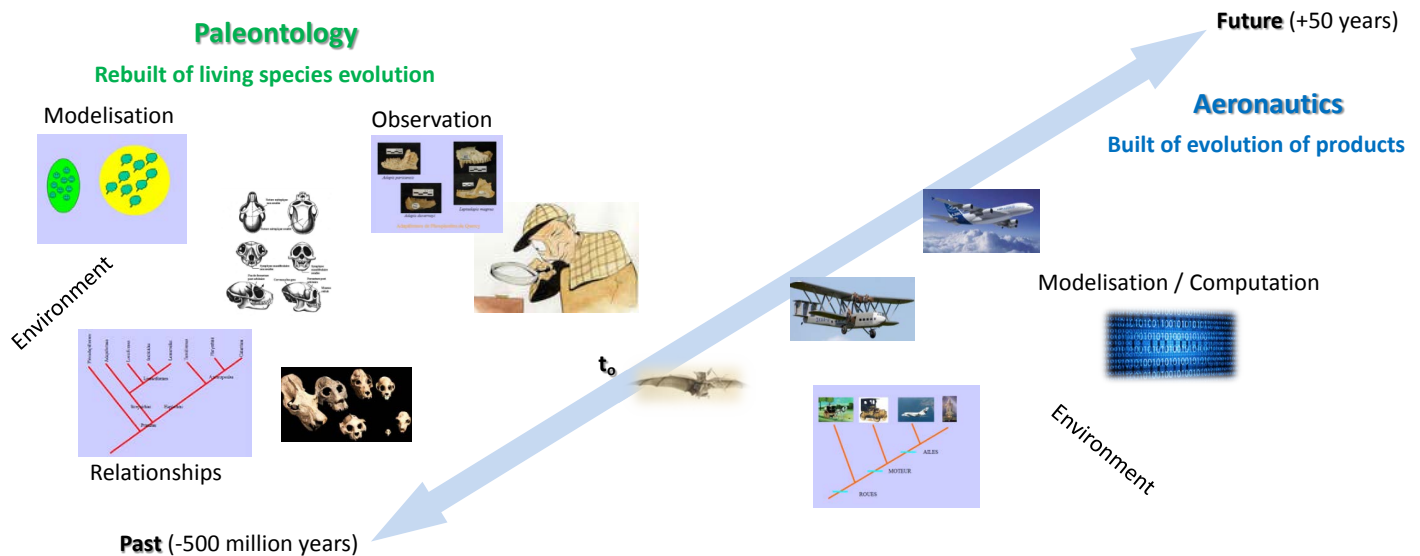


Phylogenetic approach applied on Aircraft configuration

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A lot of Aircraft configurations have been studied by aeronautic designers and a non-negligible part of them was tested in the world for decades : such activities were performed with technologies available (e.g. materials, energy densities, data processing performances) and in a specific environment (e.g. economic constraints, industrial work-sharing, competition, crisis) as existing at that time. Among the different ways to imagine some new Aircraft configurations, one is to find **inspiration from the living world** to “think out-of-the-box” in terms of design solutions, architectures, ... In this perspective, we applied an analysis methodology used for the biological evolution (i.e. the phylogenetic approach) with the aim to highlight some new and innovative ways to **revisit the current Aircraft configuration** :



We tested this application of the phylogenetic approaches on Aircraft configuration by developing a “**Proof of Concept**” on a sample of **63 types of Aircraft** (from Ader III on 1897 to Airbus A350 on 2013) with an analysis of **105 external characters** such as wings & tailplanes (e.g. number, position, shape, flap/slat), landing gears (e.g. number, types, fitting), fuselage (e.g. shape, symmetry), engines (e.g. number, location, types).

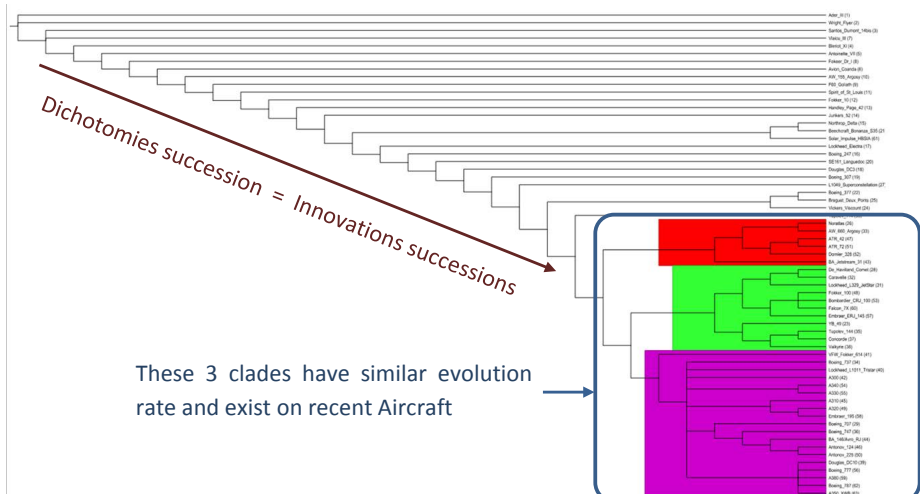


By coding all these characters on such sample of taxa (i.e. types of Aircraft), we processed about 6000 data and rebuilt its associated **phylogenetic tree** with a parsimony method (PAUP program).

The result obtained with heuristic analysis is a consensus **cladogram** of **64 parsimonious trees** (with 639 steps for each one) ⇒ see :

The **DELTRAN optimisation** (i.e. DELays the TRANSformation) was used as optimisation strategy for hypothesizing ancestral characters at each node.

Robustness Index (RI) has been also computed for quantification purpose.



These 3 clades have similar evolution rate and exist on recent Aircraft

This phylogenetic tree applied on such sample of 63 Aircraft has been **successfully re-built** because it is in line with History of Aircraft and its succession of models along the time. We have also identified a total of 8 major clades (i.e. with common ancestors and all their descendants) and each node corresponds to one “hypothetic Aircraft” (i.e. non existing ancestral configuration) that could be a starting point to imagine and **to design some new configurations of Aircraft**.

To sum up, this iconoclast **cross-fertilization** work - from biological evolution methodology to Aircraft design approach - showed that it is very promising to catalyse the future changes on aeronautic design by stimulating human thought and by **generating Innovative ideas**.