MIT International Center for Air Transportation

RESEARCH HIGHLIGHTS: PRICING, DISTRIBUTION AND REVENUE MANAGEMENT

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Presentation to
Industry Advisory Board Meeting
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OUTLINE

- **MIT PODS Research Consortium**
  - Overview of PODS Capabilities
- **RM System Performance in Low-Fare Environment**
  - Trend Towards “Fare Simplification”
  - Assessment of Revenue and Traffic Impacts
  - Development of New Forecasting and Optimization Algorithms
- **Distribution Channels and RM Systems**
  - Website Search Engines and Cached Seat Availability
  - Impacts on Airline Revenues
  - Research Into Changing Consumer Choice Patterns

PODS RM Research Consortium

- **Airline revenue management research at MIT funded in large part by PODS Research Consortium**
  - Focus on forecasting and optimization models for seat inventory control (seat allocation), as opposed to pricing/fare structures
  - Findings used to help guide each airline's RM system development
- **Most member airlines have renewed; new member added in 2004**

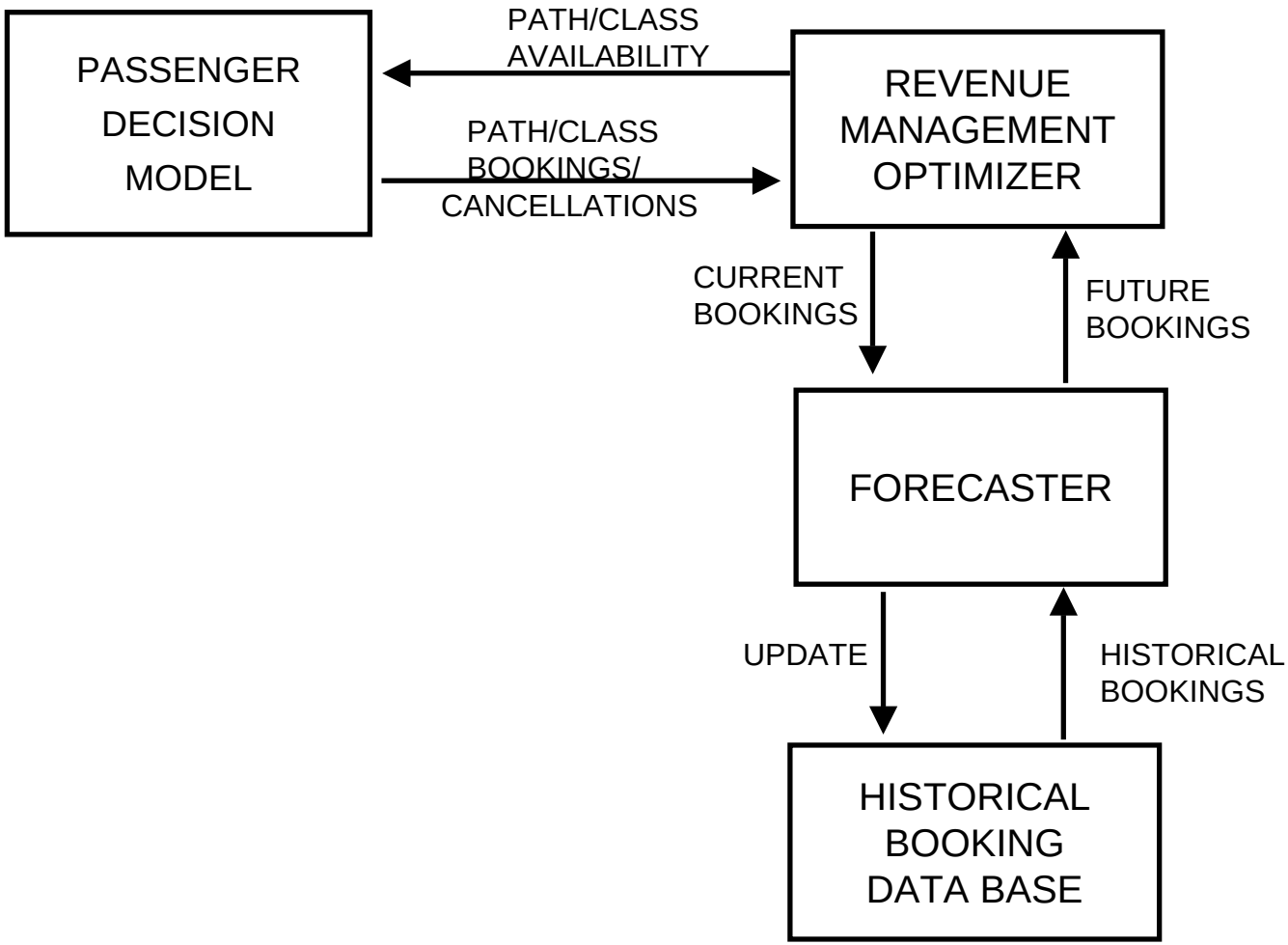
Continental Airlines
Scandinavian Airlines System
Delta Air Lines
Air New Zealand (new)
Lufthansa German Airlines
Northwest Airlines
KLM Royal Dutch Airlines
Swiss International Airlines (?)

Passenger Origin Destination Simulator

- **PODS simulates interaction of RM and passenger choice in *competitive* markets:**
  - Airlines must forecast booking demand from actual (previously simulated) historical data
  - RM systems set booking limits by leg/class or path/class (O+D) given demand forecasts and optimization/control scheme
  - Passengers choose among O-D paths/fare types and airlines based on prices, restrictions and RM availability

- **Realistic environment for testing RM methods, and their impacts on traffic and revenues**
  - Recognized as “state of the art” in RM simulation

PODS Simulation Flow



Impacts of LFA Entry with Less Restricted and Lower Fares

- **Recent trend toward "simplified" fares – compressed fare structures with fewer restrictions**
  - Initiated by some LFAs and America West, followed by Alaska as well as legacy carriers in many US domestic competitive markets
  - Also common in Canada, Europe and Asia in markets where LFAs are growing
- **PODS simulations of impacts given changing fare structures and LFA competition:**
  - Revenue impacts of "simplified" fare structures
  - Effectiveness of RM systems for both network and low-fare airlines under lower and less restricted fares?
  - Revenue gains of Network RM (O+D Control) in networks with both standard and LFA markets?

BOS-SEA Fare Structure

American Airlines, October 1, 2001

Roundtrip Fare ($)	Cls	Advance Purchase	Minimum Stay	Change Fee?	Comment
458	N	21 days	Sat. Night	Yes	Tue/Wed/Sat
707	M	21 days	Sat. Night	Yes	Tue/Wed
760	M	21 days	Sat. Night	Yes	Thu-Mon
927	H	14 days	Sat. Night	Yes	Tue/Wed
1001	H	14 days	Sat. Night	Yes	Thu-Mon
2083	B	3 days	none	No	2 X OW Fare
2262	Y	none	none	No	2 X OW Fare
2783	F	none	none	No	First Class

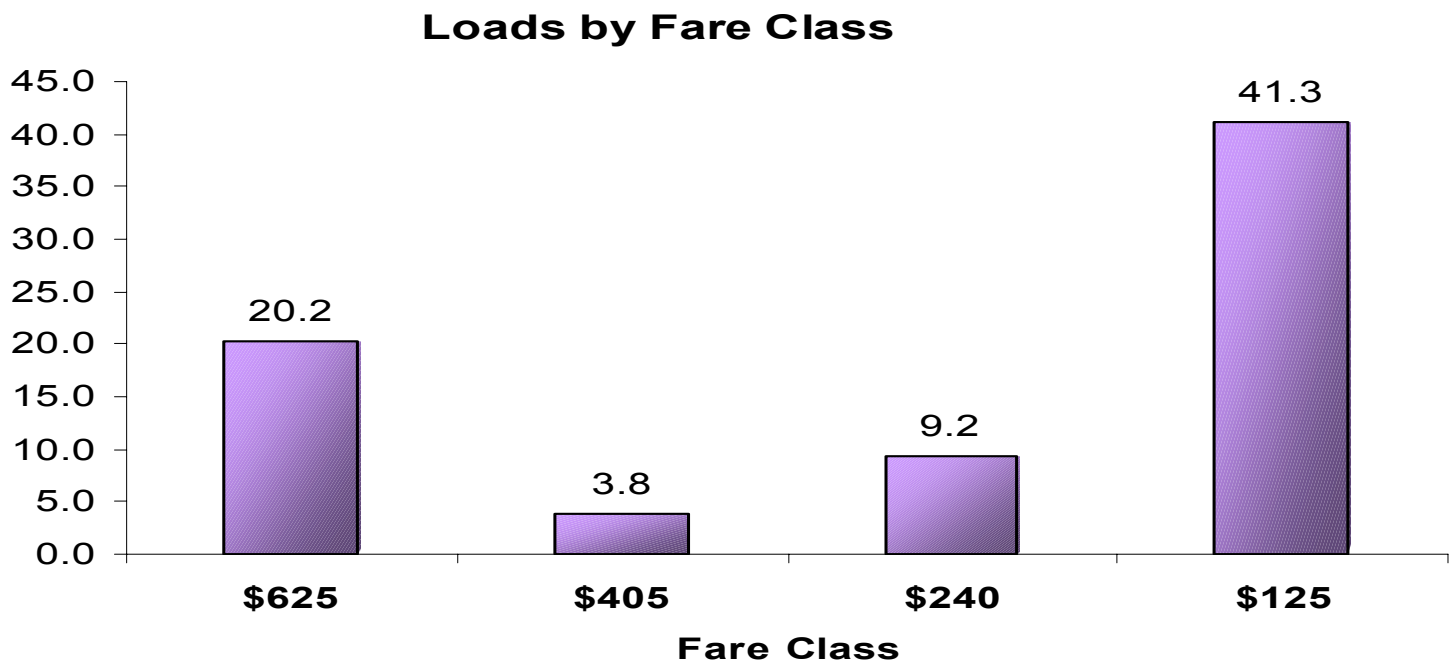
BOS-SEA Simplified Fare Structure

Alaska Airlines and American, May 1, 2004

Roundtrip Fare ($)	Cls	Advance Purchase	Minimum Stay	Change Fee?	Comment
374	V	21 days	1 day	Yes	Non-refundable
456	L	14 days	1 day	Yes	Non-refundable
559	Q	14 days	1 day	Yes	Non-refundable
683	H	7 days	1 day	Yes	Non-refundable
827	B	3 days	none	No	2 X OW Fare
929	Y	none	none	No	2 X OW Fare
1135	F	none	none	No	First Class

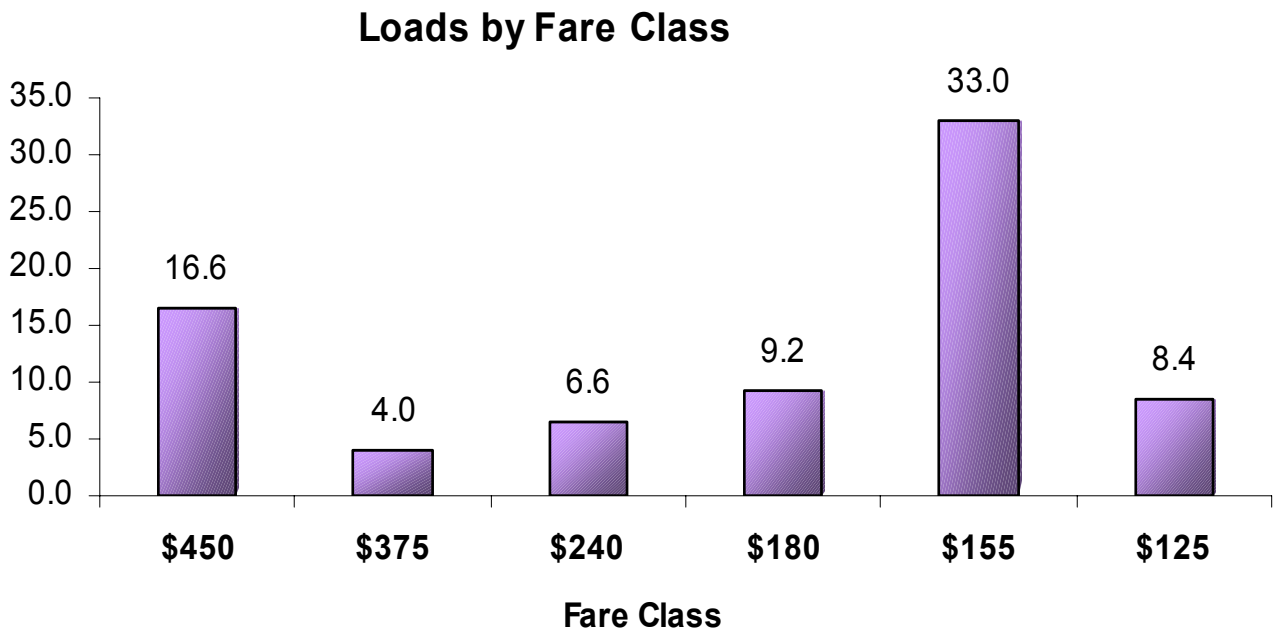
PODS Simulation Results: Traditional "Restricted" Fare Structure

- **5:1 fare ratio; all fare classes below "full fare" have Sat. night stay and 7/14/21 day AP restrictions**
  - 74.6% load factor; total flight revenue $64,716
  - 5% revenue gains from use of RM booking limit controls

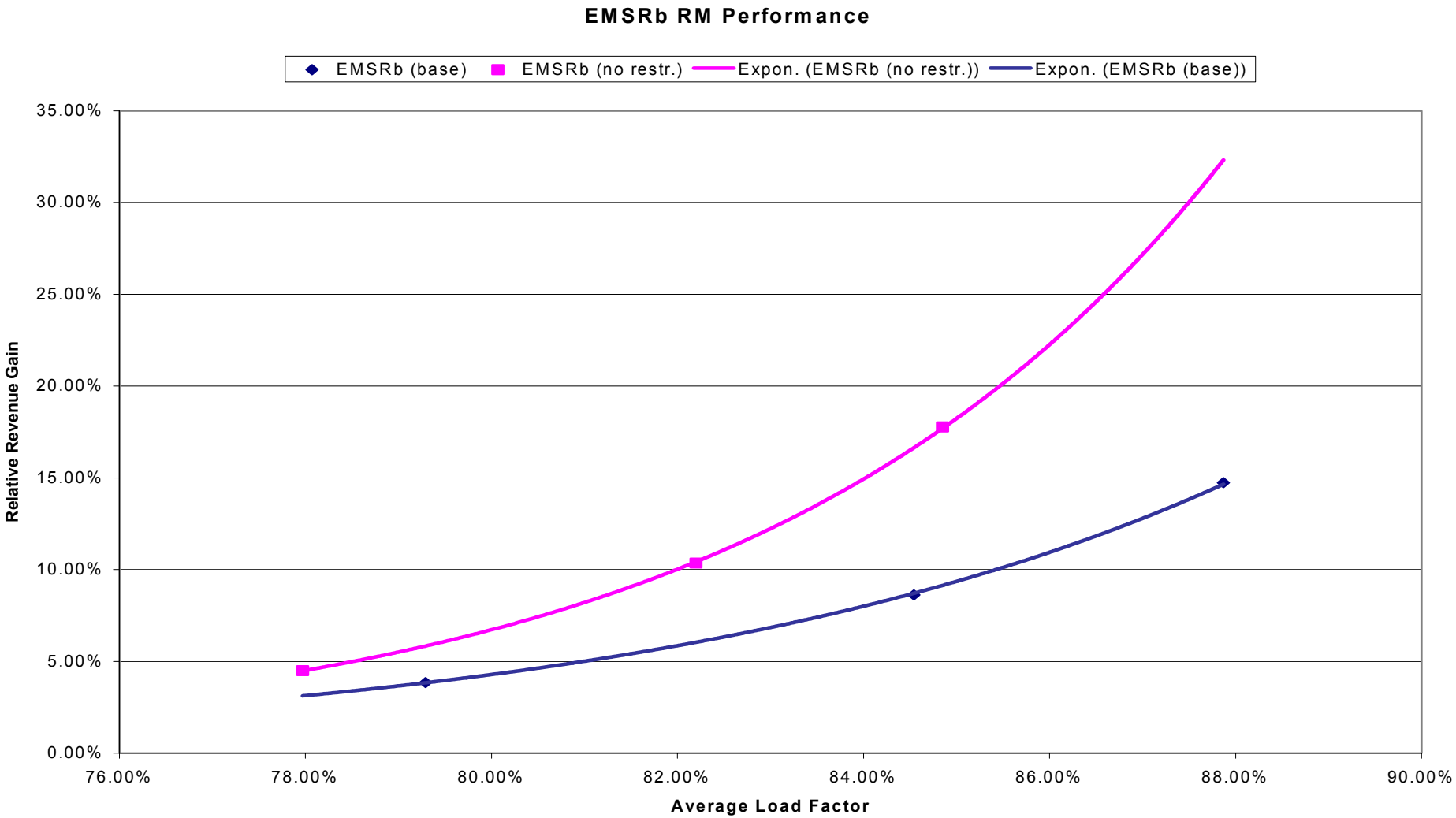


PODS Simulation Results: "Simplified" Fare Structure

- **Fare ratio compressed to 3.5:1; Sat. night stay restriction removed from all but lowest fare class; advance purchase restrictions retained**
  - Load factor increases to 77.8%; but total revenues drop by 15% to $55,221
  - % Revenue impact of RM controls increases to over 8%



RM Revenue Gains: Less Restricted Fare Structure with Advance Purchase



Findings: RM in Low-Fare and Less Restricted Competitive Markets

- **% revenue gains of effective RM are greater in less restricted fare structures**
  - RM inventory control becomes more important as fare structures are simplified and restrictions disappear
- **RM is also critical to LFA revenues when they compete against network carriers that use RM**
- **Network RM becomes more critical for network airlines when some markets have LFA competition**
  - Improved ability to provide greater seat availability to connecting passengers with higher revenue contribution to total network

Existing Airline RM Systems Need to be Modified for This New Environment

- **RM systems were developed for restricted fares**
  - Assumed independent fare class demands, because restrictions kept full-fare passengers from buying lower fares
  - With unrestricted fares, passengers buy lowest available fare
- **Without modification, these RM systems do not perform well in less restricted fare structures**
  - Unless demand forecasts are adjusted to reflect potential sell-up, high-fare demand will be consistently under-forecast
  - Optimizer then under-protects, allowing more “spiral down”
- **RM system limitations are affecting airline revenues**
  - Existing systems, left unadjusted, generate high load factors but do not maximize revenues
  - Many airlines are currently using manual overrides

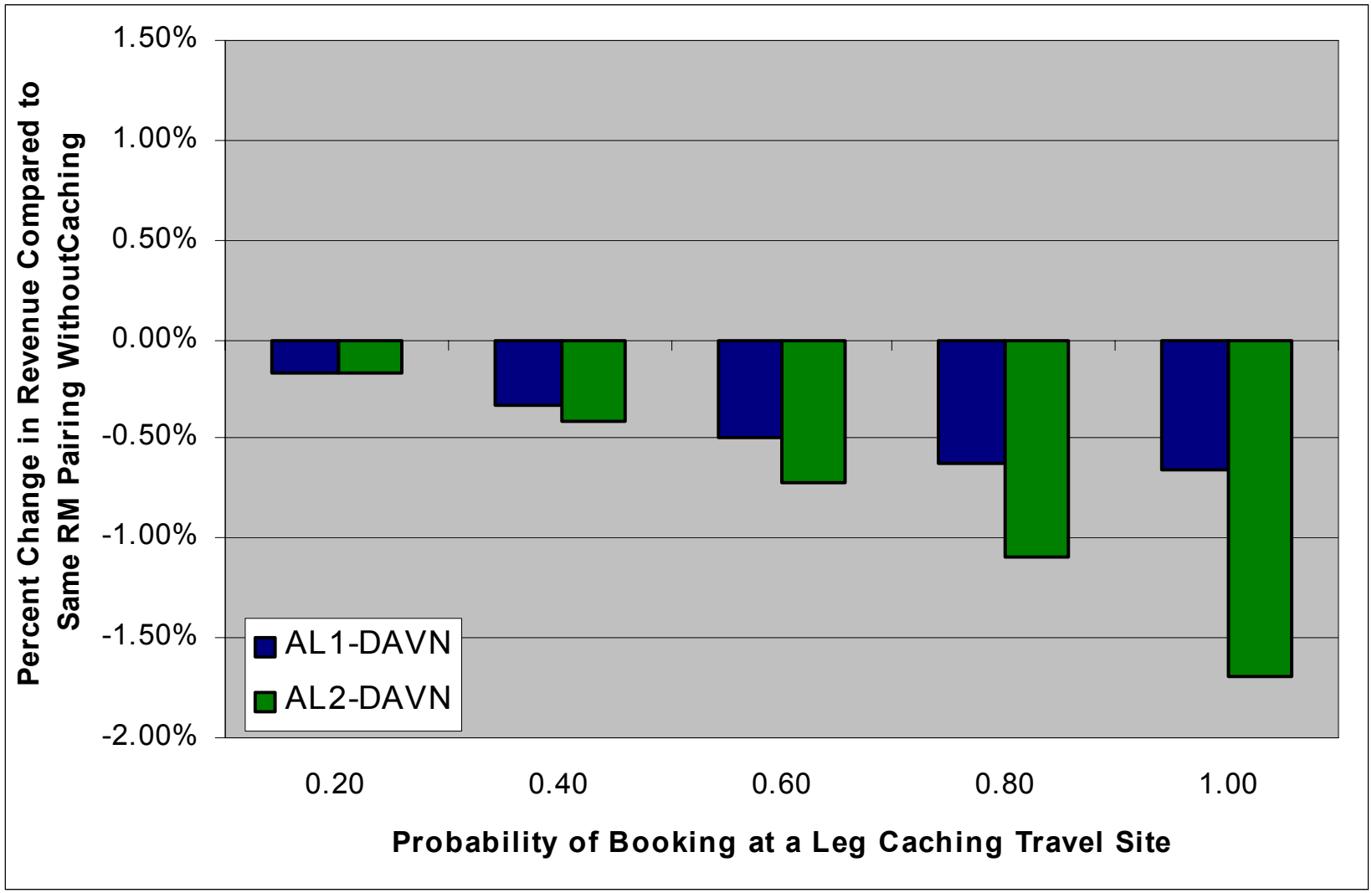
Current RM Challenge is To Find New Forecasting and Optimization Models

- **Less restricted fare structures require forecasting of passenger choice and "willingness to pay"**
  - Instead of forecasts by product/restriction
- **The new RM problem is much more complicated than independent class demand RM environment:**
  - Affected by passengers' actual willingness to pay, and ability of airline to estimate this willingness to pay
- **Existing Network RM systems also need to be modified for multiple fare structures**
  - How to control seat availability in unrestricted fare domestic markets while managing seats in more traditional fare markets
  - Seats shared by passengers in both types of markets

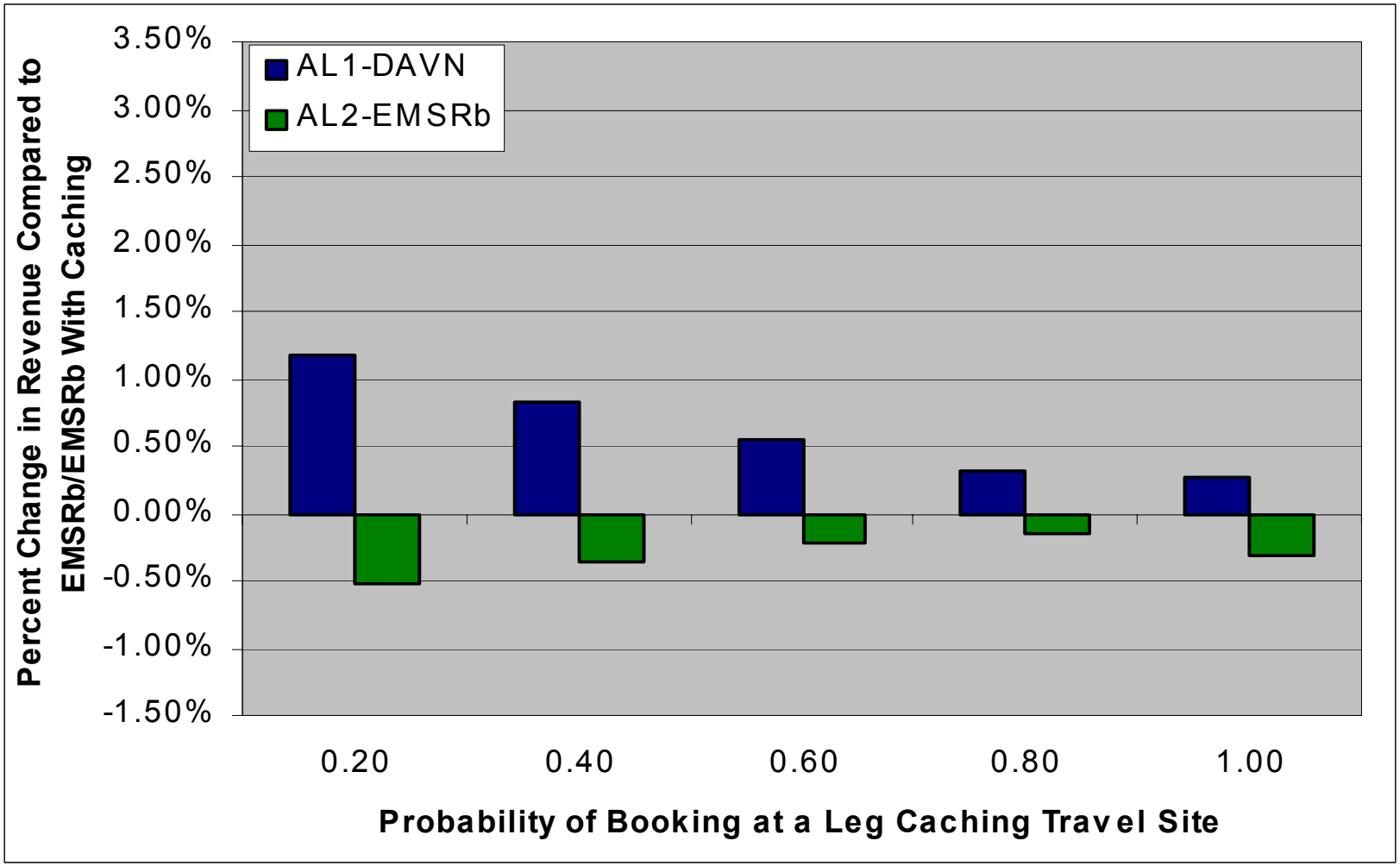
Distribution Channels – Impacts on RM System Performance

- **Example: Website "Caching" of Seat Availability**
  - Under Network RM controls, accept/reject decision for booking requests is made by each airline, based on O-D path requested
  - Airline reservations systems cannot handle volume of "shopping" requests from travel websites, so websites store (cache) availability from history or estimate it by flight leg
  - Potential inconsistency between initial website display of available fare classes and airline's current RM controls
- **Airline must either accept an undesirable booking, or reject it (and risk losing the sale)**
  - PODS simulations have shown that impacts of either option can both reduce total airline revenues and revenue benefits of Network RM

Caching and Acceptance of "Unwanted" Bookings Reduce Network Revenues



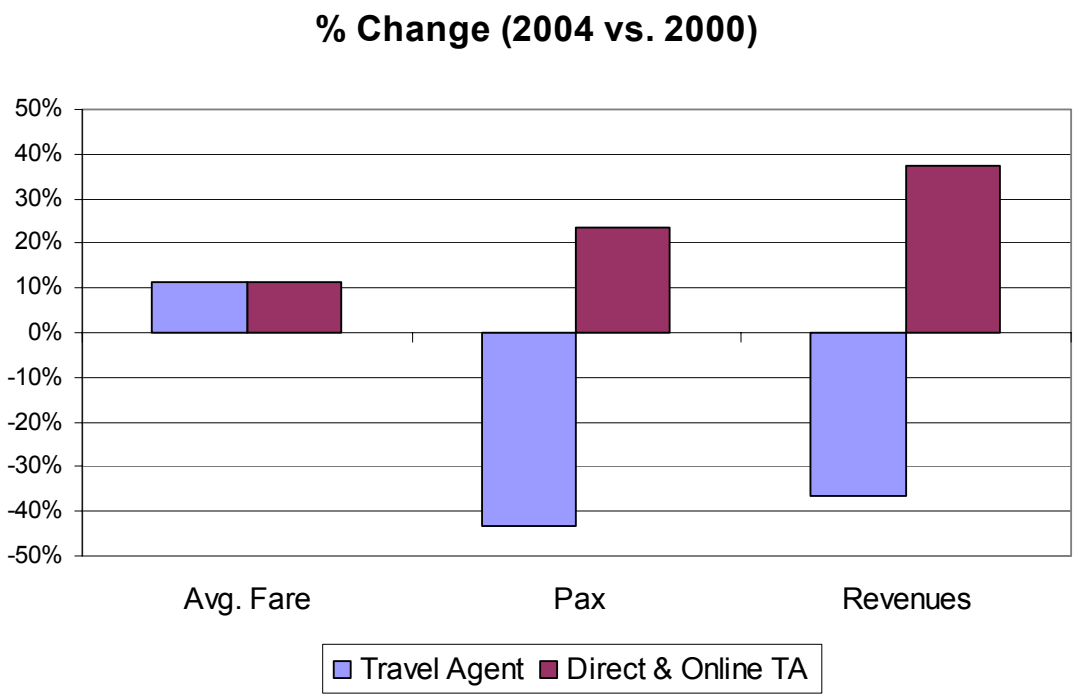
It Also Affects the Ability of Network RM to Generate Incremental Gains

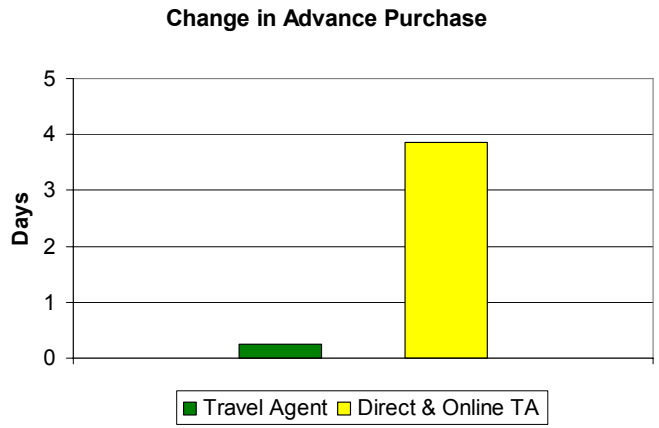


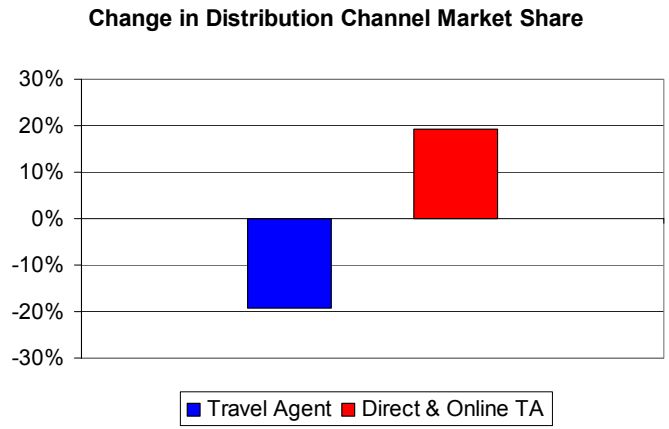
Consumer Choice Modeling Research

- **Use advanced discrete choice models to gain insight into changing air travel choice patterns**
  - Given less restricted fare structures and shift toward on-line booking and distribution channels
- **How have changes in pricing practices changed consumer choice?**
  - Removal of the Saturday night stay restriction on most fares
  - Compression of highest to lowest fare ratios
- **How have new distribution channels affected segmentation of air travel demand?**
  - Traditional segmentation by business vs. leisure travel

US Major Airline's Booking Data: Differences by Distribution Channel

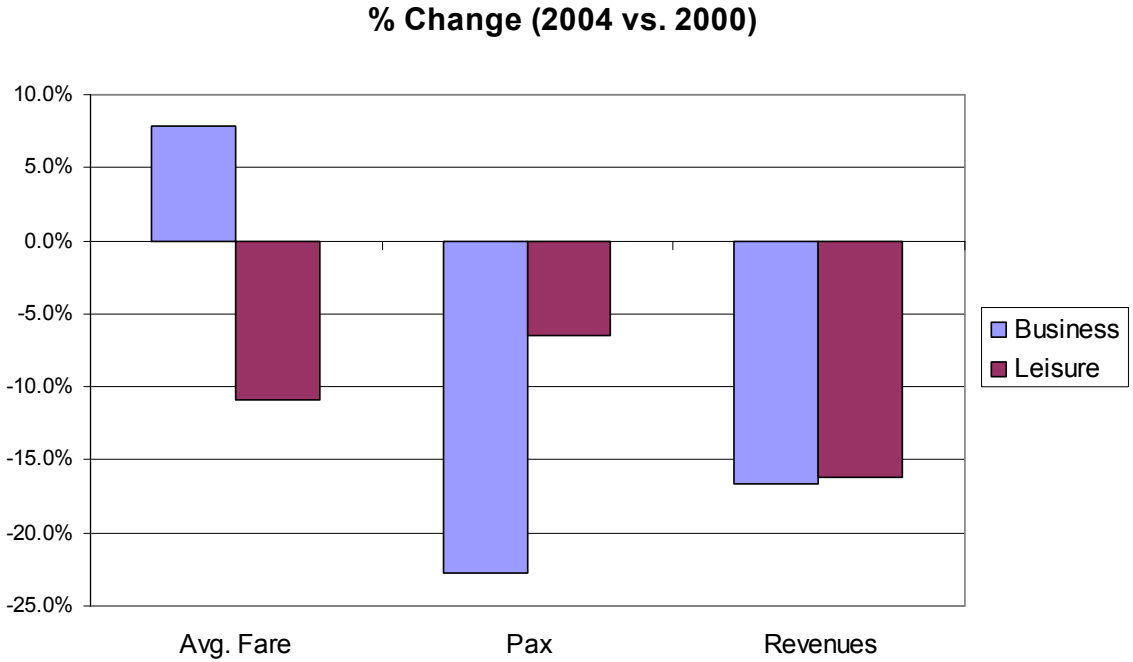


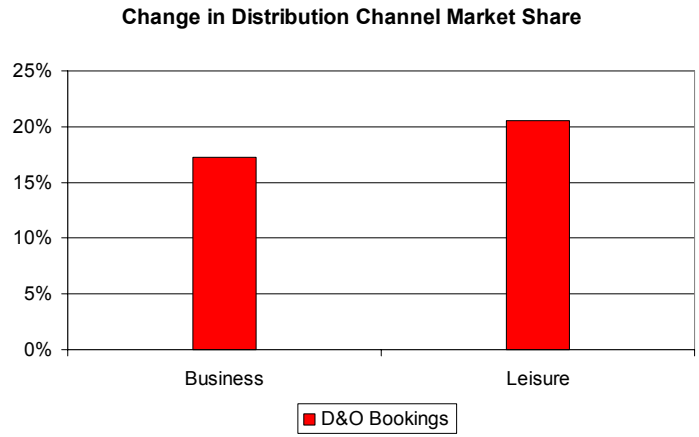


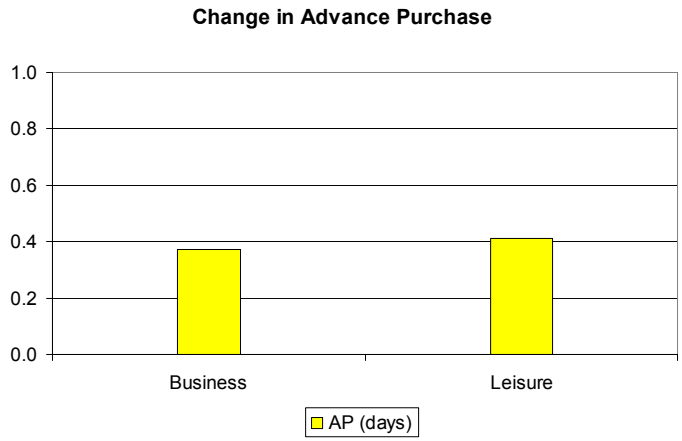


- Shift in bookings from traditional travel agents to direct/online channels
- Increased advance purchase, most notably for direct/on-line channels

Analysis of Booking Data: Business vs. Leisure Markets







- Shift to direct/on-line channels for both business and leisure markets
- Average fares decreased in leisure markets, increased in business markets

Summary: Pricing and RM Research

- **RM inventory controls become more critical under less-restricted fare structures**
  - Seat availability controls have increased revenue leverage in absence of product differentiation
- **Existing RM systems have not kept pace with recent pricing developments**
  - Major changes to forecasters and optimizers required
- **Inconsistencies between RM controls and distribution channels need to be addressed**
  - Solutions include technological and computational changes as well as modifications to industry practices developed decades ago

Thesis Titles

- Diana Dorinson, “The Evolution of Airline Distribution Channels and Their Effects on Revenue Management Performance”, MST Thesis, submitted May 2004.
- Thomas Gorin, “Assessing Low-Fare Entry in Airline Markets: Impacts of Revenue Management and Network Flows, PhD Thesis, submitted September 2004.
- Richard Cleaz-Savoyen, “Alternative RM Algorithms for Unrestricted Fare Structures”, SM Thesis, expected June 2005.
- Emmanuel Carrier, “Evolving Consumer Choice and Booking Patterns in the Airline Industry”, PhD Thesis, expected June 2006.