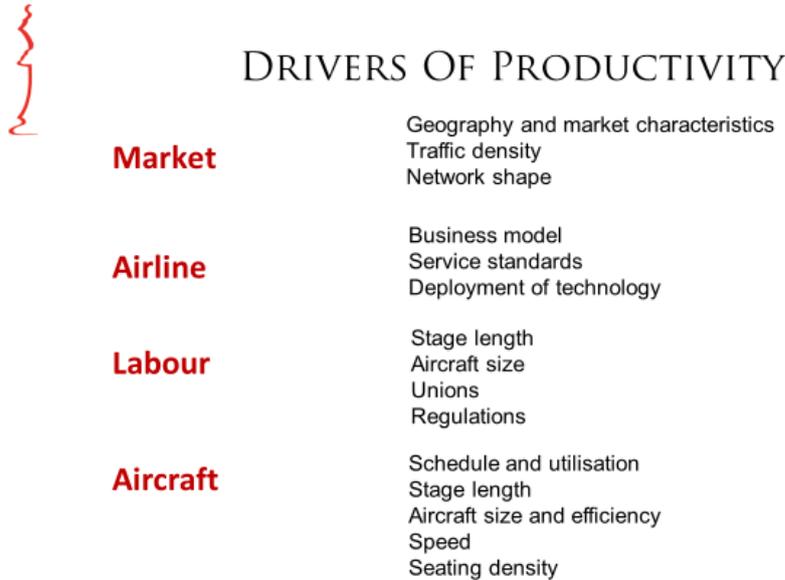


Key Performance Indicators and Economic Calculations



Key Performance Indicators

The first section of this document looks at key performance indicators (KPIs) that are relevant in SkyChess. KPIs are useful as a measure of productivity, which can be sub-divided into four areas. Many of these can be directly influenced by your decisions:



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It is usual to relate capacity and traffic to distance flown:

| | |
|-----|--|
| ASK | Available Seat Kilometre (One seat flying one kilometre) |
| ATK | Available Tonne Kilometre (One tonne of payload flying one kilometre) |
| RPK | Revenue Passenger Kilometre (One revenue passenger flying one kilometre) |
| RTK | Revenue Tonne Kilometre (One tonne of sold payload flying one kilometre) |

Non-metric values would be ASM, ATM, RPM and RTM.

Productivity is defined according to the relationship between ASKs, RPKs and load factor. Note that in SkyChess we are not considering the use of the underfloor space of the aircraft. However, the examples in this document show how cargo can be integrated into the final calculation. This is done by performing the calculations of passenger and cargo traffic on a 'per tonne' basis. It is assumed, in the example, that each passenger weighs 90 kg.

MEASURING PRODUCTIVITY-CAPACITY



(7 weekly frequencies)

74 seats
2 tonnes cargo

$$7 \times 74 \times 1620 = \mathbf{839,160 \text{ ASK}}$$

$$7 \times 2 \times 1620 = \mathbf{22,680 \text{ ATK}_{\text{cargo}}}$$

$$\frac{\text{ASK} \times 90}{1,000} + \text{ATK}_{\text{cargo}} = \mathbf{98,204 \text{ ATK}}$$

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MEASURING PRODUCTIVITY-SALES



(7 weekly frequencies)

74 seats
2 tonnes cargo

$$406 \times 1620 = \mathbf{657,720 \text{ RPK}}$$

$$5.35 \text{ tonnes} \times 1620 = \mathbf{8,667 \text{ RTK}_{\text{cargo}}}$$

$$\frac{\text{RPK} \times 90}{1,000} + \text{RTK}_{\text{cargo}} = \mathbf{67,861 \text{ ATK}}$$

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AND THE LOAD FACTOR...



Passenger load factor $\frac{RPK}{ASK} = 78.4\%$

Cargo load factor $\frac{RTK_{\text{cargo}}}{ATK_{\text{cargo}}} = 38.2\%$

Weight load factor $\frac{RTK}{ATK} = 69.1\%$

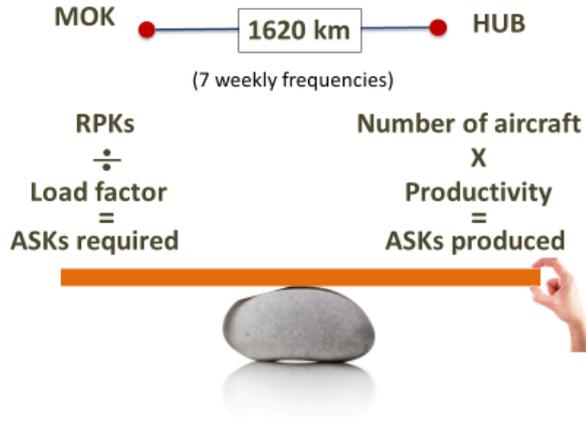
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Note that the weight load factor is considerably lower than the passenger load factor. This reflects the problems of maximising the use of the cargo hold due to directional imbalance of traffic and seasonality effects.

Another vital KPI is the break-even load factor. Break-even is defined as the percentage of capacity filled so that the revenue generated exactly equals the costs incurred. The costs can be considered on a Cash Operating plus Finance Cost basis, or on a Total Operating Cost basis. It is recommended that you work on a Total Operating Cost basis. Break-even load factor is difficult to calculate accurately because it will vary according to changes in the ticket price and load factor, each of which is dependent upon the other.



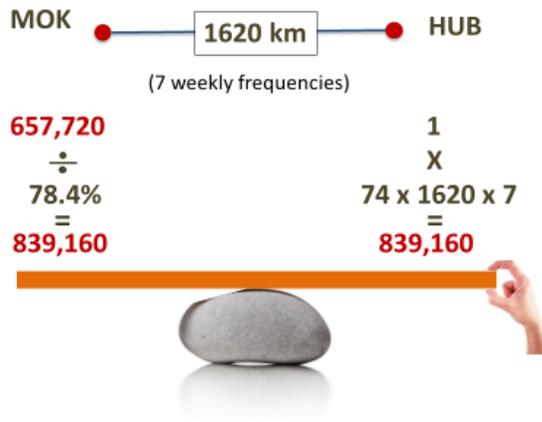
THE PRODUCTIVITY EQUATION-1



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THE PRODUCTIVITY EQUATION-2



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BELF CALCULATION

$$\text{Unit cost} = \frac{\text{Cost}}{\text{Production}} \quad \begin{matrix} \text{ASK} \\ \text{ATK} \\ \text{ASM} \\ \text{ATM} \end{matrix}$$

$$\text{Unit revenue} = \frac{\text{Revenue}}{\text{Traffic}} \quad \begin{matrix} \text{RPK} \\ \text{RTK} \\ \text{RPM} \\ \text{RTM} \end{matrix}$$

$$\text{Break even load factor} = \frac{\text{Unit cost}}{\text{Unit revenue}}$$

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BELF CALCULATION

$$\text{Unit cost} = \frac{5,000}{839,160} \quad \text{ASK}$$

$$\text{Unit revenue} = \frac{6,000}{657,720} \quad \text{RPK}$$

$$\text{Break even load factor} = \frac{0.005959}{0.009122}$$

$$= \mathbf{65.3\%}$$

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Costs and revenues are also stated on a unit basis:

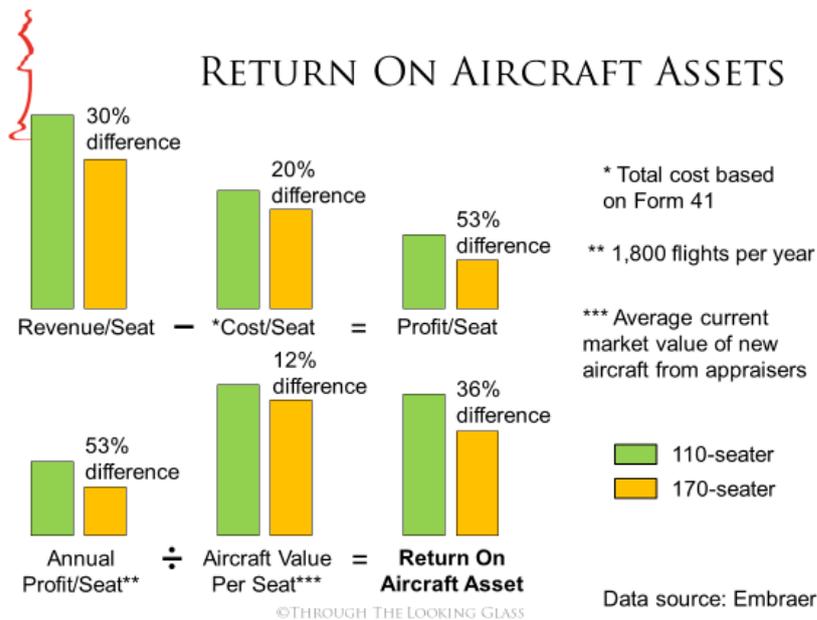
CASK Cost per Available Seat Kilometre
 RASK Revenue per Available Seat Kilometre

Non-metric values would be CASM and RASM

Comparing the CASK of competing aircraft types is extremely useful in determining cost efficiency over different sector lengths.

Another parameter is Revenue per RPK, which relates revenues to traffic rather than capacity. This is also known as 'yield', or unit revenue.

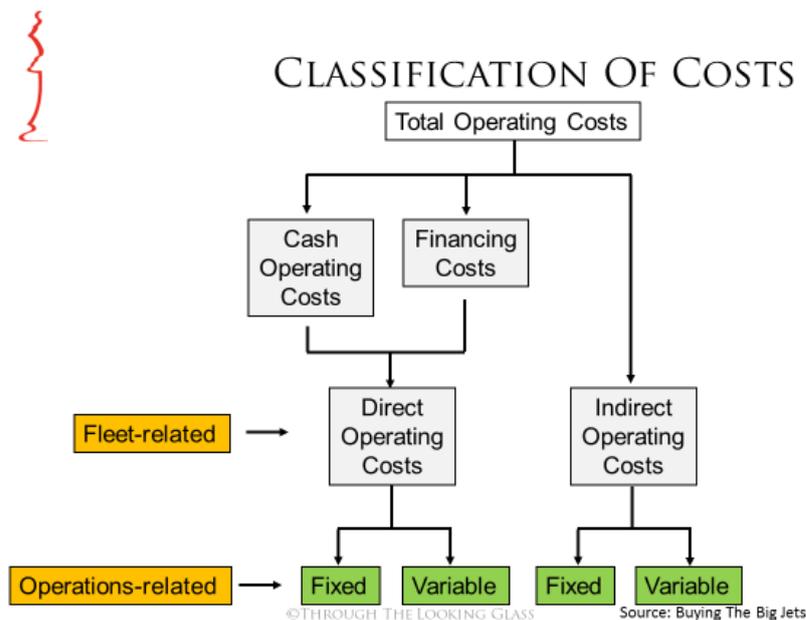
Embraer has promoted a new methodology which they call Return on Aircraft Assets. This is a technique to highlight the relationship between profit and aircraft value.



Economic Calculations in SkyChess

Costs

This section looks at some selected methods and simple equations to help you understand how the costs are calculated in SkyChess. You can use these equations to estimate the results of your own inputs, or even put together your own Excel-driven aircraft economic study. First, this is how costs are classified:



In SkyChess we use fleet-related costs. You will have to make your own estimates of the fixed and variable relationship.

Cash Operating Costs

Fuel

Volume and weight are important, so we need to determine the density of fuel. Density varies with temperature as follows:

| degrees C | Kg/l | lb/USG |
|-----------|--------------|------------|
| 45 | 0.785 | 6.6 |
| 30 | 0.803 | 6.7 |
| 15 | 0.815 | 6.8 |
| 0 | 0.822 | 6.9 |

To make it easy, SkyChess uses the most common density of 0.803 kg per litre. 1 litre is equivalent to 0.264 US gallons. To convert directly from kg to US gallons we ratio the two values, and use a factor of 0.329.

The hourly fuel cost can now be calculated.

$$\text{Fuel flow (kg/hour) x BT x 0.329 x Fuel Price (USD/USGallon)}$$

Maintenance

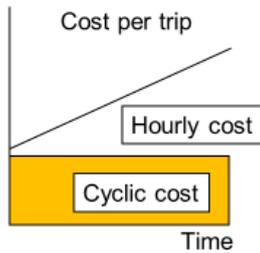
Aircraft manufacturers usually produce two values: direct maintenance cost (DMC) per flight cycle and direct maintenance cost DMC per flight hour (FH). The burden is usually excluded from their assessment as this is something influenced by the airline rather than the aircraft. Also, it is important to be certain if the manufacturer is including Life Limited Parts in their numbers. Maintenance costs are usually calculated according to flight time, rather than block time (BT), so this should be taken into account. Here is the formula used in SkyChess:

$$\text{DMC per cycle + (DMC per FH x (BT - taxi time)) + Burden}$$

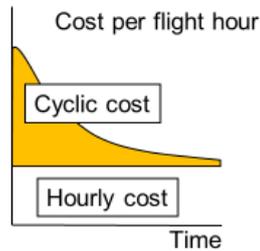
The relationship between cyclic and hourly maintenance costs is critical. Long sectors allow the cyclic costs to be spread more easily than short sectors.



MAINTENANCE COSTS – INFLUENCE OF SECTOR LENGTH



(Hourly cost x time) + cyclic cost



(Cyclic cost ÷ time) + hourly cost

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Flight crew

In a detailed exercise we would use flight crew loading curves to establish how many crews are needed per aircraft. In SkyChess we only need to focus on the crew members flying one aircraft. The important values are the aircraft utilisation, the number of hours flown by the flight crew and the salary plus allowances. BT = block time, and BH = block hour.

$$\left[\frac{\text{Annual Utilisation}}{\text{Max crew hours pa}} \times 2 \times \text{BT} \times \frac{\text{Salary}}{\text{Annual Utilisation}} \right] + \text{Allowances per BH} \times 2 \times \text{BT}$$

Cabin crew

A simpler method is used for cabin crew. In this case we are taking a block hour value for both salary and allowances. It is important to check how many cabin crew members you are assuming per aircraft by referring to the operating cost data.

$$\text{Salary per BH} + \text{Allowances per BH} \times \text{No of crew members} \times \text{BT}$$

Landing fees

This one is very straightforward. The fee is per tonne of take-off weight (TOW) multiplied by the Maximum Design Take-Off Weight (MDTOW).

Fee per tonne of TOW x MDTOW

Navigation fees

The Eurocontrol formula is widely used in aircraft economic studies. The rate (r) for route 'i' is multiplied by the distance (d) in kilometres divided by 100, then the square root of the MDTOW in tonnes divided by 50, plus a fixed rate (f). An example is shown for the route IAD to DUB.

$$r_i \times \frac{d_i}{100} \times \sqrt{\frac{\text{MDTOW}}{50}} + f_i$$

| | |
|------------|------------|
| IAD-DUB | 5,671 km |
| MDTOW | 179 tonnes |
| Unit rate | USD 20 |
| Fixed rate | USD 52 |

$$20 \times 56.71 \times 1.89 + 52 = \text{USD } 2,195$$

Aircraft related handling costs

This is another simple calculation, based on a fee per tonne of TOW, multiplied by the MDTOW.

Fee per tonne of TOW x MDTOW

Financing costs

Insurance

The cost of insurance is a percentage of the aircraft price per annum. For an economic study the cost needs to be converted to an hourly rate according to the aircraft utilisation and then multiplied by the block time.,

$$\frac{\text{Aircraft price (USDm) x insurance rate}}{\text{Annual utilisation}} \times \text{BT}$$

Interest payments

The most usual method of reflecting interest payments is through a mortgage repayment style. Here is the formula:

$$\text{PMT} = P \frac{i(1+i)^n}{(1+i)^n - 1}$$

‘PMT’ is the payment made. Helpfully, Excel incorporates a ready-made function called ‘PMT’ for interest payments. ‘P’ is the aircraft price, ‘i’ is the interest rate and ‘n’ is the number of periods. In our example we have considered interest payments to be made on a monthly basis. Therefore, the annual interest rate should be divided by 12 and the number of periods needs to be the number of months. So, for a 12-year term the number of periods is 144. Here is a worked example:

| | |
|-------------------------------------|--------------------|
| Aircraft price: | \$136.96 |
| Annual interest rate: | 2.25% |
| Term: | 12 years |
| Annual aircraft utilisation: | 4,700 hours |
| Route: | IAD-DUB |
| Block time: | 6.4 hours |

$$\text{PMT per month} = 136.96 \frac{0.001875 (1 + 0.001875)^{144}}{(1 + 0.001875)^{144} - 1}$$

$$\text{PMT per month} = 1.086169 \text{ million}$$

$$\frac{\text{PMT} \times 12}{4,700} \times 6.4 \text{ hours} \times 1,000,000 = \$17,748 \text{ per trip}$$

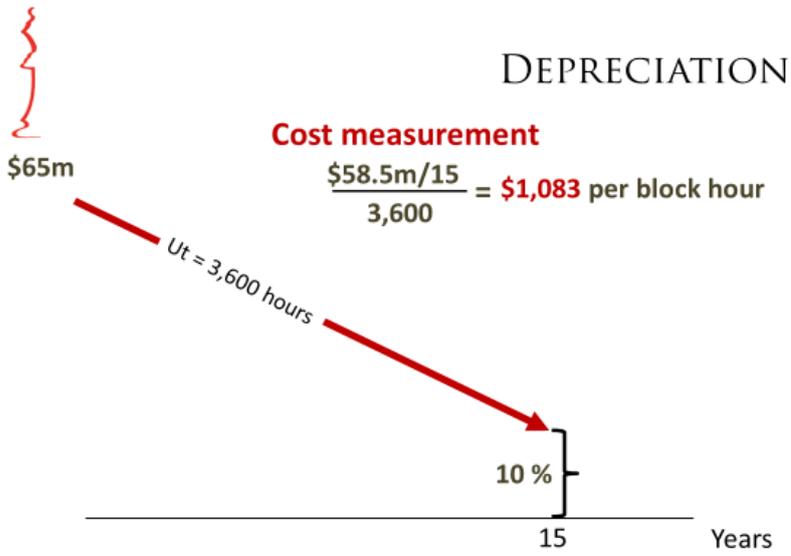
If you wish to reflect a lease rate, then it is a simple matter to take the monthly lease payment and find the hourly rate by dividing by the utilisation, and then multiply by the block time.

Depreciation

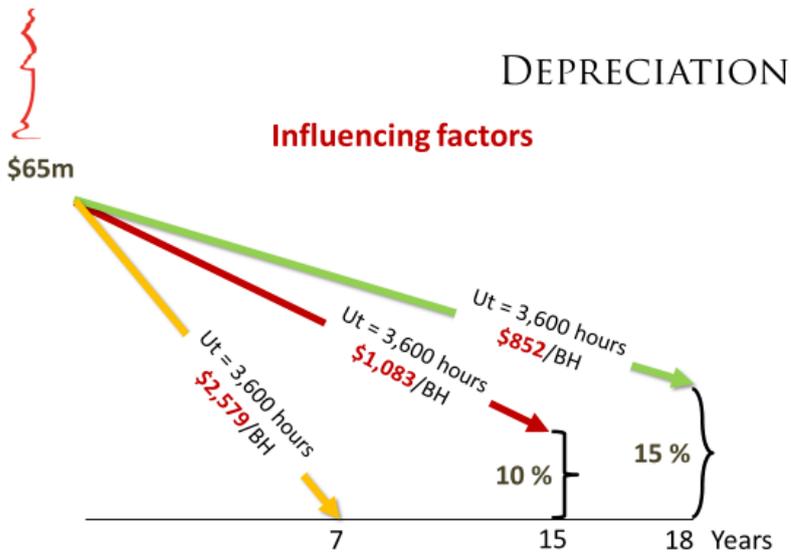
Depreciation is derived from the time period and residual value. Here is the formula:

$$\left[\frac{\text{Aircraft price (USD m)} - \text{RV} / \text{Depreciation period (years)}}{\text{Annual utilisation}} \right] \times \text{BT}$$

Depreciation costs may be influenced by the residual value percentage as well as the utilisation and time period.



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Indirect Operating Costs

In fleet planning we do not always consider the indirect costs as, by definition, they are not related to the economic performance of the aircraft. However, their inclusion is vital when considering the totality of the business.

The three principle components, traffic handling, passenger services, and ticketing, sales and promotion, are dealt with by an amount per passenger carried.

General and administration costs are extremely difficult to model. A simple method is to assign an amount per available seat kilometre performed.

Revenues

Price, revenue and yield are all different. Revenue passengers included those who have paid published fares, frequent flyer program rewards, denied boarding compensation, corporate discounts, tourist packages, and government and military personnel.



DEFINITIONS

Price

Monetary cost to consumers
A mechanism to balance supply and demand
An element of the 'marketing mix'

Yield

Revenue earned per
 RPK or RPM performed
 RTK or RTM performed
(Net of commissions and fees)

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WHAT IS REVENUE?

| | |
|---------------------|--------------|
| Fare: | \$99 |
| Fuel surcharge: | \$175 |
| In flight sales: | \$17 |
| Partnerships: | \$320 |
| Excess baggage: | \$242 |
| Taxes and fees: | \$103 |
| All yours for only: | \$956 |

Values are indicative

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Profit and Cash

Finally, some important financial KPIs:

Profit = Revenue minus Costs

Cash = Profit plus Depreciation

Margin = Profit (or loss) divided by Revenue

Depreciation should be added to profit in order to obtain the cash because depreciation is a non-cash item that has already been included in the profit statement as an operating cost.

Note also that margin may be expressed as either pre- or post tax.