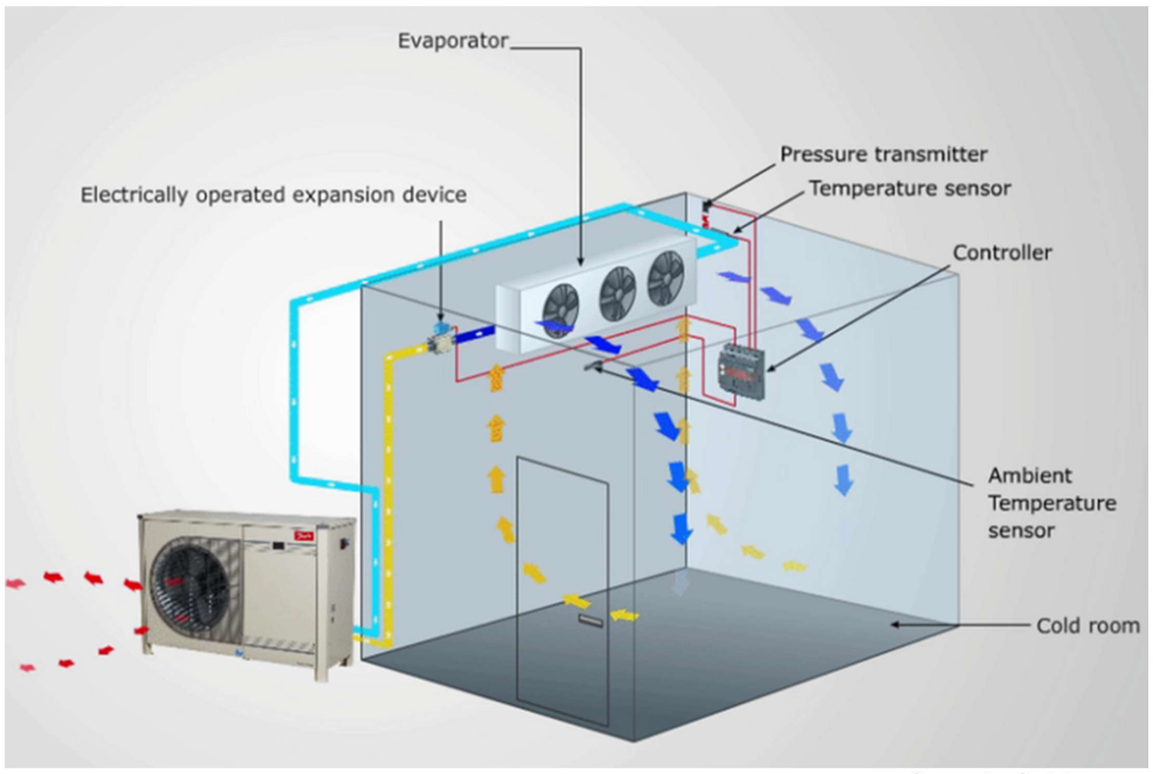
The Future of Cold Rooms

Shayan Safaei Pirooz, Le Hsu, Sanaz Mortazavian, Rahul Chandrashekhar Shende, Shaurya Pratap Singh, Chikodinaka Esther Akaeme
Project Advisors: Mathias Schmid, Kim-Van Blessin

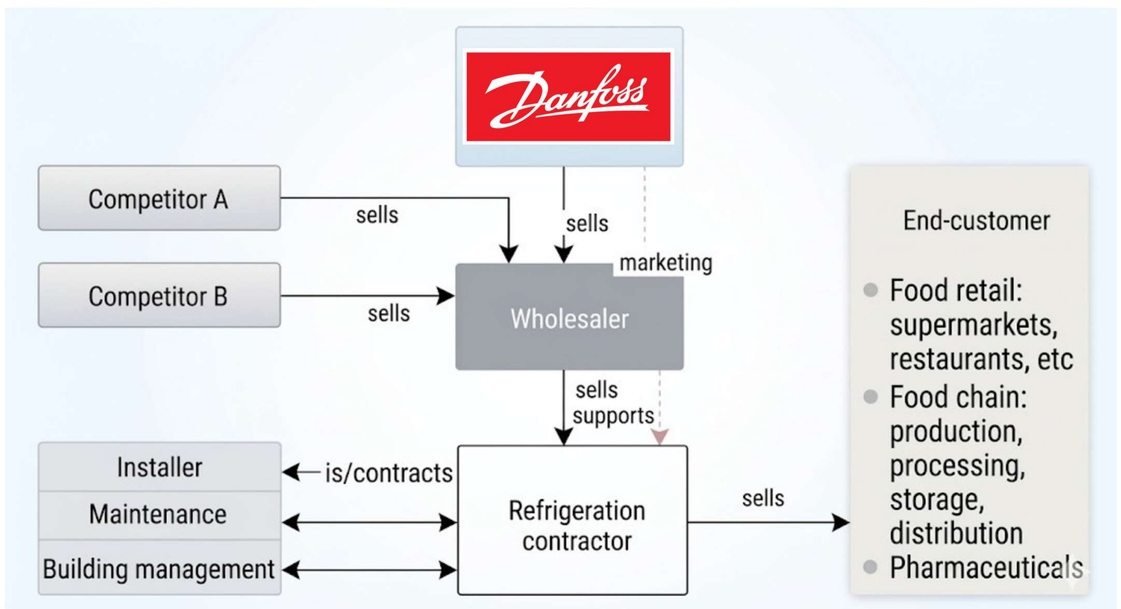
Introduction

Cold rooms are walk-in refrigerated spaces used to preserve perishable goods such as food and pharmaceuticals while maintaining product quality and safety. For small-scale applications like restaurants and local retailers, refrigeration systems must remain reliable, cost-efficient, and easy to install. This project explores potential ecosystem solutions within the Danfoss portfolio aimed at simplifying installation and improving system reliability for generic cold room applications.



Generic Cold-room

Stakeholder Mapping



*As an **installer**, I **manually cross-reference** wiring with **technical datasheets** and **input control parameters** for each device, so I can **sync** the controller's **digital logic** with the **physical hardware** without triggering a system **malfunction**.*

Project Methodologies

1 Mapping the problem space

- **Broad Brainstorming for Project Scope & Vision**
- **Stakeholder Analysis (Installers vs. Owners)**
- **Identified Key Pain Points (Simplicity vs. Reliability)**

2 Ideation & Concept Development

- **Developing Stakeholder-driven User Stories**
- **Generated Wide Range of Solution Concepts**
- **Evaluated Ideas (Cost-Benefit & Feasibility)**

3 Validation & Refinement

- **Reality Check with DANFOSS Global Application Expert**
- **Validated Top 10 Solution Concepts**
- **Clustered into 2 final actionable Concepts for Generic Cold Rooms**

Concepts

Auto-Detection

What:

A **plug-and-play** commissioning system where the controller automatically detects and identifies connected components during the installation.

Why:

To improve commissioning efficiency, reduce dependency on manual setup proficiency, and increase installation reliability.

How:

- **Digital Identification:** Controller reads device info via Modbus or embedded EEPROM over the CAN bus (targeting controller, EEV, and condenser)
- **Data Matrix Scan:** Installers scan a printed code via mobile app, transferring configuration instantly to the controller for automatic setup.

Cold room installation is often slow and error-prone because technicians must manually configure and verify sensors during commissioning. That is an answer for:

Addressed Pain Points on Installation:

- Manual sensor selection
- Complex parameter configuration
- Difficulty verifying correct wiring
- Slow setup and commissioning errors

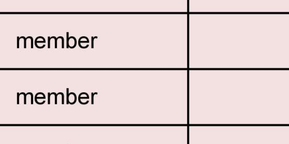
System Health Score

What:

A **simplified metric** derived from key refrigeration parameters (EEV pressure, condenser temp/pressure, humidity, ice build-up, etc.). These are continuously captured and compared against a **baseline profile** established during commissioning.

Why:

Troubleshooting traditionally relies on manual inspection and experience, making it hard to detect performance issues quickly. The system health score converts complex operational data into a **clear, interpretable indicator**.



How:

- **Local Logging:** Controller logs data and aggregates it into a health score.
- **On-site Access:** Available via a mobile app over Bluetooth during commissioning.
- **Remote Monitoring:** Data can be uploaded to the cloud for analysis by service technicians.

Addressed Pain Points:

Technicians often lack visibility into recent system performance, relying on manual measurements. The system health score provides **immediate insight** into current and historical system conditions, enabling **faster diagnostics** and more **efficient maintenance**.

Suggestion

- **Immediate:**
  - **The Cold room components which are modbus capable should be wired digitally to the controller over easier analog connections to create a 'smart' communication link with the controller.**
  - **The existing Danfoss application (AKCC Connect) should be upgraded for the increased complexity in usage by having an easy to use GUI.**
- **Future:**
  - **EEV adaptors for smoother communication with controller with a plug and play configuration.**
  - **Analog comoponents having an EEPROM memory for a smoother connection with Danfoss controllers.**
  - **Advanced refrigerant leak prevention and detection for accomodating Natural Refrigerants in the system.**

Team Member	Task Area	Hours
Shayan Pirooz	Product owner	94
Le Hsu	Scrum master	96
Sanaz Mortazavian	member	94
Rahul Shende	member	90
Shaurya Singh	member	90
Chikodinaka Akaeme	member	92