Objective

In their 2010 IMHRC paper, Montreuil, Meller and Ballot proposed a set of facility types that would be necessary to operate a Physical Internet, termed π-nodes. This paper is part of a three-paper series for the 2012 IMHRC providing functional designs of three such π-nodes.

This paper focuses on road-based distribution π-hubs. Their mission is to efficiently and sustainably transfer π-containers from their inbound to their outbound trucks, enabling their distributed route from source to destination through the Physical Internet.

The objective of the paper is to illustrate the design of such π-hubs and their components, as well as their design process.

Background

GLOBAL LOGISTICS SUSTAINABILITY GRAND CHALLENGE

2. DESIGNING THE BASIC CONCEPT OF \( \pi \)-CONTAINER FLOW THROUGH THE \( \pi \)-HUB

1. DEFINING THE MISSION OF THE \( \pi \)-HUB

2. DESIGNING THE \( \pi \)-HUB CONCEPT OF \( \pi \)-CONTAINER FLOW THROUGH THE \( \pi \)-HUB

3. DESIGING THE \( \pi \)-HUB'S NETWORK ORGANIZATION BOTH AT SITE AND FACILITY LEVELS

1. DELIVERING THE MISSION OF THE \( \pi \)-HUB

4. SIZING THE \( \pi \)-HUB'S CAPACITY

5. DESIGNING THE \( \pi \)-HUB'S LAYOUT

Conclusion

Our primary goal was to produce a functional π-hub design capable of performing at an acceptable level in terms of KPIs related to efficiency and sustainability. Our purpose was demonstration rather than optimally driven.

Our secondary goal was to establish what details are needed to provide when one provides a functional design going forward. Please see our detailed paper. We hope to motivate others to develop alternative functional π-hub designs!

Future Work

Extensive simulation experimentation is needed to extend the evaluation of the design in face of stochastic demand and behavior, and examine its sensitivity to alternative operating policies and handling technologies.

Analytical models need to be developed for helping rough preliminary sizing of the hub's key components.

Alternative functional π-hub designs need to be developed, notably π-hubs capable of dealing with π-containers smaller than the 2.4mX2.4m cross section imposed here, and less automated π-hub designs.

There is a need for developing an open design platform for Physical Internet sites, facilities & handling systems.

Acknowledgments

This research was supported in part by MHIA through a grant from its member organizations. The Canadian Research Chair in Enterprise Engineering and the NSERC Discovery Grant Program also provided support.

2012 International Material Handling Research Colloquium