TABLE 3.3  Indirect Operating Cost (IOC) Categories

<table>
<thead>
<tr>
<th>Cost categories</th>
<th>Parameters influencing cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger service</td>
<td>Load factor</td>
</tr>
<tr>
<td>Aircraft servicing</td>
<td>Trip length</td>
</tr>
<tr>
<td>Traffic servicing</td>
<td>Block speed</td>
</tr>
<tr>
<td>Reservation and sales</td>
<td>Landing weight</td>
</tr>
<tr>
<td>Advertising and publicity</td>
<td>Tons of freight/mail</td>
</tr>
<tr>
<td>Ground property</td>
<td>Maintenance labor cost</td>
</tr>
<tr>
<td>Maintenance/depreciation</td>
<td>Etc.</td>
</tr>
<tr>
<td>General and administration</td>
<td></td>
</tr>
</tbody>
</table>

3.2.3 Present methods for defining operating costs

Aircraft manufacturers developed in-house direct and indirect operating cost data by using selected airline cost information as their basis. These cost data were obtained by the U.S. Department of Transportation (DOT). Through careful evaluation of these data, they developed typical operating cost figures. Statistics and curve fits were applied, and to present their airplanes to airline customers successfully, it was necessary to provide realistic operating cost figures.

3.2.4 Methods of cost allocation

There are many ways to allocate costs. Tables 3.4 through 3.7 allocate costs based on fleet requirements, which may not be identical or even similar to the classic accounting systems shown in textbooks.

Some airlines divide costs into the following four categories:

1. Cash operation cost (COC)
2. Direct operating cost (DOC)
3. Indirect operating cost (IOC)
4. Total operating cost (TOC)

Cash operating costs might be better described as out-of-pocket cost to the company in order to get an airplane from point A to point B. They include flight crew pay, fuel and maintenance costs, and landing fees. Direct operating costs include cash operating costs, to which is added insurance (paid on an annual basis) and depreciation. Indirect operating costs include all the essential supporting items necessary to run the airline, such as administration, office rentals, advertising, and
### TABLE 3.4 Airplane-Related Costs

<table>
<thead>
<tr>
<th>Account</th>
<th>Related factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cockpit/cabin crew</td>
<td>Crew compliment</td>
</tr>
<tr>
<td></td>
<td>Block hours</td>
</tr>
<tr>
<td></td>
<td>Crew salaries</td>
</tr>
<tr>
<td>Fuel and oil</td>
<td>Fuel price/aircraft performance</td>
</tr>
<tr>
<td></td>
<td>Mile/trips flown</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Labor rates</td>
</tr>
<tr>
<td></td>
<td>Aircraft design and age</td>
</tr>
<tr>
<td></td>
<td>Number of flight hours</td>
</tr>
<tr>
<td>Aircraft service</td>
<td>Aircraft size (weight/seats)</td>
</tr>
<tr>
<td></td>
<td>Number of departures</td>
</tr>
<tr>
<td></td>
<td>Salaries/contract rates</td>
</tr>
<tr>
<td>Landing fees</td>
<td>Aircraft weight</td>
</tr>
<tr>
<td></td>
<td>Airport rate schedules</td>
</tr>
<tr>
<td></td>
<td>Number of departures</td>
</tr>
<tr>
<td>Navigation fees</td>
<td>Miles flown</td>
</tr>
<tr>
<td></td>
<td>Government/airline cost schedules</td>
</tr>
</tbody>
</table>

### TABLE 3.5 Traffic-Related Costs

<table>
<thead>
<tr>
<th>Account</th>
<th>Related factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic servicing and reservation and sales</td>
<td>Passengers/tons transported</td>
</tr>
<tr>
<td></td>
<td>Salary rates</td>
</tr>
<tr>
<td></td>
<td>Fixed expenses</td>
</tr>
<tr>
<td></td>
<td>Variable expenses</td>
</tr>
<tr>
<td>Food, liability insurance</td>
<td>RPK/RPM* produced</td>
</tr>
<tr>
<td></td>
<td>Food cost</td>
</tr>
<tr>
<td></td>
<td>Insurance rates</td>
</tr>
</tbody>
</table>

*RPK/RPM = revenue-passenger kilometer or mile.*

### TABLE 3.6 System-Related Costs

<table>
<thead>
<tr>
<th>Account</th>
<th>Related factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advertising and publicity</td>
<td>Airline size</td>
</tr>
<tr>
<td>General and administrative</td>
<td>Management philosophy</td>
</tr>
<tr>
<td></td>
<td>Salaries/overhead rates</td>
</tr>
<tr>
<td>Taxes</td>
<td>Government policies</td>
</tr>
<tr>
<td></td>
<td>Tax laws</td>
</tr>
</tbody>
</table>
### TABLE 3.7 Annual (Period) Related Expenses

<table>
<thead>
<tr>
<th>Account</th>
<th>Related factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depreciation (amortization)</td>
<td>Original asset cost</td>
</tr>
<tr>
<td></td>
<td>Useful life</td>
</tr>
<tr>
<td></td>
<td>Salvage value</td>
</tr>
<tr>
<td>Hull insurance</td>
<td>Asset insured value</td>
</tr>
<tr>
<td></td>
<td>Insurance rates</td>
</tr>
<tr>
<td>Lease/rental</td>
<td>Original asset cost</td>
</tr>
<tr>
<td></td>
<td>Lease rates</td>
</tr>
<tr>
<td></td>
<td>Supplies/demand</td>
</tr>
<tr>
<td></td>
<td>(Short-term rentals)</td>
</tr>
<tr>
<td>Finance (interest) charges</td>
<td>Amount borrowed</td>
</tr>
<tr>
<td></td>
<td>Term of loan</td>
</tr>
<tr>
<td></td>
<td>Interest rates</td>
</tr>
<tr>
<td></td>
<td>Company financial rating</td>
</tr>
<tr>
<td></td>
<td>Lenders involved</td>
</tr>
</tbody>
</table>

All other items not included in the preceding categories. Total operating costs are a combination of all the preceding categories.

Other classifications are listed below:

- **Direct operating costs**
  - Flying operations
  - Fuel cost
  - Insurance
  - Maintenance and maintenance burden
  - Depreciation/rents/interest

- **Indirect operating costs**
  - Landing fees
  - Navigational fees
  - Station costs
    - Passenger-related
    - Airplane-related
    - Cargo-related
  - System overhead
    - Administrative
    - Advertisement
    - Promotion
    - Other
  - Start-up costs (if any)

In the case of a new airline or the addition of airplanes to an existing airline fleet, start-up cost should be considered in the budget.
3.2.5 Flying operations

Cockpit crew cost can be classified into six categories:

1. Gross weight pay
2. Mileage pay
3. Benefit pay
4. Training pay
5. Personal expenses (hotels and meals)
6. Payroll taxes

The actual expenses vary for domestic or international flying, low- or high-cost airlines, and from country to country.

Another way of establishing cost figures is to take the budget of the flight department and divide it by the hours flown in order to obtain dollar per block-hour values. Caution: This approach is only applicable if the flight hours are relatively constant without any significant fluctuation for a given time period. When this is not the case, adjust the budget based on aircraft type, schedule, flight hours, and market projections.

Cabin crew assignment and cost are based on the number of passengers the airplane is able to carry and are defined by the applicable regulations. For example, Federal Air Regulation (FAR) 91 requires “for airplanes having more than 19 but less than 51 passengers, one flight attendant; for airplanes having more than 50 but less than 101 passengers on board, two flight attendants,” etc. Depending on the air carrier’s contract, the range of cabin crew cost is between $35 and $55/h.

For example, a budget for a flight department is $312,500 per month (fuel costs not included), and flying time is 825 block-hours. By dividing the dollar amount by the block-hours, a figure of $378/block-hour is established for this operation. This approach presupposes that during the near future (e.g., month) no new and/or additional aircraft are introduced into the existing fleet and the budget and block times are fairly constant from one month to the next. For example, if and when the next month is known to have increased traffic and the budget figures are planned to be $423,200 and flying time is 918 block-hours, the new value will be $461/block-hour, reflecting the anticipated changes.

Another approach is to take the budget apart and classify it into constant expenses such as rent and electricity and variable expenses such as volume of passengers and/or cargo:
Constant expenses $153,200
Variable expenses $159,300

The application of 825 block-hours for this time period would result in
$185/block-hour for constant expenses
$193/block-hour for variable expenses
$378/block-hour total

This means that the second approach furnishes the same result.

3.2.6 Fuel cost

Fuel consumption depends on airplane-engine combination, airplane operating policy, and maintenance. The operating policy is set by the flight operations department, and it affects the following:

- Derated takeoff (contributes to lower engine temperature, extends engine life, and lowers maintenance costs)
- Climb schedule
- Cruise policy (LRC, Mach)
- Descent schedule
- Optimal altitude
- Reclearance policy
- Tankering
- Fuel flow degradation based on airplane age
- Conduct performance audit
- Airport characteristics and payload

The maintenance department is responsible for keeping the airplane in such a condition that drag is minimal while engine performance is maximal. Fuel savings will be discussed in greater detail in Chapter 7.

The best way to calculate fuel cost is to obtain fuel costs for each station listed in the schedule. For example:

Trip: JFK to LHR
Trip fuel: 100,000 lbs
Fuel price at departure station at JFK: 55¢/gal
Fuel cost = (trip fuel/density) × fuel price

$8208 = (100,000/6.7) × 0.55
Another, less accurate method for defining fuel cost is based on average fuel flow of the engines in pounds per hour or gallons per hour. For example, one could use an average cruise weight at a reasonable cruise altitude (depending on the judgment of the performance engineer) and establish a gallons per hour consumption. Another approach would be to collect total fuel requirements and total time from the company’s records. The calculation becomes more complex if more types of aircraft are flown. From total fuel and total time, a fuel/time figure could be established in gallons per hour and multiplied by an average fuel cost in cents per gallon. A dollars per hour value could be established for the whole system.

The following example shows how to apply this average gallons per hour figure for a given trip:

Trip time: 6.0 h
Average fuel consumption: 2200 gal/h
Average fuel price: $0.60/gal

Fuel cost = trip hours × average fuel consumption × average fuel price

\[ \$7920 = 6.0 \times 2200 \times 0.60 \]

3.2.7 Insurance

There are three types of insurance, and each is described briefly below.

Hull insurance. Hull insurance may be related to the replacement cost of airplanes. Generally, it is a certain amount of the airplane price (less engine costs) and is expressed in percentages.

War-risk insurance. War-risk insurance is around 3 to 5 percent of the airplane hull cost, but depending on the circumstances, it may be higher.

Passenger insurance. This is based on mileage and is in the range between 10 and 30 cents per passenger.

3.2.8 Block-hours and flight-hours

Since maintenance costs are calculated and expressed in flight-hours, there is a need to understand the differences and relationship between flight-hours and block-hours. Picture an airplane at a terminal building. As soon as the engines are started and the airplane proceeds to move away from the terminal building, the time is recorded immediately in the cockpit. If there is no other traffic as the airplane taxis to the assigned runway and the airplane is cleared for takeoff, this takeoff time is recorded. Thus taxi-out time represents the time elapsed between the start of the engine and takeoff. If the airplane is in a queue for this runway due to traffic, additional time is necessary for takeoff.
This additional waiting time is included in taxi-out time. When the airplane is occasionally assigned to another (further) runway due to traffic, wind, or any other reason, it has to travel to the newly assigned runway, and this will represent an additional taxi-out time.

Taxi-out time depends on factors such as the time of day, day of the week, season, weather conditions, traffic, and airport layout (distance between terminal building and runway). Once the airplane lands at the destination airport, the time is recorded, and the airplane proceeds to the terminal building. When engines are shut down, the time is recorded anew.

*Block time* is defined as time elapsed between engine start at departure and engine shutdown at the destination airport. *Flight time* is defined as time elapsed between takeoff time at the departure runway and time of landing at the destination airport.

The difference between block time and flight time is the taxi-out and taxi-in time:

\[
\text{Block time} = \text{taxi-out time} + \text{flight time} + \text{taxi-in time}
\]

Each airline tries to minimize taxi time and fuel because they do not contribute to profit.

Cargo airplanes take off during night hours or when there is no heavy passenger airplane traffic. This shortens taxi-out time and block time. Block time is sensitive to airport layout and airplane traffic. Flight time is sensitive to en-route winds and/or traffic congestion at the airports (in the case of a holding pattern).

### 3.2.9 Maintenance cost

The figures for maintenance cost are given in flight-hours, whereas direct operating cost is calculated in dollars per block-hour. In order to incorporate maintenance cost into the direct operating cost, dollars per flight-hour have to be converted into dollars per block-hour. Taking an average figure for the relationship between flight-hour and block-hour, a ratio of 1.20 could be used, or another one could be selected based on the operator’s experience.

\[1.0 \text{ flight-hour} = 1.20 \text{ block-hour}\]

For example, a budget contains $518,300 for direct maintenance cost and a total of 912 flight-hours:

\[
\frac{518,300}{912} = 568.3/\text{flight-hour}
\]

912 flight-hours $= 1.20 \times 912 = 1094$ block-hours

\[
\frac{518,300}{(912 \times 1.20)} = 473.7 \text{ block-hours}
\]
This example shows how to switch from flight time to block time, and vice versa.

Maintenance cost consists of airframe maintenance and engine maintenance. Airframe (including APU) maintenance is divided into labor and materials.

**Airframe direct labor cost per trip:**

\[
\$ \text{ (Airframe labor per trip)} = LR \cdot (ACL + AL \times FH)
\]

where

- \( LR \) = direct labor rate, \$/man-hours
- \( ACL \) = man-hours/cycle
- \( AL \) = man-hours/flight-hours
- \( FH \) = flight-hours/trip

**Note:** Cycle consists of a takeoff and a landing.

**Airframe direct material cost per trip:**

\[
\$ \text{ (Airframe material cost per trip)} = ACM + AM \times FH
\]

where

- \( ACM \) = material$/cycle
- \( AM \) = material$/FH

**Example of maintenance cost calculation:**

Trip = 3000 miles
Flight time = 6.55 hours

Given cost elements:

- Labor rate \( LR \) = $24/man-hour
- Labor \( AL \) = 3.08 man-hours/flight-hours
- Cycle \( ACL \) = 8.75 man-hours/cycle
- Material \( AM \) = 83.28 man-hour dollars/flight-hours
- Cycle \( ACM \) = 359.00 AM $/cycle

Labor = \( LR \cdot (AL \times FH + ACL) \)

\[
\$ = (\$/man-hours) \times [(\text{man-hours}/FH) \times FH + (\text{man-hours/cycle})]
\]

\[
\$694 = 24 \times 3.08 \times 6.55 + 24 \times 8.75
\]

Material = \( AM \times FH + ACM \)

\[
\$ = (\text{Material}$/FH) \times FH + (\text{material}$/cycle)
\]

\[
\$904 = 83.28 \times 6.55 + 359
\]
Total airframe cost:

\[ $904 + $694 = $1598 \]

Engine maintenance cost is based on a similar approach; engine manufacturers provide the basic cost values (which depend on the type of engine):

Labor \((EL) = 2.31 \text{ man-hours/FH}\)

Cycle \((ECL) = 1.62 \text{ man-hours/cycle}\)

Material \((EM) = 181.44 \text{ EM$/FH}\)

Cycle \((ECM) = 135.00 \text{ EM$/cycle}\)

Labor = \(LR \times (EL \times FH + ECL)\)

\[ $ = ($/\text{man-hours}) \times [(\text{man-hours}/FH) \times FH + (\text{man-hours}/cycle)] \]

\[ $402 = 24 \times 2.31 \times 6.55 + 24 \times 1.62 \]

Material = \(EM \times FH + ECM\)

\[ $ = (\text{material$/FH}) \times FH + (\text{material$/cycle}) \]

\[ $1323 = 181.44 \times 6.55 + 135 \]

Total engine cost:

\[ $1323 + $402 = $1725 \]

When labor is given in dollars per flight-hour, the equation changes:

Airframe:

Labor \((ADF) = 73.92 \$ FH\)

Cycle \((ADC) = 210.00 \$/cycle\)

Flight-hours \((FH) = 6.55 \text{ flight-hours}\)

Airframe labor:

\[ $/\text{trip} = ADF \times FH + ADC \]

\[ $ = ($/FH) \times FH + $/cycle \]

\[ $694 = 73.92 \times 6.55 + 210 \]

Engine:

Labor \((EDF) = 55.44 \$/FH\)

Cycle \((EDC) = 39.00 \$/cycle\)

Flight-hours \((FH) = 6.55 \text{ flight-hours}\)