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The Use of a Smart Factory Laboratory to Demonstrate Digital Manufacturing Capabilities in Industrial and Systems Engineering Education

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Objective

This presentation will introduce:

- An overview of the Smart Factory
- The standard work instructions created to facilitate the smart factory's operation
- The development of a lab to be incorporated into the Simulation class at UAH

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Understand the Capabilities of the Smart Factory

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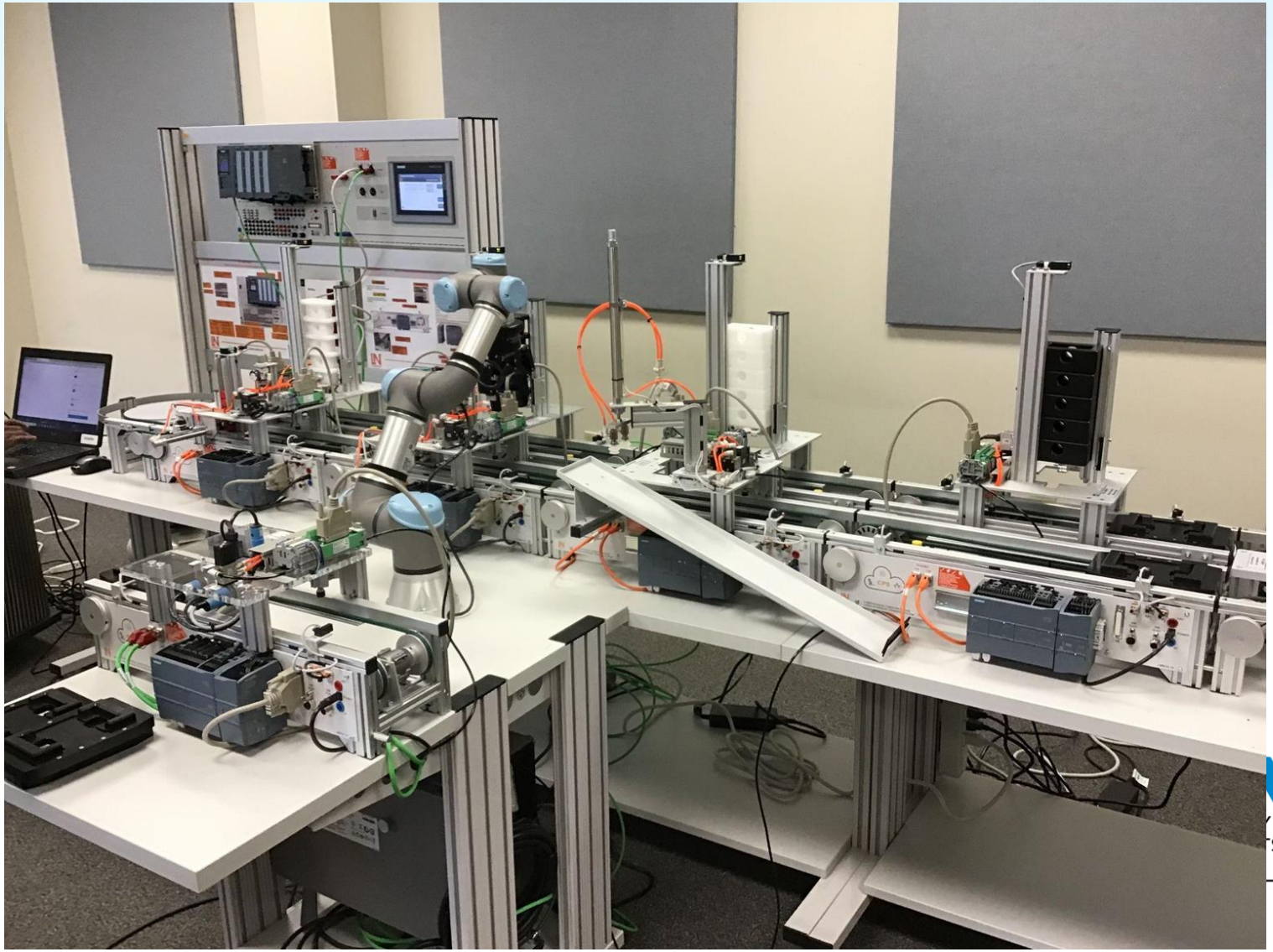
Smart Factory Overview



Product Components

Bottom Part

Top Part

Bolts

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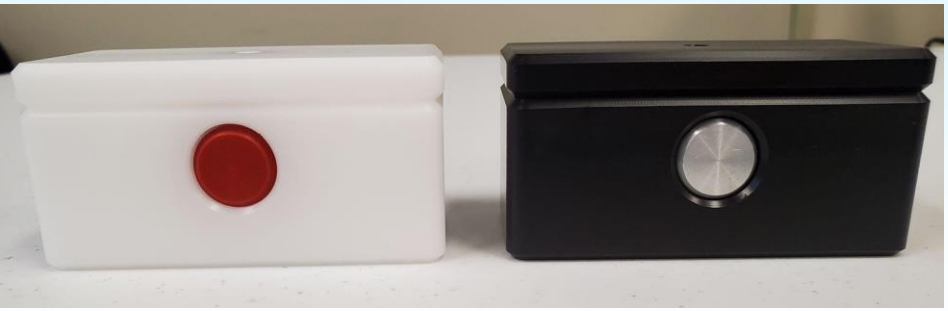
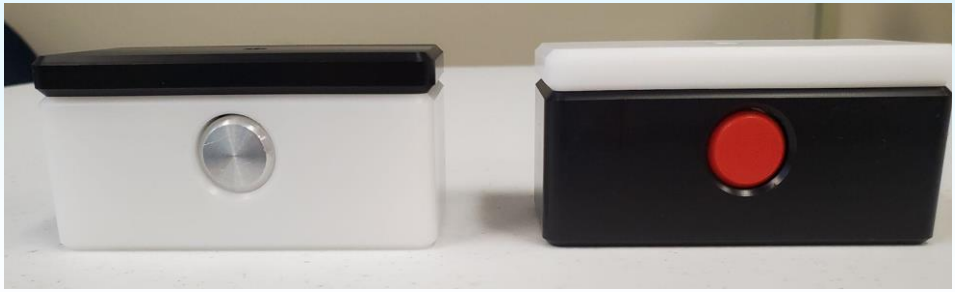
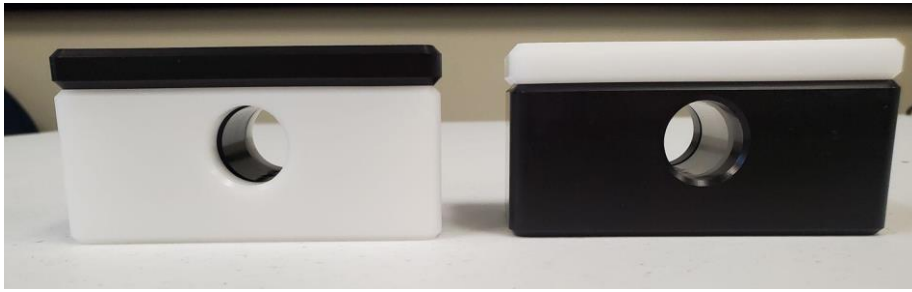
Customization Options







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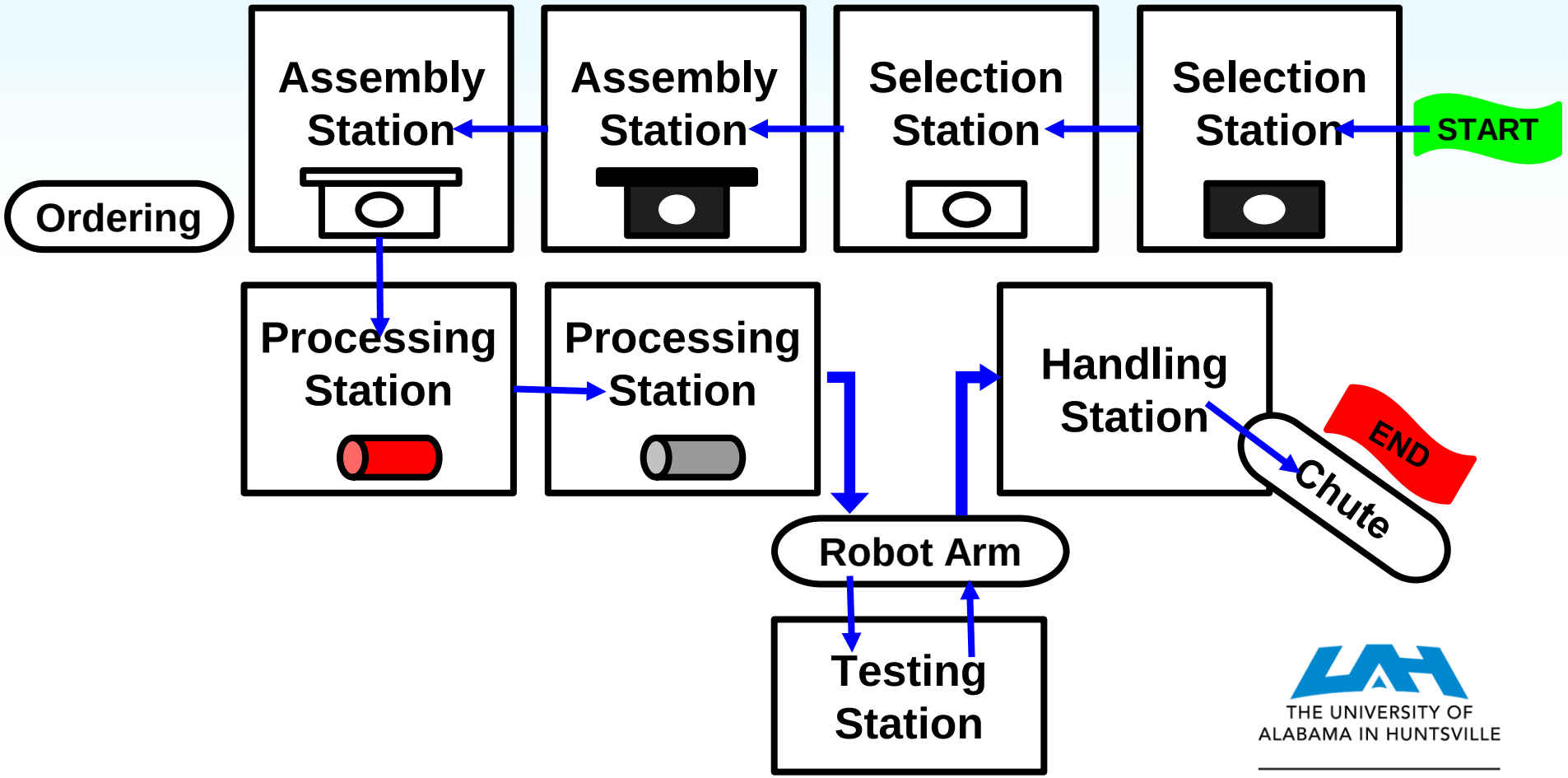
Part Flow



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Create User Documentation

Standard Work Documents (SWD)

1. System Startup
2. Customer Ordering
3. Part Disassembly and Reloading
4. System Shutdown

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SWD Examples:
System Startup & Customer Ordering

System Startup

1 Turn on power strip/surge protector

Key Points:

* Main power strip is on the back right of the Smart Factory, below station 5/6
* Ensure all other power strips come on after the first one is turned on

2 Power on laptop and log in

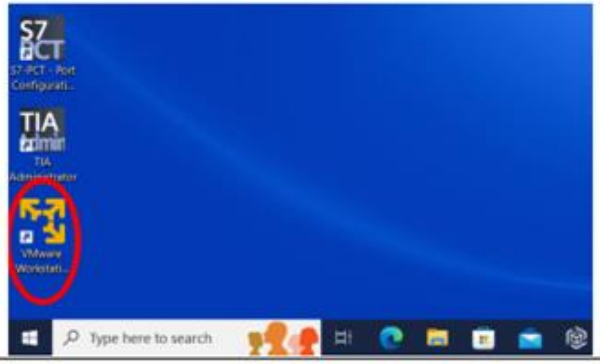
Key Points:

* Laptop password is: ***oktn102***

3 Open the virtual machine software **VMware Workstation**

Key Points:

* Shortcut is located on the lefthand bottom side of the desktop

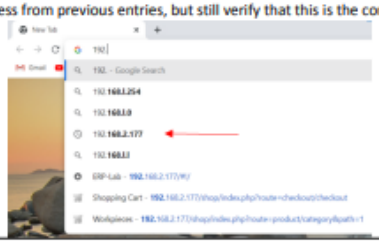


Customer Ordering

1 Open Chrome browser and enter VMWare's IP address

Key Points:

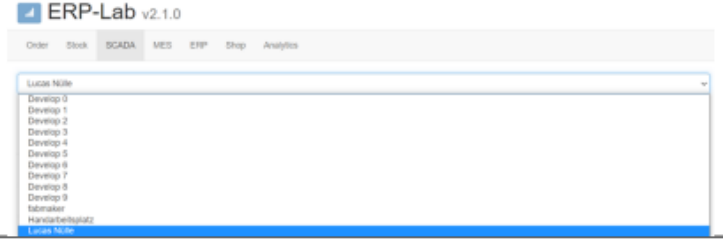
* IP Address is 192.168.2.177
* Chrome may autofill the IP address from previous entries, but still verify that this is the correct IP address before continuing



2 Click the tab that says "SCADA" and select "Lucas Nülle"

Key Points:

* After clicking "SCADA" tab, a blank dropdown box will appear right under tabs
* Click the dropdown arrow and scroll down to select "Lucas Nülle"



3 Refresh each station before ordering.

Key Points:

* Refresh button for each station is in the far-right column of its respective row

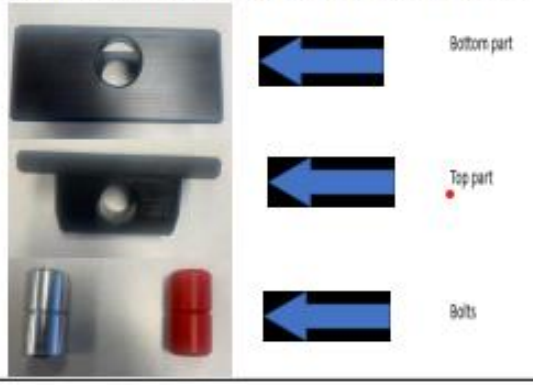
SWD Examples:
Part Disassembly/Reloading & System Shutdown

Part Disassembly and Reloading

1 Introduction to Workpieces

Key Points:

* There are two seperate bottom parts(white and black) with five total of each individual part
* There are two seperate top parts (white and black) with five total of each individual part
* There are two seperate bolts (red and silver) with five total of each individual part



2 Insert bottom part (black and white rectangle) in selection station 5-6.

Key Points:

* When inserting make sure to put the bottom part in from the top of the fixture.
* After inserting the part make sure the clear piece is in the middle of the circle of the bottom part.
* Five is the max number of bottom pieces per bottom part design. (white and dark)

3 Insert top parts (black or white rectangle with flat top) in assembly station 7-8.

Key Points:

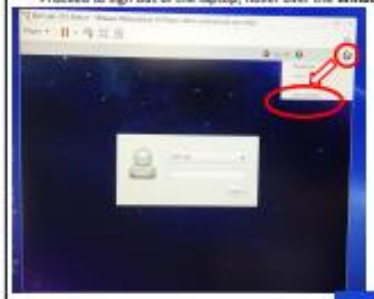
* When inserting make sure to put the top part in from the top of the fixture.
* After inserting the part make sure the part is resting on the clear piece at the bottom of the fixture.
* Five is the max number of top parts per color.

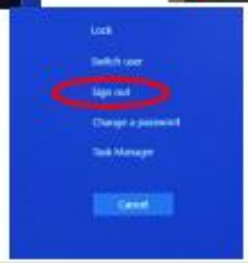
System Shutdown

1 Power off the laptop.

Key Points:

*On the **VMware Workstation 16 Player**, click the **Power Button** on the top right then **Shut Down.**
*If a pop-up window appears asking how to close the virtual machine, select the option **Power Off.**
*If an additional pop-up window appears asking if you are sure you want to power off, select **Yes.**
*Close the remainder google chrome web browsers by clicking on the X in the upper right corner.
*Proceed to sign out of the laptop, hover over the **Windows icon** on the bottom left > select **Shut down** > select **Sign out.**

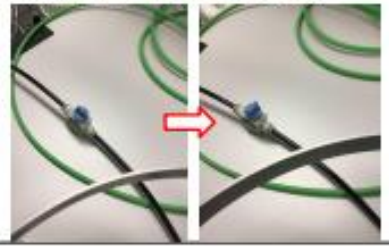




2 Power off the conveyor line and other pneumatic devices.

Key Points:

* Turn the air compressor control valve counterclockwise 90 degrees to power it off.
* Ensure the grip on the handling station drops down.



Incorporate the Smart Factory Into Coursework

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Team Labs

- **Lab 1: Simulation**
- **Lab 2:** Operating and Programming the Robot Arm
- **Lab 3:** Quality
- **Lab 4:** Minimize Lead Times using PLC

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Lab Purpose

- Simulation provides a visual understanding of how manufacturing processes function.

- This lab was designed to help the Simulation class students understand beginner simulation.

- Students will learn to:
  - Visualize a system
  - Analyze a system's behavior
  - Gather and interpret statistical data

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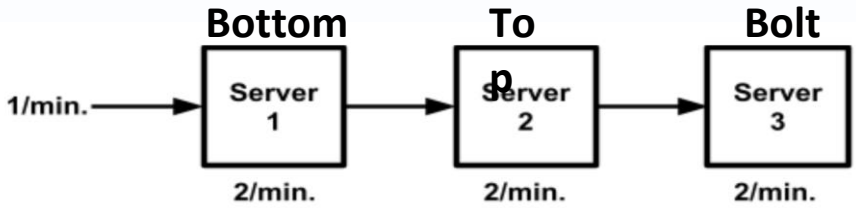
Lab Overview

- Defines the basics of how to use the simulation software product (SIMIO).
- Provides a scenario and input data to build a simple SIMIO model of the system.



  - Arrival Rate, Process Rate, Process Time
- Asks students to gather and interpret statistical data.
  - Throughput, Avg. Time in System, Avg. Number in System.
- The physical Smart Factory can be used to validate the SIMIO model

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Conclusion

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