Anomalies Filter to select the desired documents by different fields

B. Selecting the Anomaly in the Anomalies View.

In the Main window, click the Views Menu ⇒ Anomaly View or press ALT+V+A.

In order to constrain (by Product Tree Element or by filtering) the number of Anomalies listed in the view, see the steps to be followed in section 4.2.

Select the desired Anomaly among the Anomalies listed in the table at the right side of the window by double-clicking with the left button of the mouse.
13.4 Modifying existing Anomalies

The Anomaly to be modified must be already selected, which will be done by following the steps described in section 13.3.

In the Anomalies Form, the following steps must be done in order to modify the selected Anomaly.

A. **Modify the desired fields.**

Make the desired changes in the Anomaly fields, taking into account the constrains identified in section 13.2, numbered item C) and, also, that the *Code, Initiator, Starting date* and *Anomaly date* fields cannot been modified once the Anomaly has been already created.

All the rest of the fields can be modified and, in particular, the following fields must be filled after the ARB meeting where the Anomaly is presented:

- **Assigned to.** Identify the person that is going to investigate the Anomaly. All persons in the organization that have been previously introduced as Users in the application (see section 16) can be selected from the combo box.

- **Due date.** Indicate the date when the Anomaly should be solved. This is a date field with the following format: *dd-mm-yyyy*, where dd: day, mm: month and yyyy: year.

Later, each responsible (i.e., person assigned to an Anomaly) must introduce the actions performed by him/her into the fields under *Taken actions*. The following fields must be filled:

- **Name.** Identify the person that is describing the taken action. All persons in the organization that have been previously introduced as Users in the application (see section 16) can be selected from the combo box.

- **Action Description.** Describe the taken action in detail: the action done, the observed result, etc. This is a text field with a maximum length of 200 characters.

- **Suggested status combo box.** Suggest a new status for the Anomaly among the options offered in the Suggested status combo box, which includes the following ones:
  
  - *Monitorize*
  - *Close*
  - *Limitation*

  There is no default option for the combo box.

- **Action date.** Indicate the date when the action has been done. This is a date field with the following format: *dd-mm-yyyy*, where dd: day, mm: month and yyyy: year.

At the ARB when the Anomaly is finalized, the following field must be filled:

- **Action to close the anomaly.** Describe the action/s that justify changing the status of the anomaly as Closed. This is a text field with a maximum length of 300 characters.
B. Save the modified record.

In the Anomaly Form, click the Save button to save the record,

If the record is not saved, the changes will not be applied.

Once the Anomaly is saved, the application will send an email to notify that a modification has been done to the Anomaly. This notification could be the following ones depending of the modification done

“The current status of the Anomaly (Code) is (new status)” to be sent to the Initiator, the person assigned to do it and the affected persons whenever the status is changed.

“The Assigned person to the Anomaly (Code) has been changed” to be sent to the Initiator, to the previous responsible and to the new one.

“The due date of the Anomaly (Code) has been changed” to be sent to the responsible.

C. Close the Anomalies Form

In the Anomalies Form, click the Exit button to exit the form,

If the record has been saved, the Anomalies Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Help dialog box]

*Figure 145: Warning Window reporting that changes have not been saved*

⇒ Click **YES** to exit without saving.

⇒ Click **NO** to come back to the Anomalies Form.

13.5 Printing an Anomaly

The Anomaly to be printed must be already selected, which will be done by following the steps described in section 13.3.

In the Anomaly Form, the following step must be done in order to print the selected Anomaly.

C. Print the record.

In the Anomaly Form, click the Print button to print the record,
A preview of the record to be printed will appear.

![Page preview](image)

**Figure 146: Preview window for the Anomaly to be printed.**

⇒ Select the *Print button* to print the record,

or,

⇒ Select *Cancel button* to come back to the Anomaly form without printing.

If the *Print button* is selected, the application will look for the printers connected to your computer and the print menu will be opened.

A new window will appear,
select in the Name combo box the printer to be used,
define the desired properties for this job,
click Accept,

![Print Dialog](image)

**Figure 147:** Print Dialog. The selected record will be printed

### 13.6 Deleting an Anomaly

The Anomaly to be deleted must be already selected, which will be done by following the steps described in section 13.3.

In the Anomalies Form, the following steps must be done in order to delete the selected Anomaly.

**A. Delete the record.**

In the Anomalies Form, click the **Delete** button to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

![Warning Window](image)

**Figure 148:** Warning Window to check if the user wants to delete the record

- Click **YES** to delete the record.
- Click **NO** to exit without deleting.
14. RAMS COMPONENTS FOR REPAIRABLE SYSTEMS

14.1 What is a RAMS component?

RAMS stands for Reliability, Availability, Maintainability and Safety. RAMS analyses must be performed at all stages of a project to ensure that the system design meets the availability, reliability, maintainability and safety requirements targets established in the RAMS requirements. With this tool we intend to calculate the project, system or subsystems availability (in terms of global MTBF and MTTR) and reliability (in terms of percentage of time that the project, system or subsystem is available to perform its function).

The first step to perform any RAMS analysis is to breakdown the system into subsystems and each subsystem into components or elements, that is, into RAMS components.

RAMS components in this tool can be referred to:

- The hierarchically lowest elements of each system or subsystem to be analyzed in terms of availability and reliability (typically, Product tree elements or parts). These elements are named as “items” in this section.
- A set of n equal items with a functional relationship or configuration among them. These elements are named as “components” in this section. The number of items can be just two or more (n), to be defined by the user in the component form.
- The subsystems comprised of several components (component set) with a functional relationship or configuration among them; in this case, we call “children” to those elements and “parents” to those subsystems (the same way as we do for parent and child requirements). In this case, a component set representing a subsystem will be composed by several components.
- The systems comprised of several subsystems with a functional relationship or configuration among them; in this case, we call “children” to those subsystems and “parents” to their correspondent systems. In this case, a component set representing a system will be composed by several subsystems.
- A project comprised of several systems with a functional relationship or configuration among them; in this case, we call “children” to those systems and “parent” to their correspondent project. In this case, a component set representing a project will be composed by several systems.

This hierarchically chain can have as many levels as required.

14.1.1 Repairable systems

When studying system reliability and availability, non-repairable systems, missions or products are treated differently from repairable systems, missions or products. Some of the metrics, tools and mathematical models used for one type are not applicable to the other.

Repairable systems are those that receive maintenance actions that restore/renew system components when they fail to the original operating state. For such systems the time of operation is not continuous, since their operating life cycles are described by a sequence of up and down states. In this case, the important variables to be determined are the mean time between failures (MTBF) and the mean time to repair or MTTR, as well as the system availability (or the opposite concept, unavailability/downtime).
The calculations to estimate the global system MTBF and MTTR in order to verify the compliance of the availability requirement are performed with the aid of a mathematical model that we call “Availability model”.

The parameters that are used to build availability model in Repairable systems are:

- **Failure Rate (λ):** total number of failures within an item population, divided by the total operating time expended by that population, during a particular measuring interval, under stated conditions. In this tool, the failure rate is considered constant.

- **Mean Time Between Failures (MTBF):** the MTBF for a system is the mean time between two consecutive failures of the system.

- **Mean Time To Repair (MTTR):** The MTTR for a system is the mean time spent in unplanned (corrective) maintenance to repair the system.

- **Availability:** the probability that an item or system is “up” (working) at any random instant in time.

- **Unavailability or Downtime:** the probability that an item or system is “down” (not working) at any random instant in time.

The basic assumptions made in the tool calculations are:

- Elements must be completely independent.

- Failure Rate is constant, that is, all calculations are made in a steady state of the system.

- Mean Time Between Failures must be introduced in the tool “normalized” to the operation time of the system. \(^2\)

- Stand-by redundancy assumes that active failure rates are constant and passive and switching failure rates are assumed to be zero.

The equations used to calculate these parameters for a system from its components depend on the arrangement configuration of those components among each other. The main configurations are:

- **Serial:** The system will fail if one of its components fails.

- **Active redundancy or “m out of n”:** The system with \(n\) redundant components will work if either \(m\)-out-of-\(n\) component work \((m<n)\). The system fails if \((n-m+1)\) components fail. It is called “active” redundancy because the \(n\) components are active or working at the same time. “Parallel” redundancy is a special case of active redundancy with \(m=1\) (two active independent components working).

- **Stand-by redundancy:** refers to \(m\) out of \(n\) units working and \((n-m)\) “waiting” in stand-by (idle, as opposite to active). The stand-by units start to work when active units fail.

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\(^2\) For example, if the MTBF given by the manufacturer for a component is 1000h of continuous operation \((24h\ per\ day)\) but that component is active in the studied system only during 6 hours per day, the normalized MTBF of that component to be introduced in the tool will be 4000h \((24/6)*1000\).
14.2 Creating a RAMS component of repairable systems

Starting at the Main Window of the application,

![Figure 149: Main window of the application](image)

the following steps must be executed in order to create a new RAMS component:

A. **Open the RAMS Repairable System form.**

In the Main window, select *Forms Menu ⇒ RAMS Repairable System Form.*

The RAMS component form will be opened with all available records selected.
Figure 150: RAMS component form for repairable systems showing all the selected records

B. Add a new record.

In the RAMS Repairable System Form, new RAMS component can be created in two different ways:

B.I. Starting an empty RAMS component.

In the RAMS Repairable System Form, click the Add button to add a new record,

A new RAMS component form will be opened empty and ready to be filled in.

![RAMS Repairable System Form](image)

Figure 151: RAMS Repairable System Form to introduce a new RAMS component.

B.II. Cloning an already existing RAMS component.

In the RAMS Repairable System Form, click the Copy button to clone the RAMS component that is currently selected in the form,

A new RAMS component form will be opened with several fields cloned from the previous record and ready to be completed.
C. Fill in the new record.

In the RAMS Repairable System Form, the mandatory fields to be filled in are:

- **Component code.** Indicate the code of the component or component set. The code is unique for each component/component set. This is a text field with a maximum length of 80 characters.

- **Component name.** Indicate the name of the component or component set. This is a text field with a maximum length of 250 characters.

- **System combo box.** Select, among the options offered in the system combo box, the system the component or component set belongs to.

- **Sub-system combo box.** Select, among the options offered in the sub-system combo box, the subsystem (PT element) the component or component set belongs to.

- **Spare part #.** Indicate the number of spares foreseen for the component or component set. This is an integer field.

- **Configuration components combo box.** Select from the combo box the arrangement configuration of those components among each other (see 14.1 for further details).

There are some restrictions on the configuration of a *set of components*:

- For the Standby redundancy configuration, the number of components required to be working for the system to work (field \( m \)) is limited to 1.

- **Number of components (n).** In case of a component, \( n \) indicates the number of equal items of that component and it is filled in manually (see 14.1 for further details). In case of a component set (i.e. a subsystem), the application will calculate
automatically the number of “children components” that set has (the ones we have previously introduced in the application). This is an integer field.

- **m.** Indicates the minimum number of component items necessary for the system to function properly. It applies to both Active redundancy and Standby redundancy configuration. This is an integer field.

- **MTBF**, Indicates the Mean Time Between Failures of each equal item in hours. In case of a component set, this field is disabled and the application automatically displays a zero value to indicate that it is not being used for the calculations. This is a real number field.

- **MTTRi.** Indicates the Mean Time to Repair of each equal item in hours. In case of a component set, this field is disabled and the application automatically displays a zero value to indicate that it is not being used for the calculations. This is a real number field.

The following fields are disabled because they will be filled automatically by the application:

- **MTBF.** Indicates the Mean Time Between Failures of the component or component set in hours. In the case of components, this field is automatically calculated by the application from the MTBFi entered by the user and considering the arrangement of the components among each other. In the case of “component set”, this field is automatically calculated by the application from the children parameters and considering the arrangement of the components among each other. This is a real number field.

- **MTTR.** Indicates the Mean Time to Repair of the component or component set in hours. In the case of components, this field is automatically calculated by the application from the MTBFi and MTTRi entered by the user and considering the arrangement of the components among each other. In the case of “component set”, this field is automatically calculated by the application from the children parameters and considering the arrangement of the components among each other. This is a real number field.

- **Availability.** Indicate the availability \( A = \frac{MTBF}{MTBF + MTTR}\) of the component or component set (in percentage). This field is calculated automatically by the application considering the arrangement of the components among each other. This is a % number field.

- **Unavailability.** Indicate the unavailability \( U = 100 - A\) of the component or component set (in percentage). This field is calculated automatically by the application considering the arrangement of the components among each other. This is a % number field.

The rest of the fields that can be optionally filled in are:

- **Valid.** Indicate if the component is valid or not. To be valid means that the component will be used for the MTBF/MTTR/Availability calculations of the system.

- **Parent component.** Indicates the component set/subsystem to which this component or component set belongs. Select from the combo box between the components already defined in the application.
- **Component’s children.** Only in case of a component set, this field identifies the components or subsystems that comprise this component set. In the combo box, all components or component sets existing in the application can be selected.

- **Comments MTBF/MTTR/Availability.** This is a text field (with no limited length) to include comments related to the MTBF/MTTR/Availability calculations.

- **Other Comments.** This is a text field (with no limited length) to introduce any additional comment related to the component.

**D. Save the new record.**

In the RAMS Repairable System Form, click the *Save* button to save the record,

![Save button](image)

If the current record is not saved, the new record will not be created.

**E. Close the RAMS Repairable System Form**

In the RAMS Repairable System Form, click the *Exit* button to exit the form,

![Exit button](image)

If the record has been saved, the RAMS Repairable System Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning window](image)

*Figure 153: Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the RAMS Repairable System Form.

**14.3 Selecting a particular RAMS component**

In the Main window, the form view of a particular RAMS component can be opened in two different ways:

**A. Going through the Forms Menu.**

In the Main window, select *Forms Menu ⇒ RAMS Repairable System Form*.

In order to find a particular RAMS component, the following actions can be done:

⇒ Use the arrows for moving among the RAMS components currently selected in the form,
To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the Filter button to filter/un-filter the set of RAMS components currently selected in the form,

A new window will appear:

⇒ Click Data filter activated box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the Field combo box the desired field to filter the data,

⇒ select in the Op combo box how the previously selected field must match the defined Value (i.e., “starting with”, “contains”, “is”, “ending by”)

⇒ write in the Value text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click Accept,

Figure 154: RAMS component Filter to select the desired RAMS components by different fields

B. Selecting the RAMS component in the RAMS components of Repairable System View.

In the Main window, click the Views Menu ⇒ RAMS components of Repairable System View.
In order to constrain (by Product Tree Element or by filtering) the number of RAMS components listed in the view, see the steps to be followed in section 4.2.

Select the desired RAMS component among the ones listed in the table at the right side of the window by double-clicking with the left button of the mouse.

14.4 Modifying existing RAMS component

The RAMS component to be modified must be already selected, which will be done by following the steps described in section 14.3.

In the RAMS Repairable System Form, the following steps must be done in order to modify the selected RAMS component.

A. Modify the desired fields.

Make the desired changes in the RAMS component fields, taking into account the constrains identified in section 14.2, numbered item C).

B. Save the modified record.

In the RAMS Repairable System Form, click the Save button to save the record,

If the record is not saved, the changes will not be applied.

In case the component belongs to a component set (i.e., it has a parent component) and the component has modified the MTBF/MTTR/Availability numbers, the application automatically recalculates the MTBF/MTTR/Availability numbers of his parent component.

C. Close the RAMS Repairable System Form

In the RAMS Repairable System Form, click the Exit button to exit the form,

If the record has been saved, the RAMS Repairable System Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window reporting that changes have not been saved](image_url)

Figure 155: Warning Window reporting that changes have not been saved

⇒ Click YES to exit without saving.

⇒ Click NO to come back to the RAMS Form.
14.5 Deleting a RAMS component

The RAMS component to be deleted must be already selected, which will be done by following the steps described in section 14.3.

In the RAMS Repairable System Form, the following steps must be done in order to delete the selected RAMS component.

A. Delete the record.

In the RAMS Repairable System Form, click the *Delete* button to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

![Warning Window to check if the user wants to delete the record](image)

*Figure 156: Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.
⇒ Click *NO* to exit without deleting.

In case the component belongs to a component set (i.e., it has a parent component), the application automatically recalculates the MTBF/MTTR/Availability numbers of its parent component.

14.6 Exporting RAMS Repairable System calculations to XLS

In the Main window, click the *Tools Menu* ⇒ *Export RAMS Repairable System calculations to XLS*.

A new window will appear, where the user must, first, introduce the subsystem, the file name and path to save the xls file and, then, click *Accept*.
A new window (it is necessary to have a xls viewer installed) will show the MTBF/MTTR/Availability calculations of all the components that belongs to the subsystem that has been just introduced.

**Figure 157:** Window to insert the subsystem, and filename/path to generate the xls file

**Figure 158:** After entering the subsystem and filename/path, this window will show the result of the search, which will include all the MTBF/MTTR/Availability calculations of all the components for the selected subsystem.

15. RAMS COMPONENTS FOR SYSTEMS WITHOUT REPAIR

15.1 What is a RAMS component?

RAMS stands for Reliability, Availability, Maintainability and Safety. RAMS analyses must be performed at all stages of a project to ensure that the system design meets the availability, reliability, maintainability and safety requirements targets established in the RAMS requirements. With this tool we intend to calculate the project, system or subsystems availability (in terms of global MTBF and MTTR) and reliability (in terms of percentage of time that the project, system or subsystem is available to perform its function).

The first step to perform any RAMS analysis is to breakdown the system into subsystems and each subsystem into components or elements, that is, into RAMS components.

RAMS components in this tool can be referred to:

- The hierarchically lowest elements of each system or subsystem to be analyzed in terms of availability and reliability (typically, Product tree elements or parts). These elements are named as “items” in this section.
- A set of n equal items with a functional relationship or configuration among them. These elements are named as “components” in this section. The number of items can be just two or more (n), to be defined by the user in the component form.
- The subsystems comprised of several components (component set) with a functional relationship or configuration among them; in this case, we call “children” to those...
elements and “parents” to those subsystems (the same way as we do for parent and child requirements). In this case, a component set representing a subsystem will be composed by several components.

- The systems comprised of several subsystems with a functional relationship or configuration among them; in this case, we call “children” to those subsystems and “parents” to their correspondent systems. In this case, a component set representing a system will be composed by several subsystems.

- A project comprised of several systems with a functional relationship or configuration among them; in this case, we call “children” to those systems and “parent” to their correspondent project. In this case, a component set representing a project will be composed by several systems.

This hierarchically chain can have as many levels as required.

15.1.1 Systems without Repair (or non-repairable systems)

When studying system reliability and availability, non-repairable systems, missions or products are treated differently from repairable systems, missions or products. Some of the metrics, tools and mathematical models used for one type are not applicable to the other.

Non-repairable systems are those that are not to be repaired until the system is unavailable. Examples of these systems are “one-shot” devices such as a light bulb, a pacemaker or a missile to be launched. For such systems the concepts managed are the time up to the first failure, MTTF, or operation time, as well as the system reliability (or the opposite concept, unreliability/probability of failure).

The calculations to estimate the global system MTTF in order to verify the compliance of the reliability requirement are performed with the aid of a mathematical model that we call “Reliability model”.

The parameters that are used to build availability model in non-repairable systems are:

- Failure Rate ($\lambda$): total number of failures within an item population, divided by the total operating time expended by that population, during a particular measuring interval, under stated conditions. In this tool, the failure rate is considered constant.

- Mean Time To (first) Failure (MTTF): the MTTF for a system is the mean time for the system to fail.

- Reliability: the probability of being able to perform under given conditions for a given time interval.

- Probability of Failure or Unreliability: the probability of failure / not being able to perform under given conditions for a given time interval.

The basic assumptions made in the tool calculations are:

- Elements must be completely independent.

- Failure Rate is constant, that is, all calculations are made in a steady state of the system.

- The probability of failure by a given time is assumed to follow a negative exponential distribution.
- Mean Time To Failure must be introduced in the tool “normalized” to the operation time of the system. 3

- Stand-by redundancy assumes that active failure rates are constant and passive and switching failure rates are assumed to be zero.

The equations used to calculate these parameters for a system from its components depend on the arrangement configuration of those components among each other. The main configurations are:

- Serial: The system will fail if one of its components fails.

- Active redundancy or “m out of n”: The system with n redundant components will work if either m-out-of-n component work (m<n). The system fails if (n-m+1) components fail. It is called “active” redundancy because the m components are active or working at the same time. “Parallel” redundancy is a special case of active redundancy with m=1 (two active independent components working).

- Stand-by redundancy: refers to m out of n units working and (n-m) “waiting” in stand-by (idle, as opposite to active). The stand-by units start to work when the active units fail.

15.2 Creating a RAMS component of system without repair

Starting at the Main Window of the application,

![Figure 139: Main window of the application](image)

3 For example, if the MTTF given by the manufacturer for a component is 1000h of continuous operation (24h per day) but that component is active in the studied system only during 6 hours per day, the normalized MTTF of that component to be introduced in the tool will be 4000h ((24/6) *1000).
the following steps must be executed in order to create a new RAMS component:

A. **Open the RAMS System without Repair Form.**

In the Main window, select *Forms Menu ➞ RAMS System without Repair Form.*

The RAMS component form will be opened with all available records selected.

![Image of RAMS System without Repair Form]

*Figure 160: RAMS System without Repair form showing all the selected records*

B. **Add a new record.**

In the RAMS System without Repair Form, new RAMS component can be created in two different ways:

B.I. **Starting an empty RAMS component.**

In the RAMS System without Repair Form, click the *Add* button to add a new record,

A new RAMS System without Repair Form will be opened empty and ready to be filled.
B.II. Cloning an already existing RAMS component.

In the RAMS System without Repair Form, click the *Copy* button to clone the RAMS component that is currently selected in the form,

A new RAMS System without Repair form will be opened with several fields cloned from the previous record and ready to be completed.
Figure 162: RAMS System without Repair form ready to introduce a new RAMS component by cloning an existing record

C. Fill in the new record.

In the RAMS System without Repair Form, the mandatory fields to be filled in are:

- **Component code.** Indicate the code of the component or component set. The code is unique for each component/component set. This is a text field with a maximum length of 80 characters.

- **Component name.** Indicate the name of the component or component set. This is a text field with a maximum length of 250 characters.

- **System combo box.** Select, among the options offered in the system combo box, the system the component or component set belongs to.

- **Sub-system combo box.** Select, among the options offered in the sub-system combo box, the subsystem (PT element) the component or component set belongs to.

- **Operation time.** Indicate the operation time of the system in hours. This is a real number field.

- **Configuration components combo box.** Select from the combo box the arrangement configuration of those components among each other (see 15.1 for further details).

There are some restrictions on the configuration of a set of components:

- For the Standby redundancy configuration, the number of components required to be working for the system to work (field m) is limited to 1.

- **Number of components (n).** In case of a component, (n) indicates the number of equal items of that component and it is filled in manually (see 14.1 for further details). In case of a component set (i.e. a subsystem), the application will calculate automatically the number of “children components” that set has (the ones we have previously introduced in the application). This is an integer field.

- **m.** Indicates the minimum number of component items necessary for the system to function properly. It applies to both Active redundancy and Standby redundancy configuration. This is an integer field.

- **MTTFi.** Indicates the Mean Time to Failure of each equal item in hours. In case of a component set, this field is disabled and the application automatically displays a zero value to indicate that it is not being used for the calculations. This is a real number field.

The following fields are disabled because they will be filled automatically by the application:

- **MTTF.** Indicates the Mean Time to Failure of the component or component set in hours. In the case of components, this field is automatically calculated by the application from the MTBFi entered by the user and considering the arrangement of the components among each other. In the case of “component set”, this field is automatically calculated by the application from the children parameters and
considering the arrangement of the components among each other. This is a real number field.

- $\lambda_i$: Indicates the failure rate ($1/\text{MTTF}_i$) of each item. This field is calculated automatically by the application. This is a real number field.

- $\lambda$: Indicates the failure rate ($1/\text{MTTF}$) of the component or component set. This field is calculated automatically by the application. This is a real number field.

- **Reliability**: Indicates the reliability of the component or component set (in percentage). This field is calculated automatically by the application considering the arrangement of the components among each other. This is a real number field.

- **Prob. of failure**: Indicate the probability of failure of the component or component set (in percentage). This field is calculated automatically by the application. This is a real number field.

The rest of the fields that can be optionally filled in are:

- **Valid**: Indicate if the component is valid or not. To be valid means that the component will be used for the MTTF/Reliability calculations of the system.

- **Parent component**: Indicates the component set/subsystem to which this component or component set belongs. Select from the combo box between the components already defined in the application.

- **Component's children**: Only in case of a component set, this field identifies the components or subsystems that comprise this component set. In the combo box, all components or component sets existing in the application can be selected.

- **Comments MTTF/Reliability**: This is a text field (with no limited length) to include comments related to the MTBF/Reliability calculations.

- **Other Comments**: This is a text field (with no limited length) to introduce any additional comment related to the component.

**D. Save the new record.**

In the RAMS System without Repair Form, click the *Save* button to save the record.

If the current record is not saved, the new record will not be created.

**E. Close the RAMS System without Repair Form**

In the RAMS System without Repair Form, click the *Exit* button to exit the form.

If the record has been saved, the RAMS System without Repair Form will be closed.

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4 For systems without repair, the concept of failure rate is more related to a “hazard rate”, whereas for repairable systems, it means “the rate of occurrence of failures”.

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If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window]

*Figure 163: Warning Window reporting that changes have not been saved.*

- Click **YES** to exit without saving.
- Click **NO** to come back to the RAMS component Form.

### 15.3 Selecting a particular RAMS component

In the Main window, the form view of a particular RAM component can be opened in two different ways:

#### C. Going through the Forms Menu.

In the Main window, select **Forms Menu ⇒ RAMS System without Repair Form**.

In order to find a particular RAMS component, the following actions can be done:

- **Use the arrows** for moving among the RAMS components currently selected in the form,
  
  ![Arrow Icons]

  - To go to the first record of the selected ones,
  - To go to the previous record to the current one,
  - To go to the next record to the current one and
  - To go to the last record of the selected ones

- **Use the Filter button** to filter/un-filter the set of RAMS components currently selected in the form,

  ![Filter Icon]

A new window will appear:

- Click **Data filter activated** box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

- select in the **Field** combo box the desired field to filter the data,

- select in the **Op** combo box how the previously selected field must match the defined **Value** (i.e., “starting with”, “contains”, “is”, “ending by”)

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write in the Value text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

- define as many filters as wanted (by adding new lines),

- click Accept.

![Data filter activated](image)

*Figure 164: RAMS component Filter to select the desired documents by different fields*

**D. Selecting the RAMS component in the RAMS components of Systems without Repair View.**

In the Main window, click the Views Menu ⇒ RAMS components of Systems without Repair View.

In order to constrain (by Product Tree Element or by filtering) the number of RAMS components listed in the view, see the steps to be followed in section 4.2.

Select the desired RAMS component among the ones listed in the table at the right side of the window by double-clicking with the left button of the mouse.

**15.4 Modifying existing RAMS component**

The RAMS component to be modified must be already selected, which will be done by following the steps described in section 15.3.

In the RAMS component Form, the following steps must be done in order to modify the selected RAMS component.

**D. Modify the desired fields.**

Make the desired changes in the RAMS component fields, taking into account the constrains identified in section 15.2, numbered item C).

**E. Save the modified record.**

In the RAMS System without Repair Form, click the Save button to save the record,

If the record is not saved, the changes will not be applied.
In case the component belongs to a component set (i.e., it has a parent component) and the component has modified the MTBF/MTTR numbers, the application automatically recalculates the MTBF/MTTR numbers of his parent component.

**F. Close the RAMS System without Repair Form**

In the RAMS System without Repair Form, click the Exit button to exit the form,

If the record has been saved, the RAMS System without Repair Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Warning Window reporting that changes have not been saved](image)

> Click YES to exit without saving.

> Click NO to come back to the RAMS Form.

**15.5 Deleting a RAMS component**

The RAMS component to be deleted must be already selected, which will be done by following the steps described in section 15.3.

In the RAMS System without Repair Form, the following steps must be done in order to delete the selected RAMS component.

**B. Delete the record.**

In the RAMS System without Repair Form, click the Delete button to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

![Warning Window to check if the user wants to delete the record](image)

> Click YES to delete the record.

> Click NO to exit without deleting.
In case the component belongs to a component set (i.e., it has a parent component), the application automatically recalculates the MTTF/Reliability numbers of his parent component.

### 15.6 Exporting RAMS System without Repair calculations to XLS

In the Main window, click the *Tools Menu ⇒ Export rams System without Repair calculations to XLS.*

A new window will appear, where the user must, first, introduce the subsystem, the file name and path to save the xls file and, then, click *Accept.*

![Figure 167: Window to insert the subsystem, and filename/path to generate the xls file](image)

A new window (it is necessary to have a xls viewer installed) will show the MTTF/Reliability calculations of all the components that belongs to the subsystem that has been just introduced.

![Figure 168: After entering the subsystem and filename/path, this window will show the result of the search, which will include all the MTTF/Reliability calculations of all the components for the selected subsystem.](image)
16. USERS

16.1 What means to be a User in GECO

A User is commonly defined as a person, organization, or other entity that employs the services provided by a system.

In GECO, the same definition applies to the term User, so any person that is susceptible to use the application must be record as a User inside GECO.

All recorded Users will be able to start and use GECO and, also, to be selectable in the different people combo box existing in the application (such as the Document authors, the Anomaly Initiators and so on).

16.2 Creating a User

Starting at the Main Window of the application,

![Main window of the application](image)

*Figure 169: Main window of the application*

the following steps must be executed in order to create a new User:

A. **Open the Users Form.**

In the Main window, select *Forms Menu ⇒ Users Form* or press *ALT+O+U*.

The Users Form will be opened with all available records selected.
Figure 170: Users Form showing all the selected records

B. Add a new record.

In the Users Form, new Users can be created in two different ways:

B.I. Starting an empty User.

In the Users Form, click the Add button to add a new record,

A new Users Form will be opened empty and ready to be filled.

Figure 171: User Form to introduce a new User.

B.II. Cloning an already existing User.

In the Users Form, click the Copy button to clone the User that is currently selected in the form,

A new Users form will be opened with several fields cloned from the previous record and ready to be completed.
Figure 172: Users Form ready to introduce a new User by cloning an existing record

C. Fill in the new record.

In the Users Form, the mandatory fields that must be filled in are the following ones:

- **Name.** Indicate the first name of the User. This is a text field with a maximum length of 45 characters.

- **E-mail.** Indicate the User e-mail address. This is a text field with a maximum length of 45 characters.

- **User.** Indicate the user that is going to be used by this particular User to enter into GECO. This is a text field with a maximum length of 15 characters.

- **Password.** Indicate the password corresponding to the user entered in the previous paragraph, to enter into GECO. This is a text field with a maximum length of 32 characters.

- **Group.** Indicate the group this user belongs to. There are two options:
  - **read:** The user can only visualize the data.
  - **admin:** The user can add new records and modify and delete the existing ones.

  By default, the group is “read”.

The rest of the fields that can be optionally filled are:

- **Surname (1).** Indicate the first last name of the User. This is a text field with a maximum length of 45 characters.

- **Surname (2).** Indicate the second last name of the User. This is a text field with a maximum length of 45 characters.

- **Phone.** Indicate the User phone number. This is a text field with a maximum length of 45 characters.

- **Mobile.** Indicate the User mobile phone number. This is a text field with a maximum length of 45 characters.

- **Organization.** Indicate the User’s organization. This is a text field with a maximum length of 45 characters.
- **Location.** Indicate the User location inside the organization. This is a text field with a maximum length of 45 characters.

**D. Save the new record.**

In the Users Form, click the *Save* button to save the record,

If the current record is not saved, the new record will not be created.

Once the User is saved, the application will send an email to notify the creation of the User to the User’s email with the following text:

“*You have been registered in GECO. Your password is (password)*”

**E. Close the Users Form**

In the Users Form, click the *Exit* button to exit the form,

If the record has been saved, the Users Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

![Figure 173: Warning Window reporting that changes have not been saved.]

⇒ Click *YES* to exit without saving.
⇒ Click *NO* to come back to the Users Form.

**16.3 Selecting a User**

In the Main window, the form view of a particular User can be opened as follows:

**E. Going through the Forms Menu.**

In the Main window, select *Forms Menu* ⇒ *Users Form* or press *ALT+O+U*.

In order to find a particular User, the following actions can be done:

⇒ Use the arrows for moving among the Users currently selected in the form,

- To go to the first record of the selected ones,
- To go to the previous record to the current one,
16.4 Modifying existing Users

The User to be modified must be already selected, which will be done by following the steps described in section 16.3.

In the Users Form, the following steps must be done in order to modify the selected User.

A. Modify the desired fields.

Make the desired changes in the User fields, taking into account the constraints identified in section 16.2, numbered item C).
All fields in the Users form can be modified.

B. Save the modified record.

In the Users Form, click the Save button to save the record,

If the record is not saved, the changes will not be applied.

Once the User is saved, the application will send an email to notify the modification done to the User’s email. Two different emails can be sent:

“Your password has been modified” when only the password has been changed

“The User’s properties have been modified” when any other field has been changed

C. Close the Users Form

In the Users Form, click the Exit button to exit the form,

If the record has been saved, the Users Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 175: Warning Window reporting that changes have not been saved.

⇒ Click YES to exit without saving.

⇒ Click NO to come back to the Users Form.

16.5 Unsubscribe/Deleting a User

The User to be unsubscribed/deleted must be already selected, which will be done by following the steps described in section 16.3.

In the Users Form, the following steps must be done in order to unsubscribe/delete the selected User.

A. Unsubscribe the user.

In the User Form, click the Delete button to unsubscribe the user record,
A new window will appear.

![Warning Window](image)

Figure 176: Warning Window to ask unsubscribe or delete a user.

- Click **Unsubscribe** to unsubscribe the user.
- Click **Cancel** to exit without unsubscribing/deleting.

Once the User has been unsubscribed, the application will send an email to notify it to the User’s email with the following text: “You have been unregistered in GECO”

It is important to mention that, in order to maintain the history, an unsubscribed Users will not be deleted from the Person’s list where they have been already selected. It means that if, for example, the unsubscribed user was the author of a document, he/she is going to be maintained as the document’s author.

**B. Delete the record.**

In the User Form, click the **Delete** button to delete the record,

![Warning Window](image)

Figure 177: Warning Window to ask what wants to do with the user record

- Click **Delete** to delete the record.
- Click **Cancel** to exit without unsubscribing/deleting.

It is important to mention that the deleted Users are deleted from all Person’s lists. It means that if, for example, the deleted user was the author of a document, he/she is going to disappear as the document’s author.
17. ERROR MESSAGES

In this section, the error messages that could appear while the user is working with GECO are described.

1. “You are at the first record”
   This error could appear in any form whenever the User is already in the first record of the set of records selected and he/she is trying to move to the previous record.

2. “You are at the last record”
   This error could appear in any form whenever the User is already in the last record of the set of records selected and he/she is trying to move to the next record.

3. “Record has not been saved. Please, fill all the mandatory fields”
   This error could appear in any form whenever the User is trying to save it without filling all mandatory fields, which are identified with an “*”.

4. “You have to select a requirement document first by using the Document View”
   This error could appear in any view whenever the User is selecting the option Export requirements to XML in the Tool Menu without pre-selecting a requirement document first.
18. SETTING-UP GECO

GECO gives some flexibility to establish the way that the data codes are defined. The Users have to decide how they want the codification convention and these decisions will be inserted in GECO database and used as constrains during the life of each particular application.

In this section, we describe the rules and restrictions to define the code conventions. It is important to mention that once they are established, they must not be changed afterwards, to avoid any incoherencies in the data.

- **PT elements**: The PT elements follow the pattern described below:

  AA-AA-AA-AA

  where

  AA: Product Tree Element acronym to be defined as any combination of alphanumeric characters (excluding the “%”). The length of this acronym is not fixed.

  -: PT Element separator

  The user must define:

  - The user must define which character is used as separator in the PT Element code to distinguish among the different PT elements levels. In this example and along this manual, we have selected the “-”. The only character not allowed is “%”.

  **Note**: The separator character that has been chosen for the PT elements must be different to the ones selected for the other elements (requirements, documents, configuration changes, non-conformities and anomalies). Otherwise, the separator character for requirements, documents, configuration changes, non-conformities and anomalies could be the same (i.e., this restriction only applies to the PT elements).

- **Requirements**: The Requirements follow the pattern described below:

  TT/PT/nnn

  where

  /: Requirements separator

  TT: Requirements type

  PT: Product Tree Element or Interface code

  nnn: Sequence number that will be automatically generated by the application

  The user must define:

  - The character to be used as separator inside the Requirements code. In this example and along this manual, we have selected the “/”. The only character not allowed is the “%”. 
The Requirement type, which could be any combination of alphanumeric characters (excluding “%”). In this manual, we have used “FR” (Functional Requirements) and “TR” (Technical Requirements).

The order of the different parts of the Code. It means that all these combinations are possible: TT/PT/nnn, TT/nnn/PT, PT/nnn/TT, nnn/TT/PT, nnn/PT/TT and PT/TT/nnn.

- **Documents**: The Documents follow the pattern described below:

  \[ TT/PT/nnn \]

  where,

  \( / \): Documents separator

  \( TT \): Document type

  \( PT \): Product Tree Element or Interface code

  \( nnn \): Sequence number that will be automatically generated by the application

  The user must define:

  - The character to be used as separator inside the Document code. In this example and along this manual, we have selected the “/”. The only character not allowed is “%”.

  - The Document type, which could be any combination of alphanumeric characters (excluding “%”). At least, document types need to be defined for: Procedure, Report, Requirements and Specification documents. In this manual, we have used: ANA (Analysis), DR (Drawing), INT (Interface), MOM (Minutes of Meeting), PRO (Procedure), RPT (Report), RQ (Requirements Document), SP (Specification Document) and TEC (Technical Note).

    In particular, it must be clarified for setting-up the tool, that the acronyms shall be used for requirements and specification documents, interface documents, procedures and test reports, because these document types are used in some forms to filter the document list and, therefore, facilitate the document search.

  - The order of the different parts of the Code. It means that all these combinations are possible: TT/PT/nnn, TT/nnn/PT, PT/nnn/TT, nnn/TT/PT, nnn/PT/TT and PT/TT/nnn.

- **Configuration Changes**: The Configuration Changes follow the pattern described below:

  \[ CC/PT/nnn \]

  where,

  \( / \): Configuration Change separator

  \( CC \): Configuration Change identifier

  \( PT \): Product Tree Element code

  \( nnn \): Sequence number that will be automatically generated by the application
The user must define:

- The character to be used as separator inside the Configuration change code. In this example and along this manual, we have selected the “/”. The only character not allowed is the “%”.

- The Configuration change identifier which could be any combination of alphanumeric characters (excluding “%”). In this manual, we have used the acronym CC (Configuration Change).

- The order of the different parts of the Code. It means that all these combinations are possible: CC/PT/nnn, CC/nnn/PT, PT/nnn(CC, nnn/CC/PT, nnn/PT/CC and PT/CC/nnn.

- **Non-conformities**: The Non-conformities follow the pattern described below:

  **NC/PT/nnn**

  where,

  /: Non-conformities separator
  NC: Non-conformity identifier
  PT: Product Tree Element code
  nnn: Sequence number that will be automatically generated by the application

  The user must define:

  - The character to be used as separator inside the Non-conformity code. In this example and along this manual, we have selected the “/”. The only character not allowed is “%”.

  - The Non-conformity identifier which could be any combination of alphanumeric characters (excluding “%”). In this manual, we have used the acronym NC (Non-conformity).

  - The order of the different parts of the Code. It means that all these combinations are possible: NC/PT/nnn, NC/nnn/PT, PT/nnn/NC, nnn/NC/PT, nnn/PT/NC and PT/NC/nnn.

- **Anomalies**: The Anomalies follow the pattern described below:

  **AN/PT/nnn**

  where,

  /: Anomalies separator
  AN: Anomaly identifier
  PT: Product Tree Element code
  nnn: Sequence number that will be automatically generated by the application

  The user must define:
The character to be used as separator inside the Anomaly code. In this example and along this manual, we have selected the “/”. The only character not allowed is “%”.

The Anomaly identifier which could be any combination of alphanumeric characters (excluding “%”). In this manual, we have used the acronym AN (Anomaly).

The order of the different parts of the Code. It means that all these combinations are possible: AN/PT/nnn, AN/nnn/PT, PT/nnn/AN, nnn/AN/PT, nnn/PT/AN and PT/AN/nnn.