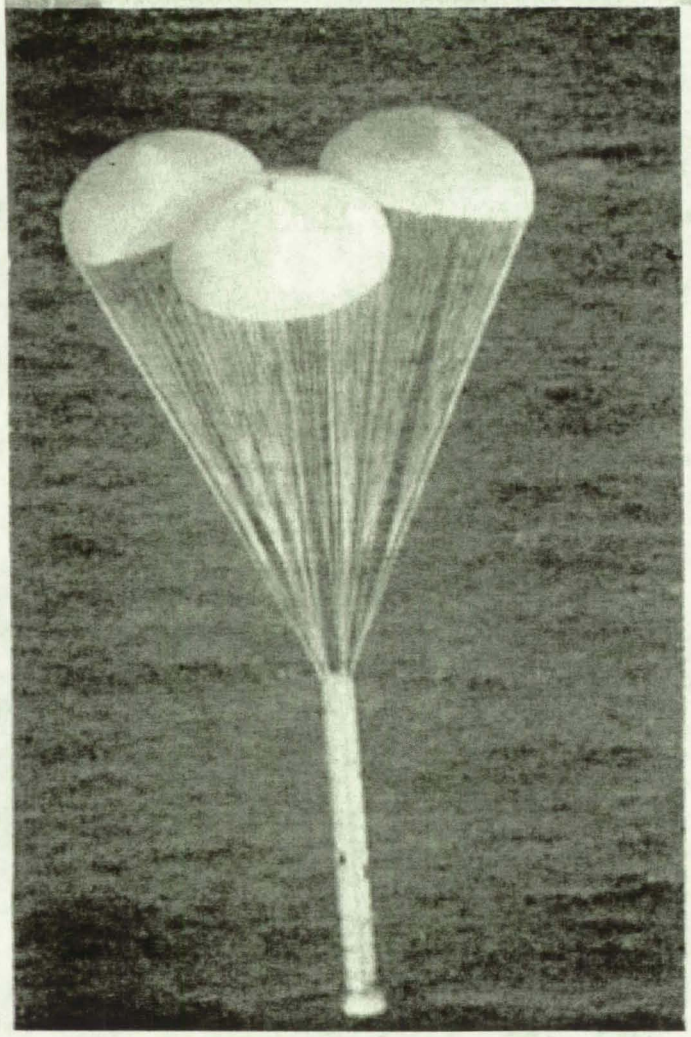
ProModel READINESS 2007



# United Space Alliance LLC Parachute Refurbishment Facility Model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Martha Pessaro

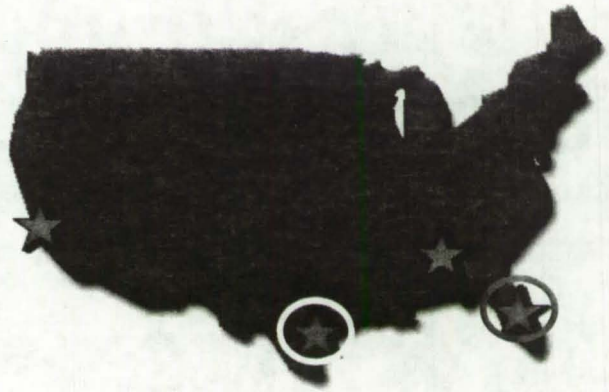
Angela Young


November 13, 2007

# United Space Alliance (USA)

## Who are we?

- Prime Contractor to NASA for Space Program Operations Contract
- Responsible for all Space Shuttle Fleet & International Space Station processing operations
- Two primary locations:
  - Johnson Space Center, TX
  - Kennedy Space Center, FL
- About 10,000 employees





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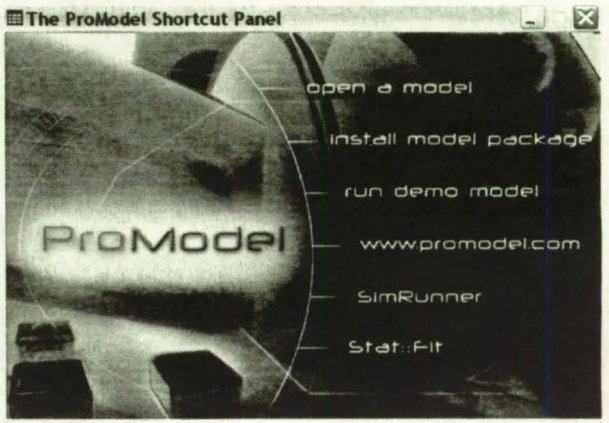
# United Space Alliance (USA)

## Simulation Experience:

- Over six years using ProModel
- Also use Process Simulator with Visio
- Over two dozen USA employees trained in simulation
- Completed over two dozen major simulation projects
  - Shop Layouts
  - Paper Processes
  - Flight Hardware Processing
  - Manufacturing Operations
  - Parachute Facility



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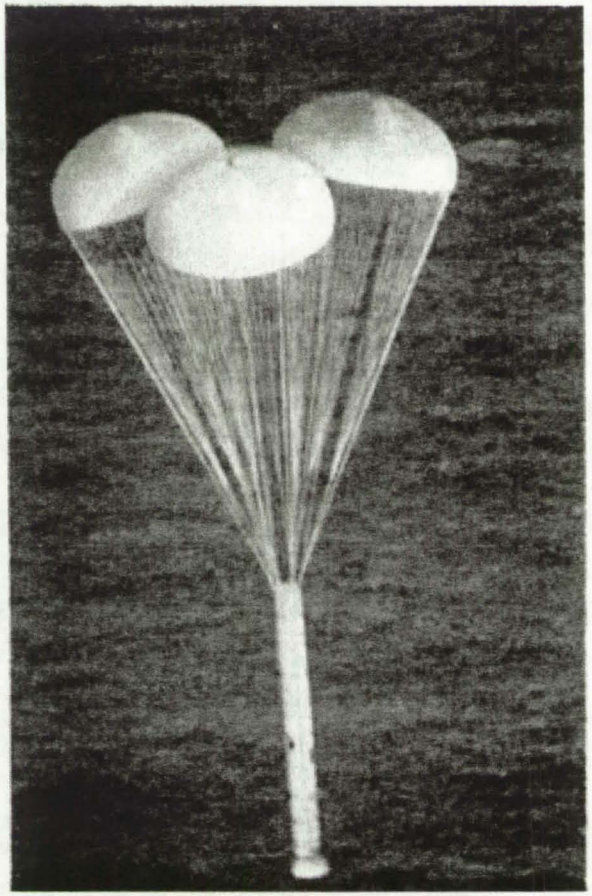
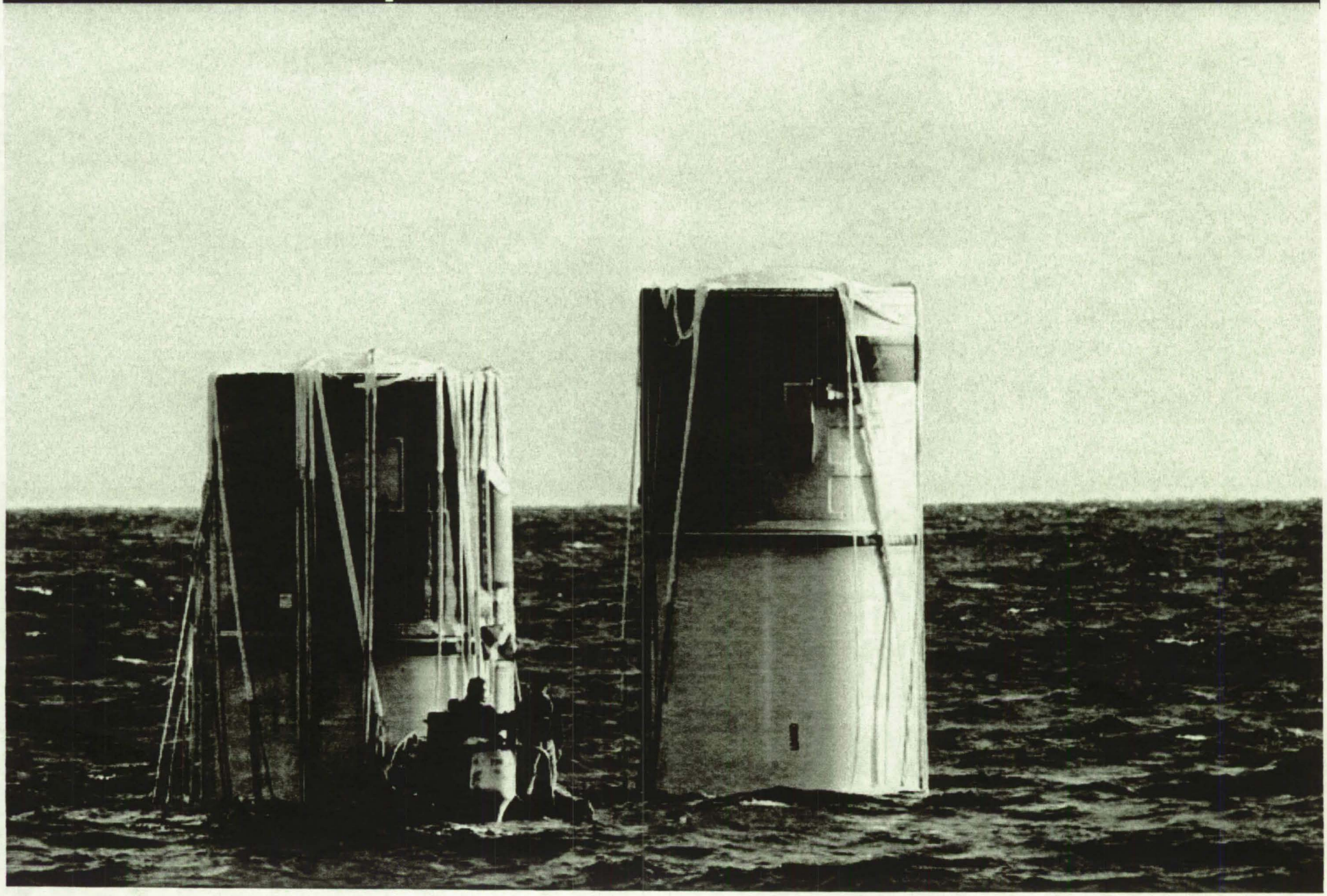
# Parachutes in Operation

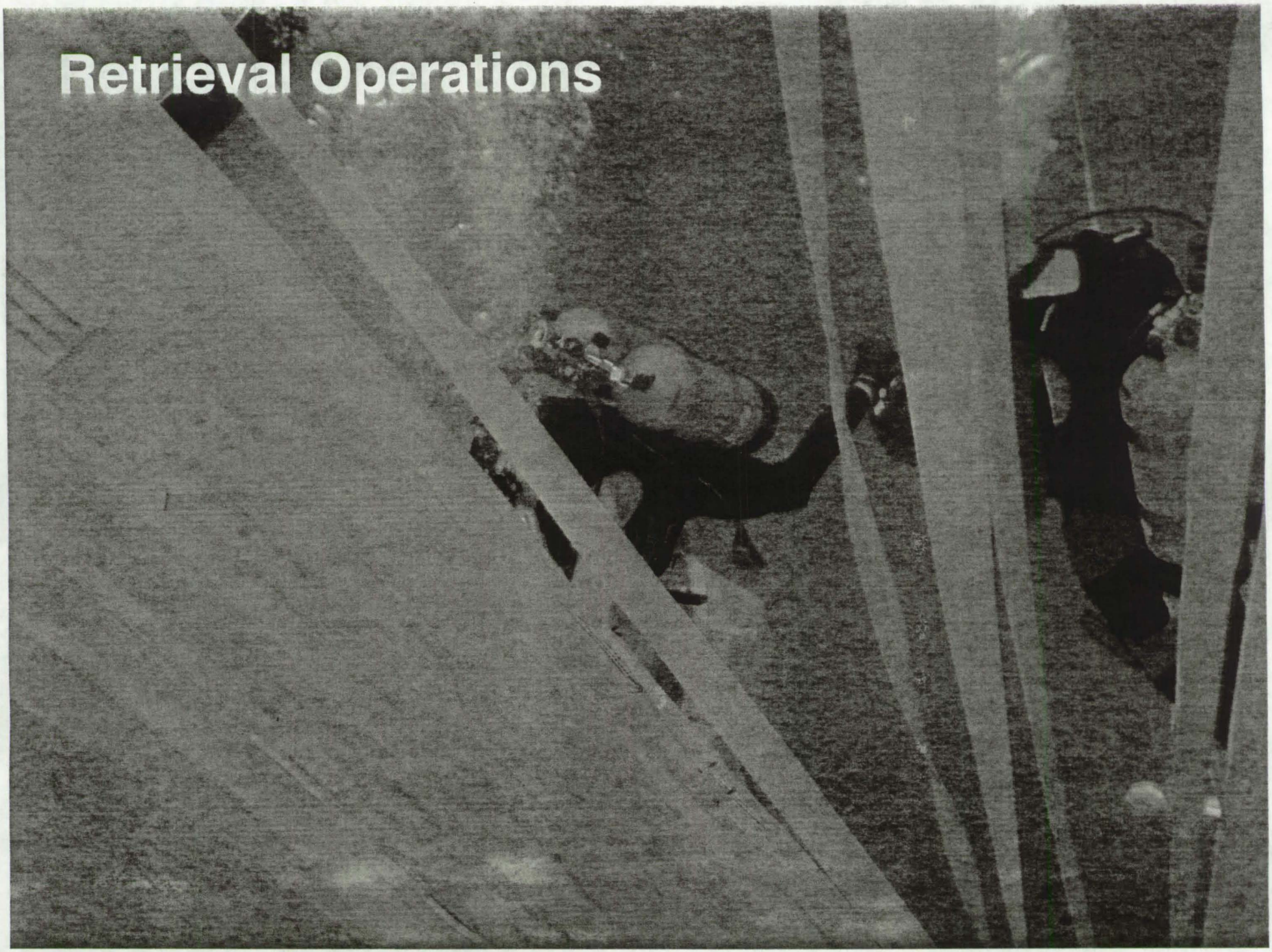
## Include short video clip here on Parachutes



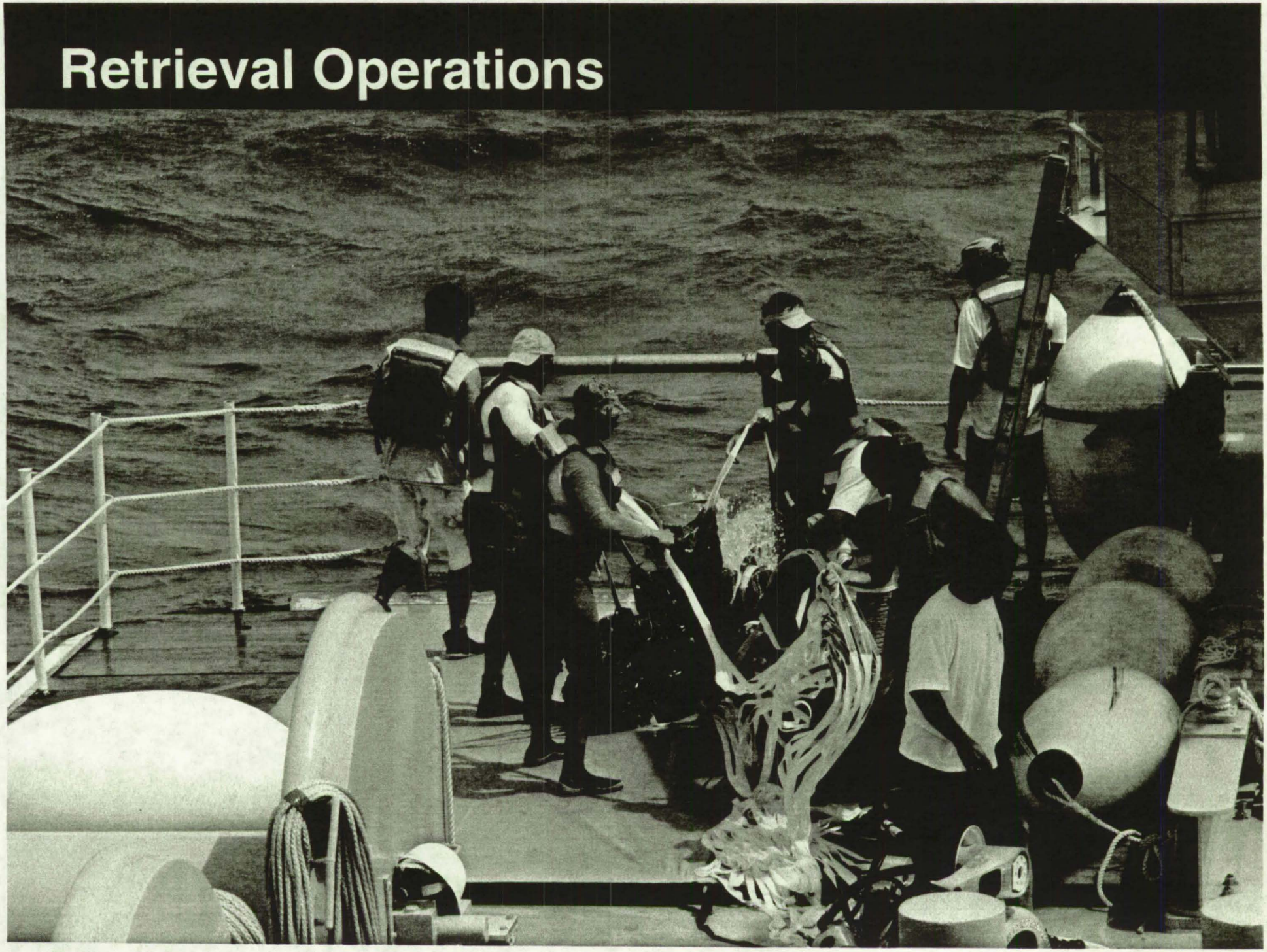
# Retrieval Operations



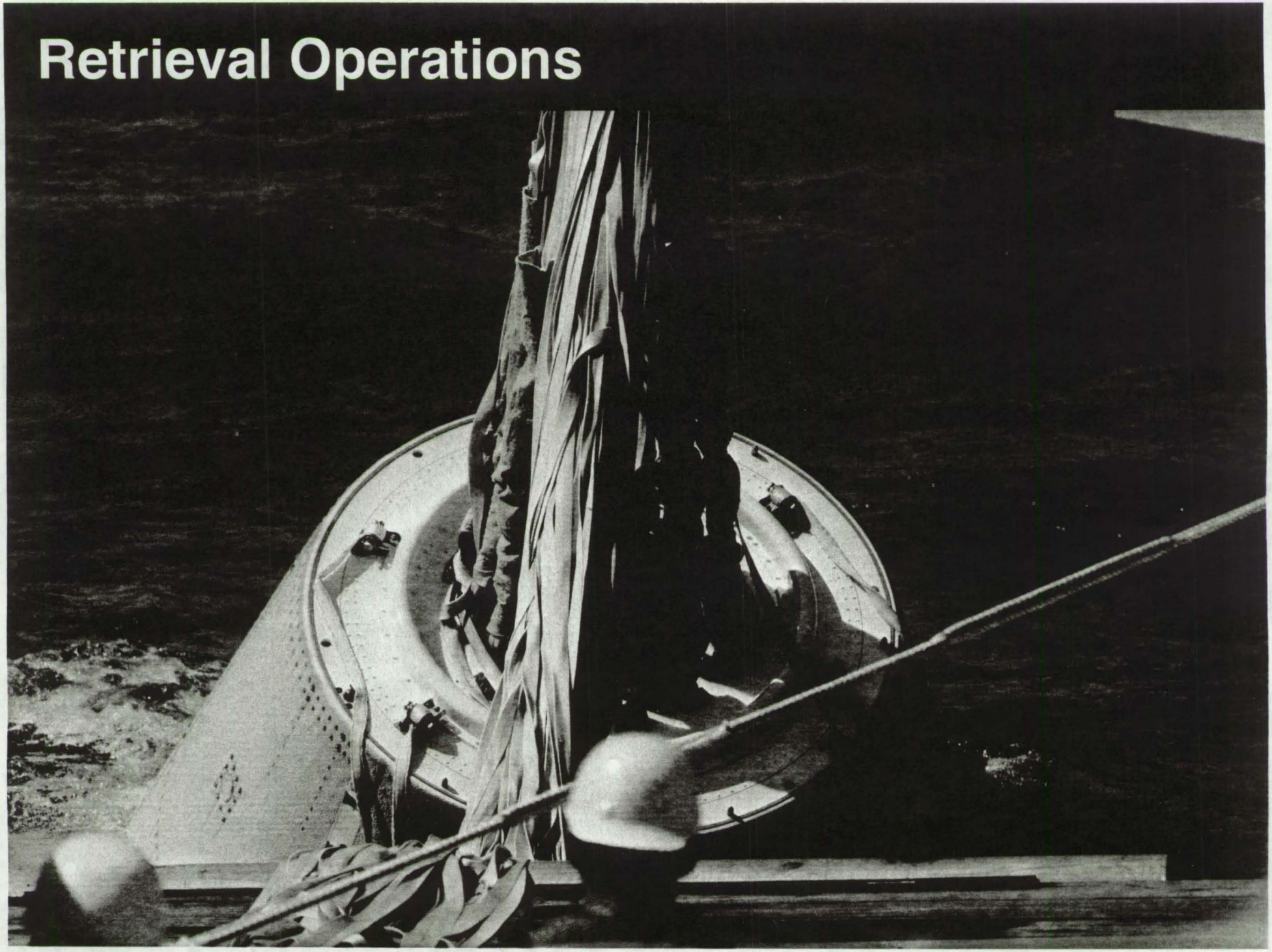
# Retrieval Operations



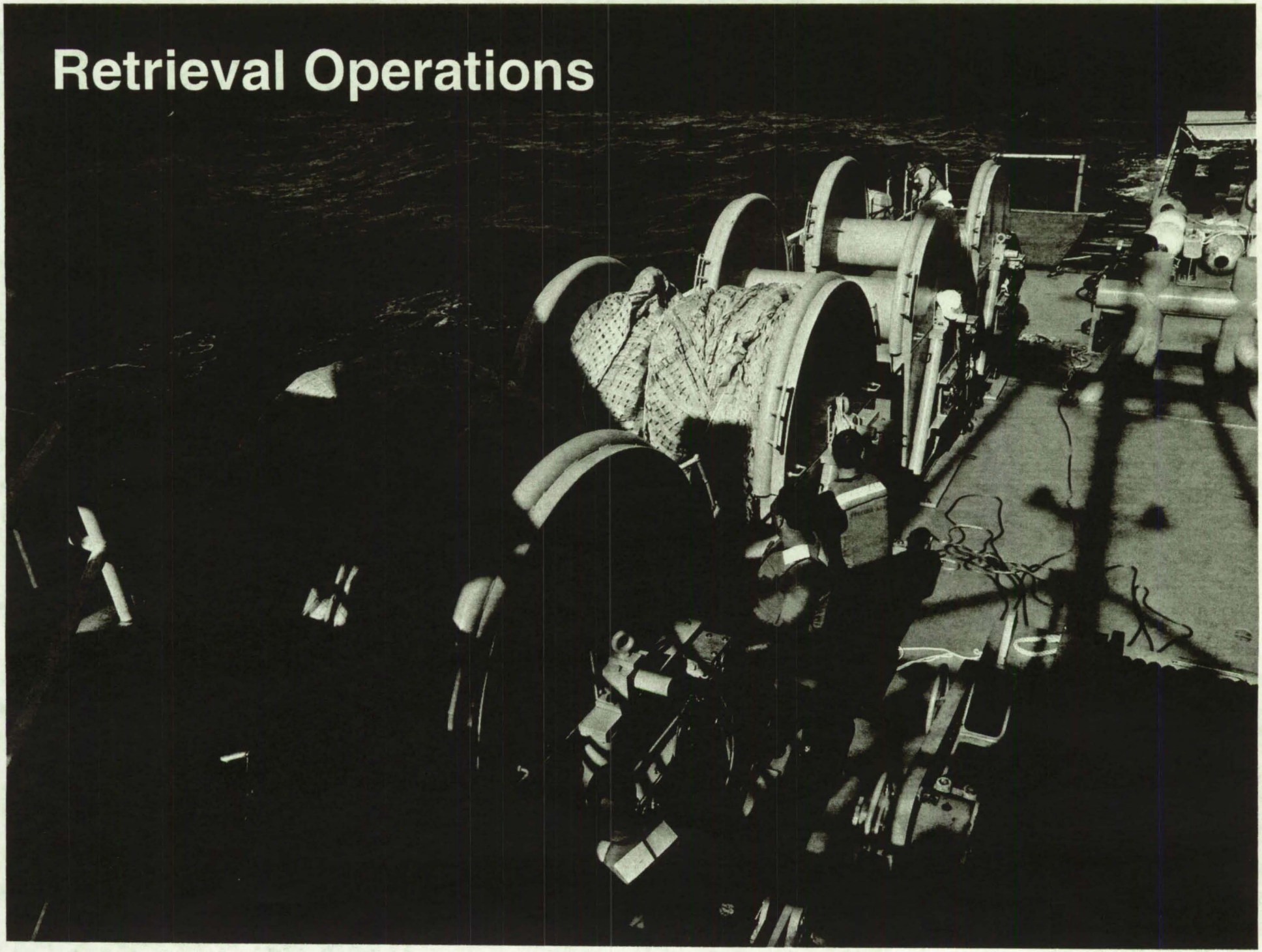
# Retrieval Operations



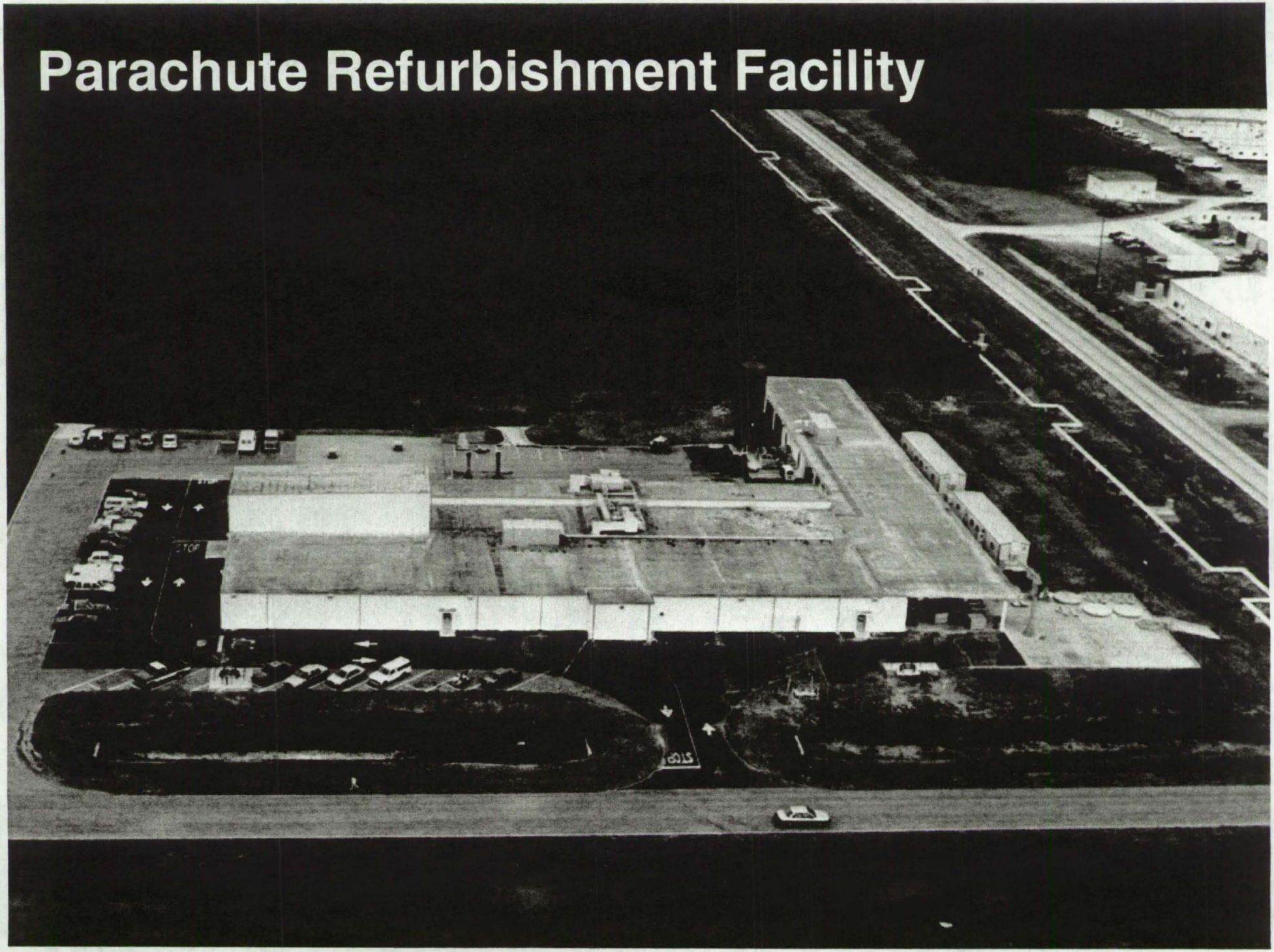
# Retrieval Operations



# Retrieval Operations



# Parachute Refurbishment Facility



# Parachute Flow Return From Launch

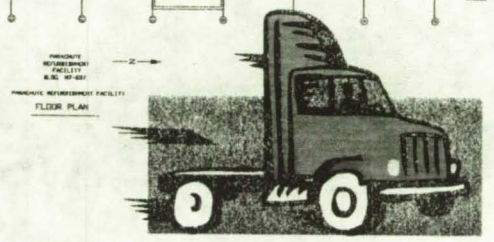
Warehouse

Wash

Dry

Go thru Defoul
On
Monorail System

Refurb
Assembly
Manufacturing



Reels arrive by truck

# Parachute Refurbishment Simulation Model

## Objective:

1. With the current shuttle work and the inclusion of CLV/ARES work, will we have enough headcount to meet schedule delivery dates, if not, can we solve the delays with overtime?
2. Do we have facility capacity to do both SPOC and CLV/ARES work and meet schedule?

# Parachute Refurbishment Simulation Model

- Model originally set up for Constellation
  - Reworked model
  - Include both SPOC and CLV/ARES mfg work flow
    - Included current work + future work (Level 4 Schedule)
      - Includes start dates and delivery dates from schedule

SPOC=Space Program Operations Contract
CLV=Crew Launch Vehicle

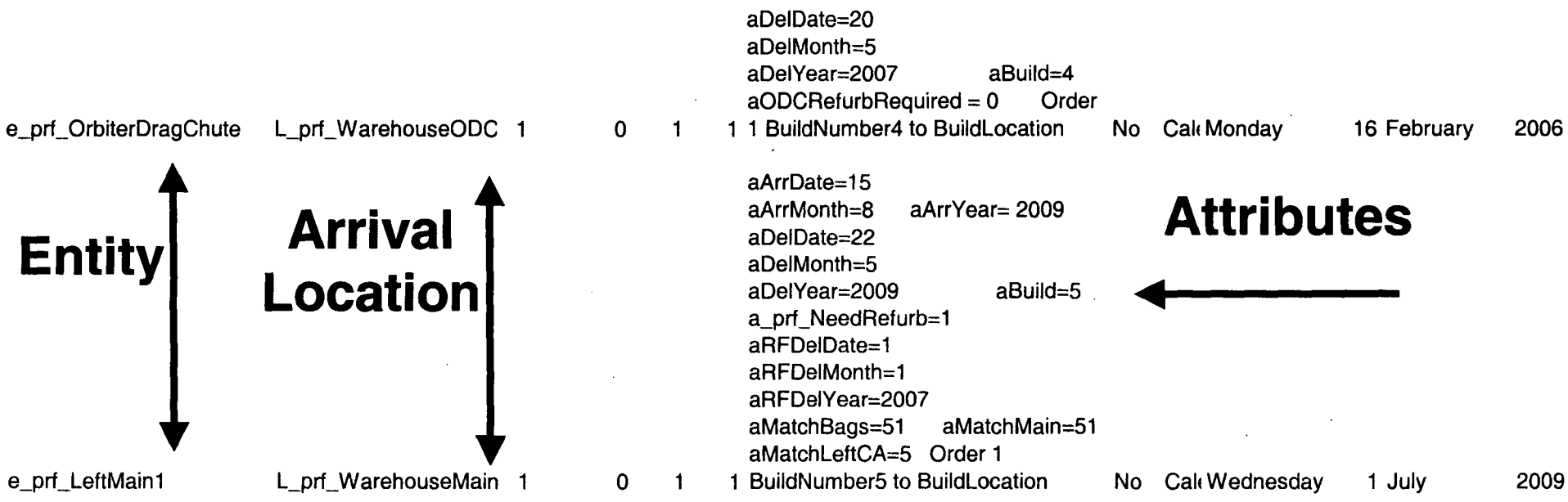
# Assumptions

- General Assumptions
  - Model timeline May 9, 2007 – December 14, 2010
  - Arrivals defined from Level 4 schedule
  - Preventive Maintenance is done on a non-interference basis
  - Technicians work on sewing machines / Model does not include downtimes
  - Model does not do workarounds, operations go from beginning to end, hardware is not moved off line to continue other work if there is a holdup
- Specific Assumptions
  - SPOC
  - CLV
  - ARES

# Tools/ProActiveX

| ProModel | Excel Tab | GET ALL | BUILD ALL | CLEAR ALL | CLEAR and UPDATE ALL |
|---|---|---|---|---|---|
| Arrays | View | GET | BUILD | CLEAR | CLEAR and UPDATE |
| Arrival Cycles | View | GET | BUILD | CLEAR | CLEAR and UPDATE |
| Arrivals | View | GET | | CLEAR | CLEAR and UPDATE |
| Attributes | View | GET | BUILD | CLEAR | CLEAR and UPDATE |
| Entities | View | GET | BUILD | CLEAR | CLEAR and UPDATE |
| External Files | View | GET | BUILD | CLEAR | CLEAR and UPDATE |
| General Info | View | GET | BUILD | | |
| Locations | View | GET | BUILD | CLEAR | CLEAR and UPDATE |
| Location Graphics | View | GET | BUILD | CLEAR | CLEAR and UPDATE |
| Macros | View | GET | BUILD | CLEAR | CLEAR and UPDATE |
| Path Networks | View | GET | BUILD | CLEAR | CLEAR and UPDATE |
| Processing | View | GET | | CLEAR | CLEAR and UPDATE |
| Resources | View | GET | BUILD | CLEAR | CLEAR and UPDATE |

# Sample from ProActiveX for PRF Model



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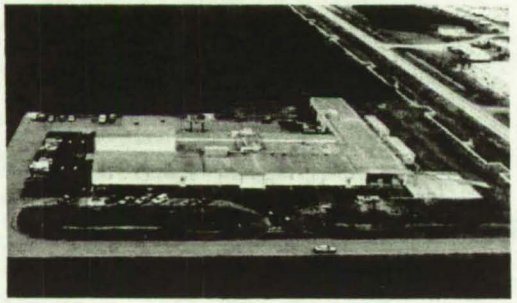
ProModel - prf 5.1.MOD (PRF Model) - [Normal Run]

File Simulation Options Information Window Interact Help

2008.06.02 Mon 18:38



SubCon 0 YUMA 1

Main RFD 5 MainRFRC 5
Main 0 DC 0
DL 1 CLV 0 DCRFD 1
ReWork 0 ODC 0 Bag 1

ARES 0
DCRFRQ 0

Transfer 31

Acceptable Del Dates 194

Missed Delivery Dates 80

PRF Headcount 26

Parachute Comp Tech 28140.14

Engineer 2588.00

Quality 1693.23

WC Spec 1625.03

Ops Staff 273.56

Total Manhours 18535.65

CLV_Fab DeploymentBags

CLV_Fab TestHardware

I-M1 Assembly Lanes

Manufacturing Lanes

DC Refurb

Refurb

DC Assembly Lanes

DWD

B129
B130
B131
B132
B133
B134

SPOC

B132
B133
B135
B136
B137
B134
B138
B139
B140

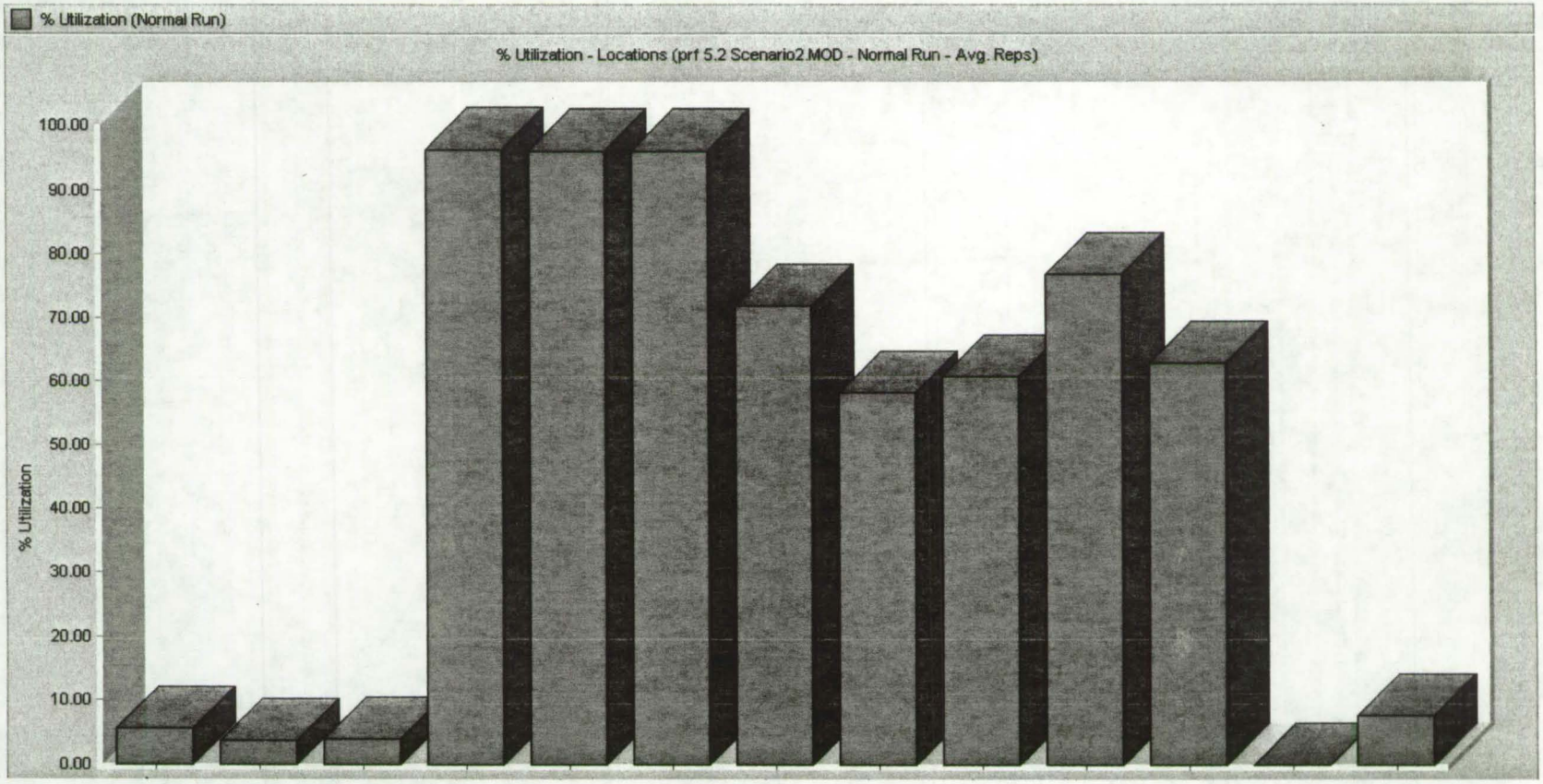
CLV

MDT1 DDT1 DDT2
MDT2 CDT1 DDT3
PDT5 PDT4
PDT3R MDT3

ARES1X

# SHOW MODEL

# Location Utilization



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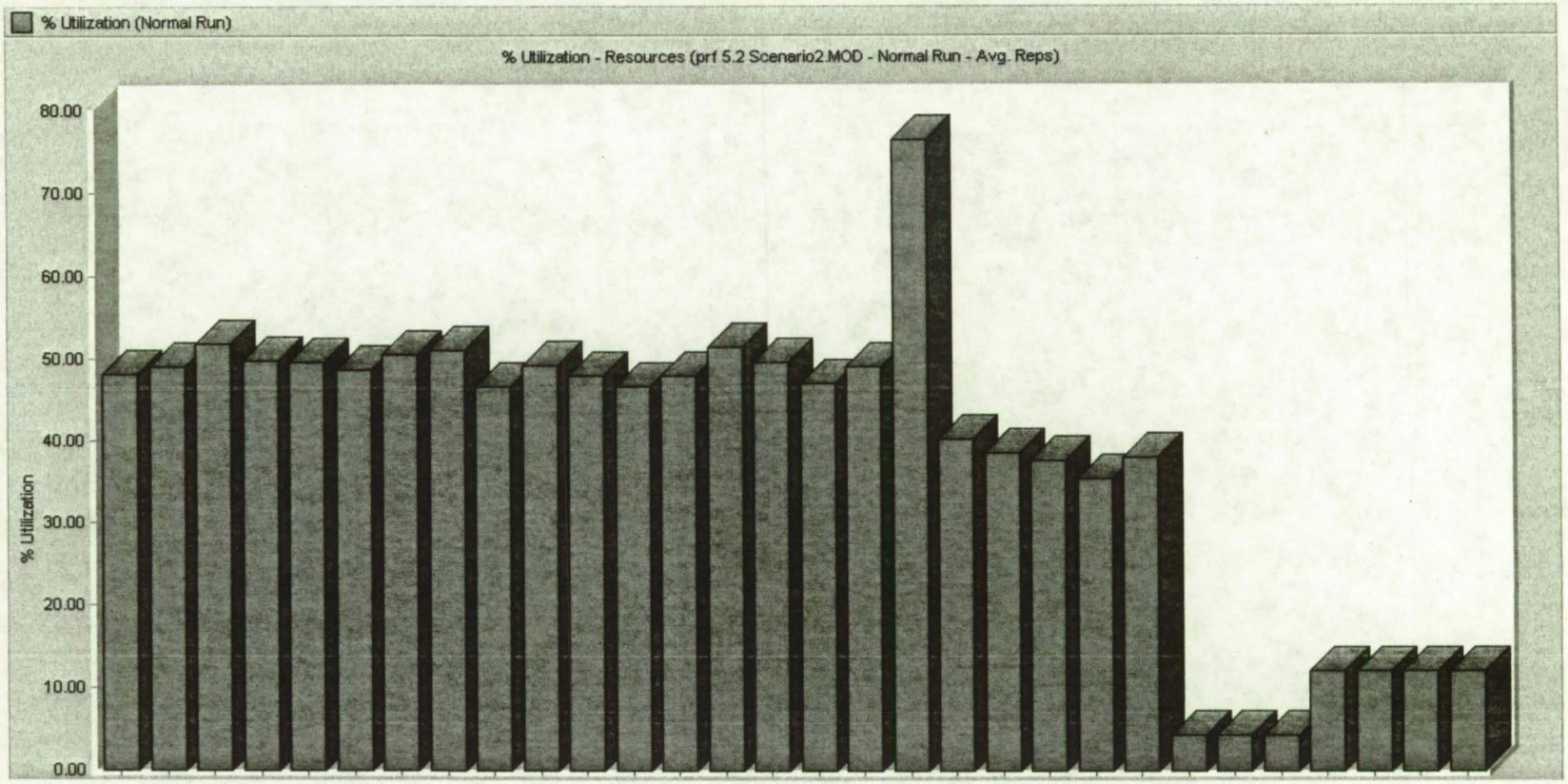
# Resource Utilization



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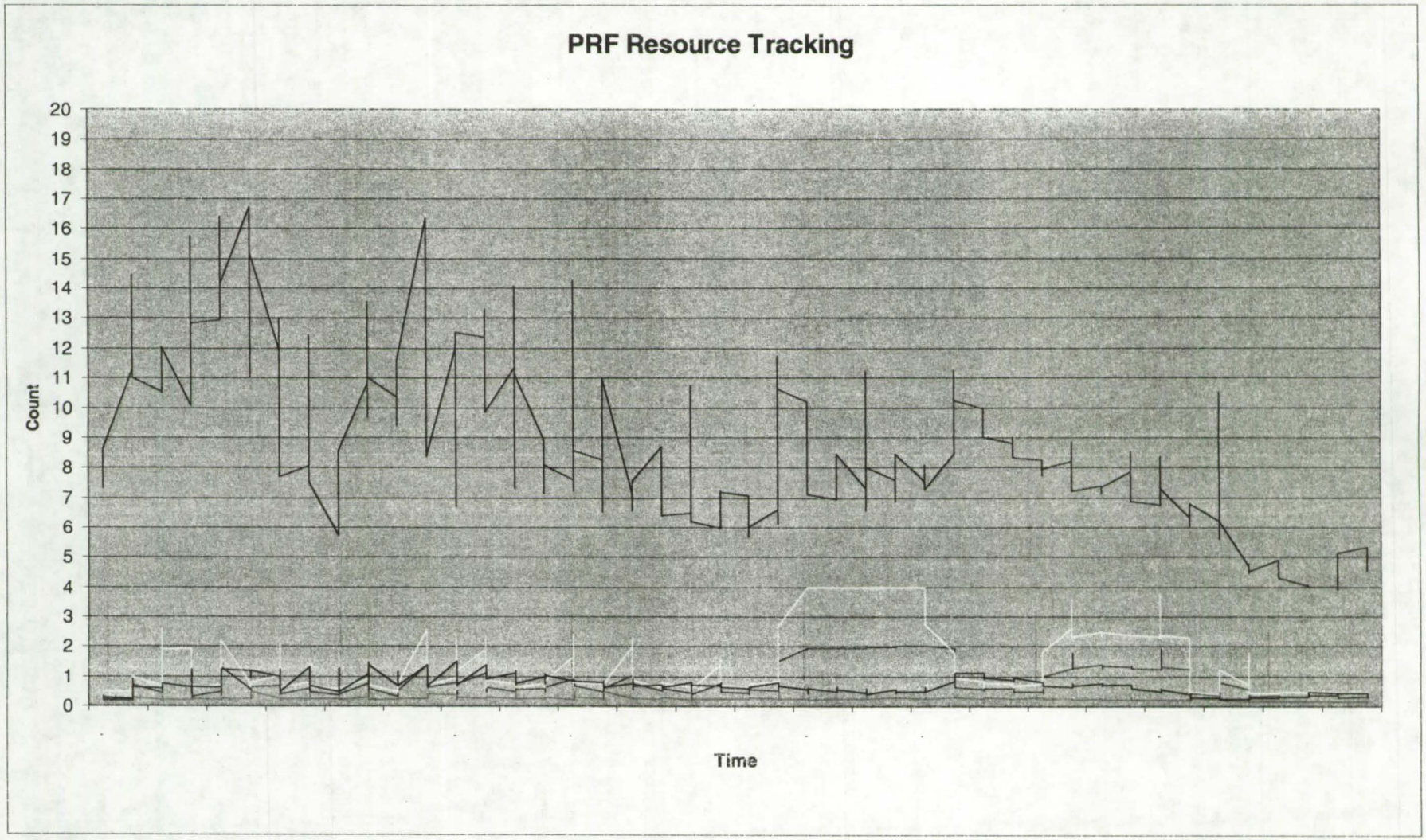
# Average Resource Utilization Over Time



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# How Did We Do That: Resource Tracking

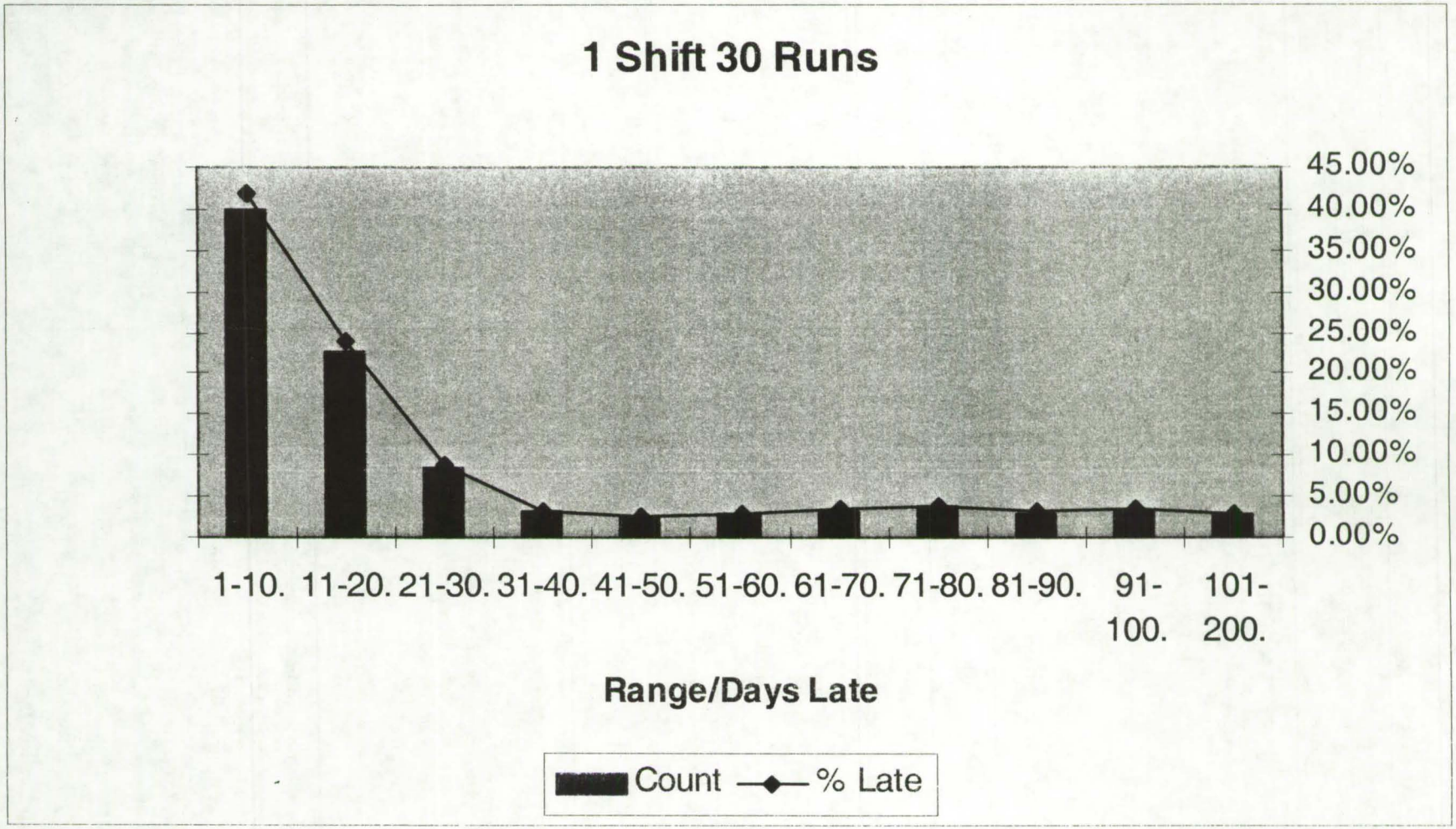
- **Ken Davis / ProModel Consultant**
  - **Built (see backup charts)**
    - Subroutine "Resource Tracking"
    - Activate in Initialization Logic
    - Array Export into Excel

# Sample Data Sheet

Scheduled Delivery Date | Actual Delivery Date | Days Late Early

| Rep# | BI Number | Hardware | Schedule Delivery Date | | | Actual Delivery Date | Early/Late Count |
|---|---|---|---|---|---|---|---|
| 1 | 2 | e_prf_LeftDroguePilot | 6 | 30 | 2007 | 05/10/2007 | 2.00 |
| 1 | 2 | e_prf_RightDrogueChutePack | 5 | 15 | 2007 | 08/05/2007 | -10.00 |
| 1 | 2 | e_prf_RightDroguePilot | 6 | 4 | 2007 | 05/10/2007 | -5.00 |
| 1 | 2 | e_prf_ClusterAssemblyLeft | 6 | 18 | 2007 | 05/17/2007 | -32.00 |
| 1 | 3 | e_prf_RiserSubAssMCPacks4 | 6 | 18 | 2007 | 05/21/2007 | -28.00 |
| 1 | 3 | e_prf_RightMain4 | 6 | 18 | 2007 | 05/21/2007 | -12.00 |
| 1 | 3 | e_prf_MainBag4 | 6 | 18 | 2007 | 05/21/2007 | -28.00 |
| 1 | 3 | e_prf_RiserSubAssMCPacks6 | 6 | 18 | 2007 | 06/06/2007 | -12.00 |
| 1 | 3 | e_prf_MainBag6 | 6 | 18 | 2007 | 06/06/2007 | -12.00 |
| 1 | 3 | e_prf_RightMain6 | 6 | 18 | 2007 | 06/11/2007 | -7.00 |
| 1 | 3 | e_prf_RiserSubAssMCPacks5 | 6 | 18 | 2007 | 06/12/2007 | -6.00 |
| 1 | 3 | e_prf_MainBag5 | 5 | 18 | 2007 | 06/12/2007 | 5.00 |
| 1 | 23 | FabPilot | 7 | 18 | 2007 | 06/20/2007 | -14.00 |
| 1 | 5 | e_prf_OrbiterDragChute | 8 | 15 | 2007 | 06/22/2007 | 3.00 |
| 1 | 5 | e_prf_RightMain5 | 6 | 18 | 2007 | 06/22/2007 | 1.00 |
| 1 | 1 | FabPilotBag | 7 | 6 | 2007 | 06/22/2007 | -4.00 |
| 1 | 1 | FabRecoveryBag | 7 | 6 | 2007 | 06/26/2007 | -2.00 |
| 1 | 3 | e_prf_ClusterAssemblyRight | 9 | 22 | 2007 | 06/26/2007 | 2.00 |
| 1 | 1 | FabPilotBridles | 6 | 28 | 2007 | 06/27/2007 | -1.00 |
| 1 | 1 | FabRecoveryBridles | 6 | 29 | 2007 | 06/28/2007 | -1.00 |
| 1 | 3 | e_prf_LeftPilot | 6 | 15 | 2007 | 06/29/2007 | 14.00 |
| 1 | 3 | e_prf_DrogueBag | 6 | 30 | 2007 | 07/04/2007 | 4.00 |
| 1 | 3 | e_prf_LeftDroguePilot | 11 | 9 | 2007 | 07/04/2007 | -6.00 |
| 1 | 1 | PackProgrammer | 7 | 13 | 2007 | 07/11/2007 | -2.00 |
| 1 | 1 | PackPilot | 8 | 13 | 2007 | 10/12/2007 | 60.00 |
| 1 | 1 | PackRecovery | 7 | 13 | 2007 | 07/13/2007 | 0.00 |
| 1 | 3 | e_prf_RightPilot | 12 | 12 | 2007 | 08/13/2007 | -121.00 |
| 1 | 1 | RiggingForTest | 7 | 27 | 2007 | 08/13/2007 | -5.00 |
| 1 | 3 | e_prf_RightDrogueChutePack | 7 | 20 | 2007 | 08/13/2007 | 24.00 |
| 1 | 3 | e_prf_DrogueBag | 12 | 30 | 2007 | 07/18/2007 | 15.00 |
| 1 | 3 | e_prf_RightDroguePilot | 7 | 20 | 2007 | 07/19/2007 | -1.00 |

# Range/Count for Days Late



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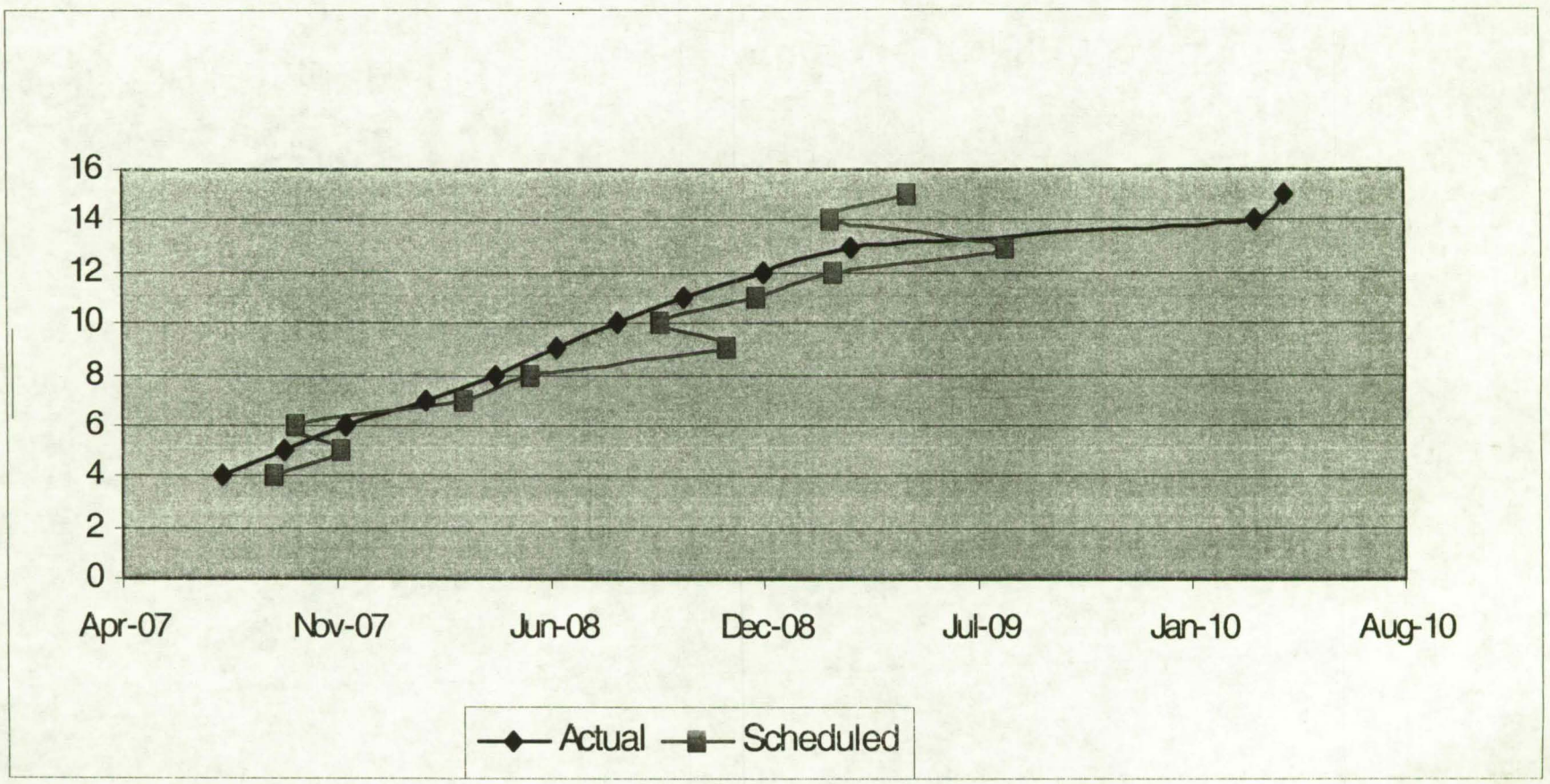
# Actual vs. Scheduled Delivery Dates



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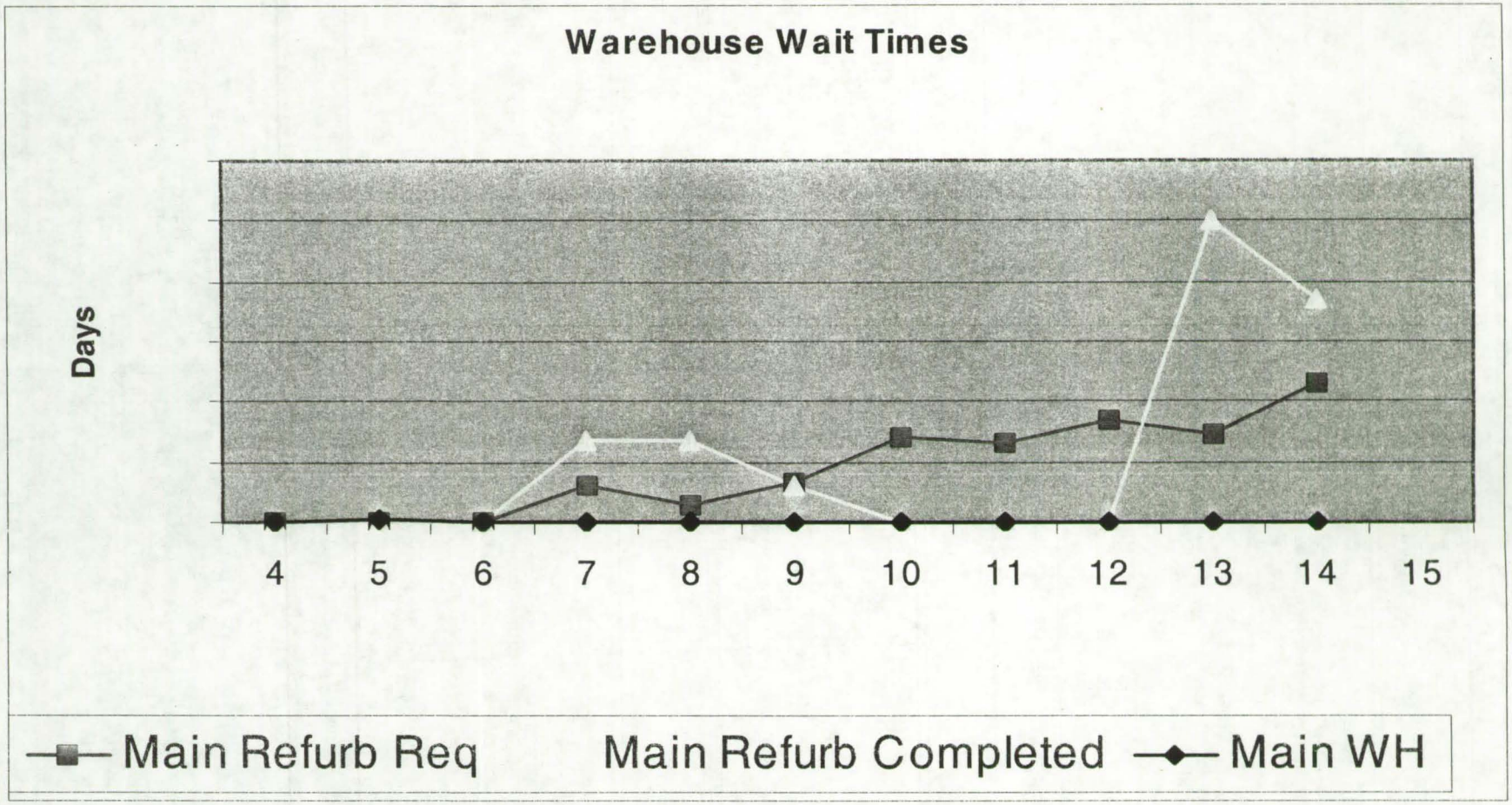
# Warehouse Wait Times



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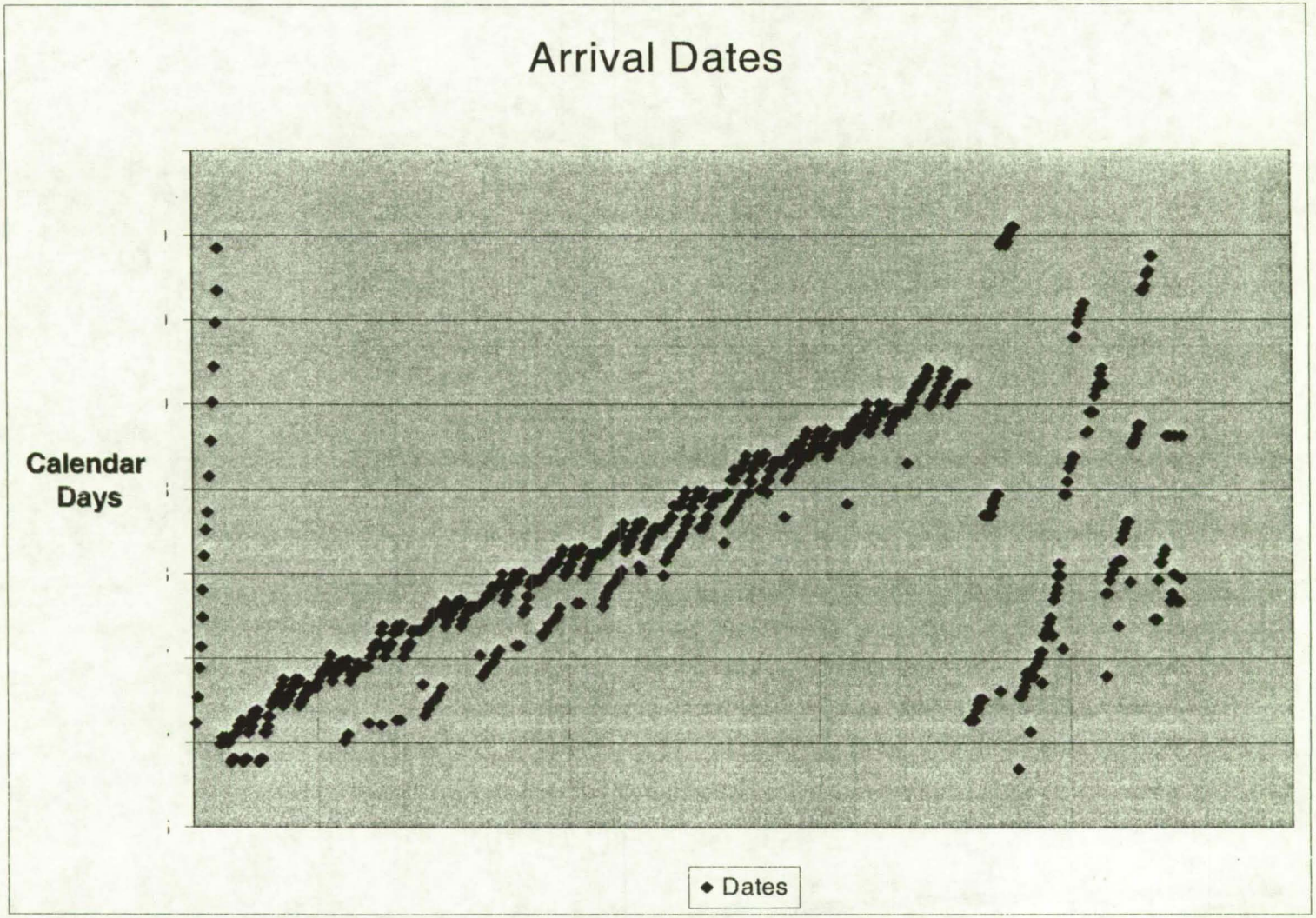
# Scatter Plot: Arrival Dates



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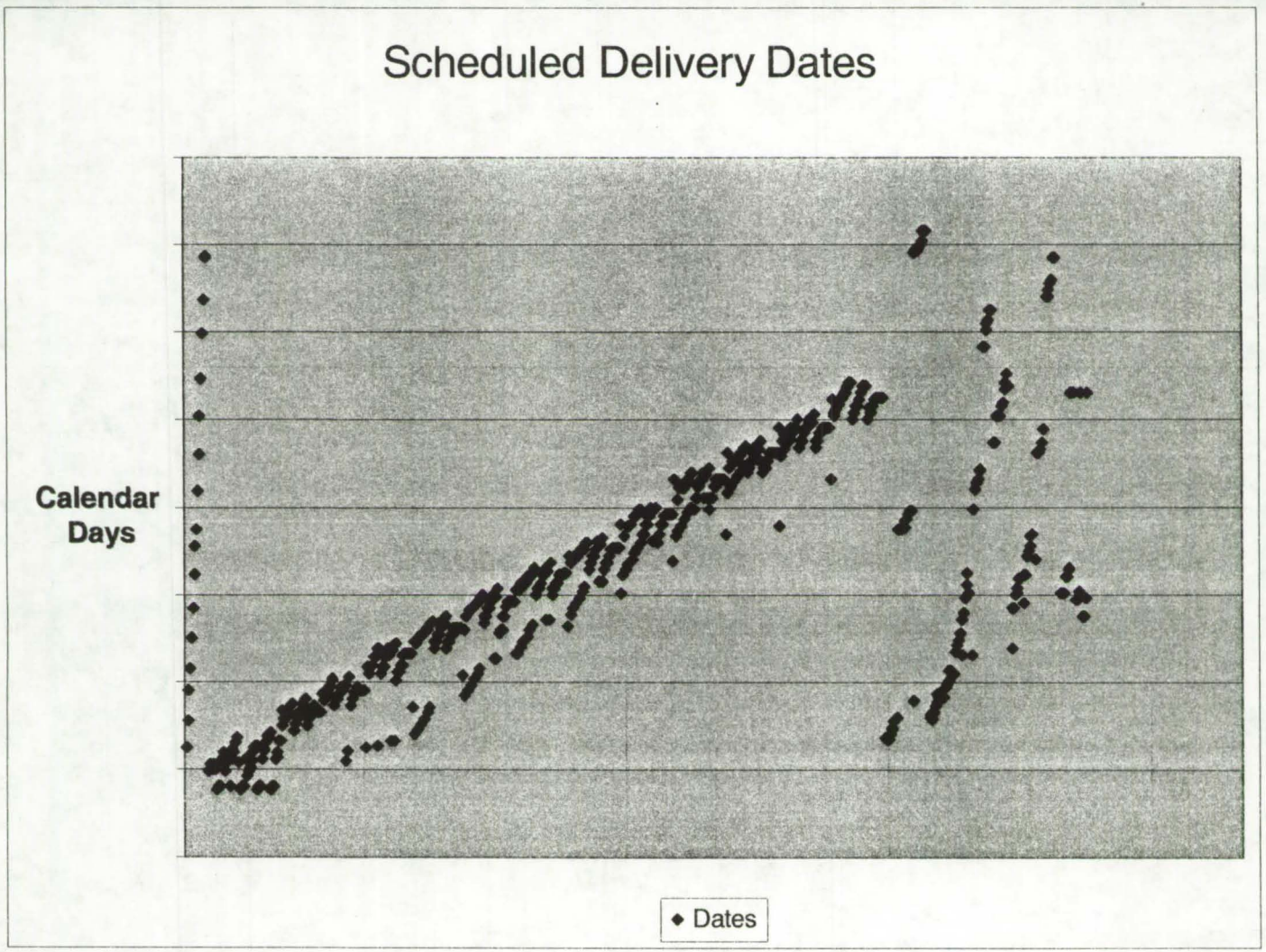
# Scatter Plot: Scheduled Delivery Dates



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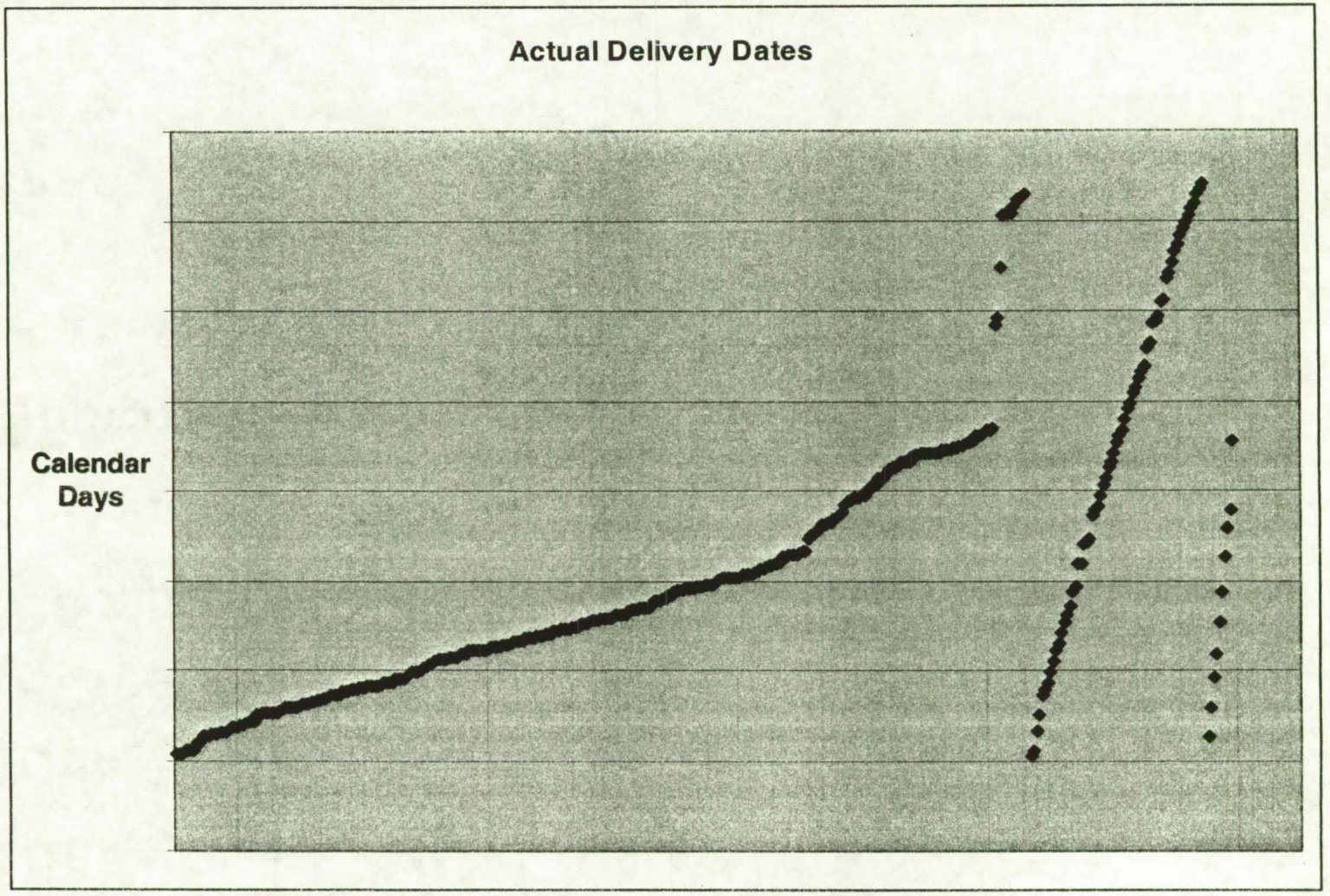
# Scatter Plot: Actual Delivery Dates



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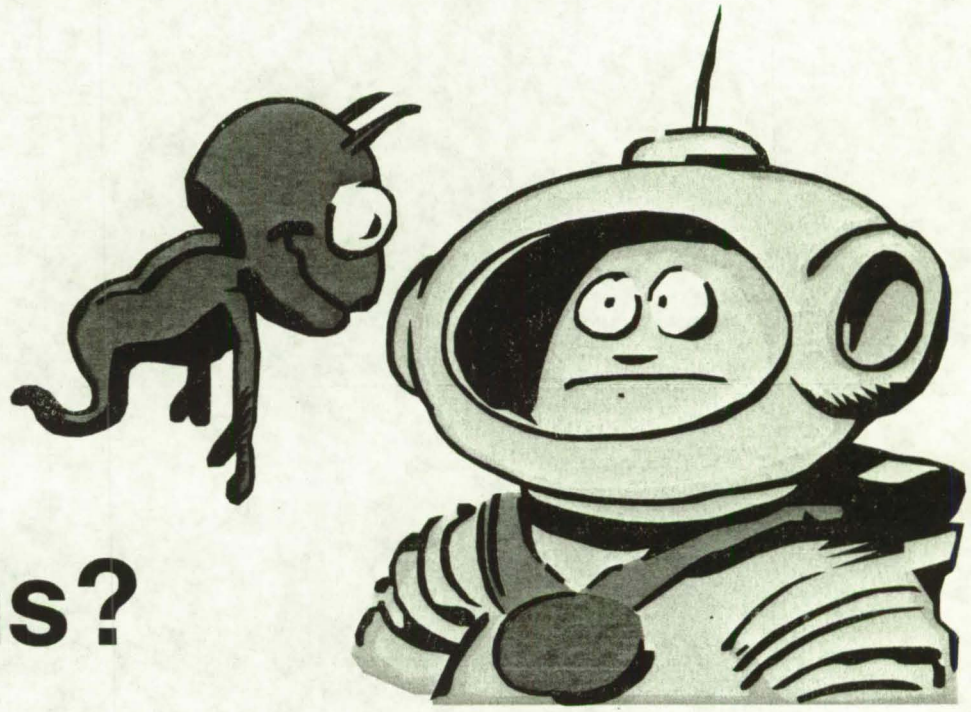
# Lessons Learned

- Utilize pre-existing models
- Utilize tools (ProActiveX, VBA, etc.) whenever possible
- Became overwhelmed with data
  - Figure out which ones tell the story best
- Important to review model/data with team frequently
- Paramount that others have confidence in model



# Questions?

# Comments?

# THANK YOU!

# Backup Charts

# Subroutine Resource Tracking

```
INT lv_TimeSliceHourly=0
INT lv_TimeSliceWeekly=y_ResourceTracking_Ave[1,15]
INT lv_PCTechBusyCount=0
INT lv_WeeklyHRCount=0
INT lv_RowInRepWeekly = 0
GOTO L1  #Model start up at 6:00am

Again:
WAIT 1 HR
L1:

IF CalDay() = 6 or CalDay() = 7 THEN GOTO Again     #Skipping Weekends from Timeslice Data
    IF CalHour() <= 5 THEN GOTO Again               #Skip mornings
    IF CalHour() >= 14 THEN GOTO Again              #Skip evenings for 1 shift operations
    INC lv_TimeSliceHourly
    INC lv_WeeklyHRCount
```

Go Back



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# Subroutine Resource Tracking

```
y_ResourceTracking1[lv_TimeSliceHourly,3]=Units(r_prf_ParachuteCompTech)-
    FreeUnits(r_prf_ParachuteCompTech)
    INC lv_PCTechBusyCount,Units(r_prf_ParachuteCompTech)-
    FreeUnits(r_prf_ParachuteCompTech)
IF lv_WeeklyHRCount=40 Then
    {
    INC lv_TimeSliceWeekly
    INC lv_RowInRepWeekly
    y_ResourceTracking_Ave[lv_TimeSliceWeekly,3]= lv_PCTechBusyCount/lv_WeeklyHRCount)
    y_ResourceTracking_Ave[lv_TimeSliceWeekly,13]= GETReplicationNum()
    y_ResourceTracking_Ave[lv_TimeSliceWeekly,14]= lv_RowInRepWeekly
    y_ResourceTracking_Ave[1,15]= lv_TimeSliceWeekly

lv_PCTechBusyCount=0
lv_WeeklyHRCount=0
    }
GOTO Again
```

Go Back

# Initialization Logic

```
If m_ActivateResourceTracking = 1 Then
        ACTIVATE s_ResourceTracking1Shift  #1 Shift
Else If m_ActivateResourceTracking = 2 Then
        ACTIVATE s_ResourceTracking2Shift  #2 Shifts
Else If m_ActivateResourceTracking = 3 Then
        ACTIVATE s_ResourceTracking1Shiftplus3  #1 Shift
+ 3Hrs OT
```

Go Back

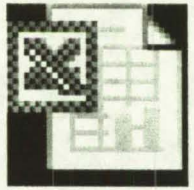
# Array/Excel

ProModel - prf 5.2 Scenario1.MOD (PRF Model)

File Edit View Build Simulation Output Tools Window Help

Arrays

| ID | mensio | Type | port File. | port File. | Disable | Persist | Notes... |
|---|---|---|---|---|---|---|---|
| y_ResourceTracking | 20000, | Inte | | Resource Tr | None | Clear | 1 Shift |
| y_ResourceTracking | 20000, | Inte | | Resource Tr | Export | Clear | 2 Shift: |
| y_ResourceTracking | 20000, | Inte | | Resource Tr | Export | Clear | 1+3 Shi: |
| y_ResourceTracking | 6000, | Real | | Resource Tr | None | Keep | 1 Shift |
| y_ResourceTracking | 6000, | Real | | Resource Tr | Export | Keep | 2 Shift: |
| y_ResourceTracking | 6000, | Real | | Resource Tr | Export | Keep | 1+3 Shi: |



Microsoft Excel Worksheet

Go Back



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