ASU Arizona State University | Industrial Engineering

Robust Designs of Serial Assembly Lines Working under Labor Turnover

By

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Agenda

- Proposed Approach
- Previous Results
- Current Research
- Questions

Simulation Approach

- Cross verification with analytical models of small instances
- Due to the complexity of analytical models the analysis of large instances will not be feasible without simulation
- Flexibility in the design of prospective models of direct use in real word systems

Proposed Approach

- Develop production systems that combine characteristics of current dynamic work allocation methods, such as work sharing and bucket brigades, to mitigate the effects of labor turnover.

Previous Results

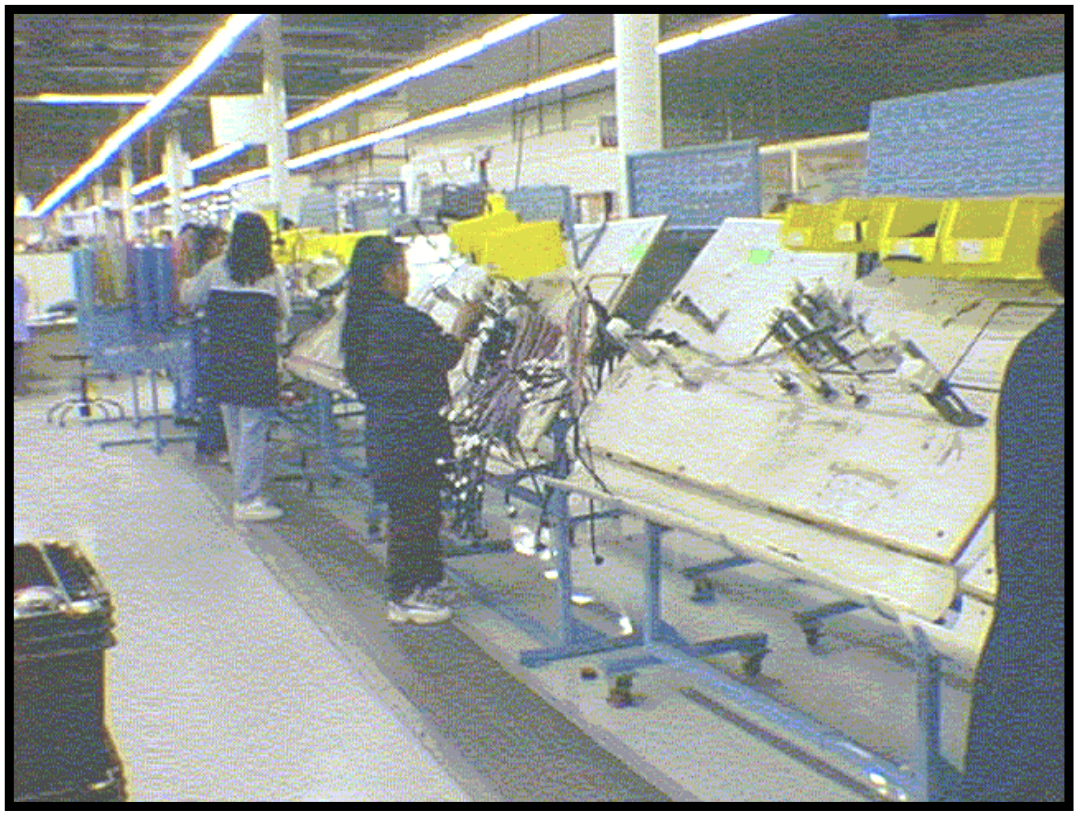
- Bucket Brigade implementation at Lear Co.
- Recent research by Muñoz

Bucket Brigades at Lear Co.

- Serial assembly line
- Six work stations
- Assembly of Toyota Camry left door wire harness

Bucket Brigades at Lear Co.

By following these rules WIP goes from this:



Bucket Brigades at Lear Co.

To this:

Bucket Brigades at Lear Co.

Comparison Criterion	Bucket Brigades	Traditional Method
Max. Historical Daily Line Production	301 harnesses	280 harnesses
Average Daily Line Production	279 harnesses	245 harnesses
Max. Line Historical Efficiency	91.56%	85.17%
Average Daily Efficiency	84.87%	74.53%
Work In Process Inventory	6 harnesses	24 harnesses

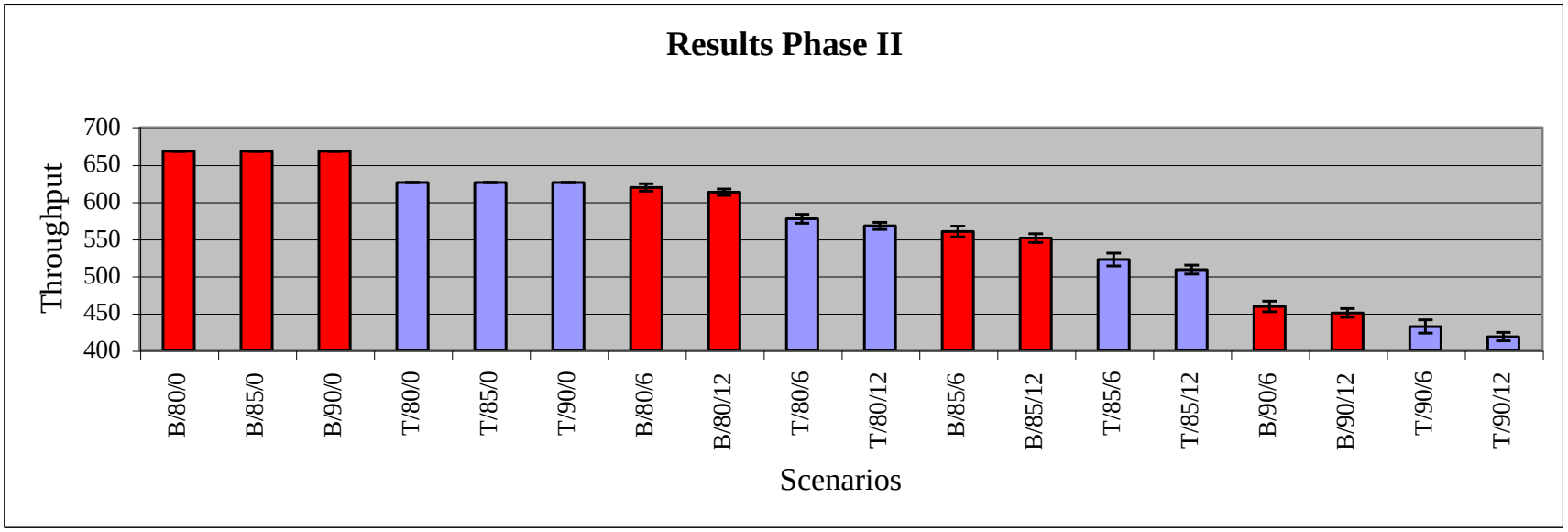
Recent Research by Muñoz

- Phase I : Small instances of assembly lines
  - Three workstations
  - Three types of work allocation
    - Traditional
    - Bucket Brigades
    - Unbalanced (High- Med -Slow)
  - DOE with three factors: Method, Leraning Curve and Level of Turnover
  - Analytical and simulation models (Promodel®)

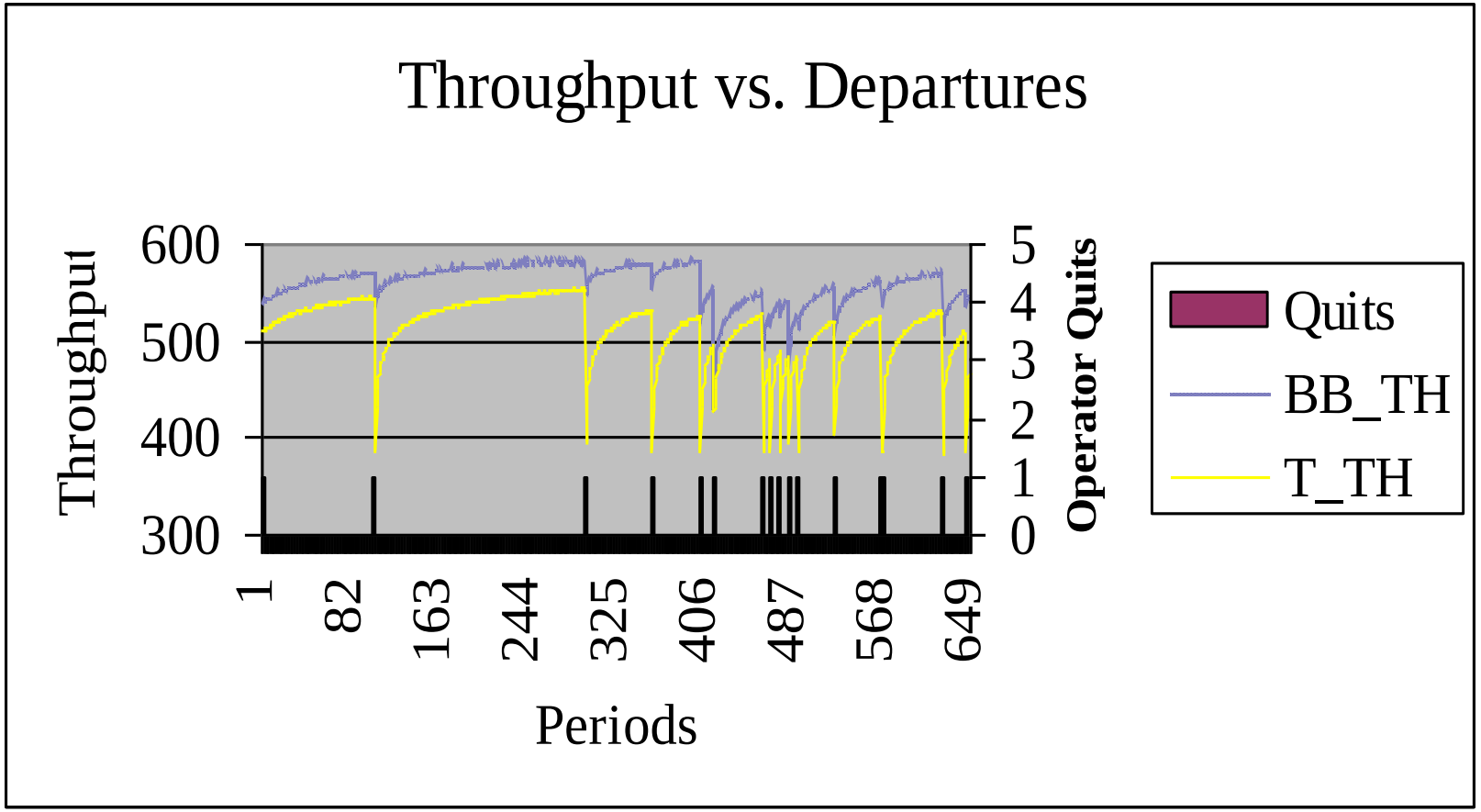
Recent Research by Muñoz

- Phase II: More realistic assembly lines
  - Six workstations
  - Two assembly methods: Bucket Brigades Vs. Traditional
  - Total assembly work divided in assembly elements
  - DOE with three factors: Method, Leraning Curve and Level of Turnover
- Simulation models (Promodel®)

Results Phase II



Results Phase II



Current Research

- Implementation of Dynamic work allocation Method (Bucket Brigades Islands) at TRW Occupant Restraint Plant, Chihuahua Mexico.
- Assembly line manufactures passenger airbag for Ford Trucks
- Sewing operation

Current Research

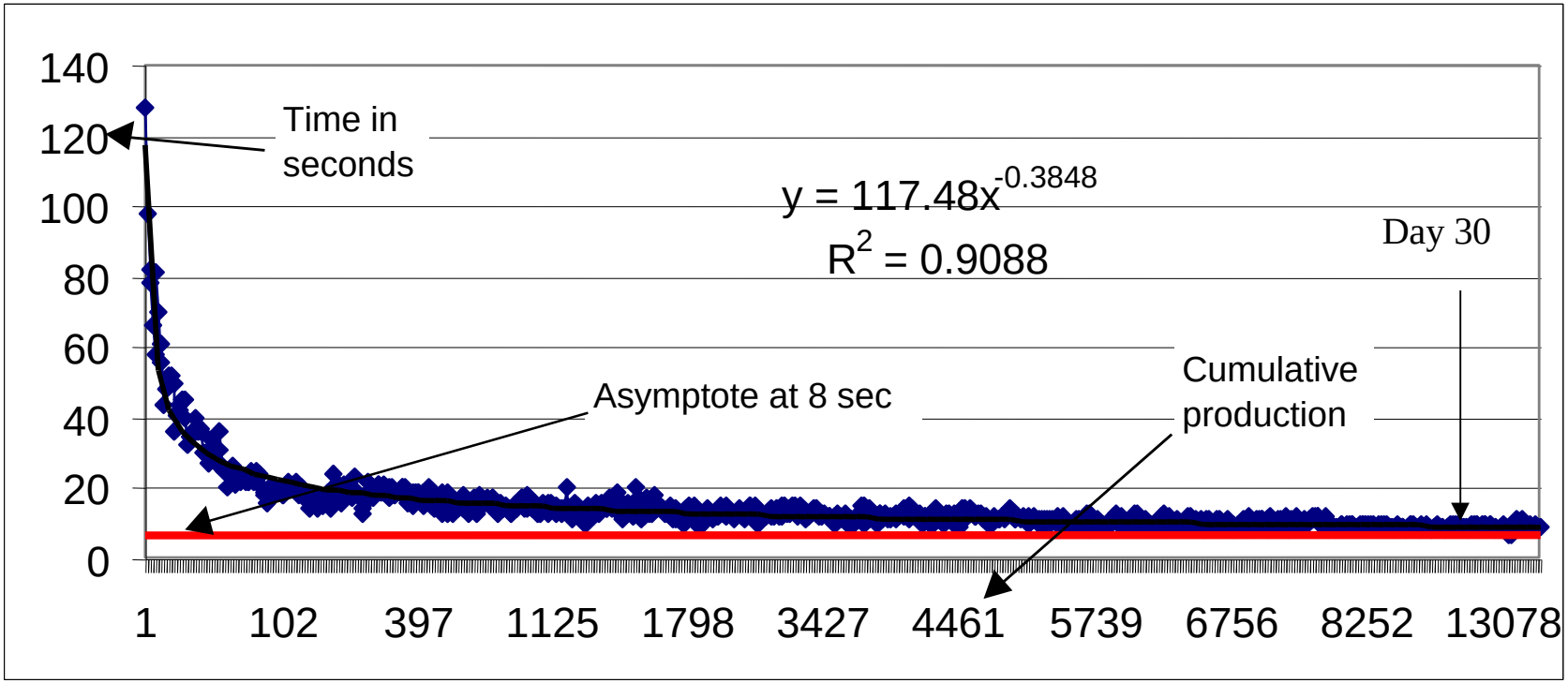
- Project divided in three phases
  - Phase I: Data gathering (completed)
  - Phase II: Simulation modeling of alternatives (validation stage)
  - Phase III: Implementation of dynamic work allocation method (11/26/01)

Preliminary Results

- Phase I: Data gathering
  - Learning curve
  - Tenure distribution
  - Thorough process description (current method)

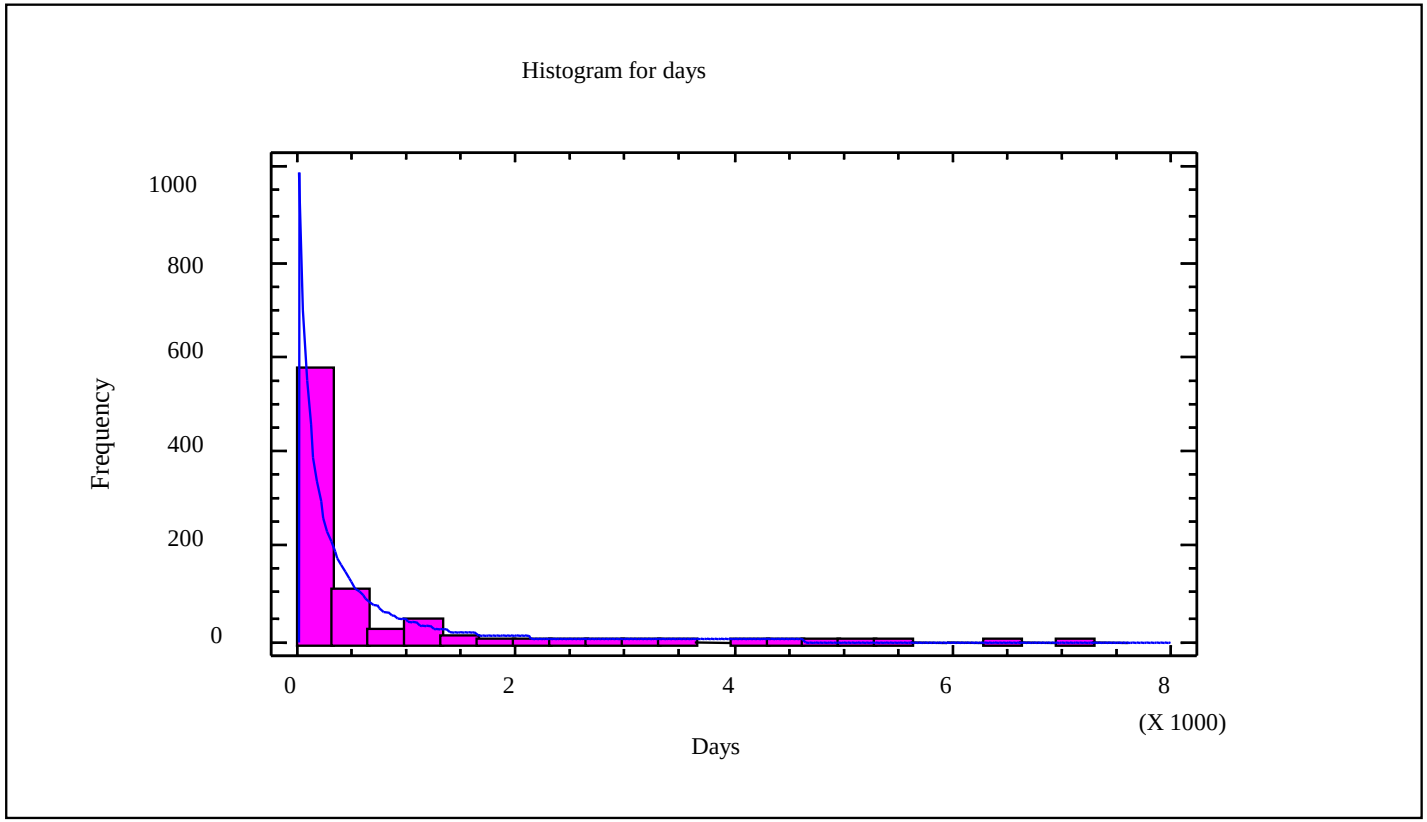
Preliminary Results

- Phase I: Learning Curve



Preliminary Results

- Phase I: Tenure Distribution



Preliminary Results

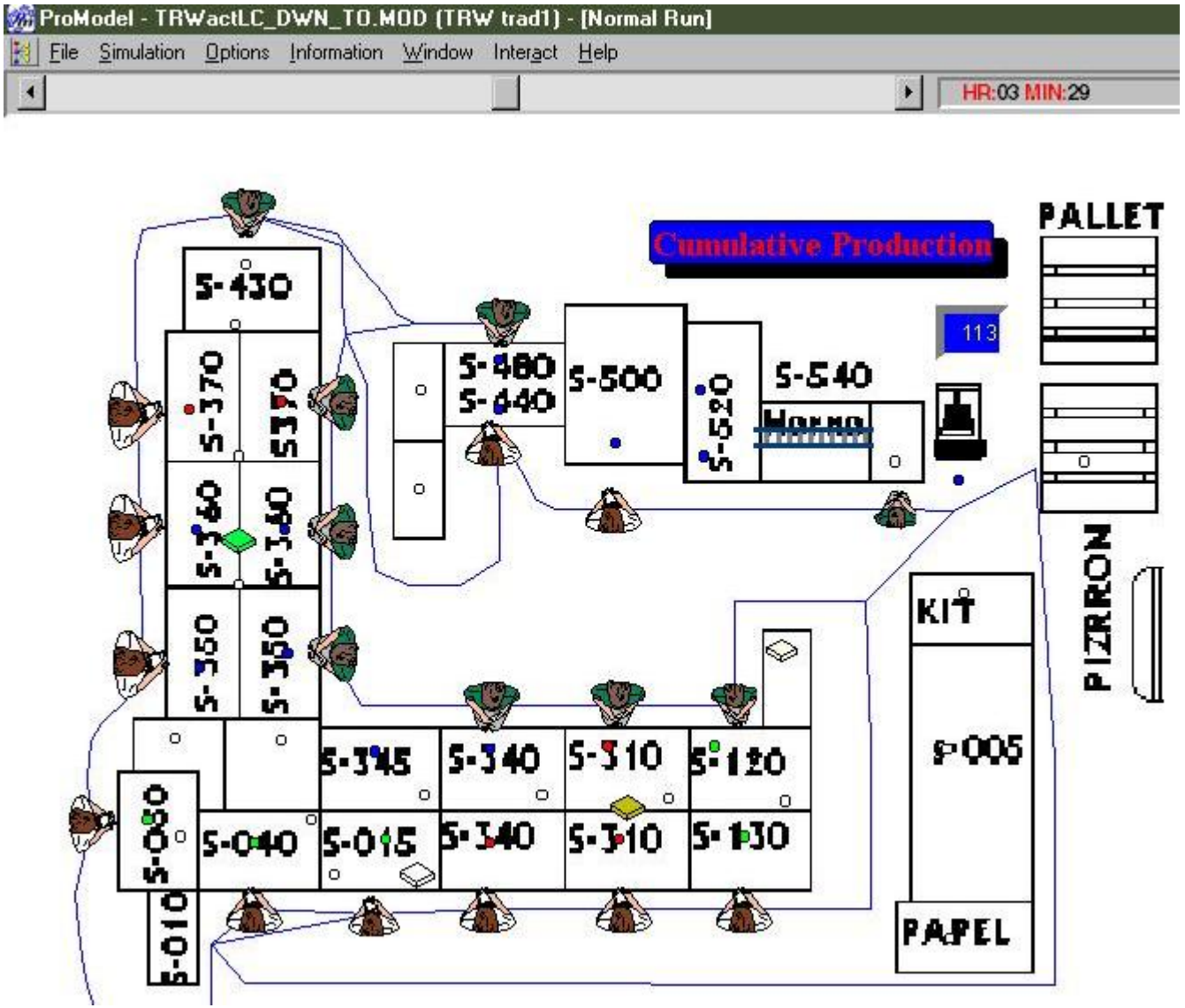
- Phase I: Tenure Distribution
  - W(.658,256.29) days (5.6 % Labor turnover/month)

Preliminary Results

- Phase II: Simulation Modeling
  - Current production method (13 people sewing)
  - Dynamic work allocation method (11 people sewing)

Preliminary Results

- Phase II: Current production method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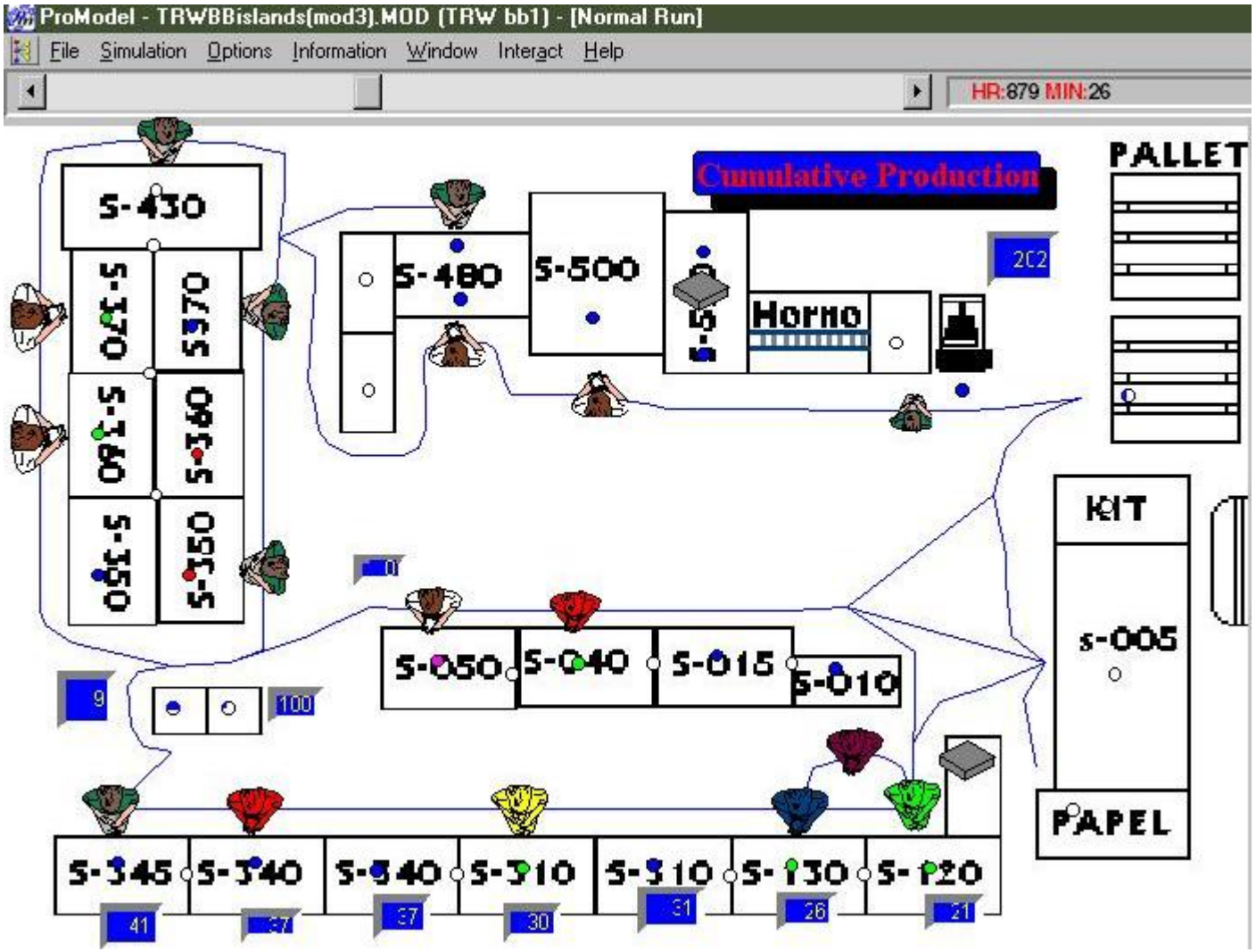
File Simulation Options Information Window Interact Help
HR:03 MIN:29
Cumulative Production
113
PALLET
PIZRRON
KIT
PAPEL
S-430
S-370
S-360
S-350
S-480
S-440
S-500
S-520
S-540
S-345
S-340
S-310
S-120
S-080
S-040
S-015
S-010
S-130

Preliminary Results

- Phase II: Proposed production method


ProModel - TRWBBislands(mod3).MOD (TRW bb1) - [Normal Run]
File Simulation Options Information Window Interact Help
HR:879 MIN:26
Cumulative Production
PALLET
S-430
S-480
S-500
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202
KIT
s-005
PAPEL
S-050
S-040
S-015
S-010
S-345
S-340
S-330
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41
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31
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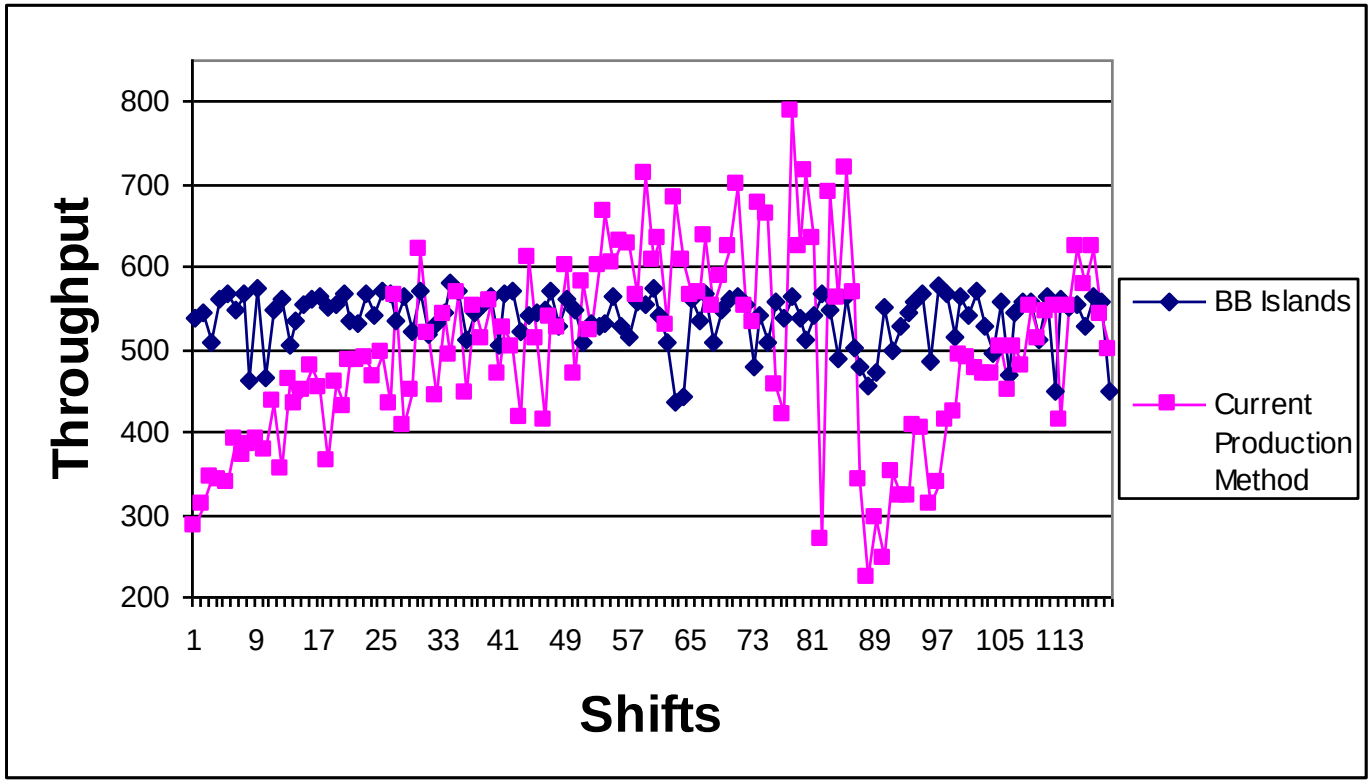
21
9
100

Preliminary Results

- Throughput BB Islands Vs Current



Preliminary Results

- Throughput BB Islands Vs Current

Method	Average throughput	Stdev
Current Method	498.6554622	113.2911681
Dynamic Work Allocation Method	537.4789916	32.80989122

Phase III: Implementation

- Pilot line implementation in three shifts
- Implementation will include training of operators, line supervisor and engineers
- Break through change, change from sitting standing/walking position
- Phase III is expected to be completed by the end of November, following a supervision period

Questions