

Fixed Trade Calculator – Application

Use of fixed trades to inform decision making in technology evaluation

Context

Consider a wide-bodied aircraft with 3,000 blind rivets installed in each wing¹.

A hypothetical alternative has been developed which would allow the manufacturer to replace 1/3 of these fastening (2,000 rivets per aircraft) with a different joining process using 1kg of a novel adhesive.

Can the Fixed Trade Calculator determine whether the change in process would be worthwhile in terms of aircraft operating cost; assuming that the rivets weigh 0.8lb/1000 rivets (installed)?

Using the Fixed Trade Calculator

The impact of the change could conceivably be considered at the whole aircraft level using the ATI Fixed Trade Calculator. However, there is no implied impact of the change on thrust specific fuel consumption (s.f.c) and it is unknown whether any of the rivets removed might have been on the external wing surface, therefore any change in drag due to step or gap changes cannot be accounted for.

The fixed trade calculator would therefore assume zero change for drag and s.f.c. The weight change could be calculated and would be of approximately 270g per aircraft. However, the impact of such a small change in weight will if calculated be more representative of the developers rounding choices than the change itself.

Discussion

The Fixed Trade Calculator is not the appropriate tool for assessing this modification. It is also likely that operating cost, fuel burn and carbon emissions are not the appropriate measures to evaluate this modification.

The impact of a change such as the hypothetical one suggested here would likely be better evaluated by considering its value in terms of metrics such as reduced manufacturing time, cost of materials, structural life and rigidity and the cost and time involved in getting any design modifications approved. Many novel technologies and processes developed in aerospace have beneficial impacts which cannot and should not be evaluated in terms of fuel burn, operating cost or carbon dioxide emissions. In such a case it is important to focus on the impacts of the proposed technology acknowledging the null impacts alongside the positive and negative implications of the change considered.

Alternate scenarios

Were additional credible input data available such as quantification of the drag implications of the fastening change then analysis using a tool such as the fixed trade calculator might be useful.

Furthermore, were this modification to be installed as part of a wider change in wing material potentially offering better aerodynamic tailoring and dynamic response to loading through a change in stiffness for which credible weight and drag change data were available then further fixed trade analyses may be useful in assessing the value of the change.

¹ According to <https://www.assemblymag.com/articles/90348-aerospace-fastening-in-the-21st-century>