

# Data in Manufacturing

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## New Data Outcomes for MANU

### Problem Identification

- Define a problem statement, hypotheses of potential root causes and solutions, and data analysis techniques required to assess, validate and solve a manufacturing problem.

### Collection

- Design and apply appropriate data collection technologies for instrumentation and manufacturing operations.

### Storage and Processing

- Prepare data for analysis, evaluate the quality of data sets, and design and implement appropriate data storage methods for manufacturing operations.

### Analysis

- Enhance manufacturing performance by using data in process simulations, creating key performance indicators, and evaluating indicators to improve operational efficiency, quality, and reliability.

### Visualization

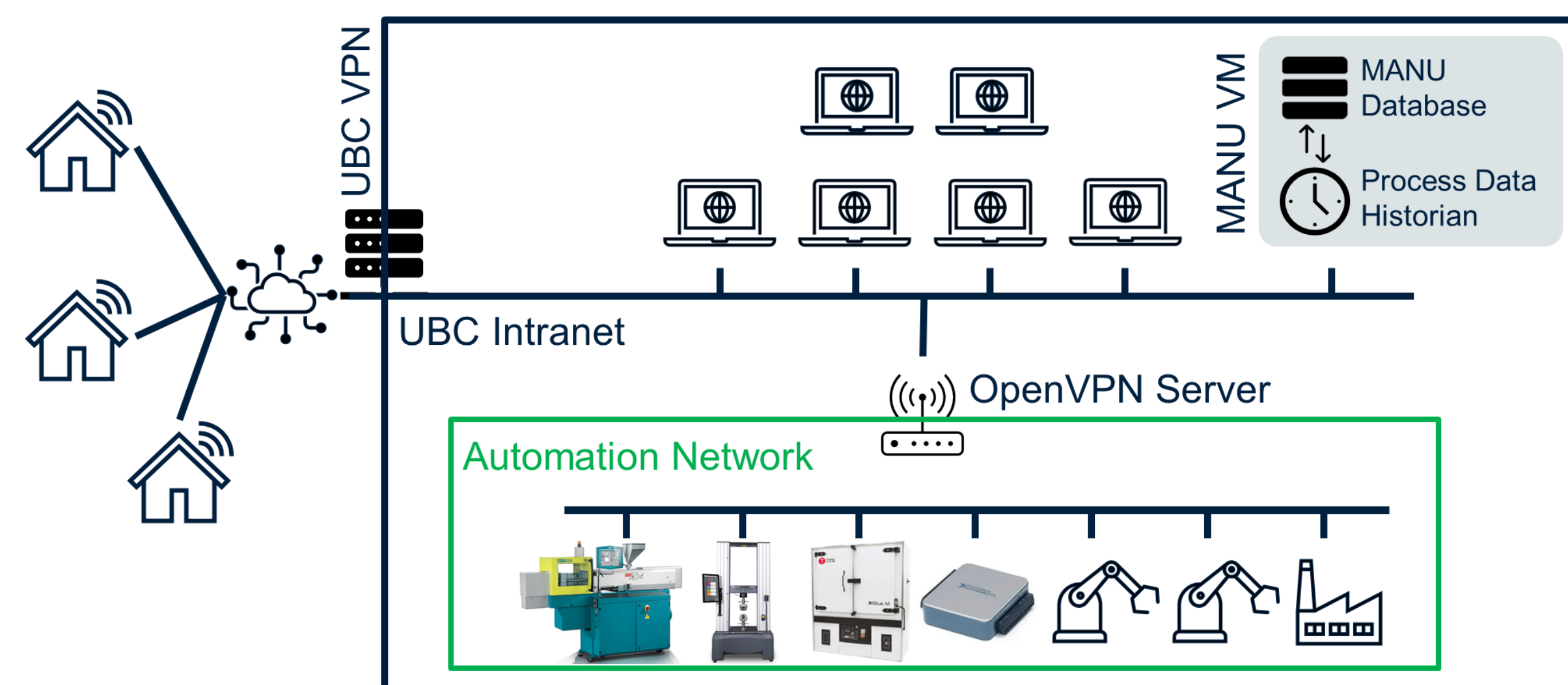
- Create, critically assess, and effectively communicate data-driven visualizations and metrics with appreciation for context, aesthetic, value, and audience.

## Evaluating Coverage

Instructors of courses in years 2-4 were asked to map their courses and their Course Learning Outcomes against the newly proposed Data in Manufacturing Stream Program Learning Outcomes on a 3-point scale: Introductory, Developing, and Advanced. This was used to investigate coverage gaps and plan new content.

Academic Year	By Course					By CLO				
	Define to Solve	Apply Tech	Data Skill	Enhance MANU	Viz & Metrics	Define to Solve	Apply Tech	Data Skill	Enhance MANU	Viz & Metrics
Year 2 12 courses	D	I	I	A	D	D	A	A	D	D
	I	D	I	A	D	I	I	I	I	I
	I	D	D		D	I				I
	I	I	I		I	I	I	I		I
	D	I	D	I	D	D	I	I	D	D
	D	I	I	I	D	I	D	D	I	I
	D	D	D	D	D	D	D	D	D	D
	D		A		D	D		A		D
	D	I	I	I	I	I	I	I	I	I
	A	A	A	A	A	A	A	A	A	A
	D	A	D	I	A	A	A	A	D	D
	D	A	I	A	A	A	A	A	D	A
Year 3 7 courses	A	A	A		D	A	A	A	A	A
	D	D	A	A	D	D	D	D	A	A
	I	I	I	I	I	I	I	I	I	I
Year 4 9 courses	A	A	A		D	A	A	A	A	A
	D	D	A	D	A	A	A	A	A	A
	I		I	I	I	D	D	D	D	D

Heatmap Illustration of Curriculum Mapping to Data in MANU Stream PLOs



Lab Automation Network Schematics

## New Content and Tools

Two existing UBC courses are proposed to be incorporated as a part of the Data in MANU Stream. Additionally, two new courses on 'Manufacturing Information Systems' and 'Smart Manufacturing' are proposed to address the content gap in the proposed data-related Manufacturing PLOs.

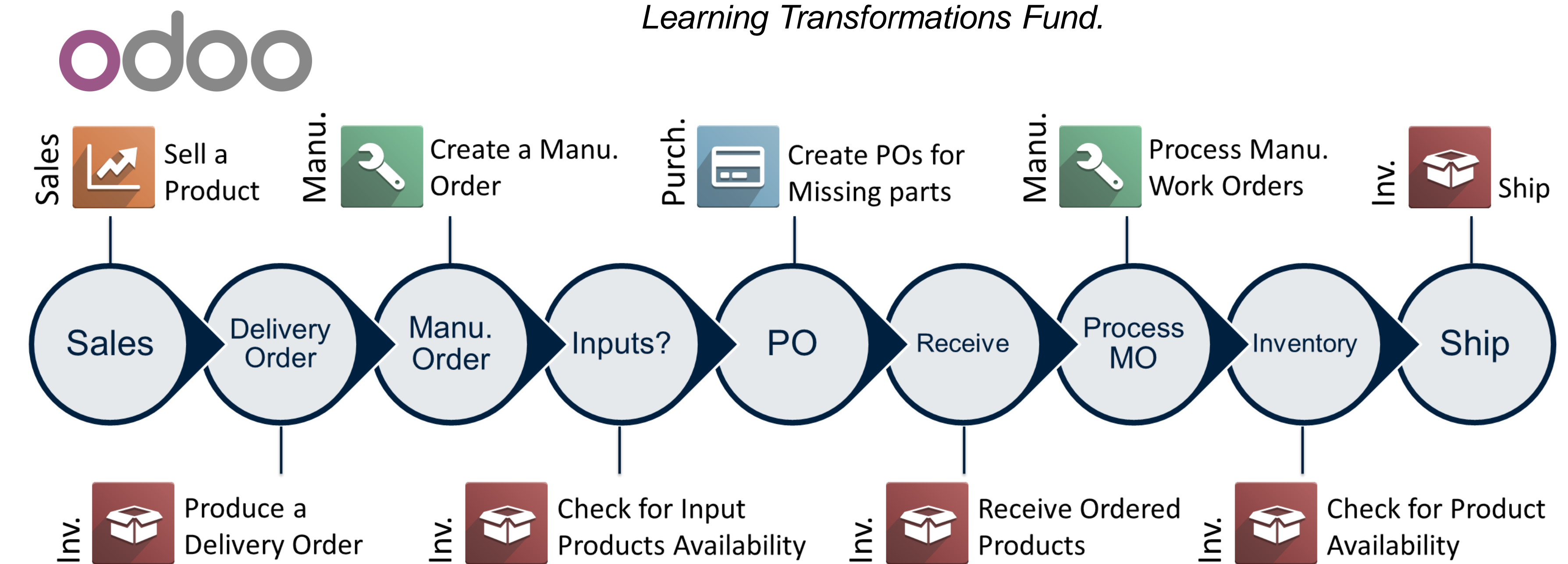
## Lab Automation

A private network was established for the MANU Program that connects lab equipment such as injection molding machine, oven, NI modules, and load frames to MANU Virtual Machine containing process historian and a database to store process data. All users will be able to access this database to retrieve or add data.

Several resources were developed to enhance the student learning experience, including LabVIEW Virtual Instruments, a Python Library, and Jupyter Notebook templates. All developed resources are thoroughly documented. Furthermore, a manual and a video tutorial are prepared to supplement learning experience.

## Enterprise Resource Planning

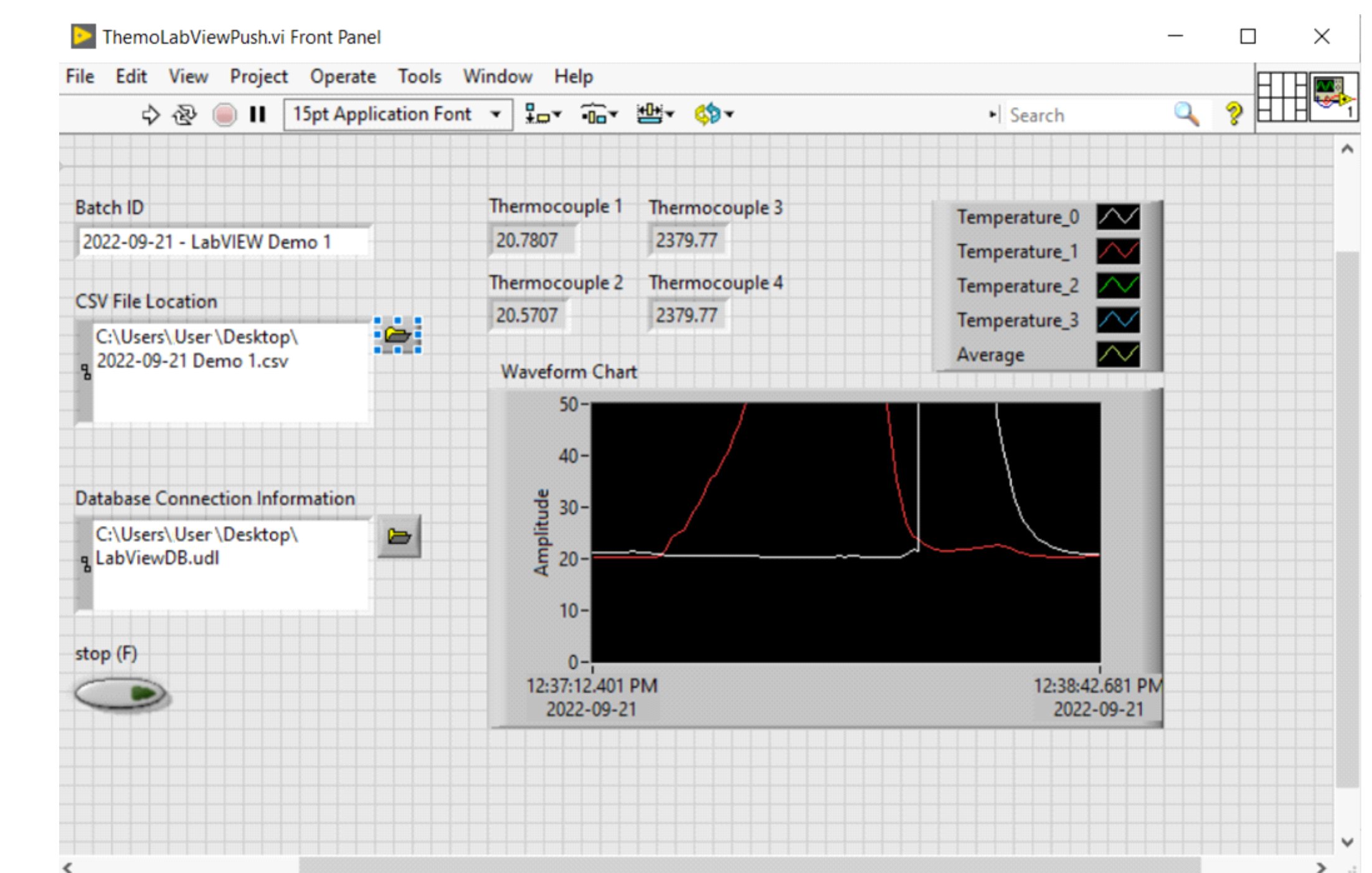
A survey of proprietary and open-source ERP systems was performed and Odoo ERP was proposed to be used for the MANU Program.



Manufacturing Operations Management Workflow in Odoo

## Course Enhancement

Four pilot courses were selected to initiate the integration of the developed resources, setting the stage for broader implementation across the curriculum. In close collaboration with course instructors, new content, such as lab instructions, guides, and lectures, was developed to facilitate the integration process.



A LabVIEW VI collecting data from a NI Module and inserting them into the MANU database

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