

Human-Machine Interaction Design for Freight Planning Systems

Research Festival

May 21, 2019

E51-372

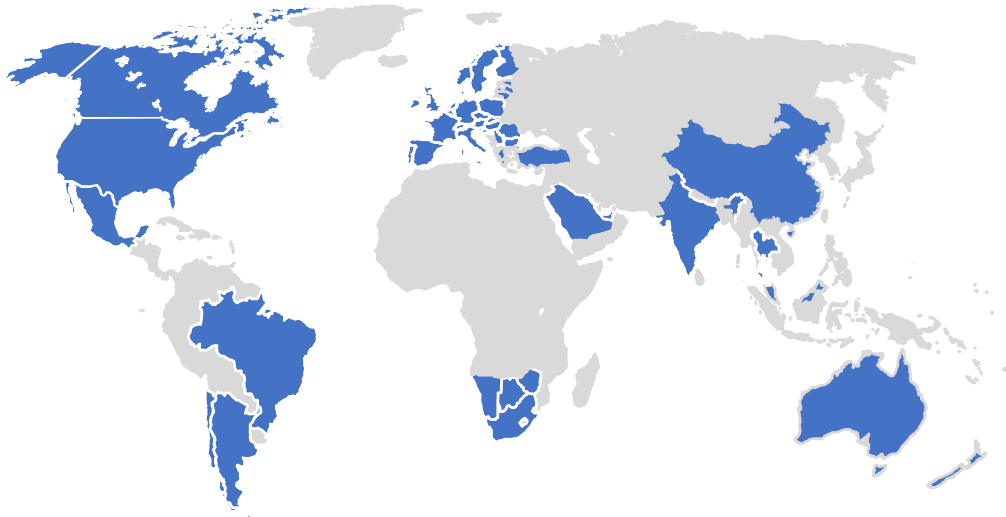


J. Bishop Ravenel



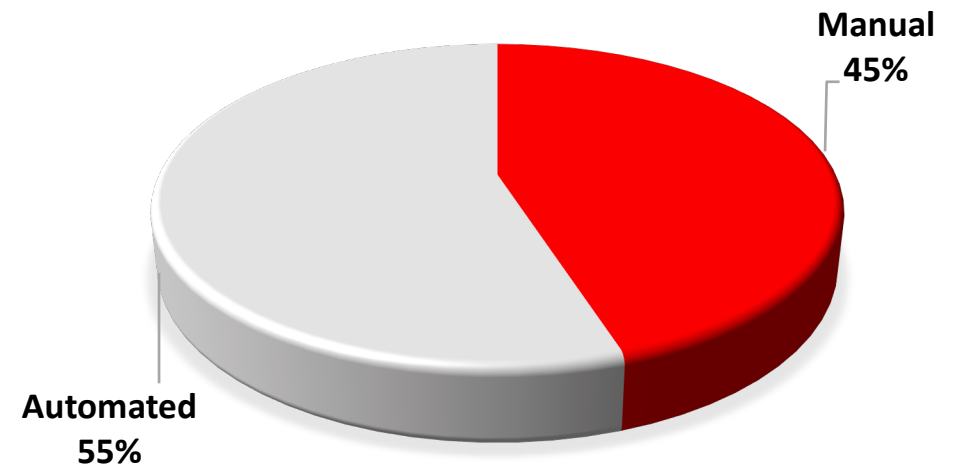
Freight Planning System

Scale

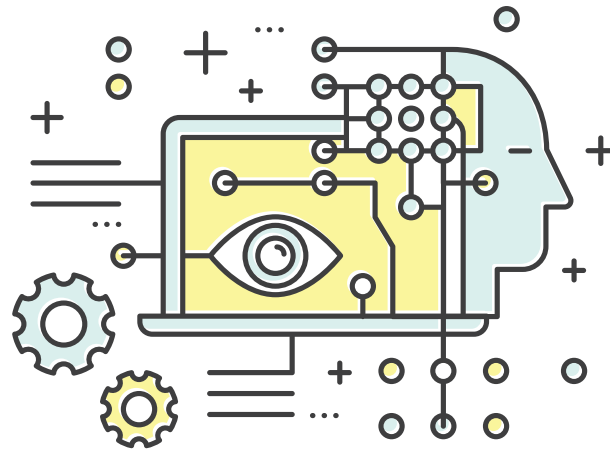
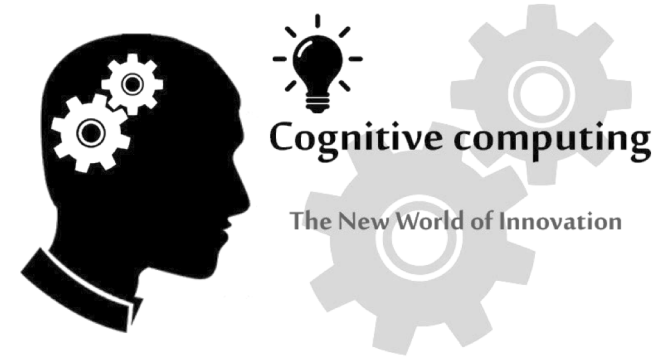


Division of Labor

AUTOMATED V. MANUAL



Today's Operating Environment



Fragile



Robust



Anti-Fragile



Research Question

What process augmentation will incrementally decrease costs, reduce manual load planning, permit a **system retrofit**, and **improve the joint cognitive system iteratively**?

Project Scope and Goals

AUTOMATED V. MANUAL



1. Characterize System using HMI
2. Propose Conceptual System Design
3. Propose Pilot Design
4. Insights from Design Process
5. Academic Contributions and Managerial Takeaways

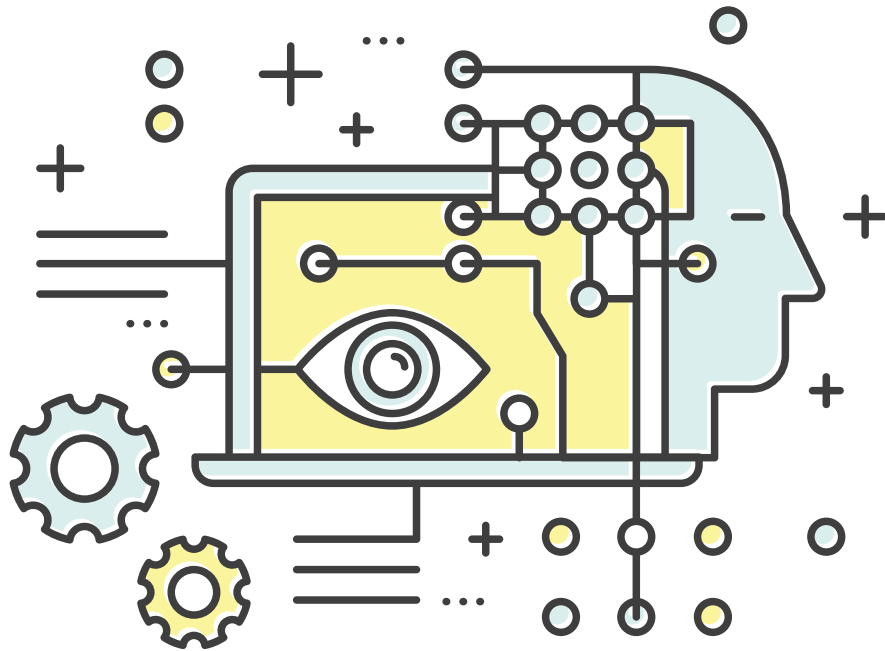
Data Collection & Modeling

Pilot Proposal

Results

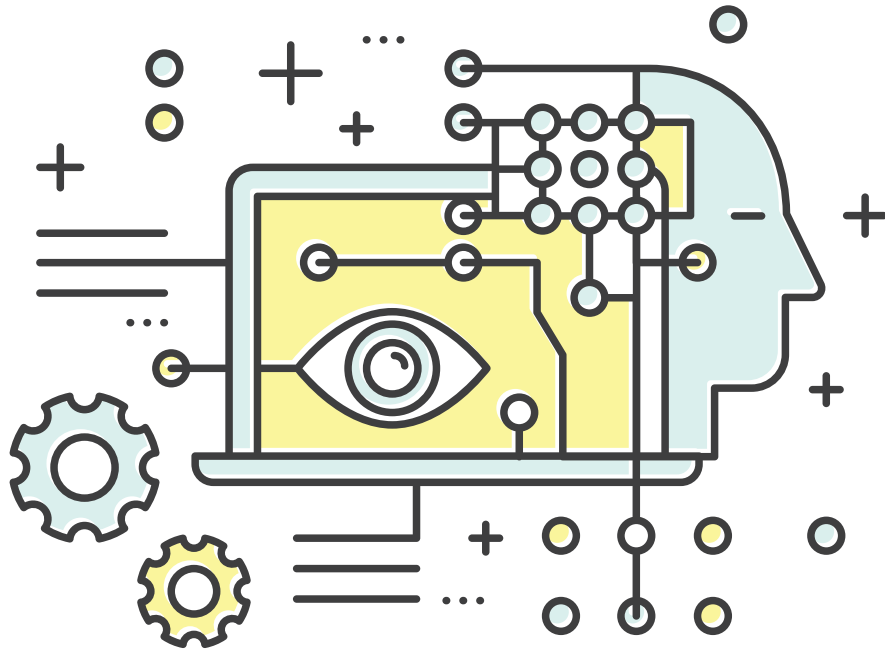
Joint Cognitive Systems

Human-Machine Interaction Design : Typical Applications



Hypothesis

Human-Machine Interaction Design : Pallets

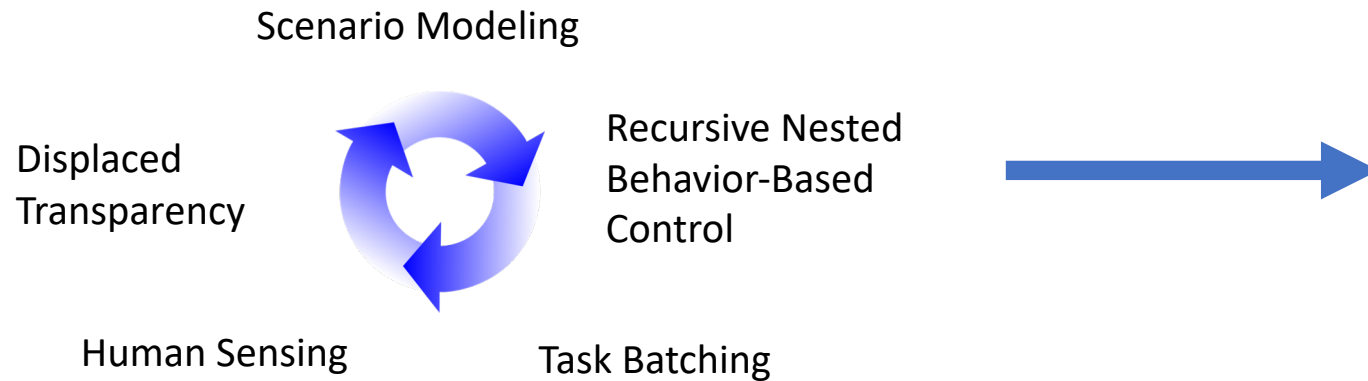


Hypothesis

Human-machine interaction (HMI) design principles can be applied to retrofit a loosely coupled joint cognitive system, particularly a freight planning system, to iteratively improve the system.

HMI Application

Initial Framework



Architectural

Scenario Modeling

Task Batching*

Human Sensing

Displaced
Transparency

Implementation

Interviews / Field Observation

Surveys (Level Setting)

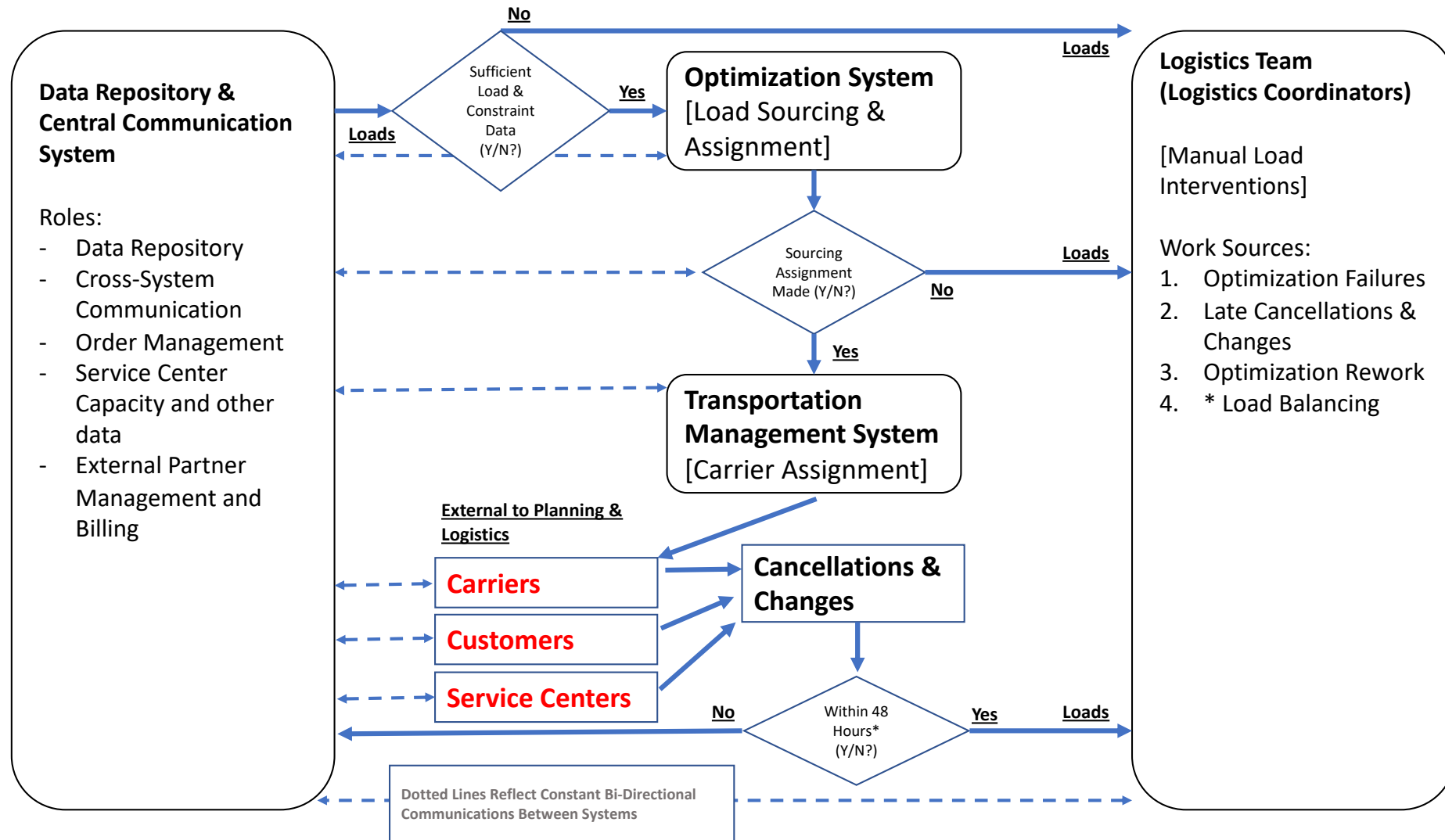
Brainstorming (What > Why)

5 Whys

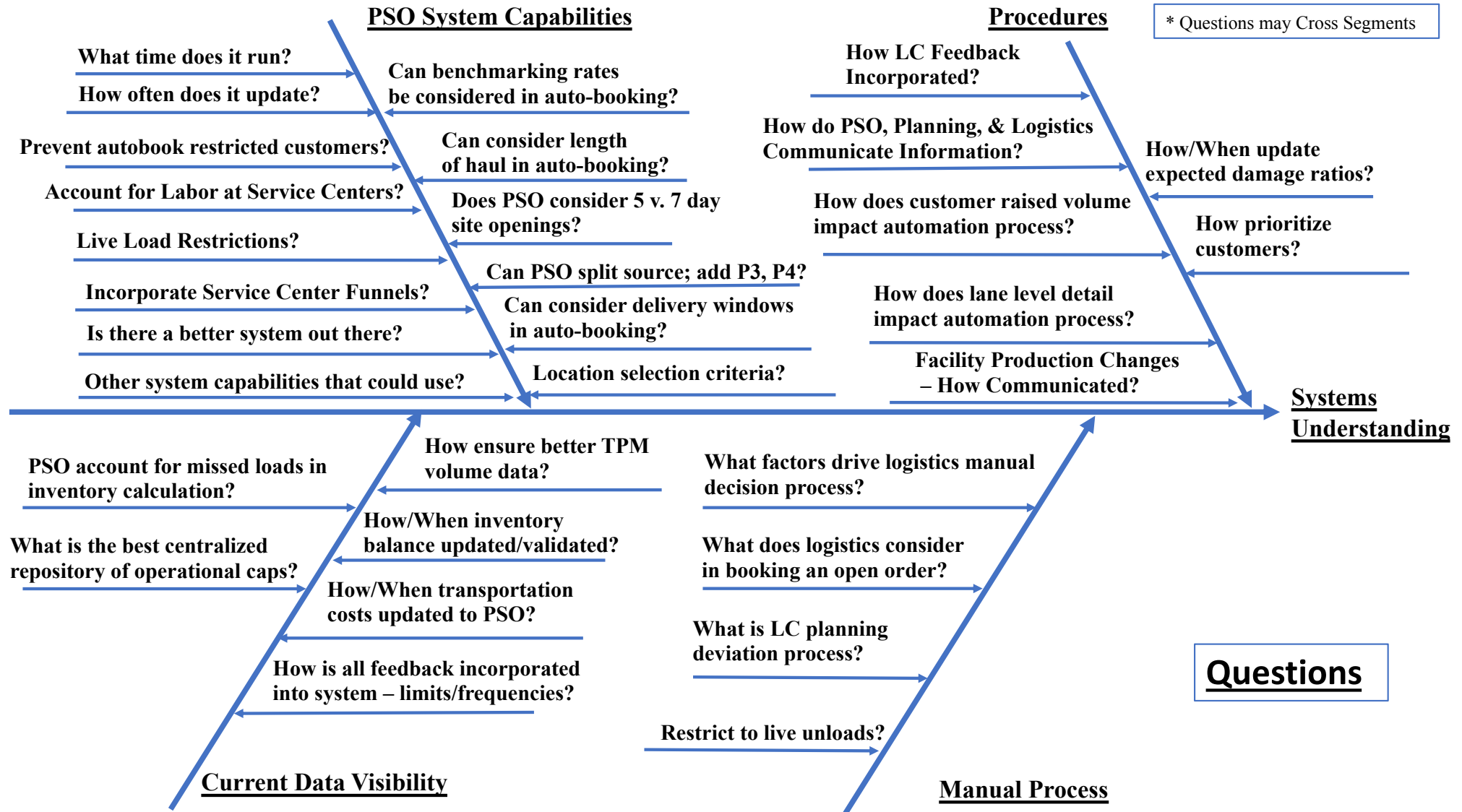
Ishikawa (Fishbone)
and Process/Swim Lane Diagrams

Prediction Market*

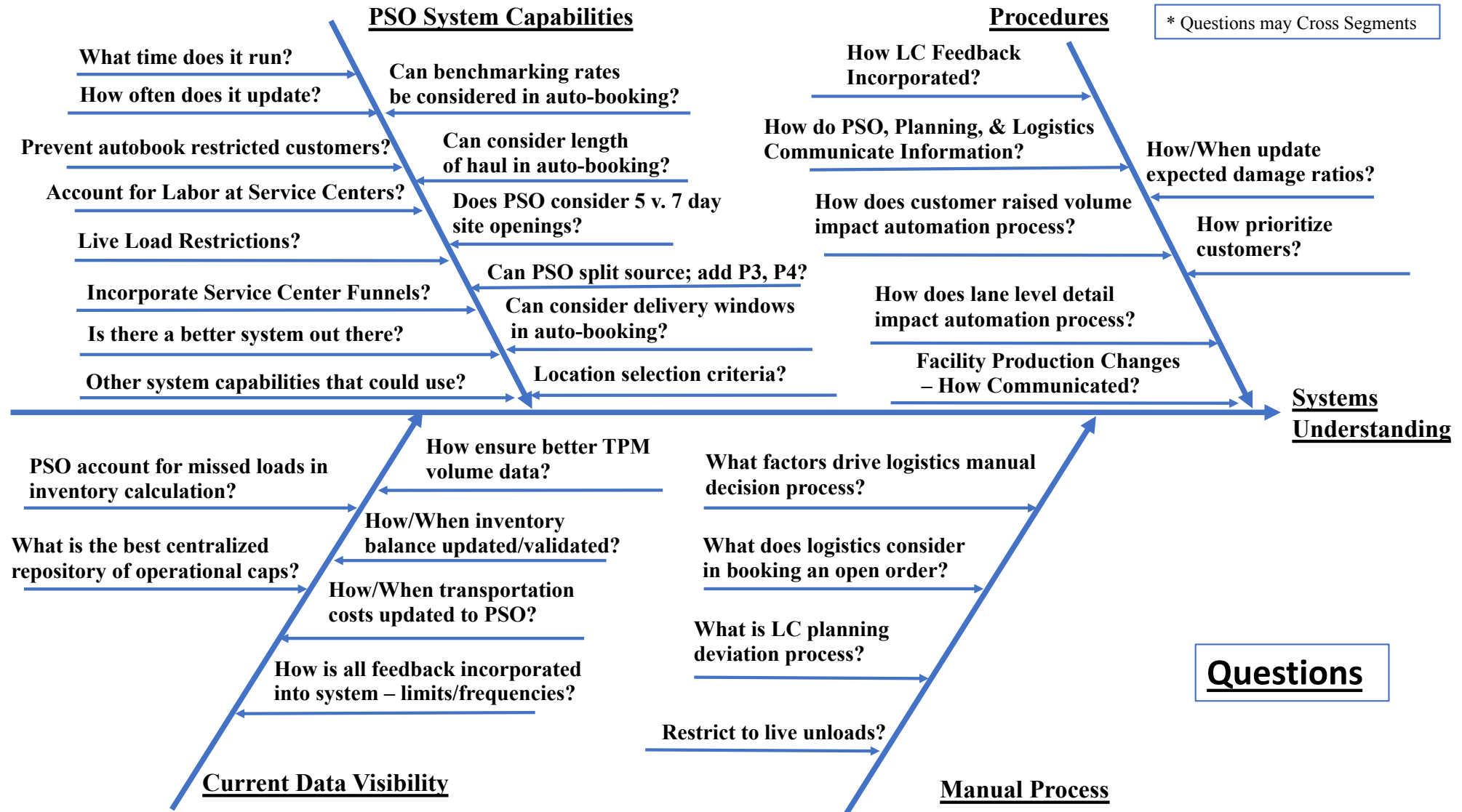
Process Diagram of System HMI



Ishikawa Diagram of Cognitive System Gaps



Ishikawa Diagram of Manual Intervention Causes

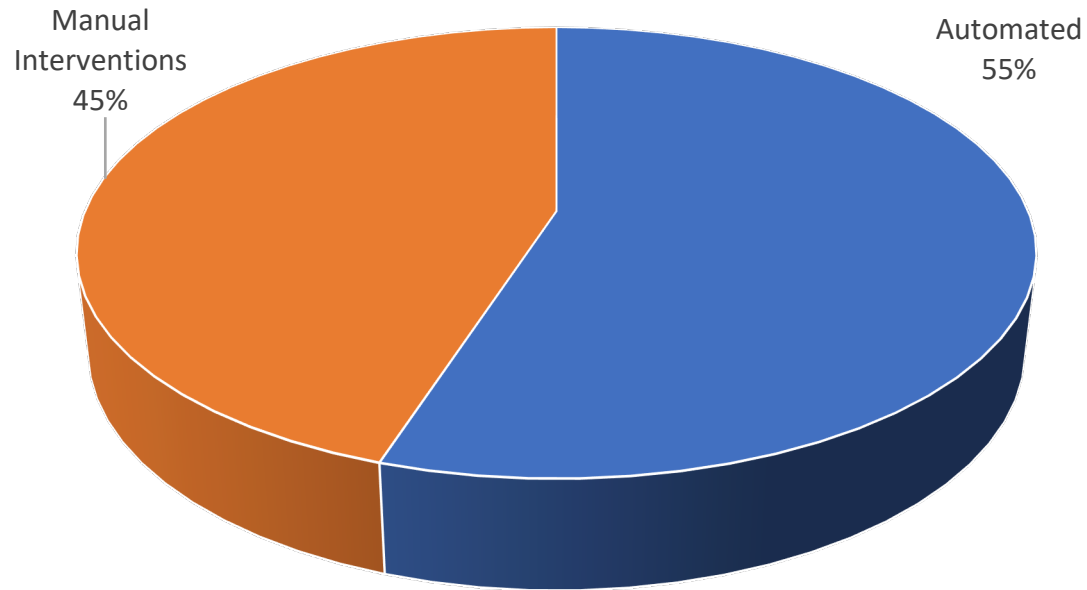


Initial

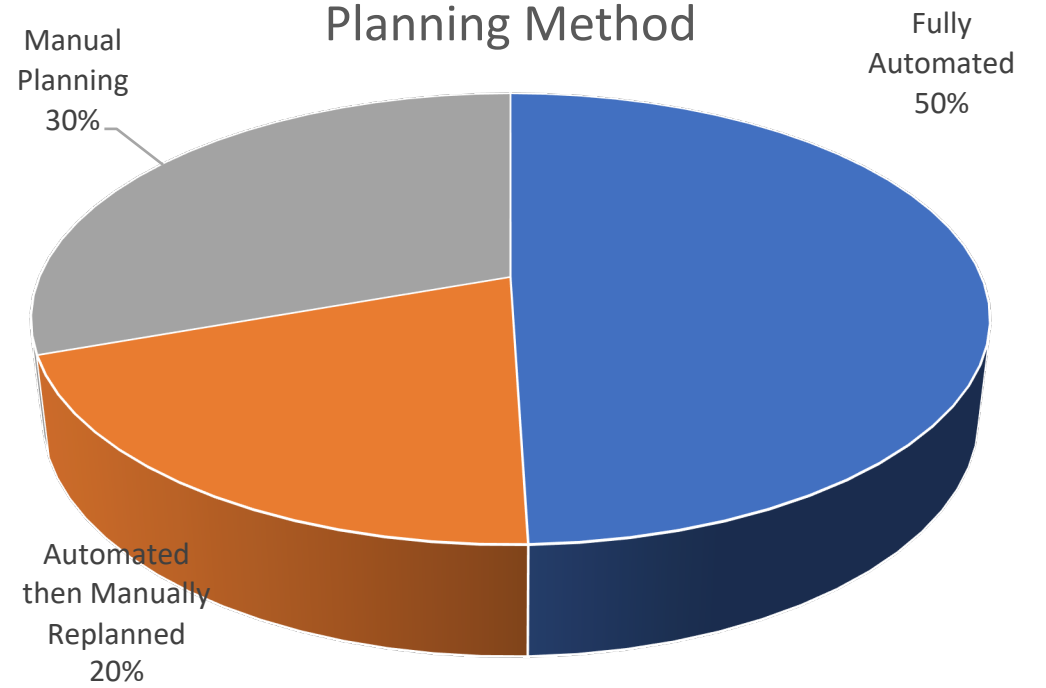
Data

Second Level Data

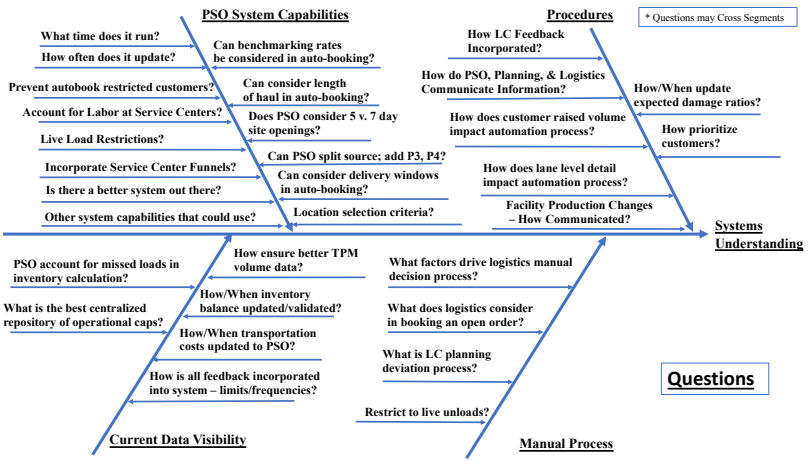
Manual Interventions



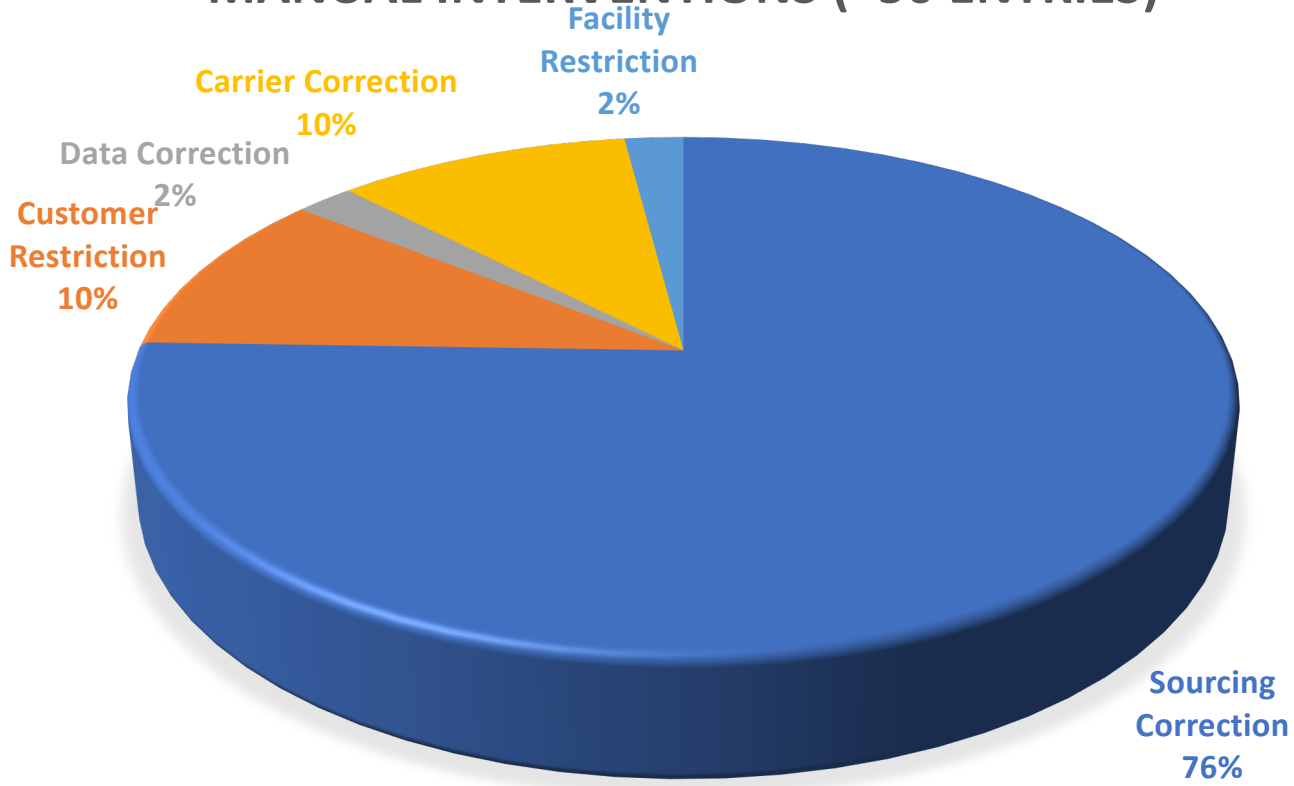
Planning Method



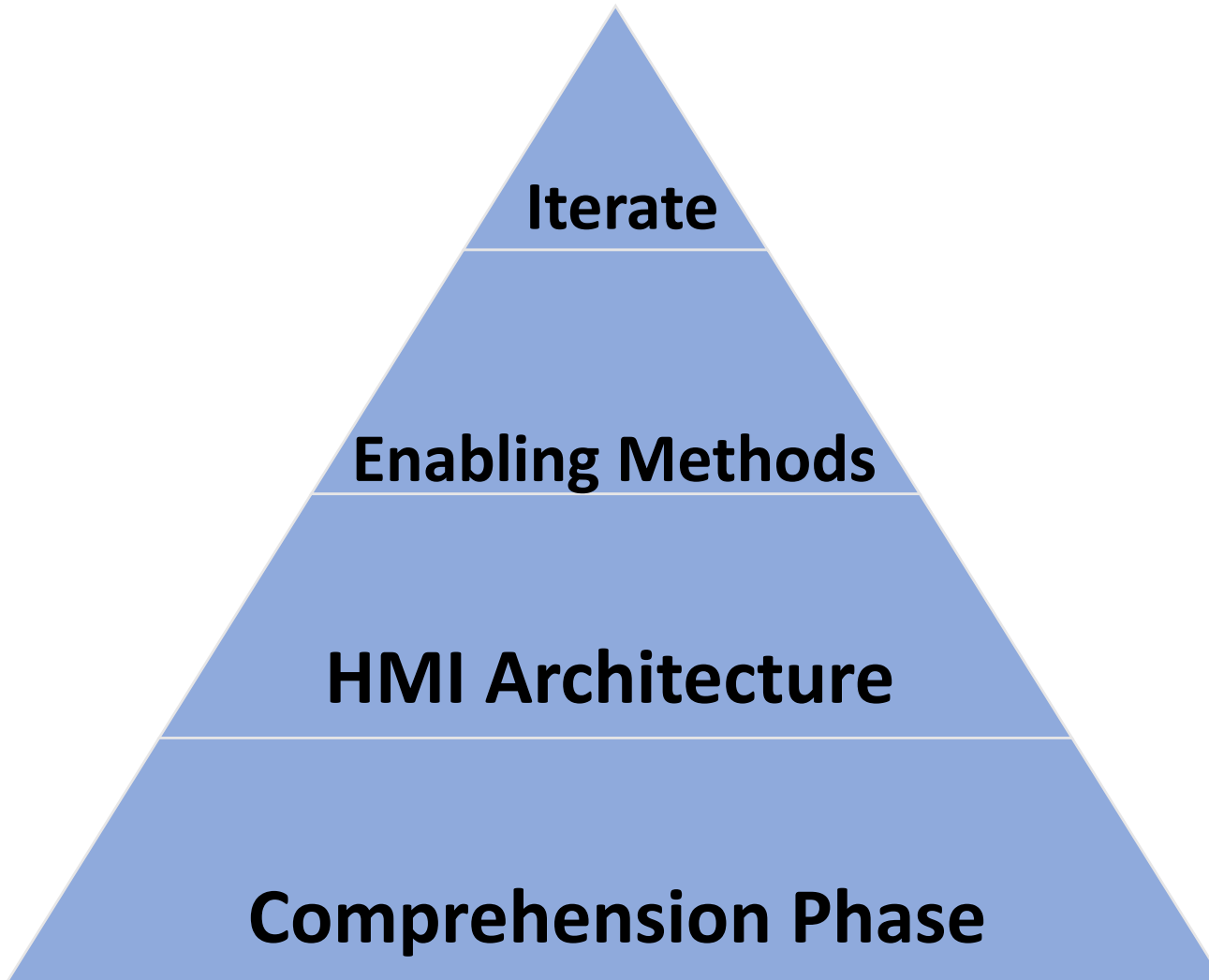
Self-Developed Data



MANUAL INTERVENTIONS (~50 ENTRIES)

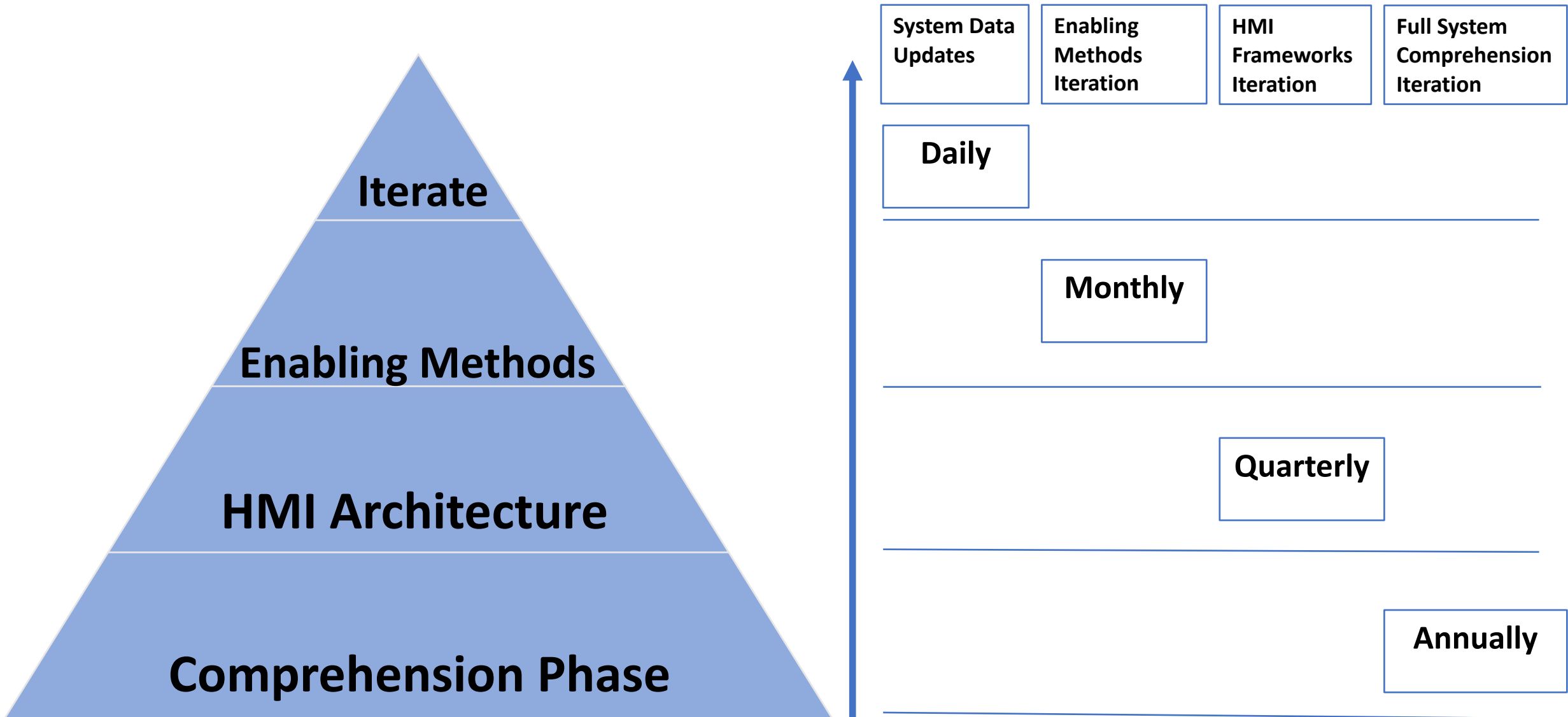


HMI Retrofit Implementation



- ↑ Implement & Iterate
- ID and Empower HMI Architect
 - Establish Human Sensing & System Update Process
 - Separate to Small (Action) & Large (Prediction) Teams
 - Stage HMI Framework Application
 - Iterate Across Stages (Closest = Fastest)
-
- Identify Relevant Facilitating Frameworks
- 5 Whys Analysis
 - Ishikawa and Swim Lane Diagramming
 - Brainstorming Sessions
 - Prediction Markets & Polling
-
- Identify Relevant HMI Architectural Frameworks
- Scenario Modeling
 - Task Batching
 - Human Sensing
 - Displaced Transparency
-
- Stakeholder Interviews, Surveys, & Field Observations
Systems Change Proposals → ID other Stakeholders
Automated Systems Analysis
Systems Conceptual Mapping
Systems Data Analysis & Additional Data Gathering

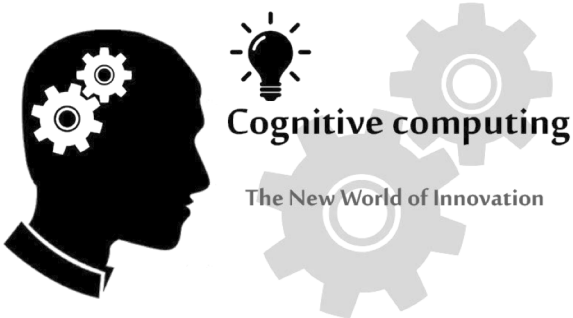
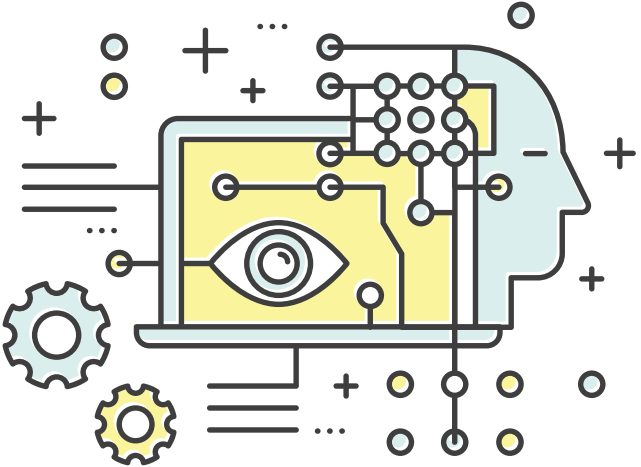
HMI Retrofit Iteration Cycles



Research Contributions

- HMI → Loosely Coupled Freight Planning System
- Other Loosely Coupled Planning Systems
 - Freight, Customer Demand, Warehouse, Labor Planning
- Application to Total System Retrofits
- Iterative System Comprehension and Development Approach

Managerial Insights



Questions

