System Design Project ● Industrial & Systems Engineering
Improvement of Material Flow in NC Shop
A Collaboration between Keppel FELS and NUS

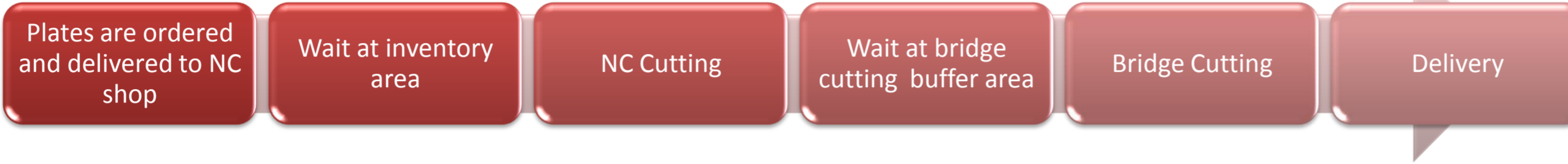NUS National University of Singapore

Keppel FELS

Introduction

Keppel FELS is the leader in the design, construction and repair of mobile offshore rigs. They provide cost-effective and state-of-the-art solutions to the customer.

Numerical Cutting Shop (NC shop) cuts raw plates in to desired shapes. It is the very beginning and fundamental stage in the production line.
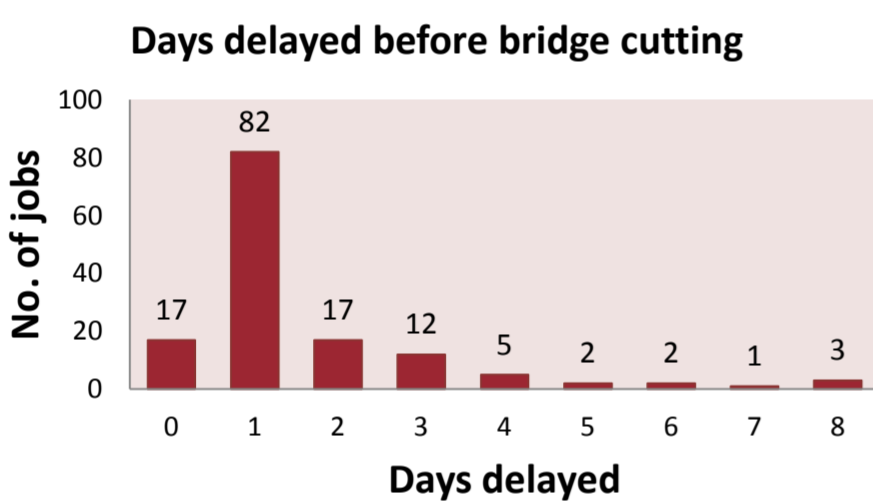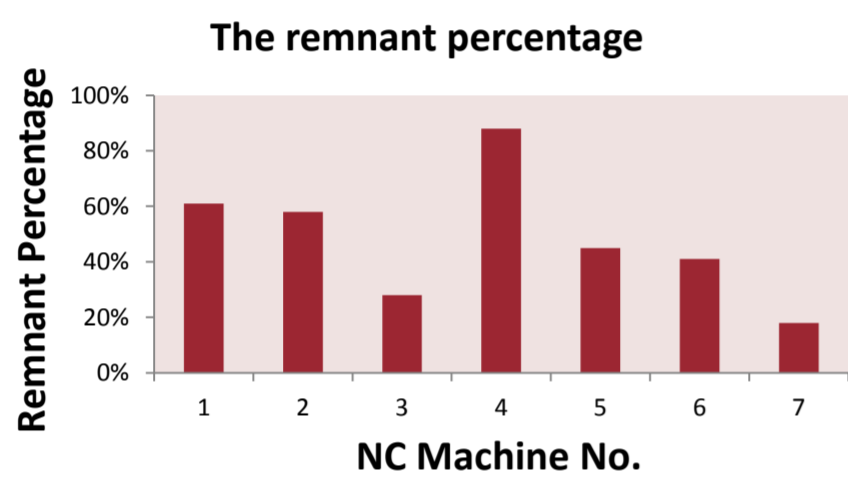
The objective of this project is to Improve the Materials Flow inside NC Shop in Throughput and Efficiency. More specifically, to reduce the *Cycle Time* of each plate staying in NC shop.

Plates are ordered and delivered to NC shop → Wait at inventory area → NC Cutting → Wait at bridge cutting buffer area → Bridge Cutting → Delivery

Tracking

Current Situation

- On average, more then half of the jobs use remnant plates
- Remnant plates are poorly tracked and hard to locate
- Bridge cutting jobs are not First In First Out (FIFO) and some plates delay for more than 3 days

The remnant percentage (chart: Remnant Percentage vs NC Machine No. 1–7)

Days delayed before bridge cutting (chart: No. of jobs vs Days delayed — values: 17, 82, 17, 12, 5, 2, 2, 1, 3 for days 0–8)

Proposed Solution

- Insert cradles in between such that multiple plates can be lifted together. It will increase the efficiency of searching plates
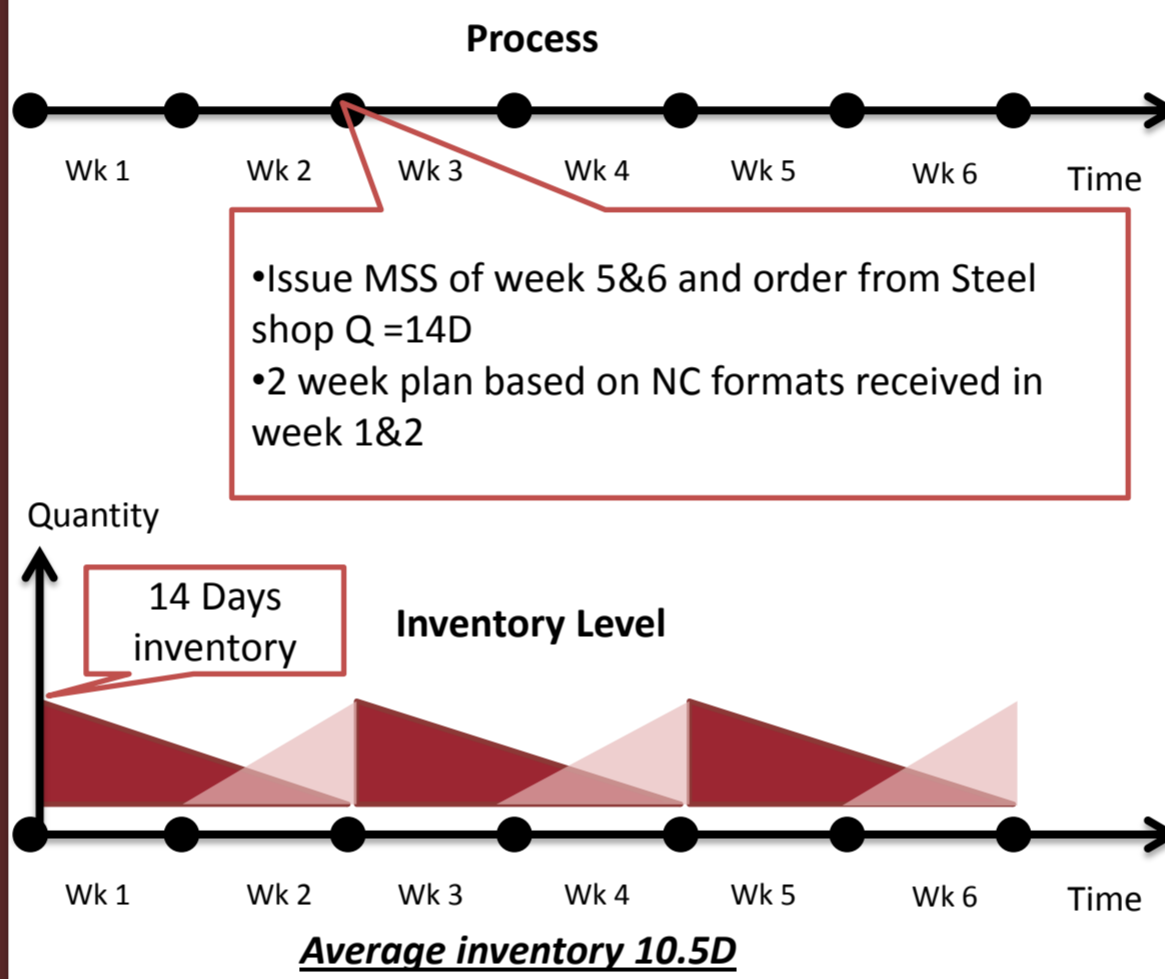- Introduce a white board to record the order of plates in a stack
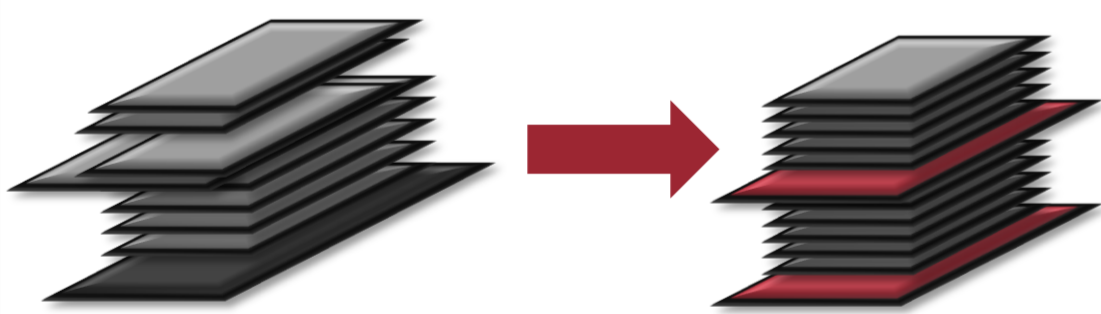
- Use two separate places on a rotational basis to store metal plates for bridge cutting buffer area
- When new shift starts, first move the remaining plates to the right stack. Then put the new comers on the left. Then continue cutting from right
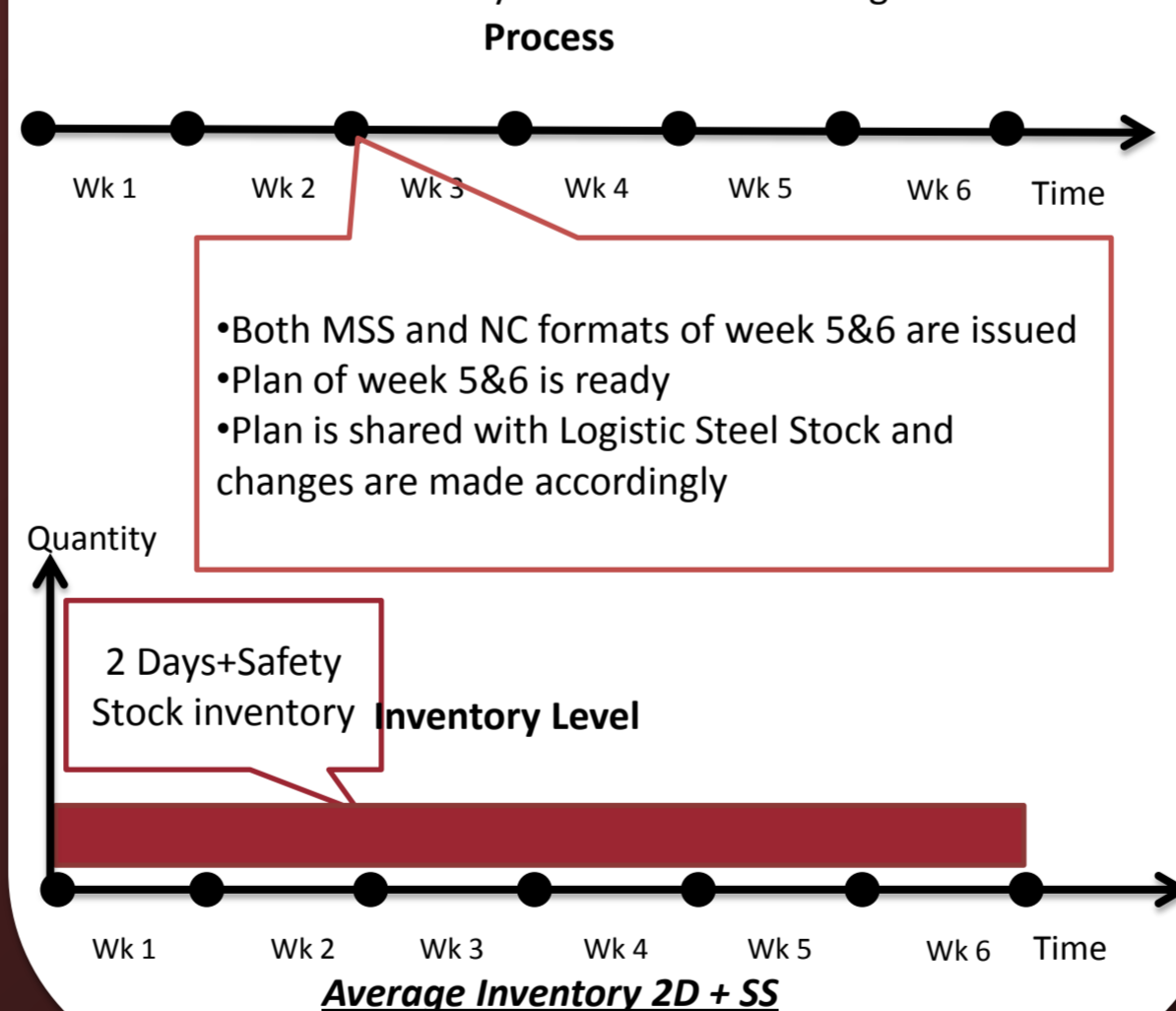
Step 1   Step 2
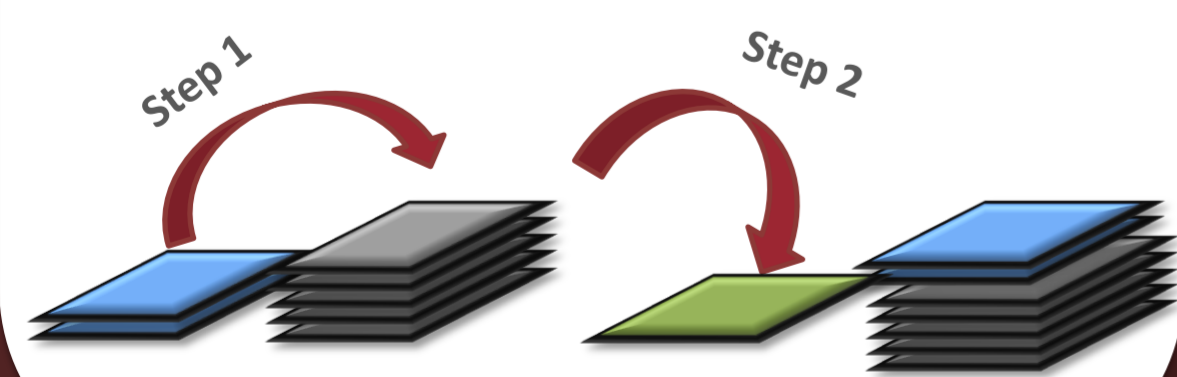
Planning

Current Situation

- Material Summary Sheets (MSS) are issued two weeks before actual cutting. NC formats are ready two weeks after MSS issued
- Plates start arriving one week after ordering
- Two week plan is settled only after all plates are ready

Process (timeline Wk 1 – Wk 6, Time)

- Issue MSS of week 5&6 and order from Steel shop Q =14D
- 2 week plan based on NC formats received in week 1&2

Inventory Level — 14 Days inventory
*Average inventory 10.5D*

Proposed Solution

- Both MSS and NC formats are ready 2 weeks before actual cutting. 2 week plan is settled right after MSS and NC are ready
- Current inventory level is monitored and shared with Logistic Steel Stock. Logistic Steel Stock can help manage the inventory level in NC shop
- Plates arrives two days before actual cutting

Process (timeline Wk 1 – Wk 6, Time)

- Both MSS and NC formats of week 5&6 are issued
- Plan of week 5&6 is ready
- Plan is shared with Logistic Steel Stock and changes are made accordingly

Inventory Level — 2 Days+Safety Stock inventory
*Average Inventory 2D + SS*

Operation

Current Situation

- Incoming plates are placed into 32 storage locations, according to different grades and thickness
- All the jobs are planned at the start of each shift, either day shift or night shift
- There are both full and remnant plates in the system
- A plate goes from raw material storage to NC machine, then to bridge cutting machine and leaves the system
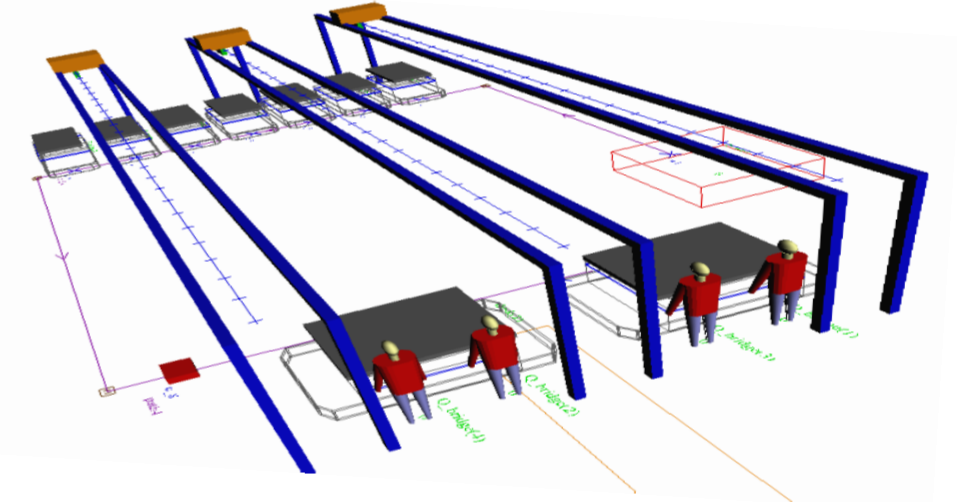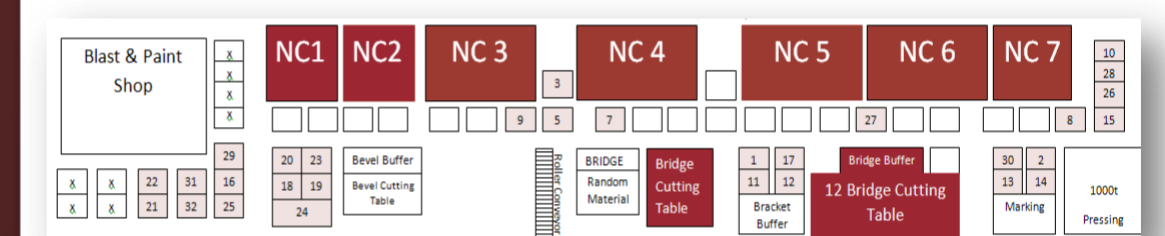
Proposed Solution

- Automod is used to simulate the situation in the NC shop, including all the NC machines, bridge cutting machines and the layout of the raw materials
- Instead of using a normal path-mover system, more sophisticated bridge-crane system is used
- Various scenario tests regarding job allocation, crane breakdown are implemented
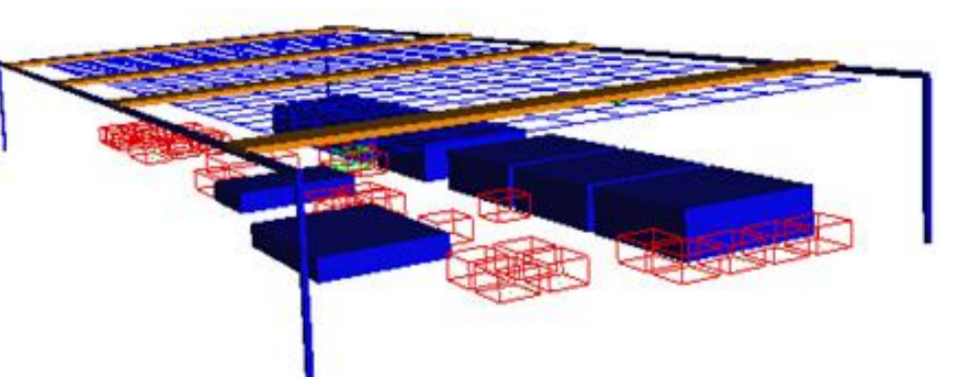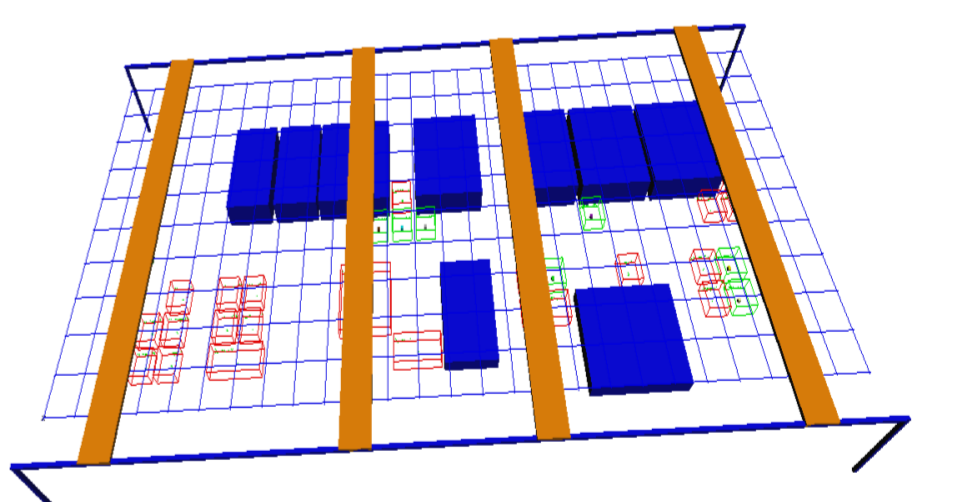
Conclusion

- In this system design project, the main focus is on the above three aspects to increase the material flow and efficiency.
- In terms of tracking, we propose to add cradles to facilitate lifting and two stacks of plates used on a rotational basis to achieve First In First Out (FIFO) for bridge cutting.
- As for the planning part, we suggest that the issuance of MSS and NC format must be in time for steel plates cutting. And it is strongly suggested that the Logistics Steel Stock can manage the inventory for NC shop, as Vendor Managed Inventory (VMI) or even Collaborative planning, forecasting, and replenishment (CPFR) is successfully used in many industries.
- Finally for the operation part, we simulated the actual situation in the software automod, and different scenarios have been tested. The proposed solutions above prove to be effective.

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