Computer Simulation of Laboratory Processes

Daniel J. Fink, M.D., M.P.H.

Director, Core Laboratory
New York-Presbyterian Hospital
Columbia Presbyterian Medical Center
Associate Professor of Clinical Pathology
Columbia University

Orlando, FL
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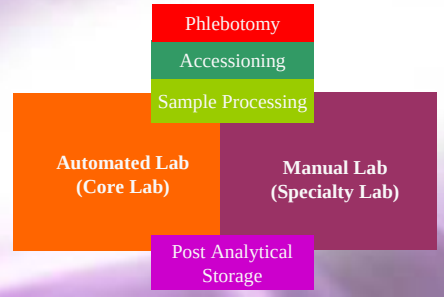
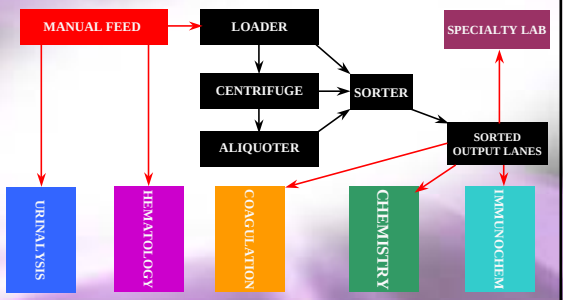
Core Laboratory Project (1997-1998) Planning Criteria

- Cost Reduction
- Major Reorganization
- Real Time Testing
- Simplify Processes
- Increase Automation
- Reduce Number of Workstations

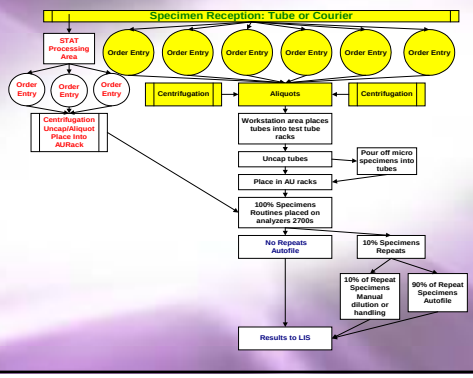
Conceptual Design



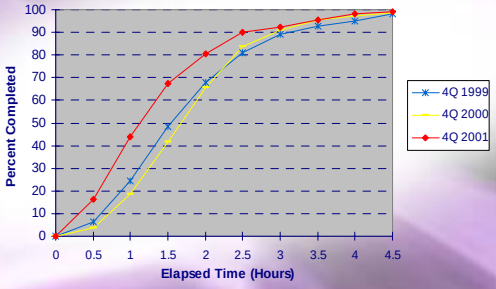
Specimen Flow Concept



Workflow Diagram



Basic Metabolic Profile Turnaround Time for Morning Specimens



Why are Physicians Complaining? Turnaround Time

- Average Registration Time 45 minutes
- Average Processing Time 45 minutes
- Average Analytical Time 30 minutes

- Average Turnaround Time 2 Hours
- 90% Turnaround Time 3 Hours

- Variance Unpredictable

Sources of Variance

- Staffing varies between and within day
- Differing staff performance
- Peak loads vary from day to day
- Large outpatient drop-offs
- Analyzer maintenance and malfunctions
- Rerun time
- Wait states
- Batching and batch size

LABMODEL™

LABORATORY WORKFLOW SIMULATION SOFTWARE

The Olympus Solution for Predictive Analysis

Goals of LabModel™ Project

- Create a simulation model of the laboratory
- Measure and report key operational parameters
- Demonstrate the reliability of the model by comparing to current process parameters
- Use the model to assess projected changes in staffing, equipment, processes

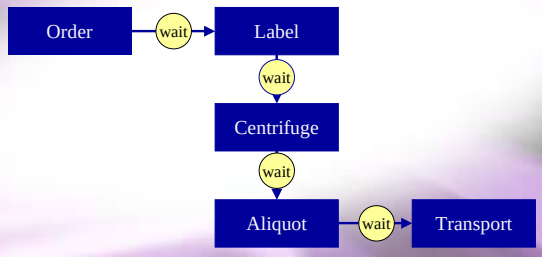
Resources

- Financial and logistical support from Olympus
- ProModel Software
- ProModel Consulting to create model
- Laboratory and Olympus staff to measure process parameters
- Equipment performance parameters

LabModel™ Contributors

- **Terry Giacomo**
- **Hiro Sekiya**
- **Chris White, PhD**
- **Deb McIntyre**
- **Kemper Taubel**
- **Wynn Blieberg**
- **Daniel Fink, MD, MPH**
- **Dale Schroyer**
- **Thomas Sodeman, MD**
- **Ronald Keelen, MBA**

Pre-analytical Workflow



Process Understanding

Level 1 – Initial Processes
Level 2 – Repeatable Processes
Level 3 – Defined Processes
Level 4 – Measured Processes
Level 5 – Optimized Processes

Automating Business Processing Reengineering
Gregory Hansen

Level 1 - Initial Processes

- Ad Hoc, chaotic, not fully documented
- Most common type of process
- Processes that have evolved over time
- Quality varies from day to day
- Inspection at the end of process
- Little communication among participants

Level 2 - Repeatable Processes

- Informal design with predictable results
- Stable output and quality
- Primary mechanism for improvement is improving communication
- Shift from technical to managerial issues
- Documentation of tasks is written and complete

Level 3 - Defined Processes

- Process defined with standardized results
- Migrating from Level 2 to Level 3 requires an understanding of the global process
- Activity diagramming or other diagramming techniques are used to describe a global view of the process
- Parallelism is represented accurately
- All details of a process have been described

Level 4 - Measured Processes

- The parameters that describe the behavior of the process are defined and measured
- Process models are based on the information gathered in Levels 1 to 3
- The parameters of the process models are based on the measurements made to reach Level 4

Level 5 - Optimized Processes

- Processes that have been “improved” by feedback of knowledge and measurements
- An archetypical process model is created to test new assumptions or fine tune a process
- CAPRE is effective in predicting the results of changes to a process; a cost effective alternative to pilot programs

Rules of Process Re-Engineering

1. Communicate and Increase Awareness
2. Document the Process Tasks
3. Diagram the Whole Process
4. Measure the Process
5. Simulate the Process

Automating Business Processing Reengineering
Gregory Hansen

Simulation – Predictive Analysis

Discrete Event Simulation takes into account the combined effects of ***variability***, ***uncertainty***, and ***complex interdependencies*** between events in ***compressed time***.

- Workload
- Resources
- Capacity
- Schedule
- Cost

When to Simulate?

- The actual process may not exist
- The process is too complex to analyze on paper
- The actual system cannot be physically disrupted
- Past decisions based on "gut feelings" or utilizing static workflow analysis did not work
- To project the impact of potential changes in the future. (Increase volume, variations in test types, addition of automation)

Simulation Enables Organizations To Quickly Evaluate alternative “What ifs” without the risk

Simulation can Help Answer the Following Questions

- Where are the bottlenecks?
- What is the impact of staffing changes?
- What is the impact of different equipment configurations?
- What will be the turnaround time?
- What will be the cost?

Why Simulate…
Static Analysis Falls Short

- **Flowcharting**
  - Helps describe processes and workflow
  - Shows relationships of activities and resources
  - Does not provide quantitative analysis
- **Spreadsheet Analysis**
  - Static, no change with respect to time
  - Deterministic, constant values, does not reflect variability
  - No interdependencies, process steps are independent

Limitations of Continuous Process Improvement

Over the last 10 years, clinical labs have focused on Continuous Process Improvement
…..stepwise improvement without predictive tools

- Labor Intensive
- Time Intensive
- Static Visualization
- Requires Implementation to Measure Improvement
- Necessitates Investment in a Pilot Project
- Pilot Project conditions may not match real conditions

What is the *VALUE* of the Olympus LabModel™ Simulation Software

Olympus Simulation LabModel Represents
True Workflow with Olympus or Other Offerings

Sample Volumes
Staffing Levels
Automation Details
Maintenance Rules

Turnaround Time
Staffing Utilization
Efficiency
Bottlenecks

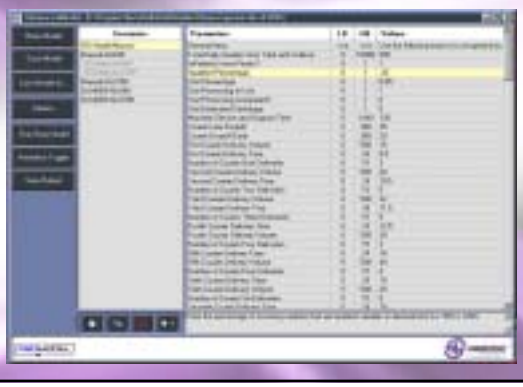
Olympus LabModel™ Accounts for:

- Workstation Configuration
- Equipment Capabilities
- Labor Requirements
- Throughput
- Routine Maintenance
- Mean Time Between Failure
- "Non-Productive Uptime"
- Variation in Specimen Volume
- Variation in Specimen Arrival Time
- Variation in Specimen Types
- Variation in Processing Rates
- Internal Lab Routing Policy
- Lab Result Review Policy
- Level of Automation

LabModel™ Tools

- Scenarios
- Parameter Setting
- Visual Layout
- Output Reports
- Output Graphics
- Export Data
- Financial Reports

Scenarios and Parameter Settings



LabModel™ Visual Layout

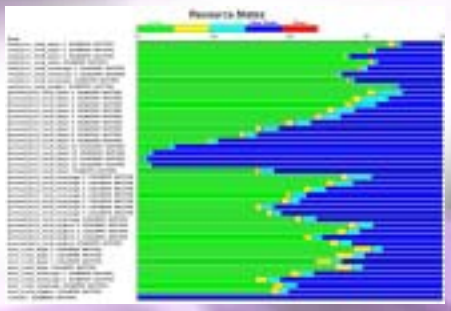
- Model potential solutions in a virtual lab environment simulating all the variables
- Predict the benefits of process improvement before risking the hospital's funds
- Optimization: Maximize throughput, minimize cost

LabModel™ Output

- Quantified results
- Clear Concise reports

LabModel™ Features

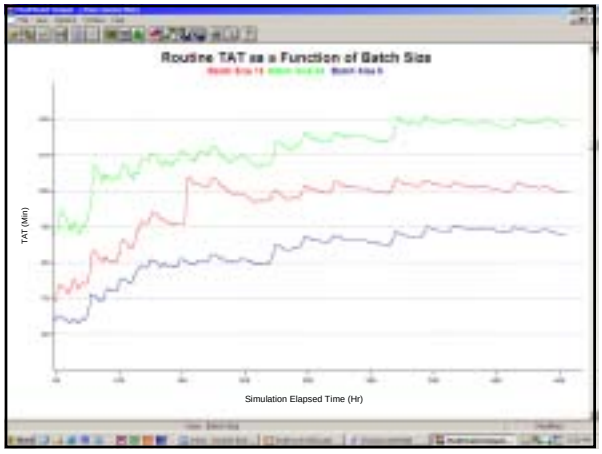
- Reduce lab processes to activity-level building blocks where resource utilization can be identified and evaluated
- Measure the hidden costs of "unproductive" activities

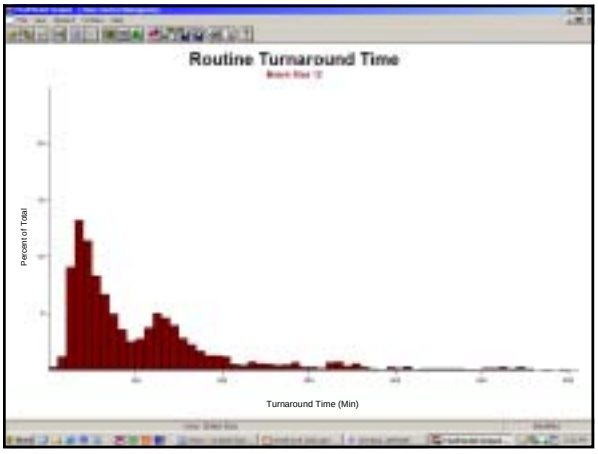


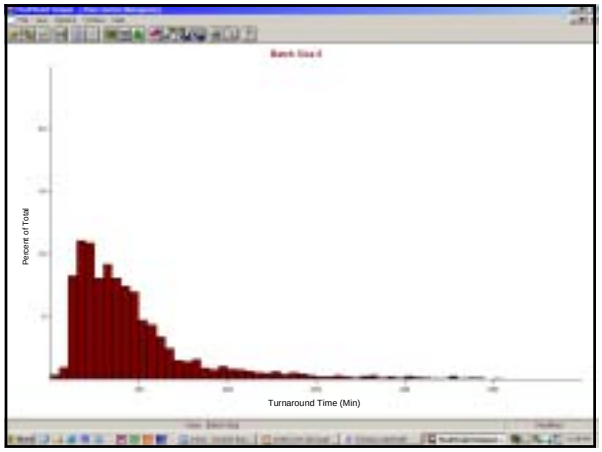
Application of LabModel™ Simulation to Typical Laboratory Questions

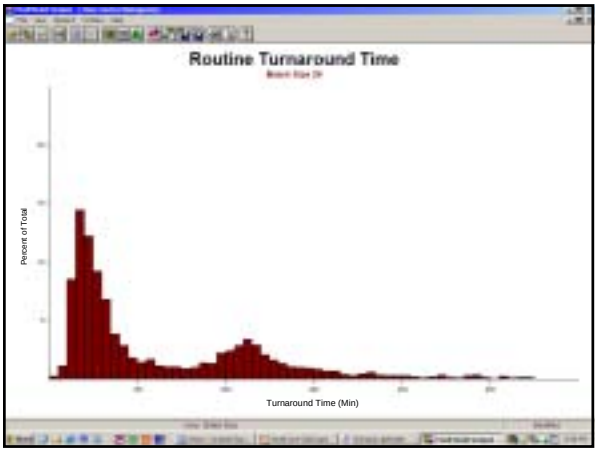
- Workflow Changes
- Staffing Assessment
- Impact of equipment changes and automation

Workflow Changes

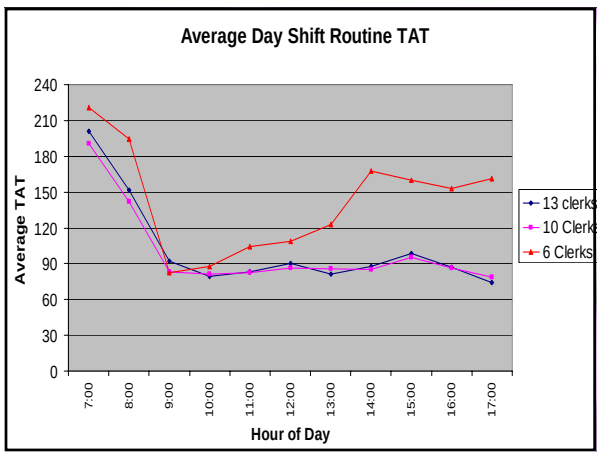


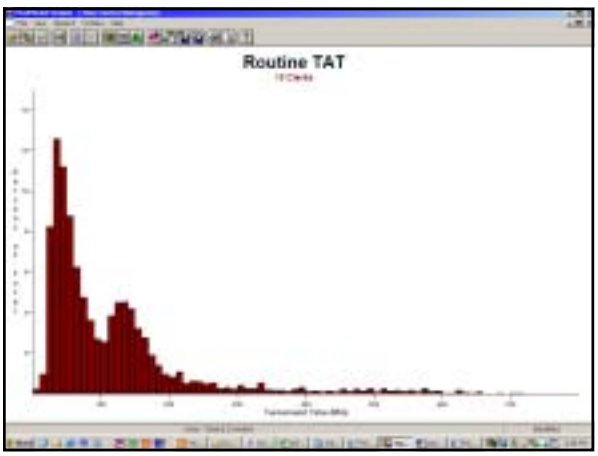


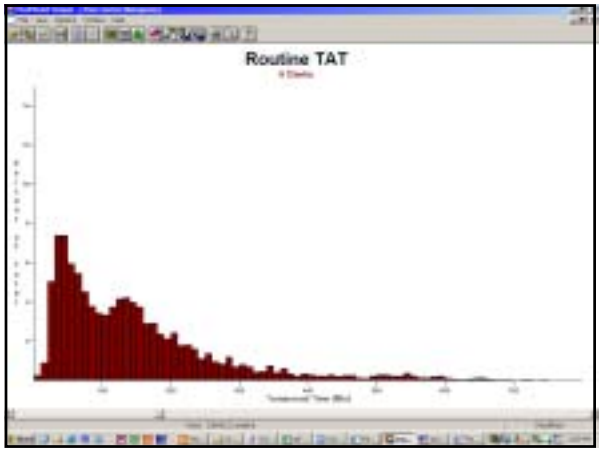


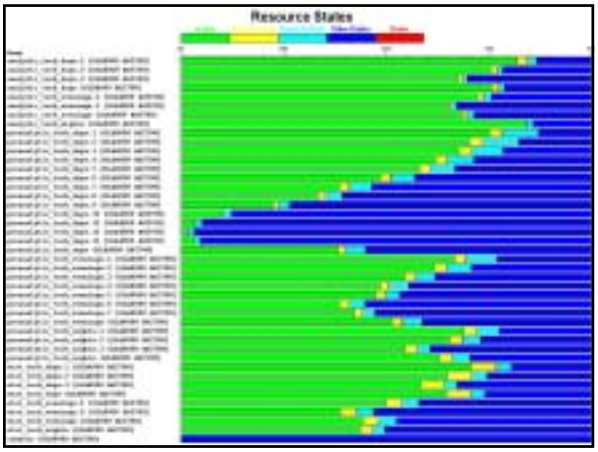


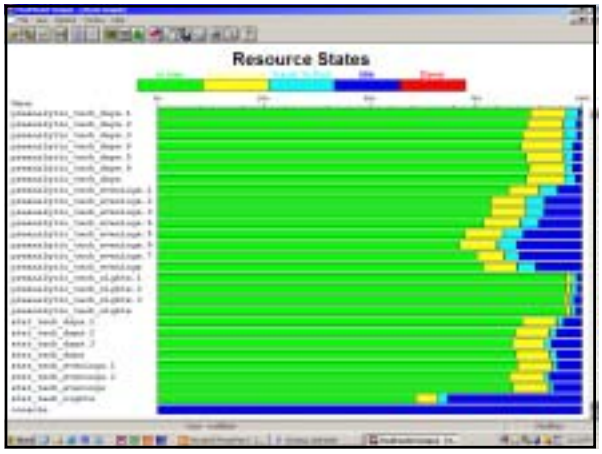
Staffing Assessment





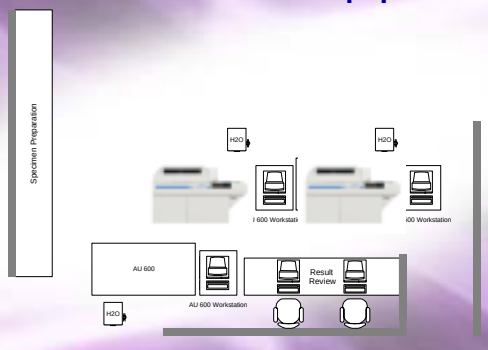




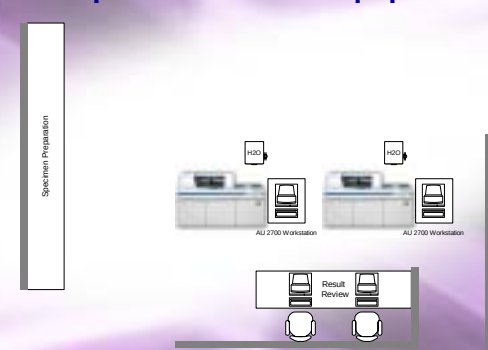


Equipment Selection

Current Core Lab Equipment



Proposed Core Lab Equipment



Olympus Throughput Comparisons

HCFA Panels (Y2000)	Number of ISE tests	Number of Photometric	AU640 Test/Hr	AU640 Sample/hr	AU2700 Test/Hr	AU2700 Sample/hr
Basic (8)	3	5	1067	133	2133	267
Comp (14)	3	11	933	67	1733	133
Renal Function (10)	3	7	1000	100	2000	200
Hepatic Function (7)	0	7	800	114	1400	200
DAU (5)	0	5	800	160	1333	267

AU600 Formula for Test Throughput.

	Tests/Hour	Test Mix
Minimum	600	ISE only
	800	Photometric only
	800	1 Photometric + ISE
	1000	2 Photometric + ISE
Maximum	1200	3 Photometric + ISE

Please answer the following two questions to determine tests per hour for your test mix...

How many Photometric tests? 6
Ise, y/n? Y

Tests per hour 800
Profiles per hour 133

AU2700 Formula for Test Throughput.

	Tests/Hour	Test Mix
Minimum	800	ISE only
	1600	Photometric only
	1067	1 Photometric + ISE
	1333	2 Photometric + ISE
	1600	3 Photometric + ISE
	1867	4 Photometric + ISE
Maximum	2133	5 Photometric + ISE

If other than above, please answer the following two questions to determine tests per hour for your test mix.

How many Photometric tests? 20
Ise, y/n? Y

Sample/Hr 67
Tests per hour 1600

Olympus Performance Specifications

WHITE RACK STANDBY TO RESULT

	AU400	AU640	AU2700	AU5400
STANDBY TO RESULT	12 min 25 sec	13 min 6 sec	14 min 44 sec	18 min 10 sec
SAMPLE TO RESULT	9 min 25 sec	8 min 52 sec	8 min 52 sec	15 min 40 sec

RED RACK STANDBY TO RESULT

	AU400	AU640	AU2700	AU5400
STANDBY TO RESULT	12 min 25 sec	13 min 6 sec	9 min 44 sec	9 min 35 sec
SAMPLE TO RESULT	9 min 25 sec	8 min 52 sec	4 min 41 sec	7 min 25 sec

PRESSING [STAT] BUTTON TO RESULT

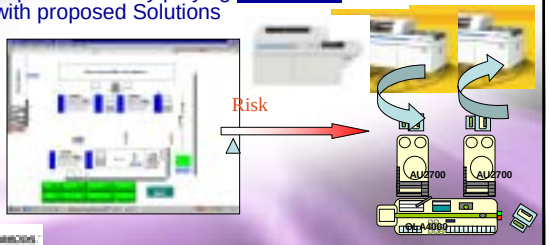
	AU400	AU640	AU2700	AU5400
STANDBY	7 min 48 sec	8 min 29 sec	9 min 44 sec	9 min 44 sec
MEASURE 1 (Sampling tube 1 of 4)	5 min 52 sec	5 min 4 sec	4 min 41 sec	4 min 41 sec
MEASURE 2 (Auto Rpt on AU400)	6 min 13 sec	4 min 55 sec	4 min 50 sec	4 min 50 sec

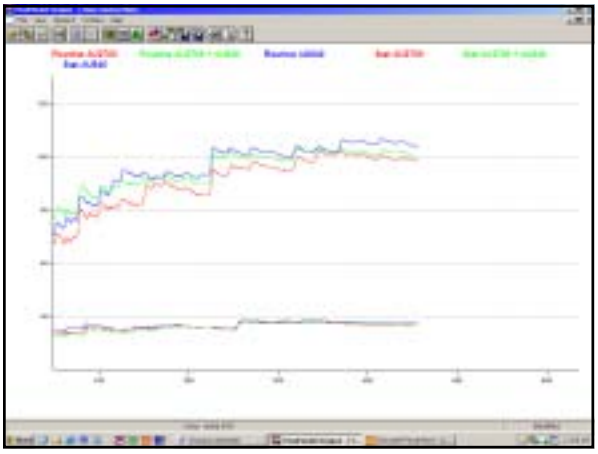
SAMPLE PROBE MOVEMENT AT STAT TABLE TO RESULT

	AU400	AU640	AU2700
STANDBY	4 min 26 sec	3 min 47 sec	3 min 53 sec
MEASURE 1	4 min 26 sec	3 min 52 sec	3 min 31 sec

Olympus LABModel Simulation Software to Evaluate Equipment Choices

- Allows Laboratory to ***"Experiment"*** using an an accurate Model to visualize the Solution
- Allows the Laboratory to Innovate Process Improvements by playing ***"What Ifs"*** with proposed Solutions





July 2002
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Thank You