

A Novel Approach for Technology Development: A Success Story

Olivier Pahud and Didier Hoste
Bombardier Aerospace

ABSTRACT

The composites development team at Bombardier Aerospace has pushed the Integrated Product Development Team to a new level. The team has been created outside the business priorities and was partially funded by a provincial government initiative to create a greener aircraft.

A dedicated R&D team can reduce the gap between the different disciplines by encouraging them to work as one entity and rapidly develop high Technology Readiness Level (TRL) and high Manufacturing Readiness Level (MRL) solutions. Additionally, the interactions between the groups create a harmonization of the development philosophy and a sharing of the building block approach. This leads to a significant cost and lead time reduction in the coupon, element and detail testing.

The constitution of the team also has a great impact on the level of expertise and the flexibility to adjust to new demands. The team has built through the years an entire and complete external partner network that helps the team in specific subject matters.

Knowledge management within the team, technology development and sharing become critical aspects as the projects grow. To ensure that all the necessary knowledge is captured throughout the development, a rigorous process is implemented in the IPDT team. The process to identify and close knowledge gaps requires a knowledge capture technique, named A3 process, adapted to the R&D needs. The A3 is used in a loop approach where specific sub-subjects of a project are each tracked with this methodology.

CITATION: Pahud, O. and Hoste, D., "A Novel Approach for Technology Development: A Success Story," *SAE Int. J. Aerosp.* 6(1):2013, doi:10.4271/2013-01-2330.

INTRODUCTION

The Composites Development department within Core Engineering in Bombardier Aerospace (BA) was built recently in the industry trend to introduce primary structural Carbon Fiber Reinforce Plastic (CFRP) to business and commercial aircrafts. The department's objectives are to develop emerging technologies up to level 6 of the TRL/MRL scale (see [Table 1](#)).

A provincial government initiative for a future greener aircraft, known as SA²GE, helped the enterprise by partially funding the department and projects. The SA²GE program, through research and development activities, strives to maintain Quebec's competitive position as a world leader in the rapidly changing aeronautics market within the challenges of climate change and resulting environmental regulations [1]. The integration of structural composites in aircraft can contribute to weight and cost savings. They also bring new

challenges to an industry of conservatism and prudent innovation insertion.

From the manufacturing of a full CFRP demonstrator fuselage to the development of new composites processes, the department has developed a rapid and efficient technology development method. With a distinctive Integrated Product Development Team (IPDT) approach, the team has been able to develop high quality technologies to a high maturity level. An iterative development flow based on the A3 process helped the team to develop and capture the acquired knowledge.

The present paper will develop first on the novel IPDT approach and on the benefits of this organization in respect to technology development. Secondly, the project and knowledge management method will be discussed in regards to knowledge capture. Finally, a quick overview will be made on the group's recent achievements.

IPDT APPROACH

The IPDT is a concept well implemented in engineering. It often refers to a management or upper committee with all stakeholders and every discipline represented. This team of experts oversees the activities and results of the development phases. The IPDT has proven to be efficient by involving all groups from the initial to the closing phase. Furthermore, it reduces the product development cycle by foreseeing the requirements from other stakeholders and thus avoiding time-consuming changes later in the development. The BA composites development team has adapted the IPDT to a Research and Development (R&D) purpose.

External Network

Through the year, the Composites Development department in BA was able to assemble a large portfolio of expertise in its own project teams and with academic, governmental and industrial partners. The large network enables the engineer to get support and expert opinions outside of their field of expertise. Moreover, the risk of the development became shared through partnerships.

The department was able to develop a highly integrated network inside and outside the organization as shown in Figure 1. The sponsor (or the Business Unit in the illustrated example) must be included in the network as they will be highly involved in the development of the technology.

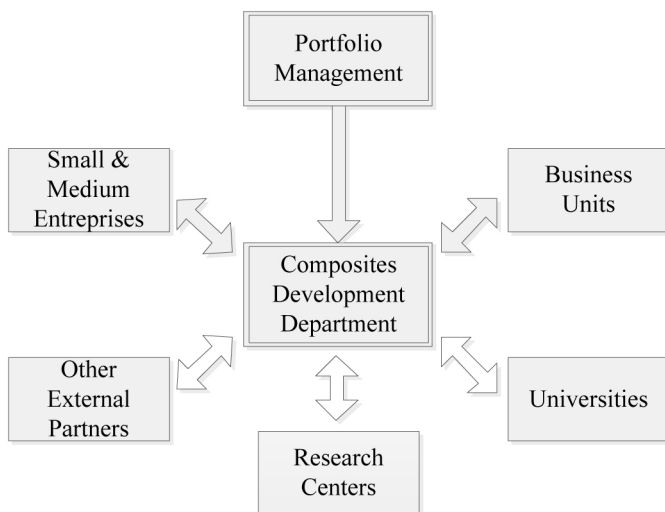


Figure 1. Internal and external network of partners

Team Structure

Most of the R&D projects in large organization are structured in weak, mixed or strong matrix caused by the engineering expertise centralized into silos as shown in Figure 2 [2]. Thus, subject matter experts are dispatched throughout the organization and projects. As a result, the engineers are dividing their work on functional and project labor. Besides, R&D projects are often perceived as optional and are deprioritized compare to production related subjects.

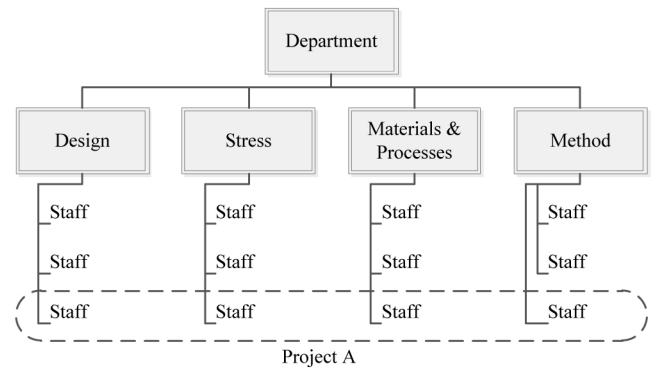


Figure 2. Matrix organization example for a typical composites engineering department

On the other hand, a projectized organization, shown in Figure 3, increases the authority and involvement of the experts by engaging them in a full-time endeavor. The Composites Development department in BA has selected this organizational structure for its projects portfolio and every discipline required for the development of process for composites is represented. This includes Design, Stress, Material & Processes and Manufacturing. Other disciplines, such as Certification, Industrialization and Operation, are considered in the stakeholders as support groups. Their expertise is considered critical in the development of the technology. Thus, they are required to provide inputs through peer reviews.

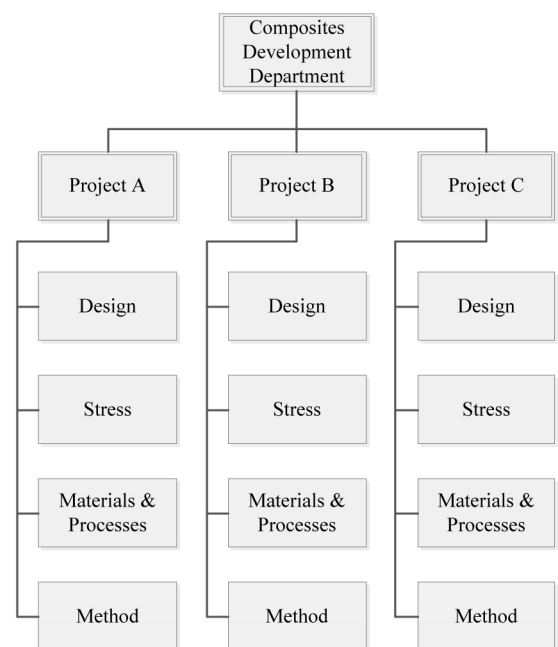


Figure 3. Projectized organization of the Composites Development department in BA

A full-time dedicated IPDT in R&D creates a work spirit for collaboration and mutual aid between the team members

as they are driven by only one project. Additionally, a common goal facilitates communication and knowledge sharing internally and externally.

A key aspect to a complete IPDT in R&D is a long-term vision of the project's scope. This vision is either obtained from the team, the department, the organization, the sponsor, the stakeholders or the external partners. Therefore, a R&D department must keep track of all technology forecasting and build itself a large and complete internal and external network of contacts.

Access to Facilities

In the domain of CFRP, a large emphasis is placed on the process, because the material and the parts are created at the same time. Therefore, the quality of the product is highly dependent on the process parameters. In order to make efficient research in composites, parts need to be manufactured with the process in development. Thereby, the process parameters can be controlled to measure the effects of each on the final part quality.

A facility dedicated to research purposes is then beneficial to the advancement of process development, because it offers space for equipment and tools. Furthermore, it gives freedom to the tests that can be executed without restrictions of space, time and resources. It also lets the team do rapid testing and manage their technicians and priorities.

Moreover, facilities outside of production sites assure independence to production lines and avoid disturbing supply management from their operations.

Rapid Development

Working in a projectized organization, team members are more involved in their respective project and are motivated for the project to be successful. Therefore, it creates a synergy between the team members and each discipline comprehends better the requirements of others. Besides, the flow of information between the disciplines is increased and considered crucial in a R&D project.

Moreover, the IPDT approach changes the development process from a concurrent flow to an integrated development flow. In a typical concurrent development flow, disciplines are working in a shifted parallel structure where each are waiting others inputs with a minimum of information sharing. On the other hand, in an integrated development flow, each discipline is working synchronously helping defining requirements as the project evolves. The two approaches are illustrated in [Figure 4](#) and [Figure 5](#).

The integrated development flow and the synergy between the disciplines in a project have brought the department to adopt an integrated strategy for the coupon, element and detail testing. The specimens are the base of the building block approach [3] as shown in [Figure 6](#) and are used to characterize mechanical properties such as Compression After Impact and Bearing strength. The coupons are also used to confirm the quality of the processed

part by testing, for example, the fiber volume and the void content.

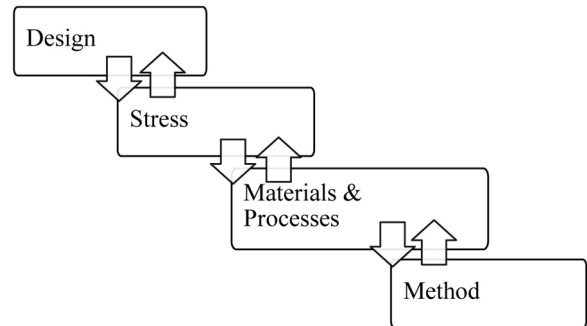


Figure 4. Concurrent Development Flow

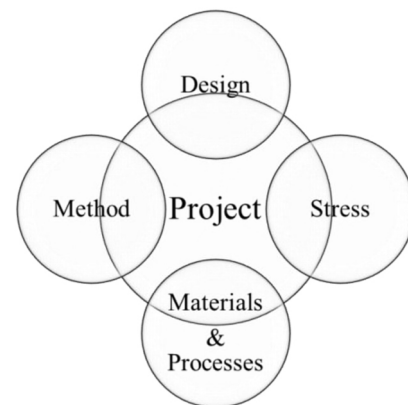


Figure 5. Integrated Development Flow

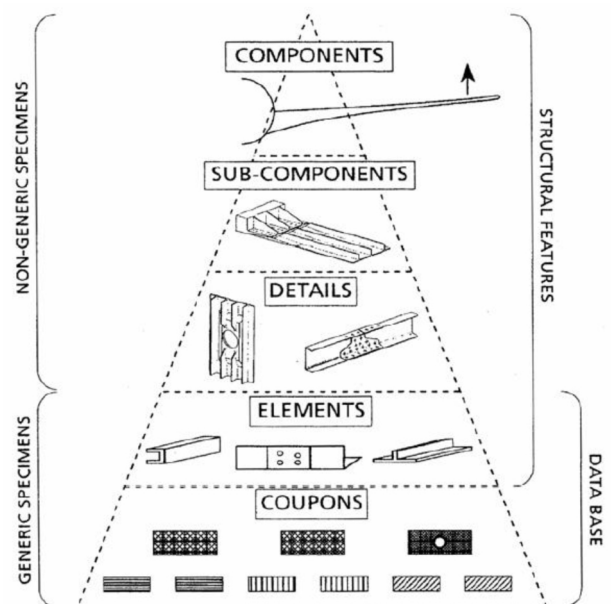


Figure 6. Building Block Approach [4]