Digital Manufacturing Cell - Standards Based Approach

Jannat Asim | Paula Clares | John Luksas | Dan Nguyen

Company Contacts: Benjamin Moses and Shaurabh Singh

Faculty Advisor: Professor L. Kenneth Harmon

Background

The Association for Manufacturing Technology:
- Founded in 1902
- Headquarter based in McLean, VA
- 580+ members (VT included)
- Supports small/ medium manufacturing companies.
- International Manufacturing Technology Show (IMTS)

Learning Factory
- Academic testbed at Virginia Tech for research
- Industry 4.0 research hub

MTConnect®
- Communication standard (i.e., language) for data protocol in manufacturing technology

Opportunity

Learn
Guide students and manufacturers seeking knowledge to implement MTConnect standard by using the Learning Factory as a testbed

Accelerate
Establish step-by-step industry documentation of MTConnect to provide recommendations and limitations encountered

Replicate
Facilitate standardization of MTConnect in Industry 4.0 and academia to ensure reproducibility
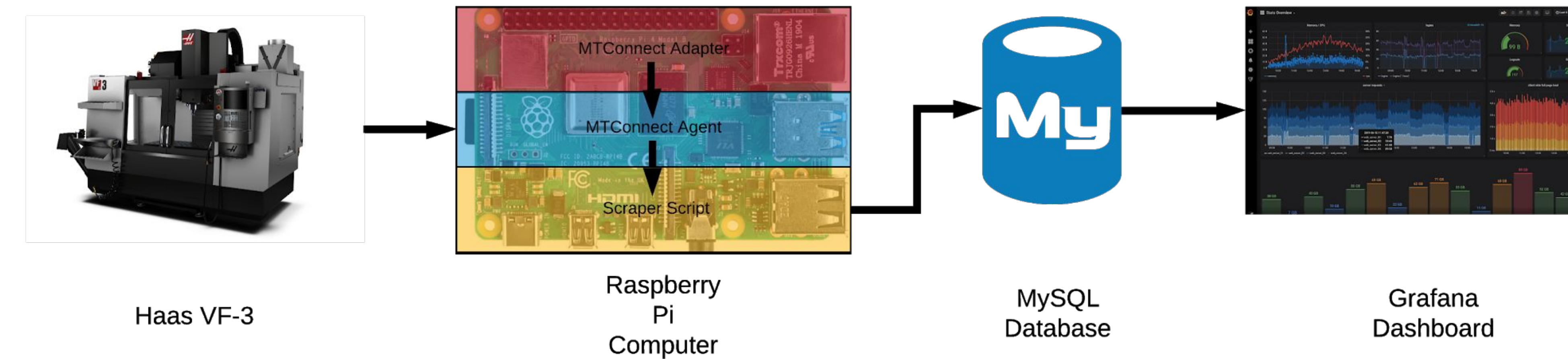
Objectives

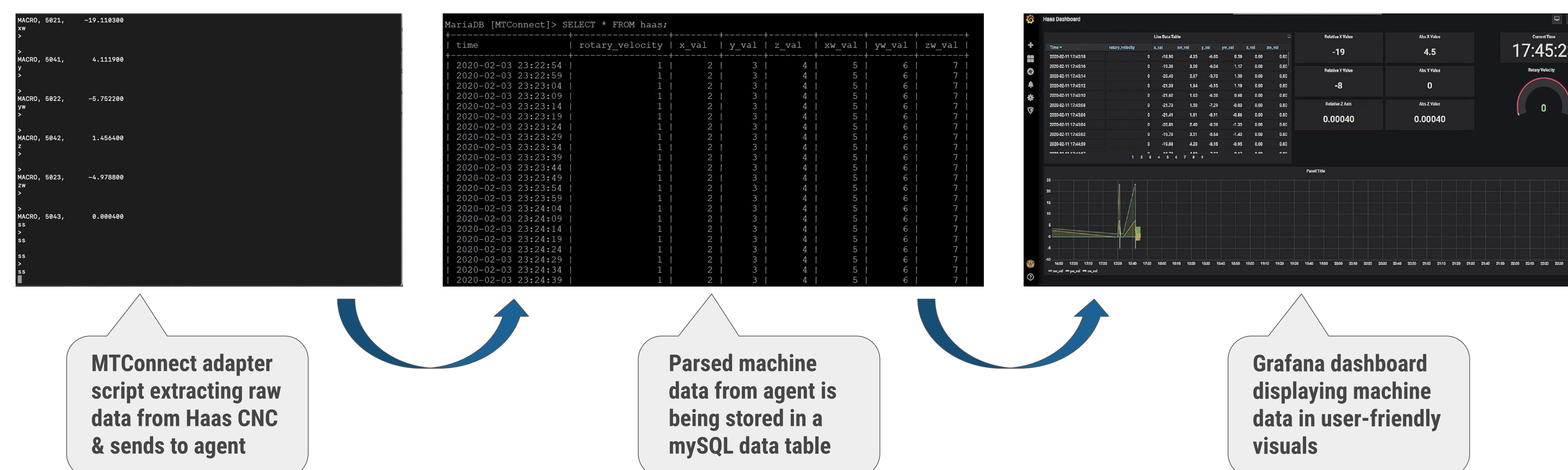|			Threshold	Units
1	Implement MTConnect Adapter and Agent	• Implement Haas CNC adapter and agent on Raspberry Pi • Ensure Haas CNC machine parameter dataflow	5	Machine Parameters
2	Implement Database Visualization of Data	• Live storage of Haas CNC machine parameters • Parsing and displaying useful live data on dashboard	5	Machine Parameters
3	Finalize Deliverables	• Functional code-base • Interactive dashboard • Industry handbook	100	Percentage Complete

MTConnect Standard

1. Open source communication standard between machines - like a language
2. Enables uniformity of data across the board - no need for translation
3. Data sources: robotics, machine tools, production equipment, sensors and other machining hardware
4. Possible applications: operational efficiency, production and productivity improvements

MTConnect Implementation

Haas VF-3 → Raspberry Pi Computer (MTConnect Adapter, MTConnect Agent, Scraper Script) → MySQL Database → Grafana Dashboard
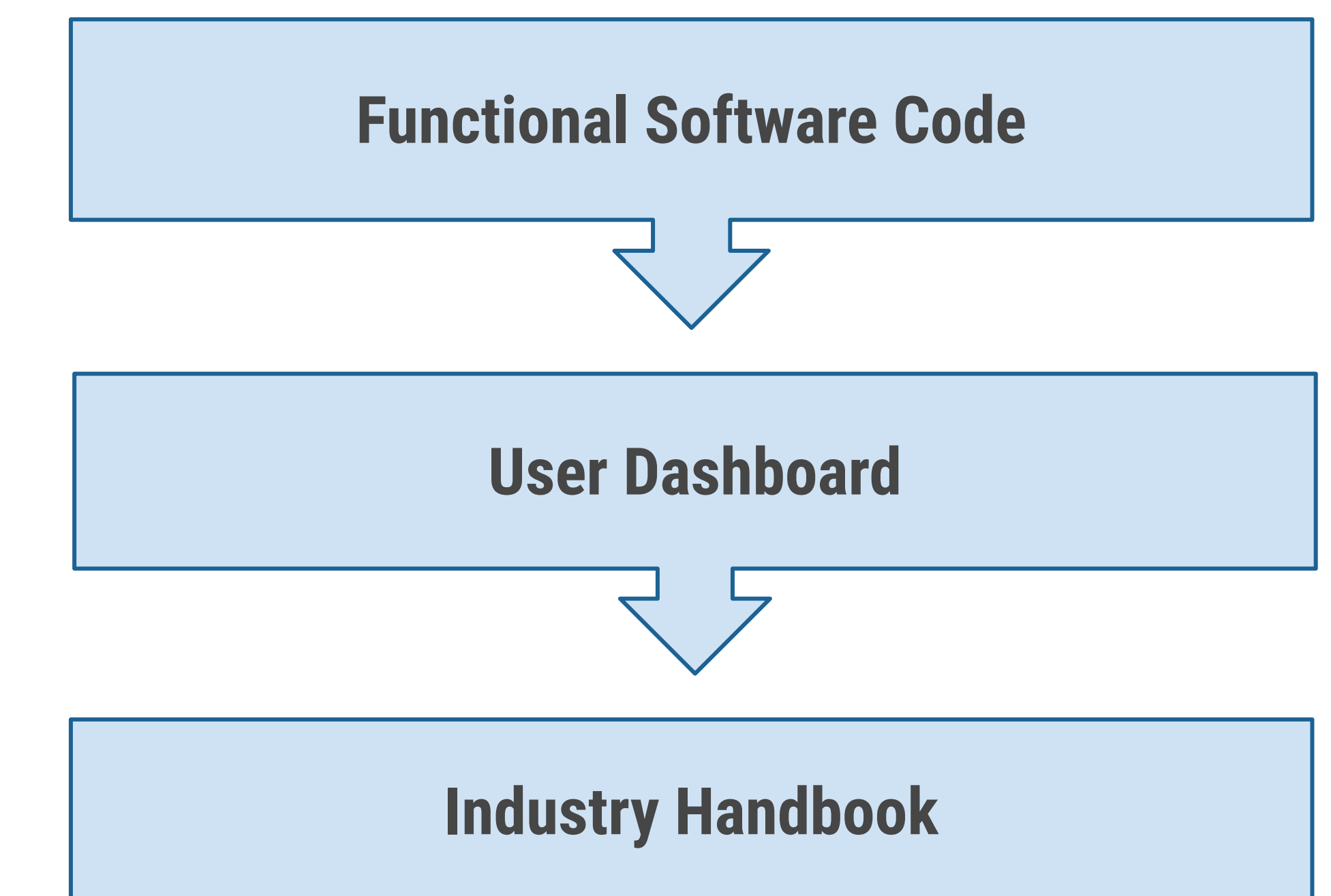
- **Haas VF-3** - A 3-axis CNC milling machine
- **Raspberry Pi Computer** - a low-cost, credit-card sized computer that can run an operating system and custom codes
  - MTConnect Adapter - a custom software script that allows us to pull parameter data from the Haas VF3
  - MTConnect Agent - stock software code from AMT that acts as a host for all the information from the adapter(s)
  - Scraper Script - custom script that takes the data hosted on the MTConnect Agent and pushes it to the MySQL database
- **MySQL Database** - basic time-series database for storing parameter data over time
- **Grafana Dashboard** - visualises our parameter data in a user-friendly and visually appealing format

Results

MTConnect adapter script extracting raw data from Haas CNC & sends to agent

Parsed machine data from agent is being stored in a mySQL data table

Grafana dashboard displaying machine data in user-friendly visuals

Deliverables
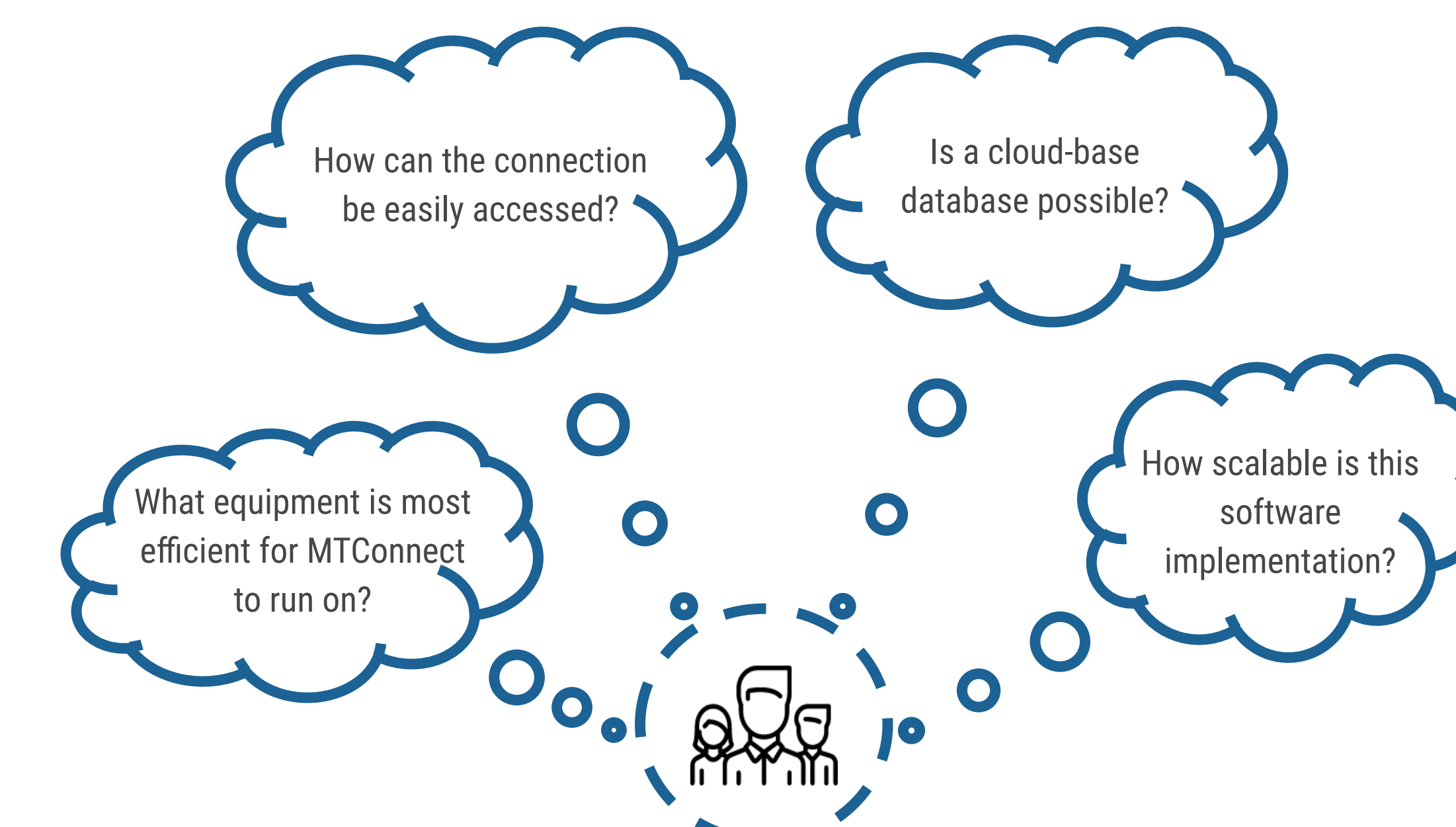
Functional Software Code
↓
User Dashboard
↓
Industry Handbook

Impact

Facilitating use of MTConnect standard in industry by lowering initial knowledge gap

Integrate manufacturing technology under one common standard and promote Industry 4.0

Enable more academic institutions to further conduct research and advance the application of MTConnect

Future Implications

- How can the connection be easily accessed?
- Is a cloud-base database possible?
- What equipment is most efficient for MTConnect to run on?
- How scalable is this software implementation?