

APPENDIX 1: TEAMWORK SURVEY

1. Do you enjoy working in teams?
 - a. Yes _____
 - b. No _____
 - c. It depends/ Can't decide/ Don't know _____

2. For you, the **positive** aspects of teamwork are (you can select more than one):
 - a. You have less workload.
 - b. You learn this for your professional life
 - c. You can focus on only doing tasks you feel most capable in
 - d. You enjoy being a leader
 - e. You enjoy having another person be a leader
 - f. You can share costs
 - g. You feel the outcome is always better
 - h. You feel you can learn from the other team members
 - i. Another

3. For you, the **negative** reasons for teamwork are (you can select more than one):
 - a. You prefer to manage your own time
 - b. You have trouble finding the time to attend meetings
 - c. You don't like having to depend on other's work
 - d. You believe workloads always end up being uneven
 - e. You don't like others telling you what to do
 - f. You don't like telling others what to do
 - g. You feel it's less efficient and productive
 - h. You feel the outcome is worse.
 - i. Another

4. You prefer working in teams of...
 - a. 6 or more persons
 - b. 4 or 5 persons
 - c. 3 persons

- d. Pairs
 - e. I definitely rather work alone
5. With which of the following statements do you agree that improve teamwork?
(Select all with which you agree)
- a. Have an established leader
 - b. Divide work and give specific assignments to each team member
 - c. Have a well planned chronogram
 - d. Do periodic meetings of the whole team
 - e. Do periodic evaluations of the performance of the team members
 - f. Divide a large team in smaller sub-teams
 - g. Have team members that only do what the leader tells them to.

Technical data

- **Type of investigation:** Quantitative, non representative.
- **Date of Survey:**
 - 11th of November 2009: Students from Projects 1, 2, 3 and 4.
 - 13th of November 2009: Students from Projects 5, 6, 7 and 8.
- **Place of Survey:** Eafit University
- **Survey distribution:**
 - Total of Students surveyed: 151
 - Project 1: 17 students
 - Project 2: 20 students
 - Project 3: 17 students
 - Project 4: 23 students
 - Project 5: 11 students
 - Project 6: 13 students
 - Project 7: 22 students
 - Project 8: 28 students
- **Tables of results:**
 - Totals:

Question/ Answer	a.	b.	c.	d.	e.	f.	g.	h.
1	103	14	34					
2	60	72	35	41	3	66	51	105
3	34	24	58	40	18	17	10	2
4	2	59	66	17	7			
5	64	110	113	63	43	33	7	

- Totals in percentages:

Question/ Answer	a.	b.	c.	d.	e.	f.	g.	h.
1	68%	9%	23%					
2	41%	50%	24%	28%	2%	46%	35%	72%
3	37%	26%	63%	43%	20%	18%	11%	2%
4	1%	39%	44%	11%	5%			
5	42%	73%	75%	42%	28%	22%	5%	

APPENDIX 2: RESULTS OF PROJECT-8 2009-2

Week	Activity	Assignee	Comments	Conclusions
7: (August 21st to August 27th). Team Meeting on September 7	Excel matrix for the engine power and revolutions in different conditions (weight, angle)(with conclusions)	Student #1 Student #2	The team work was good. All the information was obtained from the student #4 The calculations were made but after the design and engine changes we must adjust the Excel Matrix. We are waiting for the 3D model for making the finite elements analysis.	Changes and corrections are missing.
	To define suppliers, market rates and specifications for the engine, steel cable, batteries and speed controller.	Student #3 Student #4	Did not attend the meeting. The design changed. The engine was chosen (price: \$150). The steel cable was eliminated. These items are still missing: batteries and speed controller. We have to purchase the engine as used because the supplier is not available.	The engine has not been purchased (8th week).
	State of art of similar products (automation kits), to define the user's anthropometric dimensions in the lever position, the handles diameter, the height (based in percentiles)	Student #5 Student #6	Did not attend the meeting. Did not attend the meeting. "State of the art" has not been presented. There is some information but it's still needed to organize and present conclusions.	"State of the art" is missing, and it is also necessary to organize and conclude the information
8: (August 27th to September 3rd). Team Meeting on September 7	Finite elements calculations of the chassis, using different profiles.	Student #1 Student #2	There's no 3D model. Student #3 and student #4 did not deliver it. They're still waiting.	The finite element analysis is missing.
	3D model finished with assembly and technical drawings.	Student #3 Student #4	Did not attend the meeting. The 3D model is incomplete and the technical drawings are missing. They had troubles with Pro E and everything was made last-minute.	The 3D model and technical drawings are not completed, the new delivery date is: Tuesday 8th.
	Standard parts board with specifications, manufacturing process list of all the parts.	Student #5	Did not attend the meeting.	

		Student #6	Did not attend to the meeting. The task changed due to a modification on the design. They were assigned (Thursday 8th week to the student #6) the task of looking for: technical specification of the chair's wheels. The previous task is now for the 10th week.	Is almost ready, but it needs to be organized in the format with conclusions. The "standard parts chart" delivery is in the 10th week.
9: Pre-Delivery Meeting (Team Meeting on September 14)	System losses calculations (with conclusions)	Student #1	Did not attend the meeting.	There is no progress this week. Still missing: finished calculations, finite element analysis and system losses
		Student #2	Did not attend to the meeting. The Excel corrections are incomplete. The finite elements analysis is still missing.	
	Produce animations that show the product working, renders, user relations.	Student #3	Did not attend the meeting. They have not bought the engine. They did not advance in the 3D model.	This is missing: engine purchase, 3D model and everything related to the 8th and 9th week.
		Student #4	They have not bought the engine. They did not advance in the 3D model.	
Generate Market rates chart of the product and prototype	Student #5	Student #6 needs more help with the work.	Need to complete: market rates and standard parts.	
	Student #6	There are some market rates, but still need to complete them. "State of the art" is finished. The standard parts board is missing.		
10: (Team Meeting on September 28)	Present the conclusions about the engineering calculations and simulations made. Support the results and show images/videos of the CAE analysis (ANSYS, Working Model, etc.) Justify the product and prototype's materials through the engineering	Student #1	All was finished for the 11th week. The delay cause was the 3D model.	
Student #2				

	calculations.			
	Have the 3D model finished. Assembly, subassembly and technical drawings. Product's animation and renders. User's relation renders. Purchase the engine.	Student #3 Student #4	It was finished by the 11th week. They generated a delay in the rest of the group. Two engines that met the required specifications were bought for a price of 120.000.	This is missing: animation and renders with the user.
	Finish the market rates board, define the manufacturing and assembly processes and complete the standard parts chart (for the product and prototype).	Student #5 Student #6	Did not attend to the meeting. All was finished for the 11th week. The delay cause was the 3D model.	
11: Delivery (2) (Team Meeting on September 28)	Tuesday 22nd: Organize the information following the evaluation format. Write conclusions and problems/difficulties found.	Student #1 Student #2	The whole group was working and finished very late the night before. The delivery was good.	Delivery complete but poor.
	Tuesday 22nd: Organize the information following the evaluation format. Write conclusions and problems/difficulties found.	Student #3 Student #4	Things needed to be completed with more time; everything was left for last-minute.	Delivery complete but poor.
	Tuesday 22nd: Organize the information following the evaluation format. Write conclusions and problems/difficulties found.	Student #5 Student #6	Did not attend the meeting. Some things were missing, but the delivery was generally complete.	Delivery complete but poor.

PROJECT 8 GUIDE

PRODUCT DESIGN ENGINEERING



ID0021

2010-1 (PLM)

Ricardo Mejía Gutiérrez

CODE

VALIDITY

COORDINATION

1. COURSE DELIVERABLES

- 1.1 DELIVERY No.1
 - 1.1.1 Brief
 - 1.1.2 Product Design Specifications
 - 1.1.3 Design Concept
- 1.2 DELIVERY No. 2
 - 1.2.1 3D product modeling
 - 1.2.2 Product Manufacturing Drawings
 - 1.2.3 Engineering Report
 - 1.2.4 Product / prototype Cost Chart
 - 1.2.5 PDS Validation
- 1.3 DELIVERY No. 3
 - 1.3.1 Functional model of the product suitable for testing
 - 1.3.2 Product Test Plan
- 1.4 DELIVERY No.4
 - 1.4.1 Prototype- Functional Model
 - 1.4.2 Exhibition Stand
 - 1.4.3 Test results
- 1.5 EXECUTION CONTROLS
 - 1.5.1 Meeting Manager
 - 1.5.2 Project Activity Completion Form

APPENDICES

Appendix 1 – ARAS Innovator PLM Evaluation Format

3. Course Deliverables

This section of the guide contains a detailed description of the content of each one of the deliveries in the design project.

Course Chronogram Validity: 2010-1

	DESCRIPTION	%	DATE
W1	Course presentation		Extraordinary Meeting
W2 - W4	Presentation and Delivery No.1 – Design Concept - Brief - Product Design Specifications - Design Concept (Poster)	15	Control: Week 3 Delivery: Week 4
S5 - S11	Presentation and Delivery No.2 – Detailed Design - Engineering Report - Complete CAD Model - Technical Drawings - Prototype/ Product Table of Costs	30	Control: Week 9 Delivery: Week 11
S12 - S15	Presentation and Delivery No.3 – Functional Model Ready for Testing - Functional Model Ready for Testing - Product testing plan (technical and user tests)	15	Control: Week 13 Delivery: Week 15
S16 - S17	Tests - Product Tests (technical and user tests) - Normalized testing circuit	30	Delivery: Week 17
S18	Final public product launch - Prototype - Exhibition stand - Test results and analysis		Delivery: Week 18

Execution Controls (Advance control + Meeting logs)	10
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Delivery- Project phase	Week
Delivery No.1- Design Requirement and Conceptualization Phases	4
Delivery No.2- Detailed Design Phase	11
Delivery No.3- Construction and Launch Phase	15
Delivery No.4- Construction and Launch Phase	18

1.1. DELIVERY No.1

The design concept of a product is the description, through the use of graphics systems, technology, functional principles and form, of the product. This description allows determining the manner in which the product will meet the needs of the customer / end user of the same and it's usually accompanied by a set of specifications, a comparison with competing products and an economic viability study for the project. In the case of Project-8, the latter item is replaced by an estimate of the costs of product development.

1.1.1 Brief

Based on the general objectives for the project and considering the results of the exploration phase, each team should synthesize all the information gathered in a design brief. The document to be handed in should contain the following items:

- Brief description of the problem in terms of priority needs and desires of the market
- Value proposition of the design concept and opportunity to exploit
- Justification of the value proposition from the benchmarking and review of the state of the art
- Challenges and critical issues to consider in developing the design project
- Identify and describe potential project stakeholders
- Project Deadline

1. 1.2 Product Design Specifications

The design specification should consider all the requirements that the product must meet (using the taxonomy of Pugh) and it shall:

- Distinguish clearly demands and desires, as well as their relative importance (the specifications should be presented in hierarchical order from most to least important requirements).
- Specify the source of requirements expressed in the specification, for example, the client, design team, the end user, and so on.
- Attach the research and analysis services that support the specification (interviews, analysis of competitors or similar products, etc..)

The format of the specification will be proposed in the book by Ulrich & Eppinger, "Product Design and Development."

N	Project Tree	Predecessor or	Plan Hours	Attach Required	Attach Type	Lead Role	Required
Design Requirements Phase							
Market Study							
1	Context analysis					Marketing	
2	Consumer analysis					Marketing	
Benchmarking							
3	Competition analysis					Design	
4	Substitute products research					Design	
Report							
5	Brief	1,2,3,4				Marketing	
6	Brief Delivery	5		yes	Document	Marketing	yes
Gather requirements							
7	Interviews	5				Marketing	

8	Focus groups	5					Marketing	
9	Results report	7,8					Marketing	
10	Client Requirements delivery	9			yes	Document	Marketing	yes
Design requirements								
11	Requirements interpretation	10					Engineering	
12	Prioritize and identify requirements	11					Engineering	
13	Relative importance	12					Engineering	
14	Results	13					Engineering	
15	PDS delivery	14			yes	Document	Engineering	yes
Formal synthesis								
16	Mood boards	10					Design	
17	Reference selection	16					Design	
18	Visual alphabet	17					Design	
19	Formal Synthesis Delivery	18			yes	Document	Design	yes
Functional synthesis								
20	Black box analysis	10					Engineering	
21	Functional structure	20					Engineering	
22	Function tree	20					Engineering	
23	Concept architecture	21					Engineering	
24	Technical standards research	20					Engineering	
25	Physics calculations	20					Engineering	
26	Functional Synthesis Delivery	25			yes	Document	Engineering	yes

1.1.3. Design Concept

As mentioned earlier, a design concept is a description of form, function and features of a product. In this vein each team should submit the following:

- **Main design alternatives considered:** At least one should be done by each member of the team. The quality of the presentation of this alternative should be congruent with the skills expected for a student of eighth semester in Product Design Engineering.
- **Functional description of the concept:** graphic systems (diagrams, sketches, etc..) Illustrate a clear and adequate operation of the product and the technology required for it.

The selected design concept **should be presented in a professional manner on a poster.**
The team should be aware that this concept will be that developed throughout the semester.

N	Project Tree	Predecessor or	Plan Duration	Plan Hours	Attach Required	Attach Type	Lead Role	Required
Conceptualization Phase								
Internal development								
1	Morphological matrix						Engineering	
2	Internal development report	1					Engineering	
External development								
3	Creative sessions						Design	
4	External development report	3					Design	
Concept generation								
5	Concept development proposal	2,4					Design	
6	Concept generation delivery	5			yes	Document	Design	yes
Concept selection								
7	Pugh matrix	6					Marketing	
8	Concepts delivery	7			yes	Document	Marketing	yes
Concept evaluation								
9	Selection matrix	8					Engineering	
10	Delivery 1 Report and presentation	9					Engineering	
11	Chosen concept delivery	10			yes	Document	Engineering	yes
12	DELIVERY No.1	11			yes	Document	Engineering	yes
Concept testing								
13	Mock-up / soft model	11					Production	
14	Results report	11					Production	

1.2. DELIVERY No.2

The detailed design of the product includes the complete specification of the geometry, material and tolerances of all parts that are unique to the product, and identification of all standard parts to be purchased. The result of this phase is the product control documentation, that is, CAD drawings and models which describe the geometry of the pieces, the specifications of standard parts and assembly process.

1.2.1. CAD 3D Modeling:

The team must submit a complete 3D product modeling for the concept using a CAD / CAE software such as ProEngineer or Solidworks.

Assemblies and subassemblies must be modeled in detail , as well as all components of the product. It must be done on the basis of a construction tree (Model tree) and reflecting the appropriate hierarchy of components with sub-assemblies (for the BOM). Avoid interference between the different components of the product and for this it's advisable to model under the Top-Down Strategy Design and parameterization. The model must accurately represent the design intent for which it's indispensable to do a rendering of the model and present the proposed color for the product.

1.2.2. Product Manufacturing Drawings:

Each team must submit all the plans necessary to manufacture the product. This includes:

- Drawing of assembly and sub-assembly with component lists and references
In the case of manufactured components, show in the BOM table the number of the technical drawings and for standard components, attach reference number and supplier.
- Manufacturing drawings with information on materials, dimensions and geometrical characteristics of each component.
Identify dimensional and geometrical tolerances (duly justified), consistent and in accordance with the selected manufacturing process. The sizing of the pieces must consider the capabilities and processes and everything derived from the production of different components. For standard components attach catalog and provider information.

These drawings should clearly represent the piece and must show different views, isometrics, design and the whole set of benchmarks that allow a third party to perform the manufacture of the part, without the need to "assume" information or to ask the designer.

NOTE: The technical drawings must be submitted before entering the workshop. Those responsible for the workshops can keep out students who do not have the plans of the pieces to be manufactured with them.

1.2.3. Engineering Report:

The team shall submit an engineering report with the following contents:

- Calculation report presenting in an orderly manner the calculations or simulations that support engineering product design and their conclusions. It is essential to include in different sub-sections, structural analysis, thermal, dynamic, electrical, electronic, etc. of the various sub-systems of the product. Each of the different design decisions must be justified by a numerical analysis and / or experimental (well documented) with high engineering rigor.

NOTE: The most important thing is the conclusions of each analysis.

- List of product manufacturing processes: A table in which production processes for each part of the product are described
You must complete a table in which production processes are broken down for each part of the product and the standard components are reported. Establish manufacturing variables and parameters, estimated

times, and resources necessary for each of the processes. Specify what are the considerations or assumptions taken into account for the performance of the prototype, and the implications for them in the mass production of the final product.

- List of prototype manufacturing processes: A table in which production processes for each part of the prototype are described and the standard components are reported. Detail the considerations that allowed mass production of the product and determine the scale economies that may occur. Consider volume discounts and / or the implications of waste materials. Assess feasibility of manufacturing and draw conclusions.

1.2.4. Product / prototype Cost Chart:

The team will include two cost tables as follows: one for the product and another for the prototype. Both tables must show all the different components that make up the total cost (raw material, labor, etc.), where each of the items must be adequately justified. You must add documents (quotes, estimates, invoices, etc.) corroborating the estimate of the cost for each of the items.

A concluding section must be issued which refers to what was established in the PDS and the cost implications, both the prototype and product, on the viability of development. The identification of improvements is key to the industrialization of the design.

1.2.5 PDS Validation

The team should include a section of refining / validation of the PDS which demonstrate the values obtained by calculation, testing or validation of the market (justified) according to the criteria set out in the PDS. Validate importance, confirming the D / d, to demonstrate compliance with the metric and, if any, justify the proposed modifications to the PDS (previously authorized by the customer or teachers).

N	Project Tree	Predecessor or	Plan Duration	Plan Hours	Attach Required	Attach Type	Lead Role	Required
Detailed Design Phase								
3D Modeling								
1	CAD model						Design	yes
2	Technical drawings	1				Document	Design	yes
3	3D Modeling Delivery	2			yes	Document	Design	yes
Production process design								
4	Assembly card					Document	Production	
5	Tooling selection					Document	Production	
7	Manufacturing Montage	5				Document	Production	
6	Market rates	4				Document	Production	
8	Production Plan Delivery	6			yes	Document	Production	yes
Engineering calculations								
9	Component selection						Engineering	
10	Eng. Calculations Delivery	9			yes	Document	Engineering	yes
Validation								
11	Finite Element Analysis	1					Engineering	
12	Mechanical Simulation	1					Engineering	
13	Validation Delivery	11,12			yes	Document	Engineering	yes
14	DELIVERY No. 2	3,8,10,13			yes	Document	Engineering	yes

1.3. DELIVERY No.3

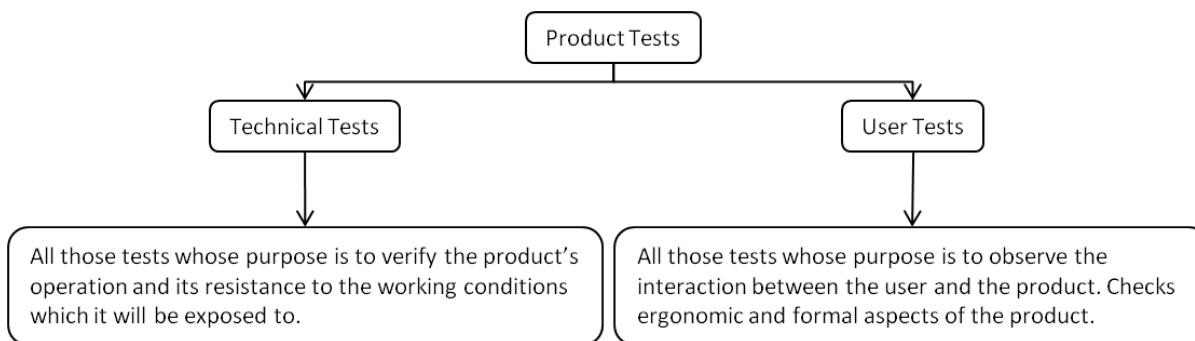
1.3.1. Functional model of the product suitable for testing.

The functional model suitable for testing has the following characteristics:

- Faithfully represents the concept defined in the detailed design.
- It's fully functional
- It's built using materials that, although at a certain percentage may not be those originally proposed in the design, resist the mechanical stresses of normal product use.
- The level of finish is suitable for presentation to users and customers for validation.

1.3.2. Product Test Plan:

The design group must do the two types of test presented in the following figure:



The product test plan is the collection of all test protocols that the team developed for the product performance evaluation.

1.4. DELIVERY No.4

1.4.1. Prototype- Functional Model:

It's the central element of the project delivery and must meet the following requirements:

- Must coincide precisely with the dimensions, assemblages and construction details presented in the technical drawings.
- Must be complete and present the proposed finishing in the design.
- The materials used withstand the mechanical forces of the normal functioning and operation of the product.
- Moving parts and controls are functional.
- The connections to energy sources, electrical cables, hoses and others are not in sight or are added with tape or tied in a crude manner the rest of the apparatus.
- The prototype should be delivered with its own packaging (if applicable) and manual. The manual is a document that describes and summarizes the requirements and criteria necessary for the care, handling and maintenance of the developed product. To facilitate reading and understanding the document should emphasize on information of a graphic nature.

1.4.2. Exhibition Stand:

At the end of the semester each team will perform the product launch. This launch will take place on the final delivery date so the stand must be designed so the product display is successful and attracts the most customers as possible. The evaluation of the stand will include not only formal aspects of the same but the rationalization of

space and relevance of information provided in it to visitors. The exhibition stand is to be thought of not only as the launch pad of the product but as an opportunity to attract investors for a later stage of project development. An important aspect to highlight is that the stand cannot obscure but enhance the product, the focus of delivery should be located on the product and not on distracting or irrelevant elements of the stand themselves.

1.4.3. Test results:

They must be submitted in the form of technical report using the format of articles published in the EAFIT University journal and must report the results of technical and user tests practiced on the functional model. The extension of the report should not exceed twenty (20) pages and must include at least the following:

- Introduction
- Objectives of testing
- Methodology (attaching the photographic record of assemblies, group sessions)
- Results
- Analysis and conclusions

For more information about the contents of the report we suggest reading the chapter "Communications in Engineering" of "The engineering design process" of Ertas & Jones available in the University Library.

N	Project Tree	Predecessor or	Plan Duration	Plan Hours	Attach Required	Attach Type	Lead Role	Required
Construction and launch								
Functional model								
1	Purchase materials						Production	
2	Manufacture parts	1					Production	
3	Assemble parts	2					Production	
4	Painting and finishes	2					Production	
5	Construction report	1,2,3,4					Production	
6	DELIVERY No.3 Functional model	5			yes	Document	Production	yes
Testing								
7	User test plans						Engineering	
8	Technical test plans						Engineering	
9	User tests	7					Engineering	
10	Technical tests	8					Engineering	
11	Testing report	10,9					Engineering	
12	Testing Delivery	11			yes	Document	Engineering	yes
Launch								
13	Presentation stand design						Design	
14	Graphic image design	13					Design	
15	Posters and info-graphics	14,13					Design	
16	Presentation stand construction	15					Production	
17	Eafit presentation	13,14,15,16					Design	
18	DELIVERY No.4 Launch	17			yes	Document	Design	yes

1.5. EXECUTION CONTROLS

1.5.1. Meeting Manager

The team will compile a report (Meeting Manager on Aras Innovator) of each of the counseling sessions you have with teachers throughout the semester. In those meeting reports there should be expressed the highlights of each session, tasks, commitments and person responsible for them for the following week.

The screenshot shows the Meeting Manager web application. The browser window title is "Meeting - 975D85CCD69142C6A92EABAE982885ED - Microsoft Internet Explorer". The application interface includes a menu bar (File, Edit, Views, Search, Actions, Reports, Tools, Help) and a toolbar. The main content area has a "Meeting" section with the following fields:

- Meeting Number: Server Assigned
- Meeting Date: [Empty]
- State: [Empty]
- Meeting Leader: [Empty]
- Description: [Empty]
- Meeting Notes: [Empty]

Below the main content area, there is a "Participants" tab and an "Action Items" section. The "Participants" section shows a table with the following columns: Name, Attended, and Notes.

1.5.2. Project Activity Completion Form

All activities that the team chooses to complete will require filling out an Activity Completion Form, stating the date the activity was started, finished, the actual time taken to complete it and the person(s) involved in its completion. Extra information provided in the "notes" section will also be regarded in the execution control evaluation.

The screenshot shows the Activity Completion Form web application. The browser window title is "Activity Completion Form - Diálogo Web". The form includes the following fields:

- Project Number: 1319
- Name: Design requirements
- Project Manager: Ricardo Mejia
- Activity Name: Delivery
- Leader: Andrés Aristizabal
- Work Estimate: [Empty]
- Actual Start Date: [Empty]
- Deliverable Type: Document
- Deliverable Required:
- Due Date: 1/14/2010
- Percent Complete: 0

Below the form, there is a "Time Record" tab and a table with the following columns: Who, Date From, Date To, Hours, and Notes.

Appendix 1 – Aras Innovator PLM Evaluation Format

Group: _____						
CRITERIA	GRADE					
	5	4	3	2	1	0
1. Learning activities(15%)						
1.1. Attendance, punctuality and preparation at training sessions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1.2. Interest shown in learning and using the software.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Work planning(20%)						
2.1. Projects were created for all phases of the course using and/or adapting the existing templates.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.2. The project planning counted with the participation of all members of the team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.3. Presents a well planned chronogram assigning dates, deliverables and assignees.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Fulfillment of the Work Plan (30%)						
3.1. Planned activities were fulfilled with punctuality.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.2. Documents, parts and deliverables were uploaded with punctuality and with all required information.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3. Information required on all activity completion forms is provided.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.4. The CAD model loaded presents a clear modeling tree, thumbnails and parts are all properly associated to assemblies and sub-assemblies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.5. Members have all participated equally in the project fulfillment and use of the software.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Meeting manager (15%)						
2.1. Meeting logs were created for every weekly meeting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.2. Meeting logs are properly filled out, taking into account the issues discussed at the meeting, participants, attendees and assignments.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Order and Presentation (20%)						
5.1. The projects, meetings, parts and documents present a proper numbering and nomenclature.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.2. The filled forms present all the required information.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.3. There's clarity and order in the documents and parts loaded to the system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.4. Finding desired files is easy and browsing them is simple.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Total Grade: _____						

Product Lifecycle Management (PLM)

Engineering School
–EAFIT University–



Contents

1. Introduction
2. Lifecycle Management
3. CAD Model management
4. PLM Software .
5. Conclusions

Justification

- The engineering department seeks:
 - The implementation of PLM tools for the development of projects.
 - To impact :
 - National productive sector
 - The engineering curriculum



What is PLM?

- Product Lifecycle Management

(Administración del ciclo de vida de un producto)

- It's a **strategy** that governs the set of People, Processes, Tools and Information throughout the **product life cycle**.

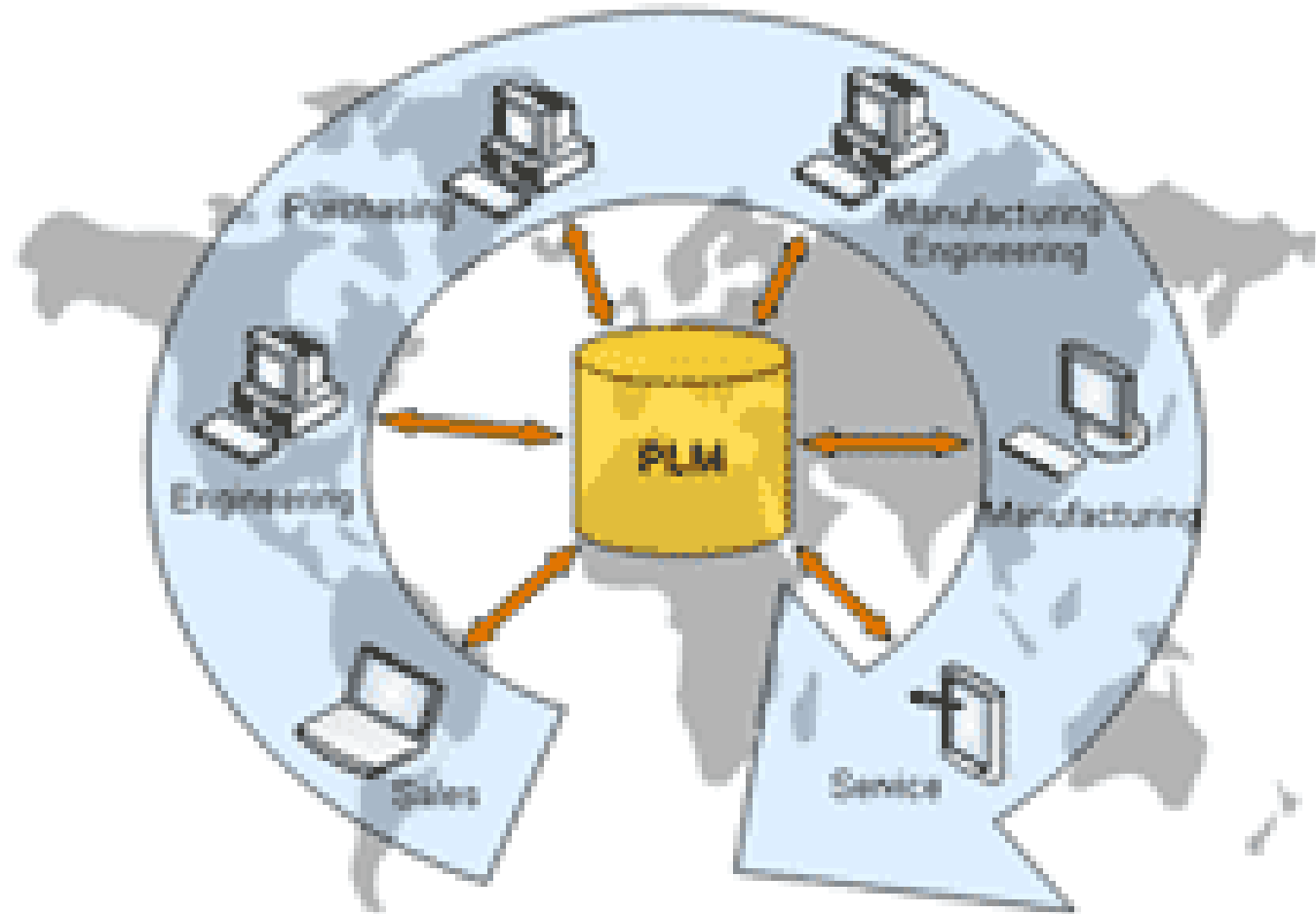
What is PLM?

People

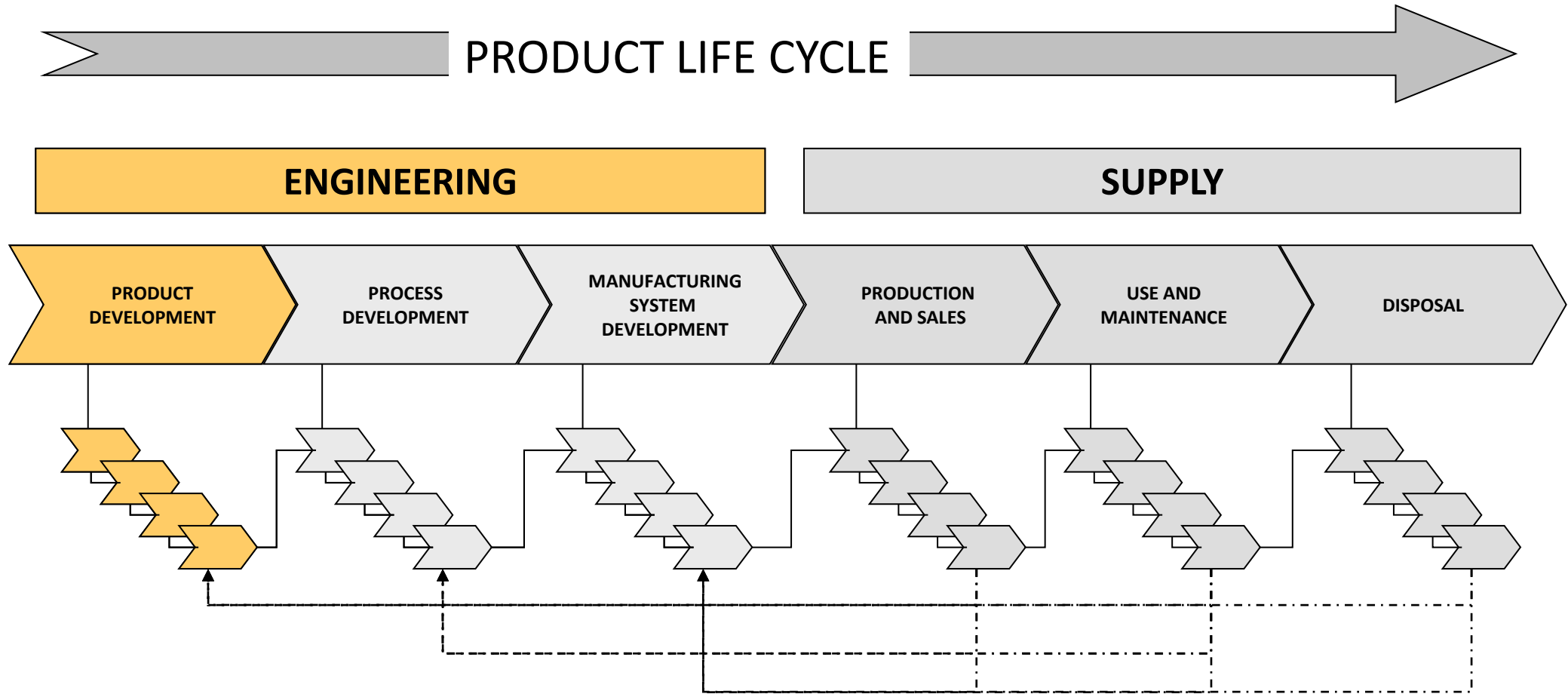
Processes

Tools

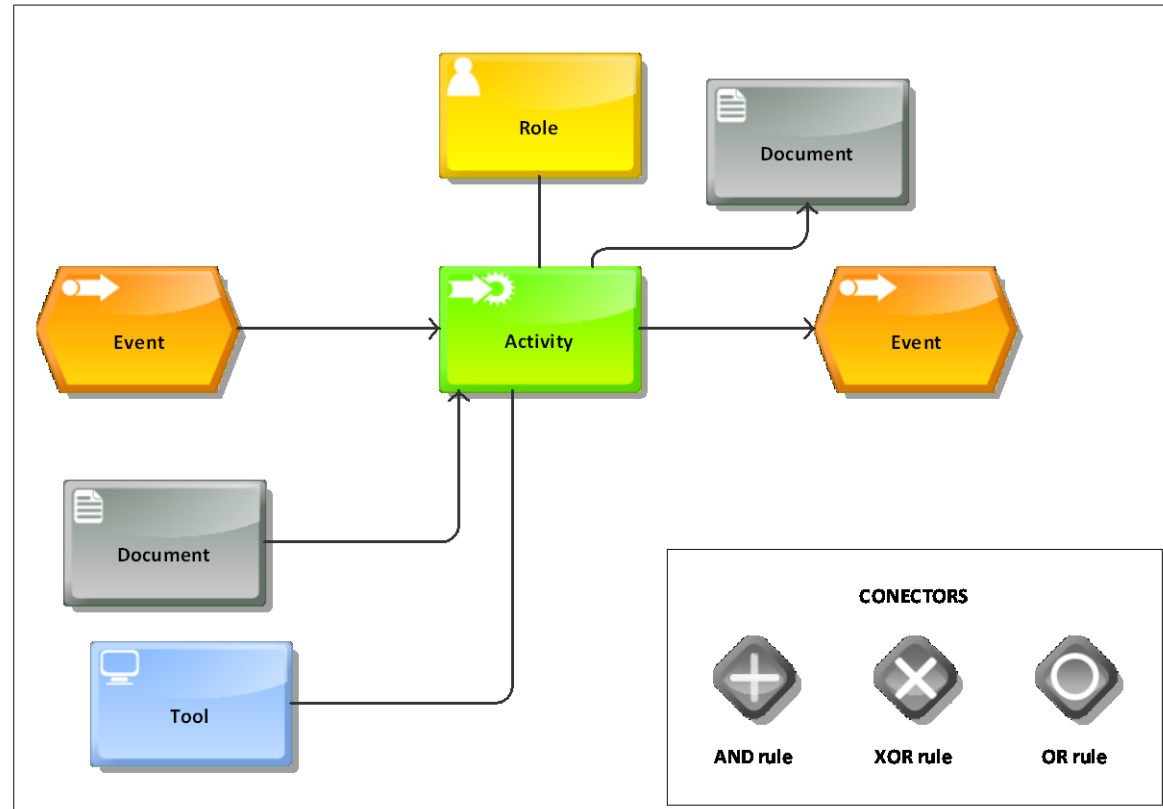
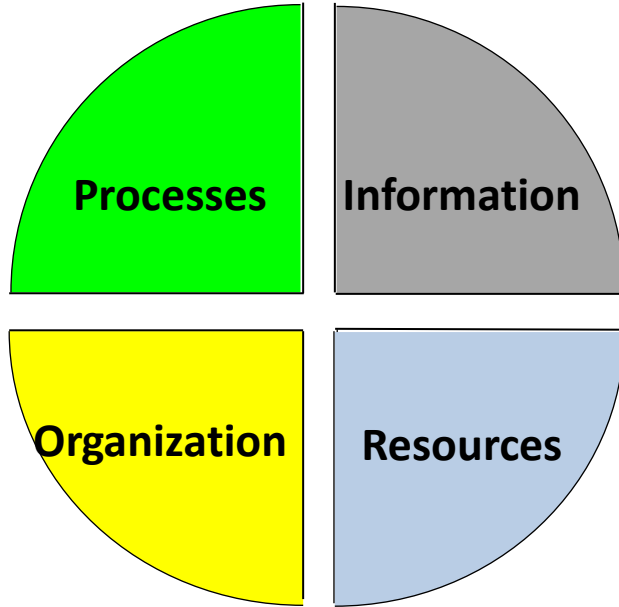
Information



Product Lifecycle



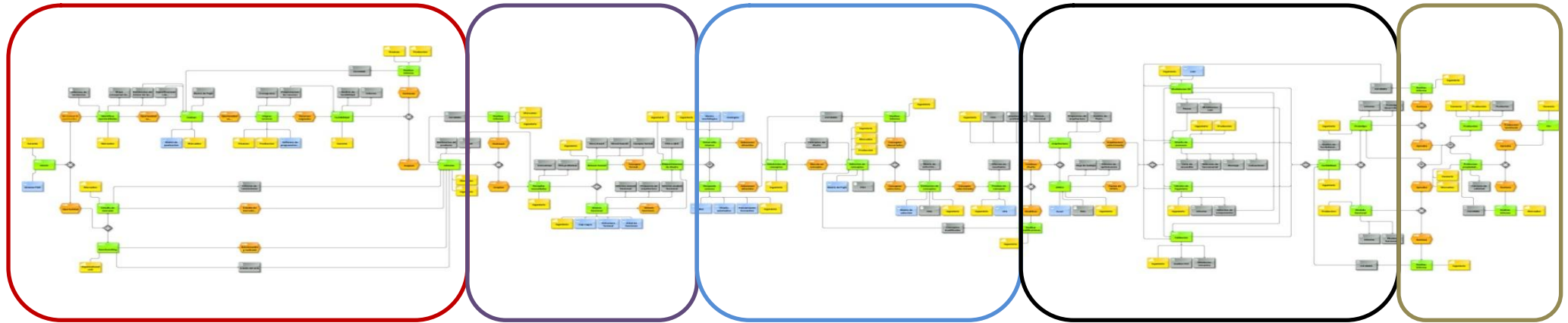
Business Process Modeling



IDP-EAFIT Process

REQUIREMENTS

DETAILED DESIGN



IDENTIFICATION OF OPPORTUNITIES

CONCEPT GENERATION

TESTS AND LAUNCH



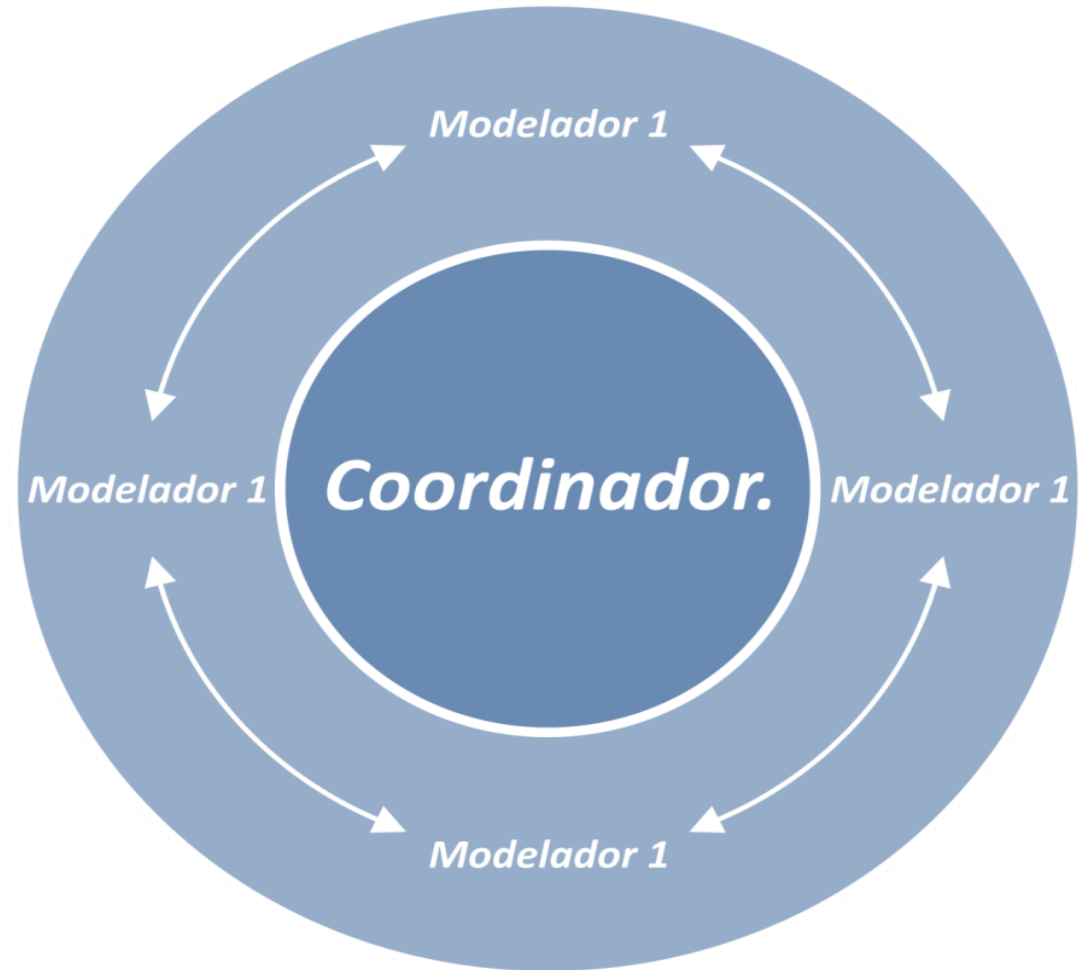
Problems linked to teamwork on CAD models:

- Communication errors.
- Lack of leadership.
- Misinterpretation of ideas.
- Disorder.
- Repetition of parts.
- Poor regeneration.
- Copies of references.
- Delays related to the dependency between the participants.
- Outdated models.

CAD Management

Work Scheme:

With regard to the projects developed during PRODUCT DESIGN ENGINEERING, where teams with 4 to 12 people are commonly found working towards the same objective, the following work scheme is developed:







CAD Management

For the development of 3D assembly is important to consider the following tools:



- Creation of template parts.
- CAD configuration.
- Drawing configurations.
- Use of formats.
- Generation of Skeleton part.
- Copy of geometries.
- Sub-assembly distribution and component assignment.
- Copy of enclosure.

PLM Systems

Provider	Business Type	Products
	<ul style="list-style-type: none"> ▪ Small-Medium 	<ul style="list-style-type: none"> ▪ Aras Innovator
	<ul style="list-style-type: none"> ▪ Small-Medium ▪ Medium-Large 	<ul style="list-style-type: none"> ▪ Enovia SmarTeam ▪ Enovia MatrixOne
	<ul style="list-style-type: none"> ▪ Small-Medium ▪ Medium-Large 	<ul style="list-style-type: none"> ▪ Windchill On-Demand ▪ Windchill
<p>Siemens PLM Software</p> 	<ul style="list-style-type: none"> ▪ Small-Medium ▪ Medium-Large 	<ul style="list-style-type: none"> ▪ Teamcenter Express ▪ Teamcenter

PLM Implementation



Conclusions

- The use of PLM at an educational level in EAFIT will allow projects to be developed with greater control, planning, efficiency and innovation in less time and at lower cost.
- Additionally PLM is expected to facilitate the collaborative work with other national and foreign universities.
- The formal implementation must be gradual and starting with the last semester while redefining some courses that will prepare engineering students to this new way of working.

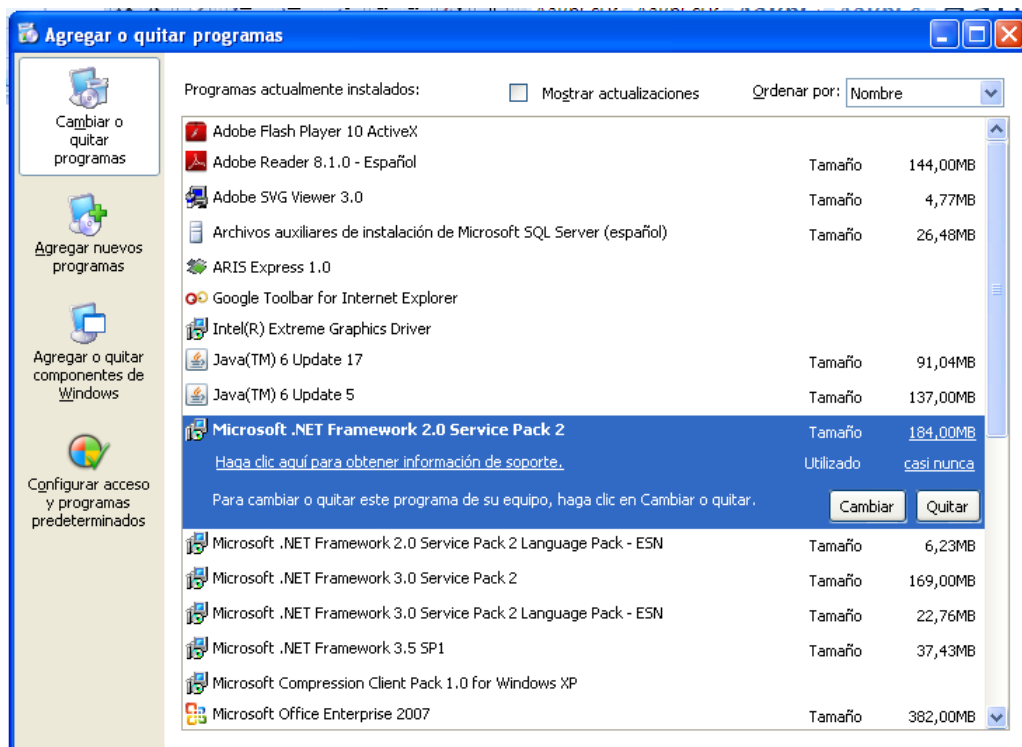
APPENDIX 5: GUIDE FOR ENNABLING ARAS INNOVATOR USE

Content

1. Previous requirements
2. Step by step enabling process
3. Troubleshooting

1. Previous Requirements

- a. Microsoft Internet Explorer 6.0 or superior.
- b. Microsoft .NET Framework 2.0 or superior. (To check if you have it installed go to Start> Control Panel> Add or Remove Programs> Change or Remove Programs).



If there is no Microsoft .NET Framework 2.0 or higher you can download the following address (Follow the instructions for downloading from the Microsoft website): <http://www.microsoft.com/downloads/details.aspx?displaylang=es&FamilyID=0856eacb-4362-4b0d-8edd-aab15c5e04f5>.

- c. Mozilla Firefox and Google Chrome: Innovator can only be accessed with Internet Explorer, but plug-ins can be downloaded and installed for the browsers Mozilla Firefox and Google Chrome to run Innovator with the Internet Explorer browser engine. Additionally, using these browsers makes Innovator faster and more stable.

To install the Firefox plug-in, go to:

<https://addons.mozilla.org/en-US/firefox/addon/10909>

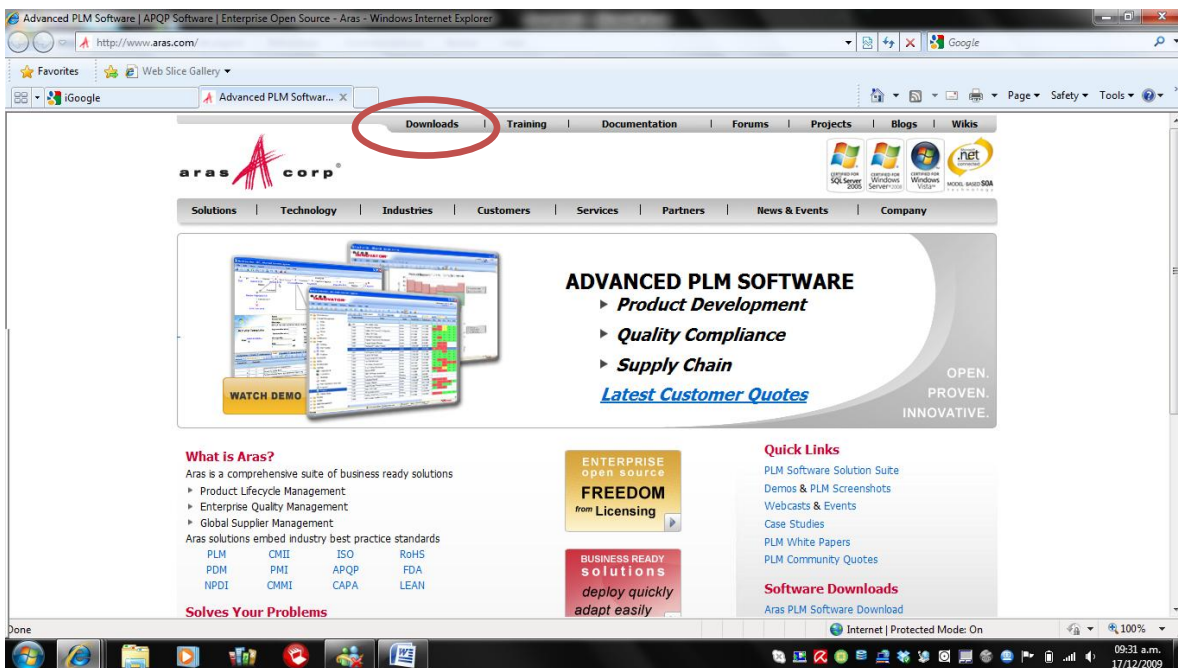
To install the Google Chrome extension, go to:

<https://chrome.google.com/extensions/detail/hehijbfgiekmjfkfjpbkbammjbdnadd>

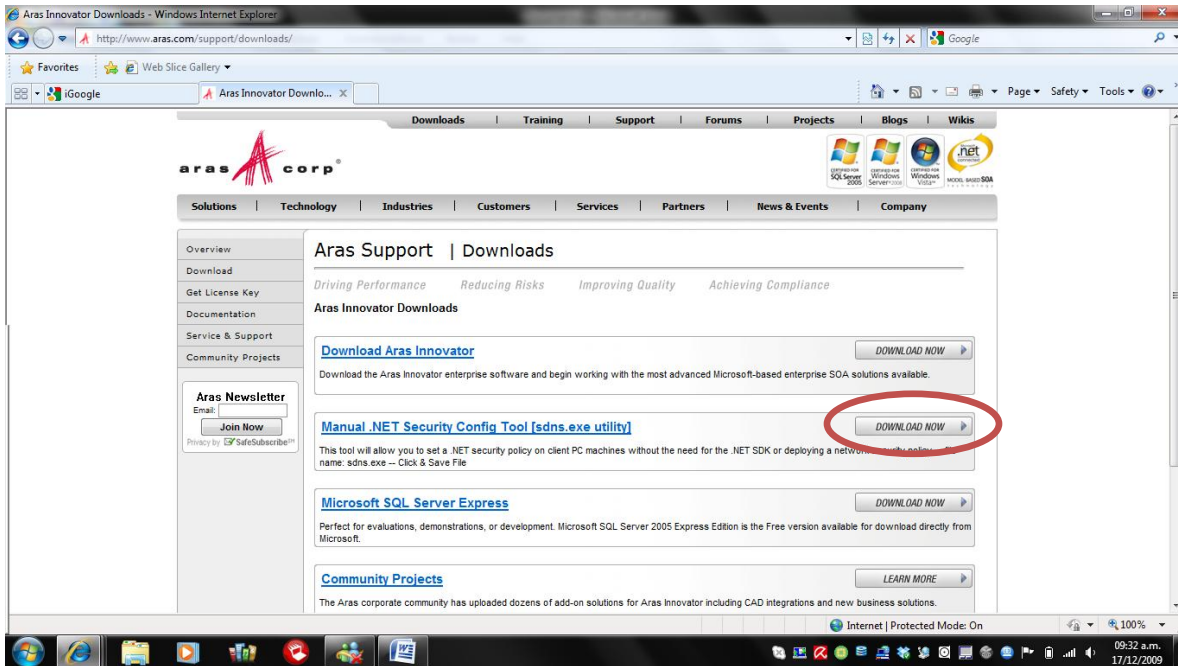
Once installed, go to the direction bar, right click, customize. Search for the Internet explorer icon and select it. This icon will now appear beside your address bar. Every time you wish to log-in to Aras Innovator using these browsers, click on this icon first.

2. Step by step enabling process

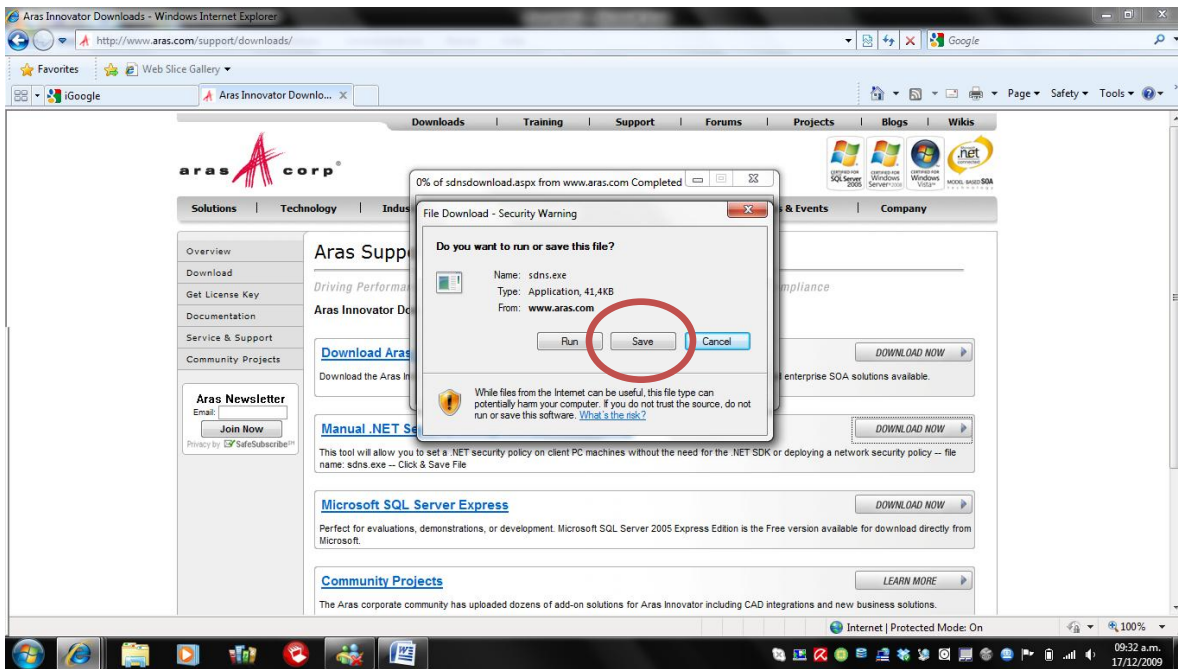
1. Enter the ARAS website through **www.aras.com** address.
2. Select the **Downloads** option.

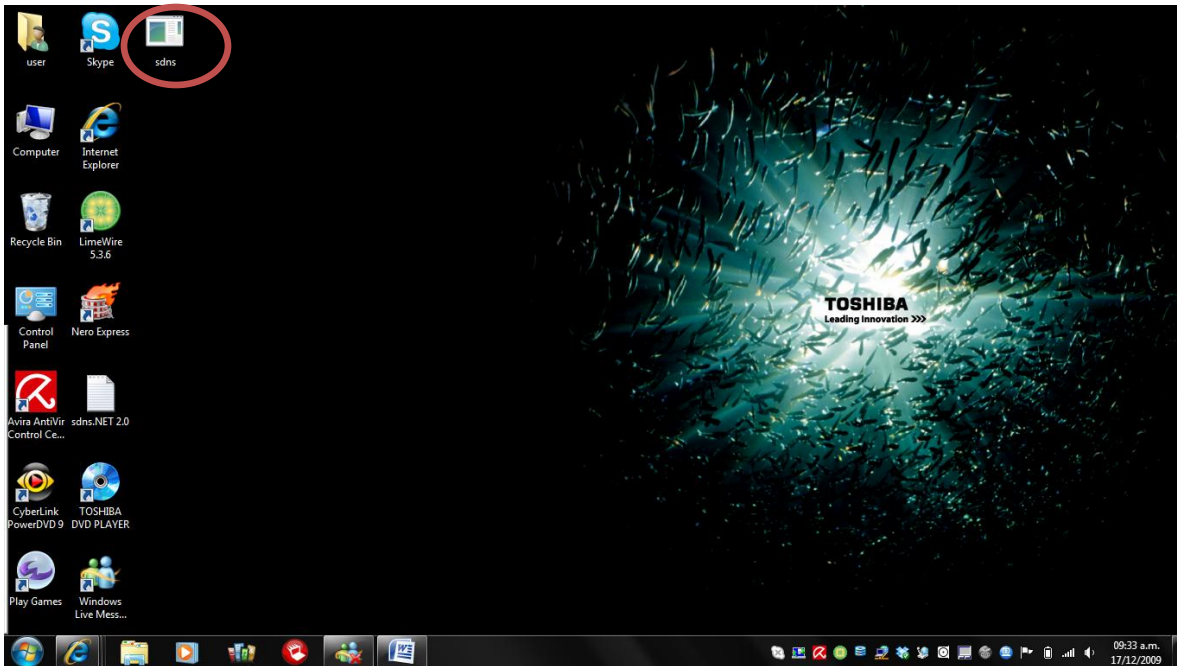


3. Click on "download now", in the option "Manual.Net Security Config Tool".

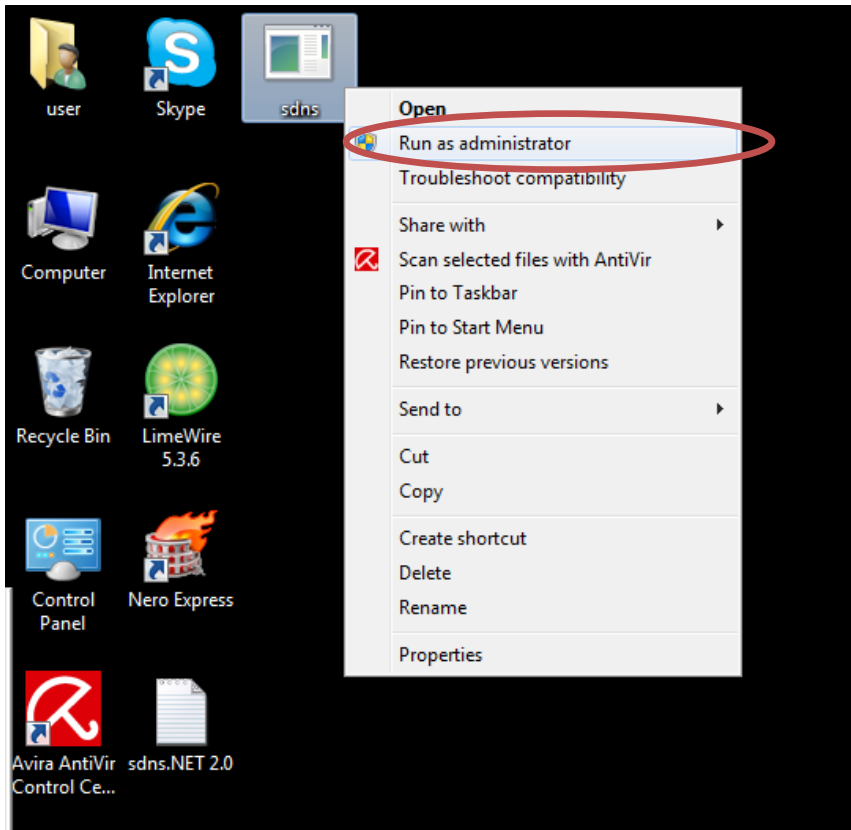


4. Then select "Save" and select the desired location. In this case "desktop" was selected. The downloaded file is called "sdns.exe".

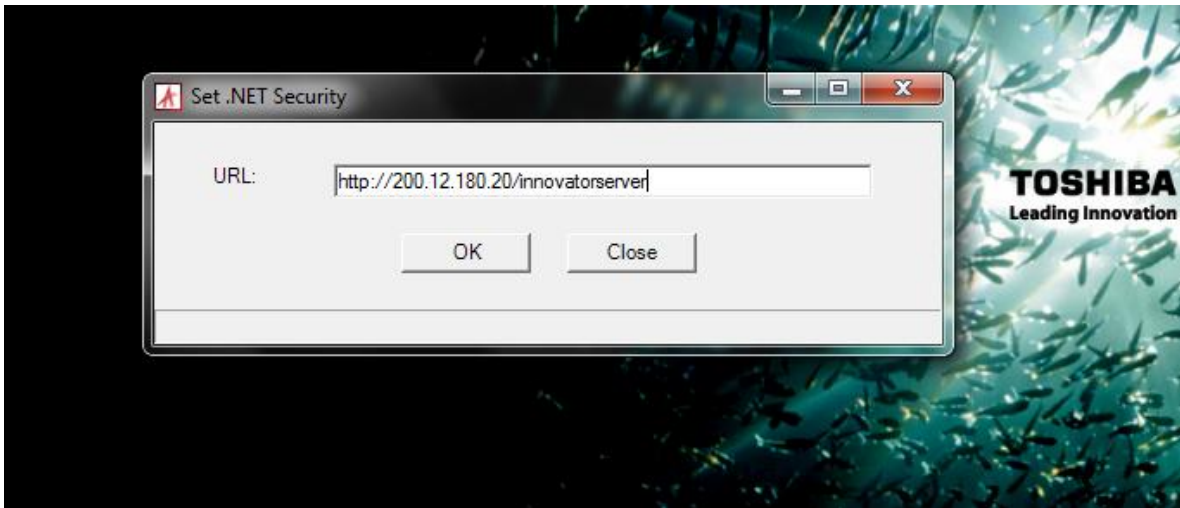




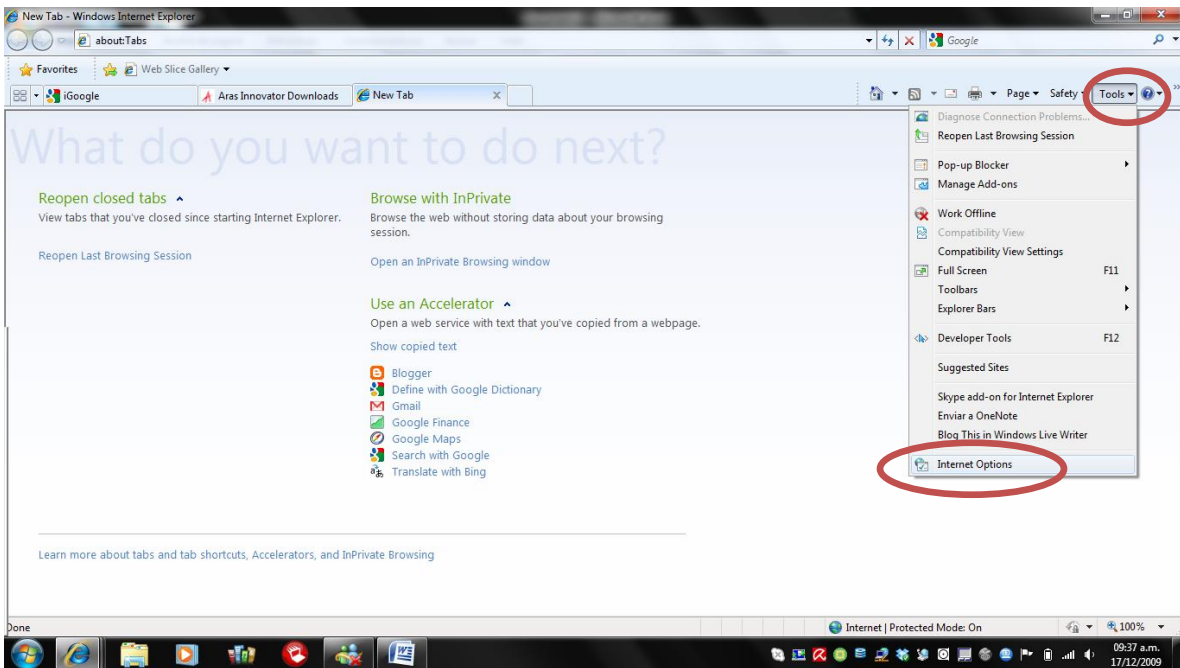
5. Run the downloaded file by double clicking on the icon. If you have Windows Vista or Windows 7, right click and select "Run as administrator".

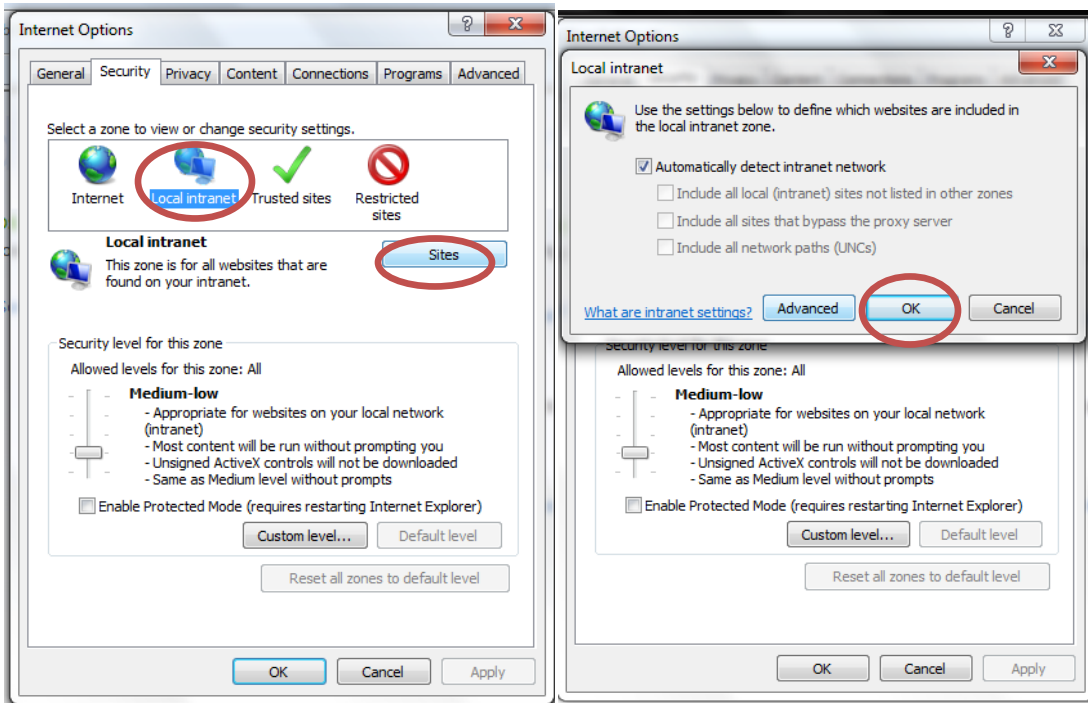


6. Write the following on the field: `http://200.12.180.20/innovatorserver` and then click on OK.

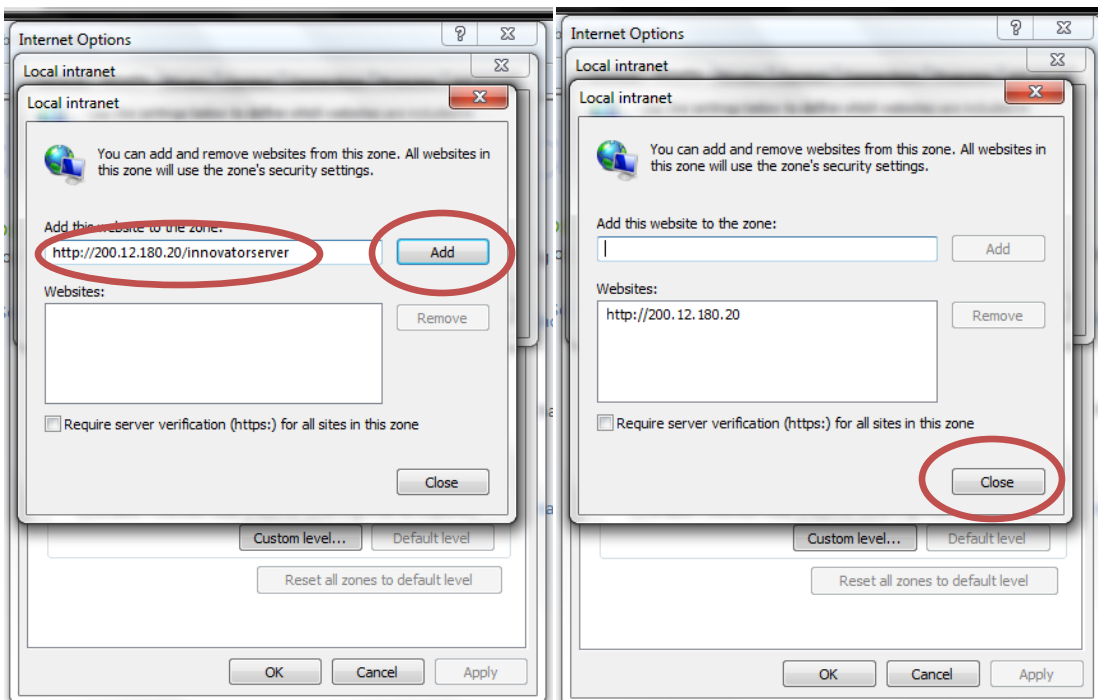


7. Open Internet Explorer (Innovator will not work in Mozilla Firefox or Google Chrome unless you've installed plug-ins) and follow the path Tools> Internet Options> Security> Local intranet> Sites> advanced options (see the following images).





8. Enter the login address > <http://200.12.180.20/innovatorserver> and click on the "ADD". Close and click OK.

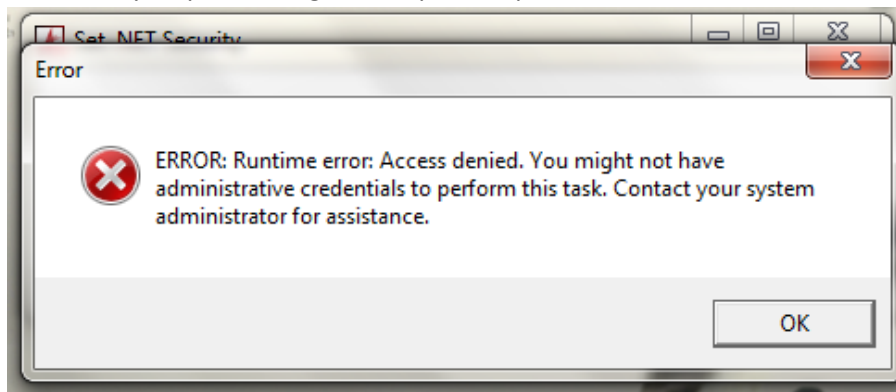


Once performed the previous steps you can access Aras Innovator in EAFIT's server via the Internet at: <http://200.12.180.20/innovatorserver>.



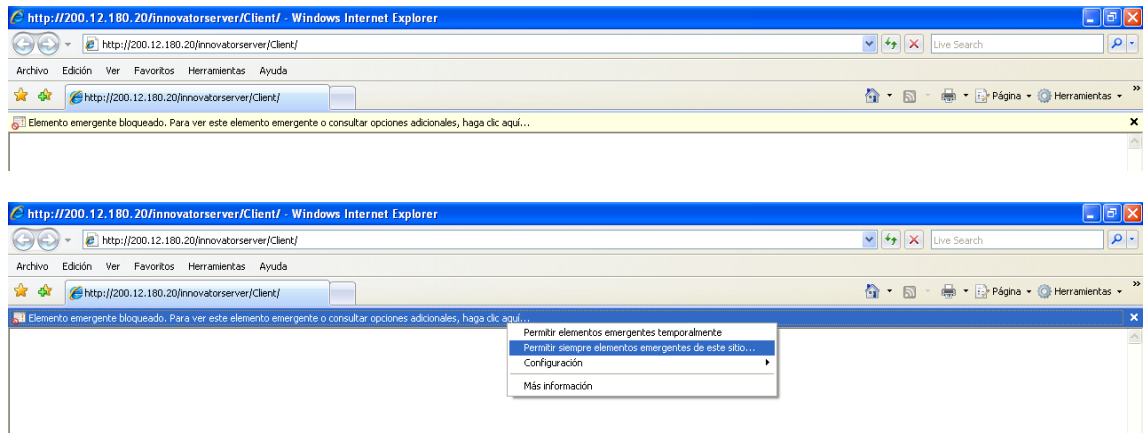
3. Troubleshooting

1. **Error window when giving the address in the .NET Security Config tool:** If you receive the following error message when you give an address for the secure addresses .NET Framework, you probably are using Windows Vista or Windows 7 and did not complete successfully step 5 of the guide. Repeat step.

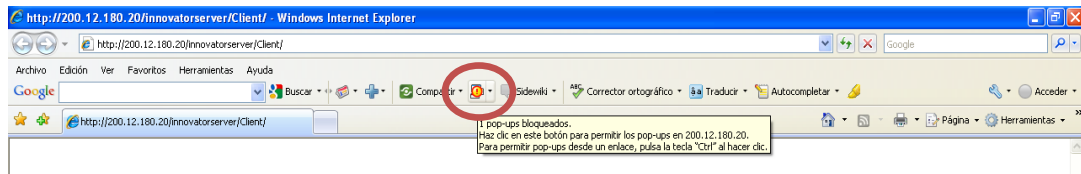


2. **The login window of Aras doesn't appear:** If you put in the address bar <http://200.12.180.20/innovatorserver> in the internet addresses field and it returns you to the page that you were as if apparently it's not changing anything you did not perform properly steps 7 and 8 of the guide. Perform these steps and try again.
3. **Pop-up Blocking:** If a yellow bar appears below the address bar you have enabled popup blocking, which will not let you open the start of ARAS Innovator. To disable this block click

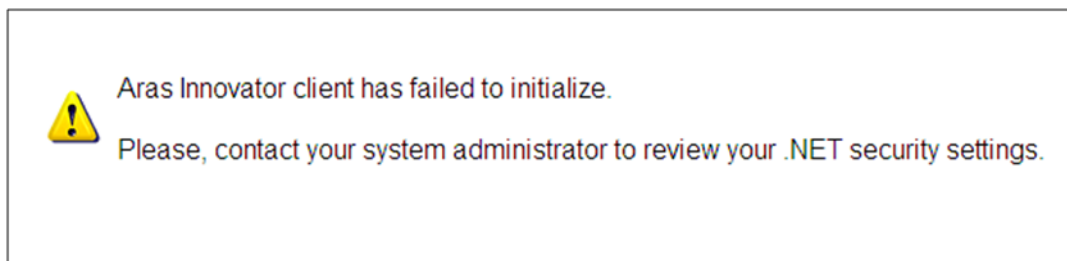
the yellow bar and click on the option "Always Allow Pop-ups from this site". Confirm ("yes") in the next window.



Additionally, you may have installed the Google toolbar and it also blocks Pop-ups. To unlock click the yellow icon with an exclamation point.

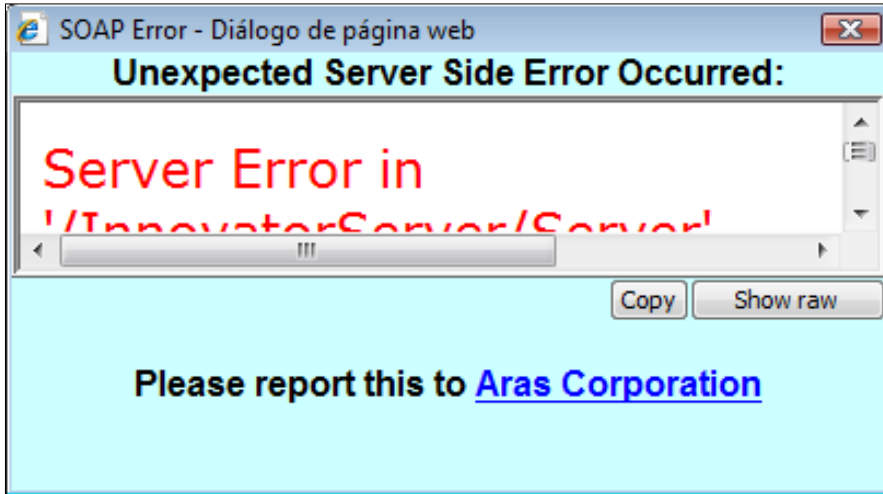


4. Notice of Error in Aras Startup screen: If you get the startup screen with the Aras warning shown in the following images you did not perform properly steps 1-6 of the guide. Close Internet Explorer, repeat these steps and try again.



However, if you performed the steps properly and the warning sign persists, contact your system administrator.

5. Another technical problem is due to EAFIT's poor Wi-Fi internet connection during peak hours at the university, especially at some locations within the University's campus. This causes the system to block, load incomplete information or take excessive loading times. To avoid this problem it's recommended to work off peak hours if possible, use the computers available at the university's designated labs (which have cable connection), or connect at your homes or offices.



APPENDIX 7: CAD MANAGEMENT IN ARAS INNOVATOR

One of the key functions of PLM systems is the management of CAD modeling files. Moreover, the administration of design files is called PDM (Product Data Management) and this is one of the origins of PLM systems. Most commercial PLM systems come from companies specializing in CAD systems, such as PTC and Dassault Systemmes, which have created a direct connection to load CAD files from their CAD systems such as ProEngineer and SolidWorks to the PLM manager. ARAS is nevertheless an independent company in which its free product “Innovator” contains no direct connection with any CAD system. Independent companies and universities have worked on this and created separate connectors that automate the loading of files from different CAD systems on the market to ARAS Innovator. Most of these connectors are available at a cost, except for some such as the one created by the French PLM lab for uploading files from Catia V5 to PTC Windchill and ARAS Innovator¹. It’s not necessary however to have an automated plug-in to upload a 3D model properly into ARAS Innovator. The manual method is also possible, which is explained below:

Manual method for uploading files to CAD ARAS Innovator:

For the next demonstration there will be used as an example a 3D model of a velomobile developed in ProEngineer software. The CAD model consists of a general assembly with a modeling skeleton and four sub-assemblies consisting of the chassis, steering, transmission and bodywork. Each of these sub-assemblies has associated components which can be visualized in Figure 1.

To load the 3D model into ARAS Innovator it’s necessary to load every part of the velomobile, list, name, and associate the corresponding document. It’s also necessary to define the hierarchical relationships in modeling to recreate the modeling tree or “Bill of Materials” (BOM) as it’s called in ARAS Innovator. All this will be shown step by step through the following pages.

¹ Una demostración de éste sistema puede ser vista en: <http://www.plmlab.fr/index.php?page=rialto>

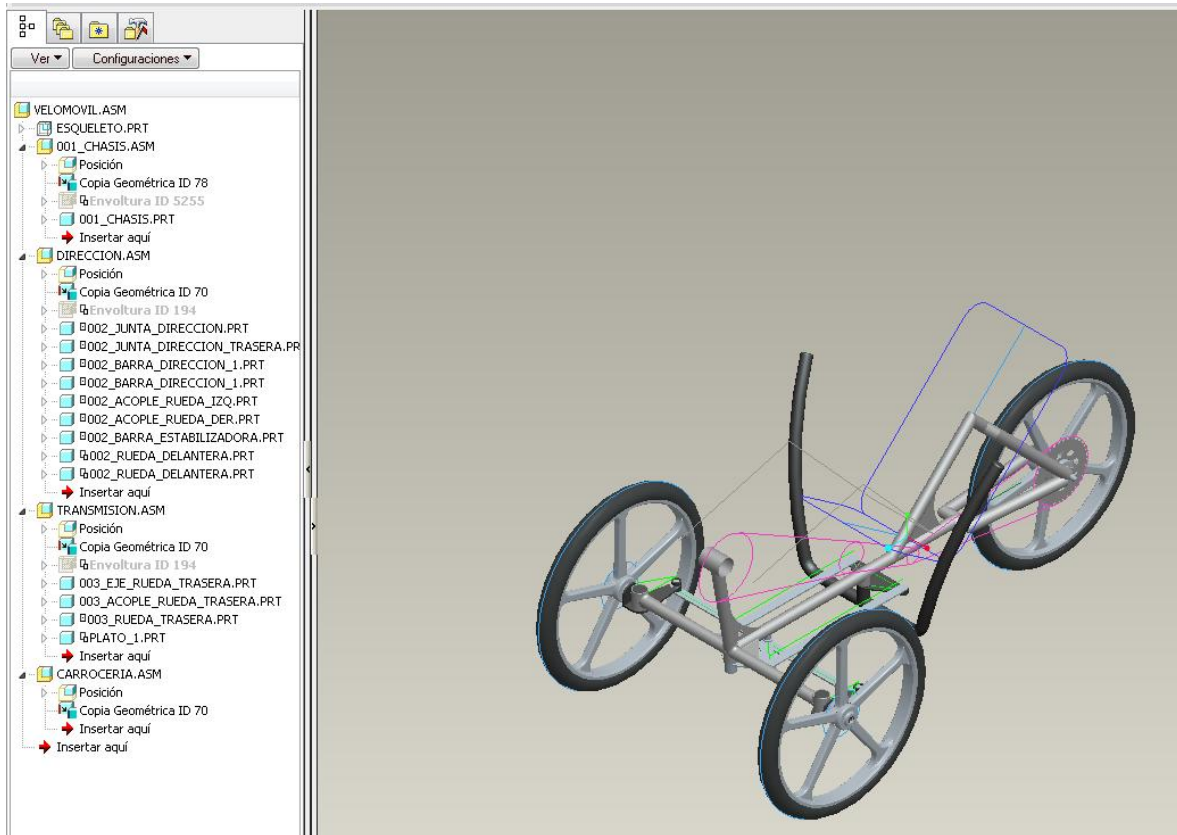
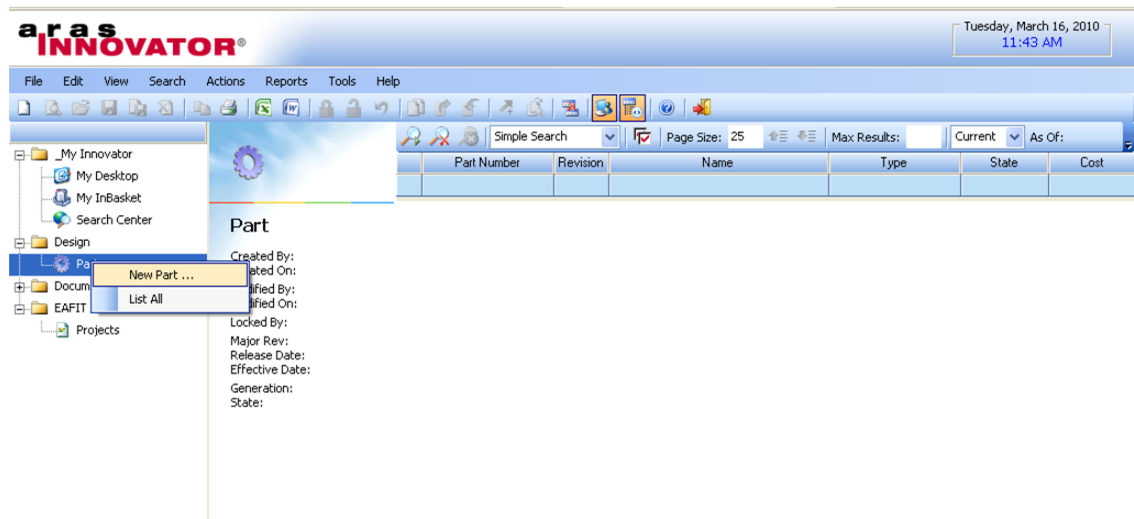


Illustration 1: CAD model of a Velomobile created by student Johan Gil (EAFIT)

Step by step procedure:

1. The first step is opening ARAS Innovator and going in the Table of Contents (left menu) to *Design> Parts> New Part*.

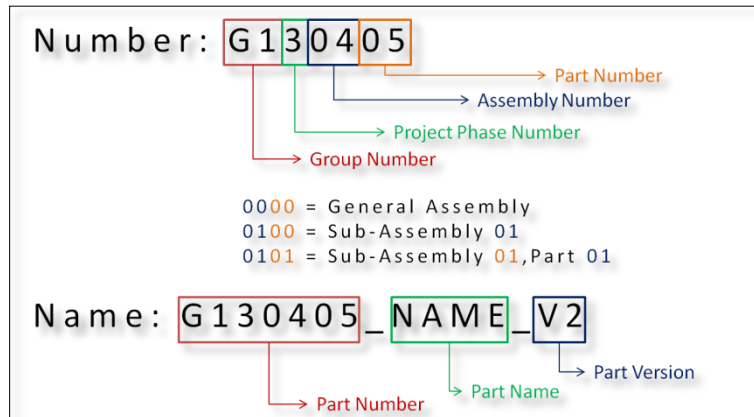


2. A window opens and asks for a number and name to the part being created. For the numbering the following format has been defined: GROUP# STAGE# ASSEMBLY# PART#.

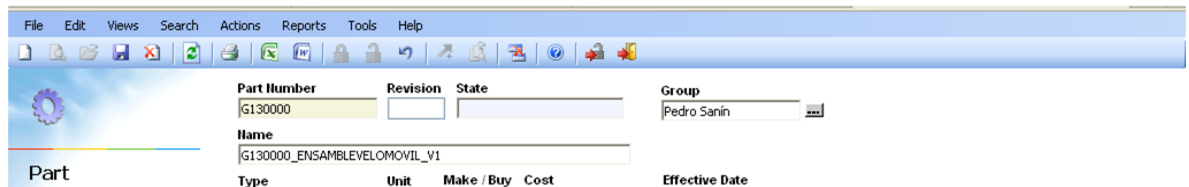
In the case of the example, starting with the general assembly they are numbered as follows: G130000 (group 1, stage 3, assembly 00, part 00).

For the name of the part it must start with the same number that was given, followed by _ Name that appears in the CAD file _ Version.

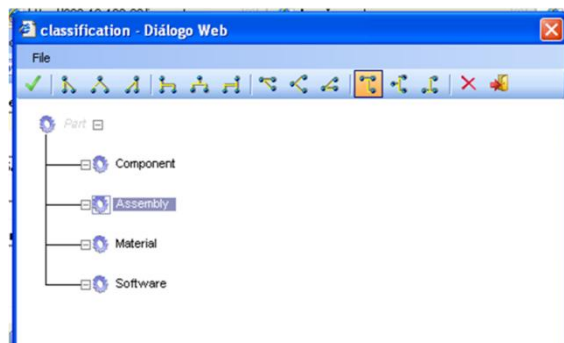
Ex: G130000_ENSAMBLEVELOMOVIL_V1.



Additionally to the number and name, the group to which the part belongs must be chosen in the “Group” field.



- Next is to click on the “Type” field and determine whether the part is an assembly or a component. As the first part being created is the general assembly, then “assembly” is defined. Click on the green check and then on OK in the warning window that appears then.



- A brief description can also be given to the part and an image uploaded to serve as a thumbnail. The description is given by filling the field with that name and for the thumbnail by clicking on the field and searching the image on your computer.

Long Description

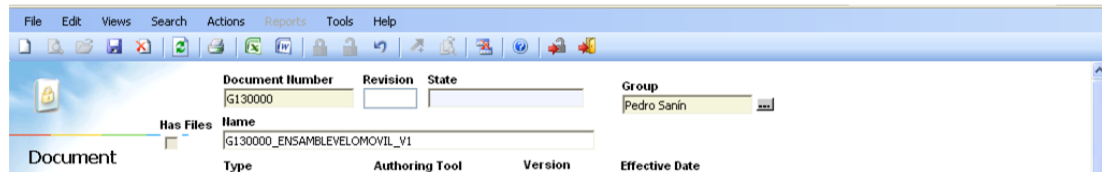
Ensamble general del velomóvil

Thumbnail

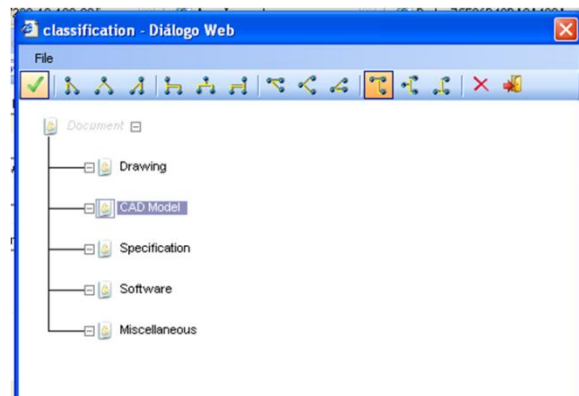
Clear



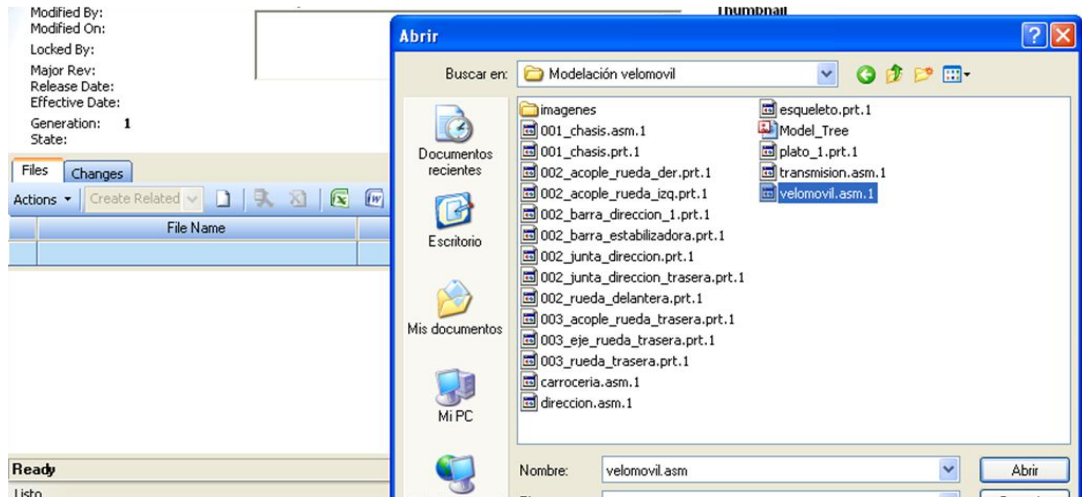
- The part file that's being created will work as a folder that will contain all the documents related to that part, such as the CAD model, a descriptive text, an Excel table, etc. In the bottom of the window go to the "Documents" tab, choose Create Related, and click on the blank sheet to create a new one. A window appears asking for a number and a name; in this case give the same as to the part file:



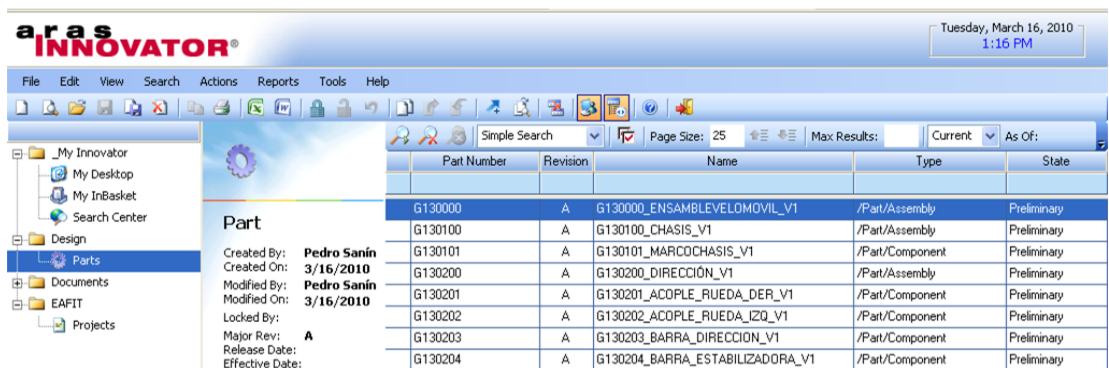
- The type of document must also be specified. Click on the "type" field and define that it is a CAD Model:



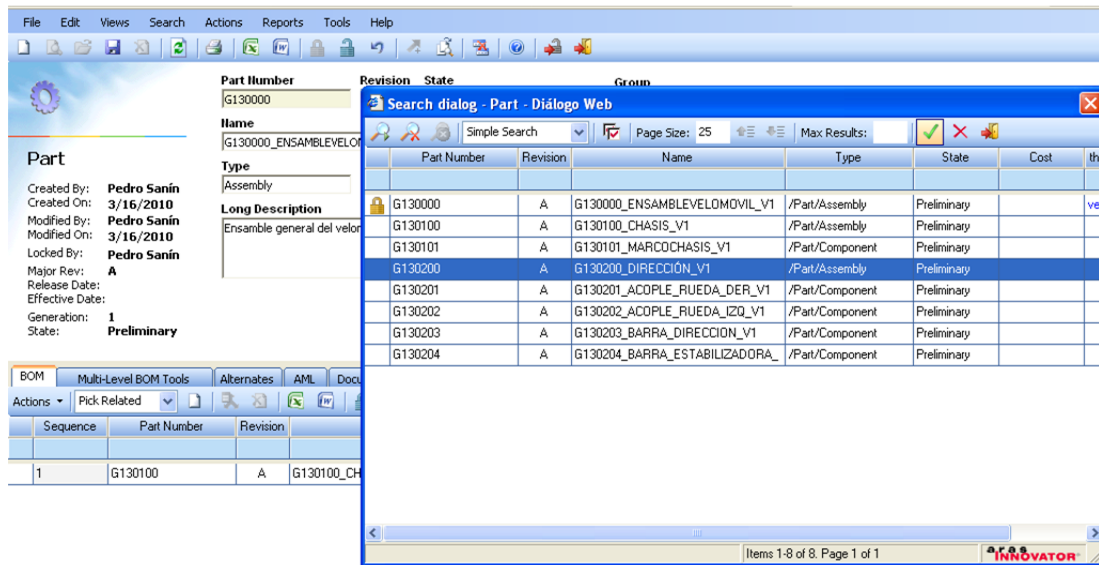
- A brief description and a thumbnail can also be given in the same way it was done for the part file (and possibly with the same content).
- To finish the document the file (s) to be contained must be loaded from the computer. To do this click at the blank sheet on the file tab.



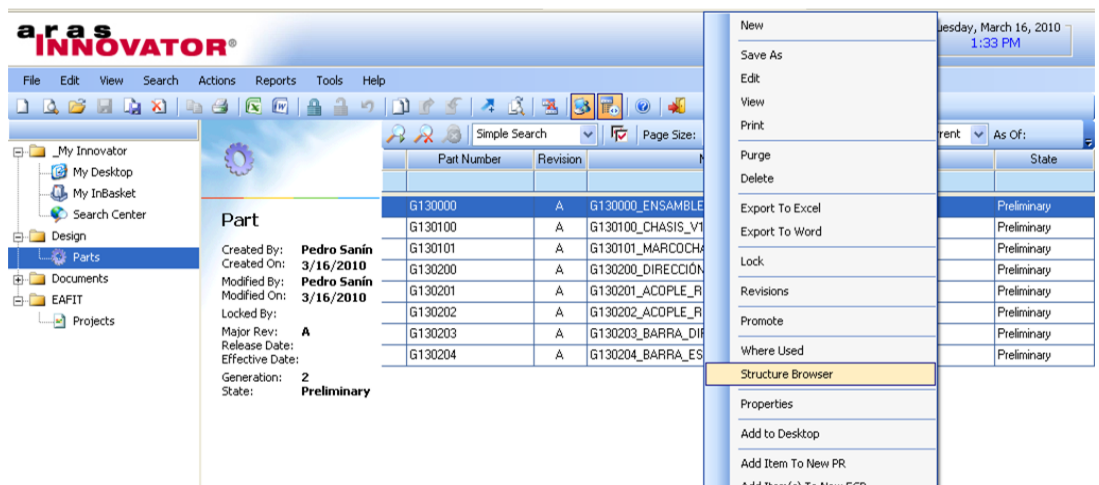
9. Now the document is saved, closed and return to the window of the part being created. Check if you have associated the newly created document. If you have, save and close the window. The part file has now been created for the general assembly of the velomobile.
10. The previous steps must be repeated to create all the model's components and assemblies. In the case of the Velomobile; the general assembly, the skeleton, the four sub-assemblies and the 12 components. The parts list should look somewhat like this:



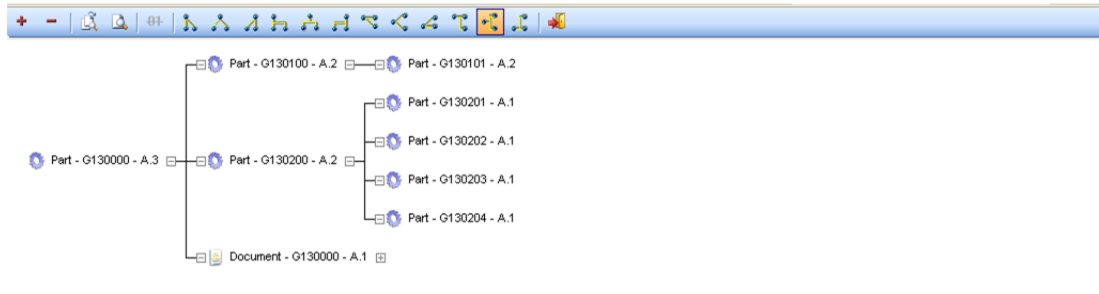
11. Now what remains is to give the hierarchical relationships to all parts to create the structure that the model tree has. First, edit the general assembly (right click> edit). Once at the window, go to the BOM tab in the menu below. There you must select "Pick Related" and click on the white sheet. A list with all parts created should appear; choose one that is "son" of the general assembly, such as the sub-assembly "chassis" or "steering":



12. Select in the same way each one of the parts that are “son” of the general assembly, which are in this case the four sub-assemblies and the model skeleton. With this the part is finished and can be saved and closed.
13. The same procedure of steps 11 and 12 must be applied on the sub-assemblies with their respective components, so these are defined as “sons” of them.
14. If the procedure has been done correctly, the model tree structure can be visualized by right-clicking on the general assembly part and choosing the option “Structure Browser”:



The window that is opened, once the highlighted option is chosen, should show something like the following:



The model tree can be visualized starting by the general assembly on the left and moving to the sub-assemblies and their respective parts and corresponding documents to the right.

In this way the process of loading the 3D CAD model to ARAS Innovator is finished. This way it will be available for download by all team members, teachers and the project client.

APPENDIX 8-PROJECT MANAGEMENT RESULTS

1. Phase 1: Design Requirements

1.1. Group 3 Results

Number	Activity	Planned Finish Date	Actual Finish Date	Days of Delay	Role
Information Compilation					
1	Primary Information	15-Feb	16-Feb	1	Design
Market Study					
2	Context analysis	15-Feb	16-Feb	1	Design
3	Target user	15-Feb	16-Feb	1	Design
Benchmarking					
4	State of the art	15-Feb	17-Feb	2	Production
Report					
5	Brief	17-Feb	16-Feb	-1	Design
6	Brief Delivery	15-Feb	16-Feb	1	Design
Gather requirements					
7	Surveys	15-Feb	17-Feb	2	Production
8	Results report	15-Feb	17-Feb	2	Production
9	Client Requirements delivery	15-Feb	17-Feb	2	Production
Design requirements					
10	Requirements interpretation	15-Feb	18-Feb	3	Marketing
11	Prioritize and identify requirements	15-Feb	18-Feb	3	Marketing
12	Relative importance	15-Feb	18-Feb	3	Marketing
13	Results	15-Feb	16-Feb	1	Marketing
14	PDS delivery	15-Feb	19-Feb	4	Marketing
Formal synthesis					
15	Mood boards	16-Feb	16-Feb	0	Design
16	Reference selection	15-Feb	16-Feb	1	Design
17	Visual alphabet	15-Feb	16-Feb	1	Design
18	Formal Synthesis Delivery	15-Feb	16-Feb	1	Design
Functional synthesis					
19	Black box analysis	15-Feb	24-Feb	9	Engineering
20	Functional structure	15-Feb	24-Feb	9	Engineering
21	Concept architecture	15-Feb	24-Feb	9	Engineering
22	Technical standards research	15-Feb	24-Feb	9	Engineering
23	Physics calculations	15-Feb	24-Feb	9	Engineering
24	Functional Synthesis Delivery	15-Feb	2-Mar	15	Engineering

Delay (days)	
Total=	88
Average=	3.67
Role	Average Delay (days)
Marketing	2.8
Design	0.67
Production	2
Engineering	10

1.2. Group 5 Results

Number	Activity	Planned Finish Date	Actual Finish Date	Days of Delay	Role
Market Study					
1	Context analysis	10-Feb	10-Feb	0	Marketing
2	Consumer analysis	10-Feb	10-Feb	0	Marketing
3	Economical Viability	15-Feb	13-Feb	-2	Marketing
Benchmarking					
4	Substitute products	10-Feb	12-Feb	2	Design
Report					
5	Brief	12-Feb	11-Feb	-1	Marketing
6	Brief Delivery	12-Feb	12-Feb	0	Marketing
Gather requirements					
7	Interviews	15-Feb	27-Feb	12	Marketing
8	Results report	15-Feb	27-Feb	12	Marketing
9	Client Requirements delivery	8-Feb	27-Feb	19	Marketing
Design requirements					
10	Requirements interpretation	12-Feb	12-Feb	0	Engineering
11	Prioritize and identify requirements	12-Feb	16-Feb	4	Engineering
12	Relative importance	12-Feb	27-Feb	15	Engineering
13	Results	12-Feb	27-Feb	15	Engineering
14	PDS delivery	11-Feb	5-Mar	22	Engineering
Formal synthesis					
15	Mood boards	10-Feb	12-Feb	2	Design
16	Reference selection	12-Feb	16-Feb	4	Design
17	Visual alphabet	16-Feb	16-Feb	0	Design
18	Formal Synthesis Delivery	16-Feb	27-Feb	11	Design
Functional synthesis					
19	Black box analysis	10-Feb	13-Feb	3	Production
20	Functional structure	12-Feb	13-Feb	1	Production
21	Function tree	16-Feb	24-Feb	8	Production

22	Concept architecture	16-Feb	24-Feb	8	Production
23	Technical standards research	16-Feb	27-Feb	11	Engineering
24	Physics calculations	16-Feb	27-Feb	11	Engineering
25	Functional Synthesis Delivery	16-Feb	24-Feb	8	Production

Delay (days)	
Total=	165
Average=	6.6
Average delay (days)	
Role	
Marketing	5
Design	3.8
Production	5.6
Engineering	11.1

2. Phase 2: Conceptualization

2.1. Group 3 Results

Number	Activity	Planned Finish Date	Actual Finish Date	Days of Delay	Role
Internal development					
1	Morphological matrix	22-Feb	22-Feb	0	Marketing
2	Internal development report	22-Feb	22-Feb	0	Marketing
External development					
3	Creative sessions	22-Feb	3-Mar	9	Design
4	External development report	22-Feb	3-Mar	9	Design
Concept generation					
5	Concept proposal development	26-Feb	3-Mar	5	Engineering
6	Concept generation delivery	26-Feb	9-Mar	11	Engineering
Concept selection					
7	Evaluation Matrix	4-Mar	3-Mar	-1	Production
8	Concepts delivery	4-Mar	10-Mar	6	Production
3-Mar					
9	Combination of alternatives	10-Mar	3-Mar	-7	Design
10	Delivery 1 Report and presentation	16-Mar	9-Mar	-7	Design
11	Chosen concept delivery	16-Mar	9-Mar	-7	Design
12	DELIVERY No.1	16-Mar	22-Mar	6	Marketing

Delay (days)	
Total=	24
Average=	2
Role	Average delay (days)
Marketing	2
Design	-0.6
Production	2.5
Engineering	8

2.2. Group 5 Results

Number	Activity	Planned Finish Date	Actual Finish Date	Days of Delay	Role
Internal development					
1	Morphological matrix	15-Feb	16-Feb	1	Engineering
2	Internal development report	15-Feb	24-Feb	9	Engineering
External development					
3	Creative sessions	16-Feb	16-Feb	0	Design
4	External development report	16-Feb	27-Feb	11	Design
Concept generation					
5	Concept proposal development	18-Feb	27-Feb	9	Design
6	Concept generation delivery	18-Feb	27-Feb	9	Design
Concept selection					
7	Pugh matrix	22-Feb	27-Feb	5	Marketing
8	Concepts delivery	22-Feb	27-Feb	5	Marketing
Concept evaluation					
9	Selection matrix	22-Feb	27-Feb	5	Production
10	Delivery 1 Report and presentation	22-Feb	20-Feb	-2	Marketing
11	Chosen concept delivery	22-Feb	7-Apr	44	Production
12	DELIVERY No.1	22-Feb	27-Feb	5	Marketing

Delay (days)	
Total=	101
Average=	8.4
Role	Average delay (days)
Marketing	3.3
Design	7.3
Production	24.5
Engineering	5

3. Phase 3: Detailed Design

3.1. Group 3 Results

Number	Activity	Planned Finish Date	Actual Finish Date	Days of Delay	Role
3D Modeling					
1	CAD model	14-Mar	22-Mar	8	Engineering
2	Technical drawings	19-Mar	10-Apr	22	Engineering
3	3D Modeling Delivery	14-Apr	14-Apr	0	Engineering
Production process design					
4	Assembly card	17-Mar	23-Mar	6	Design
5	Tooling selection	17-Mar	?*	34	Marketing
6	Manufacturing Montage	14-Apr	14-Apr	0	Production
7	Market rates	22-Mar	14-Apr	23	Production
8	Production Plan Delivery	14-Apr	14-Apr	0	Production
Engineering calculations					
9	Component selection	12-Apr	?*	8	Marketing
10	Eng. Calculations Delivery	14-Apr	14-Apr	0	Marketing
Validation					
11	Finite Element Analysis	11-Apr	14-Apr	3	Design
12	Mechanical Simulation	10-Apr	23-Mar	-18	Design
13	Validation Delivery	14-Apr	14-Apr	0	Design
14	DELIVERY No. 2	14-Apr	14-Apr	0	Design

?*= Activity not completed yet (April 20, 2010)

Delay (days)	
Total=	86
Average=	6.1
Role	Average delay (days)
Marketing	14**
Design	-1.8
Production	7.7
Engineering	10

**= Still misses completing 2 activities

3.2. Group 5 Results

Number	Activity	Planned Finish Date	Actual Finish Date	Days of Delay	Role
3D Modeling					
1	CAD model	19-Apr	13-Apr	-6	Design
2	Technical drawings	20-Apr	14-Apr	-6	Production

3	3D Modeling Delivery	20-Apr	14-Apr	-6	Design
Production process design					
4	Assembly card	20-Apr	8-Apr	-12	Production
5	Tooling selection	18-Mar	24-Mar	6	Production
6	Manufacturing Montage	18-Mar	26-Mar	8	Marketing
7	Market rates	20-Apr	8-Apr	-12	Production
8	Production Plan Delivery	22-Mar	14-Apr	23	Production
Engineering calculations					
9	Component selection	20-Apr	13-Apr	-7	Engineering
10	Eng. Calculations Delivery	20-Apr	13-Apr	-7	Engineering
Validation					
11	Finite Element Analysis	20-Apr	14-Apr	-6	Production
12	Mechanical Simulation	20-Apr	?*	0	Engineering
13	Validation Delivery	20-Apr	15-Apr	-5	Design
14	DELIVERY No. 2	20-Apr	19-Apr	-1	Marketing

?*= Activity not completed yet (April 20, 2010)

Delay (days)	
Total=	-31
Average=	-2.2
Role	Average delay (days)
Marketing	3.5
Design	-6
Production	-1.2
Engineering	-5

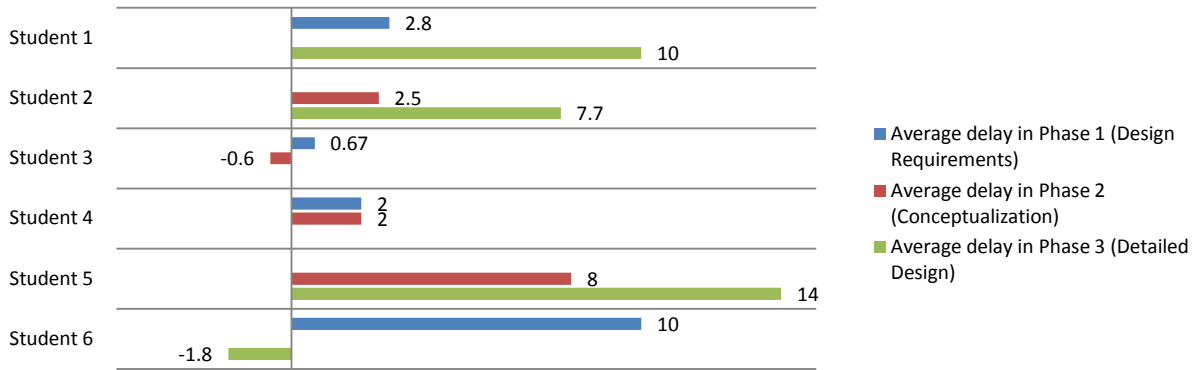
**= Still misses completing 2 activities

4. Overall student's Average Delays to complete activities

4.1. Group 3

Student	Role			Average Delay		
	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
Student 1	Marketing		Engineering	2.8		10
Student 2		Production	Production		2.5	7.7
Student 3	Design	Design		0.67	-0.6	
Student 4	Production	Marketing		2	2	
Student 5		Engineering	Marketing		8	14
Student 6	Engineering		Design	10		-1.8

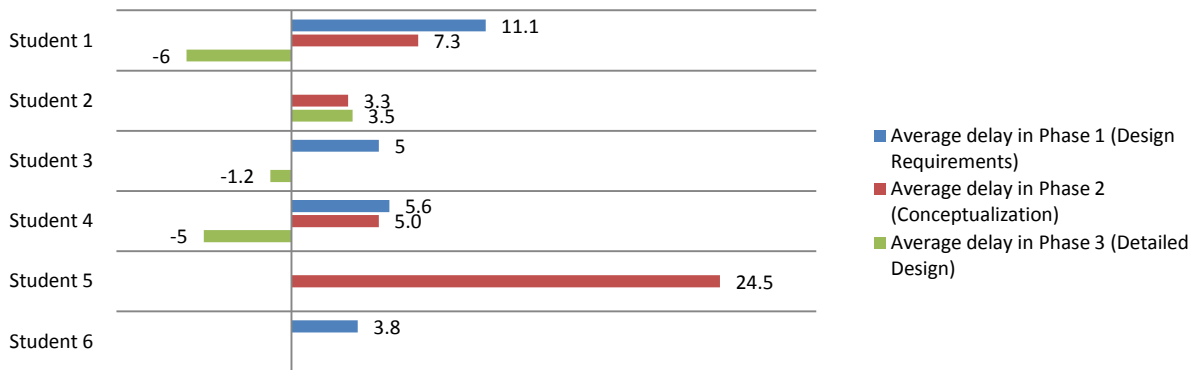
Group 3 Students' Average Delay (in days) to complete activities for each Project Phase



4.2. Group 5

Student	Role			Average Delay (in days)		
	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
Student 1	Engineering	Design	Design	11.1	7.3	-6
Student 2		Marketing	Marketing		3.3	3.5
Student 3	Marketing		Production	5		-1.2
Student 4	Production	Engineering	Engineering	5.6	5.0	-5
Student 5		Production			24.5	
Student 6	Design			3.8		

Group 5 Students' Average Delay (in days) to complete activities for each Project Phase



APPENDIX 9: DOCUMENT LIST

1. Group 3 Document List

Document Number	Name	Type
g311	g31_brief_v1	
g312	g31_sintesisformal_	
g313	g31_infoprimeria_v1	
g314	g31_Estadodelarte_V1	
g315	g315_encuestas_v1	
g316	g316_reportederesultados_v1	
g317	g317_requerimientoscliente_v1	
g318	g318_PDS_V1	
g319	g319_SintesisFuncional_v1	
g320	g320_conceptoseleccionado_v1	
g321	g321_desarrollopropuestas_v1	
G3210	g3210_entrega2_PRESENTACION_V1	
g322	g322_matriz evaluativa_v1	
G323	G323_RenderPreliminar_v1	
G324	G324_RendersFinales_V1	
g325	g325_MARKETING_RATES_V1	
g326	g326_CARTA_PROCESOS_V1	
g327	g327_CARTA_ENSAMBLE_V1	
G328	G328_Planos_V1	
G329	G329_AnalisisElementosFinitos_V1	
G330000	G330000	/Document/CAD Model
G330100	G330100_SistemadeDireccion_V1	/Document/CAD Model
G330200	G330200_BarraDerecha_V1	/Document/CAD Model
G330201	G320102_barraderecha_v1	/Document/CAD Model
G330401	G330401_sillin_V1	/Document/CAD Model
G330402	G330402_tacos_v1	/Document/CAD Model
G330403	G330403_Chasis_v1	/Document/CAD Model
G330404	G330404_uñatensor_v1	/Document/CAD Model
G330405	G330405_tornillo_v1	/Document/CAD Model
G330406	G330406_buje_v1	/Document/CAD Model
G330407	G330407_Piñon_v1	/Document/CAD Model
G330408	G330408_rodamientobasculante_v1	/Document/CAD Model
G330409	G330409_rodamientocentro_v1	/Document/CAD Model
G330410	G330410_ejebarras_v1	/Document/CAD Model
G330411	G330411_motor_v1	/Document/CAD Model
G330500	G330500_SISTEMADECAMBIOS_V1	/Document/CAD Model
G330600	G330600_sistemadefrenos_v1	/Document/CAD Model
g331	g331_presentacion_entrega2_v1	

g331	g331_presentacion_entrega_2_v1	
G331000	G331000_pedalesybielas_v1	/Document/CAD Model
G331100	G331100_amortiguador_v1	/Document/CAD Model
G338	G338_calculos de ingenieria_v1	
g339	g339_diagramadeflujocontrol_v1	

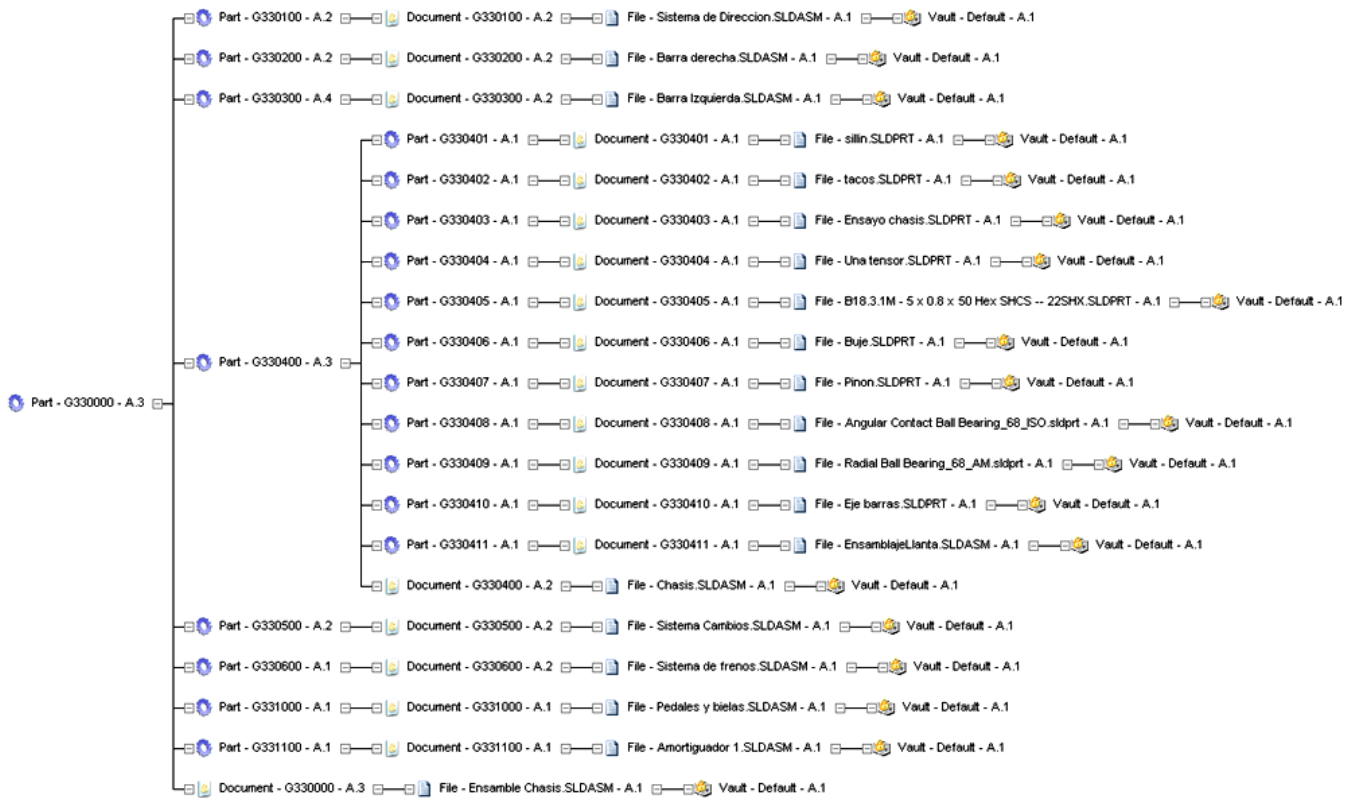
2. Group 5 Document List

Document Number	Name	Type
G51_1	G51_ANÁLISIS CONSUMIDOR Y CONTEXTO_V1	
g51_10	g51_pds_v1	
G51_2	G51_BRIEF DEL PRODUCTO_V1	
G51_3	G51_VIABILIDAD ECONOMICA_V1	
G51_4	G51_SINTESIS FUNCIONAL_V1	
G51_5	G51_SINTESIS FORMAL_V1	
G51_6	G51_ENCUESTAS_V1	
G52_1	G52_PRESENTACIÓN Y POSTER_V1	
G52_2	G52_PROPUESTAS_V2	
G52_2	G52_PROPUESTAS_V1	
G52_3	G52_MATRIZ DE COMPARACIÓN_V1	
G52_4	G52_Propuesta final	
G53_1	G53_CALCULOS DE INGENIERIA_V1	
G53_1	G53_CALCULOS DE INGENIERIA_V2	
G53_2	G53_CARTA DE PROCESOS_V1	
G53_3	G53_ANALISIS ELEMENTOS FINITOS_V1	
G53_4	G53_DISEÑO DE DETALLE_V1	
G530000	G530000_ENSAMBLE GLOBAL_V1	/Document/CAD Model
G530100	G530100_SUBENSAMBLE CUERPO PRINCIPAL_V1	/Document/CAD Model
G530101	G530101_CHASIS CARA DERECHA_V1	/Document/CAD Model
G530102	G530102_CHASIS CARA IZQUIERDA_V1	/Document/CAD Model
G530103	G530103_CAJA CENTRO_V1	/Document/CAD Model
G530104	G530104_TIJERA_V1	/Document/CAD Model
G530105	G530105_TAPA INSPECCION_V1	/Document/CAD Model
G530106	G530106_SOPORTE SUPERIOR SUSPENSION_V1	/Document/CAD Model
G530107	G530107_PUNTO QUIEBRE_V1	/Document/CAD Model
G530108	G530108_CONECTOR CARGADOR_V1	/Document/CAD Model
G530109	G530109_LUZ FRENO_V1	/Document/CAD Model
G530200	G530200_SUBENSAMBLE COLUMNA DIRECCION_V1	/Document/CAD Model
G530201	G530201_TUBO DIRECCION_V1	/Document/CAD Model
G530202	G530202_TAPA ESPIGA_V1	/Document/CAD Model

G530203	G530203_MANUBRIO_V1	/Document/CAD Model
G530204	G530204_CARCASA_DERECHA_V1	/Document/CAD Model
G530205	G530205_CARCASA_IZQUIERDA_V1	/Document/CAD Model
G530206	G530206_MANILLAR_V1	/Document/CAD Model
G530207	G530207_SUSPENSION_DELANTERA_V1	/Document/CAD Model
G530208	G530208_FAROLA_INFERIOR_V1	/Document/CAD Model
G530209	G530209_FAROLA_SUPERIOR_V1	/Document/CAD Model
G530300	G530300_SUBENSAMBLE_PEDALESYEMBIELADO_V1	/Document/CAD Model
G530301	G530301_EJE_V1	/Document/CAD Model
G530302	G530302_BIELA_DERECHA_V1	/Document/CAD Model
G530303	G530303_BIELA_IZQUIERDA_V1	/Document/CAD Model
G530304	G530304_PEDAL_V1	/Document/CAD Model
G530305	G530305_TAPA_PEDAL_V1	/Document/CAD Model
G530400	G530400_SUBENSAMBLE_LLANTA_TRASERA_V1	/Document/CAD Model
G530401	G530401_NEUMATICO_V1	/Document/CAD Model
G530402	G530402_RIN_V1	/Document/CAD Model
G530403	G530403_PACHA_V1	/Document/CAD Model
G530500	G530500_SUBENSAMBLE_SILLINCAÑA_V1	/Document/CAD Model
G530501	G530501_SILLIN_V1	/Document/CAD Model
G530502	G530502_CAÑA_V1	/Document/CAD Model
G530600	G530600_SUBENSAMBLE_SILLINCAÑA_PASAJERO_V1	/Document/CAD Model
G530601	G530601_SILLIN_PASAJERO_V1	/Document/CAD Model
G530700	G530700_SUBENSAMBLE_SUSPENSION_V1	/Document/CAD Model
G530701	G530701_RESORTE_V1	/Document/CAD Model
G530702	G530702_PARTE_INTERNA_V1	/Document/CAD Model
G530703	G530703_PRTE_EXTERNA_V1	/Document/CAD Model
G530800	G530800_SUBENSAMBLE_LLANTA_V1	/Document/CAD Model

APPENDIX 10- BOM

1. CAD Model structure Group 3



2. CAD Model structure Group 5



APPENDIX 11- FEEDBACK QUESTIONS ON ARAS INNOVATOR AND PLM

Feedback 1

Date: March 10th, 2010

1. You consider that so far you've been able to learn and use the software "Aras Innovator" correctly? Explain.
2. What problems have you found in the use of PLM software and methodology?
3. What benefits do you think PLM software and methodology has brought for your project?
4. What recommendations would you make for teaching and using this software and methodology in the future?

Feedback 2

Date: April 14th, 2010

Thinking about your work during the Detailed Design phase, answer the following questions:

1. Have you learned something new from Aras Innovator in this phase of the project? If so, explain what you have learned...
2. Have you found new problems or difficulties in the use of PLM software and methodology? Which?
3. Did you find more benefits from this methodology and software for your project? Which?
4. Considering your learning process so far, what recommendations would you make for the teaching and use of this software and methodology in the future?