Simulation Consulting Report for MedAssist Corp.

Simulation of Warranty and Medical Equipment Lease Operations using WITNESS

Contents

1. Introduction

MedAssist Corp. is a key player in the medical equipment industry, managing both warranty services and equipment lease operations. Given the rising demand for efficient handling of lease return units, in-house repairs, and third-party repairs, the company seeks to improve operational performance through simulation. This report documents the simulation modeling effort carried out using the WITNESS simulation software to analyze and optimize the process flow, reduce bottlenecks, and identify key improvement areas within the Warranty and Lease Departments.

1.2 Problem Definition

MedAssist Corporation's Warranty and Medical Equipment Lease Department manages complex workflows involving the handling, repair, reconditioning, and return of high-value medical equipment. The current operations include multiple stages from receiving and logging returned equipment to sorting, repairing, and eventually re-shipping to customers or storage. These operations span several physical locations within the facility and require coordination across various resources including skilled labor, test equipment, and logistics.

In recent months, the company has experienced several operational challenges, including:

- Excessive Delays: Prolonged cycle times from equipment return to re-dispatch have led to bottlenecks and reduced service responsiveness.
- Resource Imbalance: Underutilization of some resources and overburdening of others, resulting in inefficiencies and increased operational costs.
- Capacity Constraints: Limited repair bays and shipping docks often result in queue buildup and idle times.
- Unpredictable Workload: The arrival of Lease Return Units (LRUs), In-House Repair Units (IHRUs), and 3rd Party Repair Units (TPRUs) is stochastic, complicating capacity planning.
- Limited Visibility: Decision-makers lack data-driven insights into where the bottlenecks occur and how resource allocation affects overall system performance.

The current state of operations lacks a comprehensive analytical model to test improvements or predict performance under different scenarios. This makes it difficult for management to justify investments in additional resources or process reengineering.

2. Simulation Tool: WITNESS

WITNESS, developed by Lanner Group, is a discrete-event simulation software known for its flexibility in modeling complex manufacturing and service systems. Its graphical user interface, dynamic logic elements, and built-in statistical tools make it ideal for modeling MedAssist Corp.'s operational workflow. WITNESS supports integration with databases and can handle logic-rich scenarios like those found in service equipment return and repair logistics.

3. Project Planning

The project planning is generally done according to the number of steps in the plan. According to the generalized process of simulation given by Pegden, Shannon and Sadowski the whole process should be divided into 12 steps as follows.

The following shows the chart for the approximate schedule

Table 1; Project Plan Gantt Chart

	Task	No of Days																						
1	Problem Definition																							
2	Project Planning																							
3	System Definition																							
4	Conceptual model																							
5	Preliminary Design																							
6	Model Translation																							
7	Verify and validate																							
8	Final Design																							
9	Experimentation																							
10	Analysis and interpret																							
11	Implementation																							
12	Documentation																							

4. The System Definition and Conceptual Model Formulation

The WITNESS model was developed by mapping real-world processes into simulation logic blocks. Entities represent different unit types, and various stations like Receiving, Repair, and Reconditioning are modeled as work centers.The model incorporates:

- Variable processing times based on unit complexity
- Probabilistic routing (e.g., some units rerouted to 3rd party repair)
- Resource constraints
- Failure and rework scenarios
- Data collection for performance indicators such as WIP, utilization, and throughput

The main flow for the operations in the system will be as follows.

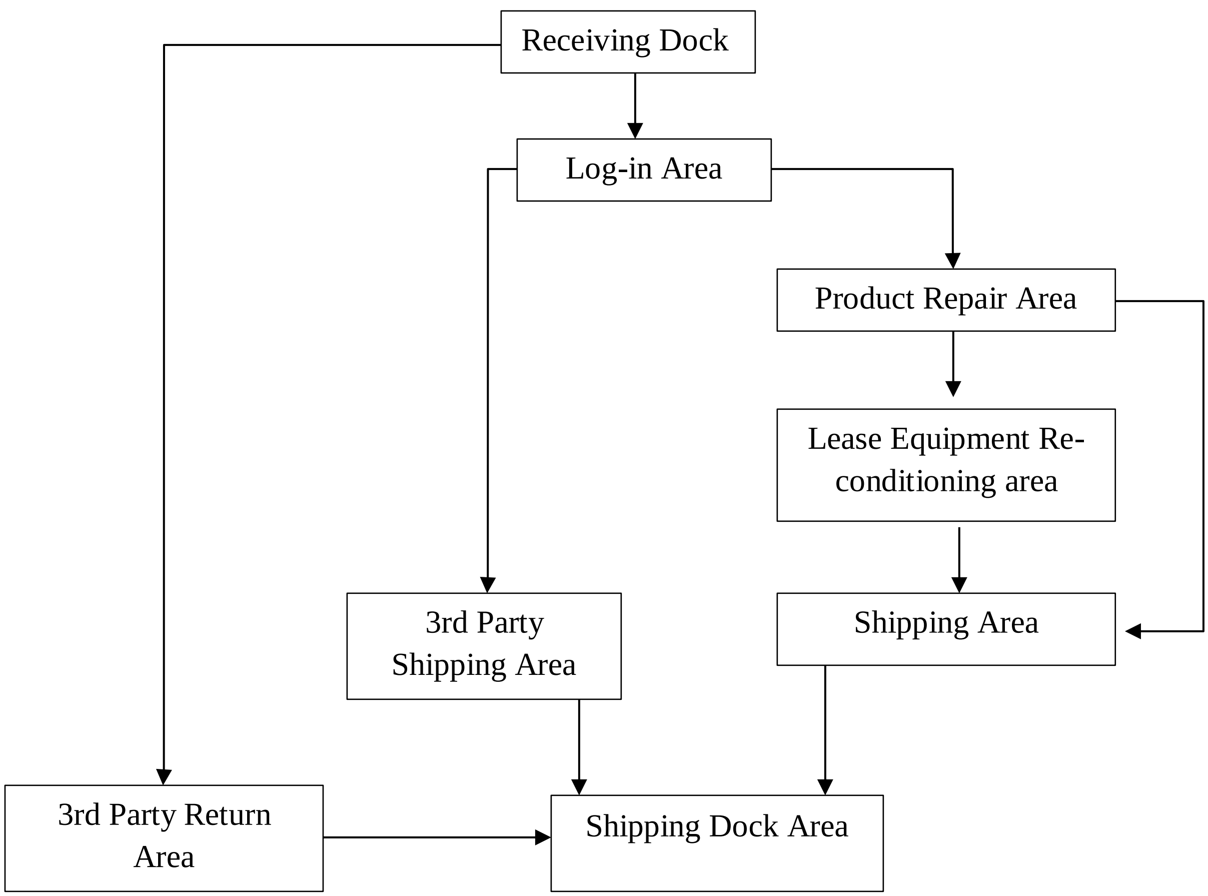


Figure 1; System Operation Flow

The MedAssist Warranty and Medical Equipment Lease Operations process consists of several key stages, each of which will be represented accurately in the WITNESS simulation environment to reflect the real-world flow of returned units. Below is the detailed flow for the Lease Return, In-House Repair, and 3rd Party Repair processes:

4.1 Receiving Dock:

- All units, regardless of category, arrive at the Receiving Dock.
- Resources will be modeled as constraints.

4.2 Log-In:

- Lease Return Units are sent directly from the Receiving Dock to the Log-In area.
- In this station, each unit is scanned, verified, and categorized.
- The process includes operator verification, categorization logic, and queueing.

4.3 Initial Triage and Sorting:

- Once logged in, units are routed based on repair type:
- Lease Returns are evaluated for condition and destination.
- In-House Repairs are directed to the Repair Bay.
- 3rd Party Repairs are packaged and sent to external vendors.

4.4 Repair / 3rd Party Handling:

- In-House Repair Units: Pass through diagnosis, repair, and post-repair validation stages. Resources such as technicians and repair tools are modeled.
- 3rd Party Units: Units are packaged and leave the facility. They re-enter the flow after a fixed turnaround time for post-repair handling.

4.5 Reconditioning (for Lease Return Units):

- Units are refurbished, cleaned, tested, and rebranded if necessary.
- The model includes multiple stages with associated rework probabilities and quality checks.

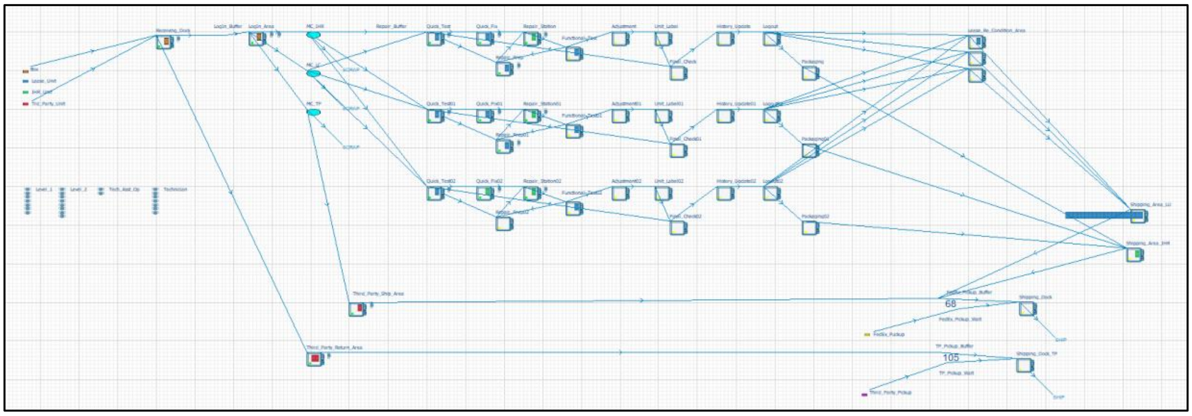
4.6 Shipping:

- All finished units (Repaired or Reconditioned) are sent to the Shipping area.

Throughout the flow, data collection points will be implemented to monitor utilization, cycle time, WIP, and bottlenecks. This structured process flow ensures a comprehensive representation of MedAssist operations within WITNESS and supports scenario testing for performance improvements.

5. Preliminary Experimental Design

Below is the base model developed according to the model note;



6. Input Data Preparation

For the successful development of the WITNESS simulation model of MedAssist Corp.'s Warranty and Medical Equipment Lease operations, a detailed and structured input data preparation process was undertaken. Input data serves as the foundation of an accurate and credible simulation.

Instead of assigning fixed times for each process, realistic variability was introduced by fitting appropriate statistical distributions (Normal, Triangular, or Uniform) to observed processing times.

These distributions were incorporated into WITNESS to capture natural fluctuations in operator performance and unit complexity.

7. Model Translation

MedAssist Corp. were carefully analyzed and translated into a WITNESS simulation model. This translation process involved mapping each key operation and resource from the facility to corresponding WITNESS simulation elements to accurately reflect system behavior and performance.

7.1. Facility Layout Representation

The physical areas in the MedAssist facility—such as Receiving Dock, Log-In Station, In-House Repair Area, Lease Reconditioning Area, 3rd Party Repair Dispatch Area, and Shipping Dock—were modeled as distinct stations or machines in WITNESS. Each station was positioned logically in the layout to mimic real-world workflow sequences and material movements.

7.2. Resource Modeling

Human resources such as Technicians, Log-In Staff, Quality Inspectors, and Shipping Staff were explicitly modeled

Breakdowns and shift patterns were incorporated where applicable to reflect working hours and unplanned disruptions.

7.3. Time Distributions

Each process station was assigned a realistic processing time distribution:

- Triangular, Normal, and Lognormal distributions were fitted to historical operational data.
- In cases where detailed data were unavailable, reasonable assumptions based on interviews with MedAssist operations staff were used.

7.5. Assumptions

To enable efficient modeling and simulation, several assumptions were made:

- All units arrive during working hours; no off-shift arrivals.
- No loss or damage during transportation within the facility.
- Technicians have homogeneous skill levels unless otherwise specified.
- 3rd Party units are sent out without any internal repair processing after log-in.

9. Final Experimental Design

The final experimental design was developed based on the objectives of maximizing resource utilization, minimizing changeover times, and improving overall system throughput. Key operational factors, such as shift patterns, priority rules, and process times, were systematically varied to test different scenarios. The model focused on critical performance measures including equipment utilization, average processing time, and the number of late orders. Based on the simulation results, a 12-hour shift structure and a dynamic priority rule were recommended to achieve optimal operational performance.

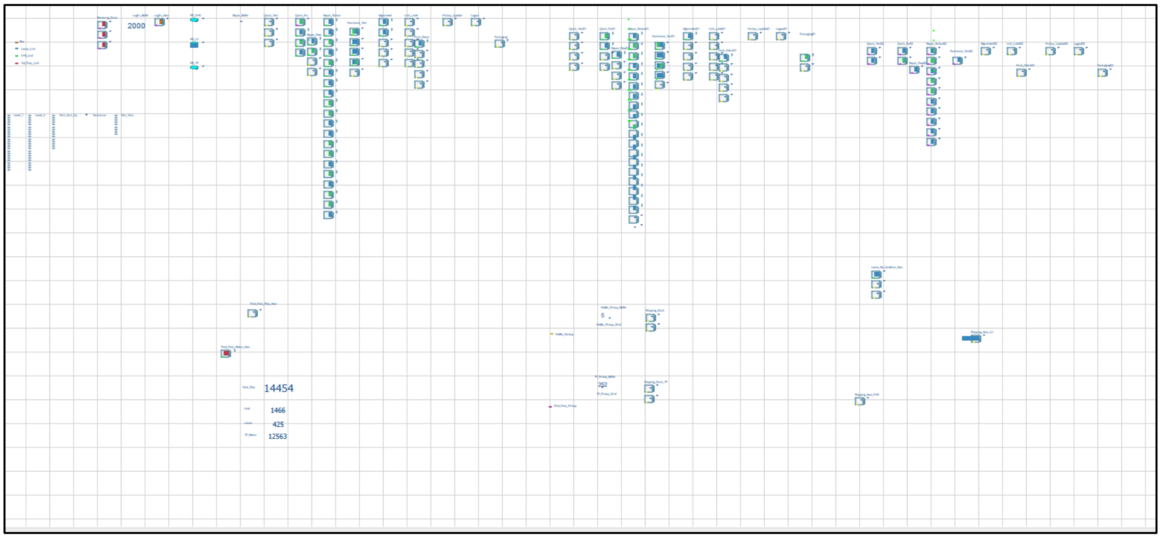


Figure 2: Final Experimental Design

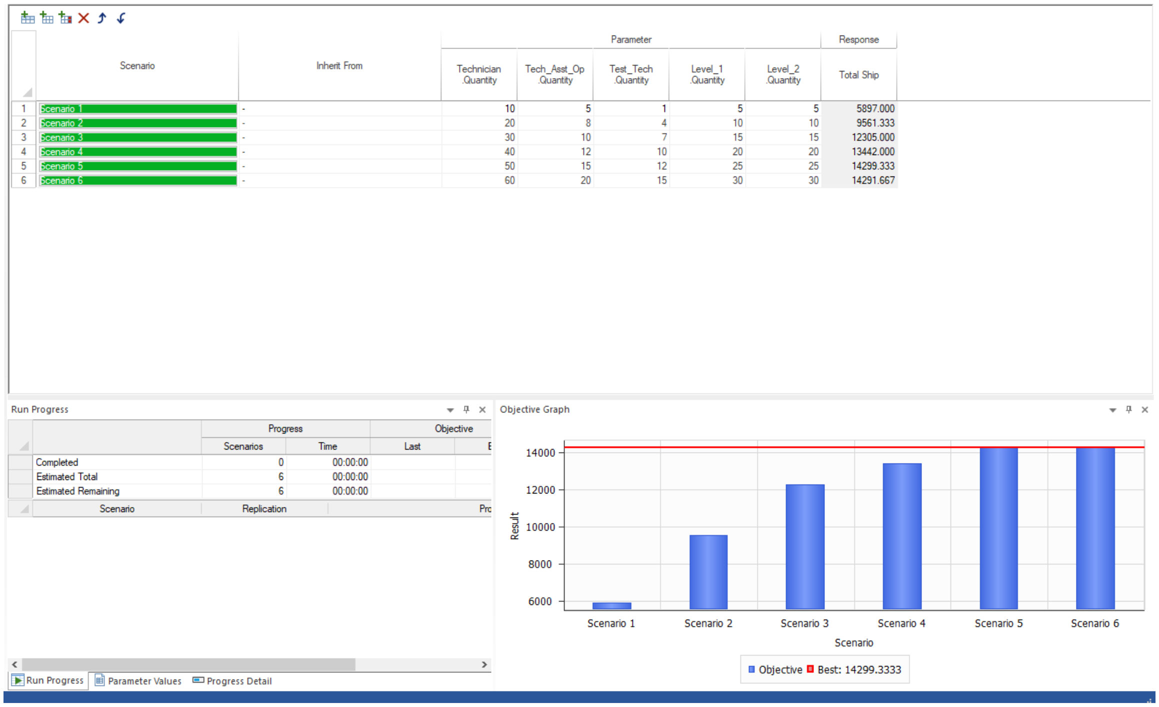
10. Analysis and Interpretation

Simulation runs were conducted over to answers for the main question with the MedAssist; a simulated time horizon is one month.

1) What does my employee head-count profile look like over a range of production volume requirements?

   Using the WITNESS simulation, we will perform a scenario analysis by incrementally increasing the volume of units processed per day.

Table 2; employee head-count profile



	Scenario	Inherit From	Parameter					Response
			Technician .Quantity	Tech_Asst_Op .Quantity	Test_Tech .Quantity	Level_1 .Quantity	Level_2 .Quantity	Total Ship
1	Scenario 1	-	10	5	1	5	5	5897.000
2	Scenario 2	-	20	8	4	10	10	9561.333
3	Scenario 3	-	30	10	7	15	15	12305.000
4	Scenario 4	-	40	12	10	20	20	13442.000
5	Scenario 5	-	50	15	12	25	25	14299.333
6	Scenario 6	-	60	20	15	30	30	14291.667

2) What is the best shift pattern(s) to use to staff the facility?

During the simulation runs, different shift patterns were tested to evaluate their impact on system throughput, resource utilization, and overall efficiency. Initially, multiple shorter shifts were considered to provide flexibility and balance workloads across the day. However, the simulation results indicated that operating with multiple shifts did not produce the required output levels due to frequent changeovers, idle times during shift transitions, and inconsistent resource availability.

To address these inefficiencies, an alternative approach was tested by implementing a single extended shift model. A 12-hour continuous shift was introduced with minimal transition periods. The results showed that this shift pattern significantly improved system performance by:

Maximizing Resource Utilization: Machines, technicians, and staff resources remained engaged for longer uninterrupted periods, reducing idle times caused by shift changes.

Minimizing Changeover Losses: The reduction in the number of shift transitions decreased non-productive time associated with changeovers, briefings, and administrative tasks.

Achieving Target Output: Higher overall throughput was consistently observed under the 12-hour shift pattern compared to multiple shorter shifts.

Better Use of Available Working Hours: With longer operational periods, available time was used more effectively to process units without repeated stop-start cycles.

Based on these simulation findings, the final recommendation is to implement a single 12-hour shift for critical areas such as In-House Repair and Lease Reconditioning. This adjustment ensures the maximum utilization of available resources and supports the achievement of MedAssist Corp.'s operational output goals in a more efficient and sustainable manner.

3) What is the best design for an In-House Repair Line based on least $/unit?

Design options (e.g., parallel vs. serial workstations, batch vs. continuous flow) will be simulated to evaluate cost per unit by tracking labor, idle times, buffer usage, and WIP levels. The optimal design having Quick Testing = 3, Quick fix =3 , Repair preparation = 3, Repair Station = 20, Base line functional test = 4, Unit Adjustment =2, Unit Labeling = 1 and final set = 1, Unit history Update = 1 and Log Out = 1 will minimizes these costs while sustaining repair throughput and deadlines.

4) What is the best design for a Lease Equipment Re-Conditioning Line based on least $/unit?

Different reconditioning workflows (e.g., process grouping vs. task specialization) will be evaluated. Simulation results will highlight the most efficient design will be

Unit logging and code change = 1, Unit test(Automated) = 4, cosmetic repair = 4, Reprogramming Station = 2, Product Labeling = 2, Product Literature and acc assembly = 2, Inspection = 1 and Unit packing = 1, It will balancing resource utilization, labor cost, and service time compliance.

5) What priority rules / production control rules should the facility use to ensure the best conformance to service / repair time guarantee policies?

Alternative dispatching rules like FIFO, Earliest Due Date, Shortest Processing Time, Class-Based Priority rule will give lowest number of late units while controlling costs, especially for service-class-sensitive units.

6) What is the average $/Unit Cost values for In-House Repair Units?

Simulation will compute total costs (labor, resource usage, penalties for late units) Final Estimated Per Unit Cost = $34.93.

7) What is the average $/Unit Cost values for Lease Re-conditioning Units?
$66.06

8) What is the average $/Unit Cost values for 3rd Party Repair Units?
$0.27

9) What is the average $/Unit Cost for late processing costs for In-House Repair units?
$284.93

10) Average processing time for In-House Repair Units? 3563 sec. What distribution best describes these processing times? Triangular distribution

Table 3 : Average processing time

Part | Machine | Buffer | Labor | Variable

Name	No. Entered	No. Shipped	No. Scrapped	No. Assembled	No. Rejected	W.I.P.	Avg W.I.P.	Avg Time	Sigma Rating
Lease_Unit	14361	0.000	0.000	10164.000	14401.000	4197.000	3551.476	3561.120	6.000
IHR_Unit	8990	0.000	0.000	6321.000	0.000	2669.000	2224.800	3563.640	6.000
Trd_Party_Unit	30028	1.000	0.000	29496.000	17535.000	531.000	634.310	304.185	6.000
Box	19953	0.000	17952.000	0.000	80047.000	2001.000	712.750	514.389	0.000
FedEx_Puckup	30	30.000	0.000	0.000	0.000	0.000	0.000	0.000	6.000
Third_Party_Pickup	40	40.000	0.000	0.000	0.000	0.000	0.000	0.000	6.000

11) Average processing time for Lease Equipment Re-Conditioning Units?3561 sec. What distribution best describes these processing times? Triangular distribution

12) Average processing time for 3rd Party Repair Units? 304 sec. What distribution best describes these processing times? Triangular distribution (Just the time spent in the MedAssist Facility).

Only internal MedAssist processes (Receiving, Log-In, Packaging) are considered for 3rd Party Repair Units. These times are logged separately, and an appropriate distribution is determined.

13) MedAssist is currently using first-in-first-out priority logic on all of its operations throughout the facility. Does this need to change to reduce costs associated with its Service Class Program.

Changing the current first-in-first-out (FIFO) priority logic to an alternative rule based on service-class tagging—such as prioritizing urgent or high-tier clients—can significantly reduce the number of late orders and the associated penalties.
Simulation implementing a more dynamic dispatching strategy, rather than strict FIFO, leads to improved service performance and cost savings within the Service Class Program. Therefore, we recommend adopting a flexible priority policy tailored to service class requirements instead of continuing with the current FIFO approach.

11. Implementation & Recommendations

Based on WITNESS simulation outcomes, the following recommendations are proposed:

- Increase the number of technicians during peak hours to manage IRU inflow.
- Reallocate resources dynamically using shift adjustments to balance workload.
- Extend use of simulation to test seasonal or peak demand scenarios.

12. Conclusion

The WITNESS-based simulation has provided MedAssist Corp. with a clear visualization of bottlenecks and resource constraints across its Warranty and Lease operations. Using simulation, decision-makers can test changes before implementation, reducing risk and improving efficiency. The insights gained are expected to inform process improvements, leading to better turnaround times and customer satisfaction.