PAUL SABATIER UNIVERSITY TOULOUSE III
IUP of Intelligent Systems

TECHNICAL UNIVERSITY OF LIBEREC
Faculty of Mechatronics, Informatics and Interdisciplinary Studies

International Master of Interactive Systems

DIPLOMA THESIS

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PAUL SABATIER UNIVERSITY TOULOUSE III
IUP of Intelligent Systems

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Faculty of Mechatronics, Informatics and Interdisciplinary Studies

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Siemens TIA PORTAL innovation

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Diploma Thesis Assignment

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Seznam doporučené literatury: **List of literature :**	

[1] ACTIF training course [PSA internal document]

[2] 03.65.036G - Machines et installations industrielles automatisme règles de conception et de réalisation des logiciels [PSA internal document]

[3] 03.65.015G - Machines et installations industrielles automatismes : référentiel technique transversal [PSA internal document]

[4] AUT-STD-525 - API S7 - Annexe norme E03.65.036.G [PSA internal document]

[5] AUT-STD-563 – Notice_d_integration_Application_WinccFlex_Multipanel_SIEMENS [PSA internal document]

[6] AUT-STD-577 - API WinCC Flex - Annexe norme E03.64.160.G - NEUTRE [PSA internal document]

[7] AUT-STD-578 - API S7 et WinCC Flex - Diagnostic et/ou commande EPO avec BPL tactiles - AF AO intégration [PSA internal document]

[8] SIEMENS SIMATIC Getting Started - Edition 03/2006 "C79000-P7077-C48-01"

[9] SIEMENS WINCC FLEXIBLE Getting started Beginner – Edition 06/2008 "5E00279568-04 "

[10] SIEMENS WINCC FLEXIBLE Getting started Expert - Edition 04/2006 "A5E00279909-03"

[11] SIEMENS WinCC V7.0 SP1 MDM - WinCC/ProAgent Information System – Edition 02/2009

[12] SIEMENS PDIAG S7-PDIAG Pour SIMATIC S7-300/400 Configuration du diagnostic processus Getting started – Edition 07/2005[13] SIEMENS PDIAG S7-PDIAG Pour SIMATIC S7-300/400 Configuration du diagnostic processus Manual – Edition 07/2005 "A5E00473486-01"

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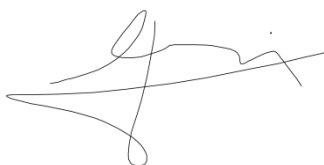
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Thanks

I would like to thank first Pascal GEHANT for giving me the opportunity to join the company PSA Peugeot Citroën and more precisely the team SDO that he is the leader. I also thank all the team, once more Pascal GEHANT, Olivier LAURENT, Mikael JULLIEN and Jean-Luc MRACHETTI for their help, availability and kindness. They enabled me to progress in my works and improve my knowledge.

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I thank as well Mathieu SERRURIER and all jury members for considering my work.

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Glossary

- OPE - Operational Part Element: mechanical component performing the physical actions under the control of the logic controller. An element of operative part is made up by one or several actuators (a motor, a pneumatic cylinder group: example: clamping assembly A…), its pre-actuators (electro valves, switches, regulators…) and its possible sensors (end of stroke, detectors, etc).

- Entity: functional decomposition element composed of an independent mechanical assembly, constituted by operational unit elements with synchronized operation (or cycled, or regulated) corresponds to an operation on the product or on the process.
In the language of various technical specialties, an entity is frequently called as follows: operation, post station, means, machinery…
Some entities that perform a specific function have a standard name: lifting section, transporter…

- GRM – Group of Running Mode: functional decomposition element composed of one or several entities which depend on the same running mode selector

- CELL: functional decomposition element composed of several GRM grouped because of safety or functional need constraints. Inside the functional decomposition of the automaton, the CELL is not mandatory: if there is no common need for GRM, the island should not be present.

General introduction

As part of my Professional Master degree in Engineering of Interactive Systems of the University Paul Sabatier of Toulouse and the Technical University of Liberec, I have done a final studies internship from March 12 to August 31 in the company PSA Peugeot Citroën based in Sochaux (DOUBS).

This internship was into the SDO team (Organic Standard and Development), part of the entity ATA (Automatic Transversal Activities) that belongs to the department AUT (Automation).

This subject was proposed following the evolutions of Siemens PLCs and HMIs. Siemens released in December 2011 a new development platform "TIA PORTAL" and announced that their future products will no longer be compatible with the current platform (Step 7 V5.5, WinCC flexible 2008 , PDIAG), forcing PSA to migrate to the new in a near future.

Aim of the internship:
- Simplify PLC and HMI standard programming
- Prepare the migration of programs to the new development platform Siemens "TIA PORTAL".

The training period was divided into two main stages, the first is handling the current tools and PSA standards, and the 2nd is working on TIA PORTAL.

During my internship, I have done several tests, programs, explorations, other more less important tasks for the company, and attended to conferences. But this report covers only the main tasks.

I start will in this report with a presentation of the company, then a presentation of the subject and tools, my works on the current tools, my works on TIA PORTAL, and I finish with other parallel tasks.

I. Chapter 1: Presentation of PSA

One group, two brands: PSA Peugeot Citroën was born by merging **Peugeot SA** and **Citroën SA** in 1976.

Key dates of Peugeot history:

1810: Peugeot brothers make springs for watchmaking in Montbéliard.
1818: A new factory is crated and the production is diversified.
1858: Appearance of the Lion emblem on products.
1889: First Peugeot car.
1910: Creation of the « Société Anonyme Automobile Peugeot ».
1952: Peugeot gets over the millions of vehicles produced.

Key dates of Citroën history:

1913: André Citroën sets up the « Société des engrenages Citroën» in Paris.
1919: The first Citroën car.
1924: Creation of the "Société Anonyme André Citroën ".
1934: Serious financial difficulties despite the launching of the "Traction avant"
1968: Citroën becomes the parent company of the group Citroën Berlier Panhard

Key dates of the group PSA Peugeot Citroën

1976: Creation of PSA Peugeot Citroën by merging Peugeot SA and Citroën SA (Peugeot takes over Citroën)
1978: PSA Peugeot Citroën takes over Chrysler Europe
2007: 4 new operational priorities are defined: Quality, cost reduction, product and international
2012: The first Hybrid car of the group.

I.1. PSA in figures

I.1.1. Corporate profile

Backed by two globally renowned brands, Peugeot and Citroën, PSA Peugeot Citroën sold 3.5 million vehicles worldwide in 2011, of which 42% outside Europe, with revenue of €59.9 billion and operations in 160 countries worldwide. In 2011, it allocated more than €2 billion to research and development, in particular in the field of new automotive propulsion technologies.

Through its subsidiaries, the Group is also active in other automotive related businesses. Bank PSA Finance provides vehicle financing in 23 countries. With operations in 150 countries, Gefco is committed to becoming the world leader in automotive supply chain solutions. Faurecia is currently the world's sixth largest automotive equipment supplier and market leader in several key vehicle modules.

I.1.2.Globalization

PSA Peugeot Citroën pursued its globalization strategy in 2011, helping to lift sales outside Europe to 42% of the total, well on track to meet the targeted 50% in 2015. Gains were posted in each of the priority markets, with growth of 7% in China, 11% in Latin America and 34% in Russia. Production capacity outside Europe will be increased in 2012 and 2013 with the construction of new plants in China, the extension to the Porto Real plant in Brazil and the ramp-up of the Kaluga plant in Russia.

The figure 1 shows sales over the world in 2011.

Picture 1 Peugeot 408

I.1.3.Upmarket strategy

The strategy of moving the brands upmarket is also well on track, with Premium models like the Peugeot 508 and the Citroën DS5 now accounting for 18% of consolidated sales, versus 13% in 2010. Moreover, the strategy of moving the brands upmarket is being extended from the Premium models to the entire line-up, so that the Peugeot 208, for example, offers a higher level of quality and features than the 207. The strategy is also bringing to market vehicles equipped with the latest innovations, notably the HYbrid4 diesel hybrid powertrain, introduced in 2012 on the Peugeot 3008, 508 and 508 RXH and the Citroën DS5. In this way, it is helping to position the Group in promising segments, while winning over new customers and enhancing the image of the brands.

With operations in 160 countries and 10,000 dealerships, Peugeot embodies a compelling blend of emotion and the pursuit of perfection. In 2010, its bicentennial year, Peugeot confirmed its ranking as the world's leading French automotive brand, while in 2011, it moved up a notch to no. 9 in the global league tables, selling 2,114,000 vehicles over the year. Peugeot is also the only automotive brand to deploy a comprehensive range of mobility solutions, with passenger cars, light commercial vehicles, scooters, bicycles and a broad array of services available through "Mu by Peugeot".

Picture 2 Peugeot 3008 HYbrid4

Picture 4 Peugeot 508 RXH

Picture 3 Peugeot RCZ

Continuing the story that began 90 years ago near the Eiffel Tower, the dynamic, creative Citroën brand introduced a new model range in 2010 with the Citroën DS3 – the first of a distinctive line that was extended in 2011 with the DS4 and now the DS5. The brand's technological leadership is regularly on display in World Rally Championship racing, where it has won the Manufacturer title seven times. Services are another focus of innovation, as demonstrated by the Citroën Multicity mobility solutions web portal. With 10,000 dealers and operations in 80 countries, Citroën sold 1,436,000 vehicles in 2011.

Picture 5 Citroën DS5 HYbrid4
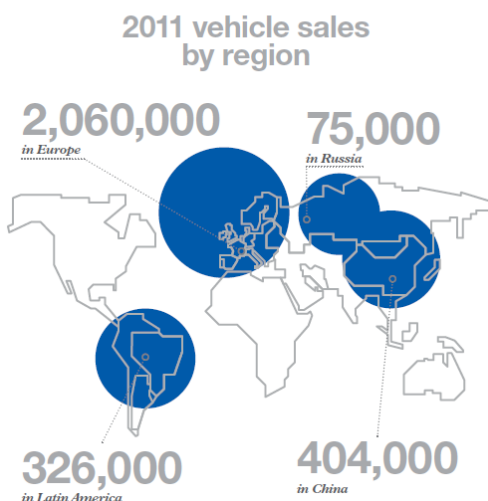

Picture 6 Citroën DS4

Picture 7 Citroën DS3

3.5
million vehicles
sold worldwide in 2011

209,000
employees

2011 vehicle sales
by region

2,060,000
in Europe

75,000
in Russia

326,000
in Latin America

404,000
in China

Figure 1 Vehicle sales by region in 2011

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I.2. Sochaux site

1810: The beginning of Peugeot in the industry
1889: First Peugeot car
1912: Sochaux site creation
1929: Launching of the Peugeot 201
2010: 20 000 000 cars produced in Sochaux
2012: Launching of the first Citroën in Sochaux (the DS5) and the first Hybrid cars of the group.(DS5, 3008 and 508)

I.2.1. PSA Sochaux activities

Sochaux site employs 12289 employees in 3 main activities:

a. Production

Four models are made, Peugeot 3008, 5008, 308 (5Dr, SW, CC) and Citroën DS5 up to 1800 vehicles/day. In 2011 the production was 373 000 vehicles in Sochaux.
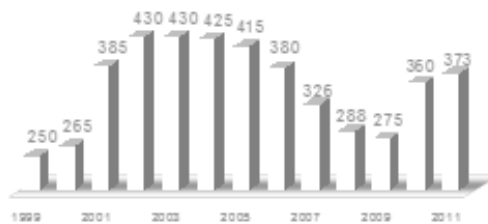The figure 2 shows sales by thousands since 1999 in Sochaux.

Figure 2 Sales by thousands

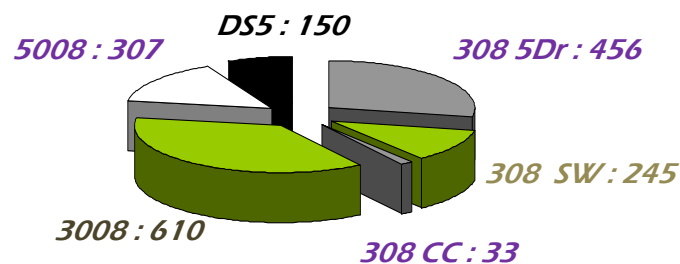The figure 3 shows the number of cars that are made in Sochaux daily for each model.

Figure 3 Models production daily in Sochaux

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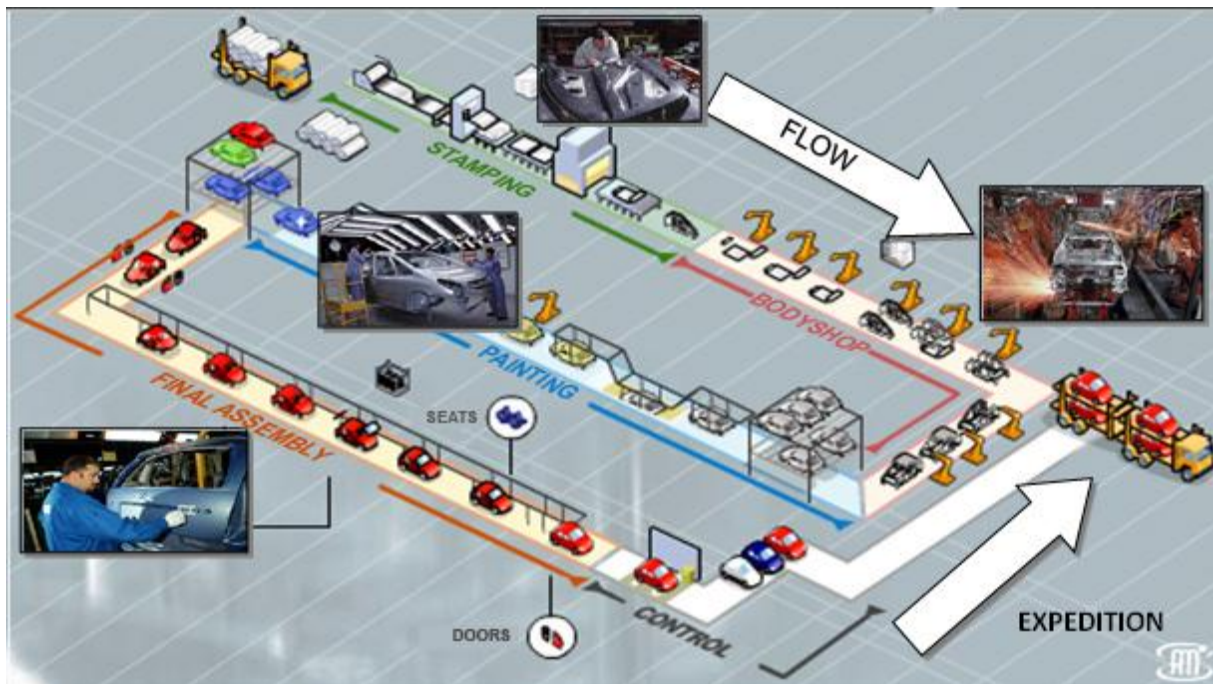In the figures 4 and 5 is the represented the plant flow

Figure 4 Plant flow

Figure 5 Plant flow synoptic

b. Development

More than 3900 employees develop and experiment the future Peugeot and Citroën vehicles, and process which allow their production. There are also 300 people from the Information Systems Direction; these teams manage the computer applications common to the whole group PSA.

c. Experimentation

The technical center of Belchamp (5km far from Sochaux) is a test center with 430 hectares and 1366 employees. It includes 17 test tracks, test resources and labs. The passive security center is also established there.

I.3. Automation in PSA

The automation gives life to the workshops making in motion the whole resources and installations in a coordinated and controlled way. The main task is assisting workers in order to improve the production performance.

The AUT (automation) entity includes all automation activities in PSA Peugeot Citroën.
It aims to:

- Define the automation politic that will be brought into the group, and ensure its applying to make sure the durability of the installations.
- Look permanently after technologic evolutions and offer all changes which can be profitable to PSA.
- Study, design, make and set up automations.
- Assist and inform operators and maintenance to increase the resources availability.
- Specify the group requirements:
  - Components to use in order to avoid inducted costs
  - Give help to choose partners
  - Technical and cost valuation
- Lead the realization:
  - Studies validations, executions , implementations
  - Ensure the link between the factories and suppliers
  - Teach the operators
  - Uphold deadlines and action plans

I.3.1. Transversal Activity in Automation
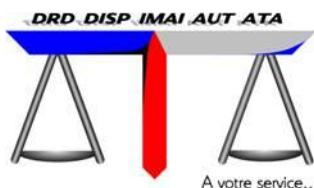
The ATA entity aims to work out strategic choices and the technical politic in automation.
The goal is to make available equipment, software, tools, and methods to ensure the success of projects.
ATA tasks are:

- Set up the industrial politic of PSA in the automation field:
  - Expend relations and guide partners choices.
  - Ensure relations with operational teams to implement solutions.
- Research in the automation field for innovations and technical baselines suitable for PSA:
  - Valuate new solutions and methods.
  - Choose the most relevant and test them.
  - Ensure their insertion in projects and the innovation mastering.
- Give to PSA rules on the safety of electrical equipment:
  - Analyze rules evolutions, standards and documents related to people safety
  - Broadcast internally important information and make them as baselines if required.
  - Take part in PSA workshop of safety procedures harmonization.

I.3.2.My position

I was within the team SDO (Standards and Organic Developments), this team gives guidelines for all PLCs projects in all countries, their developments and choices affect all PSA factories.

My works and conclusions give the main information for the team in order to start properly building and setting up the future standards and guidelines using TIA PORTAL. To accomplish this work, I have worked closely with all the team to assimilate correctly standards and ways of working, this way I was able to guide my work in accordance to PSA needs. I had also some exchanges with Siemens about some very particular points and bugs which I found.

II. Chapter 2: Subject presentation

II.1. Problematic

PSA Peugeot Citroën has as majority Siemens PLCs in Europe, and having developed consequent standard tools based on Siemens devices, PSA has to follow Siemens product evolutions (PLC, HMI mainly).

Siemens offers since December 2011 a new development platform "TIA PORTAL"; for now their products are compatible with both new and old platform, but in a near future PLC and HMI will be working only with TIA PORTAL, therefor PSA has to migrate its programs for future projects.

In order to prepare these future migrations, this subject was proposed to study the procedures and find solutions in case of incompatibility.

The main problematic is that the current diagnostic software used by PSA "Pdiag" is not available in TIA PORTAL and the diagnostic is very important in the automotive industry. Production lines are complex, with many machines and tools, and detect and find any trouble quickly is important. Therefore, my main job was to find how it is possible to make diagnostics in another way.

Another job was naturally to explore and list what TIA PORTAL gives to improve programmers job, and what is missing in comparison to the old software.

II.2. Used tools

II.2.1. What is a PLC?

PLCs are often defined as miniature industrial computers that contain hardware and software that is used to perform control functions. A PLC consists of two basic sections: the central processing unit (CPU) and the input/output interface system. The CPU, which controls all PLC activity, can further be broken down into the processor and memory system. The input/output system is physically connected to field devices (e.g., switches, sensors, etc.) and provides the interface between the CPU, information providers (inputs) and controllable devices (outputs).To operate, the CPU reads input data from connected field devices through the use of its input interfaces, and then executes, or performs the control program that has been stored in its memory system. Programs are typically created in ladder logic, a language that closely resembles a relay-based wiring schematic, and are entered into the CPU's memory prior to operation. Finally, based on the program, the PLC writes, or updates output devices via the output interfaces.

As PLC technology has advanced, so have programming languages and communications capabilities, along with many other important features. Today's PLCs offer faster scan times, space efficient high-density input/output systems, and special interfaces to allow non-traditional devices to be attached directly to the PLC. Not only can they

communicate with other control systems, they can also perform reporting functions and diagnose their own failures, as well as the failure of a machine or process.

When we consider all of the advances PLCs have made and all the benefits they offer, it's easy to see how they have become a standard in the industry, and why they will most likely continue their success in the future.
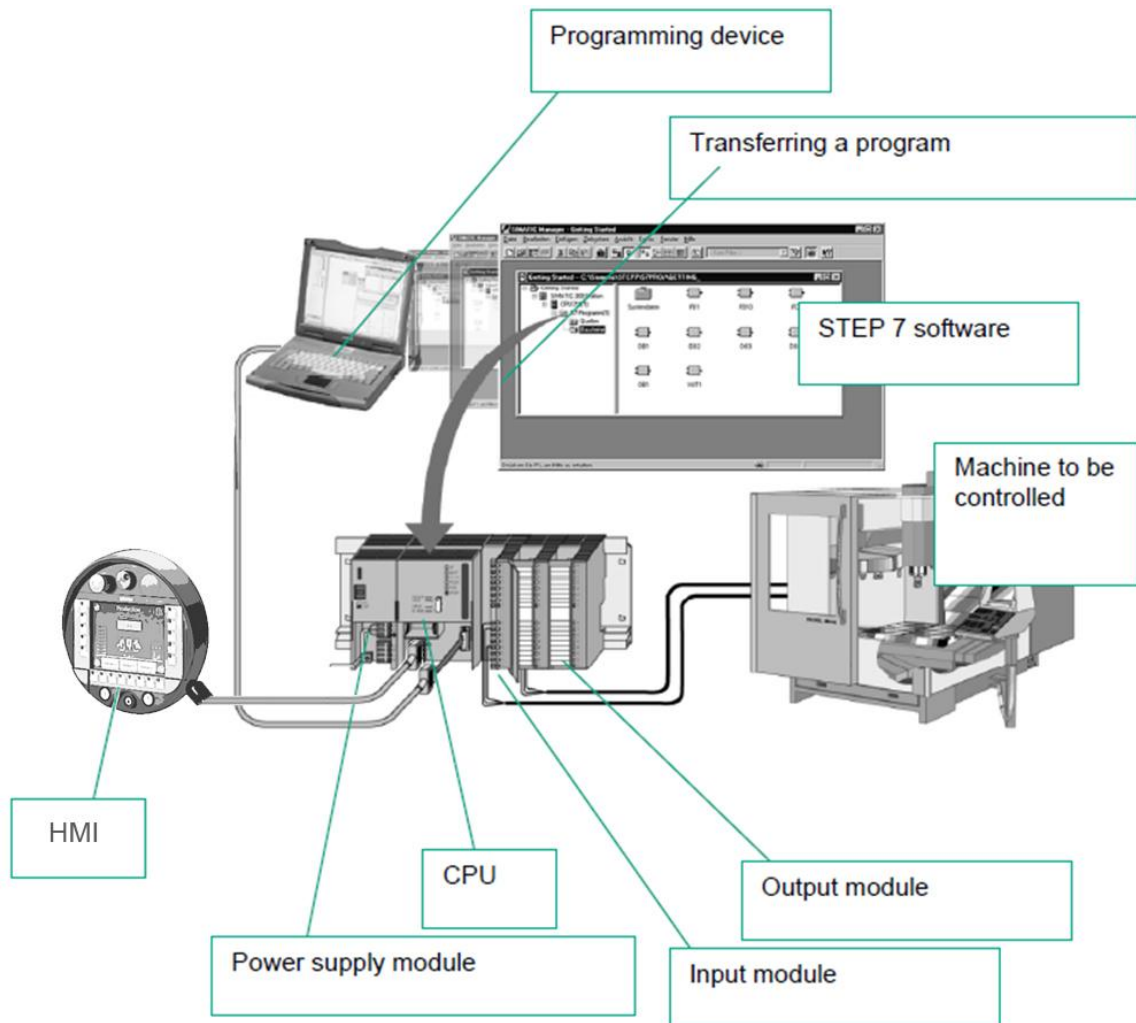
The figure 6 shows an example of an automated plant.
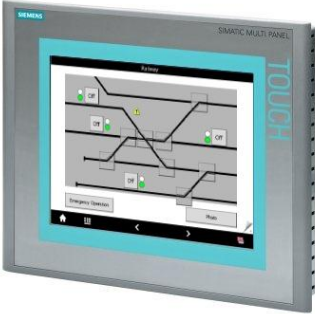
Figure 6 Automated plant example

II.2.2.Used Hardware

II.2.2.1.CPUs

CPU Name	CPU 319F-3 PN/DP	CPU 416F 2 DP
Memory	2.5 MB / 700 KB retentive	2.8 MB (Data) 2.8 MB (Program)
Interfaces	X1: MPI/DP X2: DP X3: PN (2 ports)	X1: MPI/DP X2: DP
CPU Dimensions WxHxD (mm)	120x 125 x 130	25x 290 x 219

II.2.2.2.HMI

Mobile Panel 277 8" touch screen	Multi Panel 277 10" touch screen	Comfort Panel TP900 9" touch screen

II.2.3.Used Software

II.2.3.1.Step 7 V5.5

STEP 7 is the standard tool for the Siemens automation systems. It contains convenient functions for all phases of an automation project:

- Configuring and parameterizing the hardware.
- Specifying the communication.
- Programming.
- Tests.
- Operating/diagnostics functions

II.2.3.2.Wincc flexible 2008

WinCC Flexible is the HMI software for Siemens HMIs, it gives all necessary tools to design, configure and program industrial interfaces to be used in plants for example.

II.2.3.3.PDIAG

PDIAG enhances the function scope of the STEP 7 standard software with process diagnostics functions for the programming languages LAD/STL/FBD. The Process Diagnostics function detects errors in the user process and acquires information about:

- The type of error
- The location of the error
- The cause of the error in the process.
- Provides troubleshooting information on HMIs and supervision.

II.2.3.4.TIA PORTAL

Totally Integrated Automation Portal is the new Siemens automation software. It includes all new automation softwares in one, PLC control, HMI, supervision and more.

III. Chapter 3: Works done

III.1. Standards and current tools handling

III.1.1. Introduction

Before working on the problematic, I had to learn PSA standards and automation tools that are used.

III.1.2. PSA Standards

With establishment of rules for programing, design, naming…, PSA wants to obtain a common ground for new projects in all production sites. With hundreds of new PLCs each year, we can easily figure how important is to have programs built on the same rules.

III.1.2.1. The ACTIF concept

ACTIF (Aide à la Conduite Transversale des Installations de Fabrication) "Transverse Production Installation Steering Assistance" is the standard for automation. It has 7 head standards:

- 51G (Safety)
- 15G (Terminology)
- 38G (Functional specification)
- 250G (Electric project)
- 46G (Electric realization)
- 160G (Operator terminal)
- 36G (PLC programing)

The ACTIF concept is based on 4 main basics:

a. Functional decomposition

The functional decomposition aims to structure and bring together all components of a system in different functional decomposition. There are PLC/CELL/GRM/ENTITY that respect the following arborescence:

PLC
    ⌊⟶ CELL
           ⌊⟶ GRM : Group of running
                ⌊⟶ ENTITY (contains **O**perative **P**art **E**lement "**OPE**")
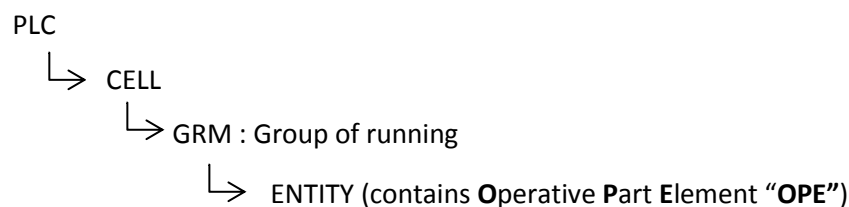
This functional decomposition is done by specifying elements from the lowest to highest level, from Entity to PLC.

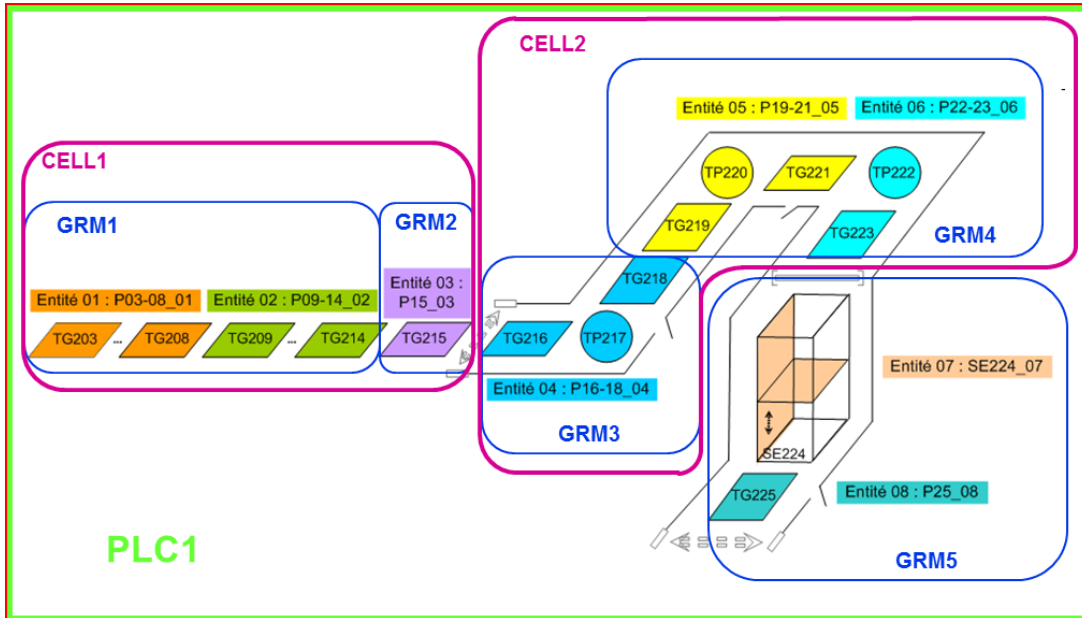The figure 7 shows an example of a functional decomposition.

Figure 7 Functional decomposition

b. Operating modes

All modes and procedures must be specified for each element of the functional decomposition.
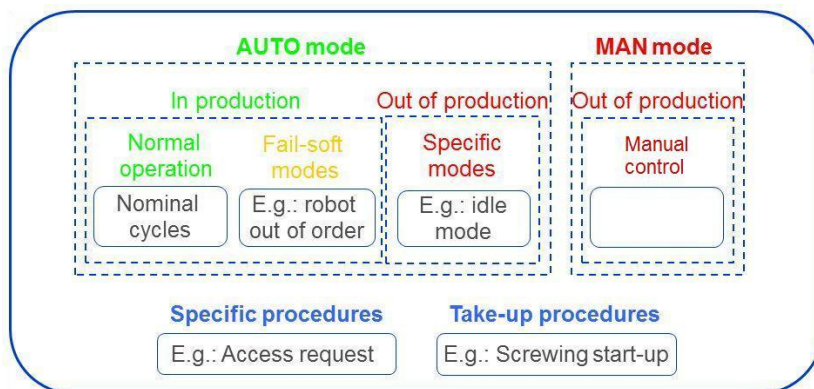
The figure 8 shows different operating modes.

Figure 8 Operating modes

c. Interfaces

Interfaces include the following elements:

- HMI : Operator terminals [figure 9 and 10]
- Information received or transmitted with third party equipment
- Information received or transmitted with computers

Figure 10 Fixed HMI
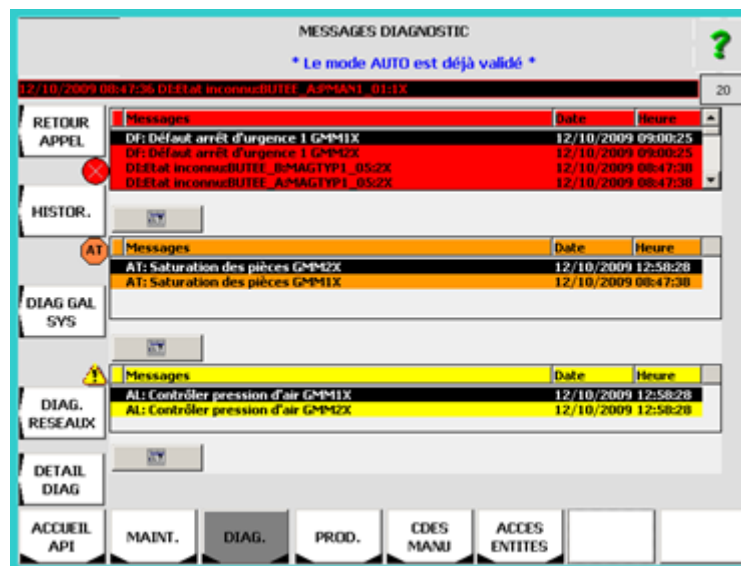

Figure 9 Mobile HMI

d. Diagnostic

Figure 11 HMI diagnostic view

The diagnostic includes event messages and steering assistance messages [figure 11]

    i. Events are categorized in 3 types:

➢ Category with a display in red : for events in the PLC area which stop the plant

> ➢ Category with a display in orange : for external events which stop the plant

> ➢ Category with a display in yellow : for events that do not stop the plant

ii.   Steering Assistance messages (**in blue on the top**). There are 2 types:
General messages: They show missing conditions for:
- Safety groups
- Energy groups
- Operating modes

Messages for operator actions: They show missing conditions in case of rejection for a command request.

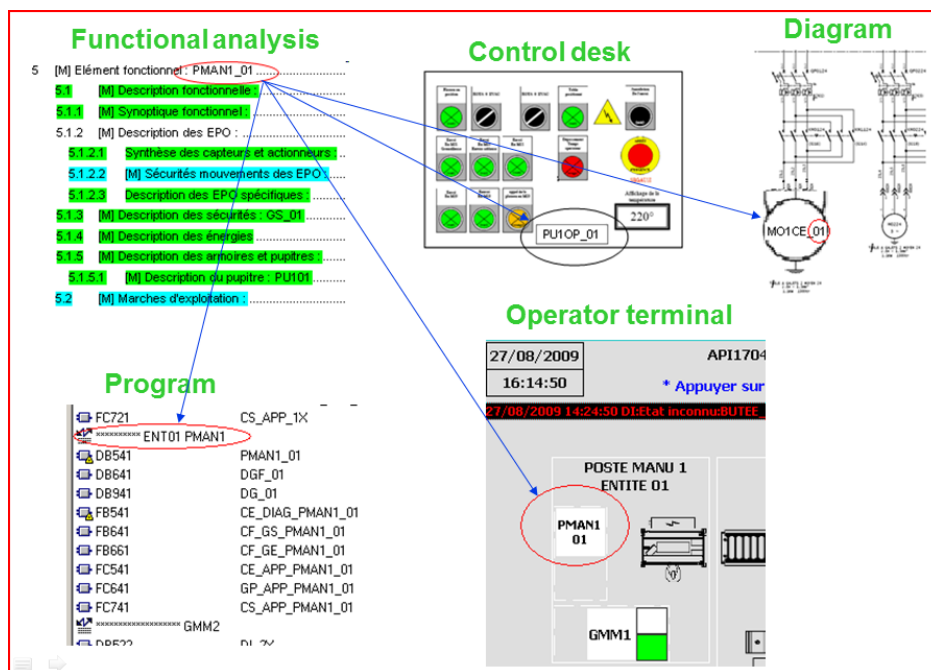In the figure 12 we can see the coherence between mnemonics with ACTIF

Figure 12 Mnemonic coherence

III.1.2.2. Organic bases

To facilitate the understanding of the standards by programmers, AUT/ATA has established four bases of programming, BODYSHOP, ASSEMBLY, POWERTRAIN and NEUTRAL, with a TOOLS program and all necessary documents needed to use these bases.

In the TOOL program [figure13], programmers have close to hand several HMI pages, blocks and standard objects. Through the use of simple functions such as Copy/Paste, they can easily incorporate in their projects standard pages and objects. The TOOL lists objects of the four bases, thanks to that they can at the same time use or adapt objects which exist specifically in a workshop.

The base program, as its name suggests, is the basis of programming. Programmers will enrich this basic program with standard objects. In this program we have all objects, pages and blocks that must be common for all systems.

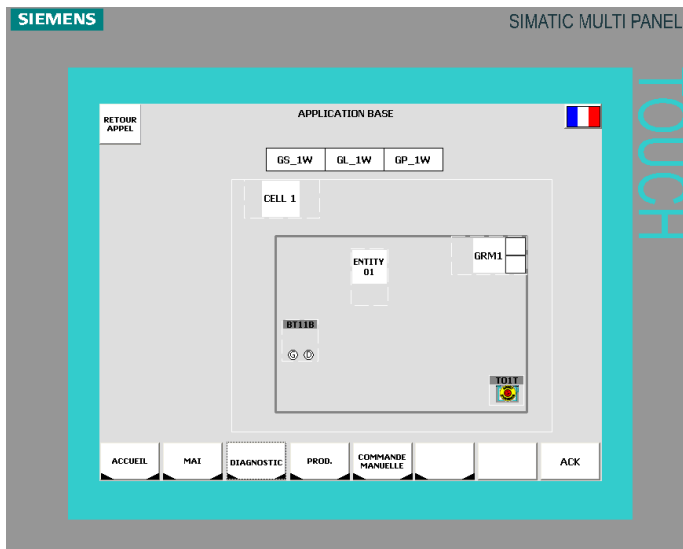The figure 14 shows the HMI home page of the BASE program.
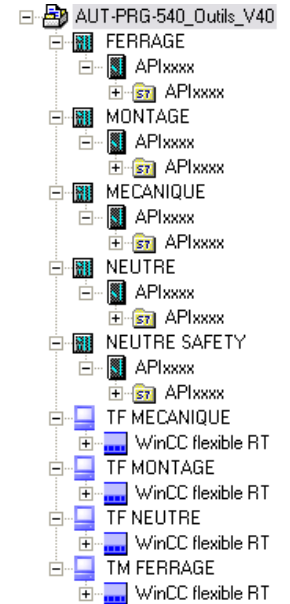

Figure 13 TOOL program

Figure 14 BASE program home page

III.1.2.3.Application with neutral base

In order to assimilate PSA standards and learn how to use Step7 V5.5, Wincc Flexible and Pdiag, I have made an application using an "ACTIF" base.

At this time the neutral base was almost finished, therefor I used this base to make in the same time tests, report bugs and help to fix them before broadcast the base.

This application aims to be as various as possible in order to know and test the most common situations [figure 15]. It includes:

- 1 PLC
- 1 CELL
- 2 GRM
- 2 ENTITIES : In each Entity there are three different kinds of OPE

- 1 fixed operator terminal (HMI multi panel)
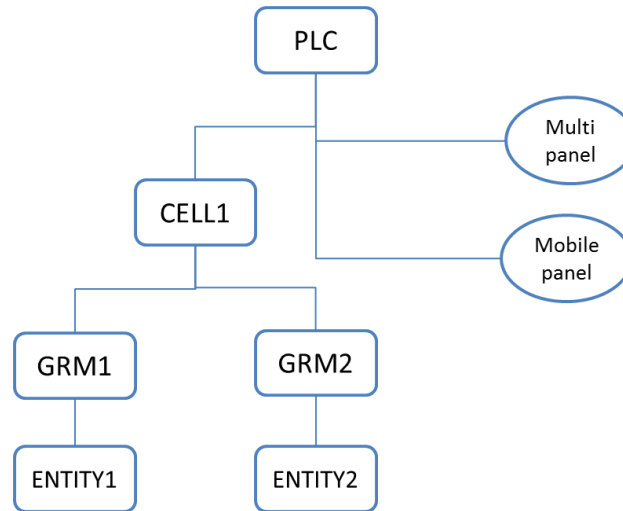- 1 mobile operator terminal (HMI mobile panel)

Figure 15 Application synoptic

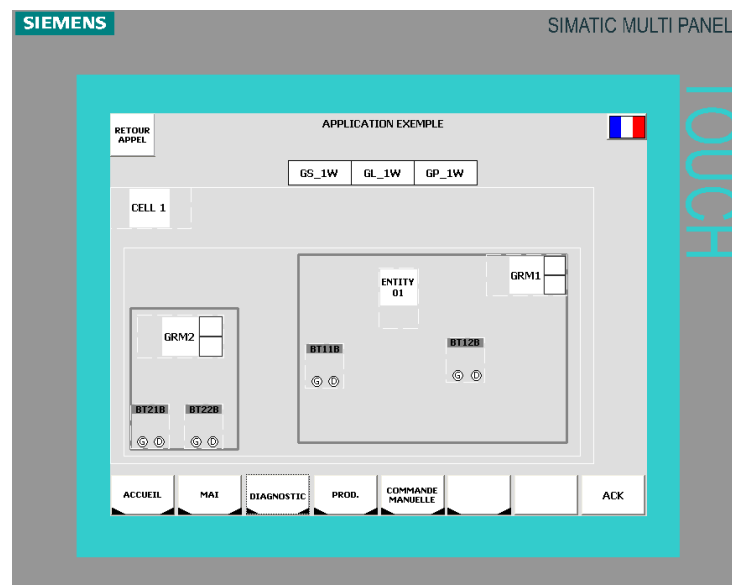The figure 16 shows the HMI homepage of my application.

Figure 16 Application HMI home page

In each Entity there are three different blocs to control three different kind of OPE:

o DIAG_2P1: Applicable to any operative part element (OPE) with 2 distinct positions, a diagnostic and the manual command is managed from the touch screen HMI.

The OPE must have at least one position physically controlled by at least one sensor.
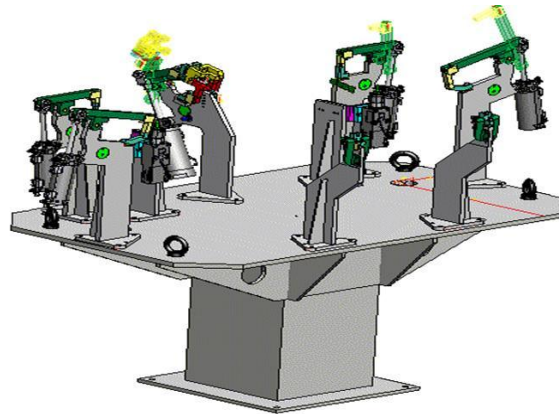
e.g., Clamp [figure 17]

Figure 17 Clamp

o DIAG_NPS: Applicable to any operative part element (OPE) with more than 2 distinct positions, a diagnostic and the manual command is managed from the touch screen HMI.
e.g., Lift [figure 18]

Figure 18 Lift

o DMVTOP: Applicable to any operative part element (OPE) with 2 distinct positions and manual command through the touch screen and which does not need sensors.
e.g., Conveyor belt [figure 19]

Figure 19 Conveyor belt

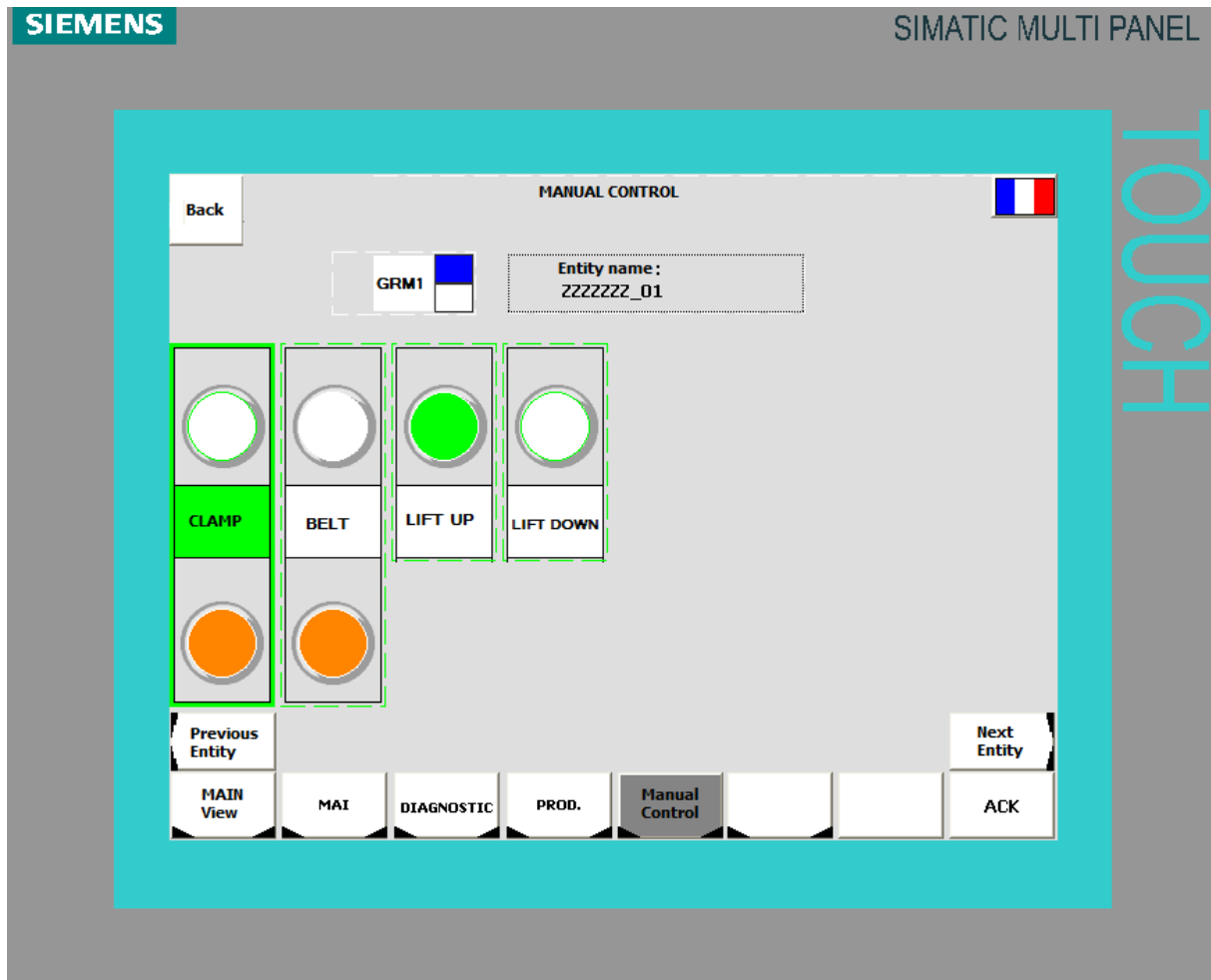The figure 20 shows manual control view of the HMI.

Figure 20 Manual control view

III.1.3.Conclusion

After this step I have got the necessary knowledge on PSA standards, PSA needs, and the current Siemens automation tools to face the problematic and find out failings and improvements.

III.2.TIA PORTAL step

III.2.1.Introduction

In this step I started the exploration of TIA PORTAL, search for solutions and bring new way for improvements.

III.2.2.Diagnostic

III.2.2.1.Introduction

The diagnostic is very important in the automotive field. In such a complex factories, any trouble in sensors, actuators, wires or something else can cost lot of money, therefor we have to find the origin of failures as fast as possible, and for this, the diagnostic must be precise to display on the HMI [figure 21] clearly where the failure is, and fix it.
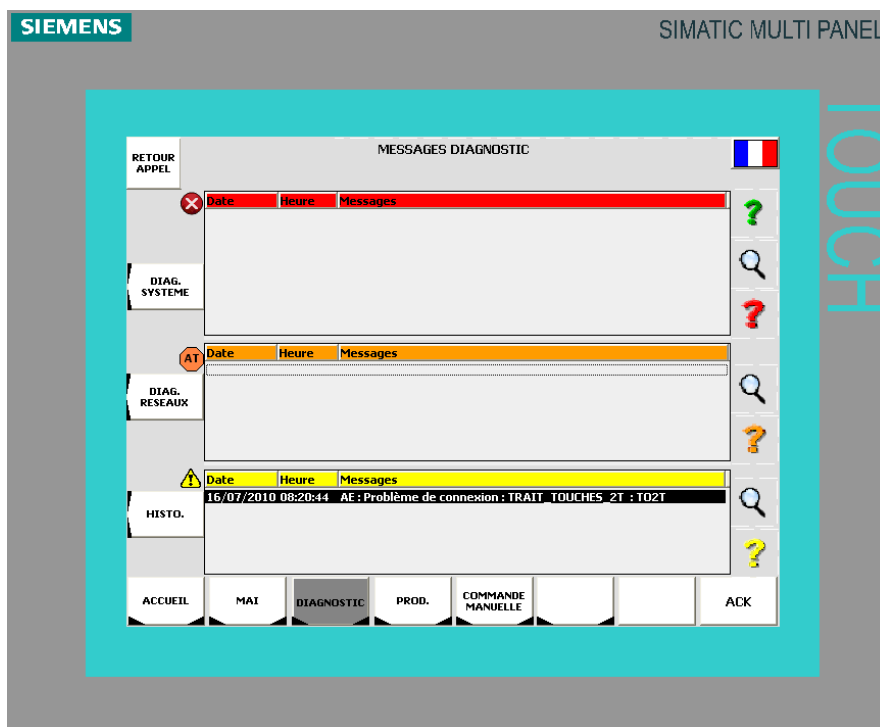

Figure 21 Diagnostic view

III.2.2.2.PDIAG - the diagnostic with Step7 V5.5

On the current bases the diagnostic is handled by the tool PDIAG, it gives the possibility to monitor variables, inputs and outputs, and raises configurable alarms in the CPU which we can display on the HMI and send it to the supervision. With these alarms a specific message is displayed for each operand. This message is composed by a written text

and specific variables which are replaced online by some data. More explanations about these data in the following table. [Table 1]

$$u$$, $$u1$$	Name of the higher-level unit
$$u2$$ to $$u9$$	The name of the corresponding higher-ranking unit. **Example:** You create an error definition with the formal address $$u3$$ in the fifth subunit of the S7-PDIAG tree structure. The unit value is therefore "u" or "u1". Starting at this value, the counter increments until the higher-ranking unit u3 is reached. Unit u3 is then output to the HMI.
$$ur$$	Name of the top unit within the tree structure
$$m$$	Name of the motion Important note:
$$o$$	Diagnostic entry address of the instance error definition (symbolic format if no symbol exists in the absolute format)
$$d1$$	Name of the motion direction 1
$$d2$$	Name of the motion direction 2
$$a$$	Diagnostic entry address in absolute format
$$s$$	Diagnostic entry address in symbolic format
$$c$$	Symbol comment for the diagnostic entry addresses **Note:** In the message text you can replace the formal address with the symbol comment from the symbol table.
$$CpuName$$	Name of the configured CPU. If no CPU was configured, the formal address will be retained and is not substituted during compilation.

Table 1 Auto filled variables

The figure 22 shows an example of a diagnostic message on HMIs.

Date	Heure	Messages
01/01/1990	14:55	Sensor expected at 1 : SQ1PP01 : OP01_01

Figure 22 Diagnostic message example

The procedure to add a monitoring with PDIAG on an operand is as follows:

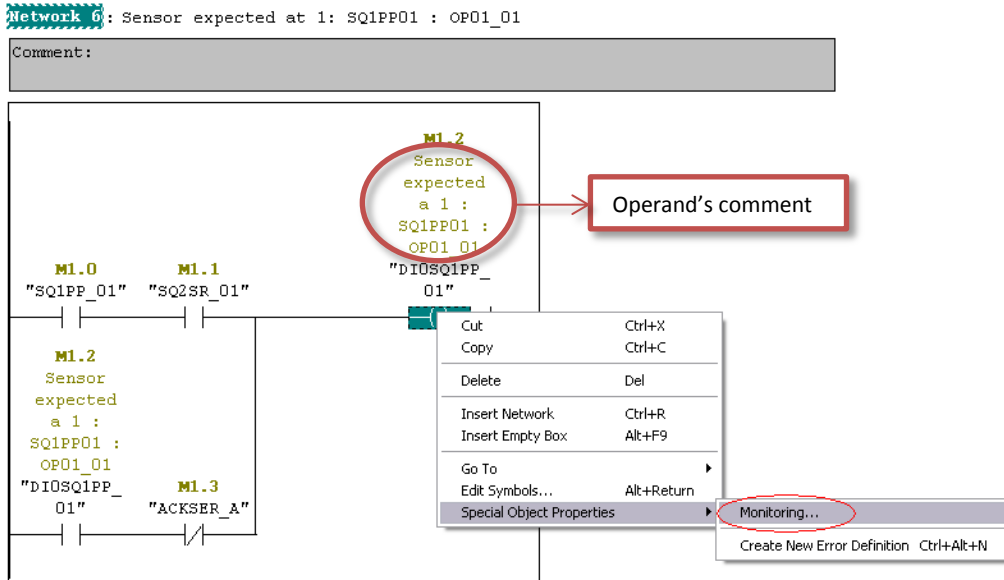➕ Select the "Monitoring…" function [figure 23]

Figure 23 Monitoring function

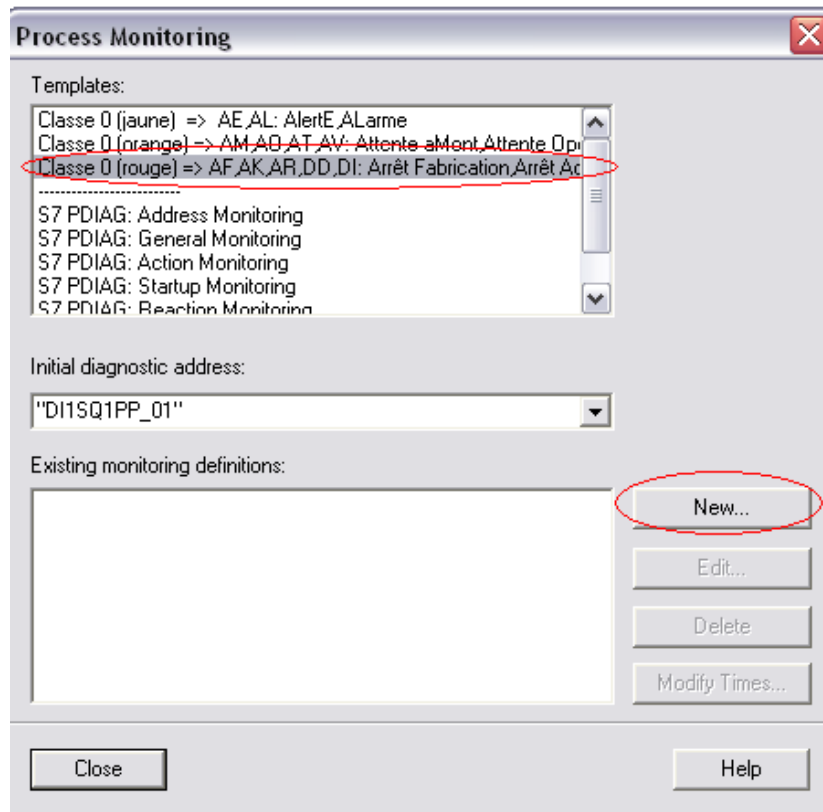➕ Choose the suitable template [figure 24]

Figure 24 Templates list

✚ Edit the message for the HMI : the default text is the operand's comment [figure 25]
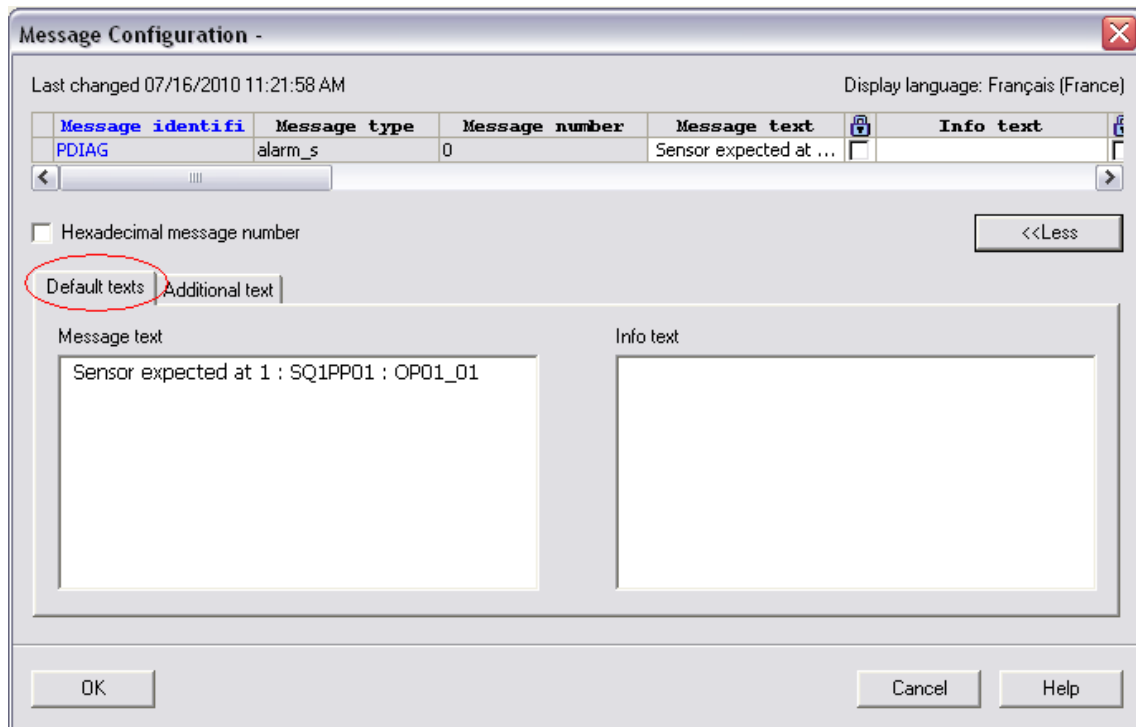

Figure 25 HMI message edition

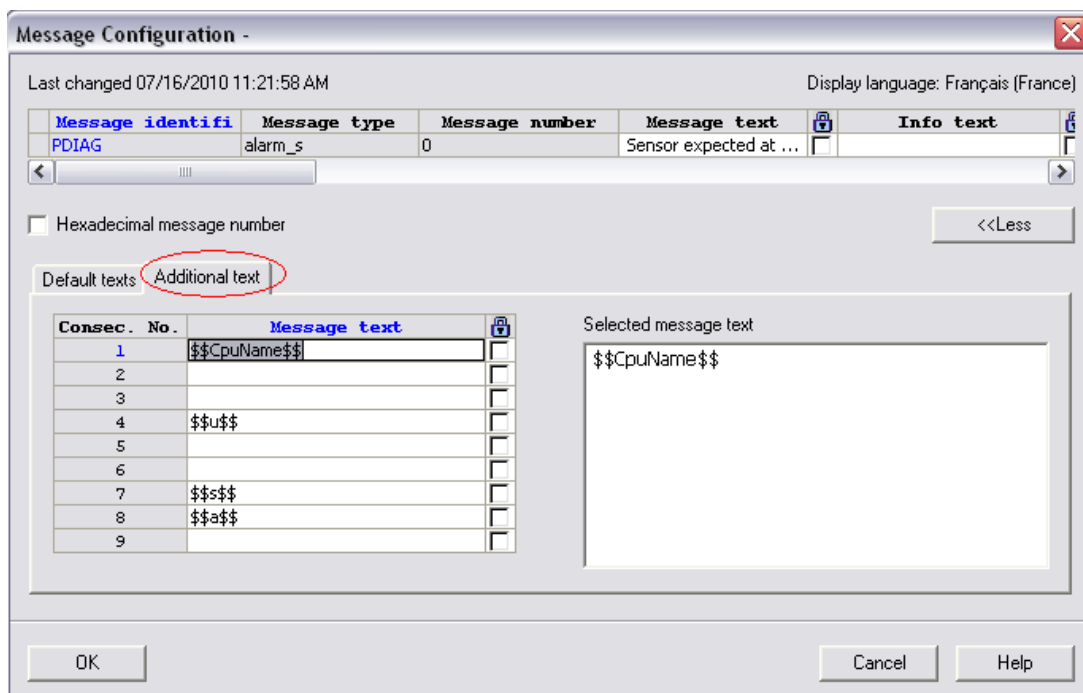✚ Edit the message for the supervision [figure 26]

Figure 26 Supervision message edition

In the example, when the stat of DI0SQ1PP_01 is "1" the configured message appears [figure27 and 28]
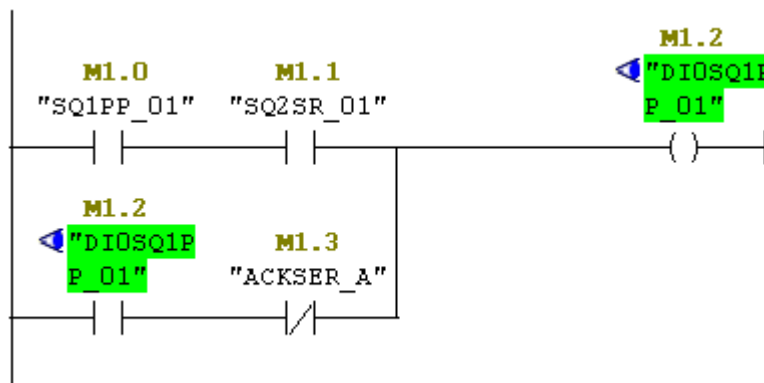

Figure 27 Network with a diagnostic

Figure 28 Diagnostic message on the HMI

III.2.2.3.Solutions on TIA PORTAL

The advantage of PDIAG is that messages are written only once as the operand comment. These messages are sent further to all HMIs. This way we avoid mistakes due to multiple writings and message affectation to the wrong operands. As well, messages being in the CPU, modifications are also done once.

To respect these last advantages, make diagnostic on the HMIs is not efficient, because it means setting up the diagnostic more than once; it must be done for each HMI. This solution is not appreciable.

SFC18

To set up the diagnostic in the PLC it is possible to use the Siemens function SFC18 (ALARM_S) which raises events with same properties as PDIAG events.

Set up a diagnostic on an operand
- Instantiate an alarm
- Declare at least the C_Alarm_s data type
- Connect inputs and outputs:

  ➢ The Annex1 shows the parameters of the block "ALARM_S":
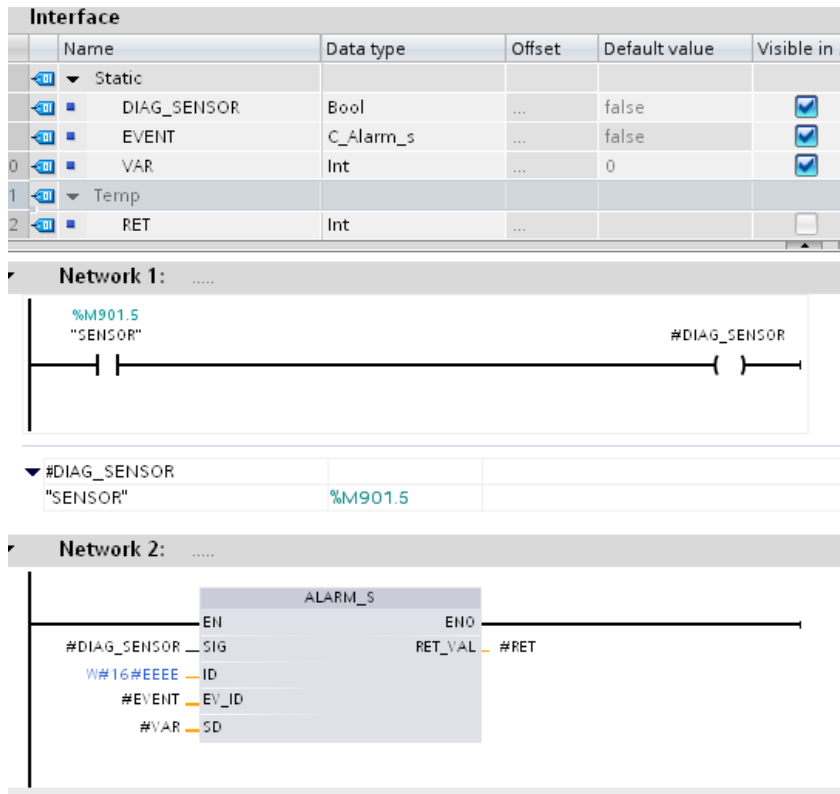
The figure 29 shows the previous steps on the TIA PORTAL.

Figure 29 SFC18 set up

➕ Edit the correspondent alarm [figure 30]

Figure 30 PLC alarms edition

When DIAG_SENSOR is in the state "1" the alarm appears and we can see our message [figure 31]
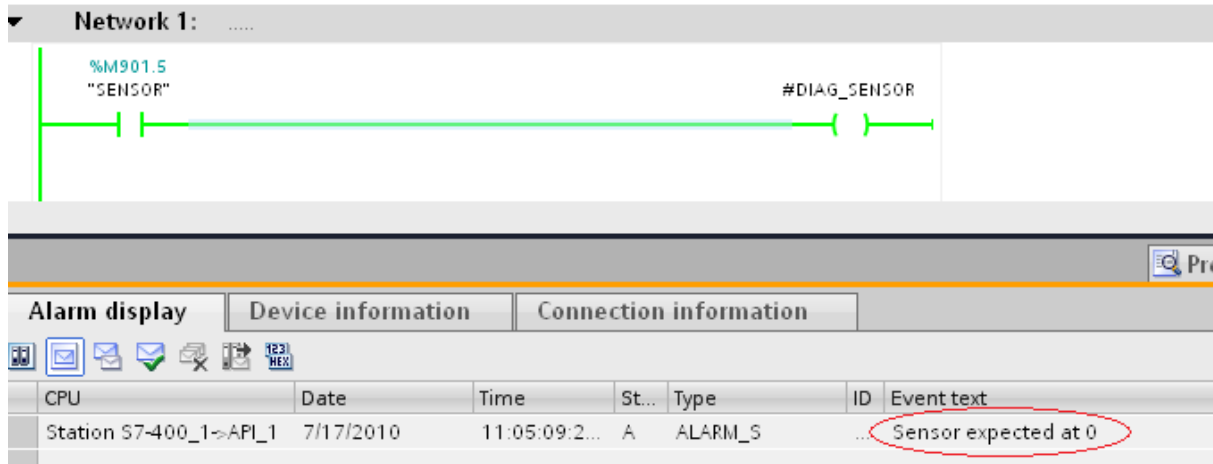

Figure 31 Diagnostic message apparition
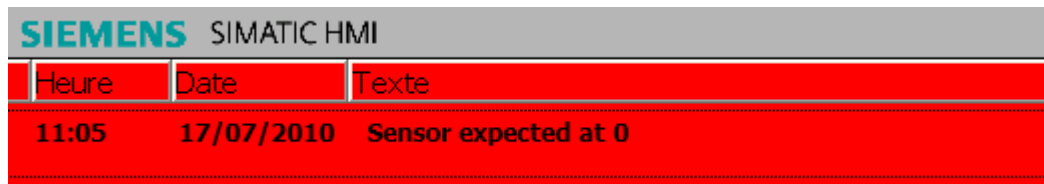
The message is also displayed on the HMI [figure 32]

Figure 32 Diagnostic message on the HMI

FB_ALARM

In order to simplify the use of alarms, I have created an instantiable functional block with only 3 inputs SIG, EV_ID, VAR (optional).

We can transfer a process value with the VAR parameter and display it via the following string: **@Pvn Typ %width[.precision]format@** [table 2]

Symbol	Meaning	Value range	Default
@	Start of the format string		
Pvn	Process value number	1-4	1
Type	Type of process value	See Annex2	
%width	Width of the display field on the OP		
.precision	Number of decimal places (optional for format = "f")		
format	Process value display mode	See Annex3	
@	End of the format string		

Table 2 Composition of the associated values

Set up the block

To see how this block works, I take the same example as before.

- First we instantiate the block
- Declare a C_Alarm_s data type
- Link the inputs

The figure 33 shows the previous steps on the TIA PORTAL
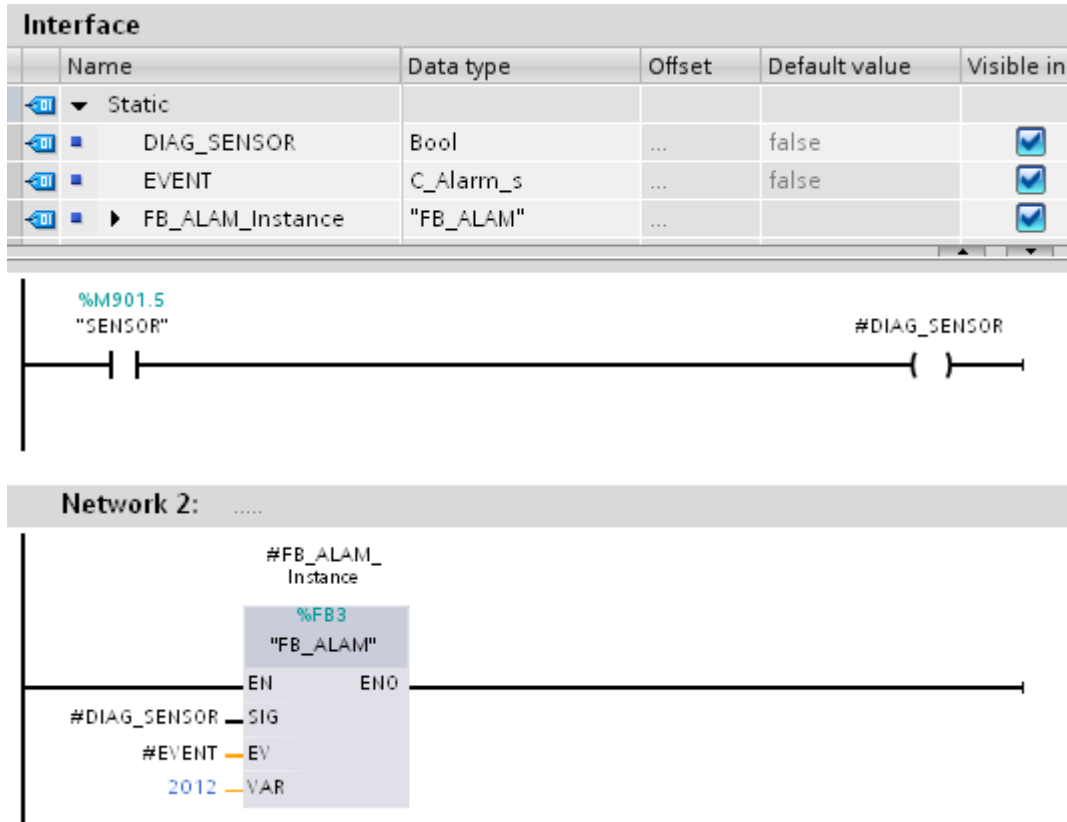
Figure 33 FB_ALARM set up

- Edit the alarm [figure 34]

Figure 34 PLC Alarms edition including an associated value

After compilation and loading the CPU and HMIs, we see the message and the value "2012" which is in the VAR input [figure 35]

Figure 35 Message apparition with VAR value

The same message is displayed on the HMI [figure 36]

Figure 36 Message on the HMI

Get CPU Name

Getting the CPU name is possible through the SFC51 RDSYSST that reads partial system status lists.[figure 37]

The system status list (SZL) describes the current status of an automation system. The contents of the SZL can only be read using information functions, contents cannot be modified. The partial lists are virtual lists, in other words, they are only created by the operating system of the CPUs when specifically requested.
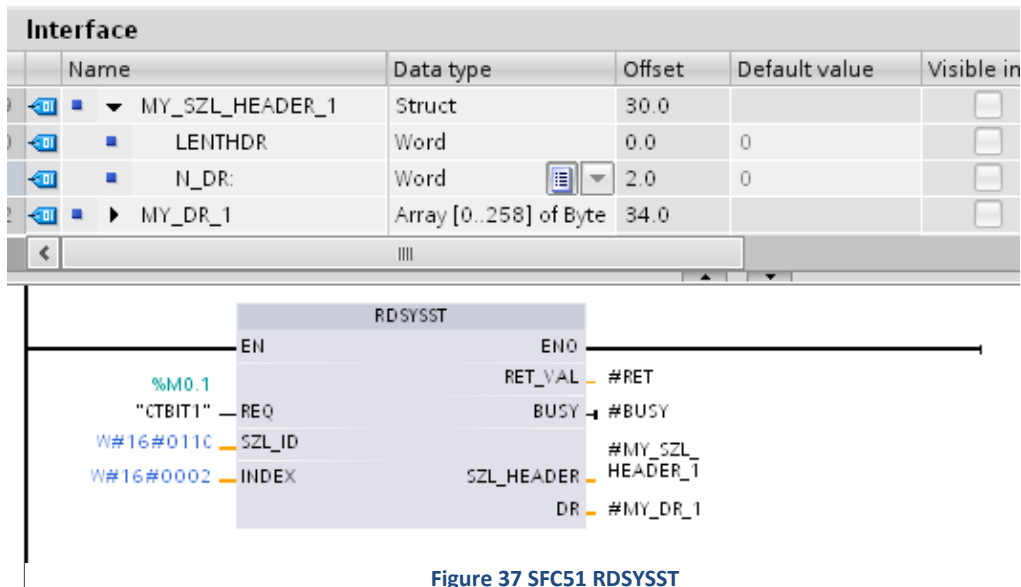
Figure 37 SFC51 RDSYSST

The ANNEXE4 shows the parameters of the instruction "RDSYSST":

After compilation and loading the CPU, we see that we got the CPU name ("API_1" in the example) as an array of chars. [figure 38]

Figure 38 CPU Name reading

The other data

After research and discussions with Siemens, I find out that it is not possible to get data such as the name of instance and others which are specified in the table 1, at least for this version V11 of TIA PORTAL.

III.2.3.Conclusion

We can see that setting up diagnostics is possible on TIA PORTAL, but comparing to PDIAG it is necessary to instantiate an SFC block for each different message and write the instance name, operand name, and operand address manually. This way, the probability of mistakes increases significantly and the procedure is time consuming.

To be able to reach this conclusion, all previous steps were necessary, and the main difficulty which I have faced was getting technical information about TIA PORTAL. As a new framework, it is not well known, people who work on it are rare around the world and documentations are almost non-existent, therefor I had to get some information directly from Siemens in Germany or through their unit in France.

III.3.Other tasks

III.3.1.Introduction

Beside my work on the migration to TIA PORTAL I have done some others tasks and activities in order to get well into the company.

III.3.2.Technical exchanges

Every year, employees of PSA in the automation field from all countries are invited to take part to these exchanges physically or through audio conferences, in order to be informed about new software, hardware, machines, tools, standards and many other subjects which are handled by experts. It aims to give more details or answer to questions about the subject, or introduce it to employees if they are not familiar with this last even if it is not their working field.

Through the list of subjects I have taken part of 3 :

1. Industrial robotics: It was about robots in the factory, new applications, safety and some other robotic subjects.
2. A research project: This project deals with innovations, manly in robotics to find new tools in order to improve production, safety and new working areas.
3. SEE ELECTICAL: It is an electrical CAD software. A new version was released this year; therefor this exchange was the opportunity to introduce it.

III.3.3.ACTIF's course

- This training course provides an introduction to PSA's automation standard
- It has the following objectives:
    - o Provide introduction on the ideas of the standard.
    - o Show how these tools complement each other.

III.3.4.Visit of workshops

In order to understand how a car is made from the beginning, how the factory works and to have an overview of the automation systems that are set up, I have visited all workshops from stamping to the final assembly.

III.3.5.Neutral base tests

When I started my trainee, a new version of the neutral base was in programing, therefor along with my handling of standards and tools I have done a plenty of tests on the base in order to detect any bugs and help to fix them before releasing it to workshops.

Besides PLC and HMI programs, there are several technical documents which are written to explain how to use the base. I have read all documents to give an external point of view, unsure that sentences cannot be interpretable in different ways and check the coherence with programs.

III.3.6.Communication with Siemens

Through my works on TIA PORTAL, I found out some bugs on this last and mistakes on its documentations. After checking that it does not come from mistakes I would have done, I sent a report to Siemens about them in order to make sure that they will fix it, especially for ALARMs.

I also contacted Siemens to get some specific information and details which are provided nowhere in the documentation.

III.3.7.Conclusion

Even if a part my activities were not really linked to my subject or not linked at all, it was very rewarding and it gave me the opportunity to see various domains and learn more about the automotive industry and the industry in general.

General conclusion

Through my internship I have got knowledge on PSA standards and Siemens automation tools, this knowledge allowed me to point PSA needs and face the problematic. Therefore I could propose a solution for the diagnostic and light on improvements, failings and bugs.

I converged to conclusions which will be used by the SDO team to build and set up the future standards and bases for the whole factories around world where Siemens PLCs are used.

I have taken part to some other activities more less linked to my subject. They helped me to get well in the company and understand more clearly how the factory works and see the place of the automation and PLCs have.

In the end of my trainee, I can say that I had a really rewarding experience into a worldwide company and with a very competent and professional team. I have learned through their experience a lot about the big industry which is the automotive. With my works I could improve my knowledge in the automation and I could see how this last is important in such a big and complex industry and how it works.

Unfortunately there are no lectures about PLCs in our Master studies, it would be interesting to get even an introduction about it, knowing that the industry is the most important part of the economy, and all automation and robotic in the industry are controlled with PLCs.

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Websites

- http://support.automation.siemens.com/

Annexes

Parameters	Declaration	Data type	Memory area	Description
SIG	Input	BOOL	I, Q, M, D, L	The alarm triggering signal
ID	Input	WORD	I, Q, M, D, L or constant	Data channel for alarms: W#16#EEEE
EV_ID	Input	C_ALARM_S (DWORD)	I, Q, M, D, L or constant	Alarm number (not allowed: "0")
SD	Input	ANY	I, Q, M, D, T, C	Associated value Maximum length: 12 bytes Only the BOOL data types are permitted (not permitted: Bit array), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND_TIME.
RET_VAL	Return	INT	I, Q, M, D, L	Error information

Annex 1 Alarm_s parameters

Type	Meaning
"B"	BOOL
"Y"	BYTE
"C"	CHARACTER
"W"	WORD
"I"	INTEGER
"X"	DWORD
"D"	DINT
"R"	REAL

Annex 2 Permissible types for VAR input

Format	Display
"d"	Decimal with a sign
"u"	Decimal without a sign
"X"	Hexadecimal
"f"	Fixed point number with a sign
"b"	Binary
"s"	Character string (ANSI string)

Annex 3 Permissible format for VAR input

Parameters	Declaration	Data type	Memory area	Description
REQ	Input	BOOL	I, Q, M, D, L or constant	REQ=1: Trigger processing
SZL_ID	Input	WORD	I, Q, M, D, L or constant	SZL-ID of the partial list or partial list extract
INDEX	Input	WORD	I, Q, M, D, L or constant	Type or number of an object in a partial list.
RET_VAL	Return	INT	I, Q, M, D, L	If an error occurs during execution of the instruction, the RET_VAL parameter contains an error code.
BUSY	Output	BOOL	I, Q, M, D,L	TRUE: Reading not yet complete.
SZL_HEADER	Output	STRUCT	D, L	See below.
DR	Output	ANY	I, Q, M, L, D	Destination area of the read SZL partial list or the read SZL partial list extract: • If you have only read out the header information of an SZL partial list, you should not evaluate DR but only SZL_HEADER. • Otherwise, the product of LENTHDR and N_DR indicates how many bytes were entered in DR.

Annex 4 RDSYSST parameters