Understanding Business Cycles in the Airline Market

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Abstract

Cyclical behavior in the airline industry is mostly endogenously generated. With the help of a relatively simple system dynamics model, basic behavior modes can be replicated. Furthermore, the model allows the identification of leverage points for improving performance. Insights generated during the project work are now going to influence order policies for new commercial aircraft jets.

The evolution of the airline market is characterized by long-term business cycles. They are the major cause for the market's poor profitability and for its low shareholder returns. Since 1970 the airline market has seen two complete cycles. These included severe crises in the early 80s and in the early 90s, affecting nearly all carriers. In order to gain insights into the dynamics of the cyclical movements and to derive strategies for long-term capacity and fleet planning, we developed a model of the airline market.

The paper first describes the generic, cycle-generating structure of the problem—a negative feedback loop with two delays. This relatively simple dynamic model already provides a first explanation for the business cycles in the airline industry. In a second step, this generic model serves as basis for the development of a general model of the airline market. The general model helps

- to identify the cycle generating components of the industry and to understand their interactions,
- to analyze different scenarios, and
- to identify key variables and leverages for cyclical management strategies.

The model reproduces historical behavior of the airline market and allows basic estimations of future order trends for commercial aircraft jets.

The project reported herein is a system dynamics study realized for the corporate planning department of Lufthansa German Airlines. It emphasizes the importance of systems thinking and systems simulation in complex environments.

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Business Cycles in the Airline Market: Planning Under Uncertainty

The evolution of the airline industry is heavily influenced by business cycles. Figure 1 shows the industry's operating profits according to the IATA-member statistics.[1] The figure shows, that the early 80s and the early 90s were periods of severe losses.

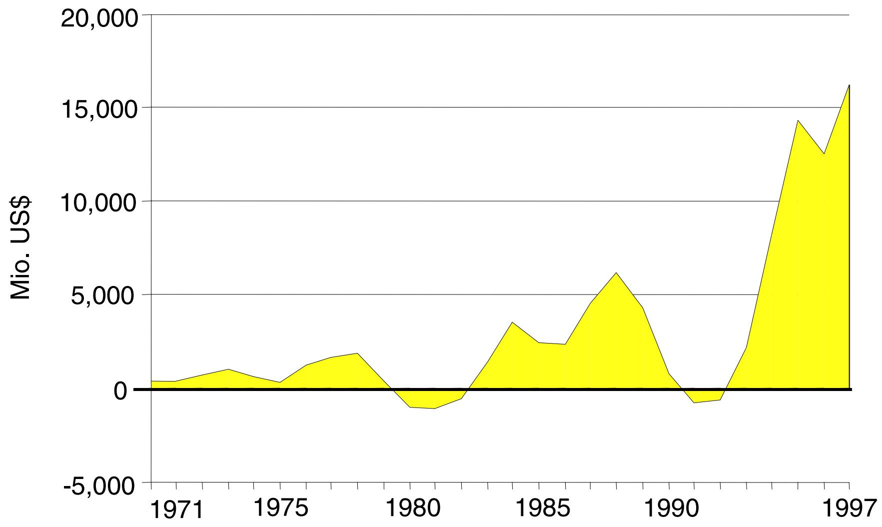

Figure 1: Total profit over all airlines from 1970–1997 (source: IATA World Air Transport Statistics)

Trying to explain these cycles, one has to look at the underlying critical factors of success within the airline market. Doing this, it has to be seen, that the air traffic as a product is basically a service, which is offered to the customer. From this point of view, the air transport market suffers from the typical service industry's problem which is the missing ability to produce on stock. Thus, the cyclical behavior of financial results corresponds with orders for new aircraft placed by airline companies. Compare Figure 2 for a summary of ordered and shipped commercial aircraft jets.

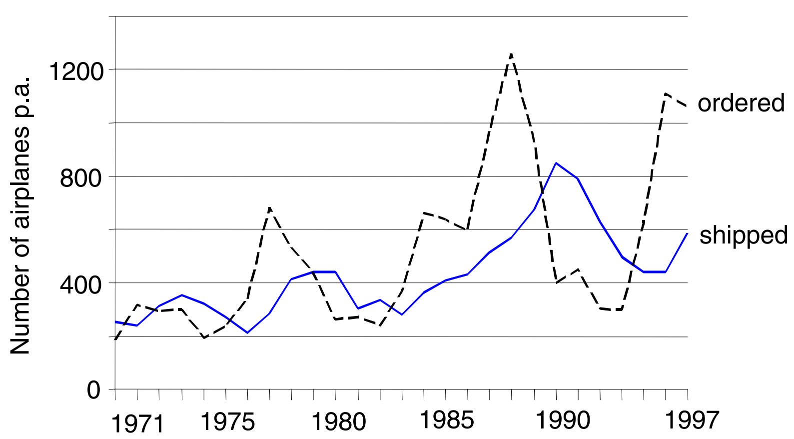

Figure 2: Orders and shipments of aircraft jets from 1970–1997 (source: Lufthansa Analytical Report)

In addition, the air transport product is an indifferent product. This means, that the service levels of different air transport companies are more or less the same. The most important factors, which influence the customer's decision for a specific airline are the schedule and the price.[2]

For business travelers, the schedule is more important than the price of the flight. Due to the higher yields in the business travel market, airlines mainly try to attract business travelers. Knowing that business travelers mainly decide according to the airlines schedule, the airline's challenge is to develop and optimize a schedule, which is characterized by a high number of destinations and frequent flights to each of these destinations.

On the other hand, the cost structure of a single flight of an airline leads to a contrary situation. Since the biggest part of the overall cost of a flight are induced by the flight itself, the marginal costs of each additional passenger are low. From this point of view the airline should try to fly with a low frequency to a specific destination, trying to fill the plane with as many passengers as possible.

Taking these aspects together, airlines are facing the fact, that capacity planning and schedule planning are mostly relevant for business success.

Business success itself became more and more important for the air transport companies. Starting in the U.S., the international air traffic markets were deregulated and according to international liberalization of the markets, most of the formerly state owned companies are now traded at the public stock markets. Being listed at the international stock markets, it becomes increasingly important for airlines to focus on shareholder returns.

Given the requirements of the global capital markets, it becomes increasingly important for the airlines to be able to show substantial growth. Against this background of increasing shareholder orientation of the airline companies, the business cycles, which determinate the profitability of the industry, are subject of growing interest of the companies' management, since these cycles are watched by professional investors, too. As long as these cycles cannot be explained or forecasted, the industry suffers from a discount in their stock prices, compared to other industries. This situation leads to the necessity to be able to explain and forecast the business cycles. Through explanation and forecasting it should be possible to prevent cyclical behavior (at least as a single company) and, thus, to be able to keep profit up and to outperform the industry.

Given this background, the following SD-project at Lufthansa German Airlines was set up to use modern systems theory to explain the dynamic behavior of the complex system of the airline market.

A System Dynamics Model to Analyze the Cyclical Behavior

The purpose of the model we developed for Lufthansa German Airlines is threefold. First, we intended to gain insights into the dynamics of the cyclical movements and to identify the core structure of the problem; second, to develop a tool for the analysis of different scenarios, for example, exogenous demand-shocks; and third, to test alternative policies in order to derive strategies for long-term capacity and fleet planning.

The cycles of the airline market are often considered to be a response to fluctuations in the evolution of the GDP and to lie beyond the sphere of the industry's influence. As a consequence there is a lack of cyclical management strategies to smooth the oscillations and to reduce their negative impact on the carriers‘ profitability. However, our research has shown that there is strong evidence to believe that the cycles of the market are endogenously driven and that there exist several strategies airlines can adopt throughout the cycle. In order to improve understanding and to create a basis for a general model, the underlying structure of airline market cycles will be illustrated in a first step. This generic, cycle-generating structure as described in Figure 3 is a very simple representation of the problem, but it already provides a first explanation for the cyclical phenomenon.

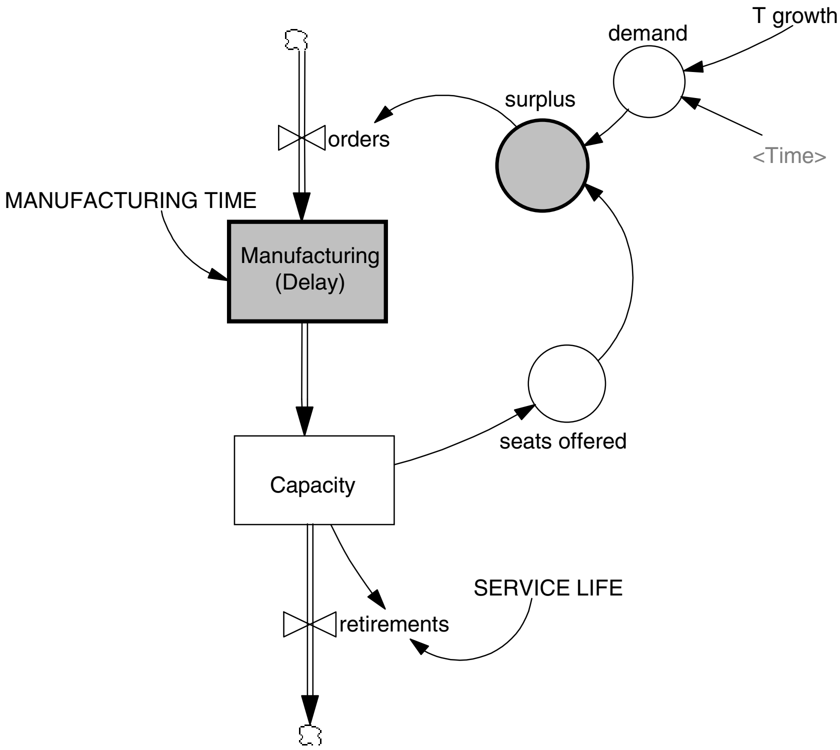

Figure 3: Generic model generating business cycles in the airline market

Figure 3 shows a negative feedback loop with two delays—a structure that can lead to non linear behavior (Forrester 1971, p. 2-37). The first delay characterizes the aircraft lead-time, the second the delayed recognition of the industry's surplus.

The description of the generic loop in action is similar to the cause and effects produced by commodity production systems (Meadows 1970) or by delayed inventory systems, as simulated with the Beer-Game (Sterman 1989, pp. 326–331): Airlines strive for high seat load factors (*Desired Surplus*) to maximize their revenue. Due to aircraft lead-times and delayed recognition of overcapacities, the system starts to oscillate around the desired seat load factor. The mechanisms underlying the expansion and contraction movements are similar to those shown by the classical theory for economic cycles (Mager 1987, pp. 3–5).

Simulations of the basic model reveal that the existence of fluctuations is independent of the development of revenue passenger. Figure 4 illustrates the surplus and seat-capacity development at a constant number (*generic*) and at linear growth of revenue passenger (*generic1*). Notice that unit values and time bounds in Figure°4 have been chosen for illustrative reasons, that is, to elucidate the cyclical behavior of the generic structure. For more realistic time bounds and unit values see simulation results of the general model below.

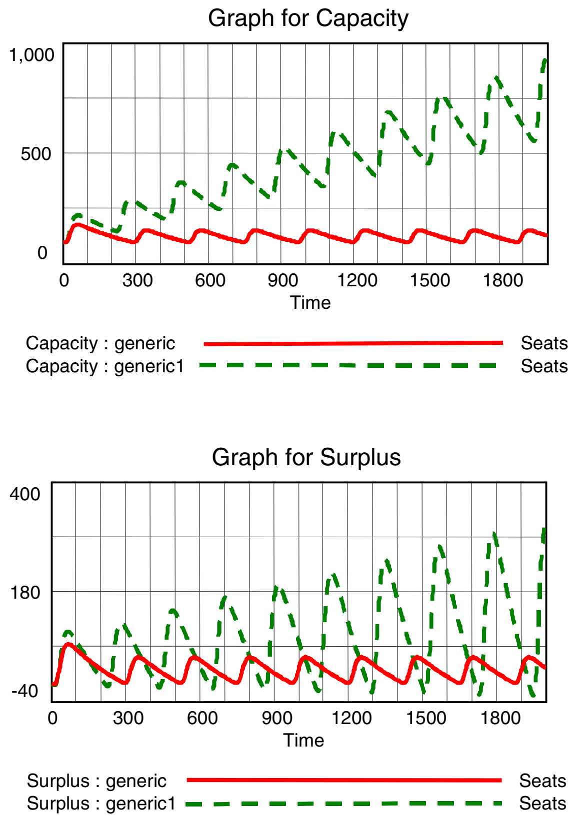

Figure 4: Dynamic behavior of capacity and surplus in the generic model

An enlargement of the generic structure—a price-loop that includes a price setting mechanism and a price-demand function—shows that yield-management strategies cannot dampen the long-term waves in the market. Different yield-management strategies only affect the amplitude and period of the cycles but not their existence.

The general model of the airline market, that builds up on the generic structure, provides a more realistic and detailed view of the cycle generating elements. It consists of three modules: (1) the airline market as a whole—including all carriers and manufacturers, (2) the structure of Lufthansa German Airlines—integrated as a micro module in the airline market and (3) the competition module, where passenger decide whether or not to fly with Lufthansa German Airlines depending on its competitive situation.

In the following we will focus on the „macro-module“ of the airline market as illustrated in Figure 5.

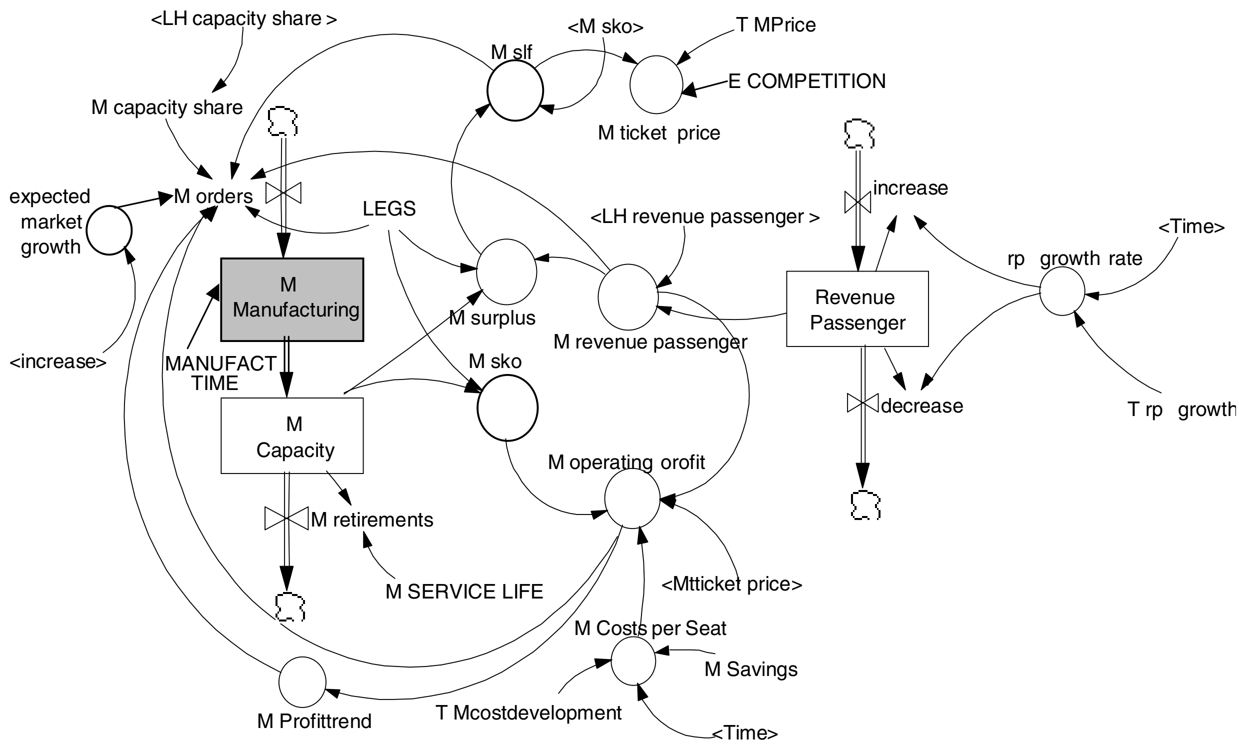

Figure 5: General model of the airline market

The flow diagram displays a demand section (*RP* = revenue passenger), a price section (*M Ticket Price*), a cost section (*M Costs per Seat*) and a capacity section (*M Capacity*), the latter comprising all variables of fleet planning. The order variable (*M Orders*) is a key element in the general model. The decision to buy new aircraft depends on seven variables including, among others, the passenger growth forecast (*Expected Market Growth*) and legs (number of daily take-offs of one aircraft). Since carriers tend to wait and see if their profitability is sustained before committing to new orders (Skinner and Stock 1998, p. 54) the model considers a variable that describes the mid-term development of operating profits (*M Profittrend*).

The general model is the result of various consultations of experts, who helped to identify the relations between the key variables and to define the system's boundaries. Hence, it was possible to construct a model that reproduces historical behavior: The characteristics of cyclical variables and the two crises of the airline market in the early 80s and 90s can be duplicated by model-simulations. Figure 6 illustrates the evolution of the seat load factor (*M SLF*) from 1970 with troughs in 1983 and 1993.

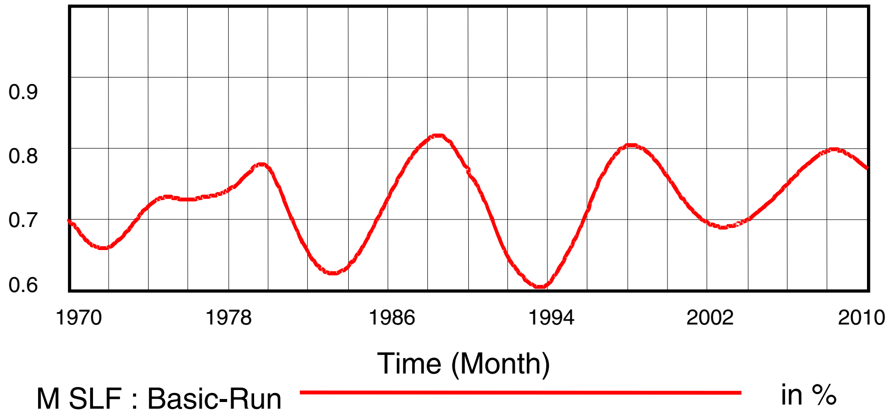

Figure 6: General model: simulation of the seat load factor-evolution since 1970

Leverage Points for Corporate Planning in the Airline Market

The model presented above satisfactorily reproduces historical behavior of the airline market. Compare, for example, actual orders from 1970 until today and data generated by the simulation model (Figure 7). Although no complete identity can be stated the dynamic, cyclical behavior is obviously the same.

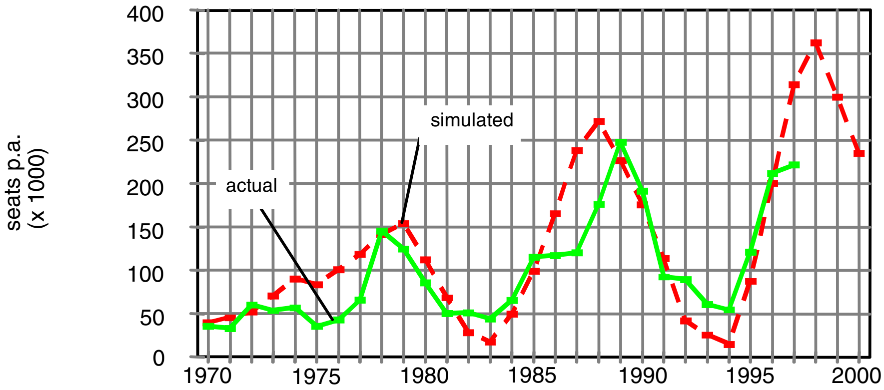

Figure 7: Comparison of historical and simulated data for orders of new aircraft jets (airline market)

Note in particular the level of similarity to results of a simulation presented by Lyneis (1998, p. 11). Our goals, however, are different. We are not interested in an numerically precise prediction of the future airline market. We aim at identifying endogenous factors that are responsible for cyclical behavior in the airline market. Furthermore, our intention is to improve the system to achieve more stable results. With these two goals, we follow Morecroft's (1988, p. 312) approach and built a model to "'prime' policymakers for debate." Nevertheless, the model presented here allows basic estimations of future order trends for commercial aircraft jets. (See Lyneis 1999, for a discussion about the use of models with different degree of detail.)

Furthermore, different scenarios, for instance, exogenous changes in demand, can be analyzed. For an example, see Figure 8, which depicts results for the basis simulation run in comparison to a simulation run where effects of the Gulf War are not included. The cycles in the simulated markets only differ in amplitude, not in their principal appearance. We interpret this results as another indication that the cycles in the airline industry are mainly caused endogenously. Exogenous factors only determine the amplitude of the cycles, but they are not responsible for the general cyclical behavior of the system.

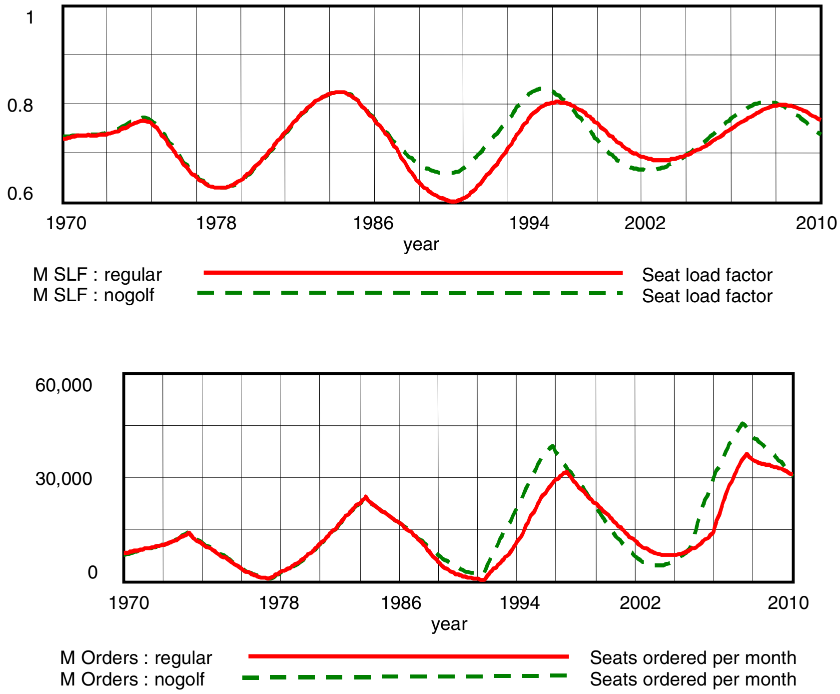

Figure 8: Comparison of seat load factor and orders with and without Gulf War (airline market)

The model presented in this paper helped to identify key variables and leverages for cyclical management strategies. Decision makers learnt that the cyclical behavior of results in their industry are to a good amount caused by their decision rules and not by exogenous factors. A fact that is no surprise for system dynamicists. As possibilities to stabilize the system, the points shown in Figure 9 were identified.

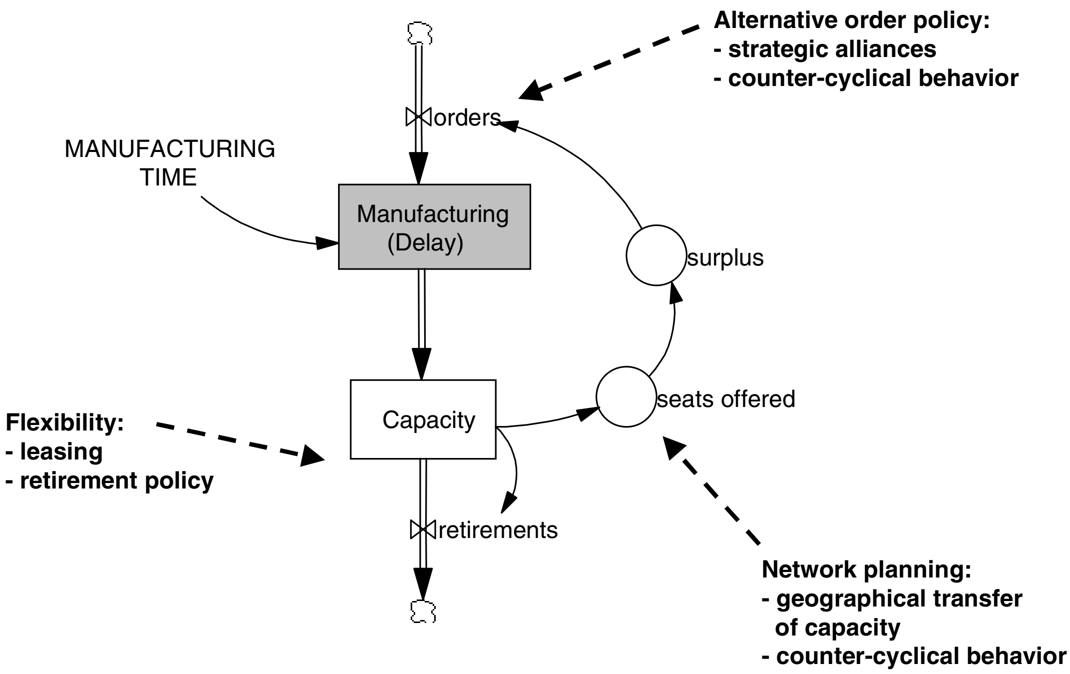

Figure 9: Leverage points to stabilize results in airline market

As an example for these leverages a leasing policy was further explored. Figure 10 depicts the dynamic consequences of a more flexible fleet, which could be achieved by leasing of a substantial part of the airplanes. Leasing of airplanes stabilizes Lufthansa's results. It has to be considered, however, that this approach does only work, if the leasing company is able to work with stable demand and order policies. That means, it will not have a positive effect if the leasing companies just reproduce behavior formerly shown by airlines.

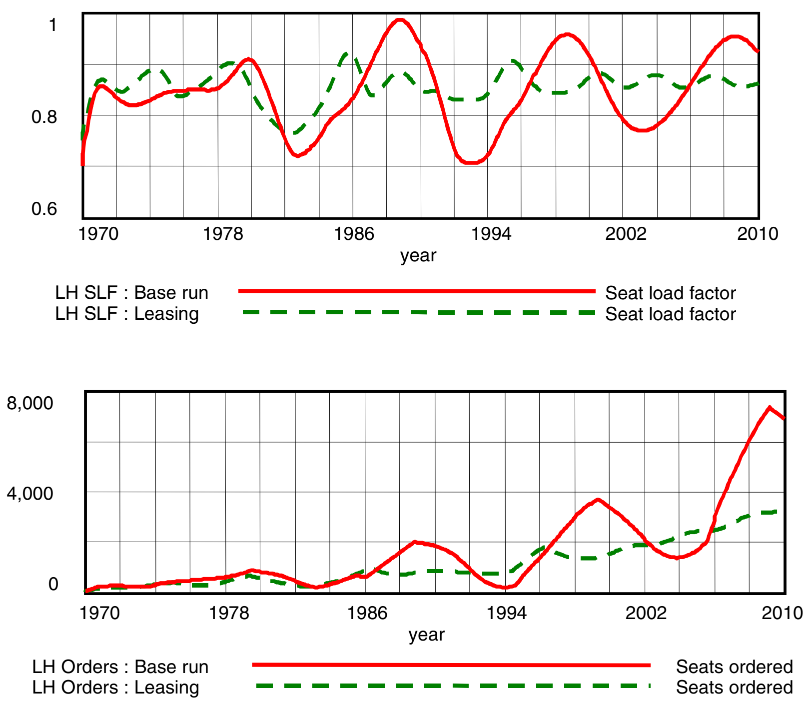

Figure 10: Consequences of leasing of airplanes on seat load factor and orders (Lufthansa)

Another possibility to stabilize the whole industry would be more cooperative policies of aircraft ordering. If airlines would consider the total amount of orders, overcapacity could be avoided. The growing importance of strategic alliances of airlines could offer chances aiming in this direction. They allow to adjust order policies within the alliance. In the competitive airline market between the different alliances, however, such cooperative behavior is still not likely to happen.

Like for many other industries before, it was shown with the help of a simulation model that cyclical behavior in the airline industry is endogenously generated. Already a small system dynamics model can replicate historical data sufficiently. Leverage points to stabilize system's behavior can be easily identified using this model. Future project work will be on the implementation of improved order and network policies. Another area of interest is to extend the model in order to achieve more precise financial statements.

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Notes

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1. IATA = International Air Transport Association
2. Lufthansa market research results / conjoint analysis