

# Introduction

This topic will be presented and illustrated by a case study of a small manufacturer with an established product but a method of manufacture that has become dependant upon operator skill and is difficult to control.

Other issues include repeatability, cost, delivery and weight.

A Design for Manufacture process aims to address all of these issues.

# Computer Aided Product Design

## Design for Manufacture

### CASE STUDY

Escapade Aviation Ltd.  
(formerly Reality Aircraft Ltd.) manufacture one and two seat micro-light / very light aircraft.



# Escapade Two seater



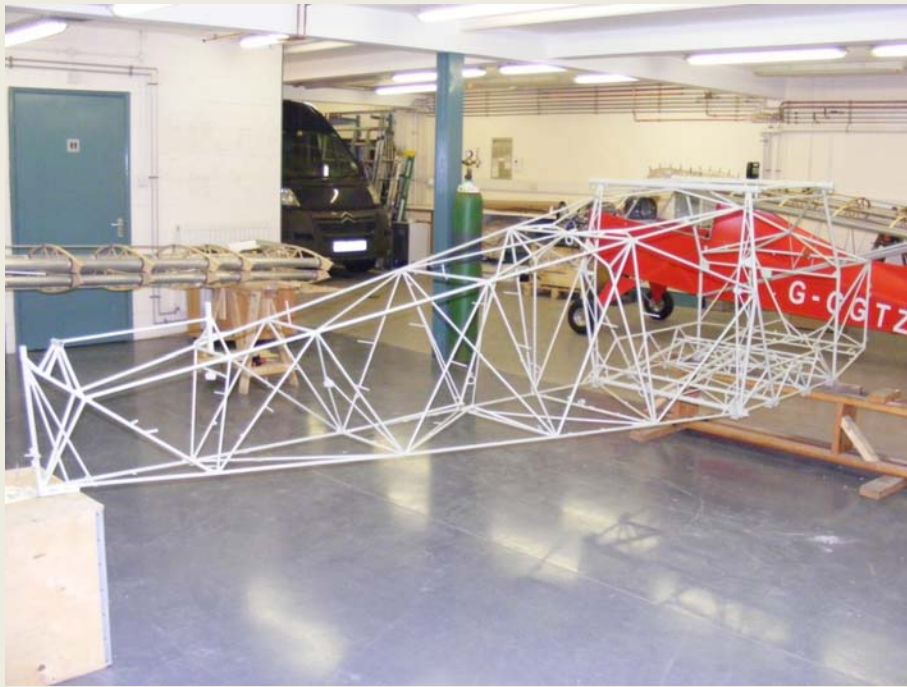
Tubular steel frameworks form the structures of the fuselage, engine mount, tail feathers, undercarriage, control sticks, seats, doors and windows.



The tubular framework is covered by a lightweight durable plastic sheeting.







A completed 2  
seater fuselage

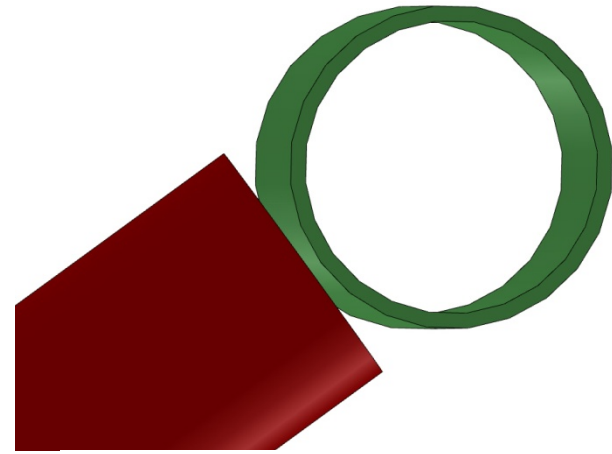
One welded  
junction



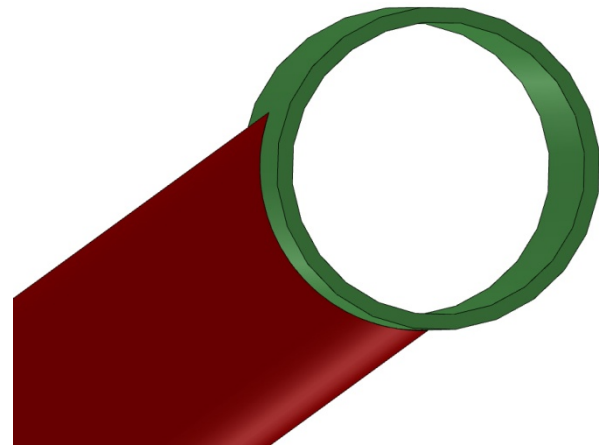
# Construction

This case study focuses on the preparation of tube ends for welding.

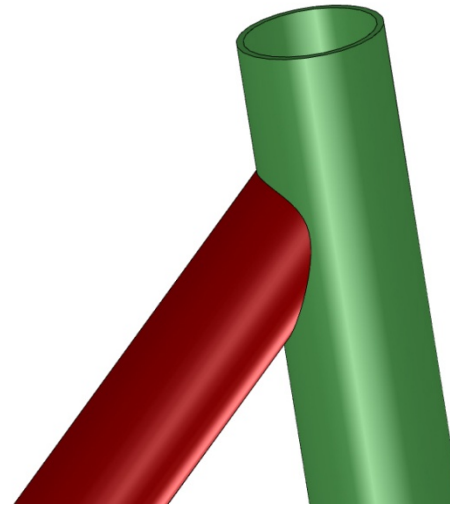
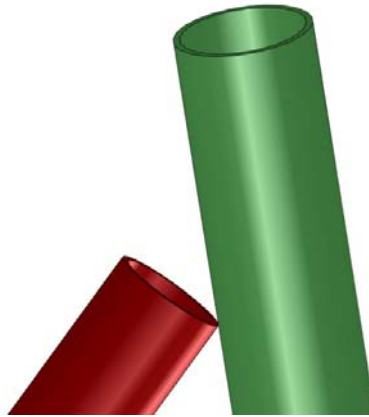
If two round tubes are joined at right angles with no preparation there is a large gap to be filled with weld:



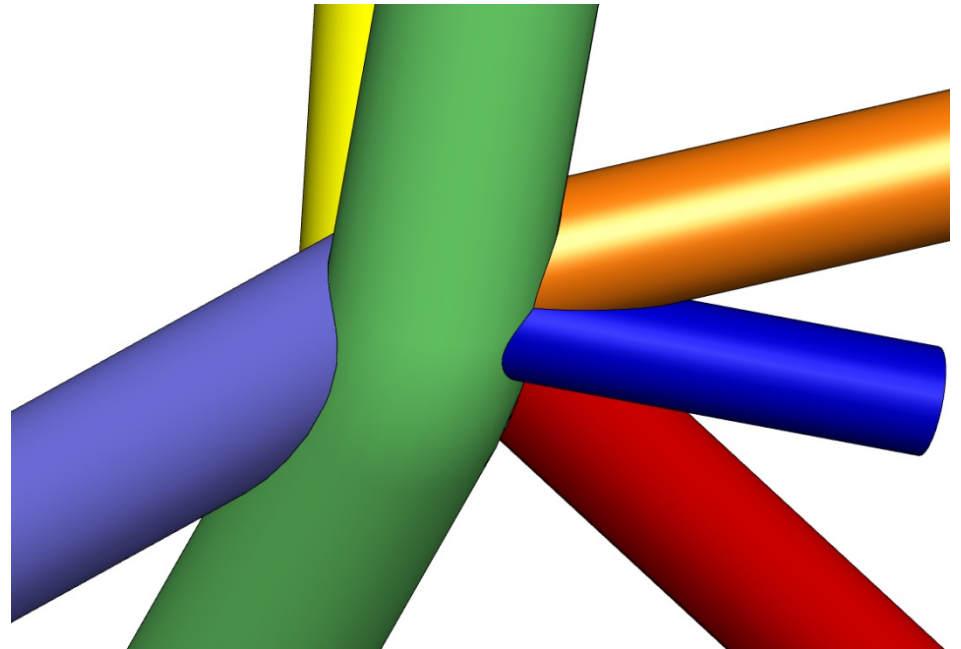
With the end of the abutting tube prepared the amount of weld can be significantly reduced:



Change the angle  
and the problem  
gets worse (and  
the solution gets  
better!):



Further complications  
arise when tubes are of  
different sizes, may be  
offset or bent, and may  
join in clusters:





# The problems

Manual cutting and welding had disadvantages:-

- A high degree of skill and product knowledge is required.
- Dependence on the skill and judgement of the welder.
- Dimensional stability and repeatability is compromised.
- Excess welds add non-beneficial weight.
- The joining sequence may not be optimised.

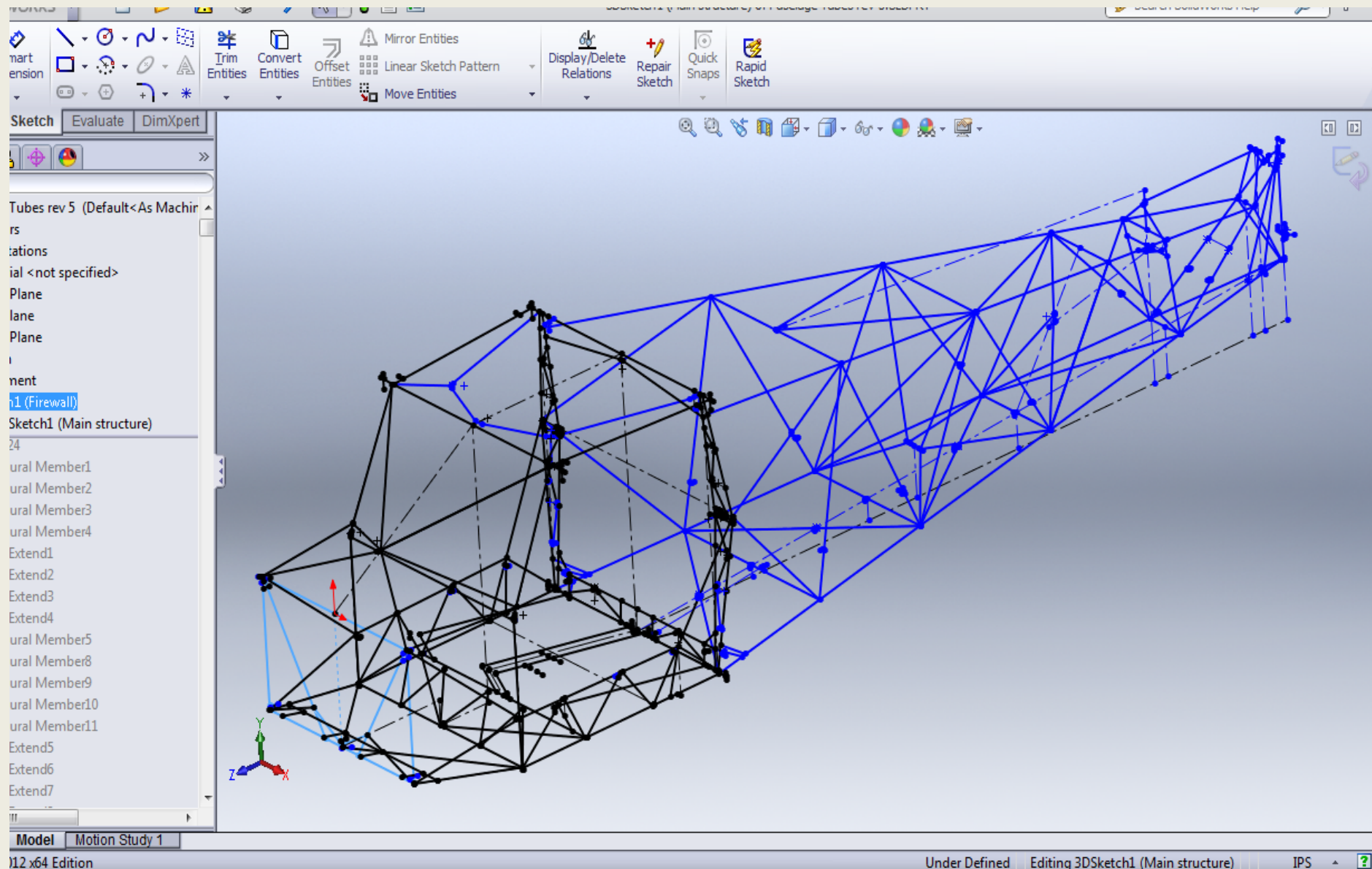
# The solution

Reality Aircraft found a manufacturer that could accurately pre-machine the tube ends to provide the optimum close fit, that is, no gap.

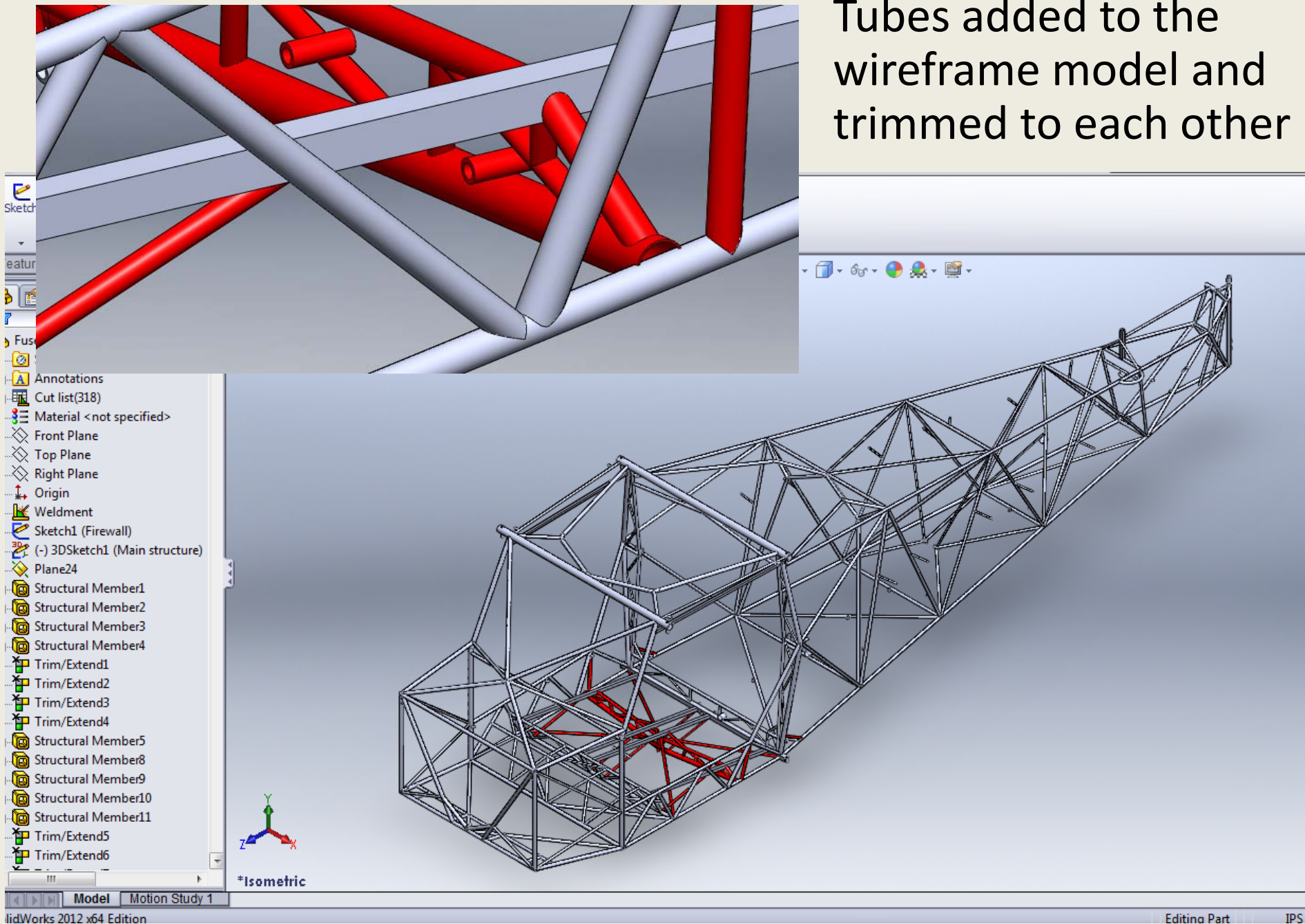
Feature based 3D CAD was used to model the tubes and to trim or extend them to each other, in the desired order. SolidWorks was used, Inventor could have been.

The solid models produced were imported by specialist CNC machine tool software to create tool paths for the precise machining of the tube ends to provide intimate contact. Once programmed, a kit of parts could be produced with reliable repeatability.

# The starting point – a 3D wireframe model of the tube centrelines



Tubes added to the wireframe model and trimmed to each other



# Summing up

This re-engineering strategy embodies Design for Manufacture and moves some of the dependence on high level skill from the end process to the detail design stage.

Not only is the manufacturing process improved, but also the quality and repeatability of the finished product.