Clockwork Solutions, Inc. (CSI)

SPAR Technologies

Discrete Event Modeling and Simulation

For "Sustainment" Mission Performance Prediction and Life Cycle Risk Assessment

23 October 2006

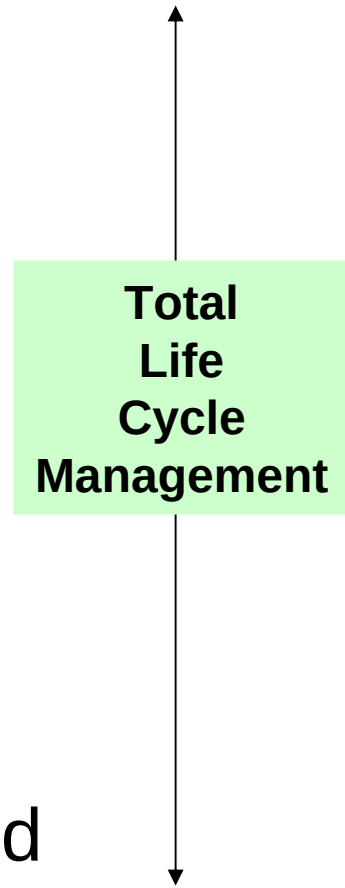
Clockwork Solutions, Inc.

Corporate Mission Statement

Provide reliability centered, ***Performance Prediction and Risk Management Solutions*** to assist defense and industry in making intelligent supportability decisions that will result in minimizing asset downtime, loss of production and inefficient use of associated support resources.

Levels of Decision Support

- Strategic
  - Fleet Assessments
  - Assumed or **Measured** Initial State
- Tactical
  - Component and Fleet Assessments
  - Assumed or **Measured** Initial State
- Operational
  - Individual Asset Assessments
  - Near Real-Time Initial State Required



Total Life Cycle Systems Management and Performance-Based Logistics

Top Level Metrics Include:

- Operational Availability
- Operational Reliability
- Cost per Unit Usage
- Logistics Footprint
- Logistics Response Time

USD(AT&L)) Memorandum
16 August 2004

- Product Support Boundaries:
  - Operational Concepts
  - Logistics Support
  - Engineering
  - Asset Management
  - Materiel Flow
  - Industry & Innovation
  - Integrated Knowledge Enterprise
  - People and Training
  - Reduction in Total Ownership Cost
  - Resource Management
  - Environment and Safety

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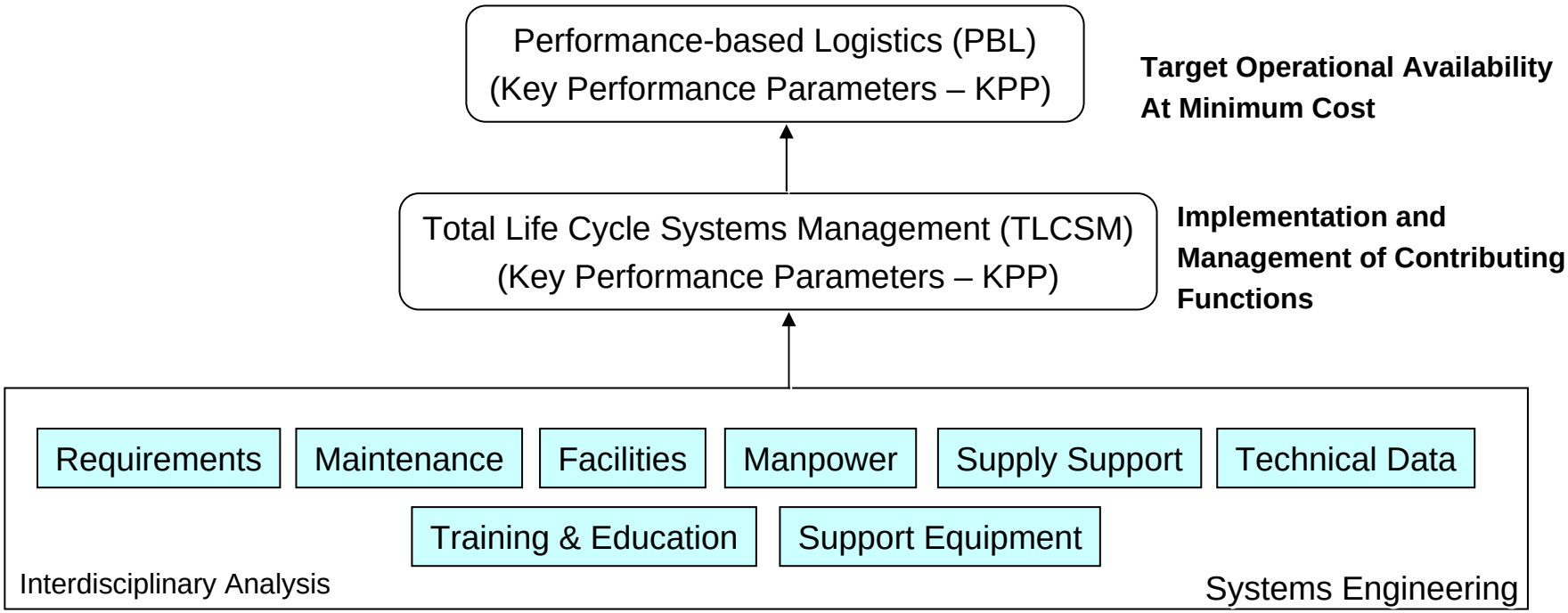
Systems Engineering Management



We must test, assess and monitor the systems engineering process, throughout the life-cycle, to evaluate and predict TLCSM and PBL KPP's. (Continuous Risk Management)

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Systems Engineering is a MUST

Systems engineering is an interdisciplinary approach encompassing the entire technical effort to ***evolve and verify*** an integrated and total Lifecycle ***balanced set of system, people, and process solutions*** that **satisfy customer needs**.

Systems engineering is the ***integrating mechanism*** across the technical efforts related to the development, manufacturing, verification, deployment, operations, support, disposal of, and user training for systems and their life cycle processes.

System engineering ***develops technical information*** to support the program management decision-making process. For example, systems engineers manage and control the definition and management of the system configuration and the translation of the system definition into work breakdown structures.

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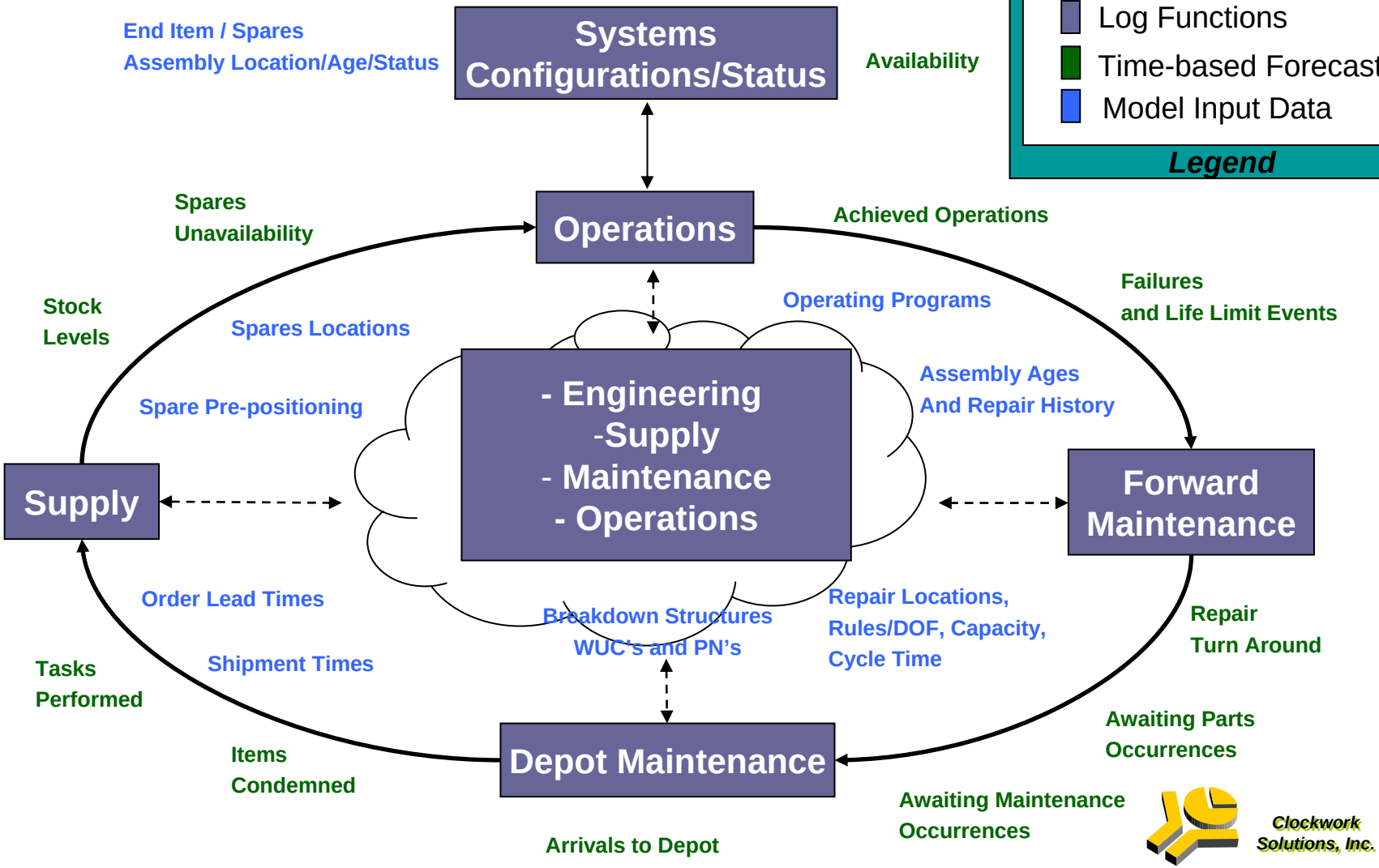
Information Source: Acquisition Community Connection, Defense Acquisition University.

SPAR Technology

- Integrates Systems Engineering Components into a Cause and Effect Prediction Tool
- Integrated R-A-M-S Modeling Platform
  - Reliability Model - System Reliability Block Diagrams
  - Maintenance Model - Repair Concept
  - Supportability Model - People, Parts, Equipment
  - Availability Model - Integration of the RMS Components
- Discrete Event Simulation Foundation
  - Applied to Solve Otherwise Computationally Intractable Sets of Equations (Monte Carlo)
  - Supports Time and Condition Based Events
  - User Defined Event/Consequence Logic
  - Provides Life Cycle Snapshots into System Ao, MTBF, MTTR and Costs throughout Periods of Simulation

Life Cycle Forecasting - Closed Loop Simulation



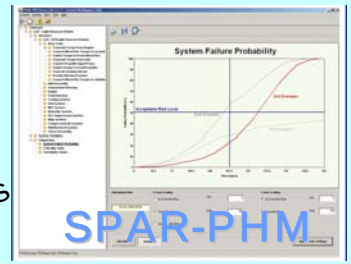
Simulation Technology Components

Tactical Predictions

•SRU/LRU Reliability Assessments
•Logic/Rule Assessments

Rules and Reliability

Operational Predictions



Reliability Adjustments

• Asset/Component/Failure Mode/ Specific
• Risk of Fault at Future Time t
• Criticality and Sensitivity

Component Predictions

Fleet Predictions

Tactical and Strategic Predictions

Ops Status →
Config. Status →
Repair Status →
Stock Status →
Program Status →

→

•Operational Availability
•Operational Reliability
•Cost per Unit Usage
•Logistics Footprint
•Logistics Response Time

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ATLAST Software - Functional Capabilities

a) Functional for Platform, LRU's, Modules and Parts

b) Model inventory and variations (increases and decreases)

c) Incorporates operations inputs and variations

d) Incorporates repair schedules

e) Models incorporation of 'improvements' to LRU's

f) Models reliability changes with age

g) Models reliability effects for improvement incorporations

h) Applies linear and non-linear relationships

i) Accepts data entry by removal cause, failure category

j) Allows data entry to be grouped together or broken into greater fidelity as necessary

k) Outputs results by year/qtr

l) Generates confidence limits/bands around the out-year projections

m) Accepts maintenance and support cost elements as inputs: labor, consumables, and reparables by maintenance level, inflation factors

n) Outputs cost by individual elements

o) Allows the analysis to document assumptions and inputs within the tool

p) Results are repeatable and auditable

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Resulting Decision Support

- **Metric-based Optimization**
  - Deployment Spares
  - Sparing Acquisition Schedule (Buy Plan)
  - Multi-Echelon Spares Positioning
  - Maintenance Resource Plan
  - Work Order Generation
- **Programs Requiring Decision Support**
  - Operations and Program Management in General
  - Reset
  - Recap
  - Modernization
  - PBL

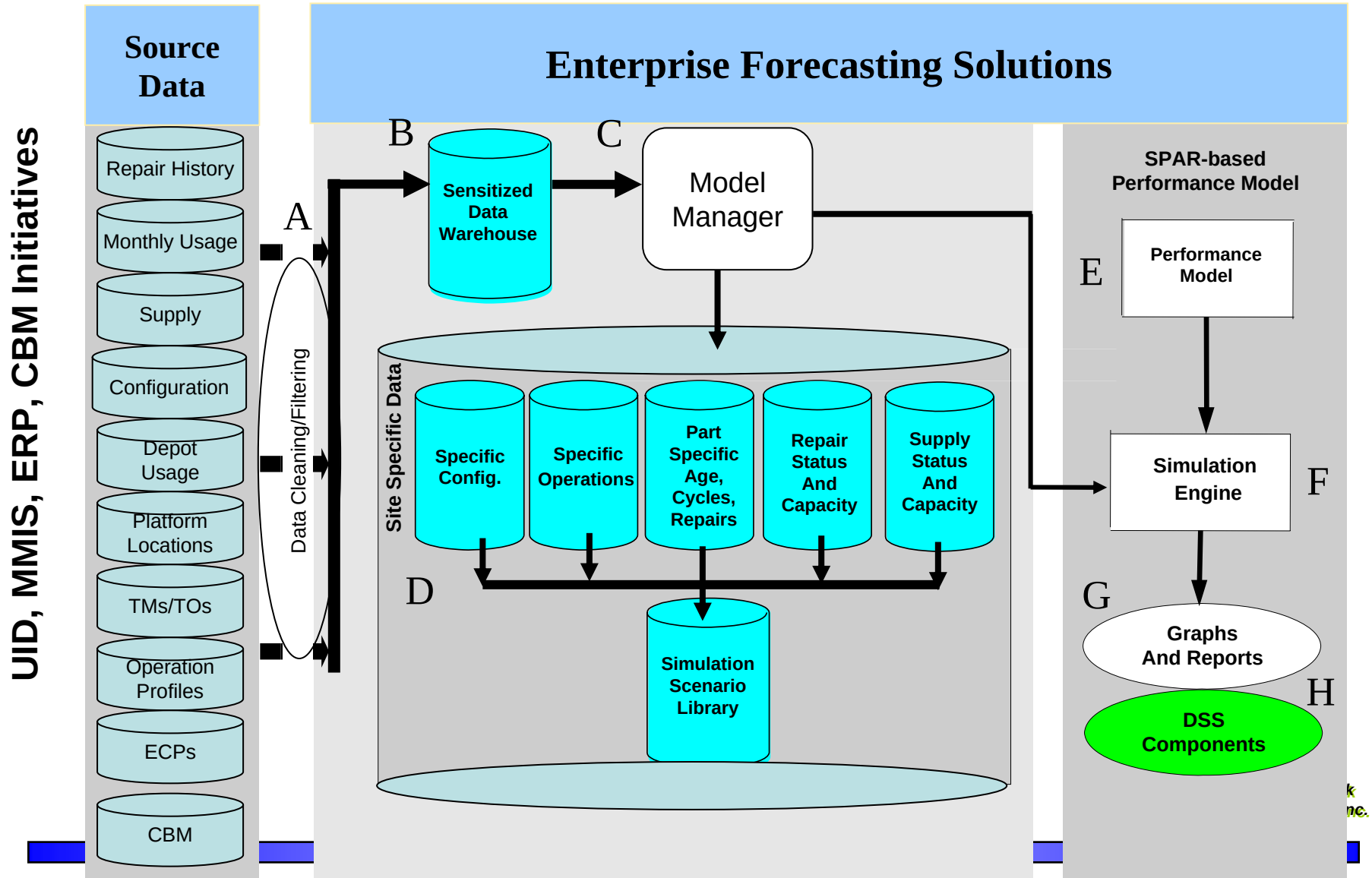
Questions Requiring Answers

- Will the fleet, or assets at some operating location, achieve required operating programs**?**
- Will the spares buy plan be suitable to maintain expected and target fleet availability**?**
- What will the parts requirements be**?**
- How will improvements in repair capacity impact repair turn around times**?**
- Where will the repair and supply bottlenecks be**?**
- What can I expect to have in the repair pipeline due to removals**?**
- What volume of part condemnations will occur and where**?**

Questions Requiring Answers

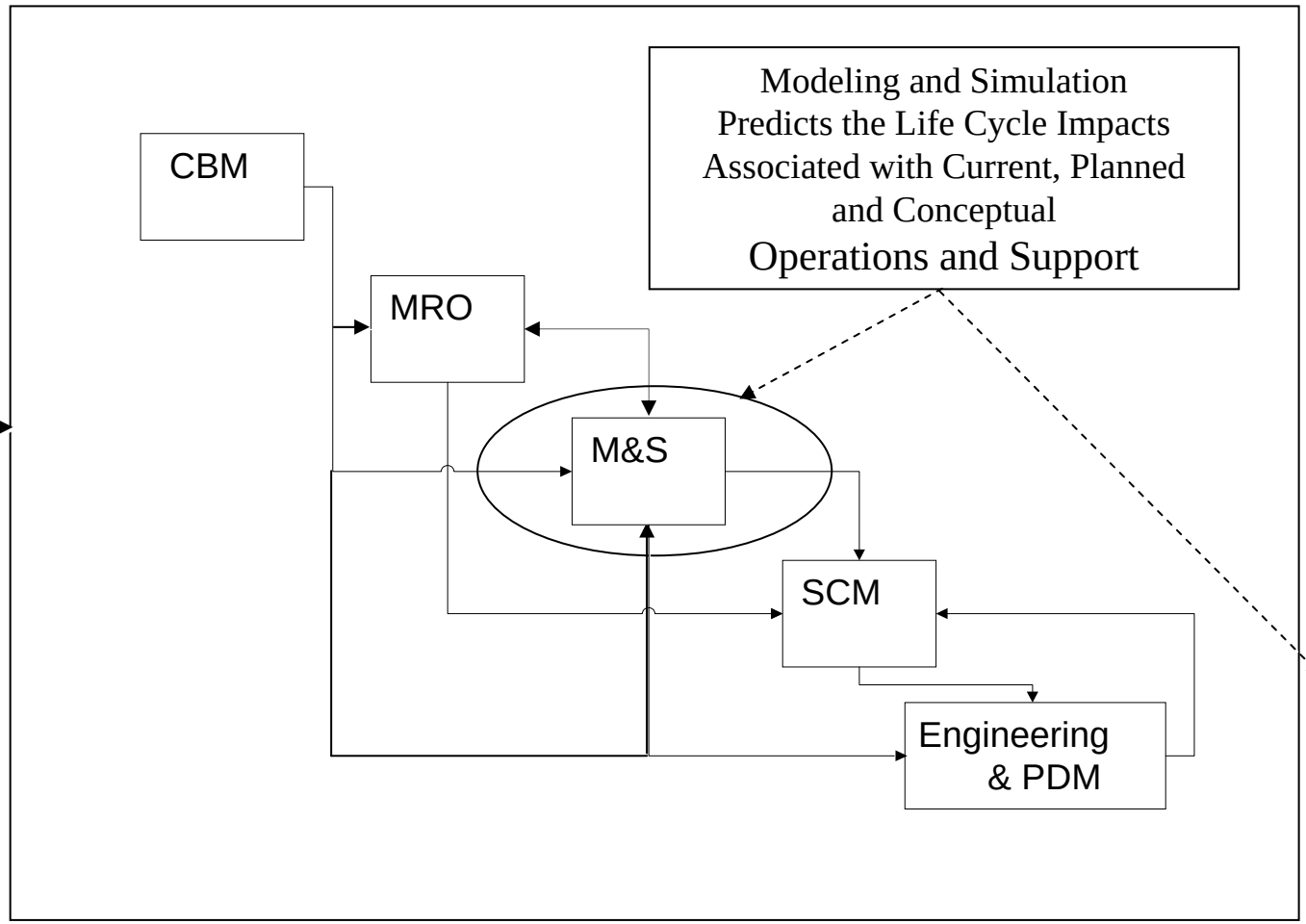
- Will a repair location be able to keep up with the demands anticipated**?**
- What percent of time will repair held up due to awaiting parts or awaiting maintenance conditions**?**
- What performance gain (fleet availability, time on wing, repair turn around time, etc.) is obtained through selection of an alternate part, with respect to part and vendor attributes such as order lead-time, ship time, purchase cost, and reliability**?**
- If fatigue-testing results in modified life limits on a part type, how will that change affect maintenance and supply volume**?**
- I have a limited budget, how should/could I spend it across supply and maintenance functions to maximize fleet availability**?**

Pulling the Data Together



Technology/Process Enablers

(In Support of Effective Maintenance Management)



Business Objectives

Cost / Profit

Availability

Reliability

Cycle Time

Products

Asset Diagnostics

Asset Prognostics

Work Orders

Asset Scheduling and Tracking

Resource Optimization

Requisitions

Order Fulfillment & Tracking

ECPs

Periodic LC Risk Assessments for Key Business Objectives

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