

Design of Overall Factory Layout

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Acknowledgement

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Project - OGSM

Objective

Reduce Lead Time and Production Cost by designing an overall factory layout to improve flow and shop floor control

Goals

Product Flow:
Reduce steps in current process by 20%.

New/Rebuild Lead Time Reduction:
Reduce Lead times by 10%.

Customer Delivery Performance:
95% OTD to promise

Strategies

Design short-term & long-term factory layouts subject to the current constraints and incorporation of new CNC machines

Investigate the feasibility of a future factory layout with separate focused factories for New & Rebuild screws

Utilize PFAST software and FAT app to visualize and analyze the production flows in the different layouts

Use quantitative metrics such as Lead Time, Labor Cost and Material Handling Distance to evaluate proposed layouts

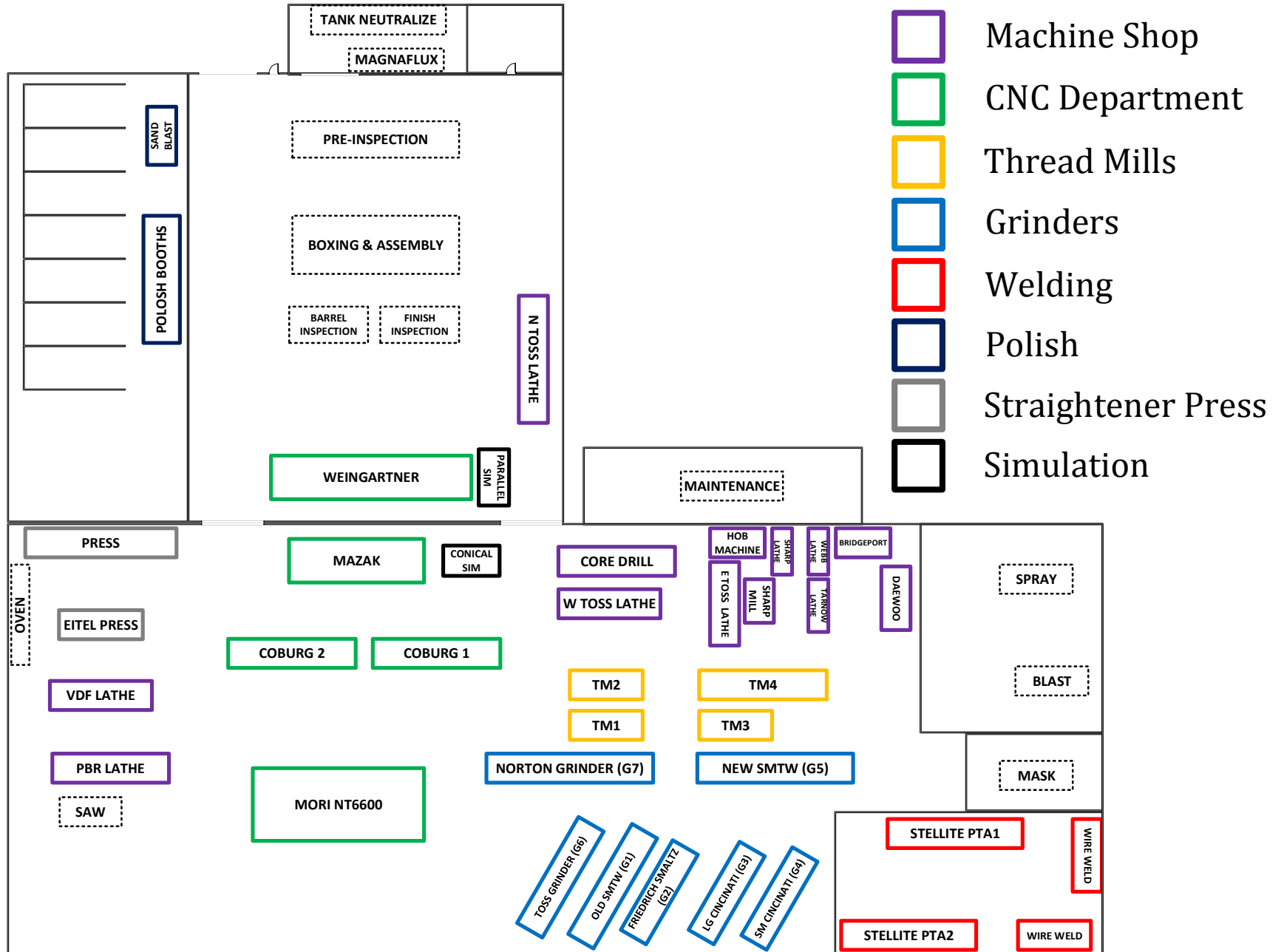
Measures

Material handling distance that Water Striders have to push carts that weigh 100-1300 lbs. throughout the year will be reduced by 100 miles

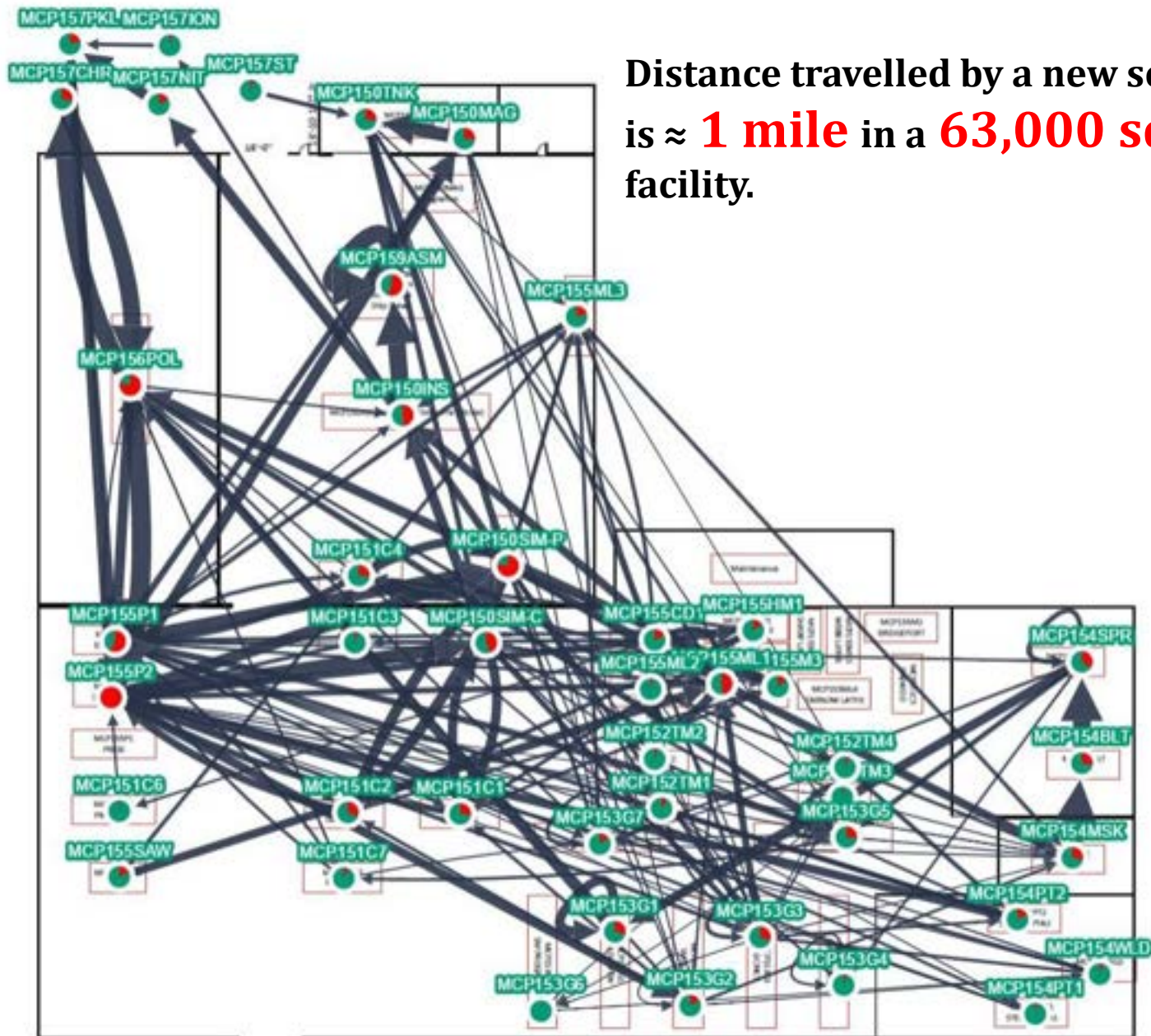
Lead time for a set of New screws will be reduced by ≈11 days

Annual Labor Cost of material handling will be reduced by ≈ \$56,925

Current Factory Layout



Production Flow in the Current Factory Layout



Distance travelled by a new set of screws is \approx **1 mile** in a **63,000 sq.ft.** facility.

Layout 1: Proposed Moves

Changes made in current factory layout to realize this new layout:

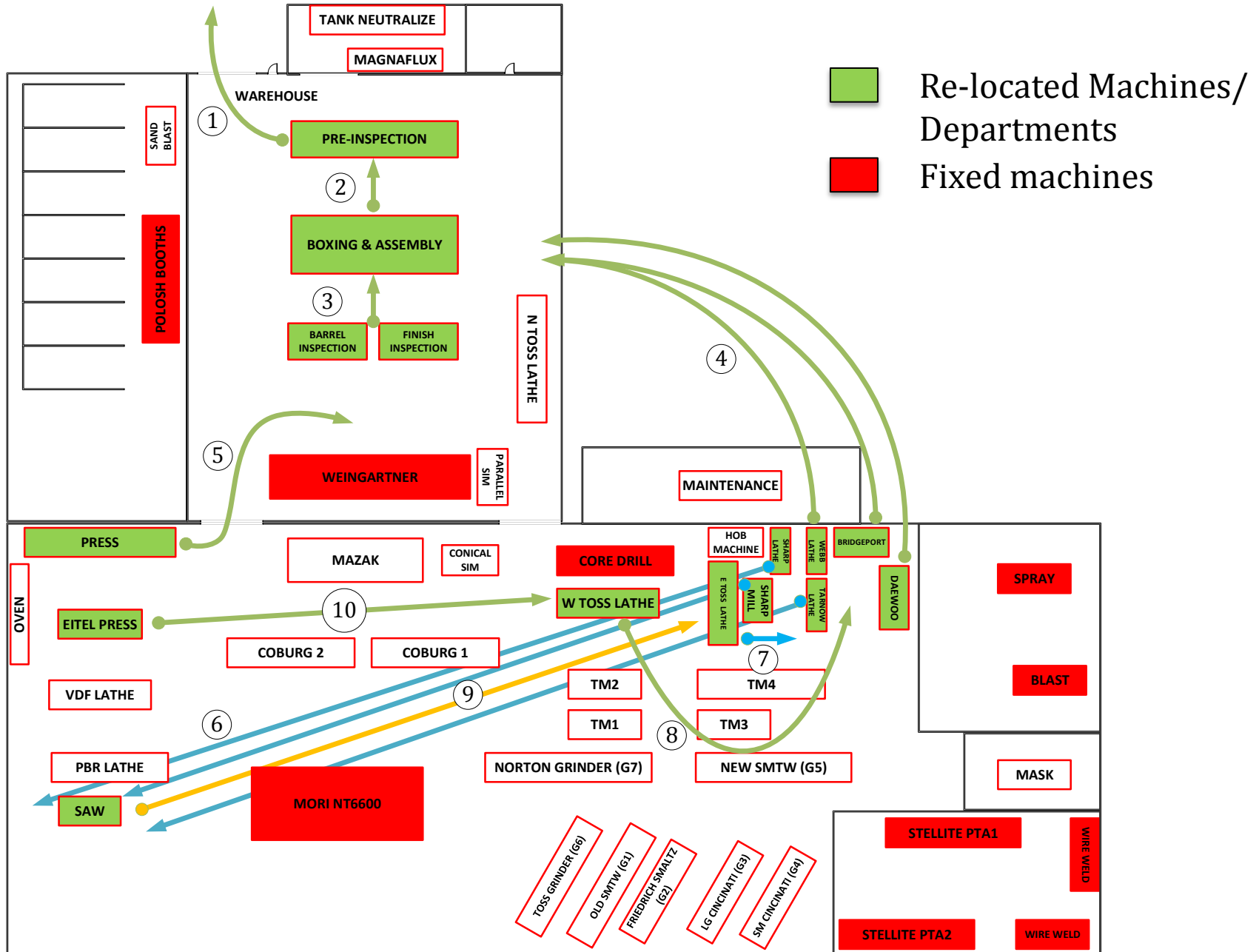
- Raw material enters main facility through the Maintenance door
- Move Pre-inspection to warehouse
- Move Boxing to current location of Pre-inspection
- Move Final Inspection & Barrel Inspection to current location of Boxing
- Move Daewoo, Bridgeport & Webb lathes next to Boxing department
- Move Yellow Press (P1) across from the Weingartner to create a cell that includes the SIM station for parallel screws
- Move Sharp Mill, Tarnow Lathe & Sharp Lathe to current location of Saw
- Move East TOS Lathe to current location of the Sharp mill
- Move West TOS Lathe to current location of Daewoo
- Move Saw to current location of East TOS Lathe
- Move Eitel Press (P2) to current location of West TOS Lathe to create a cell that includes the Coburgs, Hob and SIM station for conical screws

Layout 1: Constraints/Assumptions

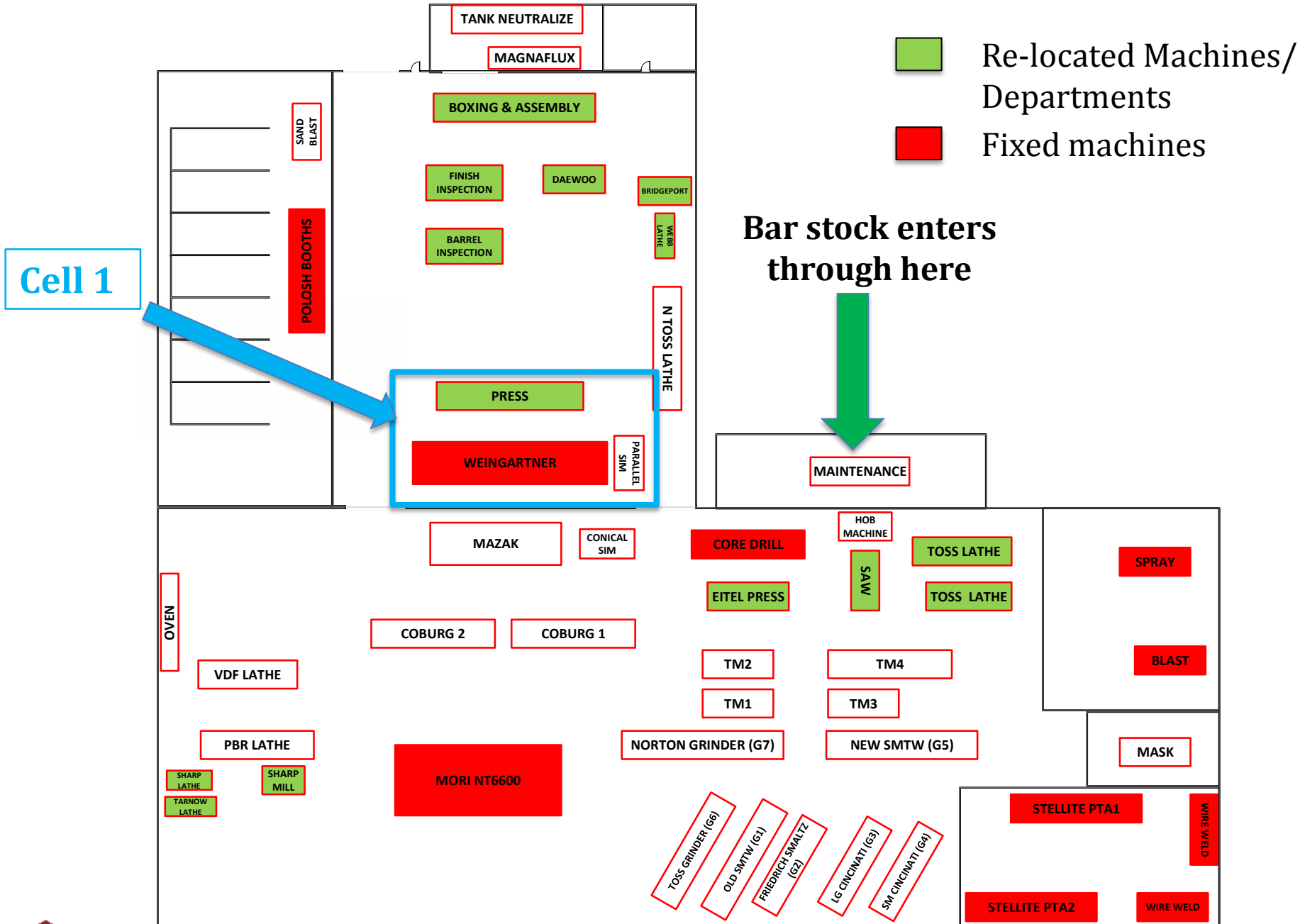
Machines/departments in the current factory layout that were not moved:

- Weingartner
 - Due to its heavy foundation
- Core Drill
 - Due to its age, the machine has experienced considerable wear and tear; any attempt to move it could damage it irreparably
- Mori Seki
 - Due to its heavy foundation
- Welding Department
 - Difficult to run gas lines
- 'Dirty' Departments – Spray, Blast & Mask
 - Requires a closed room
- Polish Department
 - Current location is good

Layout 1: Proposed Machine Moves

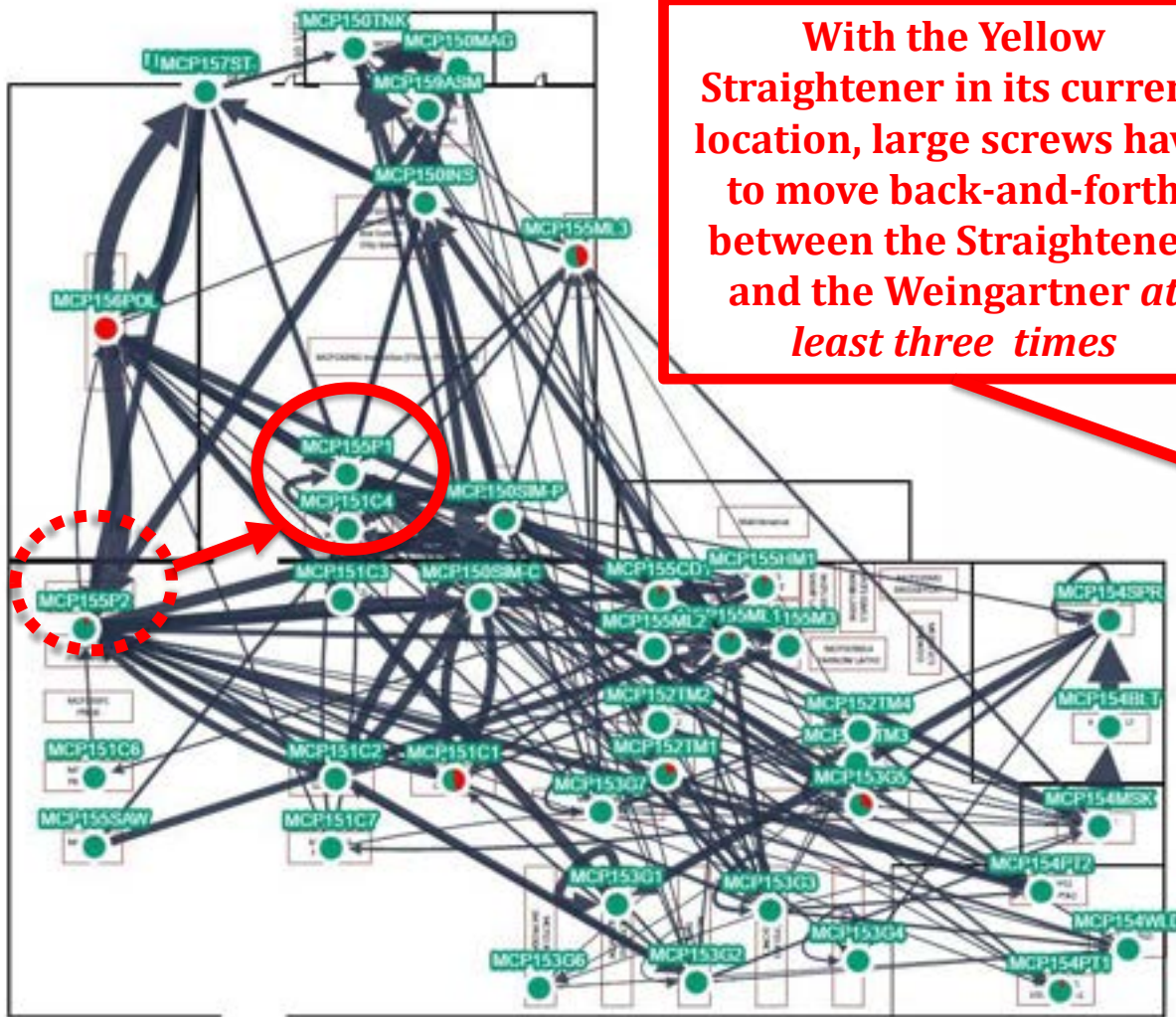


Layout 1



Layout 1: Implement a Cell

Form a cell comprised of Weingartner, Yellow Straightener and SIM station



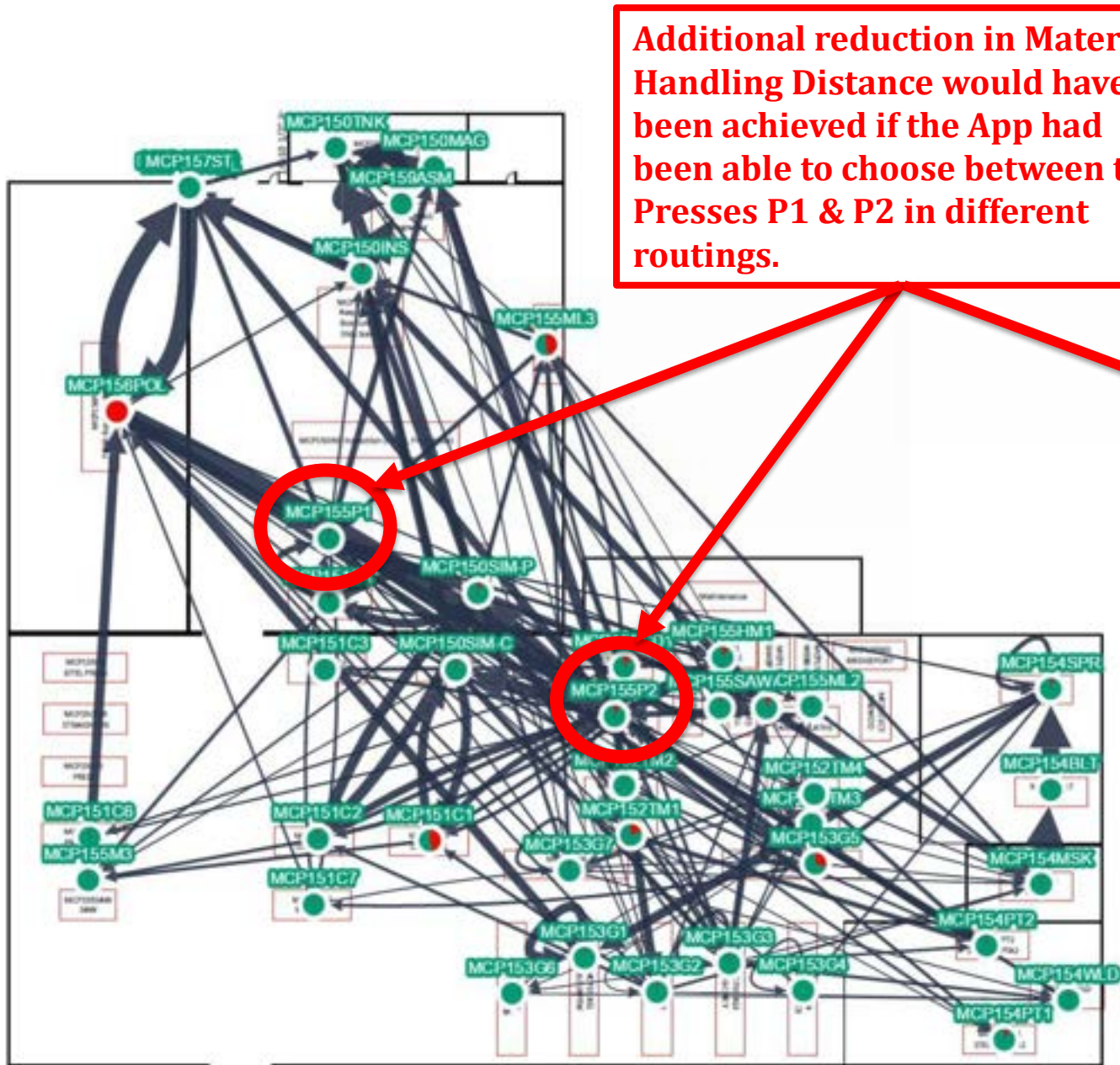
With the Yellow Straightener in its current location, large screws have to move back-and-forth between the Straightener and the Weingartner at least three times

Name	Date
Eitel shipping and boxing	05-11-2016
Existing layout	05-10-2016
just straightener	06-27-2016
Layout 1	06-24-2016
Updated Layout 1	06-27-2016

Distance Score:
Decreased 6.89%

- Pre-inspection, Boxing, Final Inspection & Barrel Inspection moved
- Yellow Straightener moved and re-located across from the Weingartner in a cell

Layout 1: Split a Department into Process Cells



Additional reduction in Material Handling Distance would have been achieved if the App had been able to choose between the Presses P1 & P2 in different routings.

Layout Part Machine

Saved Layouts

Name	Date
Eitel shipping and boxing	05-11-2016
Existing layout	05-10-2016
Improved Flow (ONLY ONE ROUTING)	06-29-2016
just straightener	06-27-2016
Layout 1	06-24-2016
layout 2.1	06-27-2016
layout 2.2	06-27-2016
layout 2.3	06-28-2016
Updated Layout 1	06-27-2016
updated layout 1.1	07-01-2016

Save the Current Layout

Distance Score:
Decreased
16.40%

Compared the Current Layout to:
Existing layout

Calculate

Layout 1: Benefits

Employee Safety

- Approximate material handling distance travelled by a new screw set = **1 mile = 5280 ft.**
- Material handling distance reduction obtained from Layout 1 = **20% = 1056 ft.**
- Average number of sets of screws done per month:
 - New screws: 24 sets
 - Rebuild screws: 12 sets
 - Repair screws: 12 sets
 - Coating screws: 12 sets
- Water Striders are solely responsible for pushing carts that weigh between 300 – 1600 lbs.
- Assuming that Rebuild, Repair & Coating screws travel half the material handling distance compared to New screws in Layout 1, **the total material handling distance reduction for the Water Striders:**
 - = $24 \times 1056 + 3 \times (12 \times 1056 / 2)$ (= 44,350 ft.)
 - = 8.4 miles per month
 - = **100 miles a year**

Layout 1: Benefits (contd.)

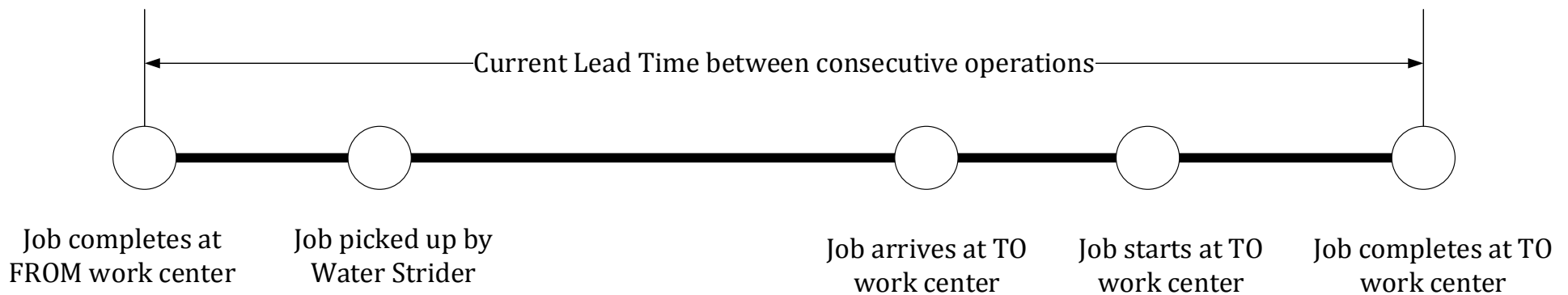
Cost Reduction

- **Assumption:** Speed of cart travel for loaded travel = *0.06 min/ft
- Time saved by reducing material handling distance = 2660 min per month
- Considering fully-burdened labor cost @ \$ 107/hour, the savings per year gained by reducing material handling distance travelled by the two Water Striders = $(2260/60 * 107)*12$
= **\$ 56,925**

Layout 1: Benefits (contd.)

Lead Time Reduction

- By reducing the travel distance between two consecutive work centers that process a job, there is an implicit assumption that current Lead Time between those two work centers can be reduced by 20% - 50%



- **Any Lead Time reductions gained from changes in the factory layout will require the following projects to be successfully implemented:**
 - **Job scheduling**
 - **Improving factory logistics using Water Striders**

Layout 1: Benefits (contd.)

Lead Time Reduction (contd.)

- Layout 1 will reduce the total time that any set of New screws spends between the following pairs of work centers:

Departments	Current Lead Time (Days)	Estimated Lead Time Reduction
Blank OD ↔ Straightener	3.4	50%
Straightener ↔ HOB	1.3	50%
CNC ↔ Straightener	3.3	50%
Straightener ↔ Simulation	1.3	50%
Polish ↔ Straightener	4.5	50%
Straightener ↔ Inspection	2.7	50%
Nitride ↔ Straightener	2.0	50%
PTA ↔ Straightener	1.1	20%
Straightener ↔ Grind	2.8	20%

- The 2015 data for completed New screws was used because E1 does not have data clocked for New screws. Based on this data, the current Average Lead Time for a set of New screws ≈ **117 days (= 16.7 weeks including weekends)**
- Using the Estimated Lead Time Reductions shown in the table, Layout 1 has the potential to reduce Average Lead Time for a set of New screws by **11 days (= 1.6 weeks)**

Layout 2

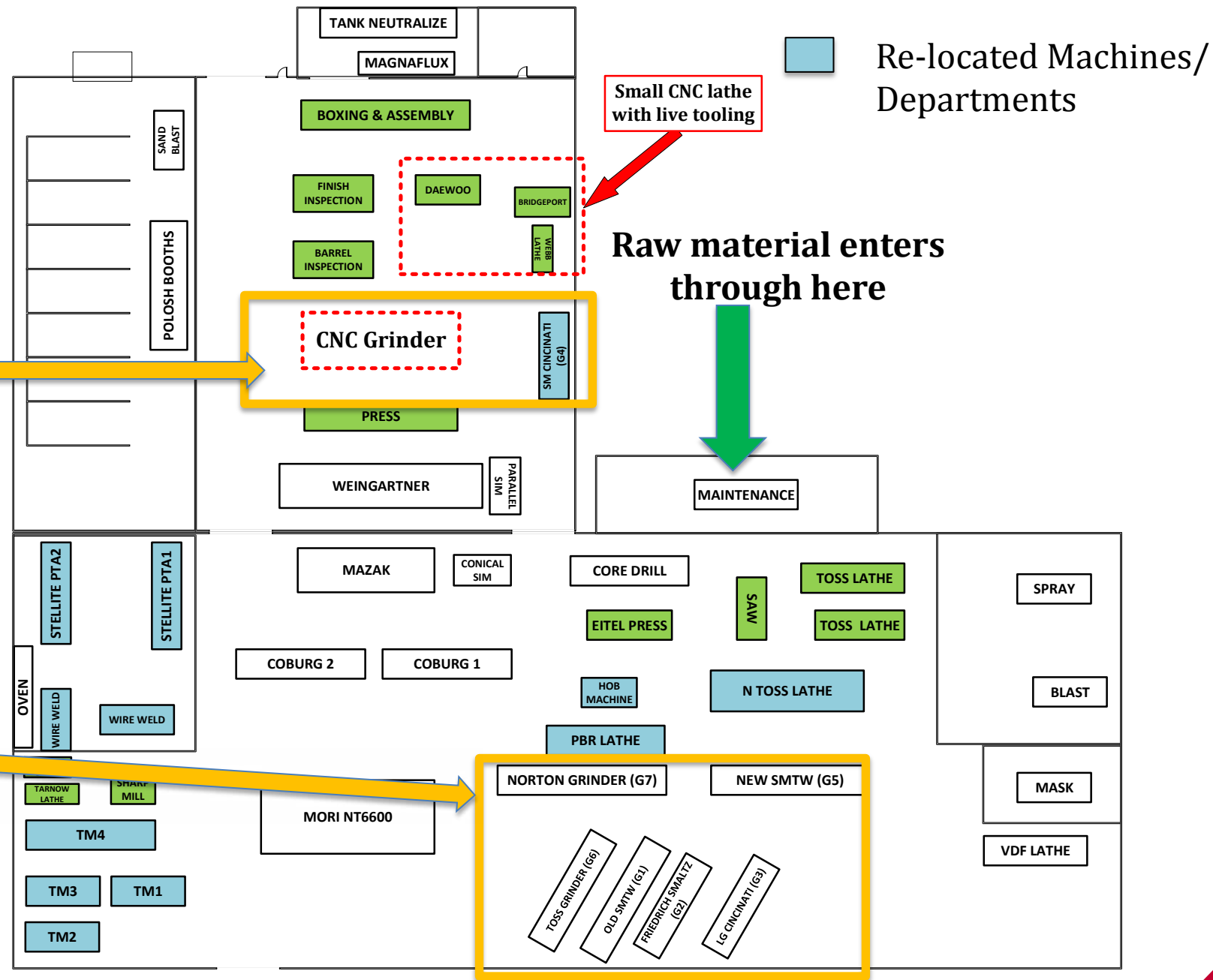
Changes made in Layout 1 to realize this new layout:

- Move Thread Mills 1, 2, 3 & 4 to the SW corner of the factory
- Move PBR Lathe next to the current location of Thread Mill 1
- Move Hob to the current location of Thread Mill 2
- Move North TOS Lathe to the current location of Thread Mill 4 to create a cell that includes Saw, Core Drill, East TOS, West TOS, North TOS and PBR Lathe.
- Move Welding department below Polishing
- Move VDF Lathe to the current location of Welding department
- Consider future Cap.Ex purchases:
 - CNC grinder put next to the Shipping department
 - Small CNC Lathe with live tooling to replace Daewoo, Bridgeport & Webb Lathe
- Move G4 to the current location of the North TOS Lathe

Layout 2: Improvements over Layout 1

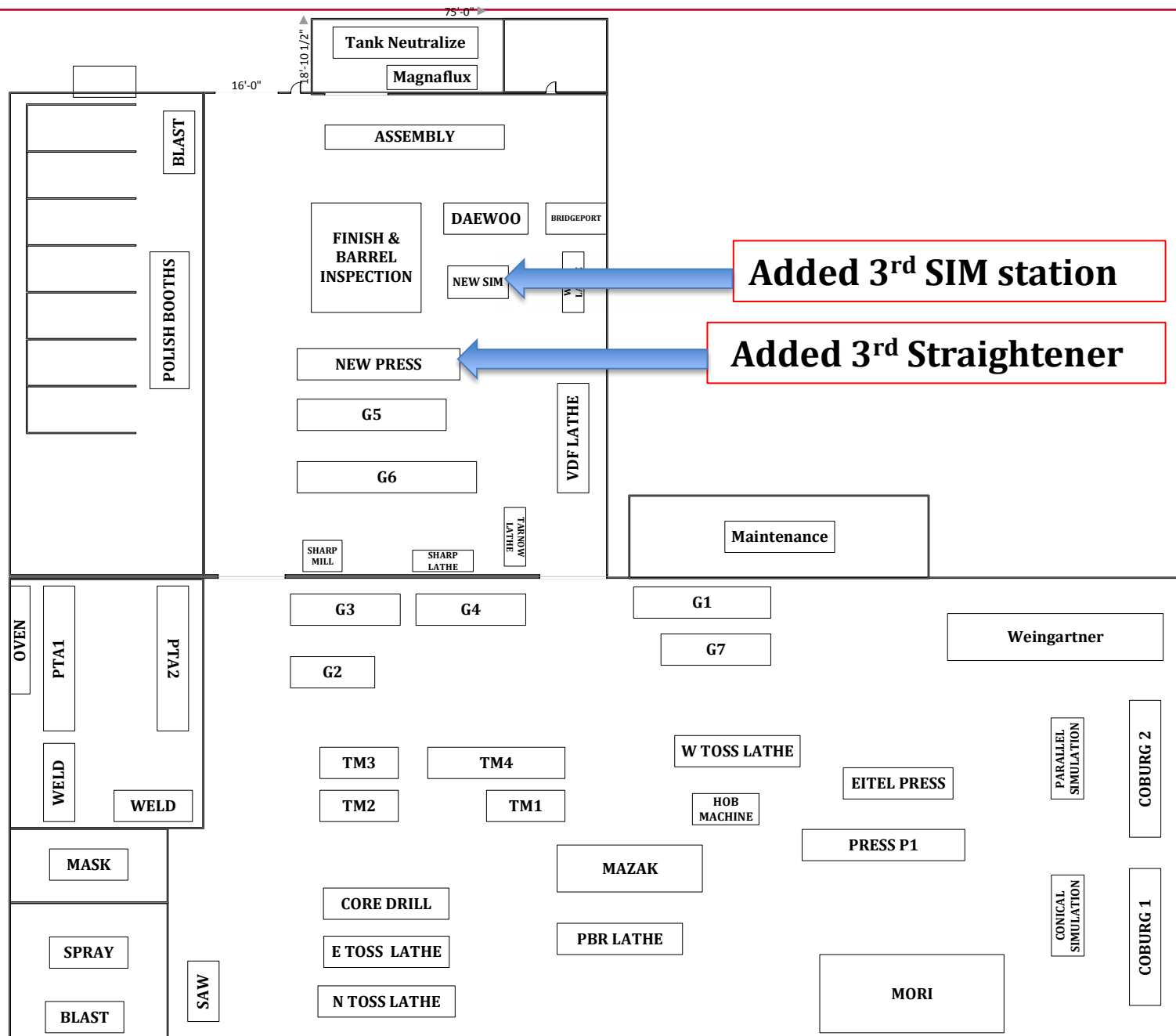
Grinding department 1:
Dedicated to grinding operations for the Weingartner and those done after Nitride process

Grinding department 2:
Dedicated to grinding operations before Nitride process



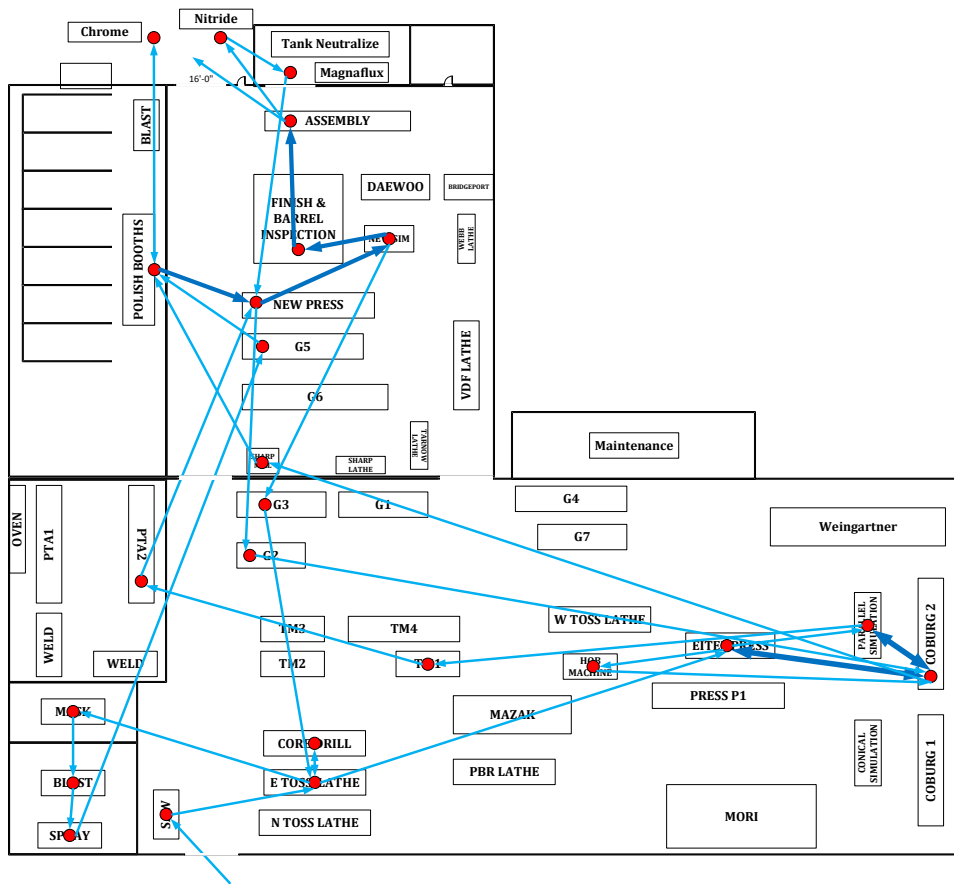
* Diagram is not to scale, kindly refer AutoCAD version

Layout 3: Ideal Flow With Current Equipment

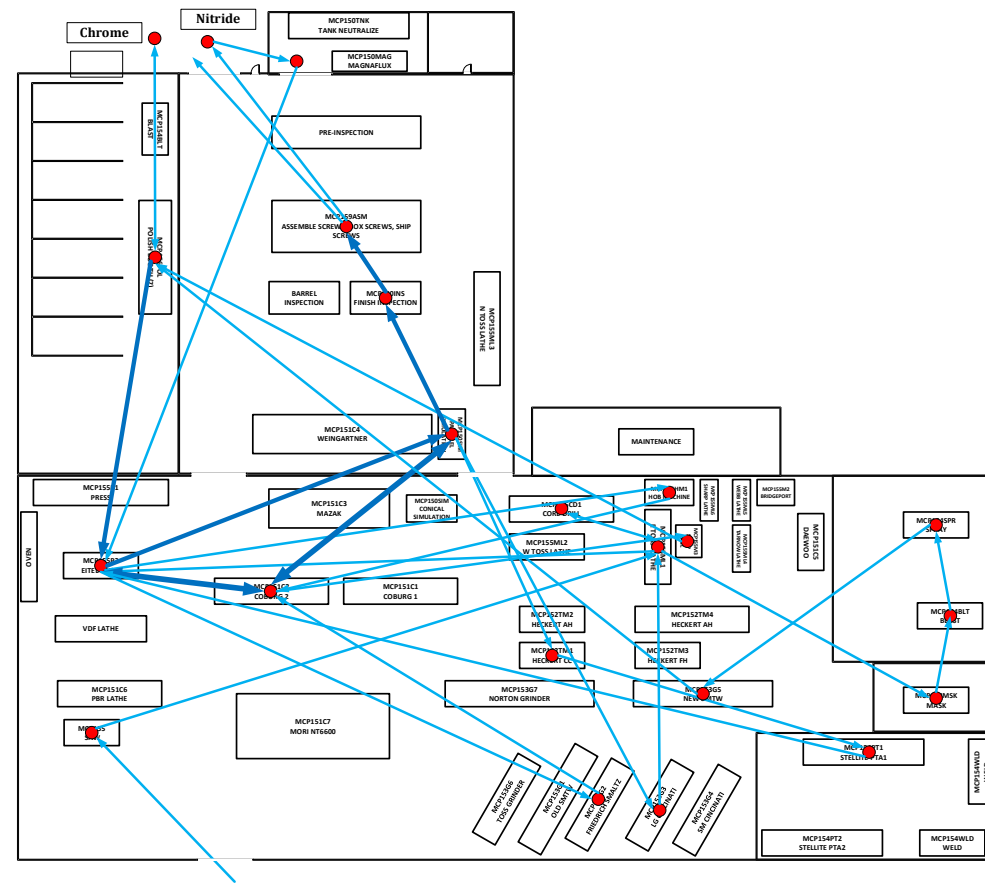


Layout 3: Ideal Flow VS Current Flow

Routing was mapped for New Tungsten Medium-size screws



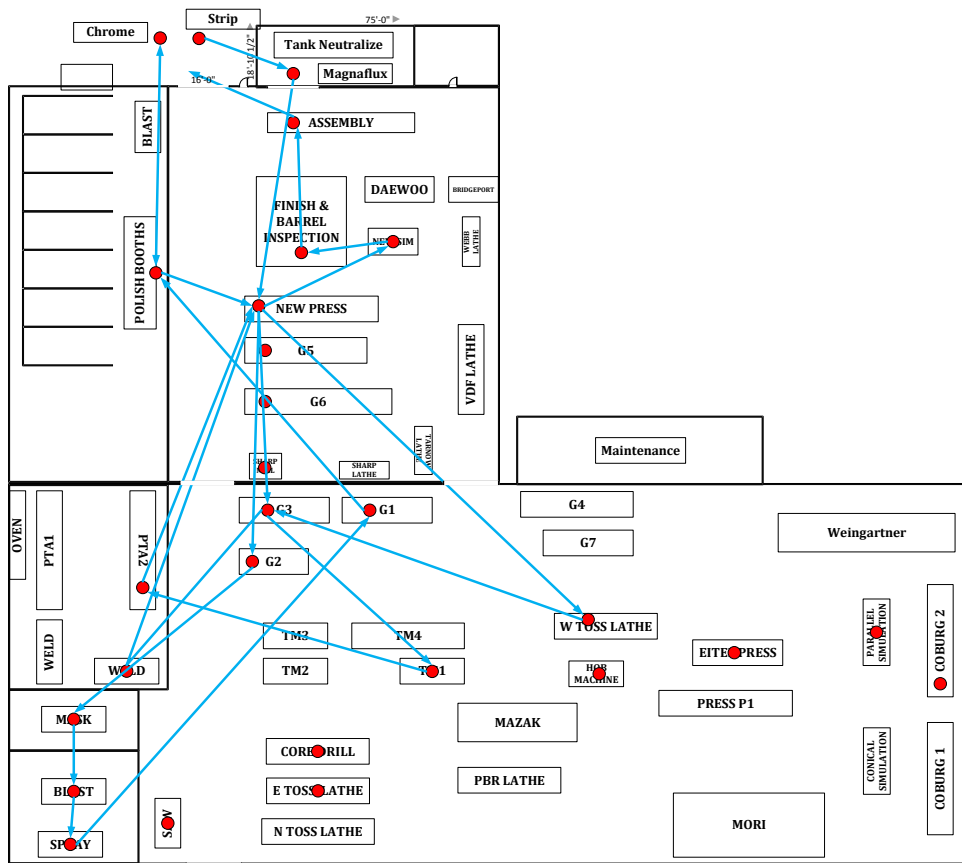
Layout 3



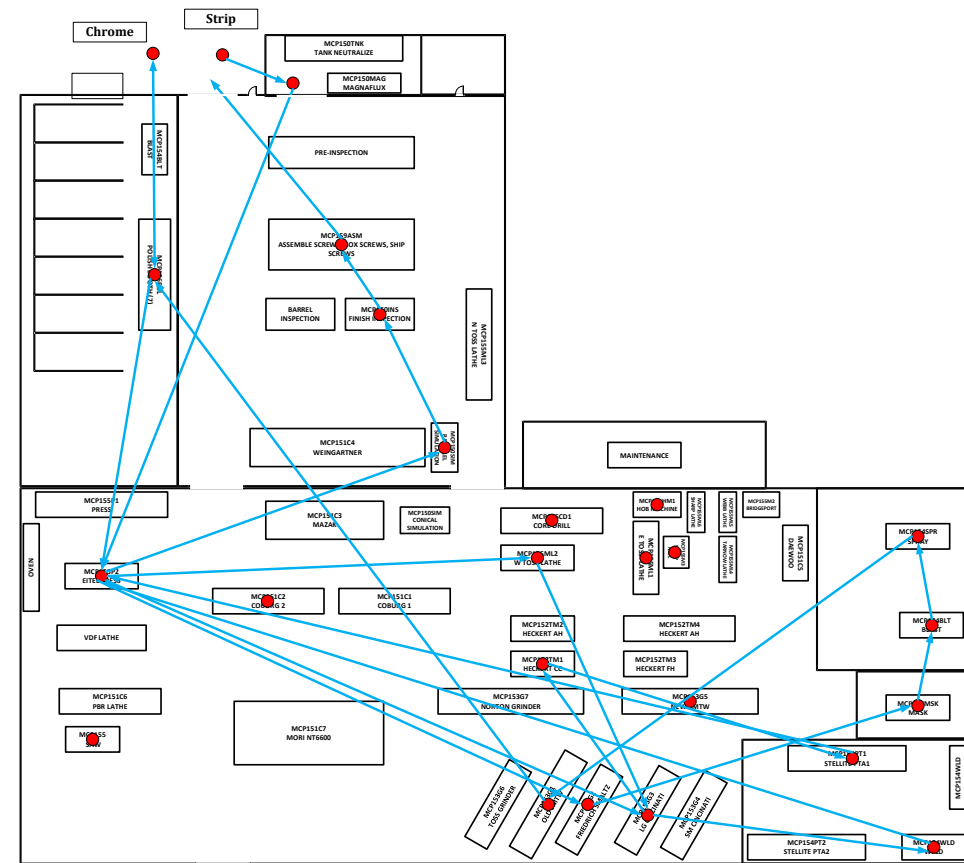
Current State

Layout 3: Ideal Flow VS Current Flow

Routing was mapped for Rebuild Tungsten Medium-size screws



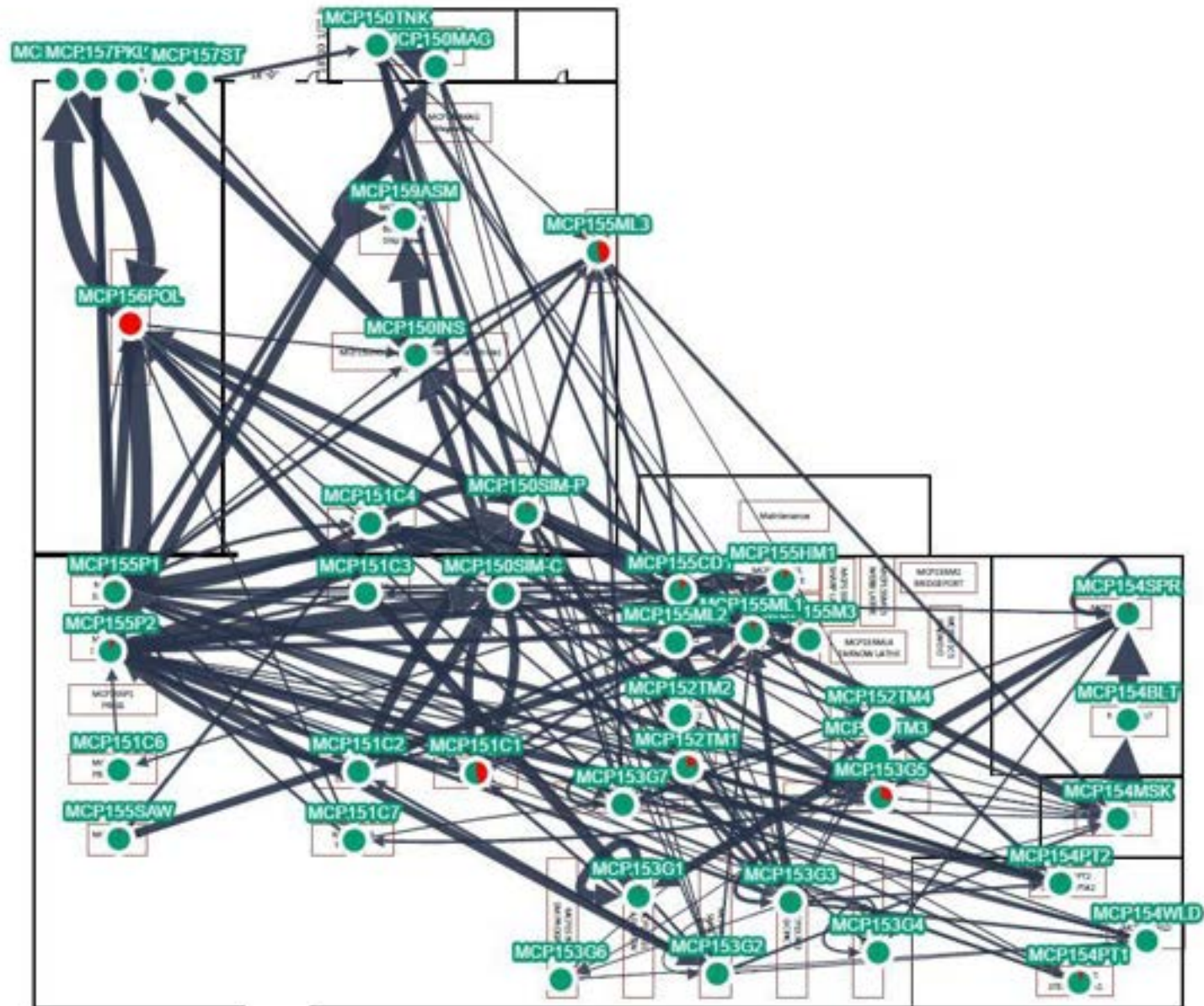
Layout 3



Current State

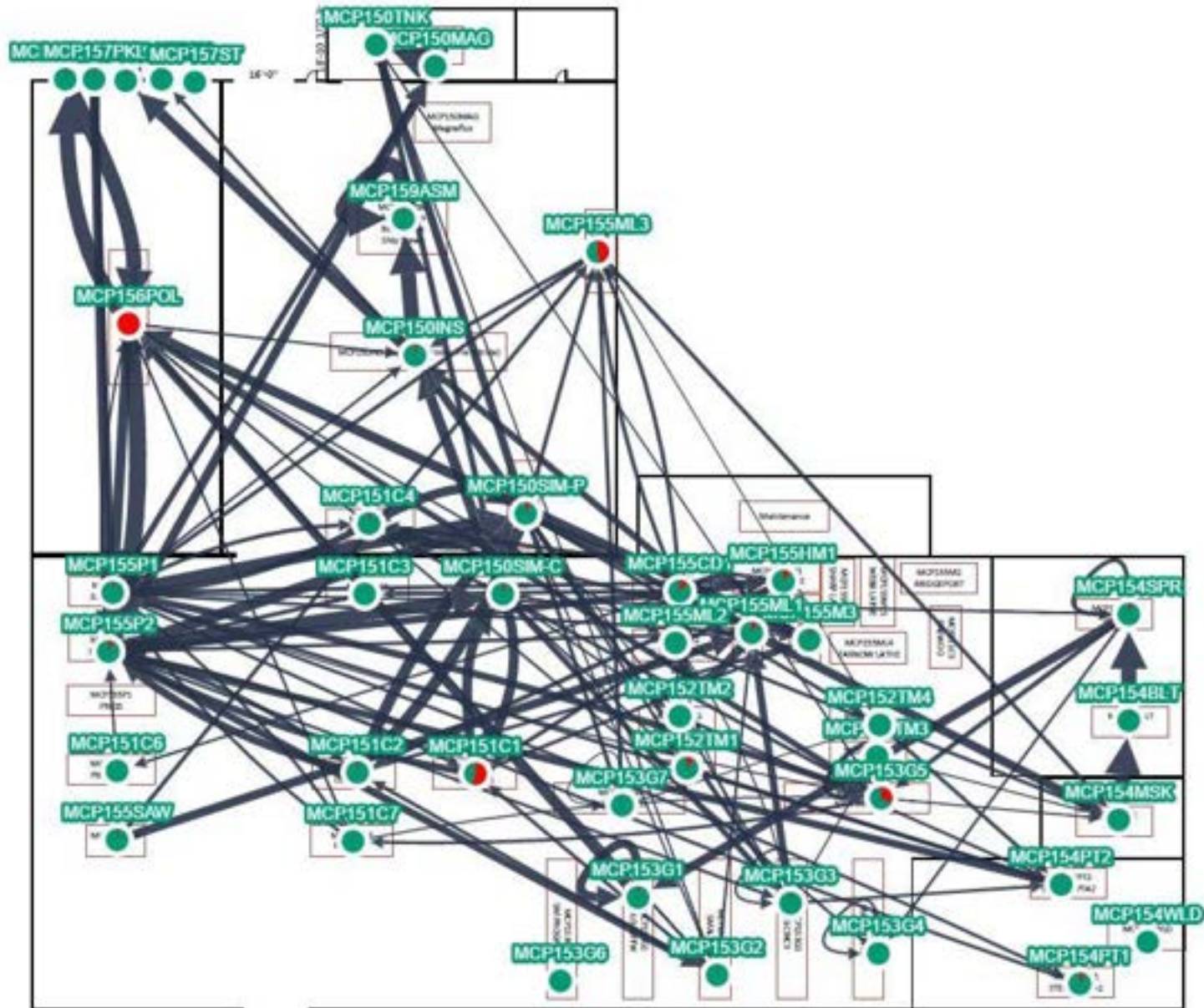
Layout 4: Two Separate Focused Factories

Current State for New, Coating & Rebuild screws



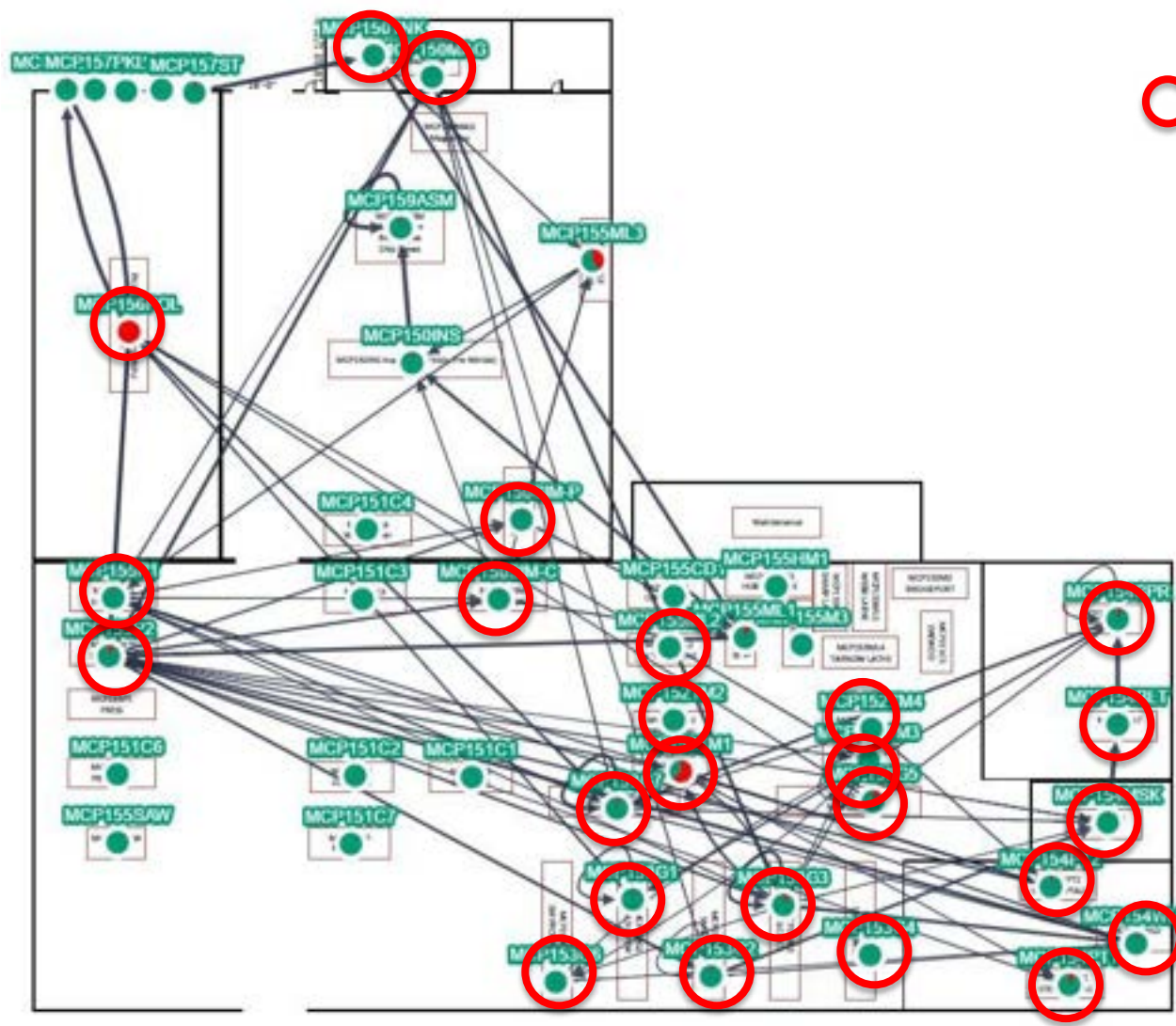
Layout 4: Two Separate Focused Factories (contd.)

Current State for only New & Coating screws



Layout 4: Two Separate Focused Factories (contd.)

Current State for only Rebuild screws



- Shared Resources:**
- Straightener Press
 - Grinders
 - Welding
 - Mask
 - Spray
 - Blast
 - Thread Mills
 - TOS Lathe
 - Simulation Stations
 - Polishing

Why Separate Focused Factories is NOT Advisable

- **Current machines do not have the flexibility to carry out all operations (ex: all existing grinders cannot perform all the different operations)**
- **Duplicating all of the shared resources requires significant CapEx**
- **Additional manpower will have to be hired**
- **Neither the resources nor the manpower will be at full utilization**
- **Current factory will have to be expanded to implement both focused factories**