

Impact of Deregulation on Investment and Production Strategies in the Commercial Aircraft Industry

ELYSE GOLOB

The impact of the Airline Deregulation Act of 1978 on the U.S. aircraft manufacturing industry is investigated. The ways in which the removal of fare and route restrictions precipitated a restructuring of the investment and production strategies of the two major domestic airframe manufacturers are explained. On the basis of a series of interviews with informants in the airline and aircraft manufacturing industries, it is concluded that deregulation has affected the commercial aircraft industry in four significant ways: (a) fleet analysis procedures were transformed following deregulation, (b) the emergent hub-and-spoke system precipitated major fleet reconfigurations, (c) there was a rise in manufacturer and institutional financing and leasing agreements, and (d) airlines were saddled with aging and multiple-model fleets. Manufacturers have responded to these developments by assuming an increased share of the risks associated with aircraft acquisition, incorporating customer concerns in aircraft design, and reducing capacity while increasing productivity.

The Airline Deregulation Act of 1978 has had a significant effect not only on the industry it was designed to reform but also on the aircraft manufacturing industry. Whereas the removal of fare and route restrictions resulted in a protracted upheaval of the airline industry, it also precipitated a restructuring of the investment and production strategies of the two major domestic airframe manufacturers. Recent evaluations of deregulation's impact, however, have focused on the increased competition among airlines, labor-management relations, and measurements of consumer benefits, including pricing, service, and safety (1-4). Aircraft industry studies, while acknowledging the effect of deregulation on such areas as airline purchasing power and changes in equipment demands, call for further research on this topic (5-8).

This study finds that deregulation has had a profound impact on the U.S. commercial aircraft industry in four significant ways: (a) fleet analysis was transformed after deregulation as airlines began to view aircraft as resources to operate rather than assets to own, (b) the growth of the hub-and-spoke system precipitated substantive fleet reconfiguration, (c) the removal of government-sanctioned price increases in response to the escalating cost of aircraft led to a rise in manufacturer and institutional financing and leasing agreements, and (d) increased competition and mergers among the airlines have resulted in aging fleets and a trend toward fleet rationalization.

American manufacturers have responded to these developments in several ways. Over the past 15 years, Boeing and McDonnell Douglas have assumed an increased share of the risks associated

with aircraft acquisition by providing manufacturer financing, flexibility in delivery dates, and extended maintenance and support agreements. Several events, however, that have occurred simultaneously with deregulation have had a significant impact on the industry: increased foreign competition from Airbus, economic recession, and the curtailment of spillover effects from military production following defense cutbacks (9-13). Since aircraft manufacturers have also undertaken various strategies to meet these challenges, including internationalizing aircraft production and improving productivity through cost-cutting efforts such as computerized design and development, the singular effects of deregulation are difficult to ascertain.

Furthermore, demand in the airline industry fluctuates in cycles of approximately 8 years. Reluctant to acquire aircraft at the bottom of a cycle, airlines prefer to reduce their risk by placing orders at the last minute, thereby taking advantage of the good deals and short lead times offered by manufacturers. When considering the industry as it comes out of the second full cycle following deregulation, one must differentiate between short-term decisions undertaken in response to cyclical factors and long-term structural effects due to the lifting of government restrictions by examining the pattern of orders during the full range of time.

METHODOLOGY

To determine the effect of deregulation on the production and investment strategies of domestic aircraft manufacturers, interviews were conducted with two primary groups of informants in the airline and aircraft manufacturing industries. In addition, leasing company personnel and institutional financiers were interviewed. The first set of interviews involved fleet planners and aircraft acquisition personnel in six domestic airlines: American, Delta, and United, the "Big Three"; USAir and Continental, generally considered "outsider" companies; and Southwest, a highly successful and much imitated company. Table 1 gives the major characteristics of these companies, including revenue passenger miles, market share, load factor, and operating profit margin. Airline profits are a result of high system load factors. A 68.5 percent load factor for a domestic carrier such as Southwest is considered high, whereas 68.6 percent for United, an international carrier, is not. A load factor below 65 percent, shown by the four remaining airlines, is considered dangerous.

Although deregulation is one of many factors affecting the competitive status of U.S. aircraft manufacturers, the use of a carefully prepared interview format enabled the researcher to isolate the

TABLE 1 Selected Profile of U.S. Airline Industry: Revenue Passenger Miles, Market Share, Load Factor, and Operating Profit Margin, 6 Months 1994

Company	Revenue Passenger Miles (000s)	Market Share (%)	Load Factor (%)	Operating Profit/Loss (000) *
United	50,271,243	21	68.6	19,000
American	46,778,707	19.6	62.7	(162,000)
Delta	41,524,629	17.4	64.7	(180,000)
Continental	19,553,427	11.8	62.3	8,495
USAir	18,426,175	7.7	62.3	(33,116)
Southwest	10,496,351	4.4	68.5	71,557

* 4th Quarter, 1993

Source: *Aviation Daily* May 31, 1994 p. 340; July 21, 1994 p. 118:

impact of deregulation from other causes. The interviews focused on four areas:

- Effect of deregulation on the airline's equipment needs, including fleet planning and selection criteria;
- Effect of deregulation on the airline's buying patterns, including financing, discounting, payment options, delivery schedule, buying versus leasing, absorption of development costs, and launch customer relationship;
 - Perceived response of U.S. manufacturers to airline needs; and
 - Assessment of the ongoing impact of deregulation on the airline industry.

The second round of interviews with aircraft manufacturers, including marketing researchers, financial officers, strategic planners, and production managers, concentrated on the following four issues:

- Changes in customers' needs following deregulation, including customer base (new versus old airlines, leasing companies), operating practices (hub-and-spoke), buying patterns (financing, timing), and equipment needs (types, options);
 - Marketing practices due to changes in customer needs, including product line and depth and demand forecasts;
 - Production and investment practices due to changes in customer needs, including capital financing, outsourcing, production rates, and technology versus economics as a driving force in aircraft design; and
 - Transfer of risk from airlines to manufacturers, including flexible delivery schedules and increased support and maintenance agreements.

DIMENSIONS OF THE COMMERCIAL AIRCRAFT INDUSTRY

The design, development, and production of a civilian transport aircraft are fraught with risk. Total launch costs for a new aircraft are estimated at \$4 billion to \$6 billion and entail a 5- to 6-year nega-

tive cash flow. Because of these enormous start-up costs, a successful aircraft does not achieve its break-even point for 10 to 15 years. In addition, numerous factors external to the manufacturing process affect the product's sales levels, including recession, political developments, and fuel costs. Manufacturers cope with these extraordinary costs through reliance on cash flow from older models, reconfiguration of existing models to meet new market demands, and cross-subsidization from military sales. A portion of this risk is assumed by the launch customer in the traditional airline-aircraft relationship. During the early stages of the program, two or three customers make a firm commitment to buy the new plane and provide progress payments to the manufacturer of 20 to 30 percent of the launch costs. In return, the launch customer receives a discounted price and is able to incorporate its suggestions into the design of the aircraft.

The high risks, immense economies of scale, and costly barriers to entry have traditionally limited the commercial aircraft industry to two or three major players. The changing market share is a result of multiple factors, including the increase in global traffic, the rising importance of offset deals, political developments, and trade policies. Table 2 provides an overview of the year-end world market shares and new aircraft sales of the three dominant manufacturers—Boeing, Airbus, and McDonnell Douglas—for 1992 and 1993.

The effects of the Airline Deregulation Act of 1978, designed to restructure a regulated oligopolistic industry into a more competitive one, were soon apparent to the commercial aircraft manufacturers. Although the removal of price and route structures created new forms of competition, it did not eliminate the oligopolistic nature of the airline industry. Whereas some carriers exited as others emerged and restructured, the identities and market shares of the largest firms—with a few notable exceptions—remained relatively stable.

Economies of scale and the long-term nature of the product and technology constrained the airlines' ability to function as players in a spot market. Following deregulation, firms continued to behave as oligopolists, watching and matching each other's actions rather than responding to market signals. This allowed airlines to aggressively assert their oligopolistic power over the aircraft manufacturers, reinforcing the bilateral oligopoly between the two industries. How-

TABLE 2 Major Aircraft Manufacturers' Market Share and New Sales—1992 and 1993

COMPANY	MARKET SHARE (%)		NEW AIRCRAFT SALES (%) *	
	1992	1993	1992	1993
BOEING	59.6	60.4	64.2	86.6
AIRBUS	17.0	25.3	37.0	14.0
MCDONNELL DOUGLAS	23.4	14.3	0.0	0.0
TOTAL**	100.0	100.0	101.2	100.6

*Nine months 9/30/92 and 9/30/93

**Figures do not always equal 100% due to negative results at McDonnell Douglas.

Sources: Prudential Securities, 3/24/94; 1/13/94.

ever, the negative profits and stock price declines resulting from the recurrent price wars and the infiltration of new entrants into well-established routes affected the airlines' ability to purchase and finance new aircraft.

IMPACT OF DEREGULATION ON AIRCRAFT DEMAND

Fleet Analysis

The transformation of airline transportation from a state-regulated utility into a competitive market structure changed the way airlines approached aircraft acquisition. Before deregulation, purchase analysis was fairly straightforward as the airline identified its mission and determined the requisite number of planes. Using a push-down analysis, each new plane purchased replaced the former top-of-the-line model and pushed the next aircraft down in position until the last plane in the fleet was sold. The stability in the marketplace allowed the airline to confidently forecast the future in a regulated era during which its market share was "god given."

Deregulation altered the fleet selection process radically. Fleet introduction, a 30-year commitment spanning the life cycle of the aircraft, became precarious in a deregulated environment where the industry changed in 3- to 5-year spurts. As fleet planners constantly reevaluated short-term route dynamics and updated the existing fleet, it became increasingly difficult to get rid of nonapplicable aircraft and to compensate for bad decisions. Airlines developed extensive models for strategic planning that analyzed markets, types of service, and plane-to-route allocations. By the mid-1980s, however, use of these models declined as airlines found it difficult to achieve this high degree of flexibility and began to search for a new source of competitive advantage.

At the same time, changes in the tax credit laws in 1985 made money available from outside the industry, and leasing companies became major players as airlines sought to avoid long-term ownership risk. As a result, the airlines began to view aircraft not as assets to own but as resources to operate. As profits declined, the deregulated airlines became even more obsessed with cost control. Low-cost new entrant carriers such as People Express forced incumbent airlines to seek fuel-efficient, two-engine, two-pilot aircraft that

offered significantly improved seat-mile costs over prevailing models. Other airlines chose to reengineer rather than replace older aircraft. For example, a number of carriers have purchased hush kits for DC-9 aircraft rather than new planes to meet FAA's Stage 3 requirements.

As airlines became reluctant to absorb the development costs of new technologies that offered no return on their investment, the decision to acquire new models became more dependent on economic than technological criteria. Airline planners interviewed indicated that technology must increasingly buy its way into the plane, or as one informant remarked, "We're not going to be an aeronautical benevolent society anymore." As the commercial aircraft industry has matured since the 1970s, technological advances have decreased. Airline officials indicated that no significant technological breakthroughs are considered necessary at the present time, and their key concern remains the acquisition of serviceable, durable, and reliable aircraft at a reasonable price. Finally, fleet-planning decisions involve factors other than traffic demand, price, and technology. Exogenous issues such as the personalities of the deal makers play a crucial role at the moment of sale. As one insider observed, "In the end, the chairman of my airline speaks to the chairman of Boeing. If he likes the aircraft he's shown, we'll buy it."

Fleet Reconfiguration and the Hub-and-Spoke System

Under regulation, fleet change depended on two factors: the age of the fleet and the awarding of new routes. Traffic was streamlined as airlines flew wide-bodied planes across the country. Because the major form of competition among regulated carriers was frequency, load factors tended to be low compared with current levels. As airlines sought to increase efficiency in serving new routes, the shift from point-to-point service to a hub-and-spoke network accelerated as traffic was consolidated between hub cities and fragmented from spokes to hubs. Although the hub-and-spoke system required smaller aircraft, airlines found themselves saddled with fleets of wide-bodied planes designed for a regulated era. Despite attempts to reconfigure fleets to accommodate different passenger loads, many airlines experienced the dumbbell effect in that they possessed a disproportionate amount of large and small planes.

Two factors contributed to the expansion of the hub-and-spoke system following deregulation. First, airlines sought to manage the increasing volume of travel more efficiently by pooling passengers through hubs and offering more flights per day between hub and nonhub centers. Second, companies used pricing to monopolize nonhub travel where they were the sole carrier. Contrary to popular wisdom, however, the hub-and-spoke system is neither a creation nor a sine qua non of deregulation. Delta's hub-and-spoke system, using feeder traffic from regional airlines into its Atlanta hub, predated deregulation. Southwest, on the other hand, has traditionally eschewed the hub-and-spoke strategy. While its competitors abandoned linear service, Southwest remained a short-haul carrier using the 737 exclusively and adding flights when demand increased. Furthermore, a recent report indicates that most passenger trips in the U.S. domestic hub-and-spoke system do not use connections. Of all domestic flights, 69 percent in 1979 and 63 percent in 1989 involved direct trips (private correspondence with Boeing, August, 1994).

Manufacturer and Institutional Financing and Leasing

After deregulation, airlines could no longer ask the government for fare increases when aircraft prices rose. Instead, they turned to the manufacturer for financing assistance, discounting, and additional givebacks in the form of support and maintenance services. During the regulatory era, airlines committed to orders and decided how to finance them as the delivery date approached. In most cases, one-half to two-thirds of the assets were purchased by the airlines, with one-third financed through leases and mortgages. As one 30-year veteran reminisced, "Aircraft purchase was a lot of fun in the old days. I just took a check out and purchased the airframe."

In the 1980s, there was a sustained change in the marketplace not attributable to the economic recession. Airlines found it increasingly difficult to pay for purchases out of their own earnings, whereas banks became reluctant to finance acquisition. As a result, manufacturers began to offer substantial discounting as well as a commitment to finance. In addition, companies turned to leasing agreements to take advantage of available tax credits. Today both

McDonnell Douglas and Boeing provide backstop financing and guarantee credit at market rate. The use of financing, however, varies substantially from company to company. Whereas manufacturer financing is important for new entrants and foreign companies, it is often uneconomical for major domestic carriers who prefer institutional lenders. The notable exception to this trend is Southwest, which pays out of its own cash flow and has not used manufacturer financing since its initial B-737 purchase in the early 1970s. In addition to financing assistance, airlines increasingly seek concessions from the manufacturer in other long-term costs, such as product support and training.

Aging Aircraft and Fleet Rationalization Strategies

Deregulation unleashed a competition among the airlines that weakened their overall financial position at the same time that aircraft prices were rising. As the price gap between new and old aircraft economics widened, it became more profitable for airlines to retain older planes with comparable operating costs. In 1988, 28 percent of the U.S. fleet was more than 20 years old, a 21 percent increase since the end of regulation (14).

The merger and acquisition frenzy in the airline industry following deregulation left many companies with an inefficient fleet containing many different aircraft types and subtypes. Additional training costs, lost working time, spare parts inventory, and service needs made the maintenance of these fleets prohibitively expensive. For example, each model requires its own flight simulator at a cost of \$15 million. Over the past few years, several airlines have announced a strategy of fleet simplification or rationalization to reduce the fleet to four or five types. The final choice of commonality, influenced by the high cost of replacement models, will have a significant impact on aircraft purchases in the coming decades. Table 3 provides an analysis of the jet fleets of selected airlines, including aircraft types, fleet size, top models, and average age for the first quarter of 1994. Today, all carriers with the exception of Southwest have upward of eight models, including subtypes.

TABLE 3 Jet Fleet Analysis, Selected Major U.S. Carriers—First Quarter 1994

AIRLINE	Aircraft Types	Total Fleet	Top 4 Models*	Average Age (Years)
American	9	689	MD-82, B727 B767, DC-10	8.3
Continental	9	297	B737, B727 DC-9, A-300	13.9
Delta	8	555	B727, MD-8 B757, B737	9.7
Southwest	1	160	B737	7.7
United	8	573	B737, B727 B757, B747	10.8
USAir	10	477	B737, DC-9 F-100, B757	11.3

*Models include subtypes; models listed in descending order.

Source: Aviation Daily July 6, 1994, p. 25.

In summary, deregulation has had several apparent effects on aircraft demand. The search for a new competitive advantage has encouraged airlines to view planes as resources to operate rather than as assets to own. The resultant focus on cost consciousness, in addition to changing tax laws and the maturation of jet technology, has affected fleet acquisition decisions. Also, the expansion of the hub-and-spoke network produced a mismatch between existing fleets and those required for new route structures. Finally, declining airline operating profits precipitated an increase in manufacturer and institutional financing, a trend toward refurbishing rather than replacing older aircraft, and the initiation of fleet rationalization strategies.

RESPONSES OF AIRCRAFT MANUFACTURERS

The precarious financial condition of the deregulated domestic airlines has forced the two major domestic commercial aircraft manufacturers, Boeing and McDonnell Douglas, to assume a greater share of the risks associated with aircraft acquisition, including manufacturer financing, flexibility in delivery dates, and improved maintenance and support agreements. In 1978, McDonnell Douglas created a separate financial division, McDonnell Douglas Finance Corporation (MDFC), to disengage its sales and financing operations. This move was undertaken after officials determined that the financing concessions associated with sales had shifted the burden back onto the manufacturer. In addition, as an autonomous subsidiary with a diversified financial portfolio, MDFC had greater borrowing power, which translated into better benefits for its customers.

Aircraft manufacturers have been forced to adjust to the increase in deferrals and cancellations since deregulation. Whereas it is unusual for manufacturers to accept cancellation without significant penalty, the lack of new orders has made them more willing to rearrange delivery schedules to avoid the dreaded "whitetail," an ownerless aircraft. Because of the long lead time associated with final assembly due to parts procurement from a large supplier base, schedule changes are more flexible further away from delivery. The period of time in which the manufacturer locks in the customer is very tight, and it is extremely expensive to make a change within that window. Manufacturers are generally most flexible 8 to 10 years in advance, and somewhat less so 2 to 3 years before delivery. As one manufacturer explained, "If the delivery date is too flexible, it costs the manufacturer. Instead we drive flexibility down to the suppliers. Although penalizing them was our former philosophy, we now offer incentives to make them more flexible."

The unstable profit levels and reduced cash flow associated with deregulation have influenced airlines to off-load the high cost of keeping, operating, and maintaining aircraft. Carriers pressure manufacturers to partner on cost reduction through lower support costs, spare parts supply, and contributions to engineering expenses. Whereas other aircraft industry activity is not directly attributable to deregulation, its impact should not be discounted. The increased oligopolistic power of the carriers has allowed them to insist that manufacturers accommodate more differences in aircraft production than previously. Although Boeing has traditionally resisted this suggestion as a matter of cost, in recent years it has attempted to position itself as the company responsive to customer needs through a greater awareness of aircraft operating costs. As one fleet planner remarked, "Boeing's mantra for the past two years has been 'life cycle cost.'" Furthermore, deregulation is only one of several fac-

tors increasing the pressure on manufacturers to lower production costs. Cutthroat competition among the carriers has produced downward pressure on prices and sales for both airline tickets and aircraft purchases. Today, both Boeing and McDonnell Douglas are reducing capacity and reorganizing to shorten production cycles, and the lead time for building a new aircraft has been shortened to 12 to 18 months from 2 years.

CONCLUSION

Deregulation, the principal cause of the ongoing upheaval in the airline industry, has had a protracted impact on the production and investment strategies of the commercial aircraft manufacturers. Whereas air carriers rapidly reorganized and restructured to capture market share and sustain profitability, aircraft manufacturers responded more slowly to the changing demand because of long production and product cycles. In addition to the uncertainties posed by an unstable domestic market, these firms were subject to the multiple pressures of international competition, declining defense sales, and foreign offset deals.

By opening up the industry to competition, deregulation drove out weaker carriers, such as Eastern and PanAm. The oligopolistic rush to reconfigure after the removal of price and route structures resulted in some poor choices on the part of individual airlines leading to overcapacity. The mid-1980s was an unstable time for the industry, as major carriers grew faster than demand justified. Airline financial officers, unable to cut labor costs due to high union wages, attempted to increase growth and revenues through expanded service and acquisitions. At the same time, out-of-work employees and cheap aircraft from bankruptcies lowered the barriers of entry for new participants. As one informant stated, "The assets wouldn't be there at cheap prices if not for the protracted death of other companies."

Following the initial shakeout, the remaining airlines continued to undergo a major corrective process in an attempt to stabilize prices and decrease operating costs. A new wave of start-ups such as Kiwi, Valuejet, Reno, and Markair are following a niche market strategy, whereas niche carriers such as Southwest have become bread-and-butter companies driving out established carriers in certain routes. At the close of the second down cycle since deregulation, airlines are beginning to experience renewed profitability and positive cash flows as costs come under control because of lower fuel prices, slowly rising wages, and low interest rates. In the U.S. domestic market, traffic and load factors have increased since the price wars of 1992 with fares climbing 15 to 20 percent by 1993. Industry observers, however, believe that the sector will continue to evolve and restructure with no stable form emerging in the next decade.

The historical correlation between aircraft orders and airline profits reinforces the cyclical nature of the business. Following an upturn in traffic cycle, airline planners realize the need for additional capacity and place orders for new aircraft.

Because of the long-term nature of aircraft manufacturing, however, improved airline results take time to translate into strong orders and shipments. Thus, whereas demand for commercial aircraft is strongly tied to airline profits, the delay between order and delivery means that initial shipments occur several years later, by which time the cycle may have reversed itself. In addition, aircraft acquisition decisions are trend-oriented as airlines follow the buildup of orders to ensure slots and match the competition. Over-

production occurs as carriers find themselves with too many aircraft during periods of declining profits and begin to cancel.

The attempt to fully use existing facilities results in excess capacity. Manufacturers and airlines produce more products and services than are warranted by market demand. Rather than eliminate capacity on both sides until prices cover costs, market forces favor overproduction especially when the downturn is expected to be short lived and capacity problems are predicted to emerge. In the words of one airline representative, "There are too many aircraft chasing too many people with negative effects on the carriers." Manufacturers, in turn, complain that deregulation has had a long-lasting effect on the airlines left with "no ground rules." Cyclical declines in orders and rises in cancellation rates force manufacturers to cut back employment in their own facilities as well as in their supplier base. New aircraft orders have declined from the record years of the late 1980s, and delivery schedules have been extended. In response, Boeing reduced its work force and cut its production rate during 1993 from 32.5 to 23 airplanes per month (15). McDonnell Douglas, following a niche market strategy based on growth and profit rather than market share, also made extensive cutbacks in its labor force and has cut production levels to 36 planes in 1994 compared with 140 in the prerecession years.

Deregulation has produced a new competitive environment in which the focus of airlines is on short-term revenues. The continuing oligopolistic nature of the industry, in which airlines cut fares to increase traffic and passenger loads, minimizes long-term profits. To raise the capital necessary to purchase new aircraft in up cycles, airlines must achieve stable levels of profitability. This leads to renewed demands for cost controls in aircraft acquisition and a shifting of risk onto the manufacturers. As a result, manufacturers are forced to assume a greater share of financing, provide flexibility in delivery dates, and offer improved maintenance and support agreements. These developments may once again change in the upcoming cycle as financing requirements decline because of increased profitability. In addition, some analysts predict a trend toward dehubbing as hubs prove too costly to operate. If this proves true, airline fleets will once again be burdened with wrong-sized aircraft (16). Finally, Stage 3 government requirements are expected to accelerate purchasing requirements as noise becomes an economic issue. Stage 2 aircraft, comprising 47 percent of the domestic fleet, are subject to U.S. usage requirements, including nonaddition rules and mandatory compliance with Stage 3 by 2000. Since compliance is possible by reengineering or hush kitting, however, order forecasts are uncertain.

The issue of who owns the capital and who owns the risk in the airline industry is critical for current policy and requires further research. Empirical analysis can indicate whether manufacturers are using more capital than previously in response to airline requirements. If manufacturers are bearing an increasing share of the airlines' risks, are their returns proportionally greater than the risk-free returns for capital in the past? In addition, the growing role of leas-

ing companies must be examined to determine whether this trend indicates a desire by manufacturers to capture the tax benefits of depreciation in times of declining airline profitability or a natural move in the marketplace. In addition, a public policy in which government or industry rationalizes production temporarily during down cycles to preserve capacity may play a role in preventing distortions due to the airline industry's cyclical nature; or as one informant cynically remarked, "If the industry should be reregulated, let them regulate the production rates."

ACKNOWLEDGMENTS

Funding for this project has been provided by TRB under the Eighth Graduate Research Award Program on Public-Sector Aviation Issues. The author would like to thank the following for their comments: Bill Swan, Adrian LeRoy, John Fisher, Ann Markusen and Candace Howes, as well as numerous individuals in the airline and commercial aircraft industries who generously shared their time and insights.

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