

System Dynamics Approach to Strategic Market Modeling in the Airline Industry

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Abstract

The domain of strategic decision making involves very complex issues with action-reaction relationships. In reality, there are system dynamics-based simulation tools that can help business managers understand the fundamental processes of their businesses. In this research paper, we have studied the strategic markets in the passenger airline industry for an international city pair between Perth and Singapore. Based on the study of major players on this route sector, we have attempted to model all the significant market elements and forces that demonstrate their explicit and implicit behaviours. The model developed in "iThink", a system dynamics-based simulation software, provides an interactive capability to the business manager for the exploration of alternative scenarios so that the decision maker can understand how the pricing or competitive positioning activities of other players affects the market leader and vice-versa.

1. Background

In recent years, the airline industry has been experiencing growth in market demand, locally, nationally, and internationally. In particular, the Asia-Pacific sector of the passenger airline market is growing at nearly 10 percent per annum. The passenger growth on the Perth-Singapore-Perth sector has been steadily increasing at a phenomenal rate over the last few years. This has been evidenced in recent years by the increase in frequency of flights by the national carriers for the city-pair with other new players in the sector. It has brought about intensive competitive pressure amongst the participants. Therefore, it is vital to understand the market and its competitive environment, and to use the airline's competitive advantage to gain market share and profitability.

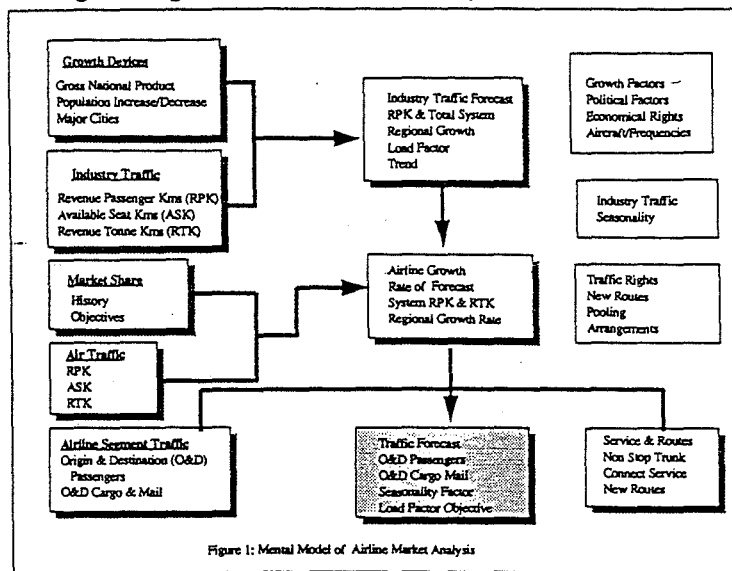
In order to preserve confidentiality, we have changed the names of the airlines involved to YQ Airlines as the main player and SY, IA, and AB as the competitors. We take no responsibility should these acroymns coincidentally reflect the real players in the airline market. A simulation model for market analysis was developed in *iThink*, to help airline managers understand and anticipate the growth in industry and market, and to develop and implement strategies effectively to attain the defined goals. The process of model prototyping involved planning, paper prototyping, model building, analysis of the simulation results and providing strategic assessments of the markets.

2. Airline Country Managers' Mental Model

It is crucial that airline managers have a thorough understanding of the market demand they want to satisfy. Aircraft selection, route development, scheduling, product planning, pricing and advertising are just some of the many decision areas which ultimately are dependent on an analysis of demand for transport of passengers and freight.

On the contrary, aircraft type and speeds, departure and arrival times, frequency of service, air fares, in-flight service, the quality of ground handling services and other features of supply will influence demand for an airline's services. The density of demand, its seasonality, the purpose of travel, the distance to be travelled will also influence supply and impact on costs. Thus, airline planning is a dynamic iterative process. New adjustments to supply then takes place to

meet the changes in demand and the interactive process continues. The more competitive and unregulated the market as IATA (International Air Transport Association) has made it, the more are the difficulties of strategic marketing - matching the supply and demand for the airline managers. Figure 1 shows a summary of the of market drivers for supply and demand.



We can assume that economic growth, political situation, major trunk route city type, population or more specifically per capita income (a socioeconomic characteristic) and past industry passenger traffic will be some of the key factors that shape the industry growth for demand on the Perth-Singapore sector. Industry convention and standards measure of air passenger traffic is defined by one of the following indicators Revenue Passenger Kilometres (RPK), Available Seat Kilometres (ASK)

or Revenue Tonne Kilometres (RTK) (Transport and Communications Department, 1993). We also assume that route sector growth forecast for passengers will not outstrip industry growth forecast.

3. Supply and Demand Drivers in the Airline Market

Market segmentation is invaluable since each market segment has its own characteristic growth rates and responds differently to variables such as fare changes, economic factors etc. We have decided to segment the market into the three categories of air travel ie First Class, Business Class, Economy Class (which includes the discounted fares category). Cost differentiation is considered the key factor. Porter(1980) describes the five force model and shows that product differentiation, can be achieved through factors such as distribution channels, frequency and timing of services, in-flight service and airport customer service. The market segments correspond to the seat categorization generally used in the airline industry. Understanding the size and characteristics of each market segment is essential for forecasting demand product planning, flight scheduling etc and even pricing. (Doganis R, 1993)

Amongst the general factors affecting demand, the price of air transport, the level and distribution of personal income are perhaps the most significant. Further, the level of economic activity and trade directly influences the growth of demand for business travel. In the case of Singapore, a global city state with a 2.6 million population base, it is the affluence and double digit economic growth that is driving the market demand. Supply and demand do not interact only through the price mechanism. Various supply conditions such as frequency, seat availability, departure and arrival times, in-flight service, flight safety record influence the level of demand and the distribution of the industry demand between competing carriers (Doganis R, 1993).

The YQ Airline process frame represented in Figure 2 is designed around the 4P's - product, place, price and promotion (Assaul. H, Reed. P, Patton. M, 1995). The sub- model pre-supposes that revenue could be increased by maximising the four-fare price structure. YQ Airlines should charge more for business travellers because their demand is relatively inelastic to price and charge less to the price-elastic leisure market using economy and discounted fares knowing that

it will in turn generate proportionate demand and thereby increase revenue. Fares in our model are based on a unit price for Economy Class, 1.4 for Business Class, 1.6 for First Class and 0.6 for discounted fares and these ratios can be varied to determine a desirable product mix in the model.

4. System Dynamics-based Model Design

Process stocks such as the YQ Airline's passenger market share always exist within information feedback loops. Feedback, fundamentally, determines the behaviour of the real world. There are two kinds of feedback loops operationalised in our model ie the positive (reinforcing) loop which generates change or growth such as gain or loss in market share of passengers. The other is the negative (balancing) loop which acts to negate change which is the "target seeking" behaviour of the YQ airline's strategies (Risch.J et al ,1995).

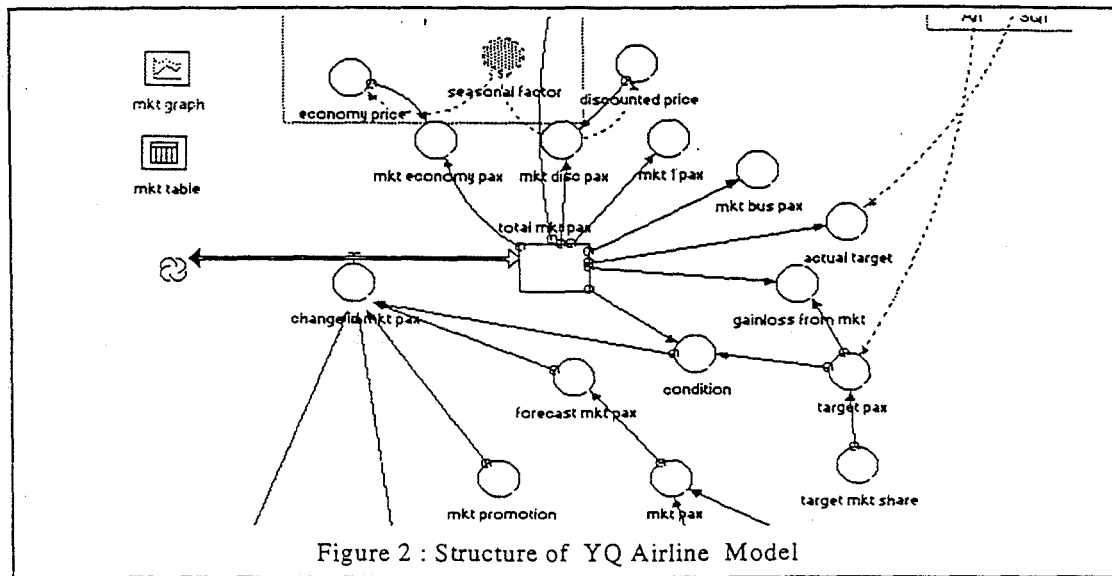


Figure 2 : Structure of YQ Airline Model

Delays can be used to represent the effectiveness of YQ Airline's Management policy change to increase the flight frequency from 4 to 8 per week. The desired response such as an increase in passenger demand might hypothetically take 3 months to filter through advertising before the full impact of the policy change is realised by the airline. Delays can be represented as conveyors (Stevenson, 1993). One of the assumptions of the design is that the relationship between the main player YQ Airline and its competitors' share (Figure 3) of the market is modeled as a zero-sum game.

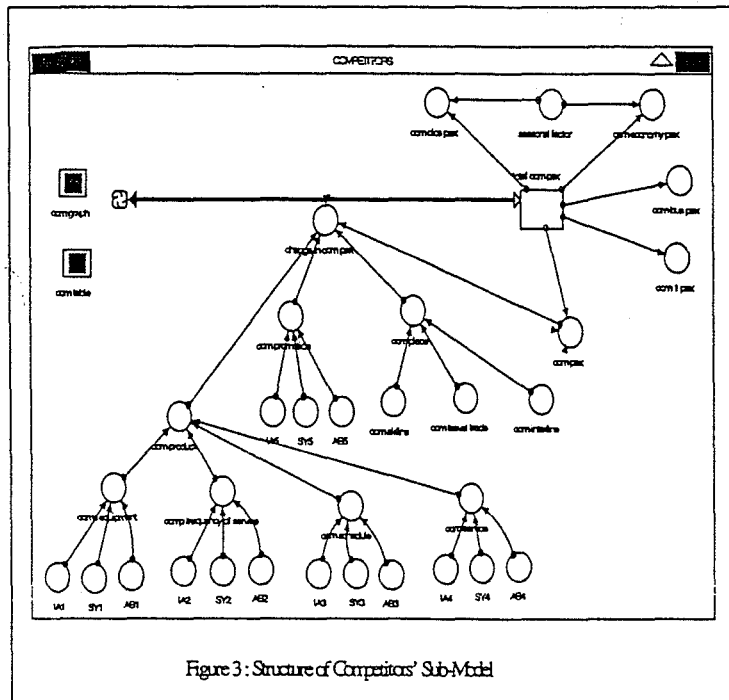
4.1 Simulation Model Validation

The usefulness of the model can only be determined after conceptual validation ie the manager is satisfied that the business processes are demonstrating expected dynamic behaviours. This was further validated against historical passenger movement statistics (both RPK and ASK) for the sector (Transport and Communications Department, Civil Aviation Authority). Marketing policies work through the interaction of feedback loops which create change and stabilise performance. It is the simulation tools' unique ability to interactively support such change for policy analysis and design that makes it so useful.

5. Strategic Market Assessment

Our analysis of the simulation model results are as follows:

- YQ Airline dominates the Perth-Singapore sector as expected even if its target market share is deliberately reduced. This is because in terms of qualitative factors such as quality of service and frequency of service, it is still the preferred airline
- YQ's competitors suffer heavily in terms of market share as YQ monopolises the market. In fact, its growth rate is only contained by the industry growth
- shifts and redistribution in the four market segments for YQ Airline due to sensitivities in cost of air fares when there is heavy discounting by the competitors



- little sensitivity to changes in economic and political factors at the Perth end of the city pair indicating that Perth is more of a leisure destination. Seasonality affects the market in the winter months although heavy fare reductions in the off-peak season attracts more passengers and thus counteracts the loss
- passenger market is, however, affected by destabilising political and economic factors in Singapore, showing its significance as "hub and spoke" destination for business and transit travellers.

Conclusions

Based on the scenarios generated by the model, some recommended long term measures for YQ Airlines are as follows:

- to ensure sufficient seat capacity to meet growth demand,
- to establish dedicated distribution channels for marketing discounted tickets,
- to reduce flight frequencies for this city-pair and use higher capacity aircraft.

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