

NATIONAL CENTER OF EXCELLENCE FOR
NEXTOR

Collaborative Decision Making:
Models for Decision Impact and
Benefits Assessment

Michael O. Ball
University of Maryland

NATIONAL CENTER OF EXCELLENCE FOR
NEXTOR

NEXTOR CDM R & D Team

- Metron: Mike Wambsgans et al
- UMD: Ball; Hoffman; Chen, Gormley, Innis, Lulli, Mahli, Ville, Vossen
- MIT: Odoni, Clarke; Chaabouni, Hall, Muharremoglu, Pujet, Rifkin
- UCB: Yano; Goodhart

NATIONAL CENTER OF EXCELLENCE FOR
NEXTOR

Models of CDM Impact on Resource
Allocation and Decision Making

NATIONAL CENTER OF EXCELLENCE FOR
NEXTOR

Improved Information and
Common Situational
Awareness

```

    graph LR
      Airlines1[airlines] --> Info[improved information]
      FAA1[FAA] --> Info
      NAS1[other NAS users] --> Info
      Info --> Airlines2[airlines]
      Info --> FAA2[FAA]
      Info --> NAS2[other NAS users]
      Info --> SA[common situational awareness]
  
```

NATIONAL CENTER OF EXCELLENCE FOR
NEXTOR

Users Solve Problem:
Control Action Unnecessary

```

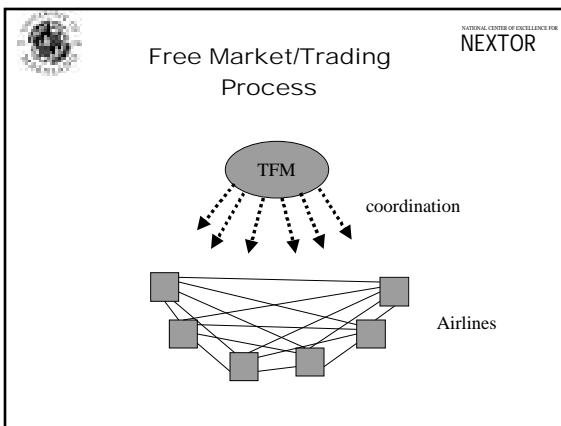
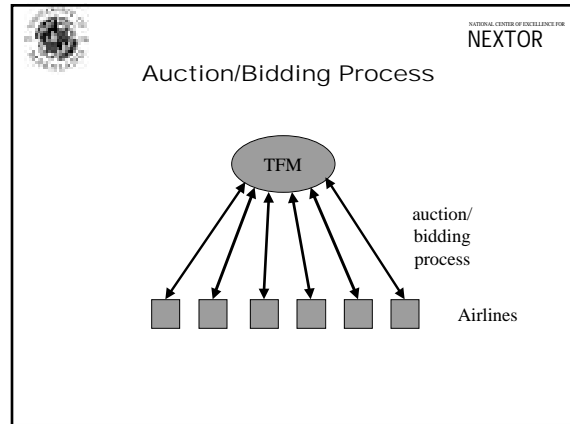
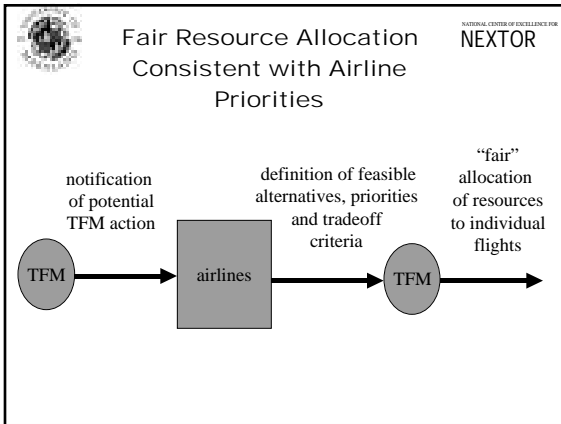
    graph LR
      TFM1((TFM)) -- "identification of future demand/capacity imbalance" --> Airlines[airlines]
      Airlines -- "proposed control action" --> Airlines
      Airlines -- "alteration or reduction in demand" --> TFM2((TFM))
      TFM2 -- "control action rescinded" --> TFM2
  
```

NATIONAL CENTER OF EXCELLENCE FOR
NEXTOR

Two Level Resource
Allocation

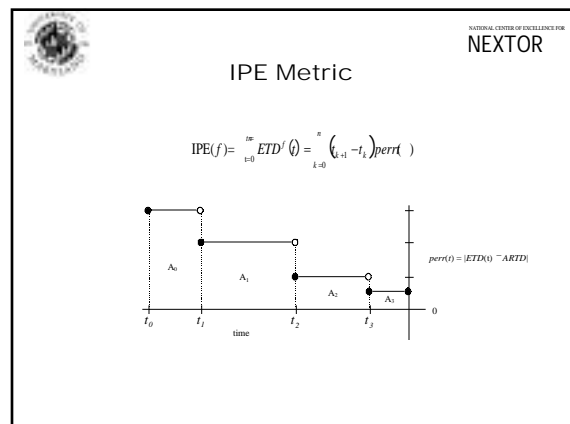
```

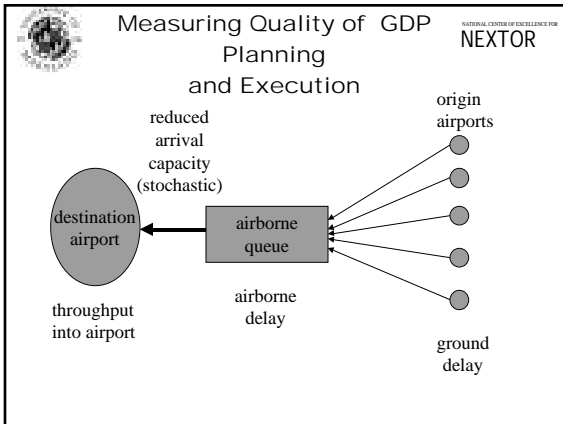
    graph LR
      TFM1((TFM)) -- "allocation of resources to individual airlines" --> Airlines[airlines]
      Airlines -- "allocation of resources to individual flights" --> TFM2((TFM))
      TFM2 -- "refinement of allocation to insure system efficiency" --> TFM2
  
```



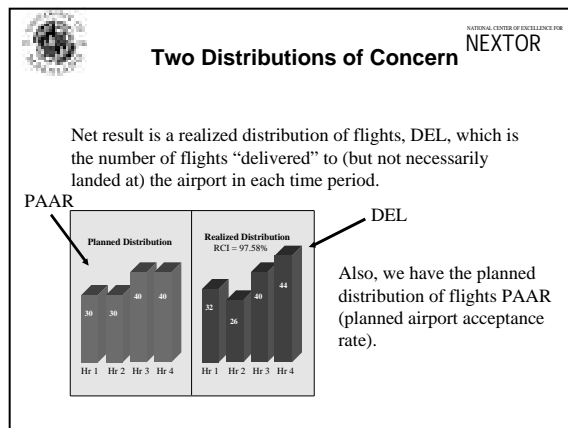
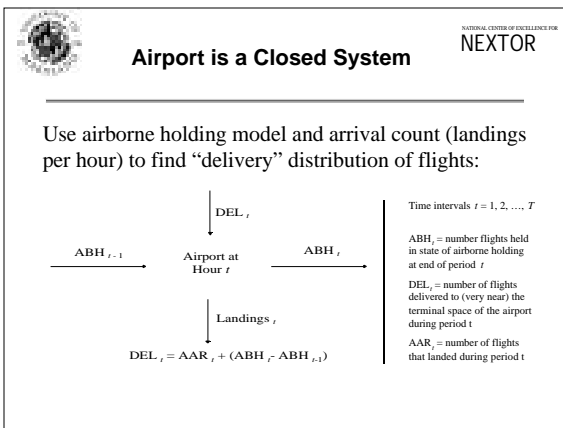
- NATIONAL CENTER OF EXCELLENCE FOR NEXTOR
- ### System Evaluation Topics to be Covered
- New Metrics:
 - Integrative Predictor Error (IPE)
 - Rate Control Index (RCI)
 - New data analysis and benefits computation
 - Evaluation of Initial Collaborative Routing Functionality

- NATIONAL CENTER OF EXCELLENCE FOR NEXTOR
- ### IPE metric
- Measures performance of a stream of predictions for a single event
 - Assigns a single value to each flight over its entire history
 - Robust w.r.t. bad flight records - more general than a snapshot
 - Can be applied to any stream of predictions for a single event (dep, arrv, cnx, etc.)
 - Allows for aggregate stats (e.g. by airline)

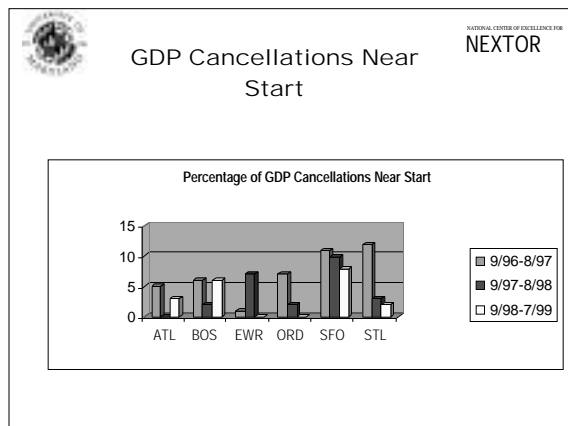


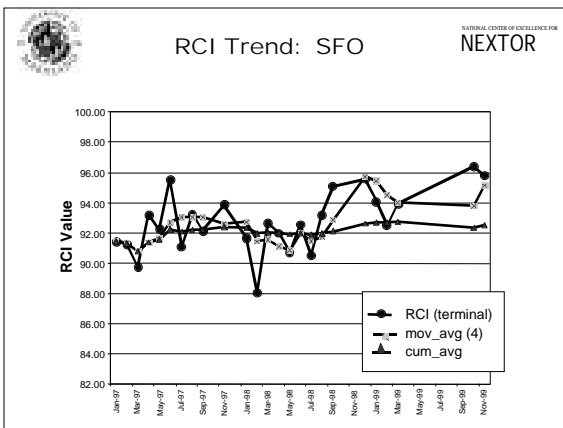
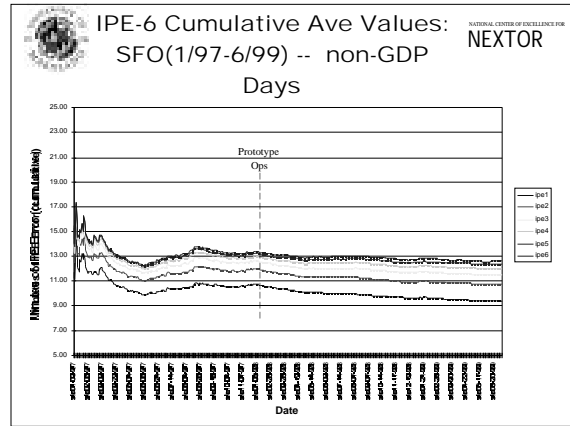
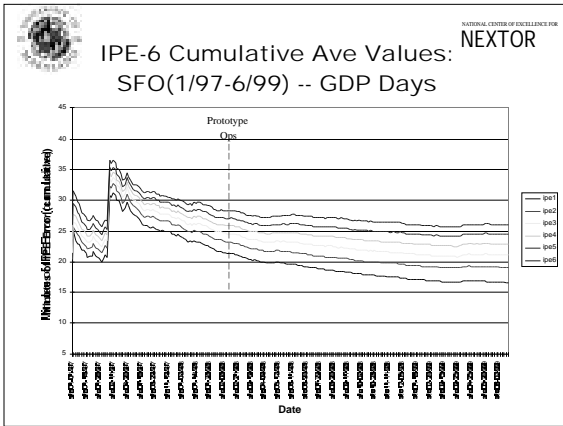


- Need for a New Metric**
- Need for a single-valued GDP performance metric that does not second-guess forecasts
 - Need to factor airport conditions out of GDP post-performance evaluation
 - View GDP as a *plan*: how well was the plan executed?



- Computation of RCI**
- The Idea behind the Rate Control Index (RCI):
- (1) measure the amount of flight movement necessary to convert Del back into PAAR: a simple network flow problem solved via a greedy algorithm
 - (2) normalize: finding “worst” flight distribution -- solved by dynamic programming





NATIONAL CENTER OF EXCELLENCE FOR
NEXTOR

Initial Collaborative Routing (ICR): Evaluation Summary

- Evaluation of functionality not systems
- Systems and Procedures used:
 - Collaborative Routing Coordination Tool (CRCT)
 - Collaborative Convective Forecast Product (CCFP)
 - Information and Application Distribution Products: PicTel & WWW
 - Low Altitude Arrival and Departure Routes (LAADR)
 - Coded Severe Weather Avoidance Program Routes (Coded SWAP)/Coded Departure Routes (CDR)
- All tools in very early stages of development ==> evaluation primarily based on user feedback and anecdotes