



***Impact of Maintenance on
Availability of the Air Traffic Control
Systems:
Cost of Service vs Quality of Service***

Presented by

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March 29, 1999



Motivation

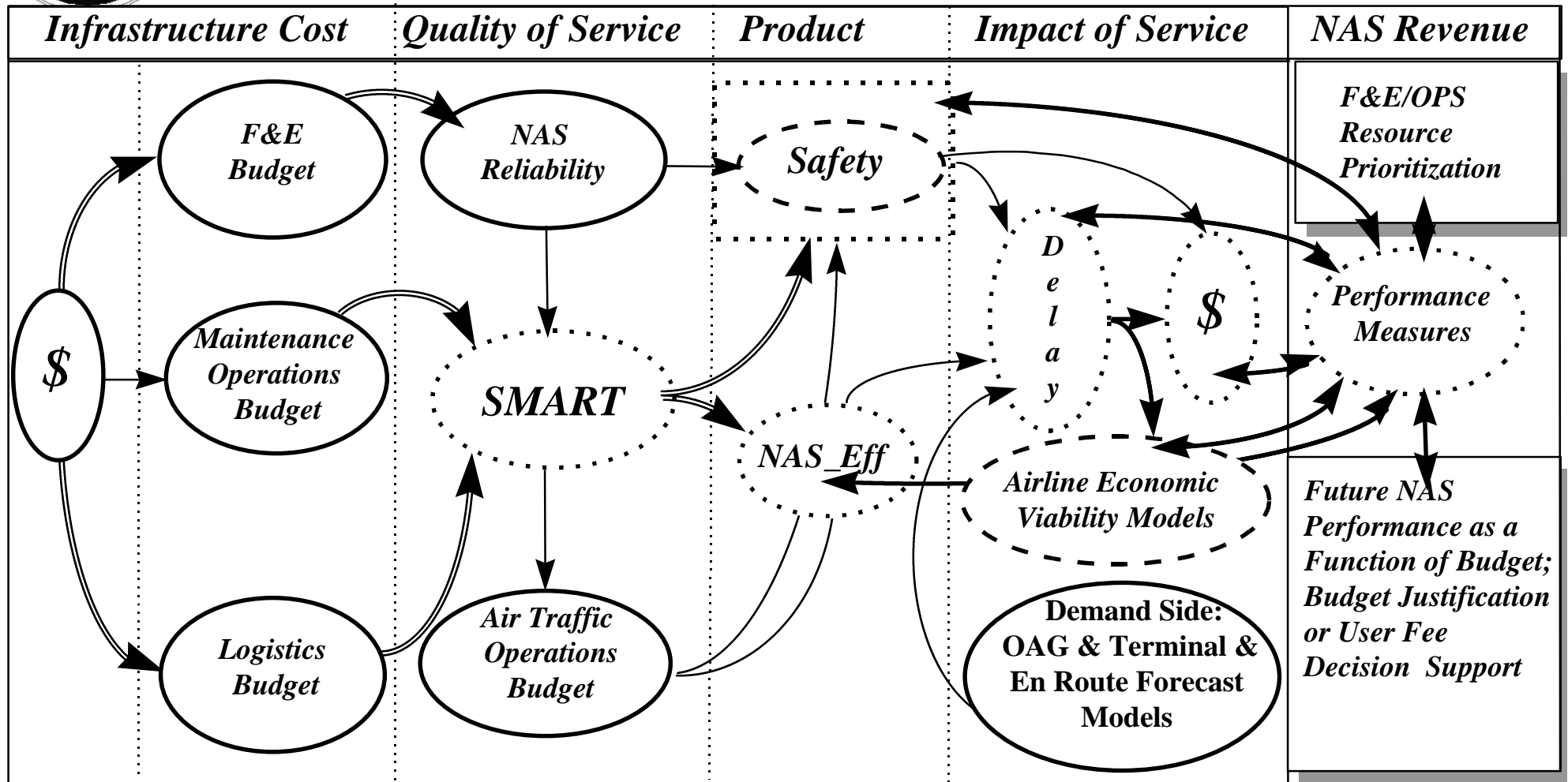


- ↪ *We are always asked, by Congress, to deliver greater efficiency - capacity, safety, access, etc.*
- ↪ *Substantiate FAA Efficiency. Show that quality, quantity and availability depend on resources provided. In the long run, FAA cannot do more with less.*
- ↪ *We need to connect Cost of Service to Quality and Quantity of Service in order to establish a dialog with Congress and the user.*
- ↪ *Relate every expenditure in the NAS to incremental Safety, Capacity and Efficiency - I.e. user economic impact, a good revenue surrogate.*
- ↪ *Have a Balanced and Integrated Strategic Business, Plan for Air Traffic Services, that is directly related to System Performance.*





Confederated Service Component Models



3 are Accomplished

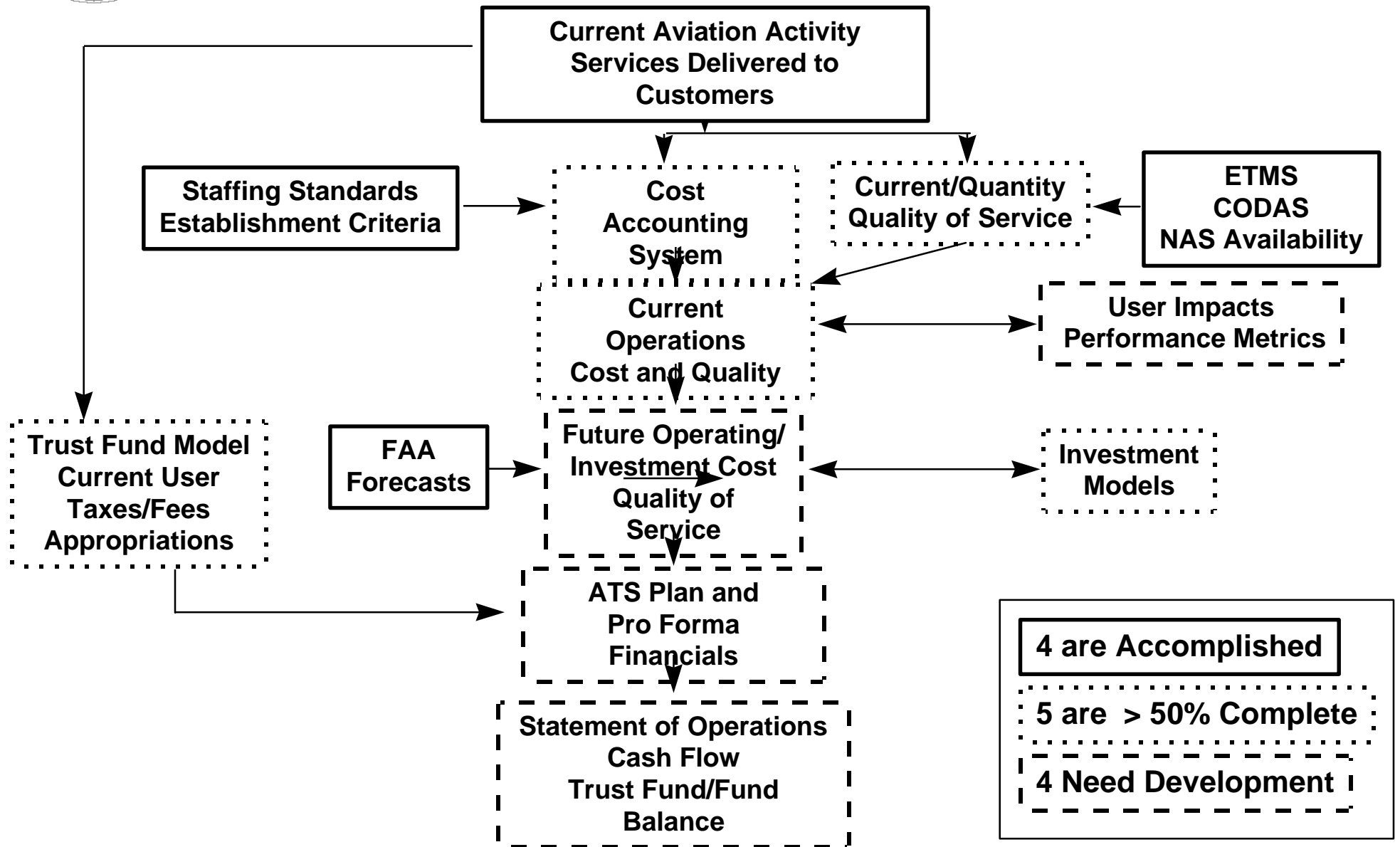
5 are >50% Accomplished

2 Need Development



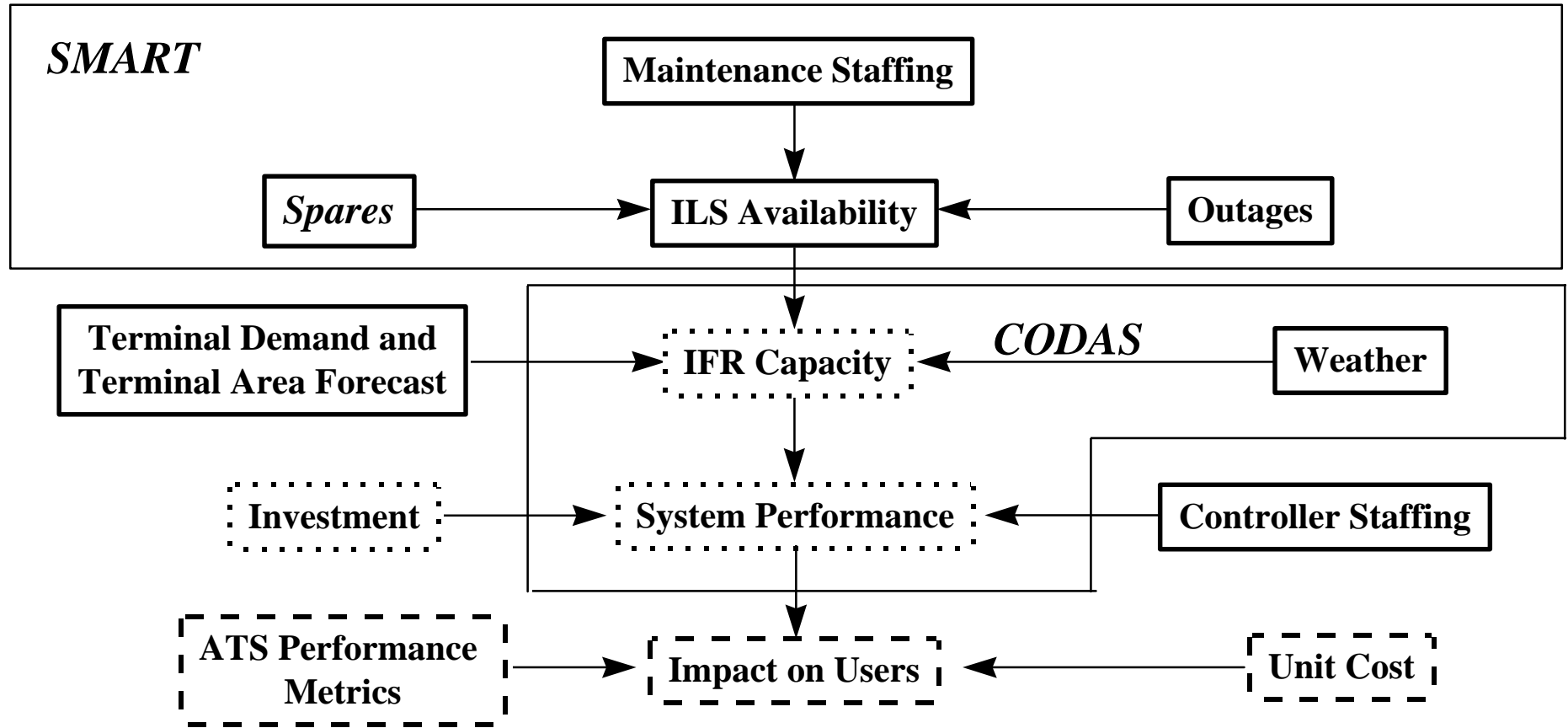
CONCEPTUAL OVERVIEW

Confederated ATS Business Model





CONFEDERATED ATS MODEL STRUCTURE AT AN AIRPORT

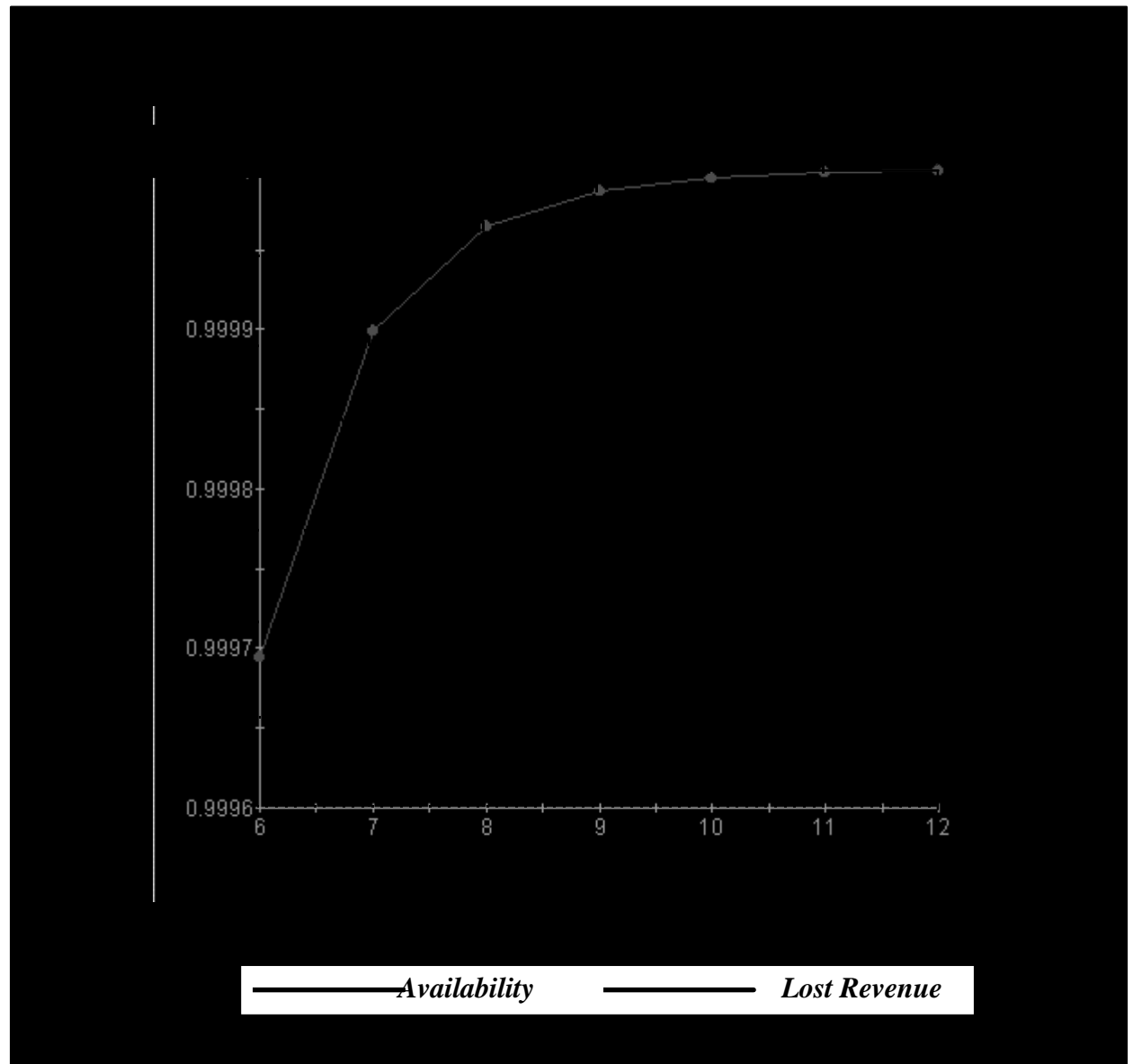


7 are Accomplished	3 are >50% Accomplished	3 Need Development
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The Goal of the AAF Business Model

The goal is to link our Quality of a Particular Service(s) at a specific location to *"revenue lost"* due to equipment quality. This provides the link between Cost of Service and Value of Service.





SMART-3

Description



Motivation

- ↪ *Clarify the relationships among Cost of Service, Quality/Quantity of Service and Value of Service*
- ↪ *An important attribute of FAA Quality of Service is Availability, however all systems are not of equal value,*
- ↪ *The Availability of systems at specific locations is a more relevant attribute.*
- ↪ *There is a direct correlation between higher levels of availability and cost: More technicians, More training, More spares, Equipment upgrades. We need to understand this.*



What is SMART-3

- ↪ *SMART-3 is SSC, SMO, Regional and Headquarters Decision Support Tool intended assist management to associate expenditure with results.*
 - ↪ *Performance - Operational Availability / Delay / Capacity.*
 - ↪ *Budget - AF Technician Staffing, Training, and Spares.*
- ↪ *It provides supporting analysis to negotiate Cost of Service and Quality of Service.*
- ↪ *Addresses Congressional questions about the impact of staff or budget reductions at the SSC level.*
 - ↪ *E.g, at BOS outage duration, (delay) will increase 20%; at LAX ...*
- ↪ *Provides a tool to focus resources to achieve very specific outcomes.*
 - ↪ *E.g. maximize operational availability on the ASR-9 at LAXN and the GS and LOC at 04L between 06:00 and 20:00, Sunday through Friday.*
- ↪ *Identifies maximum equipment availability achievable (quality) and the staffing and training (cost) required to achieve it.*



What is SMART-3 (Cont'd)

- ↳ *Relates microscopic decisions to macroscopic results.*
- ↳ *Supports Strategic and Tactical “What-if” analysis:*
 - ↳ *How will an SSC, SMO, Region or the NAS perform if specific equipment, staffing, sparing or training profiles are altered.*
 - ↳ *What would be the net effect on the utilization of a specific technician¹, if his/her training level were increased.*
 - ↳ *What is the effect on the operational availability of the system he/she is being trained to repair.*
- ↳ *Allows SSC and SMO Managers to project the benefit of specific additional assets and resources.*
 - ↳ *training within their areas of responsibility*
 - ↳ *Sparing*
 - ↳ *Resource increases, decreases or allocation by watch.*
- ↳ *Allows the SSC/SMO/Region to project the impact of additional or replacement F&E.*

1. That portion of time spent by the technician in actual repair activity. Does not include other activities such as paper work, training, etc.



What SMART-3 Can Do

- ↪ *Predicts Performance in response to “what if” questions. Such as:*
 - ↪ *changes in staffing level;*
 - ↪ *changes in the amount of equipment to be maintained (e.g. resizing SSC’s, SMOs or Regions);*
 - ↪ *Changes in MTTR or MTBO Services or equipment resulting from new equipment deployment or new architectures.*
 - ↪ *Changes in how services are provided*
- ↪ *The outcomes are the performance expected from equipment on a location by location basis.*
- ↪ *The Performance expectations are rolled up to yield a National or Regional perspective.*



Future Plans

- ↪ *Deploy tactical version of SMART at SSCs to determine anticipated outage duration, I.e. Availability, based on*
 - ↪ *watch staffing variations*
 - ↪ *staff assignment algorithms from the OCC*
 - ↪ *impact of vacation and training assignments*
 - ↪ *increase or decrease in number of qualified personnel*
 - ↪ *sparing profiles by system*
- ↪ *Link SMART to Efficiency models to prioritize repair based on Value of Service and determine the Quality of Service the is economically reasonable to provide.*



SMART-3

Examples

The numerical values used on these examples are for the sake of example; they are not real NAS values.



Summary results of a 20,000 hour discr

- *Jobs Generated* are the total number of repair a
- *Jobs Done* are the total number of repair activiti
- *Avg. Queue Length* is the average number of ec
- *Tech Utilization (%)* is the percentage of work t
of equipment, as opposed to necessary paperwo
- *Avg. Wait Time* is time spent waiting for a qual
due to service quality.
- *Avg. Outage Time* is the average duration of an
- *Avg. Repair Time* is the average time spent in re
equipment quality.

Simulation results

Results of the Simulation

Jobs Generated	11079	Avg. Wait Time (hrs)	0.1
Jobs Done	11076	Avg. Outage Time (hrs)	6.0
Avg. Queue Length	0.4	Avg. Repair Time (hrs)	5.8
Tech. Utilization (%)	46.0		

Fac. Results Tech. Results Tally Results Return



Individual Facility Results

- *Fac_Code* is the equipment identification Number
- *Failures* refer to number of repair actions per facility
- *Avg. Wait Time* is the time spent waiting for a quote
"revenue lost" due to service quality.
- *Avg. Outage Time* is the average duration of an outage
- *Avg. Repair Time* is the average time spent in repairing
equipment or infrastructure quality.

Facility Results

Individual Facility Results

Fac_Code	Failures	Avg. Wait Time (hrs)	Avg. Outage Time (hrs)	Avg. Repair Time (hrs)
45512	404	0.1	8.3	8.1
455AA	403	0.6	8.8	8.2
447HB	57	0.0	18.2	18.2
453AA	180	0.0	3.1	3.0
453AC	328	0.0	3.8	3.8
453AD	192	0.4	3.8	3.3
451AA	120	0.1	4.4	4.1
451AC	140	0.0	4.0	3.9
451CB	102	0.0	6.1	6.0
451CG	97	0.0	6.7	6.6

Return



Individual Technician

- *Util (%)* is the percentage of work time spent in pr equipment, as opposed to necessary paperwork, te
- *Tasks Done* are the number of repair activities per
- Note that the algorithm currently selects the first a load leveling is being implemented..

The screenshot shows a software window titled "Tech. Results" with a close button in the top right corner. The window displays the following table:

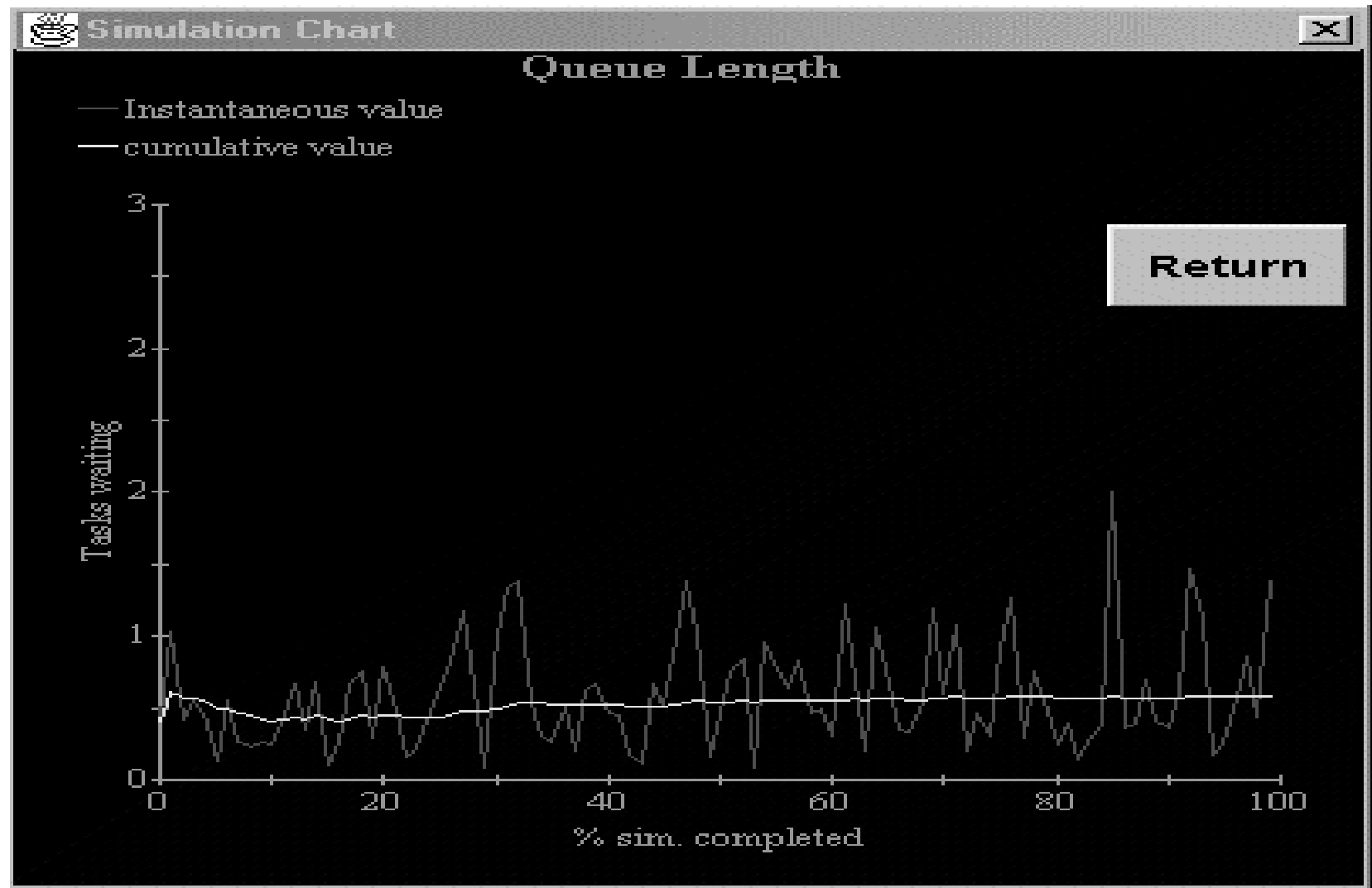
	Technician	Util (%)	Tasks Done
	tech41	61.5	2017
	tech42	77.2	2827
	tech43	52.3	1433
	tech44	43.2	1387
	tech5	49.4	2128
	tech6	37.3	1137
	tech7	4.6	150

To the right of the table is a "Return" button.



Instantaneous Queue Length

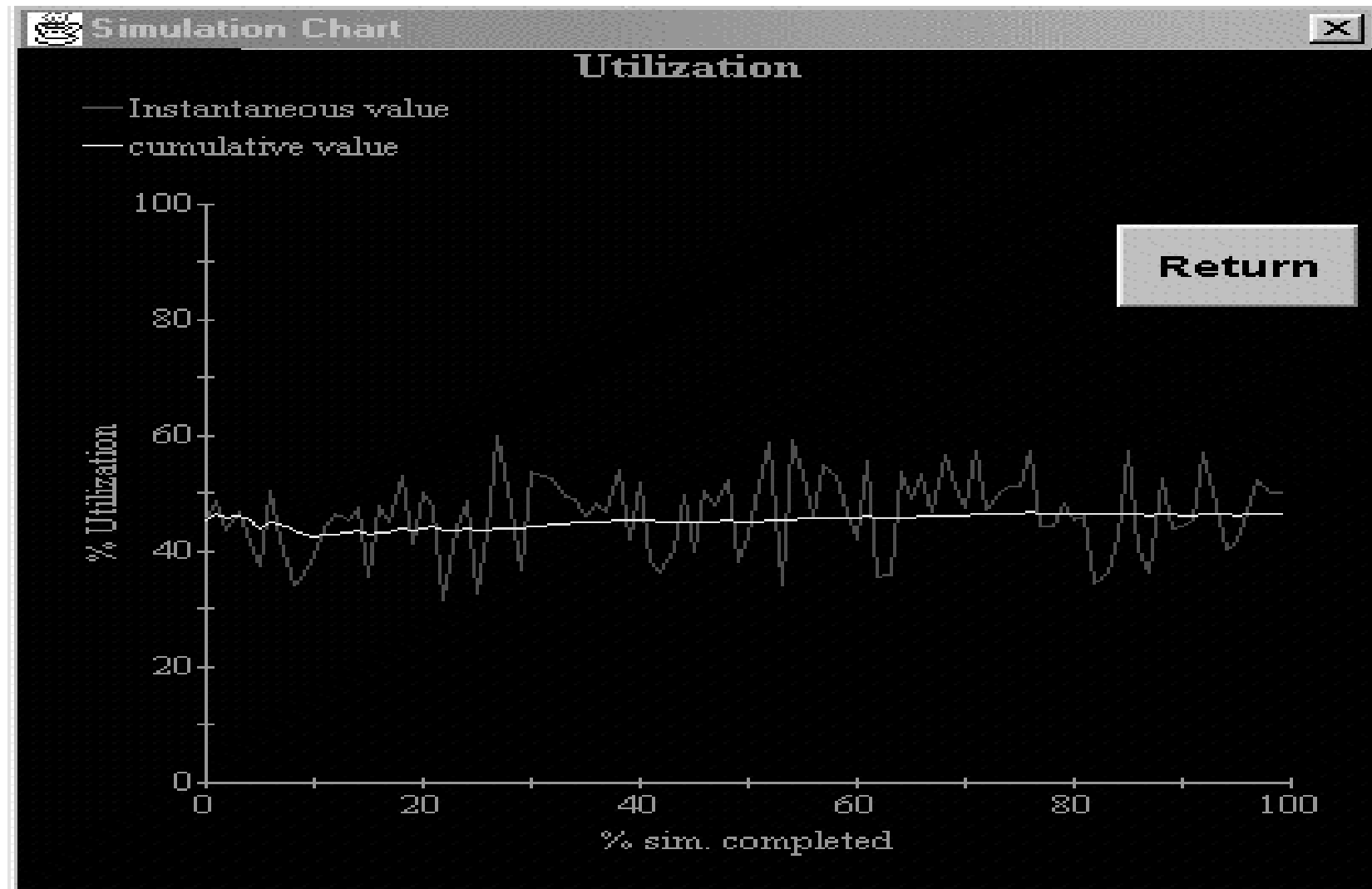
Although the “Average Queue Length” is .5, it may vary from 0.2 to 2 during the course of the year. In terms of Outage Duration, in this sample case, this is 20 minutes to 11 hours that an outage waits for a trained technician.





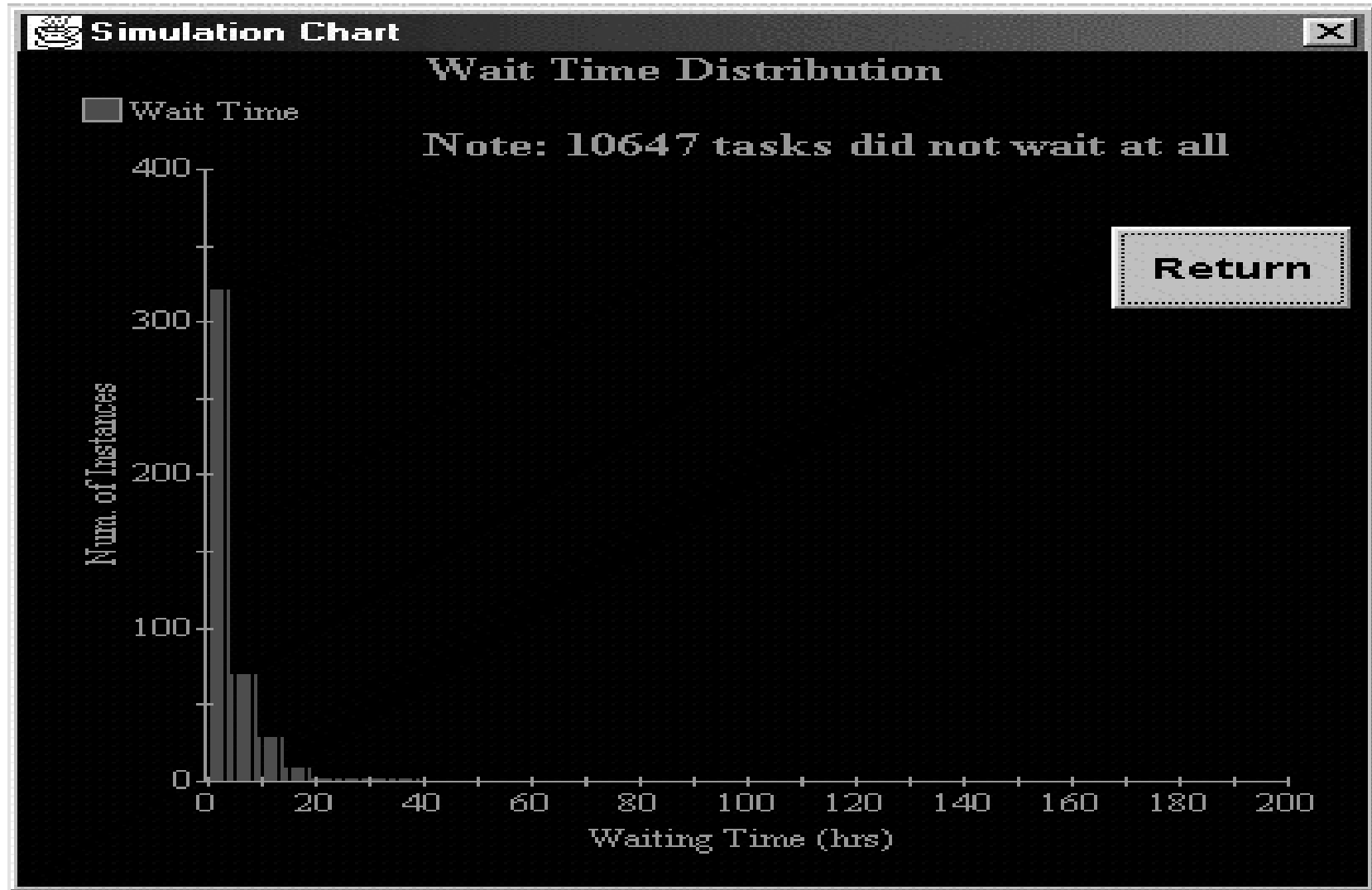
Instantaneous Technician Utilization

Note that although the “Average Technician Utilization” is ~ 47%, it may vary from ~30% to ~ 60% during the course of the year.



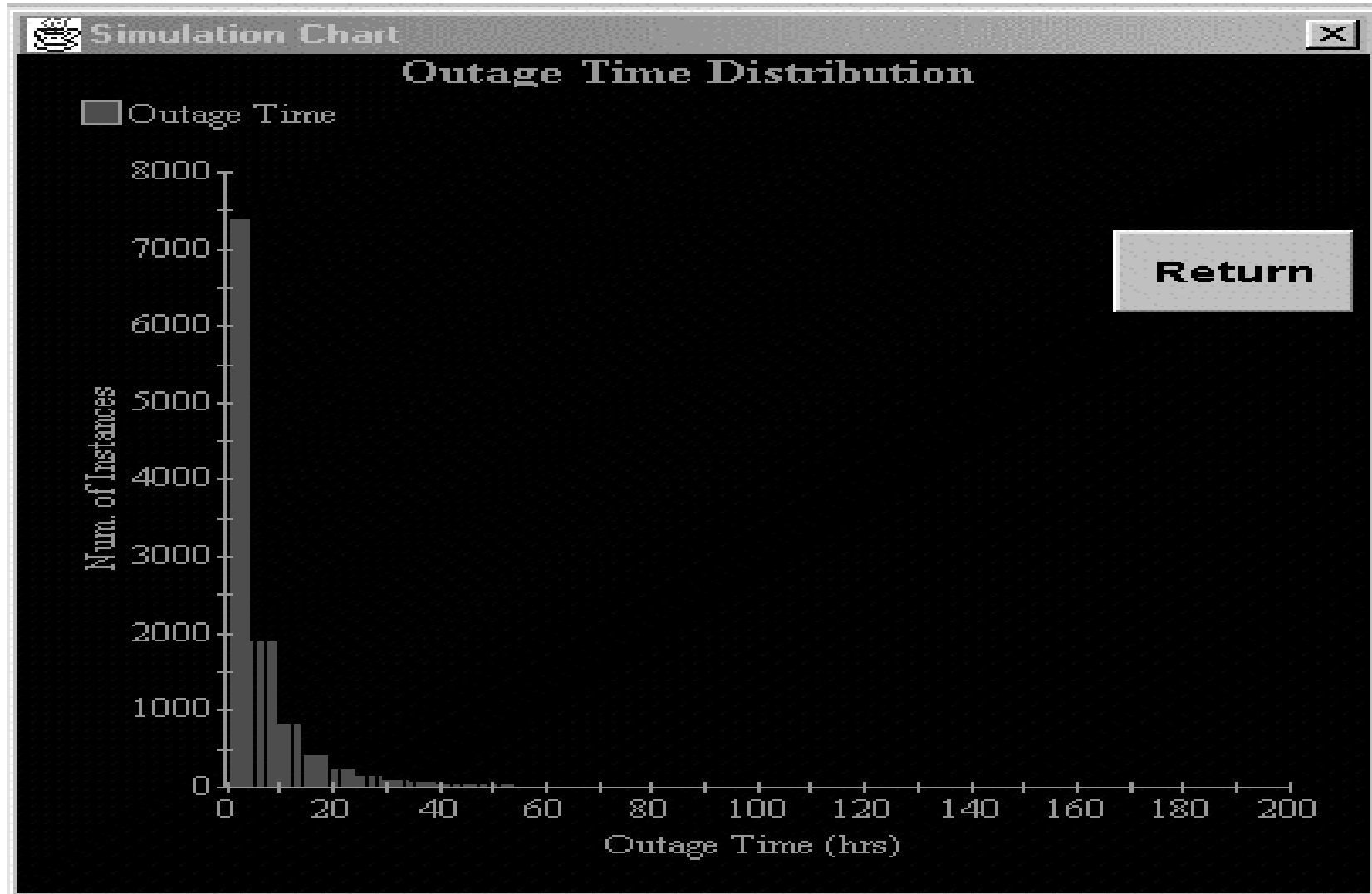


Waiting Time Distribution Histogram





Outage Distribution Histogram





Repair Time Distribution Histogram

