Universidade de São Paulo
Escola de Engenharia de São Carlos
Departamento de Engenharia Aeronáutica

Internship Report
Airbus Defence & Space

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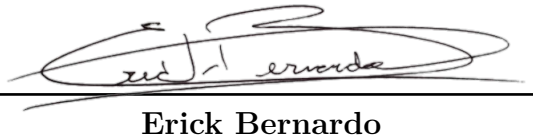

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Abstract

The internship completed during 2018 was focused on continuous improvement projects applied to the production line of solar arrays for aerospace purposes. The projects were centered mainly in processes improvement applying lean manufacturing, six sigma and quality tools for evaluation and development of improvements. The main topics of the activities are described in this report but with many results and data omitted due to Airbus Defence and Space intern rules.

Key-words: Production line of Solar Arrays; Manufacturing engineering; Continuous improvement.

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Production Line of Solar Arrays

The Solar Arrays and Structure is a unit into Airbus Defence and Space. It englobes engineering, design, procurement and production of solar arrays for satellites . Under this unit there is the Operations Solar Arrays in Ottobrunn which is responsible for the production of a variety of solar arrays for many type of customers and applications as telecommunication, earth observation, navigation, military and science missions.

The internship took place into the Manufacturing Engineering and Planning, a department into the Operations Solar Arrays, as the main department duties are the control and planning of the production of the solar arrays.

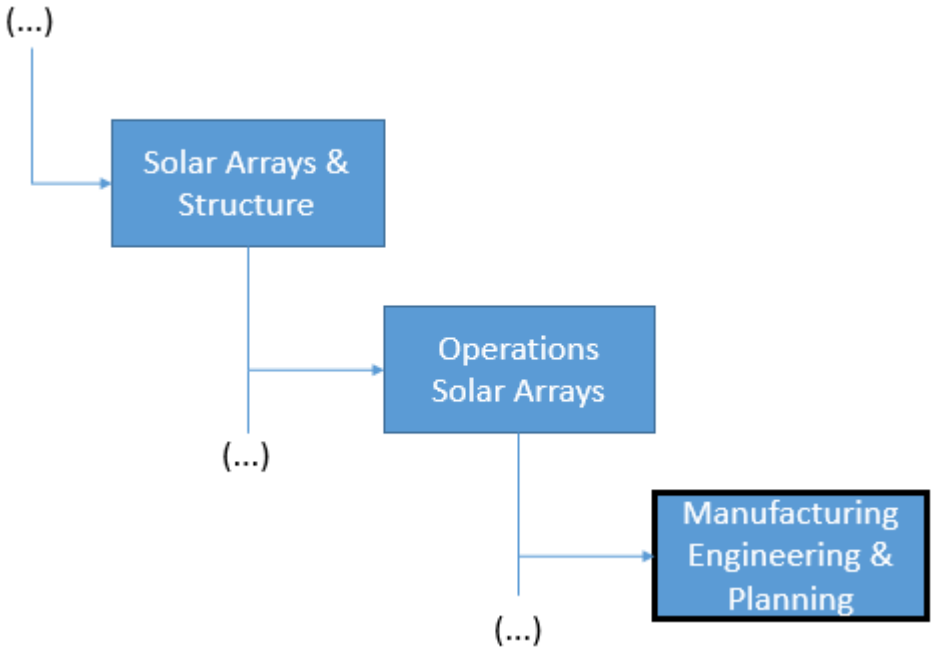

Figure 1 – Manufacturing Engineering and Planning department.

The Manufacturing Engineering and Planning department has as duties the complete planning of the production as well as the elaboration of manufacturing processes and coordination with the others departments the whole workflow throughtout the production. The main activities concentrate on the Manufacturing Preparation, phase between the Procurement & Engineering and Manufacturing.

The solar arrays are produced in a general overview in many production phases as presented in the picture below, from a single cell to an integrated and tested wing. First the single cell receives inter-connectors welded with a special technique, after this step the product income is called Connected Integrate Cell (CIC).The CIC receives a cover glass pasted with a special adhesive, tested and sorted in magazines according with its electrical proprieties to compose the Solar Cell Assembly (SCA).

Afterward the Solar Cell Assembly (SCA) are grouped into modules to be used for the panel laydown, where the modules are grouped to compose a single panel and followed by the cabling process, mechanism and Yoke integration, assembly and test. All

manufacturing phases occur into a cleaning room with environment temperature and humidity controlled. After ready the complete wing is integrate with the satellite at other Airbus site.

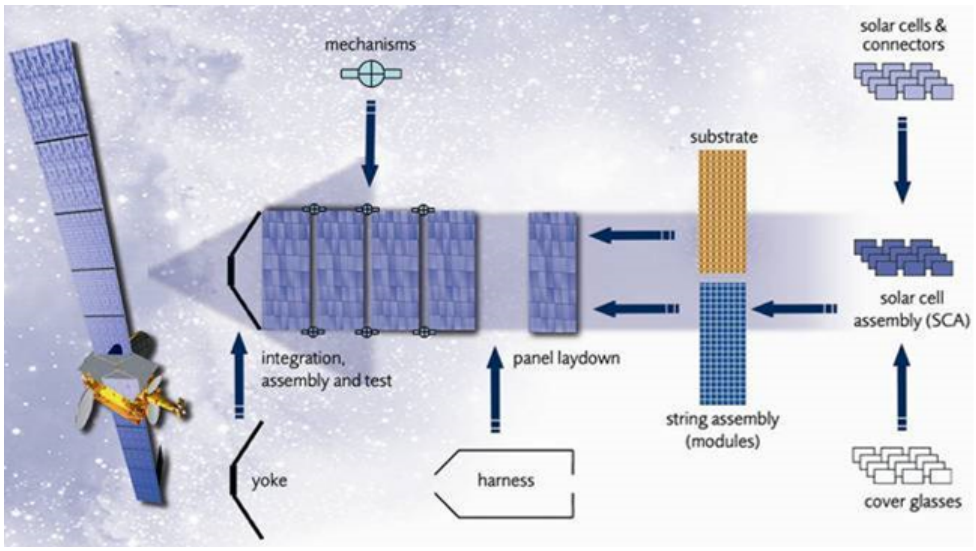

Figure 2 – Manufacturing phases. Resource: Airbus

The production line can handle from a single unit up to mass production in three parallel manufacturing lines with assembly, integration and tests facilities, providing a highly reliable and world-class technical characteristics for its products.

Figure 3 – Cleaning room. Resource: Airbus

1 Activities summary

This chapter summarizes an overview of the activities developed in the internship. Additionally, in later chapters the activities will be more detailed and discussed.

1.1 Schedule

The main activities developed since 01/04/2018 are listed below and the implementation schedule is presented in the Figure 4.

Activity	**Months**										
	1	2	3	4	5	6	7	8	9	10	11
1							✓	✓	✓	✓	✓
2						✓	✓	✓	✓	✓	✓
3					✓	✓	✓	✓	✓	✓	✓
4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5											✓

Figure 4 – Schedule completed. Legend: [✓] Activity made.

Activities:

1. Production processes and planning
2. Lean topics and performance indicators analysis
3. Students‘s Office (Coworking Space)
4. Topics concerning production
5. Report elaboration

2 Main activities

The focus of the internship was related to acting as a focal point in continuous improvement projects in the Solar Array, providing support for ongoing projects and handling with new improvement projects conducted by students as well as giving support for production activities.

Some main topics are described below:

2.1 Production processes and planning

This topic belongs to the main project conducted during the internship, entitled **Backward Planning**. It was the main project because of the following reasons:

- The improvement actions were directly over the activities of the department;
- It gathered lean manufacturing, six sigma, hard and soft skills during the whole project cycle;
- The project‘s results have strong impacts over the production efficiency and the effects can be extrapolated indirectly to other departments.

One current and often production problem has been the manufacturing disruptions during the manufacturing of production packages. It has many root cases belonging to different departments and processes. However, one of the root causes identified was the missing of clear information during the manufacturing launch phase which many times initiate the manufacturing phase without all mandatory inputs.

The project consisted of the implementation of a standard process to manage and ensure the production inputs with the goal to avoid manufacturing disruptions during the production lead time.

The focus was over two checkpoints before the manufacturing phase, the Digital Manufacturing Readiness Review (dMRR) and the Manufacturing Readiness Review (MRR), where processes and tools were developed to ensure a clear flow of data through departments and additionally create reliable resources of lead time data to the company projects.

The MRR was already implemented in the company but the information and decisions made sometimes did not reach all accountable people, either by a lack of clear processes defined or communications misunderstanding. Then a analysis was made to clear understand and identify the root causes of that lack and misunderstanding. In additional, the complete dMRR checkpoint was deployment since the begin with processes and tools developed for it.

During the project, some important developments were made:

1. Development of a tool to check and control the status of all production packages during their manufacturing process, as well as a backward planning to determine the

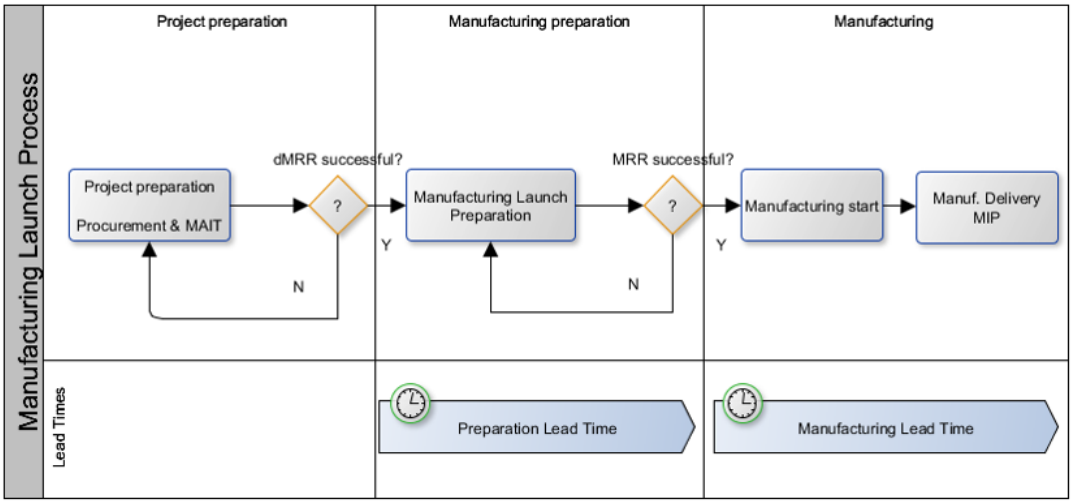

Figure 5 – dMRR process.

latest deadlines for the launch of the manufacturing preparation and manufacturing phases.

2. Implementation of standard procedures for manufacturing engineers as the management of the digital manufacturing readiness review (dMRR) and weekly status reports.

3. First version of the document "Lead Times in use as per Lean Strategy", which intend to be the baseline for new projects.

4. Development of a VBA code and an Excel tool to track production lead times and calculate four new production key-performance indicators. The four new KPI can be show in the pictures (6), (7), (8) and (9).

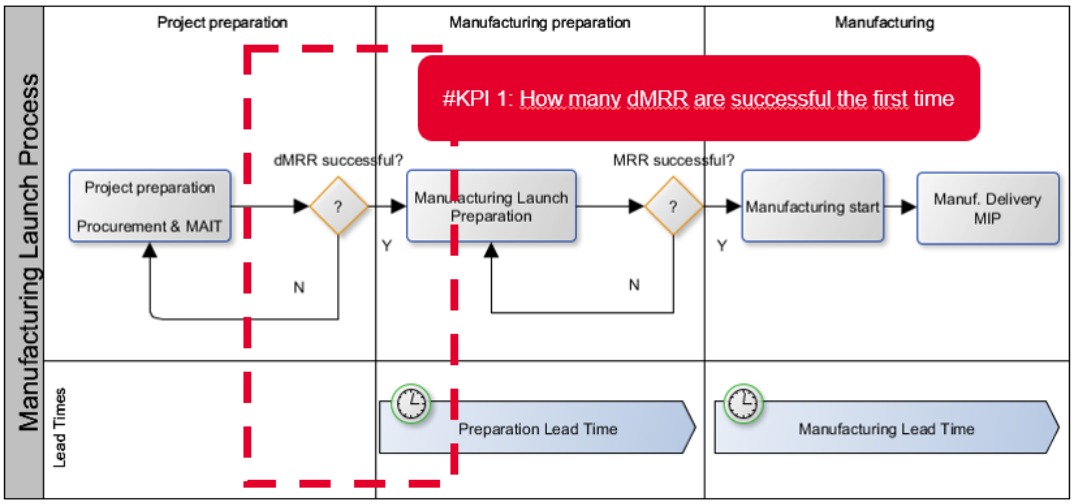

Figure 6 – Number of in time successful dMRR.

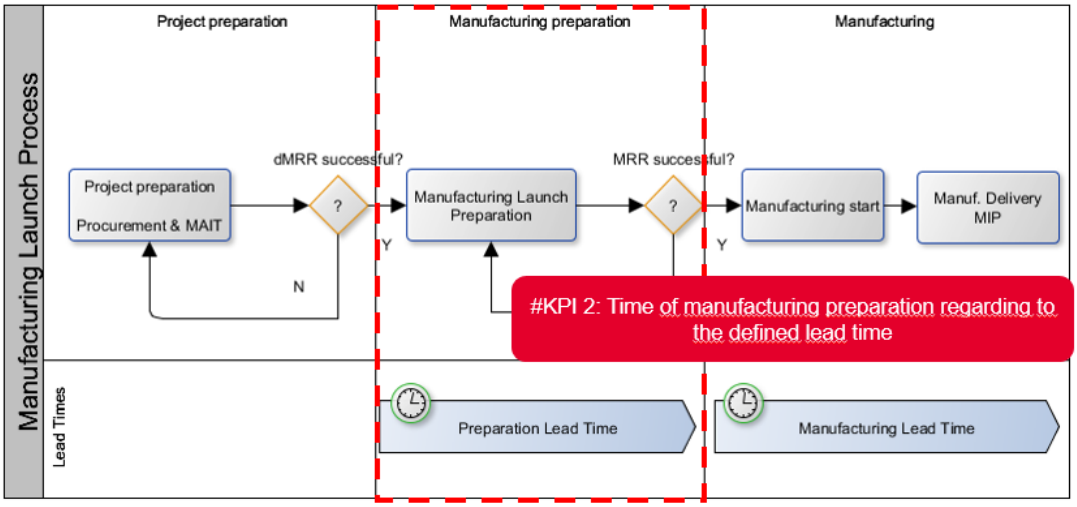

Figure 7 – Adherence of the Manufacturing Preparation lead time.

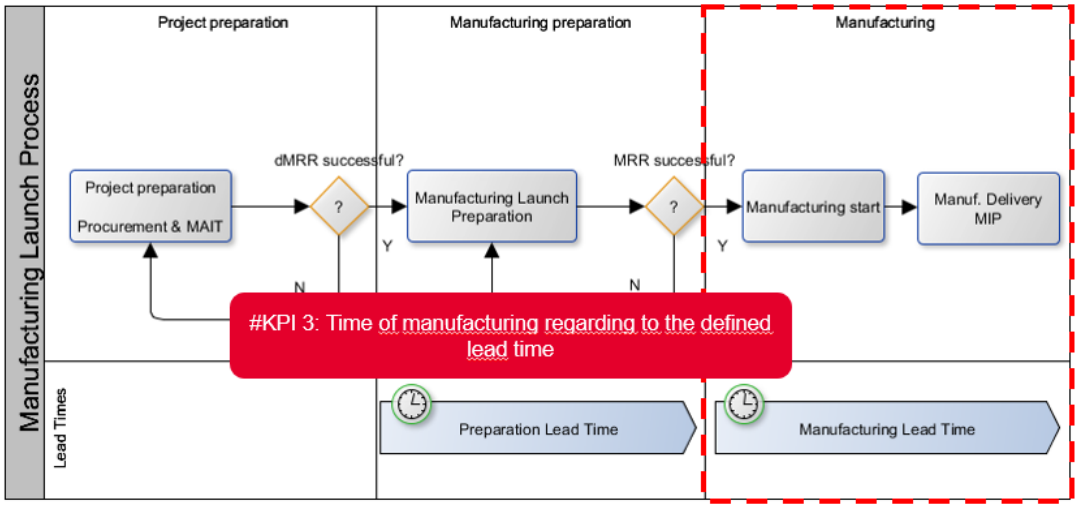

Figure 8 – Adherence of the Manufacturing lead time.

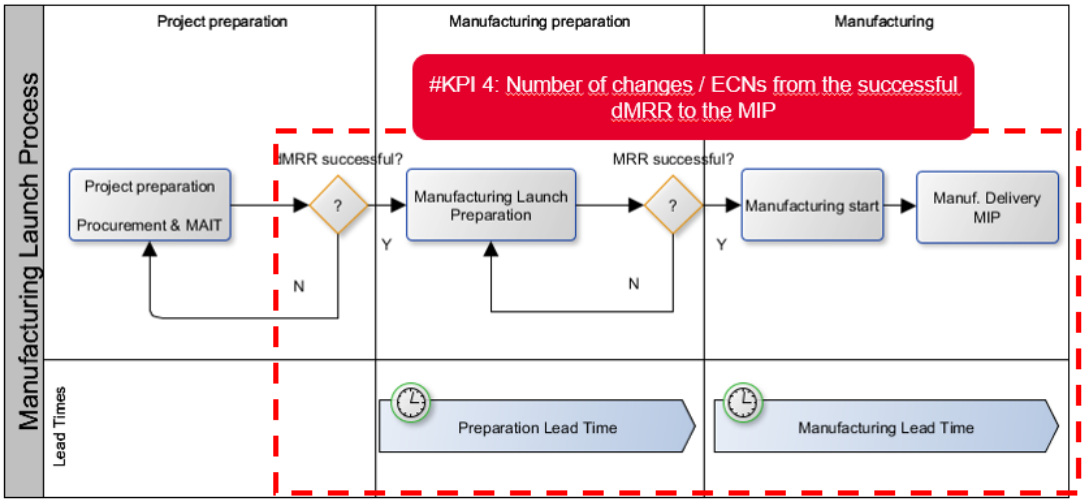

Figure 9 – Number of Engineering changes notice during the production lead time.

2.2 Lean topics and performance indicators analysis

Topics concerning lean manufacturing and performance indicators analysis were constantly present during the whole internship as part of the improvements projects conducting individually or in a team.

One activity related to lean manufacturing was the elaboration of Value Stream Maps (VSM) for a new upcoming constellation project, identifying the value flow through the production line.

In addition, two projects were conducted during the internship concerning key-performance indicator (KPI). The projects involved the definition of new KPIs and review of current ones; statistical analysis and presentation of insight based on the results.

Both projects are shortly described below:

- **Balanced Scorecards**: Elaboration of monthly Balanced Scorecards reports for the Solar Array Production, this activity consisted of the calculation and statistical analysis of the key performance indicator and further initiation of the PDCA problem-solving model together with the managers. The KPIs analyzed in the balanced scorecards are related to four main perspectives: financial, customers, processes and operational.

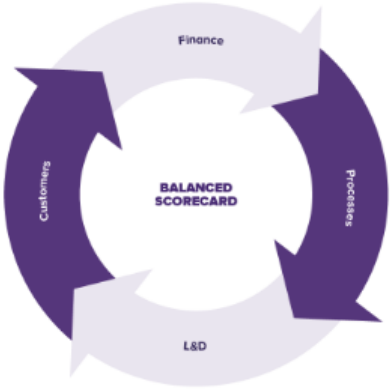

Figure 10 – Balanced Scorecard.

- **SQCDP**: Digitalization and configuration of the SQCDP boards into an in-company digital platform (DeMat). The SQCDP review happens daily on the shop floor, in different hierarchy levels evaluating KPIs of Safety, Quality, Cost, Delivery and People;

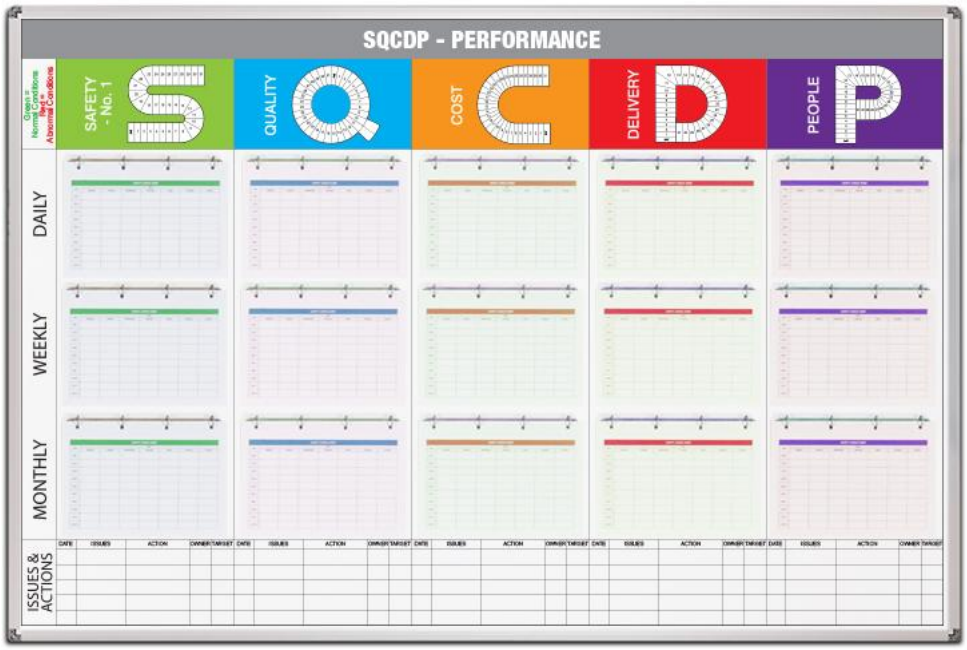

Figure 11 – SQCDP board.

2.3 Students´Office

A concept of co-working space (a Students' Office) has been presented for the Solar Array. It has been implemented and has been allowing students to work integrated into the department projects using Agile methodologies for project management.

The main objective of the Students' office was to integrate the students of the department, providing a team of differentiated skills to handle with real corporate challenges related with the production of solar arrays in many aspects. The group was independent to define its organization, structure and procedures similar as the Junior Companies, largely implemented in the Brazilian Universities.

During the internship, some points can be highlighted:

- It provided the development of soft skills as leadership due to the opportunity to lead and coordinate a team of 6 students.
- An Agile way of work has been set up to integrate students in continuous improvement projects, providing the opportunity to acquire experience with SCRUM and Agile principles.

O A total amount of 12 projects have been conducting by the Students' office until February 2019. The project's name list can be viewed below with a short description:

- **SQCDP**: Digitalization and configuration of the SQCDP boards into an in-company digital platform (DeMat);
- **Roadmap Improvement**: Definition of guidelines for improvement projects for the Industry 4.0;

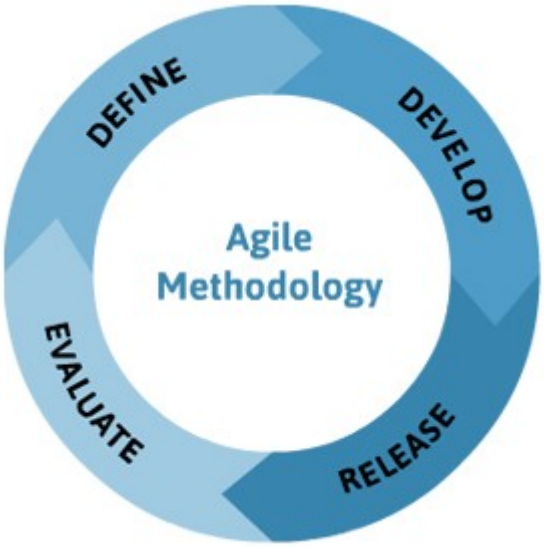

Figure 12 – Agile methodology.

- **Orientation Plan**: Providing a document to orientate newcomer employers;
- **Lead time baseline**: Providing manufacturing lead times which intend to be a baseline for future new projects;
- **Handling frame**: Supporting the design of a new handling frame for use on the shop floor;
- **Backward planning**: Developing a lead time database for projects and deployment of the Digital Manufacturing Readiness Review (dMRR);
- **Material Flow**: Supporting actions to improve material flow in the production line;
- **Propose tool**: Supporting improvements in the proposing tool for new upcoming projects;
- **SAP ERP Data Quality**: Supporting improvement actions for correct wrongly allocated warehouse materials in the SAP;
- **Balanced Scorecards**: Supporting Balanced Scorecard reports elaborations and KPIs analysis;
- **Matching**: Developing a automate Excel tool for saving time in the Matching procedure for Solar Cell Assembly (SCA);
- **M-BoM** : Supporting the implementation of the Windchill MPM-Link for Manufacturing Bill of Material (M-BoM) generation;

The perspective for the Students‘ Office is to continue with the next Brazilian interns and other students, keeping the focus in improvements at the production line.

2.4 Topics concerning production

During the internship, many general activities concerning the production came up, some of them are described below:

For example:

- Development of an Excel macro to automatize the link between manufacturing documents into the Windchill (an online platform) and the software IMS Predictive ERP, saving a lot of manual work time.
- Supporting the implementation of the Windchill MPM-Link for Manufacturing Bill of Material (M-BoM) generation.
- Supporting the Proof of Concept of an algorithm based planning tool (IMS Predictive ERP) for dynamic production planning.
- Supporting projects of SAP Data Quality and Material Flow.
- Supporting elaborations of production documentation;
- Supporting Warehouse reorganization.

3 Conclusions and perspectives

The internship was entirely related with aerospace focused mainly in the production area. Despite it has not covered subjects directly centered in airplanes the experience and knowledge acquired in the aerospace field were valuable. The opportunity to work with production topics, which can be applied for many different industries, for sure enriched my undergraduate formation with many professional and personal skills. Highlighting from all the experience acquired, two can be cited:

- The leadership experience provided by the Students'Office, involving project and team management;
- The lean six sigma and manufacturing engineering skills developed during the often projects and activities.