Aircraft Component Life Cycle Cost Analysis

Background
The world civil aviation industry plays a crucial role in fostering trade and making the world places quickly accessible and connected. The massive aviation demand not only asks for a highly efficient production process with a large production capacity, but also a user-friendly and environmental friendly design. This leads to an integrated design and development process, in which the life cycle performance is considered at early design stage, and where a synthesized design can be generated.

Aircraft Life Cycle Cost, as a fundamental performance indicator relating every aspects of the life cycle from aircraft design to disposal, is researched within the integration process. The emphases have been putting on:

- the effective LCC evaluation methods
- the cost influence of the component design and operational factors
- The design optimization considering cost performance under design and operation constraints.

Research Objective
In order to evaluate LCC performance within the conceptual design phase, it aims at developing an automated and detailed cost estimation including design and operating influence for aircraft component.

Life Cycle Cost composition

- conceptual design cost
- preliminary design cost
- detailed design cost
- manufacturing cost
- operation cost
- disposal cost

Cost Estimation Process
- Product Breakdown Structure
  cost estimations are aggregated according to Product Breakdown Structures (PBS). A PBS is generated based on the aircraft component meta model (Fig.2).
- Generalized cost estimation process
  The cost estimation process is generalized and implemented on production cost estimation, direct operating cost estimation and scheduled maintenance cost estimation.

Study case and results
A study case of scheduled maintenance labor cost estimation is shown in Fig.4 to 7.

- Component structure and breakdown (Fig.4, 5)
- Derive scheduled maintenance program
  Maintenance tasks are assigned to each item for rudder PBS based on rules for maintenance program planning. A maintenance task is identified with an unique task number, a task interval and a maintenance time. Maintenance times followed after the slash symbol are shown in the unit of man hours. (Fig.5)
- Scheduled maintenance labor cost estimation
  By relating maintenance tasks to materials, part functions in rudder PBS, the cost is evaluated.

- The composite structures including spar, rib and skin are mostly checked and repaired during overhaul (Fig.6). It is seen that the expenses of composite structures are expended mainly during the overhaul period (Fig.7).

Research Methodologies

Cost Breakdown structure
Aircraft LCC mainly includes:
- research and development cost, including conceptual design, preliminary design and detailed design cost
- production cost, including manufacturing and assembly cost
- operation cost, including operation and maintenance cost
- disposal cost

Form Fig.1, production and operation cost take the most of the share in LCC. Besides, 95% of the LCC is determined during the research and development phase.

By considering the component LCC, which drives the cost analysis to a more detailed level, cost breakdown to the labor cost and material cost are applied for each element in LCC. The relation between design, operation and cost is analyzed in particular.

Publications