TREBALL DE FI DE CARRERA

TÍTOL DEL TFC: A data transfer model in the space field

TITULACIÓ: Enginyeria Tècnica Aeronàutica, especialitat Aeronavegació

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DIRECTOR: Prof. Paolo Maggiore

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Resum

El seguent treball s'encarrega de l'estudi del transeriment de dades en temps real, entre empreses del sector Aeroespacial. Aquest intercanvis són molt importants per tal d' optimitzar el desenvolupament de satèl·lits i altres vehicles espacials.
En els posteriors capítols s'expliquen conceptes importants com els metalinguatges XML, el qual esdevé l'eina mare per poder realitzar aquests processos; l 'ambient de desenvolupament CoDE, el qual permet optimitzar el procés; el concepte de CDF, i els beneficis que aquest comporta en el camp Aeroespacial. També es presenta una aplicació creada a Alcatel Alenia Spazio per una posterior utilització en la missió EXOMARS-ESA.

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Overview

This work takes charge of the study of the data change in real time, among companies of the aerospace sector. These exchanges are important to optimize the development of satellites and other spacel vehicles.
In the next chapters the more important concepts like the XML metalanguage are explained, which is the main tool used to perform these preocesses: the development CoDE area, which allows us to optimise the process, the CDF concept, and the benefits that this entail in the aerospace field. All the result of this work will be used to perform engineering analyses the ESA - EXOMARS mission under definition by Alcatel Alenia Space .

A Carlo Paccagnini i Paolo Magiore per donarme la oportunitat de realitzar aquest treball.

A la Miriam per tota la pasiencia i ajuda prestada al llarg d'aquest quatre mesoss.

Als meus pares per poder-hi contar sempre.

INTRODUCTION

The aerospace field is a complex business frame. A satellite is not a project that can be carried out in a few months, either in years. This complexity is because the high number of builder and collaborator companies that invested in the same project, which have to carry the project out by a coordinated and collaborated form.

But collaborate among companies sometimes is not easy, the companies can be far away, or use different work tool. So how it is possible to exchange information? Thanks the new networks technologies, it allows us to accede among distributed computers, but once connected nothing ensure that the sent data from one company will be the ones that the other waits for.
Then in the moment when one works with the collaboration of other companies, and needs a data exchange in real time, it is necessary that this is standardized, so to speak, being compatible with the other systems that we can find.

In our case, the different engineers have the need of the data introduced in the CDF-MIS can be seen and modified and return for another group of engineers, in real time and without raising problems of Software compatibility .
Alcatel Alenia Spazio and Politecnico di Torino is carrying out a project with ESA on this subject. The solution consists of sending data (in XML format) to a Web Service by means of Soap messages.
This work concept suppose an important help for engineers, and it is possible thanks to XML that was born in the 1998, a Metalanuage that allows, among other characteristics, a direct use about internet. But the bigger XML added value is that supports a high variety of applications, being ideal for the necessities mentioned previously.

The following work explains my contribution to the project, which consists in transform the CDF-MIS data(which are in an Excel format) into a XML format, and then send these to a web-service created for another member of the work group.

1. MOTIVATIONS AND AIMS

1.1. Motivations

The motivations of choosing this project, has been several, but we have to stand out that from the first moment the foreseen results could be useful for the European aerospace sector

From the first moment the project seems to be the suitable one because my aim was to create a software that has to fit perfectly with software's developed by other people.

All these concepts are included in a real space project, formed by Alcatel Alenia Spazio, Politecnico di Tornino and E.S.A., my part has been developed in Alcatel Alenia Spazio.

Outlining the motivations to carry out this project were:

- To work in a business frame
- My contribution is part of a real project.
- The relation with the space field
- The possibility to learn new programming languages, and the development in a team

I should stand out, that the formation has been very high and from the first moment I knew that I have to learn a lot of things that were unknown since then

During the project the motivations have been present and I think that I took the correct decision to carry out it.

1.1.1. Project aims

From the first moment the project has a clear and detailed aims, so much to technical and personal levels. These are explained in the following paragraphs.

1.1.2. Technical aims

- **The translator CDF MIS XML:** the principal aim of the project was to create a software that could transform the CDF (which is a Microsoft Excel document) in a well formed and validate XML file. This XML file has to fulfilling a requirement.
- **The SOAP messages generator:** a macro, that has been developed previously, for any document Excel sheet that allows us to send a part of

the data from this sheet in a message SOAP form, to a Web Service, create for another person of the global project.

- **The manual:** all SW development has to be well documented with two documents, one is the User Manual and the second is the Design&Development manual

1.1.3. Global aims

- **Compatibility:** my part has to be designed to be compatible with the others, developed in parallel.

- **Coordination:** the different development phases have to be coordinated.

1.1.4. Personal aims

- **Optimization of the Software's:** the creation of a software's, which were the most possible efficient, and with a good reliability.

2. THE CoDE PROJECT AND CDF

2.1. The CoDE project

Looking forward improvements in the managerial and technical design process, in order to enhance performance thus reducing time and cost, Alenia Spazio in collaboration with Politecnico di Torino has decided to investigate new design concepts and methodologies. As the system complexity grows, an efficient design paradigm should be capable of keeping the system level coherence while the design activity spreads among the involved disciplines. The improvement of computer-aided engineering enabled methodologies such as concurrent design and engineering, capable of carrying system level evaluation and project level design efforts thus optimizing the problem fragmentation process and the subsequent rebuilt of solution.
Following the philosophy of functional modeling and simulation, Alenia Spazio is working on a modeling environment allowing integration of distributed multidisciplinary models, upgradable to the necessary detail depth during the different phases of the project life cycle (from preliminary design to verification and operative phases, envisaging the capability for H/W in the loop and testing support in remote mode).

The development activity of a system or a space mission, in his classical approach, involves different technician-scientific capabilities, quite independent between them. Each subsystem is developed inside a determinate project in relatively autonomous way, using its tools. The interactions at system level take place through periodic meetings in which the got results are compared to set up further development directives. The organizational control, the integration and the interfaces management are top-down coordinated, while the solution of the problems, optimized by a team of specialists, is raised from the bottom toward the top. Nearby to the values of such a well-consolidated procedure, this approach has the disadvantage to support a certain segregation of the expertise, reducing the chance to identify multidisciplinary solutions and limiting the vision at system level. Besides, this methodology can require a too high time of development, as regards the standards than the new market tendencies they go imposing, also in space field.
An alternative to this classical approach is offered by the "Concurrent Engineering techniques" which provide a new approach for a more effective design, exploiting the information technology. The idea is to involve all the perspectives in parallel, since the beginning of the product life-cycle: the communication is not limited or canalized through the teams via the team-leader, but yield also at level lower, supporting a greater consciousness and a quicker answer to all development issues.
Thanks to the automated information exchange and the use of integrated tools, the path from a sequential vision to a concurrent one involves the possibility of afford and solve problems and to take real-time decisions, allowing a quick exploration of overall solutions not only faster, but also greater. The idea is not new and is already practiced in many industrial realities in correspondence of the various phases of the development life-cycle. In the Space domain NASA/JPL has created the Project Design Center, while the European Space

Agency is proposing the Concurrent Design Facility (CDF). In both these environments a broad use of Concurrent Engineering is performed to obtain a quick response on the technical and economical feasibility of new space missions. These are applications involving preliminary project of space systems, typically referred as phases A and pre-A.
The Alenia Spazio goal is to develop an environment to support the application of these methodologies not only during the initial phases, but also during the overall life-cycle of space missions. The CODE initiative answer to this intent, re-organizing the tools and the specific competencies already present in the company, in a more efficient way trying to enhance their interaction with a Concurrent Engineering approach.

Arriving to a work style among the different development, such as is shown in the following schema, opposing it to the classical concepts.

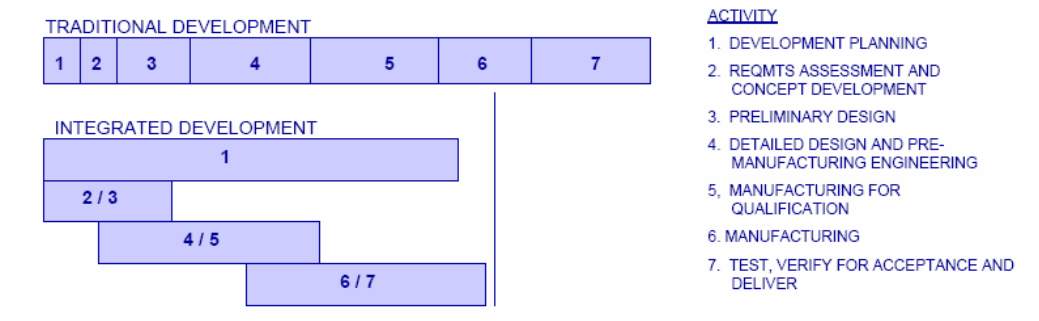


Fig.2.1 Development process evolution

In order to reach the fidelity level required for simulation, concurrent involvement of all disciplines is required, for either the simulation set-up an its utilization. On the other hand, such a system is not intended to substitute the complex subsystem analytical tools, thus the simulation environment can be seen as a “core” to which all the involved contributors and users concur with relevant modelizations/inputs. The system level CODE approach is shown in figure 2.2.

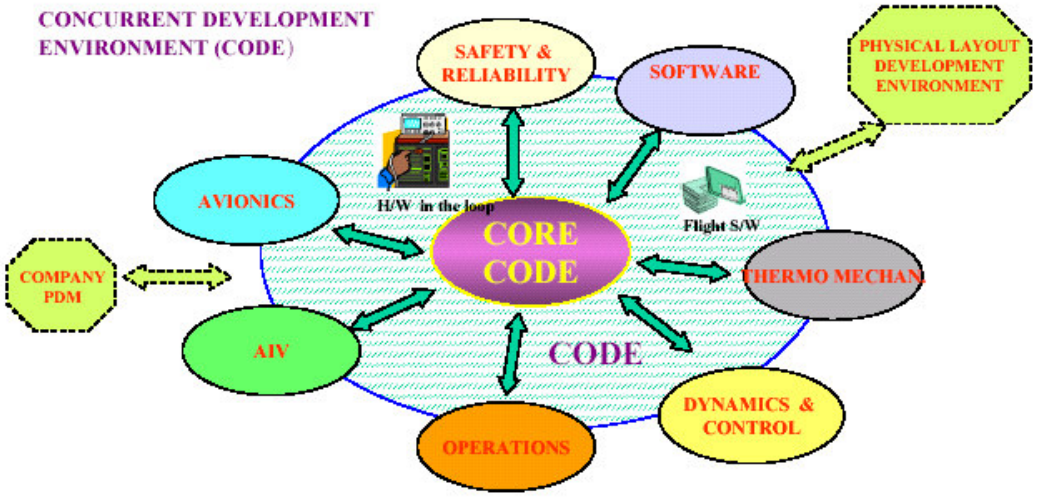


Fig.2.2 Development environment CoDE

The methodology and the analysed instruments that support the different areas, are endowed with a high efficiency, but with a problem, the limited visibility with relation of the complete system. This can produce an isolation with regard to the others development areas. We can state that the principal aim of the CoDE activity is avoid this isolation, creating an environment development such as is shown is the previous image.
An important characteristic of the CODE is its extinction not only of a transversal form among the different disciplines, but also in a vertically form by means of the life cycle. So to speak, the development environment is able to control all the development parts.
Also we should enter to the distribution concept, the development environment is not only a system instrument , which the analyses come done in a competitive form between a subject set, and also an useful instrument for the subsystems that is connected for obtain the necessary information.
The situation concept has to come solved habilitating the forms that allows the possibility to ride work at the same time sessions among subjects collocated in different places.

2.1.1. Benefits

As it was intended, CODE is a system simulation facility conceived to support project along its complete life time, from conceptual design through engineering, integration, testing, flight support and crew training. In addition, the environment is supported by a distributed architecture: envisaging the possibility, for all actors involved, to have a direct access to the system. This approach provides the opportunity to subsystem engineers to carry on their work on the basis of

most updated information and to early evaluate the impact of theirs solutions. As the end users of CODE is the system engineers, attention is mainly on the reduction of the size and complexity of models, as well as on standardization of operational constrains and interfaces. CODE interface or integrate models from the different disciplines and it provides requirements and constrains for the models to be provided by disciplines, keeping to a minimum the effort of developing new dedicated models. Moreover the spread across different users implies the provision of user friendly interfaces, model implementation and upgrade, scheduling definition, application to user defined scenarios, interfaces with on going project growth, as well as support to input preparation and results exploitation and analysis.

The aims and benefits have been experienced in the following areas:

- to ensure the coherence of information exchange during different stages of the project and among the different disciplines involved;
- to optimise the design effort with capability to quickly respond to system configuration trades in preliminary design phase and to lower level design changes evaluation in development phases;
- to anticipate problem discovery and resolution by adequate simulations;
- to analyse system behavior during failure modes or new operations test sequences, before implementation to flight hardware;
- to support integration and operative phases;
- to optimise the reuse of generated information along the program life cycle;
- to reduce and minimize the duplication of effort

This initiative requires an environment featured to support:

- concurrent engineering approach;
- collaborative design, with support and interaction among different discipline and life cycle actors;
- distributed simulation supporting remote interactions;
- portability and re-usability.

2.1.2. Projects and CoDE

Throughout these years the following projects have benefited by the support of the CoDE:

- the satellite for the terrestrial observation **GOCE** (Gravity field and Ocean Circulation Explorer) during the development part,
- the **Bepi, Colombo** probe for the exploration of Mercury,
- ExoMars (Mars) also in phase of preliminary B project.

In the next future it is foreseen the use of CODE in support to GAIA (satellite for the stellar cataloguing).

2.2. The Concurrent Design Facility (CDF)

2.2.1. Introduction

The Concurrent Design Facility (CDF) is an ESA facility located in the ESTEC centre in Noordwijk (NL).

It is a state-of-the-art facility equipped with a network of computers, multi-media devices and software tools, which allows a multi-disciplinary team of experts to apply the concurrent engineering method to space mission design. It facilitates a fast and effective interaction of all disciplines involved, ensuring consistent, high-quality results.

The CDF is primarily used to assess the technical and financial feasibility of future space missions and new spacecraft concepts, typically Phase 0 (also known as pre-phase-A or level-0) internal assessment studies. The Facility's software infrastructure, which includes an extensive database, is an efficient working tool to ensure consistent end-to-end design of a space mission.

The spacecraft design process is based on mathematical models, which make use of custom software and linked Excel workbooks. By this means, a consistent set of design parameters can be defined and exchanged throughout the study, and any change which may have an impact on other disciplines can immediately be identified and collectively assessed. In this way, a number of design iterations can be performed, and different design options can easily be analysed and compared.

2.2.2. Structure

The CDF-MIS is structured in 14 worksheets, each of them has the data of all the mission subsystems: System, AOCS, GNC; Comms, Data_Handling, Mechanisms, Propulsion, Structures, Thermal, Power, Payload instruments, Aerothermal and Decent & Landing.

Each sheet presents the data that will be important in that subsystem during the mission. Each parameter can have a name, a value, an unit, a remark and a comment. But only the Parameter, Value and Unit are compulsory. The following image shows an example

Parameter	Value	Units	Remarks	Comments
Attitude stabilisation			3-axis, spinning, gravity-gradient	

Fig.2.3. CDF-MIS line

2.2.3. Form to work

In the following scheme is represented the form to work in the CDF environment. In which all the subsystem and system workbooks are linked to a

central data repository (Data Exchange) that provides the flow of data between disciplines. For bigger data structures like tables of information, the Data Parking acts as the data repository.
The interface data described in this document are used as input to the Data Exchange for the instantiation of each subsystem model.

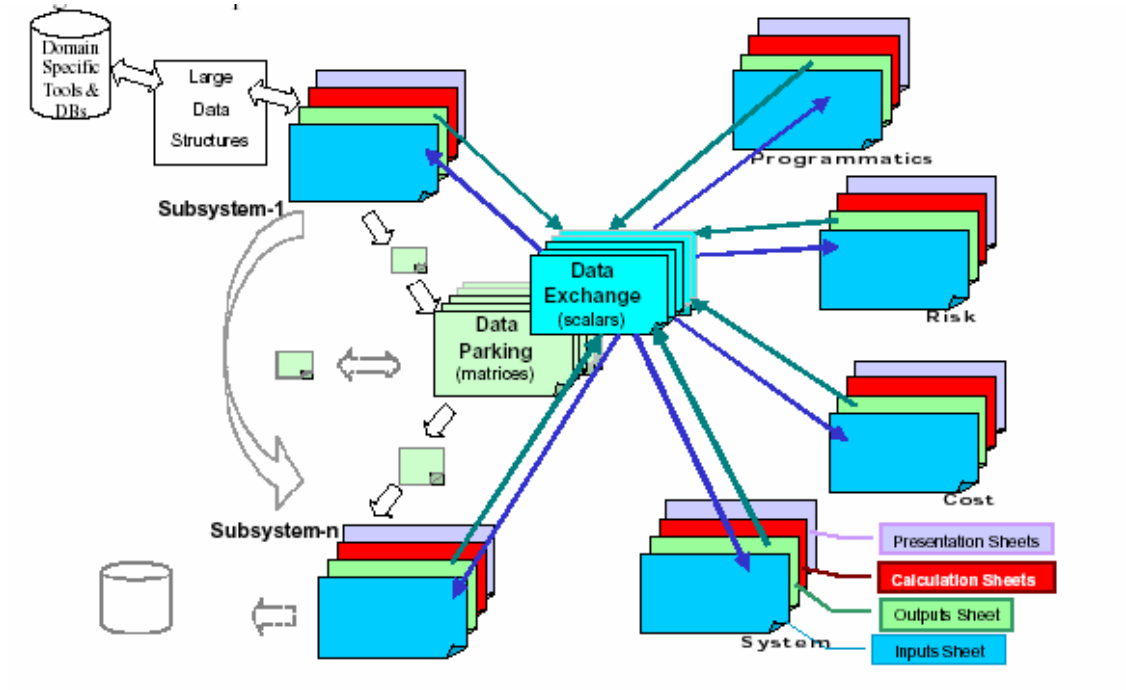


Fig.2.4 Schematic of CDF Integrated System Design Mode

3. EXTENSIBLE MARKUP LANGUAGE (XML)

3.1. What is XML

The XML abbreviations are the acronym of Extensible Markup Language, in short it is an information presentation format, which was developed in 1998 as a W3C recommendation. The XML file is the representation of the structured information, for any type, structures according to the syntax rules of the metalanguage. The XML was born as a SGML (Standard Generalized Markeup Language) subpartition. SGML is a metalanguage, or a rules set used for create multiples particulars languages that has the name of Markup Language. The Markup term indicates the content of the message which is defined by etiquettes that indicate accurately the informative metalanguage, with the aim of represent textual organized contents by a hierarchic form.
Many times we associate the abbreviations XML with the Web world, but actually the XML is not a technology for the Web only. The definitions of XML base, cab be extended to any working environment,.
So what is XML? XML is a metalanguage thought to represent any time of contents that is reduce to a hierarchy of information, and as a result this one adapts very well in Web and database environments, but this does not imply that it has to be used by one of the two fields mentioned previously.

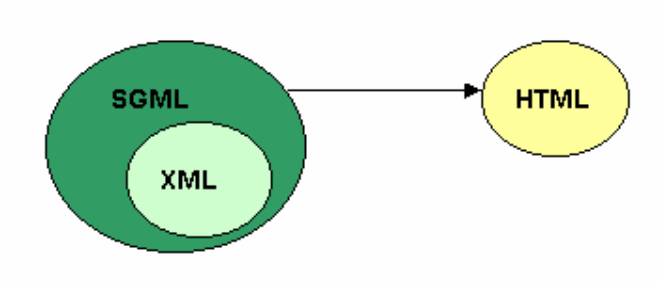


Fig.3.1 the relation among SGML, XML and HTML

Before the creation of the XML, there were defined a clear and concise aims

- XML has to be used directly on Internet.
- XML has to support a high number of applications.
- XML has to be compatible with SGML.
- The development of programs that processes XML documents it has to be easy.
- The optional number of characteristics has to be minimized, preferably zero.

- A XML document has to be read by people, and reasonably clear.
- The XML engineering has to be quick.
- The XML engineering has to be formal and concise
- The XML documents have to be easy to create
- The definition in the marks is the minimum importance

The fact of being SGML compatible, allowed XML to use it to easily represent pure text formatting.
This decision has constituted the force point of XML and has endured the later popularization. XML is comfortable to exchange structured information documents among different platforms, using Internet as a channel of transport, because represents the contents in a compatible format with any platform and software.
If we think a little we see that we always have used a pure text format for the data exchanges, like the TXT files. But the problem of these formats is that each time we must agree with our speakers for the structures, the data of the columns, the validation rules of the contents, etc.
The users must to face up to these problems, to concentrate in the data and the information, doing without its structure or its physical nature. XML offers clear answers to daily problems about the exchange and the management of the information.

3.1.1. Principal characteristics

First the XML documents are characterized for having a more opened and extensible architecture. The identifying ones can be created in a simple way by Internet or an intranet by means of documents validator
Also presents a major homogenius and widely consistency of the identifying descriptive ones of the document, in comparison with the attributes of the HTML etiquette.
But without any doubt the most important characteristic of a XML related with this project is the integration of data from different diusciplines, allowing the exchange of documents between applications, such as our computer as in a local o extensive net. Allowing to group a great variety of applications, from web pages to Database.

As already mentioned XML allows documents exchanges over internet or intranet: it means that it allows data management or data manipulation from web client, extending the possibilities of working over the network. Another advantage of the XML over networks is that the research motors returns a suitable and precise answers because the codification of the Web content in XML present the information more reasonable.

In few words, we can say that XML is a technology that allows us to work with different instruments on our PC or connected to the network, allowing data exchanges and modifications.

The following table summarize the most important XML characteristics :

GRAMMAR	EXTENSIBLE
STRUCTURE	HIERARCHIC
NUMBER OF MARKS	WITHOUT LIMITE
SHEET DESIGN	CSS o XSL
CONNECTIONS	XLL
EXPORTABILITATION??	YES
VALIDATION	CAN BE VALIDATED

Table.3.1 XML characteristics

3.2. How is presented an XML document

The XML documents have to respect rules set for being read from any platform. These rules are not so many, but rigorous. As general approach the XML document can be divided in two blocks: a prologue and the document body.
The prologue is constituted by different information, some of them optional. The first that we find in a XML document is the declaration that indicates the XML version we are using, this information can have the encoding information.

```
<?XML version="1.0" encoding="UTF-8"?>
```

The document body is created freely by the user, respecting the syntactic norms, structured in the different tags that this one has defined, following a concret hierarchic order.

For example, into the following tags we can see the hierarchic order. We have a school with its students, and from each one we know two data: the age and the name. The hierarchic order is demonstrated in the schema situated on the left.

```
<school>
        <student id=" 1 ">
                <name>Jordi</name>
                <ages>12</ages>
        </student>
        <student id=" 2 ">
                <name>Maria</name>
                <ages>11</ages>
        </student>
</school>
```

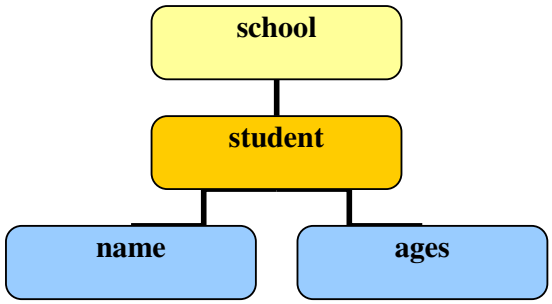


Fig.3.2 The hierarchy in a XML document

Reading the previous code, any person without knowing XML could draw the conclusions explained in the paragraphs and the previous schema. This is because of the labels which are created freely by the user, choosing the names and the order that he considers the suitable one.

If we followed the previous concepts we would obtain a XML document well-format, but how can we know what can include a label? We would have to validate it.
XML does not anticipate in its base definition the semantic rules, only the syntactic ones. But the semantic ones have a support thought for the function. A XML document that respects the semantic rules is considered valid, like the XML document that follows the syntactic rules is considered well-format. And how can we validate a XML document?
There are two ways, by means of a schema or a DTD. The year when the XML appears (1998) the W3C decided to us the Document Type Definition (DTD) for validate the XML documents. This is language thought for describe SGML data structures, and for this reason can also describes the XML.
Nowadays the DTD are used a lot, but being a previous technology than the XML, it does not allow to take all the advantage it defines. From the first moment the W3C realized of these limitations, for this reason using XML decided to create a language that could validate it, and in the same time uses the syntactic rules. In the 2001 the XML Schema Definition (XSD) appears. Its aim was to contribute to the suitable elements and attributes for describe the elements and attributes names of any XML document, and also the hierarchic relations established among the different elements.
At the moment XSD is a validation recommended language, because it takes advantage of the XML potential and does not need the knowledge of another semantic.

3.3. The future

We can not forget the XML is a new language, and it is undergoing modifications, so its potential could be higher than nowadays. Also we can not forget that the XML allows us to describe the document content, but not its look. This fact makes that we think with possible interrelations among other languages: this aspect is solved with the use of the eXtensible StyleSheets Language (XSL).
Also the internet browsers are being adapted to XML, and Microsoft in its Internet Explorer 5.0 has incorporated modifications that allow XML documents into the classical HTML, or using sheets similar at XSL.
Also the Mozzilla is starting to adapt to XML and has thought to incorporate a XML parser in its latest version.

4. THE TRANSLATOR CDF MIS XML

In the previous chapters we present XML and CD , but how we transform a CDF worksheets into a XML document?
This has been the main goal of my project, how to use theabove technologies, and how they areinterrelated.

In short the next paragraphs will present:

- What is the translator CDF MIS => XML?
- How to use the application
- How this software has been designed?

The CDF MIS XML translator is computer science application, developed with Microsoft Visual Basic 6.0, which allows us to take the CDF worksheet parameters, explained in chapter 5, and transforming them in a XML document. Next we have in a schematic form this procedure

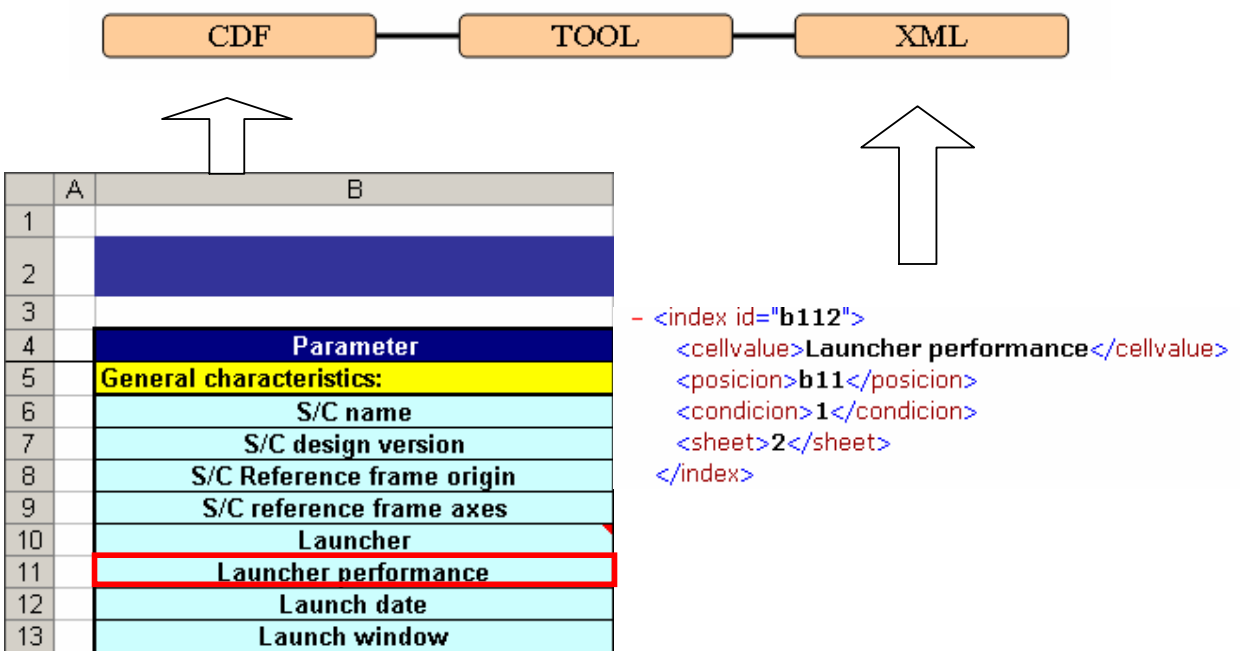


Fig.4.1 The transformation of a CDF cell to a XML code

We can see that by means of a Tool (the program developed with the Visual Basic), the Launcher Performance cell is transformed in a XML document node.

4.1. How use the aplication

The CDF MIS XML translator is an application that will appear in a executable file form, which will has a graphical interface, and in this way the user can perform the procedure through this interface.
In this section the execution procedure of the application is explained in detail, with all its variations, and explaining the results that we have obtained in each case.

4.1.1. General Information

The program has a graphical interface of simply use, which is divided in 4 different and clear parts

1. To load the CDF-MIS Excel file
2. To use or not a database
3. Database characteristics
4. Worksheets with we will work

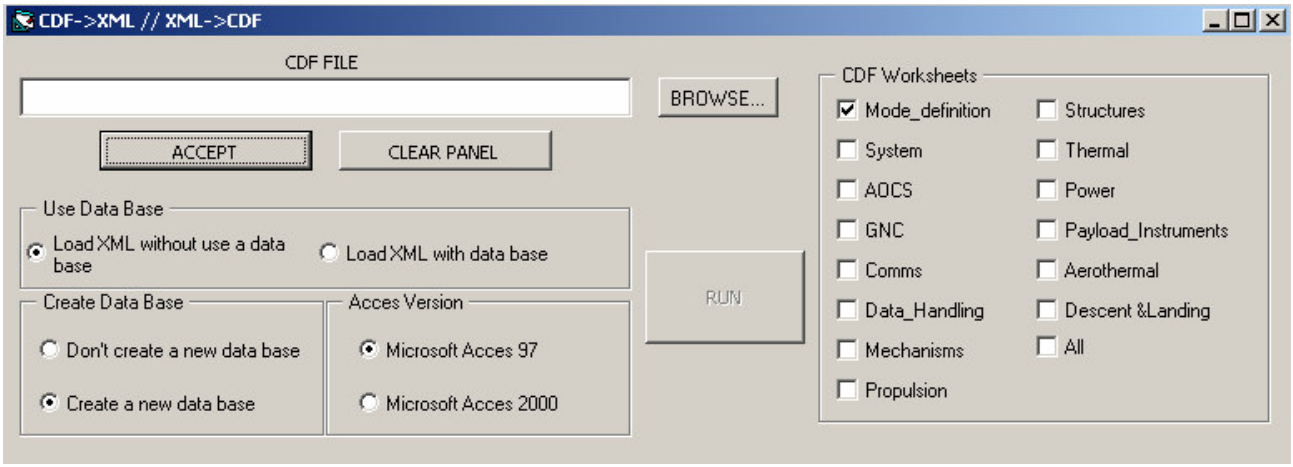


Fig.4.2 Graphical User Interface

To load the CDF-MIS Excel file we can use the browse key, which allows to accede easily to the filepath, such as is showed in the following image.
Once introduced the file, if we agree, we will have to click the accept key, in opposite case we can look for the browse key again and introduce the new file, or touch the cancel key to clean the text cabin and introduce the file path manually.

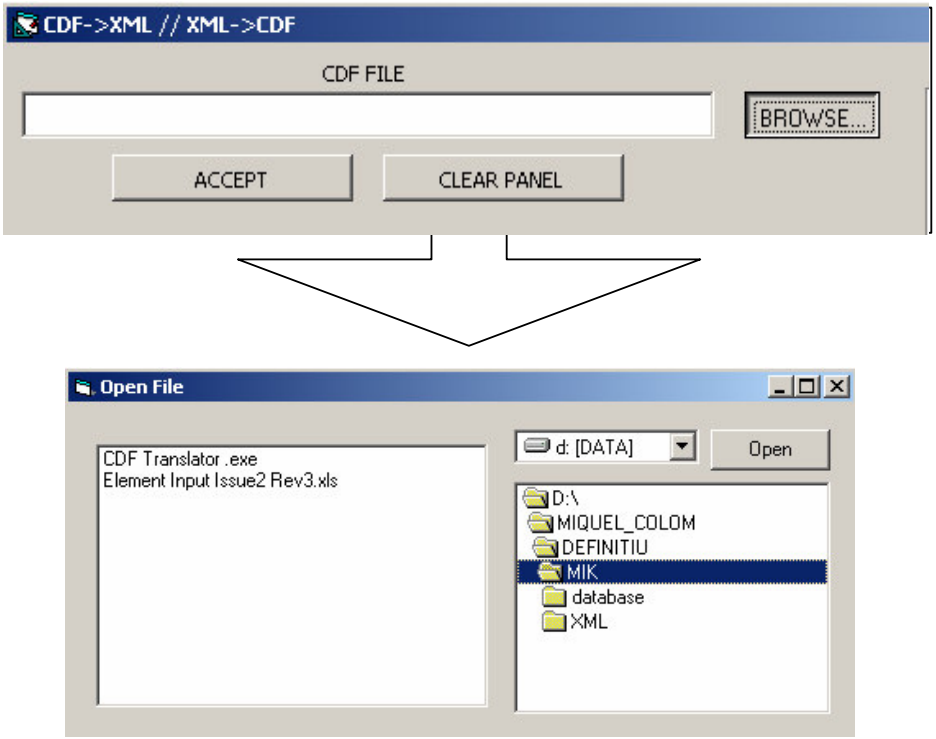


Fig.4.3 Browsing to open the CDF MIS file

Once selected the CDF-MIS Excel file, we have to choose if to create or not a database, in opposite case the block number 3 will not be shown, because it has only relation to the creation of a database. The option that does not use a database is faster than the other one.

- If we do not use a database the program will not show the block number 3

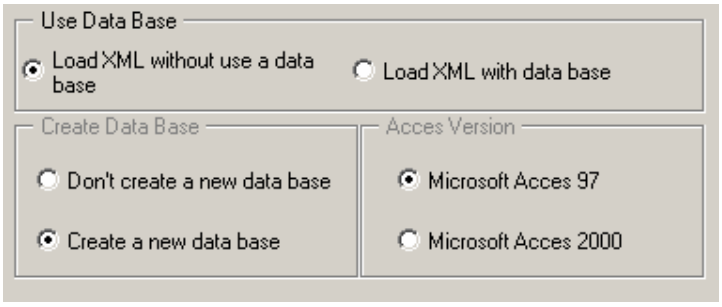


Fig4.4 Not using a data base

- If we use the database the program will activate the block number 3

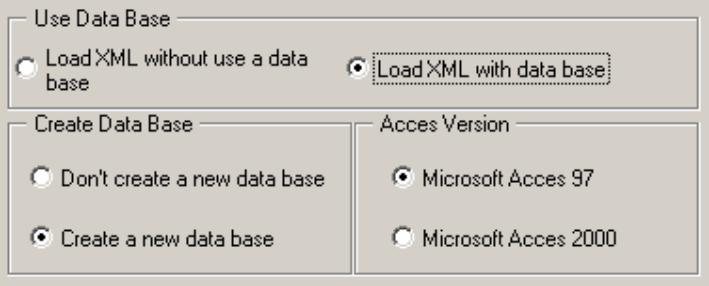


Fig.4.5 Using the data base

In case we have selected the *Load XML without use a database* option if we finally decide to use a database we have to select the *Load XML with database* option, and touch the accept key which is locate in the block 1 (to load the CDF-MIS Excel file)

4.1.2. To create a database and the selector of the Microsoft Access version

In case we have selected the option of create a database the program will allow us to choose the Microsoft Access version and it will ask if we want to create a database. In case that it has not been created it will be forced to do it, if not the program will show the following message and will create a database.

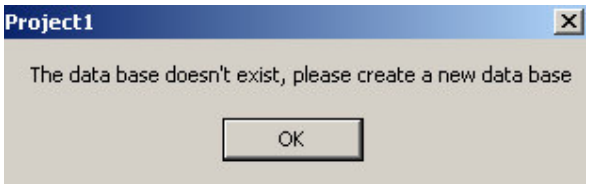


Fig 4.6 if data base don't exist

In case we select to create a database but this one exists, the program will inform us and will not create a new database, but that rewrite the previous one. The following image will show us the message that the program shows in case it is produced the previous action.

Fig.4.7 if data base exist

The following action will be to select the correct Microsoft Access version: it is very important not to miss this step because if we do it, it will close the program. When we select the Microsoft Access version we are saying to the program that it has to choose internally the correct Microsoft Jet Provider version, in case of Microsoft Access 97 it will be Microsoft.jet.OLEDB.3.51, in case it is Microsoft Access 2000 it will be Microsoft.Jet.OLEDB.4.0., so if a mistake is produced when the database is create it, it would be caused of not have installed the correct version of the Microsoft.Jet.Provider, which it can be found on the Microsoft site (www.microsoft.com)

On the right we can see a panel with all the worksheets names, by fault it is select the first one, but the user can deselect this one and select all that he wants manually, or all touching the ALL key,

On the right of the graphical interface of the program the user can see a list of the different worksheets that has the application. By fault, when the program is executing, *Mode_Definition* is select, but the user can deselect this one if he wants. At the bottom of the list we can see the option *All*, which allows us to apply the transformation to all the sheets, without being necessary to select one by one.

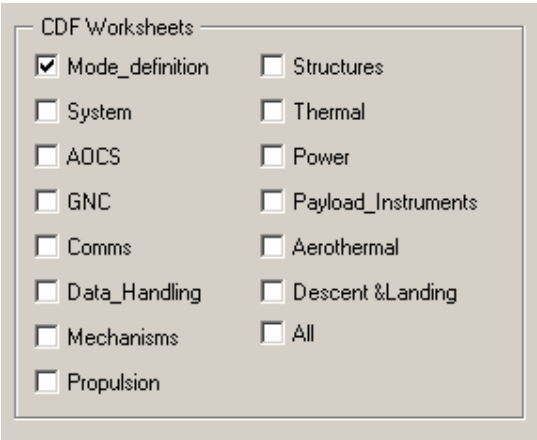
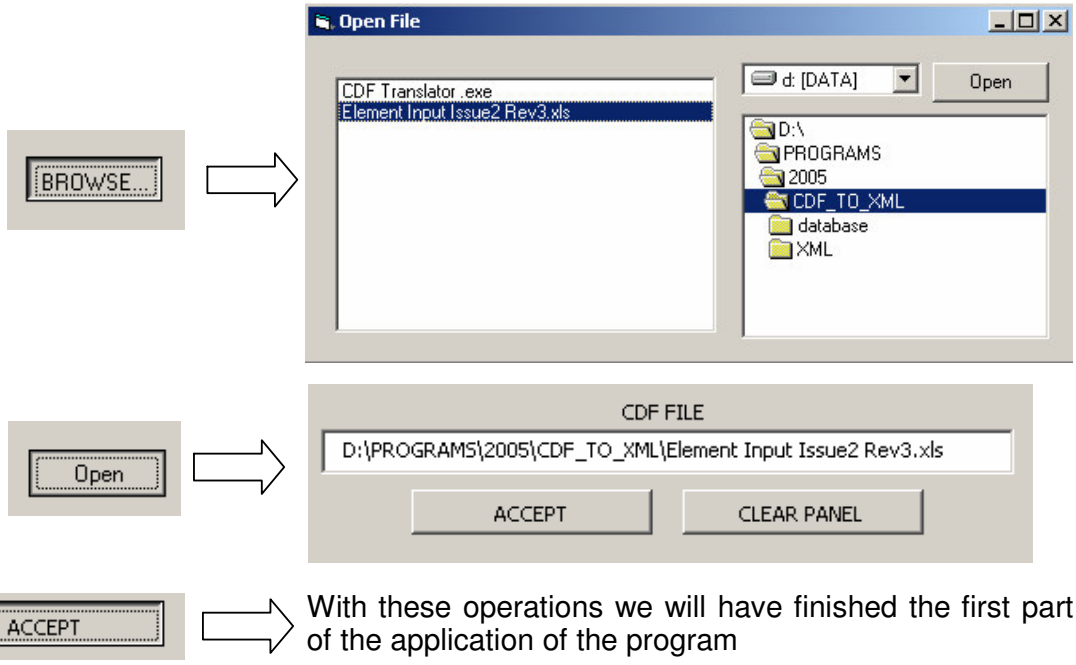


Fig.4.8 select worksheets

4.1.3. Execution order

1 First of all, we have to select the CDF Element Excel file



With these operations we will have finished the first part of the application of the program

Fig.4.9 load CDF worksheets

2 Now we have to decide if we will use or not a database and go on with the following steps

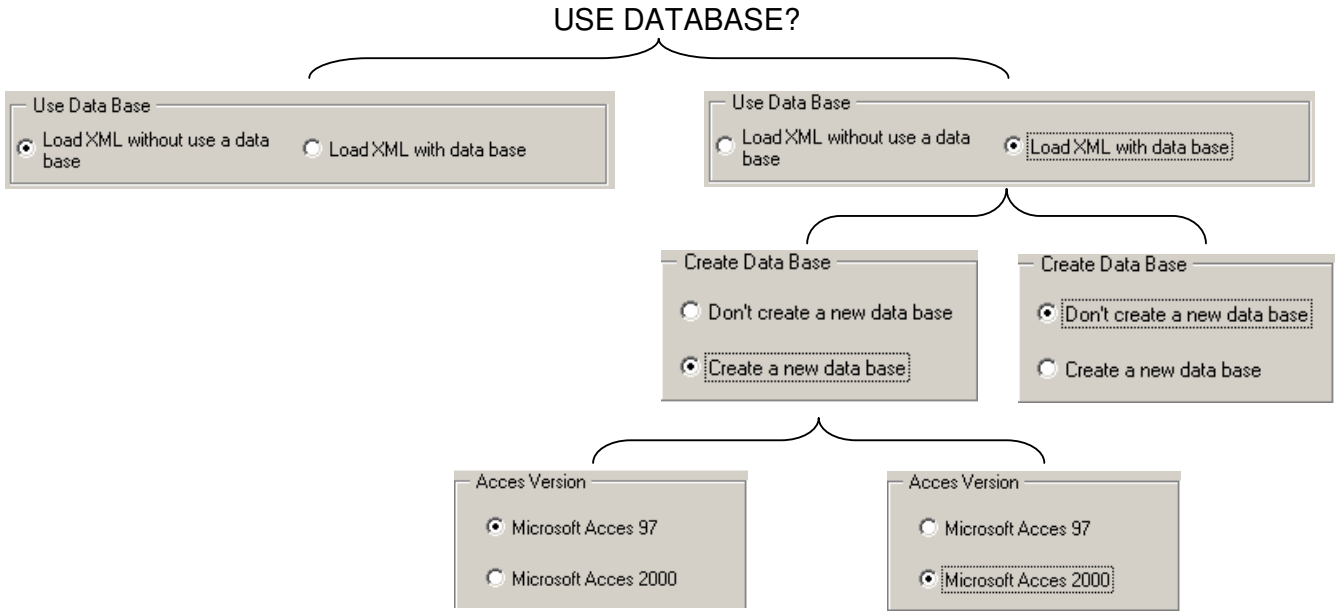
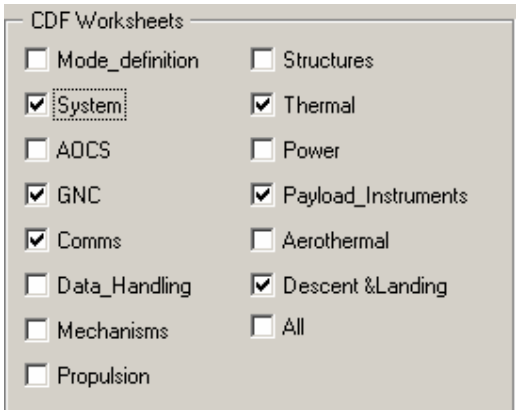


Fig.4.10 data base schema choices

3 Once previous actions are performed, we have to select the number of worksheets that we want to transform, by means of a selective form or by a general transformation.

SELECTIVE FORM



GENERAL FORM

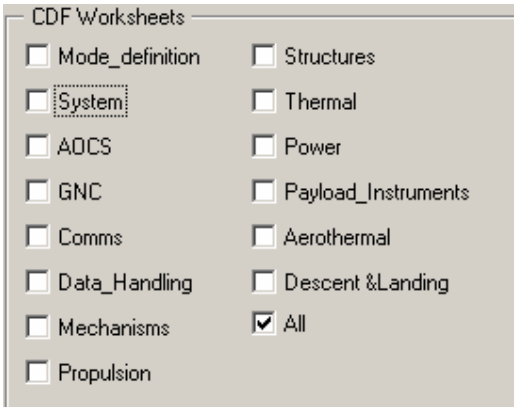


Fig.4.11 general form or selective form

3 After all these steps we will have to touch the RUN key, and wait until the program finishes its execution.

In case we missed the Microsoft Access version, the program produces a mistake, we would have to eliminate manually all the XML files and the database before execute the program again, and in this way we will save unnecessary possible mistakes.
The program is compatible with 2000 Microsoft Windows version and later versions *, and with the 2000 Microsoft excel version, and later versions, too*. Therefore all the intents with the previous versions to the mentioned ones, will produce mistakes that have not been considered during this development..

* When the application was developed the latest version of Microsoft Windows was XP, and the Microsoft Access one was the 2003, so possible mistakes of future versions of these Softwares are not known.

4.1.4. Worksheets

It is recommended to transform only the number of worksheets that we will use: it clearly improve the transformation time of the CDF-MIS file.

In the following image we can see the different selection boxes: each corresponds to the CDF worksheets. If we select ”All”, the program will apply the transformation to all the worksheets.

3.3 The worksheets and the execution time

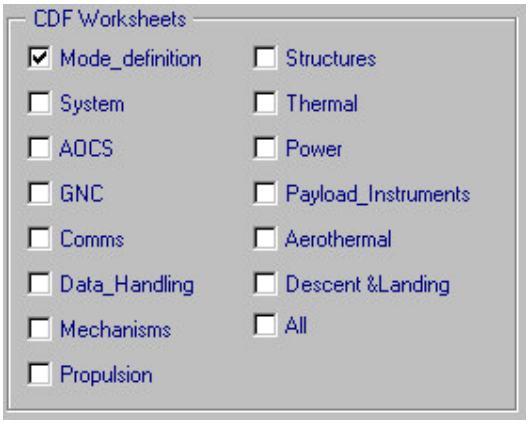


Fig.4.12 select worksheets

The time of execution of the program will depend on the number of worksheets that we want to transform. The execution time for the transformation of a worksheet is ~20 seconds. In case we apply the transformation to all the worksheets the execution time will be ~5 minutes.

4.1.5. Before the execution

Before execute the program the user has to insure himself to have READ access to the CDF-MIS file.

If we want to use the option which uses a database, we should verify if it has the Microsoft Jet OLEDB right version, if it is not the case, you have to download and install it, as previously explained.

4.1.6. After the execution

After the execution the program will create one or two folders. Depending on the execution of the program, in case we have create a folder, this will be named “XML”, in case we requested to create a Database, two folders will be created: XML and DATABASE. In both cases, these folders will be created under the same directory of the CDF-MIS Excel file.
In the XML folder we will found two files, one .XML and the other .XSD (the XML document and the schema that validate), in the DATABASE folder, we will found a database document from Microsoft Access (.mbd).

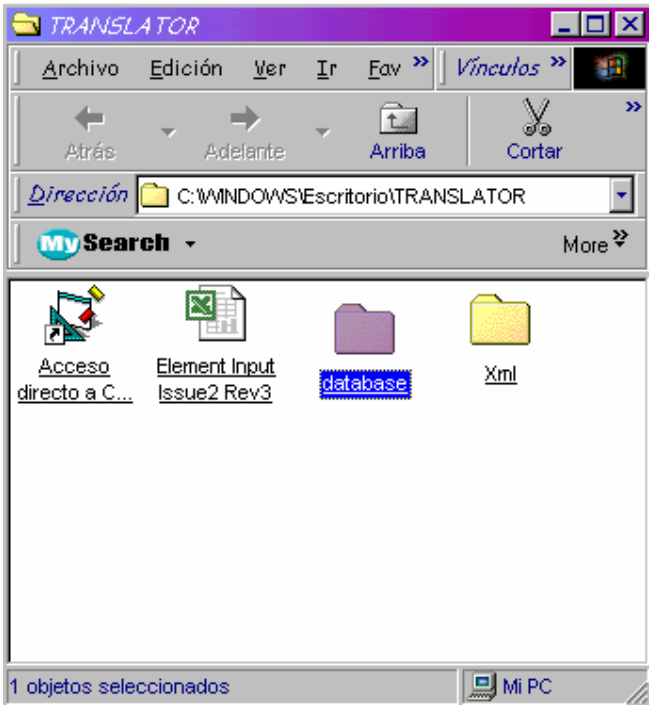


Fig.4.13 the new folders

The XML document could change its dimensions depending on the number of worksheets which we have applied the transformation, but not in this format. In the following image we can see the heading aspect of all XML documents, followed by the one which will receive a cell after the transformation.

```
<?xml version="1.0" ?>
- <worksheet xmlns="http://www.example.com/worksheet" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.example.com/worksheet D:\MIQUEL_COLOM\DEFINITIU\MIK\XML\XML.xsd">

  - <index id="b52">
      <cellvalue>General characteristics:</cellvalue>
      <posicion>b5</posicion>
      <condicion>1</condicion>
      <sheet>2</sheet>
    </index>
```

In each cell transformed to XML we will see five elements:

- **Cellvalue**: this part has the value of the cell in case that this contents something, and NULL if it is empty. The content of the field of the previous example has arisen from the remark cell of the following image

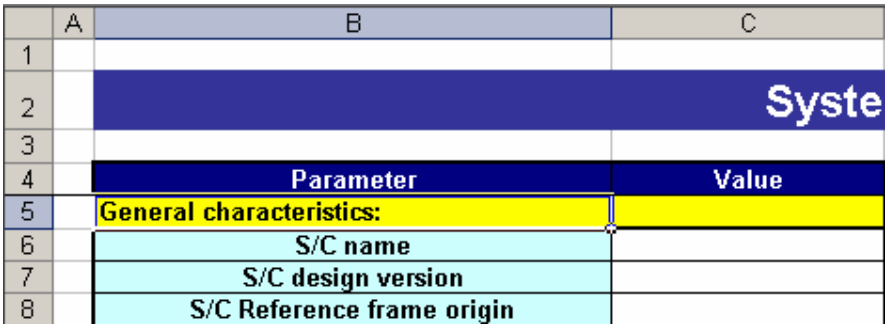


Fig.4.15 the General caractehrisitcs Cell

- **Position**: this cell specify about the row and the column where the cell was situated in the CDF-MIS Excel file, watching the previous image we can see that the row is the number 5 and the column is B.

- **Condition**: the condition element can take the values 1, 2 or 3. Depending if it is a constant field: 1, if it is a value introduced by the user, 2 if it can be changed, 3 if it is a comment.

- **Sheet**: specify the worksheet where we can found the cell.

- **Index**: the index element acts as main and it is the result of concatenate the contents of the position field and the sheets, this will allows us to do the next operations faster.

The schema created by the program is used for validate the XML “well format” document, which it has been explained previously. The schema determines the possible contents in the elements of the XML file.
To visualize the schema it is recommended to use the Altova XMLSpy freeware. All the information about this software can be found in annex 1. But it can be visualized in applications more commons like Notepad or Microsoft Internet Explorer. At the following image we can obtain a general vision of the schema, which represent it in a hierarchical form.

```
<?xml version="1.0" ?>
<!--  edited with XMLSpy v2005 rel. 3 U (http://www.altova.com) by Carlo (Paccagnini)  -->
- <xsd:schema id="worksheet" xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns="http://www.example.com/worksheet"
    targetNamespace="http://www.example.com/worksheet" elementFormDefault="qualified">
  - <xsd:element name="worksheet">
    - <xsd:complexType>
      - <xsd:sequence>
        - <xsd:element name="index" maxOccurs="unbounded">
          - <xsd:complexType>
            - <xsd:sequence>
                <xsd:element name="cellvalue" type="xsd:string" />
                <xsd:element name="posicion" type="xsd:string" />
                <xsd:element name="condicion" type="xsd:string" />
                <xsd:element name="sheet" type="xsd:string" />
              </xsd:sequence>
              <xsd:attribute name="id" type="xsd:ID" use="required" />
            </xsd:complexType>
          </xsd:element>
        </xsd:sequence>
      </xsd:complexType>
    </xsd:element>
</xsd:schema>
```

Fig.4.16 a XSD schema

This document will be only created if we specifies during the execution of the program, is a conventional database where data of the cells will be kept, in a table, following a similar format of the XML document

	CELLVALUE	CONDICION	INDEX	POSICION	SHEET
▶	NULL	1	b1	b1	2
	System Worksl	1	b2	b2	2
	NULL	1	b3	b3	2
	Parameter	1	b4	b4	2
	General charac	1	b5	b5	2
	S/C name	1	b6	b6	2
	S/C design vers	1	b7	b7	2
	S/C Reference	1	b8	b8	2
	S/C reference fr	1	b9	b9	2
	Launcher	1	b10	b10	2
	Launcher perfor	1	b11	b11	2
	Launch date	1	b12	b12	2
	Launch window	1	b13	b13	2
	Design lifetime	1	b14	b14	2

Fig.4.17 a MDB database sheet

The CELLVALUE, CONDITION, POSITION and SHEET fields, are the same that the XML document, but the INDEX field is different.
At the database, the index field take the value of the first useful cell position of the row, in this way all the row is select by means of this parameter.

4.2. Software Development

Previously we have explained how the application works. In this section we will talk deeply about how have been design and developed,.

The program has been written with Visual Basic using the Visual Basic of Microsoft Excel Editor, previously, and then using the Microsoft Visual Basic 6.0 This language has been chosen because allows us to work with comfort and efficiently in the Microsoft Excel circle.

4.2.1. Data Structure

Data are structured as following:

```
Type cell
position As String
contents As String
condition As Byte
End Type

Type window
Cells (1 To 15, 1 To 300) As cell
End Type
```

As above presented, we have a matrix of the Cell structure, which has three elements.
The elements have been created will the following aims:

- Position: where the cell position of the Excel sheet will be stored (ex: A2, B5, F123, etc.)
- Cellvalue: where the content of the cell will be stored (ex: “launch Mode”, “on”, “kg”, etc.)
- Condition: the cells will be classificated in three blocks (1, 2 or 3) which are explained at the following pages.

The matrix dimensions are enough for the standard version of the CDF-MIS, but could produce mistakes in case we use a bigger Excel sheets (it would produce over float).
It is important to remember that the Visual Basic does not allow us to determine the proportions a struct of unlimited form (the memory of this one limits us), and if we increase the matrix dimensions we could find with the following mistake:

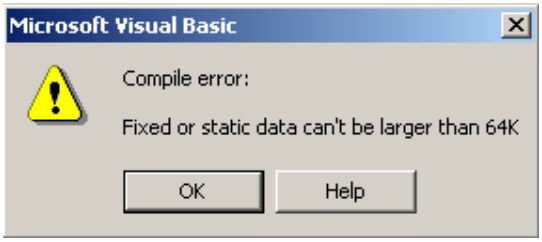


Fig.4.18 Overfloat error

Which informs us of a maximum value for the variable of 64K

4.2.2. Block schema

The User Form 1 is the base of the program, where we can find all the functions and subroutines. As presented in the next picure, we have 5 processes groups:

- Reading process of the Excel sheet: this block includes the functions that they determine the proportions and read the Excel sheet (determinate_rangesheet, selecct_sheet, other_sheets, first_sheet, determinate_rangecol and determinate_rangeline).

- Storage process of data on a struct: in this process we keep data of each cell in the structure which had been explained in section 4.2.1. This part includes the functions: evaluate_cell_sheet1, save_struct and evaluate_cell_other_sheets.

- Processes related to XML: in this block the XML file is load, and data of the struct are stored. This block includes the following functions: load_database_and_XML, put_index, carachter_cellvalue, create_schema, Load_XML_without_database.

- Processes of general area: this part includes the functions that affect different parts, and processes that can control be controlled by the user by means of the graphical interface: CommandButton1_Click, CommandButton2_click, CommandButton3_Click and CommandButton7_Click, validate_floder.

- Processes related to the database: this part includes the functions that control the creation and the implementation of the database: Create_database, load_database_and_XML, database_options.

The first four blocs are absolutely dependent from each other and need the block number 5 only if the user specifies during the execution of the program.

Next appears in block diagram the dependence of the different blocks, according to the execution time

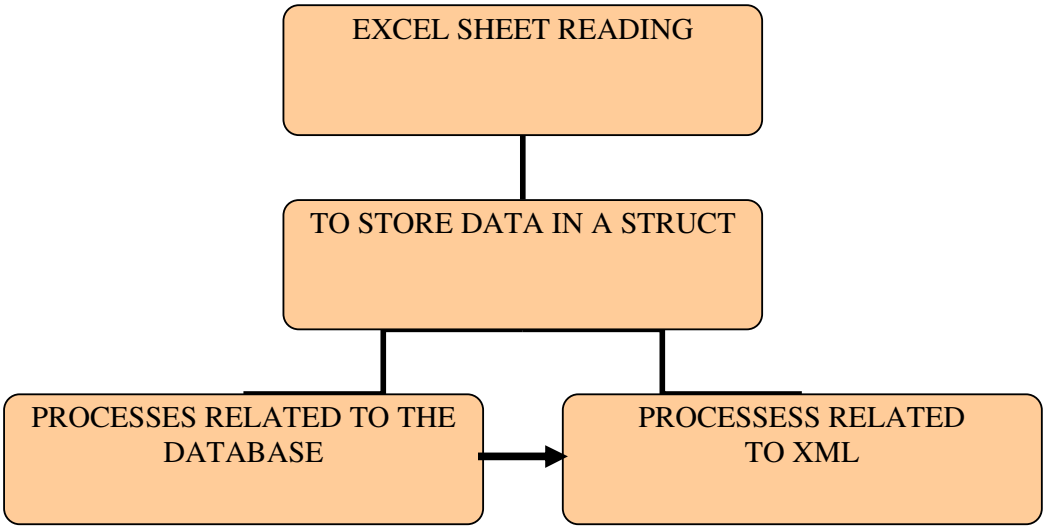


Fig.4.19 blocks schema

At a glance we can see that the block “processes related to the database” can be or not a way during the execution, but the others are obligated and necessary.
We can see through a schematic and approximate form the execution order of the program.

The “user Form 1” has a part where the variables of a general character are defined, in this way they could be used for all the functions:

```
Dim num As Byte
Dim bloc(1 To 200) As finestra
Dim zor As Integer
Dim direcc As String
Dim MAX As String
Dim MIN As String
Dim colmx As Integer
Dim filmx As Integer
Dim colmx1 As Integer
Dim filmx1 As Integer
Dim ndatbse As String
Dim schema As String
Dim fulls(14) As Integer
Dim indexx As String
Dim versio As String
Dim create As Boolean
Dim str1 As String
Dim rec As Integer
Dim exist As String
Dim ms As New excel.Application
Dim msW As New excel.Workbook
Dim excelfile As String
```

```
Dim msWsheet As New excel.Worksheet
```

4.2.3. The Form 1

The Command_button7 button of the User Form 1 shows a new window. The Form1 has only three functions, which they are related among them, and they use for create a file seeker at the disc units. These functions are of a predefined kind, and in their total don't occupy more than ten code lines.

4.2.4. The 5 blocks

4.2.4.1. The Excel sheet reading

This block carries the processes controlled by the 6 functions out, which allow us, to determine the proportions, to cross and reading the different worksheets. In this remote will not be a technical description of the functions, instead we will found the operation of the global set.
The first thing that we do is determines the number of worksheets of the document, then we will entry to the sheets which had been selected one by one, and posterior use are determine the proportions the columns and rows. When this project has finished the program read one by one all the cells. After that all the other blocks start the execution.

4.2.4.2. Store data in a struct

This block formed by only three functions can compiles all the information that has been read in the Excel sheet of a Visual Basic struct, and from this moment the program does not need the Excel sheet for anything more.
This block not only stores data in a Struct, determines the condition of each cell too (the parameter condition had been explains in the User Manual).

4.2.4.3. Processes related to XML

This block has to turn data which were stored at the struct in the XML document which was well formed and validated thanks to the creation of a XML-Schema. This block has two variations according if uses or not a database to create a XML.This two variations are determined by two functions, load_XML_without_database and load_database_and_XML.
This block creates a XML file, and the XSD file, but makes the appropriate changes to the text, so, in this way can be compatible with the XML specifications , and create the index field for each cell, too.

4.2.4.4. Processes of general area

This block includes the functions that are controlled by the user and the validate_folders function, which has to check the Excel file used by the user and create the folders where the other files will be kept.

4.2.4.5. Processes related to the database

This is the optional block (determines if the user wants to use or not a database), formed by all the functions that if it is necessary implement the database.

4.2.5. Functions execution order

The program is strucured by a set of functions and subroutines, which keep the hierarchic orders of the execution. To understand better how all the process works, we have to observe the block schema of the following page:

The process starts when the user use the CommandButton2m which call the function of its same name, next the validate_folders function is executed, which will do the suitable checking, for allow to the user to continue or not with the execution. If all is correct the CommandButton1 will be activated, and the program will start the process main automatically, until the procedure will have finished.

Watching the schema we can see the execution order of the dependents functions of the Commandbutton1. We can see three subordinate branches, and a small support branch, which starts or not its work if the user decide to use a database or not.
Of the three subordinate branches, the central and the left ones, have loaded functions of reading data of the CDF-MIS sheet and stored them in a struct. While the branch situated on the right has loaded functions to create the XML file and the XML schema.

At the following schema is represented the execution order of the functions by a linear form:

CommandButton2_Click → validate_folders

Commandbutoon1_click →database_options → cretate_database → determinate_rangesheet → other_sheets// first_sheet → selecct_sheet (if worksheet <>1) → determinate_rangecol → determinate_rangeline → save_struct → carachter_cellvalue → evaluate_cell_other_sheets // evaluate_cell_sheet1 → load_database_and_XML → put_index → create_schema

Commandbutoon1_click → determinate_rangesheet → other_sheets// first_sheet → selecct_sheet (if worksheet <>1) → determinate_rangecol → determinate_rangeline → save_struct → carachter_cellvalue → evaluate_cell_other_sheets // evaluate_cell_sheet1 → load_ XML_without_database → create_schema

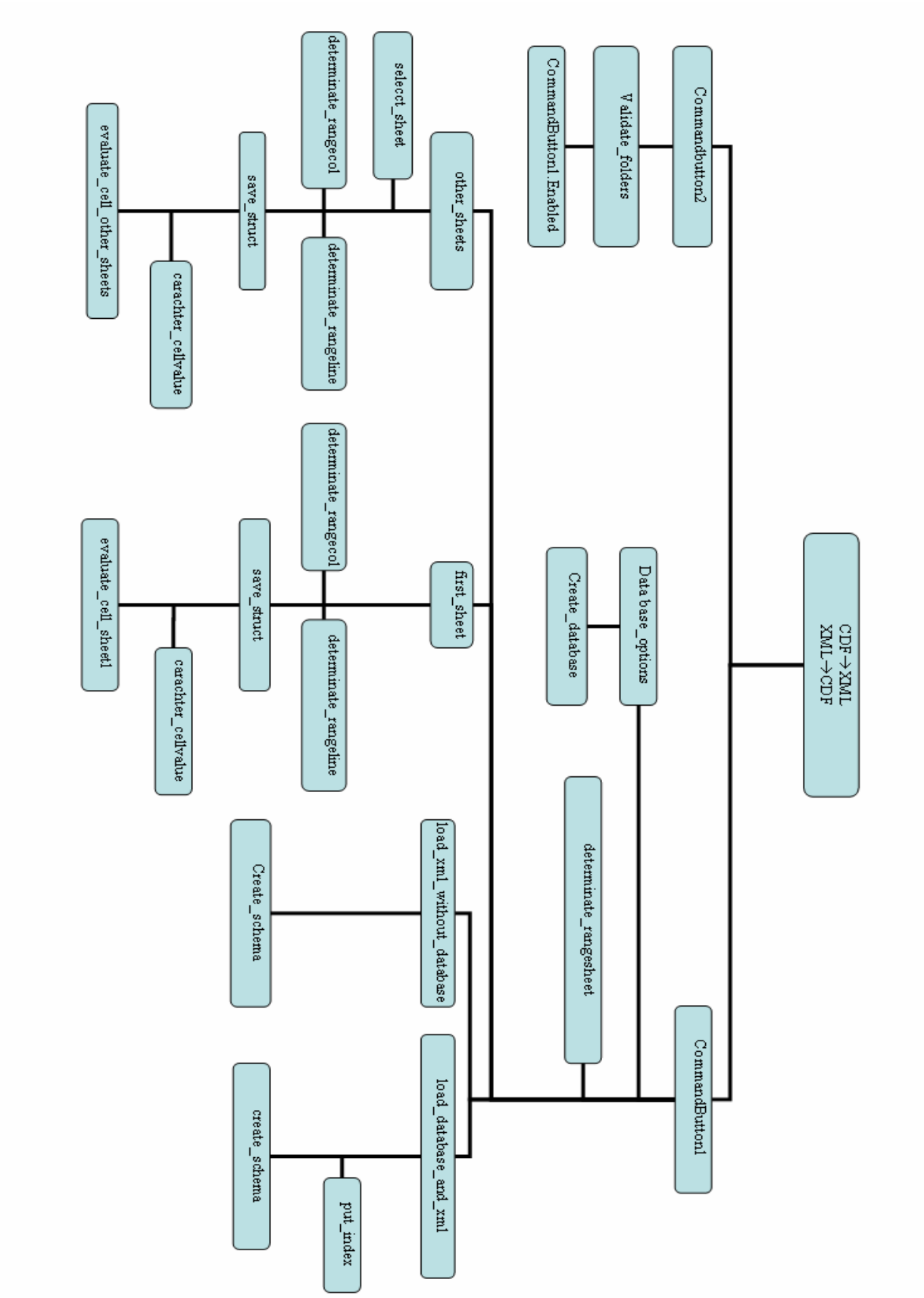

CDF→XML
XML→CDF
Commandbutton2
Validate_folders
CommandButton1.Enabled
CommandButton1
Data base_options
Create_database
determinate_rangesheet
load_database_and_xml
load_xml_without_database
Create_schema
create_schema
put_index
first_sheet
other_sheets
save_struct
determinate_rangecol
determinate_rangeline
carachter_cellvalue
evaluate_cell_sheet1
selecct_sheet
save_struct
determinate_rangecol
determinate_rangeline
carachter_cellvalue
evaluate_cell_other_sheets

Fig4.20. Functions schema

4.2.5.1. Aims of the UserForm1 functions

In this section we will talk about all the functions one by one, explaining the inputs and outputs, the relation with the other functions and the way that the process is developed.

Function name: CommandButton1_Click
Calls: database_options, determinate_rangesheets, other_sheets, first_sheets, load_database_and_XML, load_XML_without_database.
Inputs: MIN, MAX and optionbutton13.value.
Description: this functions is a start function, first has to call to a function to know the conditions for create a database (if we want to create it), then calls to another function which determines the number of sheets and they are crossed. Next for each sheet, it phones to the first_sheet or other_sheets functions, depending on the number of the sheet, if it is the 1 or another. This distinction is made because of the difference between the sheet 1 and all the others
Once routes all worksheets (and all the operations of the subordinate functions are made) it phones to the correct function related to the XML block

Function name: **other_sheets**
Calls: selecct_sheet, determinate_rangecol, determinate_rangline and save_struct.
Inputs: num, colmx, filmx
Description: this function has to set contact with all the other functions to determine the dimensions of the analysed worksheet, and then read the Excel sheet that it considers useful. This function can read all the worksheets, except the first one, which has another function.

Function name: **evaluate_cell_other_sheets**
Calls: ----------
Inputs: m, n, num (column, line and sheet)
Description: this function assigns a number (1, 2 or 3) for every cell. This number will be stored in the condition area of the struct. The base that follows to assign one of the three numbers is: 1 the constant cell, 2 if the cell element can be changed, and 3 if is a commentary. The function determines the cells condition of all the analysed worksheets.

Function name: **save_struct**
Calls: carachter_cellvalue, evaluate_cell_other_sheets and evaluate_cell_sheet1
Inputs: count, b, c (column, line, position)
Description: this function assigns to each element of the structure the different values to the different fields, but only in case these are not empty. In case they are empty the cellvalue field assigns “NULL”.
The last thing it has to do is phone to the functions in charge of implement the field condition.

Function name: **selecct_sheet**
Calls: ----------
Inputs: num
Description: this is a simple function that has to select the worksheet that we want to work with.

Function name: **first_sheet**
Calls: determinate_rangecol, determinate_rangline and save_struct.
Inputs: num, colmx1, filmx1
Description: this function is equivalent to the other_sheet function, in case of the first sheet.

Function name**: evaluate_cell_sheet1**
Calls: ----------
Inputs: m, n, num (column, line and sheet)
Description: this is equivalent to the evaluate_cell_other_sheets function, in case we are working with the first worksheet.

Function name: **command_button2**
Calls: validate_folders
Inputs: ----------
Description: this function has to update the graphic interface according to the decisions taken by the user before touching the command_button2

Function name: **command_button3**
Calls: ----------
Inputs: ----------
Description: this is a very simple function, which has to leave in white the text bar of the UserForm1.

Function name: **determinate_rangeline**
Calls: ----------
Inputs: ----------
Description: this function has to determine the proportions vertically each worksheet of the Excel sheet. The sizing process can change in case the worksheet we want to analyse is the first one.

Function name: **determinate_rangecol**
Calls: ----------
Inputs: ----------
Description: this functions has to determine the horizontally proportions of each worksheet. The sizing process can change in case the worksheet that we want to analyse is the first one.

Function name: **determinate_rangesheets**
Calls: ----------
Inputs: ----------
Description: this function determines the number and which worksheets that the user has decided to translate.

Function name: **create_database**
Calls: ----------
Inputs: ----------
Description: this function has to create a database in case it does not exist, and introduce a table.

Function name: **load_database_and_XML**
Calls: put_index and create_schema,
Inputs: MAX, colmx, filmx, direcc, MIN,num, cretate, colmx1 and filmx1
Description: this function has to introduce all the kept data in the struct in the table of the database. Then will create a XML file with all the kept data from the database, and will record them in the direction *direcc.*

Function name: **put_index**
Calls: ----------
Inputs: b and num
Description: is a simple function that creates the index element for the database.

Function name: **database_options**
Calls: create_database
Inputs: ----------
Description: this function determines if it is necessary to create a database and of which type must be.

Function name: **carachter_cellvalue**
Calls: ----------
Inputs: count, b and num
Description: this function has to modify the restricted characters of the XML code, for its respective equivalences.

Function name: **create_schema**
Calls: ----------
Inputs: ----------
Description: this function creates the XSD schema, that will validate the XML file that has been created previously, and will record it in the same folder that the XML file.

Function name: **validate_folders**
Calls: ----------
Inputs: excelfile
Description: this function determines the folders and the files that will have to be created. Create the folders and determines the name that will receive the files that then will be created.

Function name: **load_XML_without_database**
Calls: create_schema
Inputs: clomx, filmx, clomx1, filmx1, count, b and num
Description: this function create the XML file without needing a database, it do it from the struct directly.

4.2.6. The XML output

How it has been commented previously, the program creates a XML file, and validate it with a XML Schema. The user can find these two files in the same folder.
The XSD schema does not change and has a tree structure like the one that is shown at the following schema.

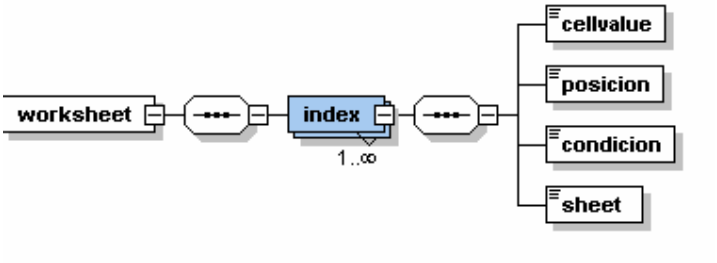
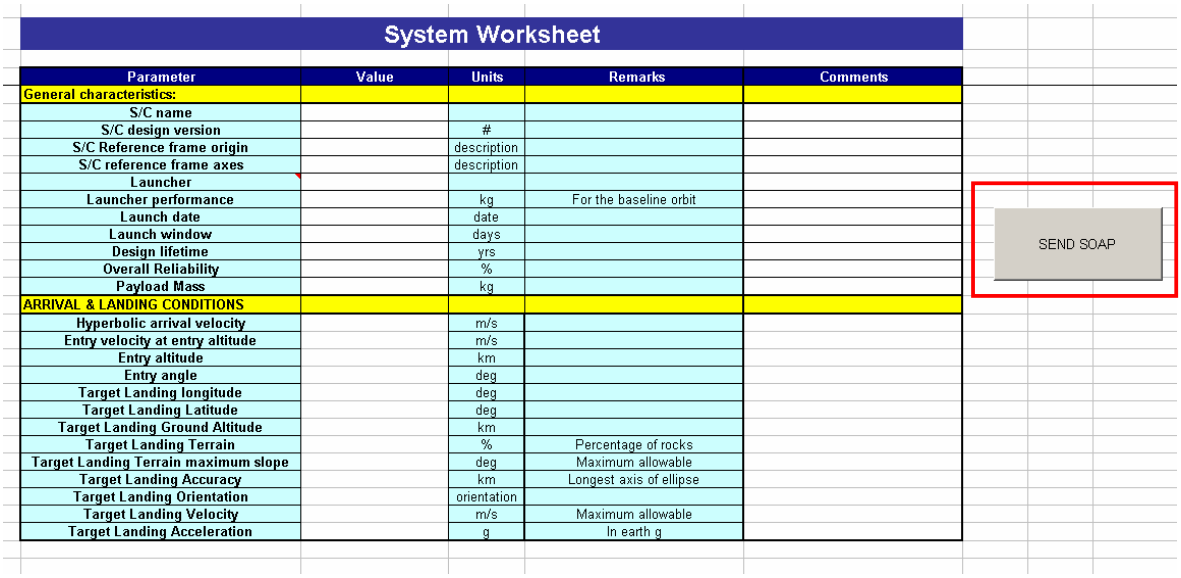


Fig.4.22 The XSD schema

5. THE MESSAGES SOAP GENERATOR

Another application developed during my project has been the SOAP messages generator. This tool allows the user to get data from the CDF worksheets, send them to a Web Service automatically, and finally receive back an acknowledge . The execution is carrying out from the CDF worksheet in which the user is working, reducing the complexitys derived from external applications.
The launching button of the application can be found in each worksheet on the top-right, and is presented as a button with written “Send Soap”, as it is showed in the following image (in a red square)



System Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
S/C name				
S/C design version		#		
S/C Reference frame origin		description		
S/C reference frame axes		description		
Launcher				
Launcher performance		kg	For the baseline orbit	
Launch date		date		
Launch window		days		
Design lifetime		yrs		
Overall Reliability		%		
Payload Mass		kg		
ARRIVAL & LANDING CONDITIONS				
Hyperbolic arrival velocity		m/s		
Entry velocity at entry altitude		m/s		
Entry altitude		km		
Entry angle		deg		
Target Landing longitude		deg		
Target Landing Latitude		deg		
Target Landing Ground Altitude		km		
Target Landing Terrain		%	Percentage of rocks	
Target Landing Terrain maximum slope		deg	Maximum allowable	
Target Landing Accuracy		km	Longest axis of ellipse	
Target Landing Orientation		orientation		
Target Landing Velocity		m/s	Maximum allowable	
Target Landing Acceleration		g	In earth g	

Fig.5.1 Send Soap

5.1. The program

5.1.1. General approach

As already said, the graphical interface showned to the user is very simple. It opens a window with the same message (Send Soap), needed for confirmation, (in case of erroneous clicking of the shhet-button)..

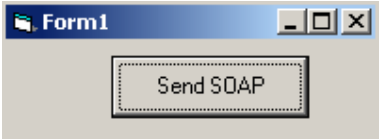


Fig.5.2 The GUI

After accept, the program will be executed automatically, without any more intervention by the user.

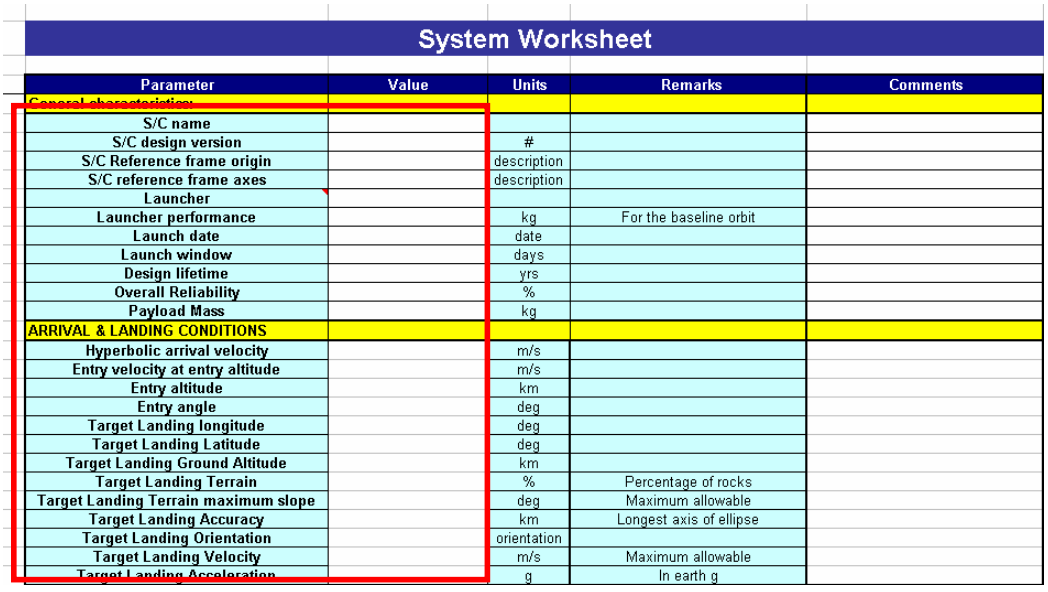
5.1.2. The send message

The send message is a SOAP message. SOAP means Simple Object Access Protocol, this protocol derives form a XML-RPC, and allows to perform HTTP requests to a Web Service.
The SOAP standard is implemented by all major Software companies (Microsoft, IBM, SUN, Microsystems, SAP, Ariba, etc.).

Summarizing the SOAP characteristics (for more information see in chapter 7 bibliography):

- It is not associate to any language
- it is not strongly associate to any transport protocol
- it is not bound to any infrastructure of distributed object
- Uses the standards existents from the industry
- Allows the interoperability surroundings.

Which kind of data are sent by SOAP message to the Web Service? The message sends data from its value field name, so to speak, each message element has two subelements: cellvalue and value. In the following image we can see all the values that would be send in case of the CDF-MIS (the values are in a red square)



System Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
S/C name				
S/C design version		#		
S/C Reference frame origin		description		
S/C reference frame axes		description		
Launcher				
Launcher performance		kg	For the baseline orbit	
Launch date		date		
Launch window		days		
Design lifetime		yrs		
Overall Reliability		%		
Payload Mass		kg		
ARRIVAL & LANDING CONDITIONS				
Hyperbolic arrival velocity		m/s		
Entry velocity at entry altitude		m/s		
Entry altitude		km		
Entry angle		deg		
Target Landing longitude		deg		
Target Landing Latitude		deg		
Target Landing Ground Altitude		km		
Target Landing Terrain		%	Percentage of rocks	
Target Landing Terrain maximum slope		deg	Maximum allowable	
Target Landing Accuracy		km	Longest axis of ellipse	
Target Landing Orientation		orientation		
Target Landing Velocity		m/s	Maximum allowable	
Target Landing Acceleration		g	In earth g	

Fig.5.3 The chosen CDF-MIS cells

5.1.3. The program structure

All the process are divided in two blocks: the executable program and the related macro (both developed in Visual Basic): the macro execute the program and send data.

The program read the CDF-MIS data, creates a SOAP messages, and then send this message to a Web Service.

The next figure presents an example of the SOAP message:

```
<?XML version="1.0" encoding="utf-8" ?>
- <soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:xsd="http://www.w3.org/2001/XMLSchema"
    xmlns:soap="http://schemas.XMLsoap.org/soap/envelope/">
- <soap:Body>
- <somma xmlns="http://urn:servizionumeri#somma">
  <cellname>'General characteristics:'</cellname>
  <value />
  <cellname>'Sub system Total Mass '</cellname>
  <value />
  <cellname>'Sub system Mass Margin'</cellname>
  <value />
  <cellname>'Redundancy level'</cellname>
  <value />
  <cellname>'PARACHUTE DESIGN'</cellname>
  <value />
  <cellname>''</cellname>
  <value />
  <cellname>'Nominal area of the pilot chute of drogue system'</cellname>
  <value />
  <cellname>'Inflation time of the pilot chute of the drogue system'</cellname>
  <value />
```

<cellname>**'Drag coefficient of the pilot chute of the drogue system'**</cellname>
<value />
<cellname>**'Opening altitude of the drogue chute system'**</cellname>
<value />

5.1.3.1. The executable program

The executable program is developed with the Microsoft Visual Basic 6.0, and is structured in four functions. These functions have to take data from the CDF worksheets, create a SOAP message, send it to a Web Service and wait for a receipt acknowledge.
At the following image we can seeits hierarchic structure:

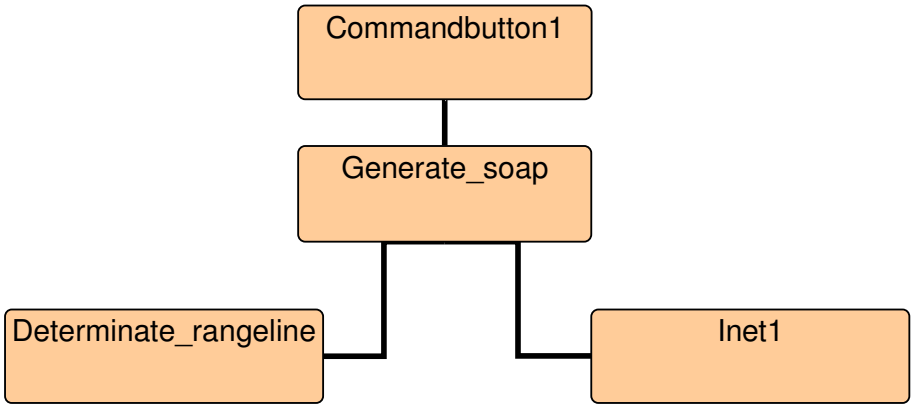


Fig.5.4 SEND SOAP Hierarchical structure

The program includes an initiation function **Commandbutton1**, which is executed by the user. This function has to determinate where the CDF worksheets is located, then shout to the **Generate_soap** function, this one reads data of the CDF worksheets, with the help of the **Determinate_rangeline** function, which says the number of linees that has to read. Then the function creates a SOAP message inserting the CDF worksheets data. Once created the message is send to the Web Service using the **Inet1** function. The Inet1 function allows to recieve the acknowledge returned by the Web Service

5.1.3.2. The CDF macro

The CDF worksheets have a macro, which allows us to execute the program that has been explained previously, automatically. This macro is structured as a single function.

5.2. What is a Web Service?

For the W3C the Web Service is a software system design to support the interoperability and the interaction between computers over an IP network.
It has an interface, which is described in a compatible format by a machine (specially WSDL). Another systems “talking” with a Web Service using a SOAP message, transported by HTTP with XML serialitzation, to a set with other Web standards that are related.

In short, a Web Service is a technology that allows the connection and the communication between two systems. The requested application does a request, create a message with the XML format, and send it by means of the network supplier. This can answer with a message that has a XML format.
The standard Web Service specifies the message interface that is sent, the format of the message, the heders and the form by wich the server can publishes and discovers other Web Services.

The architecture model of the Web Service is structured in four models: the model oriented to the message, oriented to the service one, the model oriented to the resources and the model orientied to the politics.

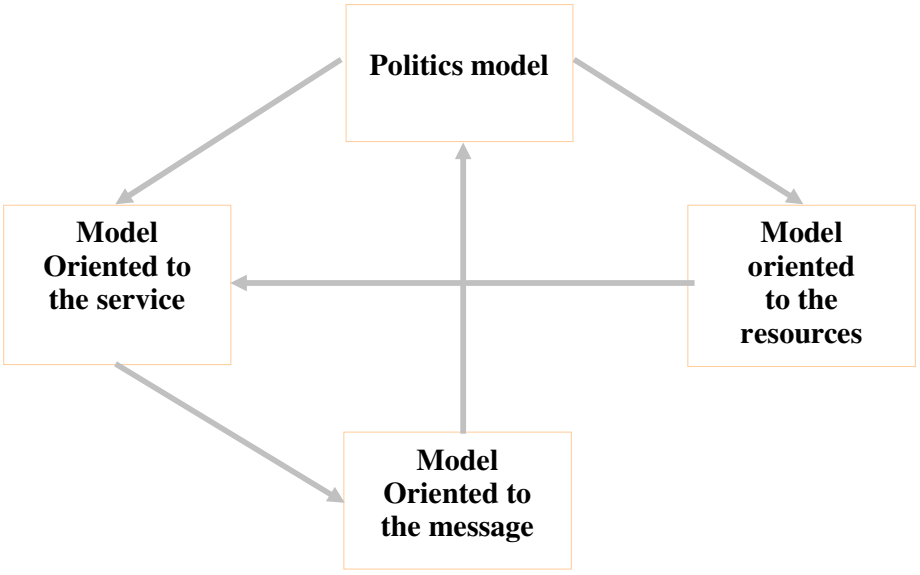


Fig.5.5 The architecture model

- **MOM:** it is centered to the structure and the transport of the message
- **SOM:** it is centered in the service and the action
- **ROM**: it is centered in the existing resources
- **Politics model:** it is centered in the restriccions of the behavior of the agents and services

6. PROJECT AND CONCLUSIONS

6.1. The project

At the beginning of June 2005 arose the possibility to participate in the CoDE project for four months. During this time I have been followed by Carlo Paccagnin I (an Engineer of the Software department of Alenia Spazio).
In the initial part of this period I've been trained for being capable to develop the application presented in the previous chapters . The following paragraphs describe this training

6.1.1. The first stage

First I had to understand the Space context asoftware nd in particular the CODE and the CDF-MIS. Then I focus my training on the technology to be adopted: Visual Basic 6.0, Visual Basic for Applications, XML concepts and the Web Service theory.

6.1.2. The second stage

When tha basic training have finished, I started to collaborate with the project team to coordinate the Software development and in particular how my contribution fit in the overall project. Then I started the development and all related documentation.

6.1.3. The third stage

Once developed the application I performed all suitable tests to verify the correctness of its operation. I defined and performed all tests regarding the standalone application, and all integration tests with the software developed by the other members of the project team to verify that when I send a message to a Web Service, it was received correctly and the data sent were what was expected.
Once finished the tests, my collaboration in the CODE project was concluded.

6.1.4. The experience

Once finished this experience I can say that all has gone perfectly in the work group and in Alcatel Alenia Space. The work from the beginning has arise a good rate carrying out the things with the time that I had previously thought
In Alcatel Alenia SpaceI felt very well because when I had a problem Software engineers helped me, as well as how to raise a situation, how solve it, etc.

6.2. Conclusions

The four months have finished, and now it is the time to extract a conclusion about the project, explaining if all we expect at the beginning reached the proper goal, and evaluating if the project has been a good expierience in an academic, but also in a personal level.

The project was based on the development of a new application in order to explore the possibilities that the XML metalanguage offers. XML is a new technology, with an high potential, which will be used in more applications in the aerospace field.

In the following I will expose by a schematic and detached form all the conclusions that I have obtained in these four months:

The first block of conclusions arise from working in a foreign country, in a company and being part of a working team, which was formed by people from universities or companies.

- The project has allowed me to see the working environment of an aerospace company. The way to organize the work and to use Space Engineering tools.

- I have been able to be trained linguistically, because I have used three languages: Italian to speak within the company and the workgroup, Spanish and English for documenting the project.

- The fact of being in a project (CoDE) allows me to learn how to work in a team, considering not only my part, but also to discuss and verify with the other members of the team, the overall development.

The second conclusion block it would be marked by the technogies that I used throughout the project

- The first thing to emphasize in this block is that the project has allowed me to learn the XML programming metalanguage, that for me, which has an importan present and a more important future like informatic tool. It has not been the language knowdlege only, but also the fact that I can extend my knowledge to other computing languages and science tool.

- Then I would emphasize the knowledge of all the languages related to XML, like: XSD, DTD, HTML and XSL. It allowed me to understand the interrelations that exist among different languages, which have the same origin.

- Without any doubt the Visual Basic is the tool that I used more and, once finished the work, I have acquire the major experience, with the Microsoft Visual Basic version and the Visual Basic version for applications. With

Visual basic I learned the concepts of Object Oriented Programming. I also learned, in a simple form, the structured programming, and I have developed a program of ~700 lines of code.

- I learned to use the Microsoft Office macros,

- I learned to use the Microsoft Office macros, applied to Microsoft Excel, and its editor (Visual Basic for Applications), trying in order to use its potential, and watching its limitations

- I learned the Web Service concept and its form of operation. And also what is it and how to create a SOAP messages.

The third conclusions block includes all the concepts related to the work group

- The application creates a XML document, well specified, validated and useful by the Web Service. This was the most important goal for the work group, and which has been occurred successfully.

- All the application is documented in a User Manual form, but also in a Technical Design Manual, allowing to the application user an absolute knowledge of the Software use, and its internal structure. In this way any maintenance correction can be performed easily.

The fourth and the last block includes all the aims, I have acquired in a formative level during the degree and which have been applied in the project

- Without any doubt the subjects of the first course related to the programming, are the ones that have been more related with my work. But during all my experience I have found sense at all the thing that I discovered that during these fourth months I applied many concepts learned along all my University studies

7. BIBLIOGRAPHY

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SUMMARY: it is a manual about the programming with Visual Basic.

[2] PROGRAMARE CON XML

AUTHOR: Paolo Pilarosi
SUMMARY: it is a programming manual of XML, with information about XSD, Web Service and the XML application on platforms

[3] INTRODUCCIONE ALLA PROGRAMACIONE IN VISUAL BASIC FOR APLICATIONS

AUTHOR: Claudio Fornaro
SUMMARY: is a manual about Visual Basic for Applications, in which we can found programming chapters but also about optimization and adaptation of our code for other applications.

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Is the official web page of XML METALINGUATGE

[5] http://www.gamarod.com.ar

Is the programming page, where we can found information about the different languages

[6] http://www.elguille.info/

Page about the programming with some Visual Basic, XML contents and the Web Service theory

[7] http://www.lawebdelprogramador.com

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ANNEXOS

TÍTOL DEL TFC: A data transfer model in the space field

TITULACIÓ: Enginyeria Técnica Aeronàutica, especialitat Aeronavegació

AUTOR: Miquel Colom i Vilarrubla

DIRECTOR: Prof. Paolo Maggiore

DATA: 15 de Setembre de 2005

Annex 1: UserForm1 Code

```
Dim num As Byte
Dim bloc(1 To 200) As finestra
Dim zor As Integer
Dim direcc As String
Dim MAX As String
Dim MIN As String
Dim colmx As Integer
Dim filmx As Integer
Dim colmx1 As Integer
Dim filmx1 As Integer
Dim ndatbse As String
Dim schema As String
Dim fulls(14) As Integer
Dim indexx As String
Dim versio As String
Dim create As Boolean
Dim str1 As String
Dim rec As Integer
Dim exist As String
Dim ms As New excel.Application
Dim msW As New excel.Workbook
Dim excelfile As String
Dim msWsheet As New excel.Worksheet

Public Sub CommandButton1_Click() 'this is the most important function!
control the execution of the program
ms.Workbooks.Open excelfile
Set msexcelapp = GetObject("", "excel.application")
If OptionButton13.Value = False Then
Call Database_options
End If
Call determinate_rangesheet 'User value for sheets
If MAX <> 0 Then
For rec = MIN To MAX
num = fulls(rec)
If num <> 1 Then
Call other_sheets
End If
If num = 1 Then
Call first_sheet
End If
Next
If OptionButton13.Value = False Then
Call load_database_and_xml
End If

If OptionButton13.Value = True Then
Call load_xml_without_database
End If
End If
```

```
ms.ActiveWorkbook.Close
Set ms = Nothing
Set msW = Nothing
Set msexcelapp = Nothing
excel.Application.Quit
End
End Sub
Public Sub other_sheets() ' this function implement the sheets <>1
Dim a(1 To 26) As String
Dim b As Integer: b = 0
Dim c As String
Dim count As Byte
Call selecct_sheet(num)
a(1) = "a": a(2) = "b": a(3) = "c": a(4) = "d": a(5) = "e": a(6) = "f": a(7) =
"g": a(8) = "h": a(9) = "i": a(10) = "j" _
: a(11) = "k": a(12) = "l": a(13) = "m": a(14) = "n": a(15) = "o": a(16) = "p":
a(17) = "q": a(18) = "r": a(19) = "s" _
: a(20) = "t": a(21) = "u": a(22) = "v": a(23) = "w": a(24) = "x": a(25) = "y":
a(26) = "z"
Range("a1").Select ' select the first cell
b = 1
count = 1
Call determinate_rangecol 'User value for columns
Call determinate_rangeline 'User value for lines
For count = 1 To colmx
b = 1
For b = 1 To filmx
c = a(count) & b ' c is the name of cell
Range(c).Select 'select the cell
Call save_struct(count, b, c)  'call save function for save the paramethers
Next
Next
End Sub

Public Sub evaluate_cell_other_sheets(ByRef m As Byte, ByRef n As
Integer) 'This function determines the cell condition
'parameter/ value/comment
Dim b As Byte
Dim c As String
Dim a(1 To 26) As String
a(1) = "a": a(2) = "b": a(3) = "c": a(4) = "d": a(5) = "e": a(6) = "f": a(7) =
"g": a(8) = "h": a(9) = "i": a(10) = "j" _
: a(11) = "k": a(12) = "l": a(13) = "m": a(14) = "n": a(15) = "o": a(16) = "p":
a(17) = "q": a(18) = "r": a(19) = "s" _


: a(20) = "t": a(21) = "u": a(22) = "v": a(23) = "w": a(24) = "x": a(25) = "y":
a(26) = "z"
b = 4
c = a(m) & b
If Range(c) = "Value" Then 'the parameter is a value
bloc(num).cells(m, n).condicion = 2
```

```
ElseIf Range(c) = "Manual Value" Then 'the parameter is a value
bloc(num).cells(m, n).condicion = 2
ElseIf Range(c) = "Comments" Then
bloc(num).cells(m, n).condicion = 3 'the parameter is a comment
ElseIf Range(c) <> Empty Then 'the paerameter is a constant value
bloc(num).cells(m, n).condicion = 1
End If
End Sub

Public Sub save_struct(ByRef count As Byte, ByRef b As Integer, ByRef
c As String) 'this function save the cells in a struct
If ms.cells(b, count).Value <> Empty Then
bloc(num).cells(count, b).posicion = c
bloc(num).cells(count, b).cellvalue = ms.cells(b, count).Value
Call carachter_cellvalue(count, b)
End If
If ms.cells(b, count).Value = Empty Then
bloc(num).cells(count, b).posicion = c
bloc(num).cells(count, b).cellvalue = "NULL"
End If
If num <> 1 Then
Call evaluate_cell_other_sheets(count, b) 'call condicion_ot for
determinate the condition of active cell
End If
If num = 1 Then
Call evaluate_cell_sheet1(count, b) 'call condicion_opt1 for determinate
the condition of active cell
End If
End Sub

Public Sub selecct_sheet(num As Byte) 'select the sheet
ms.Sheets(num).Select
End Sub

Public Sub first_sheet() 'generic function for sheet 1. call the other
functions
Dim a(1 To 26) As String
Dim b As Integer: b = 0
Dim c As String
Dim count As Byte
ms.Sheets(1).Select
a(1) = "a": a(2) = "b": a(3) = "c": a(4) = "d": a(5) = "e": a(6) = "f": a(7) =
"g": a(8) = "h": a(9) = "i": a(10) = "j" _

: a(11) = "k": a(12) = "l": a(13) = "m": a(14) = "n": a(15) = "o": a(16) = "p":
a(17) = "q": a(18) = "r": a(19) = "s" _

: a(20) = "t": a(21) = "u": a(22) = "v": a(23) = "w": a(24) = "x": a(25) = "y":
a(26) = "z"
Call determinate_rangecol 'User value for columns
Call determinate_rangeline 'User value for lines
Range("a1").Select
```

```
For count = 1 To colmx1
b = 1
For b = 1 To filmx1
c = a(count) & b 'c is the name of cell
Range(c).Select 'select the cell
Call save_struct(count, b, c) 'call save for save the cells in a struct
Next
Next
End Sub

Public Sub evaluate_cell_sheet1(ByRef m As Byte, ByRef n As Integer)
'is the same of condicion_ot but for shhet1
Dim b As Byte
Dim c As String
Dim a(1 To 26) As String

If ms.cells(4, m).Value = "Mode Duration" Then 'is the same  that value
bloc(num).cells(m, n).condicion = 2
ElseIf ms.cells(4, m) = "Subsystem Status" Then 'three diferent chooise
(on/of/stand by)
bloc(num).cells(m, n).condicion = 2
ElseIf ms.cells(4, m).Value <> Empty Then 'constants
bloc(num).cells(m, n).condicion = 1
ElseIf ms.cells(6, m).Value <> Empty Then
bloc(num).cells(m, n).condicion = 1
End If
End Sub

Private Sub CommandButton2_Click() 'this function read the textboxs
excelfile = TextBox4.Text
If TextBox4.Text <> Empty Then
CommandButton1.Enabled = True
Else
MsgBox "Load Error", vbExclamation
End If
Call validate_folder
If OptionButton13.Value = True Then
Frame6.Enabled = False
Frame7.Enabled = False
Else
Frame6.Enabled = True
Frame7.Enabled = True

End If
End Sub

Private Sub CommandButton3_Click() 'this function clear textbox1,4 and
3
TextBox4.Text = Empty
End Sub
```

```
Private Sub determinate_rangeline() 'this function dterminate the range
of lines
Dim nfila As Integer
Dim nnfila As Integer
Dim fila As Integer
Dim b As Byte: b = 2
Dim i As Integer
Dim d As Byte: d = 4
fila = 2
filmx = 2
nfila = fila + 1
nnfila = nfila + 1
If num <> 1 Then
For i = 1 To 300
If ((ms.cells(nnfila, b) <> Empty) Or (ms.cells(nfila, b) <> Empty) Or
ms.cells(nfila, b) <> Empty) Then
filmx = filmx + 1
fila = fila + 1
nfila = fila + 1
nnfila = nfila + 1
End If
Next
Else
fila = 5
nfila = 6
nnfila = 7
For i = 1 To 300
If ((ms.cells(nnfila, d) <> Empty) Or (ms.cells(fila, d) <> Empty) Or
ms.cells(nfila, d) <> Empty) Then
filmx1 = filmx1 + 1
fila = fila + 1
nfila = fila + 1
nnfila = nfila + 1
End If
Next
filmx1 = filmx1 + 7
End If
filmx = filmx
End Sub

Private Sub determinate_rangecol() 'this function dterminate the range of
columns

Dim a(1 To 26) As String
Dim z As String
Dim y As String

Dim ncol As Integer
Dim col As Integer
Dim b As Byte: b = 4
a(1) = "a": a(2) = "b": a(3) = "c": a(4) = "d": a(5) = "e": a(6) = "f": a(7) =
"g": a(8) = "h": a(9) = "i": a(10) = "j" _
```

```
: a(11) = "k": a(12) = "l": a(13) = "m": a(14) = "n": a(15) = "o": a(16) = "p":
a(17) = "q": a(18) = "r": a(19) = "s" _
: a(20) = "t": a(21) = "u": a(22) = "v": a(23) = "w": a(24) = "x": a(25) = "y":
a(26) = "z"
z = a(1) & b
y = a(2) & b
colmx = 1
col = 1
ncol = col + 1
If num <> 1 Then
For i = 1 To 50
If ((Range(y) <> Empty) Or (Range(z) <> Empty)) Then
colmx = colmx + 1
col = col + 1
ncol = col + 1
z = a(col) & b
y = a(ncol) & b
End If
Next
Else
Dim t As String
Dim ds As Byte: ds = 6
colmx1 = 0
b = 4
col = 1
t = a(col) & b
For i = 1 To 50
If ((ms.cells(4, col).Value <> Empty) Or (ms.cells(4, ncol).Value <>
Empty)) Then
colmx1 = colmx1 + 1
col = col + 1
ncol = col + 1
ElseIf (ms.cells(6, col) <> Empty) Then
colmx1 = colmx1 + 1
col = col + 1
End If
Next
colmx1 = colmx1 - 1
End If
colmx = colmx - 1

End Sub

Private Sub determinate_rangesheet() 'this function dterminate the range
of sheets

Dim jj As Integer: jj = 1
MIN = 1
MAX = 0
If CheckBox15.Value = True Then
CheckBox1.Value = True
CheckBox2.Value = True
```

```
CheckBox3.Value = True
CheckBox4.Value = True
CheckBox5.Value = True
CheckBox6.Value = True
CheckBox7.Value = True
CheckBox8.Value = True
CheckBox9.Value = True
CheckBox10.Value = True
CheckBox11.Value = True
CheckBox12.Value = True
CheckBox13.Value = True
CheckBox14.Value = True
End If
If CheckBox1.Value = True Then
MAX = MAX + 1
fulls(jj) = 1
jj = jj + 1
End If
If CheckBox2.Value = True Then
MAX = MAX + 1
fulls(jj) = 2
jj = jj + 1
End If
If CheckBox3.Value = True Then
MAX = MAX + 1
fulls(jj) = 3
jj = jj + 1
End If
If CheckBox4.Value = True Then
MAX = MAX + 1
fulls(jj) = 4
jj = jj + 1
End If
If CheckBox5.Value = True Then
MAX = MAX + 1
fulls(jj) = 5
jj = jj + 1
End If

If CheckBox6.Value = True Then
MAX = MAX + 1
fulls(jj) = 6
jj = jj + 1
End If

If CheckBox7.Value = True Then
MAX = MAX + 1
fulls(jj) = 7
jj = jj + 1
End If

If CheckBox8.Value = True Then
```

```
MAX = MAX + 1
fulls(jj) = 8
jj = jj + 1
End If
If CheckBox9.Value = True Then
MAX = MAX + 1
fulls(jj) = 9
jj = jj + 1
End If
If CheckBox10.Value = True Then
MAX = MAX + 1
fulls(jj) = 10
jj = jj + 1
End If
If CheckBox11.Value = True Then
MAX = MAX + 1
fulls(jj) = 11
jj = jj + 1
End If
If CheckBox12.Value = True Then
MAX = MAX + 1
fulls(jj) = 12
jj = jj + 1
End If
If CheckBox13.Value = True Then
MAX = MAX + 1
fulls(jj) = 13
jj = jj + 1
End If
If CheckBox14.Value = True Then
MAX = MAX + 1
fulls(jj) = 14
jj = jj + 1
End If
If jj = 1 Then
MsgBox "You don't select a workshhet", vbInformation

End If
End Sub

Private Sub create_database() 'this function cretate a empty data base
Dim cat As ADOX.Catalog
Set cat = New ADOX.Catalog

Dim TBL As ADOX.Table
Set TBL = New ADOX.Table
Dim sProvider As String
Dim snombrebase As String
snombrebase = ndatbse
If versio = 1 Then
sProvider = "Microsoft.Jet.OLEDB.3.51"
```

```
ElseIf versio = 2 Then
sProvider = "Microsoft.Jet.OLEDB.4.0"
End If
exist = Len(Dir$(snombrebase))
If exist = "0" Then
' Create data base
cat.create "Provider=" & sProvider & ";" & _
          "Data Source=" & snombrebase & ";"

With TBL
TBL.Name = "Mission modes"
TBL.Columns.Append "CELLVALUE", adLongVarChar
TBL.Columns.Append "POSICION", adVarChar
TBL.Columns.Append "CONDICION", adVarChar
TBL.Columns.Append "SHEET", adVarChar
TBL.Columns.Append "INDEX", adVarChar
End With
cat.Tables.Append TBL
Set TBL = Nothing
Set cat = Nothing
Else
MsgBox ndatbse & " exist", vbInformation
create = False
End If
End Sub

Private Sub load_database_and_xml() 'load data base and xml file
Dim col As Integer
Dim fil As Integer
Dim BDD As Database
Dim TBL As Recordset
Set BDD = OpenDatabase(ndatbse) 'open data base
Set TBL = BDD.OpenRecordset("Mission modes")
Dim myXMLDOM As Object

Dim mik As String
Dim strXML
Dim num As Byte
Dim count As Byte
Dim b As Integer
If create = False Then
TBL.MoveFirst

While Not TBL.EOF
TBL.Delete
TBL.MoveNext
Wend
End If
For rec = MIN To MAX
num = fulls(rec)
If num = 1 Then
col = colmx1
```

```
fil = filmx1
ElseIf num <> 1 Then
col = colmx
fil = filmx
End If
For count = 1 To col
For b = 1 To fil
If bloc(num).cells(count, b).cellvalue <> Empty Then 'if the cell isn't
empty call funcxml and save_xml
If bloc(num).cells(count, b).posicion <> Empty Then
If bloc(num).cells(count, b).condicion <> Empty Then
TBL.AddNew
TBL.Fields("CELLVALUE") = bloc(num).cells(count, b).cellvalue
TBL.Fields("POSICION") = bloc(num).cells(count, b).posicion
TBL.Fields("CONDICION") = bloc(num).cells(count, b).condicion
TBL.Fields("SHEET") = num
Call put_index(b)
TBL.Fields("INDEX") = indexx
TBL.Update
End If: End If: End If
Next
Next
Next
Call create_schema
TBL.MoveFirst
If Not TBL.EOF Then
strXML = "<?xml version='1.0'?>" & vbNewLine
strXML = strXML & "<worksheet
xmlns='http://www.example.com/worksheet'
xmlns:xsi='http://www.w3.org/2001/XMLSchema-instance'
xsi:schemaLocation='http://www.example.com/worksheet " & vbNewLine

strXML = strXML & schema & "'" & ">" & vbNewLine
While Not TBL.EOF
strXML = strXML & "<index" & " id=" & " ' " & TBL.Fields("posicion") &
TBL.Fields("sheet") & " ' " & ">" & vbNewLine
        strXML = strXML & "<cellvalue>" & TBL.Fields("cellvalue") &
"</cellvalue>" & vbNewLine
        strXML = strXML & "<posicion>" & TBL.Fields("posicion") &
"</posicion>" & vbNewLine

        strXML = strXML & "<condicion>" & TBL.Fields("condicion") &
"</condicion>" & vbNewLine
        strXML = strXML & "<sheet>" & TBL.Fields("sheet") & "</sheet>"
& vbNewLine
        strXML = strXML & "</" & "index" & ">" & vbNewLine
TBL.MoveNext
Wend
strXML = strXML & "</worksheet>" & vbCrLf
Open direcc For Output As #3
Print #3, strXML
```

```
Close #3

End If
End Sub

Private Sub put_index(b As Integer)
indexx = bloc(num).cells(2, b).posicion
End Sub

Private Sub Database_options() 'control the data base creation
Dim bran As String
Dim exdat As String
If OptionButton9.Value = True Then
versio = 1
ElseIf OptionButton10.Value = True Then
versio = 2
End If
If OptionButton11.Value = True Then
create = True
Call create_database
CommandButton1.Enabled = True
End If
If OptionButton12.Value = True Then
create = False
CommandButton1.Enabled = True
End If
exdat = Len(Dir$(ndatbse))
If exdat = "0" Then
MsgBox "The data base doesn't exist, please create a new data base"
CommandButton1.Enabled = False

End If
End Sub

Private Sub carachter_cellvalue(ByRef count As Byte, ByRef b As
Integer) 'change the caracter & for &amp;
Dim xuwei As String
Dim imirec As Integer
Dim equil As String
Dim lascia As String

Dim definit As String
xuwei = bloc(num).cells(count, b).cellvalue
imirec = InStr(1, xuwei, "&")
If imirec <> 0 Then
equil = Left(xuwei, imirec - 1)
lascia = Right(xuwei, Len(xuwei) - imirec)
definit = equil & " &amp; " & lascia
bloc(num).cells(count, b).cellvalue = definit
End If
End Sub
```

```
Private Sub create_schema() 'create the xml schema
Dim strXSD

strXSD = "<?xml version='1.0'?>" & vbNewLine
strXSD = strXSD & "<!-- edited with XMLSpy v2005 rel. 3 U
(http://www.altova.com) by Carlo (Paccagnini) -->" & vbNewLine & _
"<xsd:schema id='worksheet'
xmlns:xsd='http://www.w3.org/2001/XMLSchema'
xmlns='http://www.example.com/worksheet'
targetNamespace='http://www.example.com/worksheet'
elementFormDefault='qualified' >" & vbNewLine & _
   "<xsd:element name='worksheet'>" & vbNewLine & _
      "<xsd:complexType>" & vbNewLine & _
         "<xsd:sequence>" & vbNewLine & _
            "<xsd:element name='index' maxOccurs='unbounded'>" &
vbNewLine & _
               "<xsd:complexType>" & vbNewLine & _
                  "<xsd:sequence>" & vbNewLine & _
                     "<xsd:element name='cellvalue' type='xsd:string'/>" &
vbNewLine & _
                     "<xsd:element name='posicion' type='xsd:string'/>" &
vbNewLine & _
                     "<xsd:element name='condicion' type='xsd:string'/>" &
vbNewLine & _
                     "<xsd:element name='sheet' type='xsd:string'/>" &
vbNewLine & _
                  "</xsd:sequence>" & vbNewLine & _

                  "<xsd:attribute name='id' type='xsd:ID' use='required'/>" &
vbNewLine & _
               "</xsd:complexType>" & vbNewLine & _
            "</xsd:element>" & vbNewLine & _
         "</xsd:sequence>" & vbNewLine & _
      "</xsd:complexType>" & vbNewLine & _
   "</xsd:element>" & vbNewLine & _
"</xsd:schema>"
Open schema For Output As #4
Print #4, strXSD
Close #4

End Sub

Private Sub validate_folder() 'control the urls of
textboxs(excel\xml\database)
Dim c As String
Dim cc As Boolean
Dim Fs
Set Fs = CreateObject("Scripting.FileSystemObject")
Dim num1 As Byte: num1 = 1
Dim num2 As Byte
Dim str2 As String
If Len(Dir$(excelfile)) = 0 Then 'excel
```

```
MsgBox "The direction of excel file don't exist", vbInformation
CommandButton1.Enabled = False
GoTo c:
End If

While num1 <> 0 'saber el directori del excel
num1 = InStr(num1 + 1, excelfile, "\")
If num1 <> 0 Then
num2 = num1
End If
Wend
str1 = Left(excelfile, num2 - 1)
direcc = str1 & "\XML\XML.xml"
ndatbse = str1 & "\DATABASE\DATABASE.MDB"
schema = str1 & "\XML\XML.xsd"
str2 = str1 & "\XML"
cc = Fs.FolderExists(str2)
If cc = False Then
Fs.CreateFolder (str2)
End If
If OptionButton13.Value = False Then
str2 = str1 & "\database"
cc = Fs.FolderExists(str2)
If cc = False Then
Fs.CreateFolder (str2)
End If
End If

c:
Set Fs = Nothing
End Sub

Private Sub CommandButton7_Click()
Form1.Visible = True
End Sub

Private Sub load_xml_without_database()
Dim col As Integer
Dim fil As Integer

Dim myXMLDOM As Object
Dim strXML
Dim num As Byte
Dim count As Byte
Dim b As Integer
strXML = "<?xml version='1.0'?>" & vbNewLine
strXML = strXML & "<worksheet
xmlns='http://www.example.com/worksheet'
xmlns:xsi='http://www.w3.org/2001/XMLSchema-instance'
xsi:schemaLocation='http://www.example.com/worksheet " & vbNewLine
strXML = strXML & schema & "'" & ">" & vbNewLine
For rec = MIN To MAX
```

```
num = fulls(rec)
If num = 1 Then
col = colmx1
fil = filmx1
ElseIf num <> 1 Then

col = colmx
fil = filmx
End If
For count = 1 To col
For b = 1 To fil
If bloc(num).cells(count, b).cellvalue <> Empty Then 'if the cell isn't
empty call funcxml and save_xml
If bloc(num).cells(count, b).posicion <> Empty Then
If bloc(num).cells(count, b).condicion <> Empty Then
strXML = strXML & "<index" & " id=" & " ' " & bloc(num).cells(count,
b).posicion & num & " ' " & ">" & vbNewLine
        strXML = strXML & "<cellvalue>" & bloc(num).cells(count,
b).cellvalue & "</cellvalue>" & vbNewLine
        strXML = strXML & "<posicion>" & bloc(num).cells(count,
b).posicion & "</posicion>" & vbNewLine
        strXML = strXML & "<condicion>" & bloc(num).cells(count,
b).condicion & "</condicion>" & vbNewLine
        strXML = strXML & "<sheet>" & num & "</sheet>" & vbNewLine
        strXML = strXML & "</" & "index" & ">" & vbNewLine

End If: End If: End If
Next
Next
Next
strXML = strXML & "</worksheet>" & vbCrLf
Open direcc For Output As #3
Print #3, strXML
Close #3
Call create_schema
End Sub
```

Annex 2: Form1 Code

```
Private Sub Command1_Click()
UserForm1.TextBox4.Text = File1.Path & "\" & File1.FileName
Form1.Visible = False
End Sub

Private Sub dir1_change()
File1.Path = Dir1.Path
End Sub

Private Sub drive1_Change()
Dir1.Path = Drive1.Drive
```

```
End Sub
```

Annex 3: CDF Worksheets

S/C Mission Modes

Number	Mode Name	Description (Hereafter an example of description is provided)	Mode Duration	Subsystem status				
				AOCS	Comms	DHS	Heating	Instruments
1	Launch Mode	*From lift-off until upper stage separation* Battery fully charged (charging until 8 min (tbd) before lift-off) Payload Instruments switched off Power S/S (PCU,PDU,TCU) , OBDH S/S (CDMU) switched on Comms S/S for RX switched on		stand-by	on	on	on	on
2	Transfer mode	*From upper stage separation until Halo orbit* Payload Instruments switched off AOCS Initialisation-coarse mode Solar Arrays operational TT&C Active		on	on	on	on	on
3	Initialisation Mode	*From Halo Orbit acquisition until normal operation* Mode entered after transfer phase or during recovery from safe phase Detumbling and stabilisation AOCS Initialisation-coarse mode Solar Arrays operational Payload Instruments initialisation		on	on	on	on	on
4	Operational Mode	*Fine Pointing Mode* Payload Operational S/C Sun Pointing AOCS active and satisfying the pointing requirements TT&C Active via Medium Gain Antenna		on	on	on	on	on
5	Safe Mode	*Failure Recovery Mode* S/C attitude automatically set to Sun Pointing Payload Instruments switched off Failure Detection, Isolation and Recovery to normal mode are executed by the ground. TT&C Active via Low Gain Antenna TM/TC access to OBDH is guaranteed to enable failure detection and reconfiguration.		stand-by	stand-by	stand-by	stand-by	stand-by
n	-	*Description*		stand-by	stand-by	stand-by	stand-by	stand-by

System Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
S/C name				
S/C design version		#		
S/C Reference frame origin		description		
S/C reference frame axes		description		
Launcher				
Launcher performance		kg	For the baseline orbit	
Launch date		date		
Launch window		days		
Design lifetime		yrs		
Overall Reliability		%		
Payload Mass		kg		
ARRIVAL & LANDING CONDITIONS				
Hyperbolic arrival velocity		m/s		
Entry velocity at entry altitude		m/s		
Entry altitude		km		
Entry angle		deg		
Target Landing longitude		deg		
Target Landing Latitude		deg		
Target Landing Ground Altitude		km		
Target Landing Terrain		%	Percentage of rocks	
Target Landing Terrain maximum slope		deg	Maximum allowable	
Target Landing Accuracy		km	Longest axis of ellipse	
Target Landing Orientation		orientation		
Target Landing Velocity		m/s	Maximum allowable	
Target Landing Acceleration		g	In earth g	

AOCS Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
Pointing Accuracy (APE)		arcmin		
Pointing Stability (RPE)		arcsec		
Pointing Knowledge (AMA)		arcsec		
Attitude stabilisation			3-axis, spinning, gravity-gradient	
Spin rate		rpm	if spinning	
Spin Axis direction		description		
Total disturbance torque		Nm		
Total Delta-V due to AOCS		m/s		
Thrust level of thrusters (if any)		N		
AOCS total mass		kg		
AOCS mass margin		%		
Redundancy level		description		
Subsystem Power Budget				
Peak Transient Power Consumption		W	Typically the Subsystem Power budget is provided for the first iteration when there is no Unit/detailed information available. Preferably the Power information should be provided to the Power Specialist at Unit level (see below)	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Equipment Details:				
Unit 1				
Unit Name				
Number (of units)		number		
Mass (without margin)		kg	per unit	
Mass Margin to be applied		%	5%, 10% or 20%	
Design Status			Off The Shelf, Modified, New	
Dimension 1		mm	Length	
Dimension 2		mm	Width or Diameter	
Dimension 3		mm	Height	
Max. Operational T		deg C		
Min. Operational T		deg C		
Max. Non-Operational T		deg C		
Min. Non-Operational T		deg C		
Peak Transient Power Consumption		W	The power consumption on Unit level must take into account the number of units. Example: If there are 3 units, 2 working in parallel and 1 redundant, then the "Power on" must be the sum the 2 units on. If the one, which is redundant is on hot redundancy, then any power consumption must be added to the "Power on". The Duty Cycle is given with respect to the Mode duration.	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Mode 6 Power Consumption (on)		W		
Mode 6 Power Consumption (stby)		W		
Mode 6 Duty Cycle		%		
Mode 7 Power Consumption (on)		W		
Mode 7 Power Consumption (stby)		W		
Mode 7 Duty Cycle		%		
Data Volume		kbits	HouseKeeping	
Mounting Concept			description	
Supplier			Company (or project)	
Unit 2				
Unit 3				
Unit 4				
Unit 5				
Unit n				

GNC Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
Achieved Landing Accuracy		km	Longest Axis of landing Ellipse	
Ignition altitude of ACS thrusters		m	Above the ground	
Total thrust for ACS thrusters		N		
Pointing Accuracy (APE)		arcmin		
Pointing Stability (RPE)		arcsec		
Pointing Knowledge (AMA)		arcsec		
Attitude stabilisation			3-axis, spinning, gravity-gradient	
Spin rate		rpm	if spinning	
Spin axis direction		description		
Total disturbance torque		Nm		
Total Delta-V for GNC		m/s		
Thrust level of thrusters (if any)		N		
GNC total mass		kg	Excludes Subsystem margin	
GNC mass margin		%		
Redundancy level		description		
Subsystem Power Budget				
Peak Transient Power Consumption		W	Typically the Subsystem Power budget is provided for the first iteration when there is no Unit/detailed information available. Preferably the Power information should be provided to the Power Specialist at Unit level (see below)	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Equipment Details:				
Unit 1				
Unit Name				
Number (of units)		number		
Mass (without margin)		kg	per unit	
Mass Margin to be applied		%	5%, 10% or 20%	
Design Status			Off The Shelf, Modified, New	
Dimension 1		mm	Length	
Dimension 2		mm	Width or Diameter	
Dimension 3		mm	Height	
Max. Operational T		deg C		
Min. Operational T		deg C		
Max. Non-Operational T		deg C		
Min. Non-Operational T		deg C		
Peak Transient Power Consumption		W	The power consumption on Unit level must take into account the number of units. Example: If there are 3 units, 2 working in parallel and 1 redundant, then the "Power on" must be the sum the 2 units on. If the one, which is redundant is on hot redundancy, then any power consumption must be added to the "Power on". The Duty Cycle is given with respect to the Mode duration.	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Mode 6 Power Consumption (on)		W		
Mode 6 Power Consumption (stby)		W		
Mode 6 Duty Cycle		%		
Mode 7 Power Consumption (on)		W		
Mode 7 Power Consumption (stby)		W		
Mode 7 Duty Cycle		%		
Data Volume		kbits	HouseKeeping	
Mounting Concept			description	
Supplier			Company (or project)	
Unit 2				
Unit 3				
Unit 4				
Unit 5				
Unit n				

Communications Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
Frequency Band UP		MHz		
Frequency Band DOWN1		MHz		
Frequency Band DOWN2		MHz		
Ground Station		description		
Coding				
Telemetry data rate 1		kbps		
Telemetry data rate 2		kbps		
Antenna dof				
Antenna steering range		deg		
Antenna pointing stability req		deg		
Comms total mass		kg	Exclude subsystem margin	
Comms Mass Margin		%		
Redundancy level		description		
Subsystem Power Budget				
Peak Transient Power Consumption		W	Typically the Subsystem Power budget is provided for the first iteration when there is no Unit/detailed information available. Preferably the Power information should be provided to the Power Specialist at Unit level (see below)	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Equipment Details:				
Unit 1				
Unit Name				
Number (of units)		number		
Mass (without margin)		kg	per unit	
Mass Margin to be applied		%	5%, 10% or 20%	
Design Status			Off The Shelf, Modified, New	
Dimension 1		mm	Length	
Dimension 2		mm	Width or Diameter	
Dimension 3		mm	Height	
Max. Operational T		deg C		
Min. Operational T		deg C		
Max. Non-Operational T		deg C		
Min. Non-Operational T		deg C		
Peak Transient Power Consumption		W	The power consumption on Unit level must take into account the number of units. Example: If there are 3 units, 2 working in parallel and 1 redundant, then the "Power on" must be the sum the 2 units on. If the one, which is redundant is on hot redundancy, then any power consumption must be added to the "Power on". The Duty Cycle is given with respect to the Mode duration.	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Mode 6 Power Consumption (on)		W		
Mode 6 Power Consumption (stby)		W		
Mode 6 Duty Cycle		%		
Mode 7 Power Consumption (on)		W		
Mode 7 Power Consumption (stby)		W		
Mode 7 Duty Cycle		%		
Data Volume		kbits	HouseKeeping	
Mounting Concept			description	
Supplier			Company (or project)	
Unit 2				
Unit 3				
Unit 4				
Unit 5				
Unit n				

Data Handling Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
On-board memory		Mbits		
Total Housekeeping data		kbits	If based on assumption	
Total Radition dose		krads		
S/C data Bus type				
Processor type				
Redundancy level		description		
DHS total mass		kg	Exclude subsystem margin	
DHS harness mass		kg		
DHS Mass Margin		%		
DHS harness mass margin		%		
Subsystem Power Budget				
Peak Transient Power Consumption		W	Typically the Subsystem Power budget is provided for the first iteration when there is no Unit/detailed information available. Preferably the Power information should be provided to the Power Specialist at Unit level (see below)	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Equipment Details:				
Unit 1				
Unit Name				
Number (of units)		number		
Mass (without margin)		kg	per unit	
Mass Margin to be applied		%	5%, 10% or 20%	
Design Status			Off The Shelf, Modified, New	
Dimension 1		mm	Length	
Dimension 2		mm	Width or Diameter	
Dimension 3		mm	Height	
Max. Operational T		deg C		
Min. Operational T		deg C		
Max. Non-Operational T		deg C		
Min. Non-Operational T		deg C		
Peak Transient Power Consumption		W	The power consumption on Unit level must take into account the number of units. Example: If there are 3 units, 2 working in parallel and 1 redundant, then the "Power on" must be the sum the 2 units on. If the one, which is redundant is on hot redundancy, then any power consumption must be added to the "Power on". The Duty Cycle is given with respect to the Mode duration.	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Mode 6 Power Consumption (on)		W		
Mode 6 Power Consumption (stby)		W		
Mode 6 Duty Cycle		%		
Mode 7 Power Consumption (on)		W		
Mode 7 Power Consumption (stby)		W		
Mode 7 Duty Cycle		%		
Data Volume		kbits	HouseKeeping	
Mounting Concept			description	
Supplier			Company (or project)	
Unit 2				
Unit 3				
Unit 4				
Unit 5				
Unit n				

Mechanisms Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
Mechanisms total mass		kg	Exclude subsystem margin	
Mechanisms Mass Margin		%		
Subsystem Power Budget				
Peak Transient Power Consumption		W	Typically the Subsystem Power budget is provided for the first iteration when there is no Unit/detailed information available. Preferably the Power information should be provided to the Power Specialist at Unit level (see below)	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Equipment Details:				
Unit 1				
Unit Name				
Number (of units)		number		
Mass (without margin)		kg	per unit	
Mass Margin to be applied		%	5%, 10% or 20%	
Design Status			Off The Shelf, Modified, New	
Dimension 1		mm	Length	
Dimension 2		mm	Width or Diameter	
Dimension 3		mm	Height	
Max. Operational T		deg C		
Min. Operational T		deg C		
Max. Non-Operational T		deg C		
Min. Non-Operational T		deg C		
Peak Transient Power Consumption		W	The power consumption on Unit level must take into account the number of units. Example: If there are 3 units, 2 working in parallel and 1 redundant, then the "Power on" must be the sum the 2 units on. If the one, which is redundant is on hot redundancy, then any power consumption must be added to the "Power on". The Duty Cycle is given with respect to the Mode duration.	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Mode 6 Power Consumption (on)		W		
Mode 6 Power Consumption (stby)		W		
Mode 6 Duty Cycle		%		
Mode 7 Power Consumption (on)		W		
Mode 7 Power Consumption (stby)		W		
Mode 7 Duty Cycle		%		
Data Volume		kbits	HouseKeeping	
Mounting Concept			description	
Supplier			Company (or project)	
Unit 2				
Unit 3				
Unit 4				
Unit 5				
Unit n				

Propulsion Worksheet				
Parameter	**Value**	**Units**	**Remarks**	**Comments**
General characteristics:				
Main engine thrust level		N		
Main engine specific impulse		s		
Total mass of propellant		kg	Excludes propellant for AOCS	
Mass of propellant for AOCS		kg		
Propellant mass margin		%		
Prop S/S total dry mass		kg	Exclude subsystem margin	
Prop S/S Mass Margin		%		
Subsystem Power Budget				
Peak Transient Power Consumption		W	Typically the Subsystem Power budget is provided for the first iteration when there is no Unit/detailed information available. Preferably the Power information should be provided to the Power Specialist at Unit level (see below)	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Equipment Details:				
Unit 1				
Unit Name				
Number (of units)		number		
Mass (without margin)		kg	per unit	
Mass Margin to be applied		%	5%, 10% or 20%	
Design Status			Off The Shelf, Modified, New	
Dimension 1		mm	Length	
Dimension 2		mm	Width or Diameter	
Dimension 3		mm	Height	
Max. Operational T		deg C		
Min. Operational T		deg C		
Max. Non-Operational T		deg C		
Min. Non-Operational T		deg C		
Peak Transient Power Consumption		W	The power consumption on Unit level must take into account the number of units. Example: If there are 3 units, 2 working in parallel and 1 redundant, then the "Power on" must be the sum the 2 units on. If the one, which is redundant is on hot redundancy, then any power consumption must be added to the "Power on". The Duty Cycle is given with respect to the Mode duration.	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Mode 6 Power Consumption (on)		W		
Mode 6 Power Consumption (stby)		W		
Mode 6 Duty Cycle		%		
Mode 7 Power Consumption (on)		W		
Mode 7 Power Consumption (stby)		W		
Mode 7 Duty Cycle		%		
Data Volume		kbits	HouseKeeping	
Mounting Concept			description	
Supplier			Company (or project)	
Unit 2				
Unit 3				
Unit 4				
Unit 5				
Unit n				

Structures Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
Configuration CAD file		name		
CAD tool version		name		
Launcher Fairing type		name		
Satellite envelope (stowed) Z		mm		
Satellite envelope (stowed) Y		mm		
Satellite envelope (stowed) X		mm		
Satellite body length Z		mm		
Satellite body width Y		mm		
Satellite body height X		mm		
Satellite COG x		mm		
Satellite COG y		mm		
Satellite COG z		mm		
Solar Array nr of wings		number		
Solar Array nr of panels per wing		number		
Structures total mass		kg	Exclude subsystem margin	
Structures Mass Margin		%		
Equipment Details:				
Unit 1				
Unit Name				
Number (of units)		number		
Material		name		
Mass (without margin)		kg	per unit	
Mass Margin to be applied		%		
Dimension 1		mm	Length	
Dimension 2		mm	Width	
Dimension 3		mm	Height	
Mounting Concept			description	
Max. Operational T		deg C		
Min. Operational T		deg C		
Max. Non-Operational T		deg C		
Min. Non-Operational T		deg C		
Design Status			Off The Shelf, Modified, New	
Supplier			Company (or project)	
Unit 2				
Unit 3				
Unit 4				
Unit 5				
Unit n				

Thermal Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
Radiator total area		m2		
Radiator emissivity				
Radiator solar absorptivity				
Insulation emissivity				
Insulation solar absorptivity				
Solar Array temperature		degC		
Total heating power		W		
Thermal total mass		kg	Exclude subsystem margin	
Thermal Mass Margin		%		
Entry Vehicle Case:				
Max heat flux density constraint		W/m2		
Maximum front shield thickness		mm		
Maximum back shield thickness		mm		
Subsystem Power Budget				
Peak Transient Power Consumption		W	Typically the Subsystem Power budget is provided for the first iteration when there is no Unit/detailed information available. Preferably the Power information should be provided to the Power Specialist at Unit level (see below)	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Equipment Details:				
Unit 1				
Unit Name				
Number (of units)		number		
Mass (without margin)		kg	per unit	
Mass Margin to be applied		%	5%, 10% or 20%	
Design Status			Off The Shelf, Modified, New	
Dimension 1		mm	Length	
Dimension 2		mm	Width or Diameter	
Dimension 3		mm	Height	
Max. Operational T		deg C		
Min. Operational T		deg C		
Max. Non-Operational T		deg C		
Min. Non-Operational T		deg C		
Peak Transient Power Consumption		W	The power consumption on Unit level must take into account the number of units. Example: If there are 3 units, 2 working in parallel and 1 redundant, then the "Power on" must be the sum the 2 units on. If the one, which is redundant is on hot redundancy, then any power consumption must be added to the "Power on". The Duty Cycle is given with respect to the Mode duration.	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Mode 6 Power Consumption (on)		W		
Mode 6 Power Consumption (stby)		W		
Mode 6 Duty Cycle		%		
Mode 7 Power Consumption (on)		W		
Mode 7 Power Consumption (stby)		W		
Mode 7 Duty Cycle		%		
Data Volume		kbits	HouseKeeping	
Mounting Concept			description	
Supplier			Company (or project)	
Unit 2				
Unit 3				
Unit 4				
Unit 5				
Unit n				

Power Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
Solar cell technology				
Solar Array Total Area		m2		
Battery technology				
Cells per battery		#		
Battery capacity		Ah		
Bus Voltage		V		
Power S/S total mass		kg	Excludes Subsystem margin	
Power S/S mass margin		%		
Power Harness total mass		Kg		
Power Harness mass margin		%		
Overall Power Consumption			Includes Power Consumption from all diciplines	
MODE 1 total Power (on)		W		
MODE 2 total Power (on)		W		
MODE 3 total Power (on)		W		
MODE 4 total Power (on)		W		
MODE 5 total Power (on)		W		
Subsystem Power Budget				
Peak Transient Power Consumption		W	Typically the Subsystem Power budget is provided for the first iteration when there is no Unit/detailed information available.	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Equipment Details:				
Unit 1				
Unit Name				
Number (of units)		number		
Mass (without margin)		kg	per unit	
Mass Margin to be applied		%	5%, 10% or 20%	
Design Status			Off The Shelf, Modified, New	
Dimension 1		mm	Length	
Dimension 2		mm	Width or Diameter	
Dimension 3		mm	Height	
Max. Operational T		deg C		
Min. Operational T		deg C		
Max. Non-Operational T		deg C		
Min. Non-Operational T		deg C		
Peak Transient Power Consumption		W	The power consumption on Unit level must take into account the number of units. Example: If there are 3 units, 2 working in parallel and 1 redundant, then the "Power on" must be the sum the 2 units on. If the one, which is redundant is on hot redundancy, then any power consumption must be added to the "Power on". The Duty Cycle is given with respect to the Mode duration.	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Mode 6 Power Consumption (on)		W		
Mode 6 Power Consumption (stby)		W		
Mode 6 Duty Cycle		%		
Mode 7 Power Consumption (on)		W		
Mode 7 Power Consumption (stby)		W		
Mode 7 Duty Cycle		%		
Data Volume		kbits	HouseKeeping	
Mounting Concept			description	
Supplier			Company (or project)	
Unit 2				
Unit 3				
Unit 4				
Unit 5				
Unit n				

Instruments Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
Instruments total mass		kg	Excludes Subsystem margin	
Instruments mass margin		%		
Subsystem Power Budget				
Peak Transient Power Consumption		W	Typically the Subsystem Power budget is provided for the first iteration when there is no Unit/detailed information available. Preferably the Power information should be provided to the Power Specialist at Unit level (see below)	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Equipment Details:				
Unit 1				
Unit Name				
Number (of units)		number		
Mass (without margin)		kg	per unit	
Mass Margin to be applied		%	5%, 10% or 20%	
Design Status			Off The Shelf, Modified, New	
Dimension 1		mm	Length	
Dimension 2		mm	Width or Diameter	
Dimension 3		mm	Height	
Max. Operational T		deg C		
Min. Operational T		deg C		
Max. Non-Operational T		deg C		
Min. Non-Operational T		deg C		
Peak Transient Power Consumption		W	The power consumption on Unit level must take into account the number of units. Example: If there are 3 units, 2 working in parallel and 1 redundant, then the "Power on" must be the sum the 2 units on. If the one, which is redundant is on hot redundancy, then any power consumption must be added to the "Power on". The Duty Cycle is given with respect to the Mode duration.	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Mode 6 Power Consumption (on)		W		
Mode 6 Power Consumption (stby)		W		
Mode 6 Duty Cycle		%		
Mode 7 Power Consumption (on)		W		
Mode 7 Power Consumption (stby)		W		
Mode 7 Duty Cycle		%		
Data Volume		kbits	HouseKeeping	
Mounting Concept			description	
Supplier			Company (or project)	
Unit 2				
Unit 3				
Unit 4				
Unit 5				
Unit n				

Aerothermal Worksheet

Parameter	Manual Value	Units	Remarks	Comments
General Characteristics				
Total time of entry		s		
Terminal Velocity		m/s		
Landing Acceleration without thrusters		g		
Entry altitude		km		
Entry Velocity		m/s		
Entry Angle Nominal		degree		
Entry Angle used in Analysis		degree	Worst Case	
Parachute				
Main Chute Area		m2		
Drogue Chute Area		m2		
Heat Shield Geometry				
Cone Angle		deg		
Nose Radius		m		
Base Radius		m		
Corner Radius		m		
Heat Fluxes and Dynamic Pressures				
Maximum heat flux density		kW/m^2		
Maximum Dynamic Pressure		N/m^2		

Descent and Landing System Worksheet

Parameter	Value	Units	Remarks	Comments
General characteristics:				
Sub system Total Mass		kg	Excludes Sub system margin	
Sub system Mass Margin		%		
Redundancy level		description		
PARACHUTE DESIGN				
Nominal area of the pilot chute of drogue system		m^2		
Inflation time of the pilot chute of the drogue system		s		
Drag coefficient of the pilot chute of the drogue system				
Opening altitude of the drogue chute system		m		
Opening altitude of the drogue chute reserve system		m		
Nominal area of the drogue chute		m^2		
Stowed volume of the drogue chute		m^3		
Reefing ratio of the drogue chute		no unit		
Inflation time of the drogue system		s		
Drag coefficient of the drogue system		no unit		
Nominal area of the pilot chute of main system		m^2		
Inflation time of the pilot chute of the main system		s		
Drag coefficient of the pilot chute of the main system				
Opening altitude of the main chute system		m		
Opening altitude of the main chute reserve system		m		
Nominal area of the main chute		m^2		
Stowed volume of the main chute		m^3		
Reefing ratio of the main chute		no unit		
Inflation time of the main system		s		
Drag coefficient of the main system				
Terminal velocity of the parachute (nominal case)		m/s		
Terminal velocity of the parachute (reserve case)		m/s		
Nominal area of the pilot chute of drogue system reserve		m^2		
Nominal area of the drogue chute reserve		m^2		
Nominal area of the main chute reserve		m^2		
PROPULSION LANDING DESIGN				
Necessary Total Thrust in nominal case		N		
Necessary Total Thrust in backup case		N		
Burn time nominal case		s		
Burn time backup case		s		
Stowed volume of stabilizing balls		m^3		
Subsystem Power Budget				
Peak Transient Power Consumption		W	Typically the Subsystem Power budget is provided for the first iteration when there is no Unit detailed information available. Preferably the Power information should be provided to the Power Specialist at Unit level (see below)	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Equipment Details:				
Unit 1				
Unit Name				
Number (of units)		number		
Mass (without margin)		kg	per unit	
Mass Margin to be applied		%	5%, 10% or 20%	
Design Status			Off The Shelf, Modified, New	
Dimension 1		mm	Length	
Dimension 2		mm	Width or Diameter	
Dimension 3		mm	Height	
Max. Operational T		deg C		
Min. Operational T		deg C		
Max. Non-Operational T		deg C		
Min. Non-Operational T		deg C		
Peak Transient Power Consumption		W	The power consumption at Unit level must take into account the number of units. Example: If there are 3 units, 2 working in parallel and 1 redundant, then the "Power on" must be the sum the 2 units on. If the one, which is redundant is on hot redundancy, then any power consumption must be added. The Duty Cycle is given with respect to the Mode duration.	
Mode 1 Power Consumption (on)		W		
Mode 1 Power Consumption (stby)		W		
Mode 1 Duty Cycle		%		
Mode 2 Power Consumption (on)		W		
Mode 2 Power Consumption (stby)		W		
Mode 2 Duty Cycle		%		
Mode 3 Power Consumption (on)		W		
Mode 3 Power Consumption (stby)		W		
Mode 3 Duty Cycle		%		
Mode 4 Power Consumption (on)		W		
Mode 4 Power Consumption (stby)		W		
Mode 4 Duty Cycle		%		
Mode 5 Power Consumption (on)		W		
Mode 5 Power Consumption (stby)		W		
Mode 5 Duty Cycle		%		
Mode 6 Power Consumption (on)		W		
Mode 6 Power Consumption (stby)		W		
Mode 6 Duty Cycle		%		
Mode 7 Power Consumption (on)		W		
Mode 7 Power Consumption (stby)		W		
Mode 7 Duty Cycle		%		
Data Volume		kbits	Housekeeping	
Mounting Concept			description	
Supplier			Company (or project)	
Unit 2				
Unit 3				
Unit 4				
Unit 5				
Unit n				

Annex 4: The XML Document (first workshhet)

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Anex 5: The XSD document

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(Paccagnini) -->
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xmlns:xsd='http://www.w3.org/2001/XMLSchema'
xmlns='http://www.example.com/worksheet'
targetNamespace='http://www.example.com/worksheet'
elementFormDefault='qualified' >
<xsd:element name='worksheet'>
<xsd:complexType>
<xsd:sequence>
<xsd:element name='index' maxOccurs='unbounded'>
<xsd:complexType>
<xsd:sequence>
<xsd:element name='cellvalue' type='xsd:string'/>
<xsd:element name='posicion' type='xsd:string'/>
<xsd:element name='condicion' type='xsd:string'/>
<xsd:element name='sheet' type='xsd:string'/>
</xsd:sequence>
<xsd:attribute name='id' type='xsd:ID' use='required'/>
</xsd:complexType>
</xsd:element>
</xsd:sequence>
</xsd:complexType>
</xsd:element>
</xsd:schema>
```

Anex 6: The MDB docuement (first Worksheet)

CELLVALUE	CONDICION	INDEX	POSICION	SHEET
NULL	1	b1	b1	1
S/C Mission	1	b2	b2	1
NULL	1	b3	b3	1
Number	1	b4	b4	1
NULL	1	b5	b5	1
NULL	1	b6	b6	1
1	1	b7	b7	1
NULL	1	b8	b8	1
NULL	1	b9	b9	1
NULL	1	b10	b10	1
NULL	1	b11	b11	1
NULL	1	b12	b12	1
NULL	1	b13	b13	1
2	1	b14	b14	1
NULL	1	b15	b15	1
NULL	1	b16	b16	1
NULL	1	b17	b17	1
NULL	1	b18	b18	1
NULL	1	b19	b19	1
NULL	1	b20	b20	1
3	1	b21	b21	1
NULL	1	b22	b22	1
NULL	1	b23	b23	1
NULL	1	b24	b24	1
NULL	1	b25	b25	1
NULL	1	b26	b26	1
NULL	1	b27	b27	1
NULL	1	b28	b28	1
4	1	b29	b29	1
NULL	1	b30	b30	1
NULL	1	b31	b31	1
NULL	1	b32	b32	1
NULL	1	b33	b33	1
NULL	1	b34	b34	1
NULL	1	b35	b35	1
5	1	b36	b36	1
NULL	1	b37	b37	1
NULL	1	b38	b38	1
NULL	1	b39	b39	1
NULL	1	b40	b40	1
NULL	1	b41	b41	1
NULL	1	b42	b42	1
NULL	1	b43	b43	1
n	1	b44	b44	1
NULL	1	b45	b45	1
NULL	1	b46	b46	1
NULL	1	b47	b47	1

NULL	1	b1	c1	1
NULL	1	b2	c2	1
NULL	1	b3	c3	1
Mode Name	1	b4	c4	1
NULL	1	b5	c5	1
NULL	1	b6	c6	1
Launch Mode	1	b7	c7	1
NULL	1	b8	c8	1
NULL	1	b9	c9	1
NULL	1	b10	c10	1
NULL	1	b11	c11	1
NULL	1	b12	c12	1
NULL	1	b13	c13	1
Transfer mode	1	b14	c14	1
NULL	1	b15	c15	1
NULL	1	b16	c16	1
NULL	1	b17	c17	1
NULL	1	b18	c18	1
NULL	1	b19	c19	1
NULL	1	b20	c20	1
Initialisation	1	b21	c21	1
NULL	1	b22	c22	1
NULL	1	b23	c23	1
NULL	1	b24	c24	1
NULL	1	b25	c25	1
NULL	1	b26	c26	1
NULL	1	b27	c27	1
NULL	1	b28	c28	1
Operational	1	b29	c29	1
NULL	1	b30	c30	1
NULL	1	b31	c31	1
NULL	1	b32	c32	1
NULL	1	b33	c33	1
NULL	1	b34	c34	1
NULL	1	b35	c35	1
Safe Mode	1	b36	c36	1
NULL	1	b37	c37	1
NULL	1	b38	c38	1
NULL	1	b39	c39	1
NULL	1	b40	c40	1
NULL	1	b41	c41	1
NULL	1	b42	c42	1
NULL	1	b43	c43	1
-	1	b44	c44	1
NULL	1	b45	c45	1
NULL	1	b46	c46	1
NULL	1	b47	c47	1
NULL	1	b1	d1	1
NULL	1	b2	d2	1
NULL	1	b3	d3	1
Description	1	b4	d4	1

NULL	1	b5	d5	1
NULL	1	b6	d6	1
From lift-off	1	b7	d7	1
Battery fully	1	b8	d8	1
Payload	1	b9	d9	1
Power S/S	1	b10	d10	1
Comms S/S	1	b11	d11	1
NULL	1	b12	d12	1
NULL	1	b13	d13	1
From upper	1	b14	d14	1
Payload	1	b15	d15	1
AOCS	1	b16	d16	1
Solar Arrays	1	b17	d17	1
TT & C	1	b18	d18	1
NULL	1	b19	d19	1
NULL	1	b20	d20	1
From Halo	1	b21	d21	1
Mode entered	1	b22	d22	1
Detumbling	1	b23	d23	1
AOCS	1	b24	d24	1
Solar Arrays	1	b25	d25	1
Payload	1	b26	d26	1
NULL	1	b27	d27	1
NULL	1	b28	d28	1
Fine Pointing	1	b29	d29	1
Payload	1	b30	d30	1
S/C Sun	1	b31	d31	1
AOCS active	1	b32	d32	1
TT & C	1	b33	d33	1
NULL	1	b34	d34	1
NULL	1	b35	d35	1
Failure	1	b36	d36	1
S/C attitude	1	b37	d37	1
Payload	1	b38	d38	1
Failure	1	b39	d39	1
TT & C	1	b40	d40	1
TM/TC access	1	b41	d41	1
NULL	1	b42	d42	1
NULL	1	b43	d43	1
Description	1	b44	d44	1
NULL	1	b45	d45	1
NULL	1	b46	d46	1
NULL	1	b47	d47	1
NULL	2	b1	e1	1
NULL	2	b2	e2	1
NULL	2	b3	e3	1
Mode Duration	2	b4	e4	1
NULL	2	b5	e5	1
NULL	2	b6	e6	1
NULL	2	b7	e7	1
NULL	2	b8	e8	1

NULL	2	b9	e9	1
NULL	2	b10	e10	1
NULL	2	b11	e11	1
NULL	2	b12	e12	1
NULL	2	b13	e13	1
NULL	2	b14	e14	1
NULL	2	b15	e15	1
NULL	2	b16	e16	1
NULL	2	b17	e17	1
NULL	2	b18	e18	1
NULL	2	b19	e19	1
NULL	2	b20	e20	1
NULL	2	b21	e21	1
NULL	2	b22	e22	1
NULL	2	b23	e23	1
NULL	2	b24	e24	1
NULL	2	b25	e25	1
NULL	2	b26	e26	1
NULL	2	b27	e27	1
NULL	2	b28	e28	1
NULL	2	b29	e29	1
NULL	2	b30	e30	1
NULL	2	b31	e31	1
NULL	2	b32	e32	1
NULL	2	b33	e33	1
NULL	2	b34	e34	1
NULL	2	b35	e35	1
NULL	2	b36	e36	1
NULL	2	b37	e37	1
NULL	2	b38	e38	1
NULL	2	b39	e39	1
NULL	2	b40	e40	1
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NULL	2	b42	e42	1
NULL	2	b43	e43	1
NULL	2	b44	e44	1
NULL	2	b45	e45	1
NULL	2	b46	e46	1
NULL	2	b47	e47	1
NULL	1	b1	f1	1
NULL	1	b2	f2	1
NULL	1	b3	f3	1
Subsystem	1	b4	f4	1
NULL	1	b5	f5	1
AOCS	1	b6	f6	1
on	1	b7	f7	1
NULL	1	b8	f8	1
NULL	1	b9	f9	1
NULL	1	b10	f10	1
NULL	1	b11	f11	1
NULL	1	b12	f12	1

NULL	1	b13	f13	1
on	1	b14	f14	1
NULL	1	b15	f15	1
NULL	1	b16	f16	1
NULL	1	b17	f17	1
NULL	1	b18	f18	1
NULL	1	b19	f19	1
NULL	1	b20	f20	1
on	1	b21	f21	1
NULL	1	b22	f22	1
NULL	1	b23	f23	1
NULL	1	b24	f24	1
NULL	1	b25	f25	1
NULL	1	b26	f26	1
NULL	1	b27	f27	1
NULL	1	b28	f28	1
on	1	b29	f29	1
NULL	1	b30	f30	1
NULL	1	b31	f31	1
NULL	1	b32	f32	1
NULL	1	b33	f33	1
NULL	1	b34	f34	1
NULL	1	b35	f35	1
stand-by	1	b36	f36	1
NULL	1	b37	f37	1
NULL	1	b38	f38	1
NULL	1	b39	f39	1
NULL	1	b40	f40	1
NULL	1	b41	f41	1
NULL	1	b42	f42	1
NULL	1	b43	f43	1
stand-by	1	b44	f44	1
NULL	1	b45	f45	1
NULL	1	b46	f46	1
NULL	1	b47	f47	1
NULL	1	b1	g1	1
NULL	1	b2	g2	1
NULL	1	b3	g3	1
NULL	1	b4	g4	1
NULL	1	b5	g5	1
Comms	1	b6	g6	1
on	1	b7	g7	1
NULL	1	b8	g8	1
NULL	1	b9	g9	1
NULL	1	b10	g10	1
NULL	1	b11	g11	1
NULL	1	b12	g12	1
NULL	1	b13	g13	1
on	1	b14	g14	1
NULL	1	b15	g15	1
NULL	1	b16	g16	1

NULL	1	b17	g17	1
NULL	1	b18	g18	1
NULL	1	b19	g19	1
NULL	1	b20	g20	1
on	1	b21	g21	1
NULL	1	b22	g22	1
NULL	1	b23	g23	1
NULL	1	b24	g24	1
NULL	1	b25	g25	1
NULL	1	b26	g26	1
NULL	1	b27	g27	1
NULL	1	b28	g28	1
on	1	b29	g29	1
NULL	1	b30	g30	1
NULL	1	b31	g31	1
NULL	1	b32	g32	1
NULL	1	b33	g33	1
NULL	1	b34	g34	1
NULL	1	b35	g35	1
stand-by	1	b36	g36	1
NULL	1	b37	g37	1
NULL	1	b38	g38	1
NULL	1	b39	g39	1
NULL	1	b40	g40	1
NULL	1	b41	g41	1
NULL	1	b42	g42	1
NULL	1	b43	g43	1
stand-by	1	b44	g44	1
NULL	1	b45	g45	1
NULL	1	b46	g46	1
NULL	1	b47	g47	1
NULL	1	b1	h1	1
NULL	1	b2	h2	1
NULL	1	b3	h3	1
NULL	1	b4	h4	1
NULL	1	b5	h5	1
DHS	1	b6	h6	1
on	1	b7	h7	1
NULL	1	b8	h8	1
NULL	1	b9	h9	1
NULL	1	b10	h10	1
NULL	1	b11	h11	1
NULL	1	b12	h12	1
NULL	1	b13	h13	1
on	1	b14	h14	1
NULL	1	b15	h15	1
NULL	1	b16	h16	1
NULL	1	b17	h17	1
NULL	1	b18	h18	1
NULL	1	b19	h19	1
NULL	1	b20	h20	1

on	1	b21	h21	1
NULL	1	b22	h22	1
NULL	1	b23	h23	1
NULL	1	b24	h24	1
NULL	1	b25	h25	1
NULL	1	b26	h26	1
NULL	1	b27	h27	1
NULL	1	b28	h28	1
on	1	b29	h29	1
NULL	1	b30	h30	1
NULL	1	b31	h31	1
NULL	1	b32	h32	1
NULL	1	b33	h33	1
NULL	1	b34	h34	1
NULL	1	b35	h35	1
stand-by	1	b36	h36	1
NULL	1	b37	h37	1
NULL	1	b38	h38	1
NULL	1	b39	h39	1
NULL	1	b40	h40	1
NULL	1	b41	h41	1
NULL	1	b42	h42	1
NULL	1	b43	h43	1
stand-by	1	b44	h44	1
NULL	1	b45	h45	1
NULL	1	b46	h46	1
NULL	1	b47	h47	1
NULL	1	b1	i1	1
NULL	1	b2	i2	1
NULL	1	b3	i3	1
NULL	1	b4	i4	1
NULL	1	b5	i5	1
Heating	1	b6	i6	1
on	1	b7	i7	1
NULL	1	b8	i8	1
NULL	1	b9	i9	1
NULL	1	b10	i10	1
NULL	1	b11	i11	1
NULL	1	b12	i12	1
NULL	1	b13	i13	1
on	1	b14	i14	1
NULL	1	b15	i15	1
NULL	1	b16	i16	1
NULL	1	b17	i17	1
NULL	1	b18	i18	1
NULL	1	b19	i19	1
NULL	1	b20	i20	1
on	1	b21	i21	1
NULL	1	b22	i22	1
NULL	1	b23	i23	1
NULL	1	b24	i24	1

NULL	1	b25	i25	1
NULL	1	b26	i26	1
NULL	1	b27	i27	1
NULL	1	b28	i28	1
on	1	b29	i29	1
NULL	1	b30	i30	1
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NULL	1	b32	i32	1
NULL	1	b33	i33	1
NULL	1	b34	i34	1
NULL	1	b35	i35	1
stand-by	1	b36	i36	1
NULL	1	b37	i37	1
NULL	1	b38	i38	1
NULL	1	b39	i39	1
NULL	1	b40	i40	1
NULL	1	b41	i41	1
NULL	1	b42	i42	1
NULL	1	b43	i43	1
stand-by	1	b44	i44	1
NULL	1	b45	i45	1
NULL	1	b46	i46	1
NULL	1	b47	i47	1
NULL	1	b1	j1	1
NULL	1	b2	j2	1
NULL	1	b3	j3	1
NULL	1	b4	j4	1
NULL	1	b5	j5	1
Instruments	1	b6	j6	1
on	1	b7	j7	1
NULL	1	b8	j8	1
NULL	1	b9	j9	1
NULL	1	b10	j10	1
NULL	1	b11	j11	1
NULL	1	b12	j12	1
NULL	1	b13	j13	1
on	1	b14	j14	1
NULL	1	b15	j15	1
NULL	1	b16	j16	1
NULL	1	b17	j17	1
NULL	1	b18	j18	1
NULL	1	b19	j19	1
NULL	1	b20	j20	1
on	1	b21	j21	1
NULL	1	b22	j22	1
NULL	1	b23	j23	1
NULL	1	b24	j24	1
NULL	1	b25	j25	1
NULL	1	b26	j26	1
NULL	1	b27	j27	1
NULL	1	b28	j28	1

on	1	b29	j29	1
NULL	1	b30	j30	1
NULL	1	b31	j31	1
NULL	1	b32	j32	1
NULL	1	b33	j33	1
NULL	1	b34	j34	1
NULL	1	b35	j35	1
stand-by	1	b36	j36	1
NULL	1	b37	j37	1
NULL	1	b38	j38	1
NULL	1	b39	j39	1
NULL	1	b40	j40	1
NULL	1	b41	j41	1
NULL	1	b42	j42	1
NULL	1	b43	j43	1
stand-by	1	b44	j44	1
NULL	1	b45	j45	1
NULL	1	b46	j46	1
NULL	1	b47	j47	1