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For full control over software development process: MCL, our methodology

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Abstract

Creating, improving and implementing a methodology is quite a difficult task. Studies for the creation of our first methodology started in 1982. It became fully operational in 1984 and was named MELODIE. A certain amout of difficulties and experience-feedback led us to remodel it in 1985. Two years later our new methodology, named MCL, was beginning to be used. It was distributed in 1988. We did the first updating of the MCL in 1992. Next step was its self-assessment with the CMM. To reach the next level, a improvement plan had to be implemented. The future looks like SPICE for the moment.

1 System activity history in Elecma

Control laws are steadily growing in complexity and performance. The needs for maintenance are also increasing. All of this has led to introduce more and more electronics on aircraft engines. Elecma, the Electronics Division of Snecma, was created in 1961 to answer this new demand.

Since then, the electronic part of the engine control unit has been continuously rising from 15% on the ATAR 9K50 (1974, MIRAGE

F1) up to 60% of the control system on the M88 (1990, RAFALE). Digital components were first introduced on a mock-up of a turboshaft control unit in 1981 entailing the need for a relevant software.

The first operational control unit was a prototype for the M53-5 engine (MIRAGE 2000) in January 1984. The same year, FADEC (Full Authority Digital Engine Control) units started to be studied for the Snecma M53-P2 (MIRAGE 2000) engine and the Turbomeca TM319 (ARRIUS 1-A) and TM333. In 1988, Elecma began to design the M88 FADEC unit (based on a 68020 computer and coded in "C" language). Next one was the FADEC unit of the MTR390 for the Franco-German TIGRE helicopter, (coded in Ada language), in 1990.

2 Presentation of software activities and of development process improvement

a Introduction

Software on engines appeared at the beginning of the eighties in the Division. The development cycle and adjusting of our methodology is coherent with the phases of the process improvement described by figure 1.

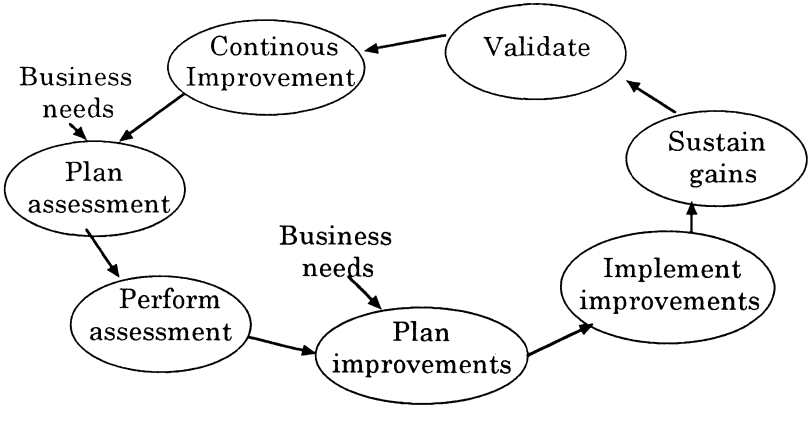

figure 1

b First rotation : MELODIE

(MEthodologie LOgiciel de Développement Industriel Embarqué = Software methodology for industrial airborne development)

Our first industrial need was simply to have a methodology for the mastery of the development process. That is why in 1981 the existing standards in software were studied. The Software Quality

function was created in September 1982. In November of the same year, a Methodology Analysis and Structured Programming was distributed. During the next month, plenty of actions took place :

- After evaluating several methods, we chose to adapt the SDM-70 (Software Development Method -70) to the specificity of our softwares.
- A Software Engineering Office (BGL : Bureau de Génie Logiciel) was created.
- A Software Standardization Committee (CNL : Comité de Normalisation Logiciel) was also created.

In the beginning of 1983, two documents about Quality Assurance were distributed for application at Snecma :

- General rules for Quality assurance applicable to airborne software systems development done under the responsibility of the Control and Equipments Division.
- Standard for Quality Assurance Plan, Design and Development applicable to airborne software systems development done under Snecma's responsibility.

In parallel, work groups were implemented to create the methodology (MELODIE) and write the DT11-51, (Methodology for airborne software development). MELODIE was distributed on March 12, 1984 and the DT11-51 on December 18, 1984.

There was also a Technical Standard Group (GST) who started working at the beginning of 1984 on writing out three documents :

- Structured Programming Standards
- PDL Standards
- Configuration Management Standards

In 1984 also, a member of Snecma's staff was involved in the RTCA SC152 committee to update the DO178.

The application of MELODIE to projects was done immediately. Between 84 and 85, all the new projects used MELODIE, including RM1627, (M53-P2 FADEC unit), TM319, (ARRIUS 1-A FADEC unit), ...

In March 1985, the GST pointed out difficulties for drafting the Configuration Management Standards. The analysis of the projects in progress and of the following works of the GST (Requirements and Analysis Standards) put in evidence five points:

- Our quality level was high but not measured, consequently it was expensive.
- Developers lack homogeneousness because of missing standards.

- The lack of methods produced omissions in requirements.
- Each project was using different tools because there was no CASE (Computer Aided Software Engineering) tools at that time.
- For the same reason, project management was different depending on the project.

In March of the same year, the decision was taken to ask external experts to perform an assessment of Elecma.

c Second rotation : MCL

(Manuel du Concepteur Logiciel = Software Designer's Manual)
The assessment started in March 1985 and 35 persons were interviewed. The results indicated three weak points :

- In training, because of the knowledge and methods disparity between the different teams.
- In procedures, except in quality.
- In tools.

Afterwards, a technology transfer, named ACGL (Acquisition de Connaissance en Génie Logiciel = Knowledge Acquisition in Software Engineering) was decided. It had six aims which were :

- Training employees in methods (SADT, MACH).
- Definitions of Standards
- Remodelling the Methodology
- Specialization training.
- Tool definition to be more productive (CASE).
- Making people increasingly involved.

The ACGL is a joint representation between the Control and Equipments Division, Elecma and the Quality Department. It started in October 1985 with the implementation of six work groups in the following fields : Requirements, Design, Testing, Quality Assurance, Project Management, Configuration Management. In December 1985 the ATL (ATelier Logiciel = CASE tools Office) was created. In 1986, the first trainings started on SADT and MACH methods. At the end of the year, the methods were used for the first time on a software project. In May 1987, the work groups had completed their missions. From 1987 on, all the new projects started to use the methods, amongst which the pilot project : the M88. The MCL was published in 1988. It contains about sixty documents with, for each development phase, a procedure, recommendations and standards. The development cycle chosen is a classical V model (figure 2). The DT11-51 has also been updated and became the DTG11-51B.

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Projects which are maintained are progressively updated in accordance with the new standards. All the new projects, including the FADEC unit of the MTR390, use the MCL. This methodology complies with DO178A, DOD MIL STD2167A and STD2168, IEEE and AFCIQ recommendations and the DGA GAMT17-V2.

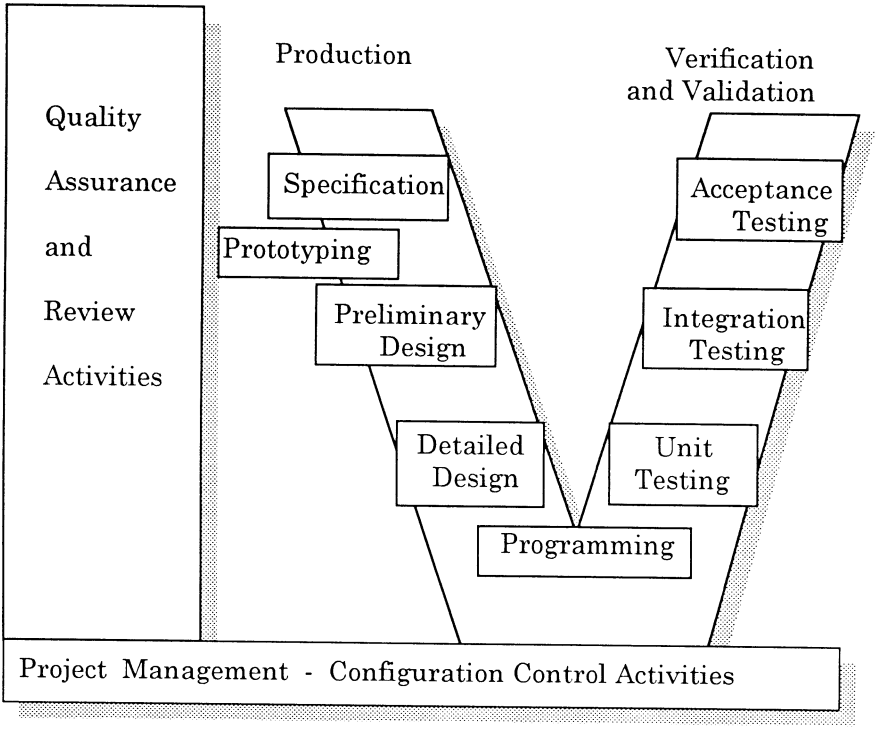

figure 2

If compared to the DO178A, it includes a supplementary step : the Organizational phase. It defines the project management in terms of lead times, human and material resources, and the configuration management. All the Quality Assurance part, that is to say the selected development cycle, the quality activities during each phases of development, the quantity of inspections, reviews, etc. is also determined during this phase. Quality is thus obtained as well as the mastery of cost and lead times.

During the following rotation several audits, which started in 1992, are going to be taken into account.

d Third rotation : first updating of the MCL

At the beginning of 1992, the French Ministry of Defence performed assessment on our methodology, with the AQAP13 recommendations, (NATO Allied Quality Assurance Publication). By the same time, they audited several projects which were using the methodology : M88, MTR390, ARRIUS 1-A, MAKILA. Besides, a member of Elecma was participating in the EUROCAE work group which was in the charge of writing the version B of the DO178.

We were granted the RAQ1/AQAP13 Agreements in August 1993, (RAQ, Règlement sur l'Assurance de la Qualité = Quality Assurance Rule). We were also evaluated by AeroSpatiale in 1993 which gave us the A level. In November 1993, the British Ministry of Defence wrote to us to confirm our compliance with ISO9001 Standards.

But according to the DO178B evolution, official services remarks and projects conclusions, we had to update the MCL. That is why its modularity was an important factor. We were able to release the documents one by one and only those which had to be corrected. The update consisted in correcting coherence defects not seen in the first version or in adding new needs like commercial "off-the-shelf" softwares, reused codes, field-loadable softwares, ...

The corrected and new documents are being published and the new MCL should be distributed in the beginning of 1995.

e Fourth rotation : the CMM

End of 1993, Elecma decided to perform the self-assessment with the CMM (Capability Maturity Model) of SEI (Software Engineering Institute). This self-assessment took place in March 1994. Three projects and fifteen persons were involved.

We obtained a good level due to the following factors :

- Mastery of the configuration management.
- Correct application of the methodology.
- Reuse of codes.
- Records of measurements.
- High skilled teams.

To reach the next step, an effort is to be made on the human resources, tools and training. Improvement actions also must be planned.

A progress plan is under way and should be achieved by the end of 1995.

3 Conclusion

Elecma is preparing for its fifth rotation. One of our Quality Manager is involved in the establishment of SPICE, (Software Process Improvement and Capability dEtermination). We have been chosen among the companies which wanted to do the SPICE trial. It should be finished by April 1995. This way, the implementation of our progress plan will help us to keep our advance in software development process.

All these rotations help Elecma to keep its software development process at the level necessary to develop critical A softwares (DO178B).