Hyperconnected Distribution Facilities in a PI-enabled World: Innovative Concepts and Automation

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Hyperconnected Distribution Facilities in a PI-enabled World: Innovative Concepts and Automation

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Hyperconnected Distribution Facilities in a PI-enabled World: Innovative Concepts and Automation

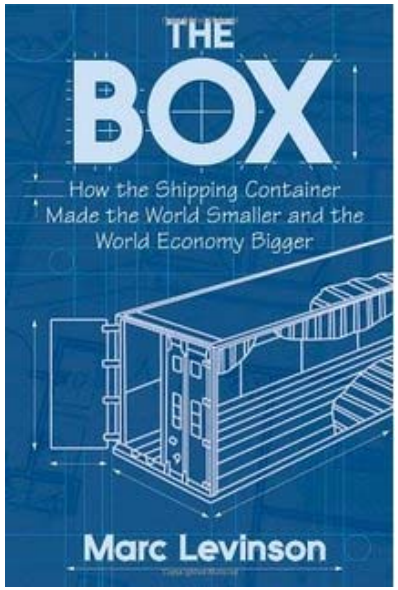
Abstract

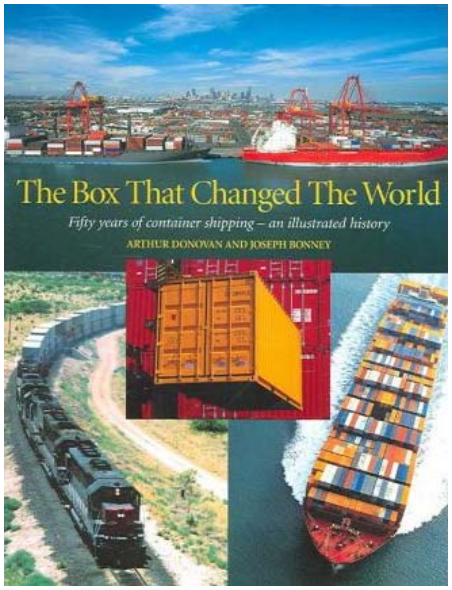
Focus on how PI-enabled distribution facilities will be redesigned to enhance their critical role as a connector of supply and demand for the flow of goods. The PI concepts of standardized containers and an open network of distribution facility resources will result in many innovative facility design concepts and a greater use of automation. This session will show you how the traditional "box" will be changing as a hyperconnected link in the supply chain.

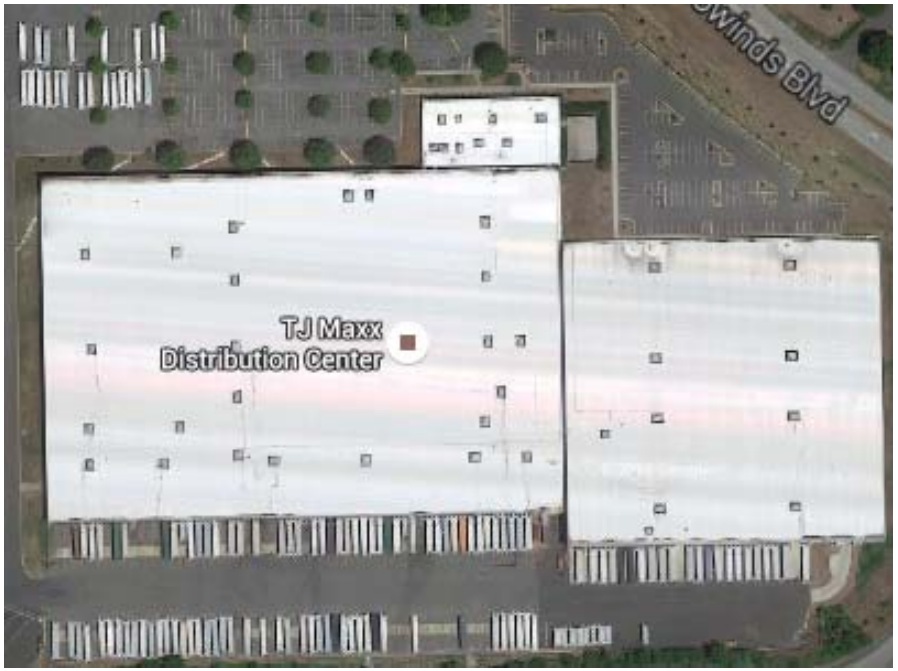
What does the Physical Internet Manifesto Tell Us About Distribution Facility Design?

Physical Internet
Efficient Sustainable Logistics

Version 11.1.1







What does the Physical Internet Manifesto Tell Us About Distribution Facility Design?

13 logistics inefficiency and unsustainability symptoms

#4 Product idle time high, place/time availability low

#5 Facilities idle time high, but can't handle peaks

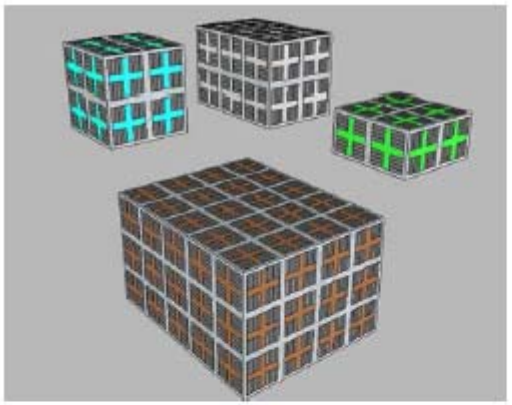
#9 Fast and reliable multimodal transport is a dream

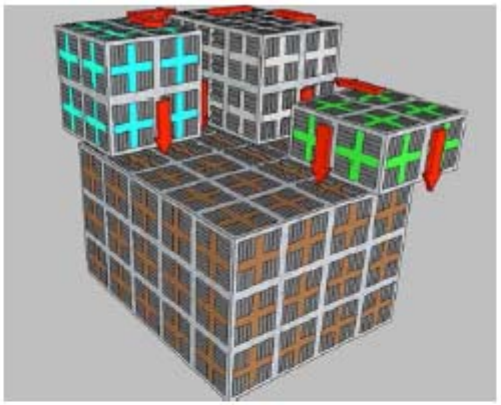
#10 Getting products in and out of cities is a nightmare

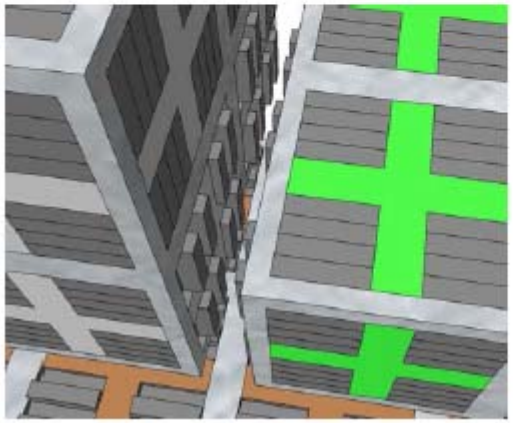
#12 Smart automation & technology are hard to justify

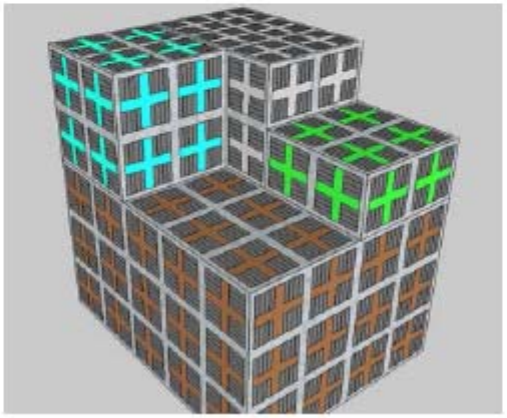
What does the Physical Internet Manifesto Tell Us About Distribution Facility Design?

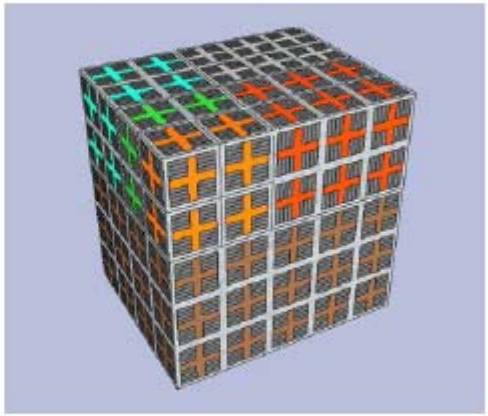
PI containers with standardized, modular dimensions











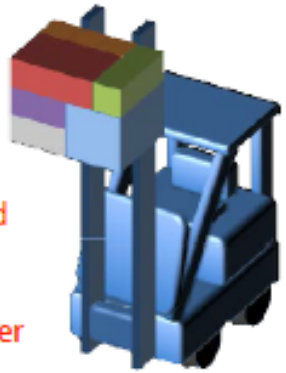
Conceptual design illustrating the composition functionality of π-containers

What does the Physical Internet Manifesto Tell Us About Distribution Facility Design?

Movement and Storage of PI Containers in Facilities

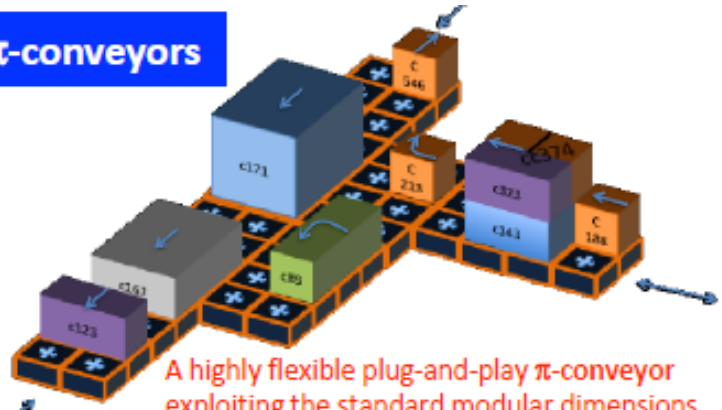
π-movers

A fork-less lift exploiting the snapping and interlocking functionalities of the π-container



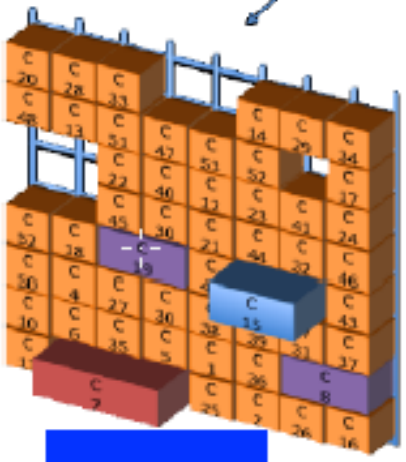
A π-container equipped with wheels snapped through its standard modular interfaces

π-conveyors

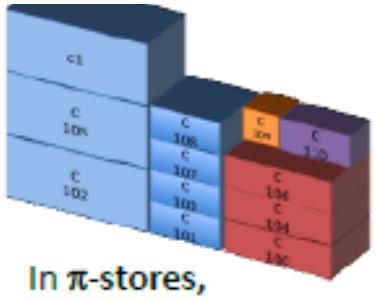


A highly flexible plug-and-play π-conveyor exploiting the standard modular dimensions and interfaces of the π-containers

In π-stores, contemporary racking can be used, however innovations in storage technologies exploiting the functional characteristics of modular π-containers are bound to be exploited



π-stores



In π-stores, modular π-containers can be stacked as in container port terminals

What does the Physical Internet Manifesto Tell Us About Distribution Facility Design?

fortna®

The Distribution Experts®

IPIC 2016

PI-Enabled Distribution Facility Design

Panel Session Opening Comments

Russell D. Meller, Ph.D.

Vice President, Solution Design and R&D

June 28, 2016

Perspective

Where you stand depends on where you sit.

- Miles's Law

Designing and Operating a Distribution Center

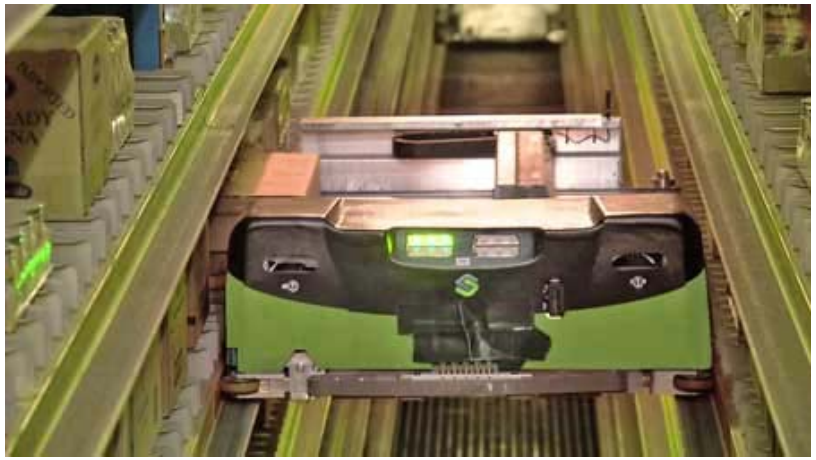
Three aspects of how the distribution center will change …

- Software
- Scalable Technology
- Standardized Containers

Goods to Person

Highly Scalable Technologies

Roaming Shuttle Systems



Roaming Robots

Designing and Operating a Distribution Center

Three aspects of how the distribution center will change …

- Software
- Scalable Technology
- Standardized Containers

Designing and Operating a Distribution Center

Three aspects of how the distribution center will change …

- Simplified Software for Operating DCs
- Greater Use of Scalable Technology to Make Systems More Efficient
- Standardized Containers for Analysis, Design and Operation

Georgia Tech Institute for Robotics and Intelligent Machines

Hyperconnected Logistics Facilities: Towards Innovative Concepts and Automation

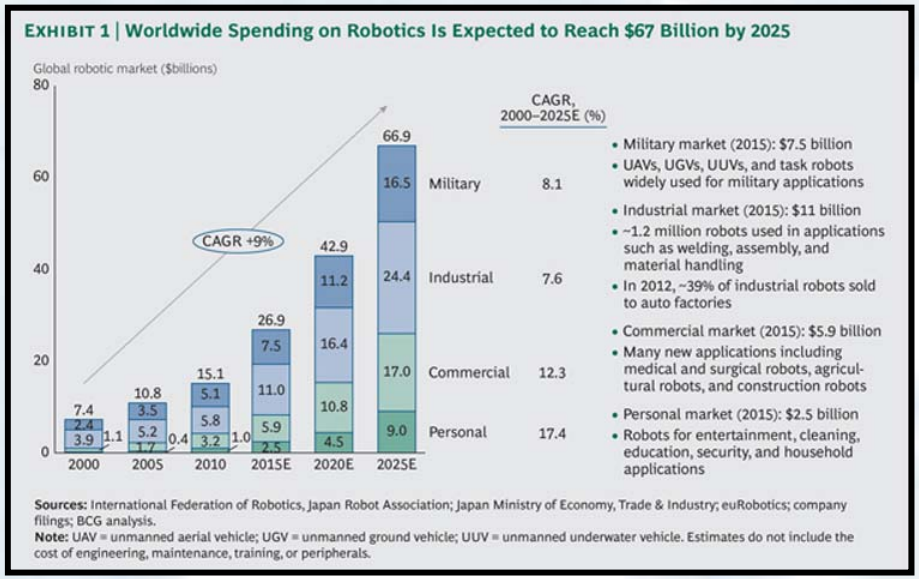
Larry M. Sweet

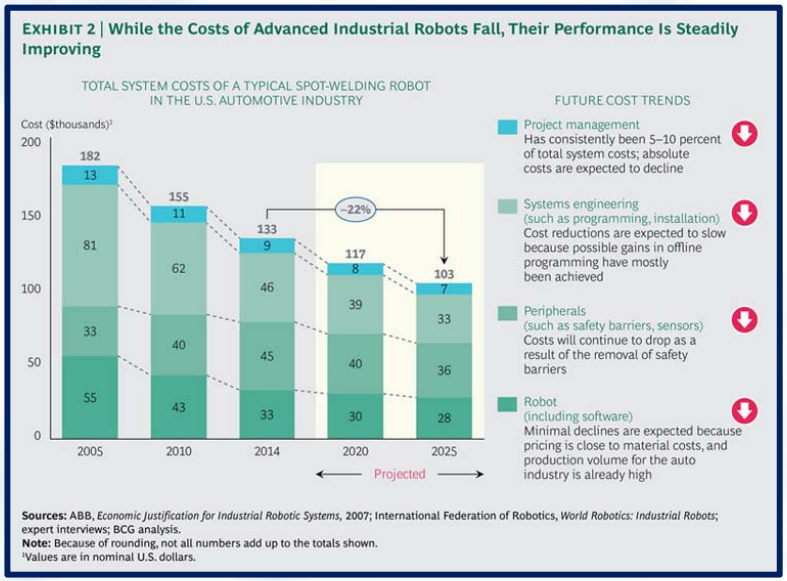
3rd International Physical Internet Conference

Atlanta, Georgia

June 29, 2016

Explosive robot growth through 2025





- Worldwide dollar growth at 9% CAGR through 2025
- Unit growth at 22% CAGR with cost reductions

- Cost reductions: robot HW / SW
- System engineering
- Safety systems
- Perception (from personal device & electronics gaming industry)

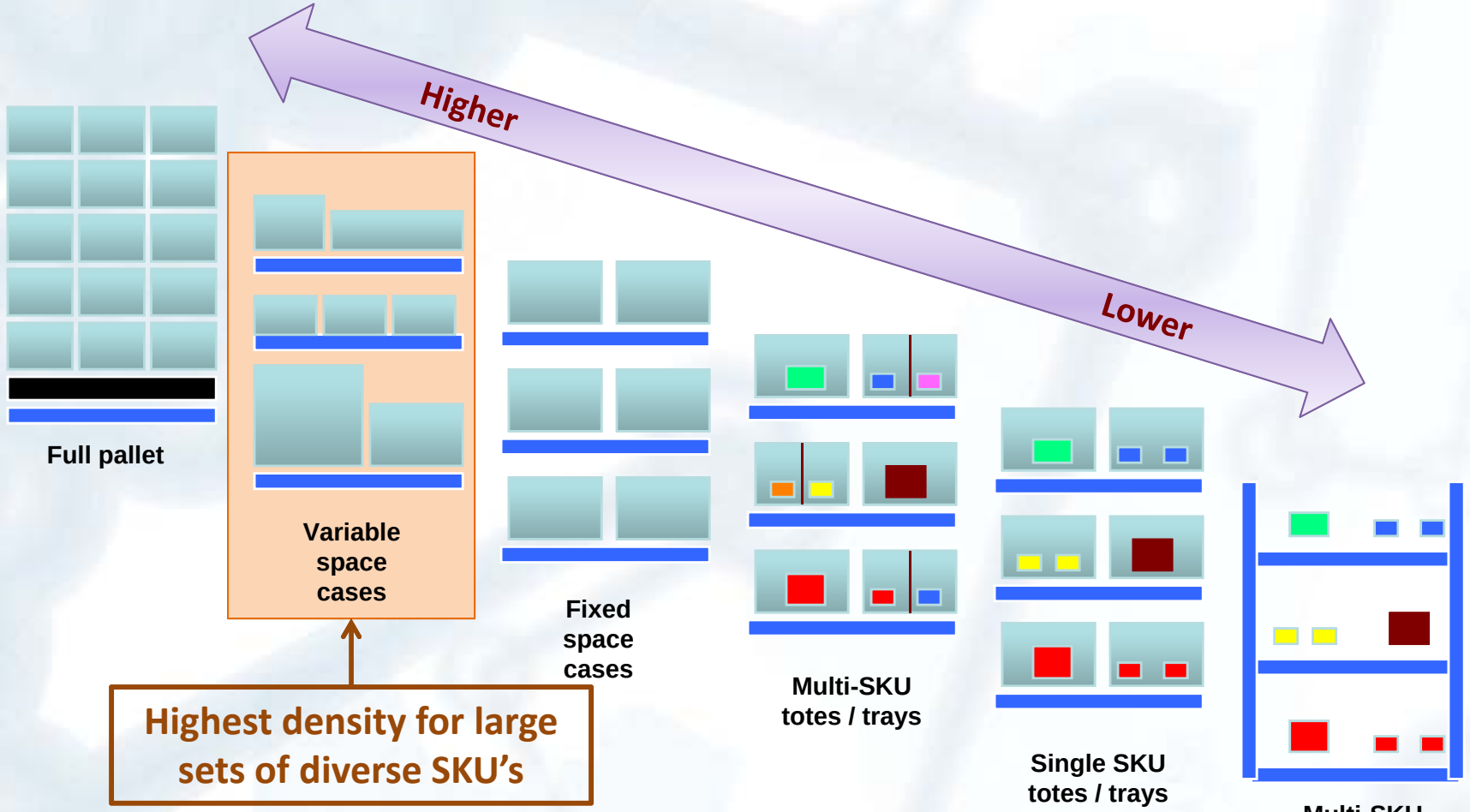
Source of graphs: BCG report “The Robot Revolution”, September 2015

Will robots provide sufficient flexibility?

How to produce higher product mix demanded by customers?

How to delivery when they want it (and return it too)?

Approaches to increased storage density



Mobile robot 2D and 3D layouts

3D storage topology

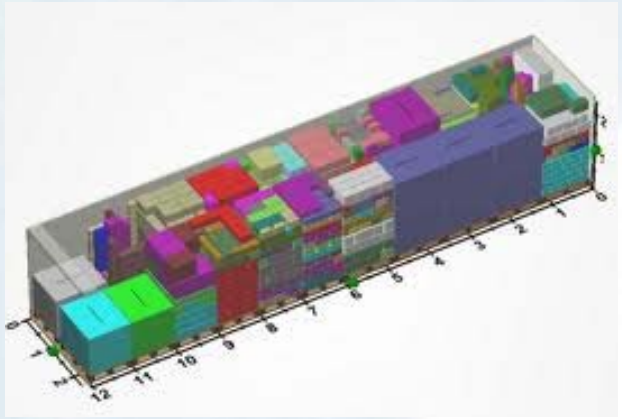
2D storage topology

Optimal density: random vs. fixed access storage

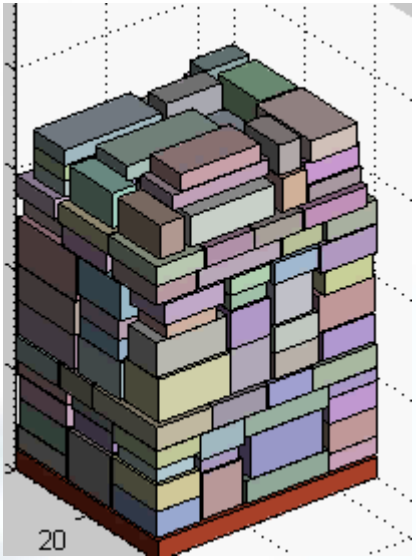
Variable spacing storage

Fixed spacing storage

Applications for sequenced product flow



Truck loading

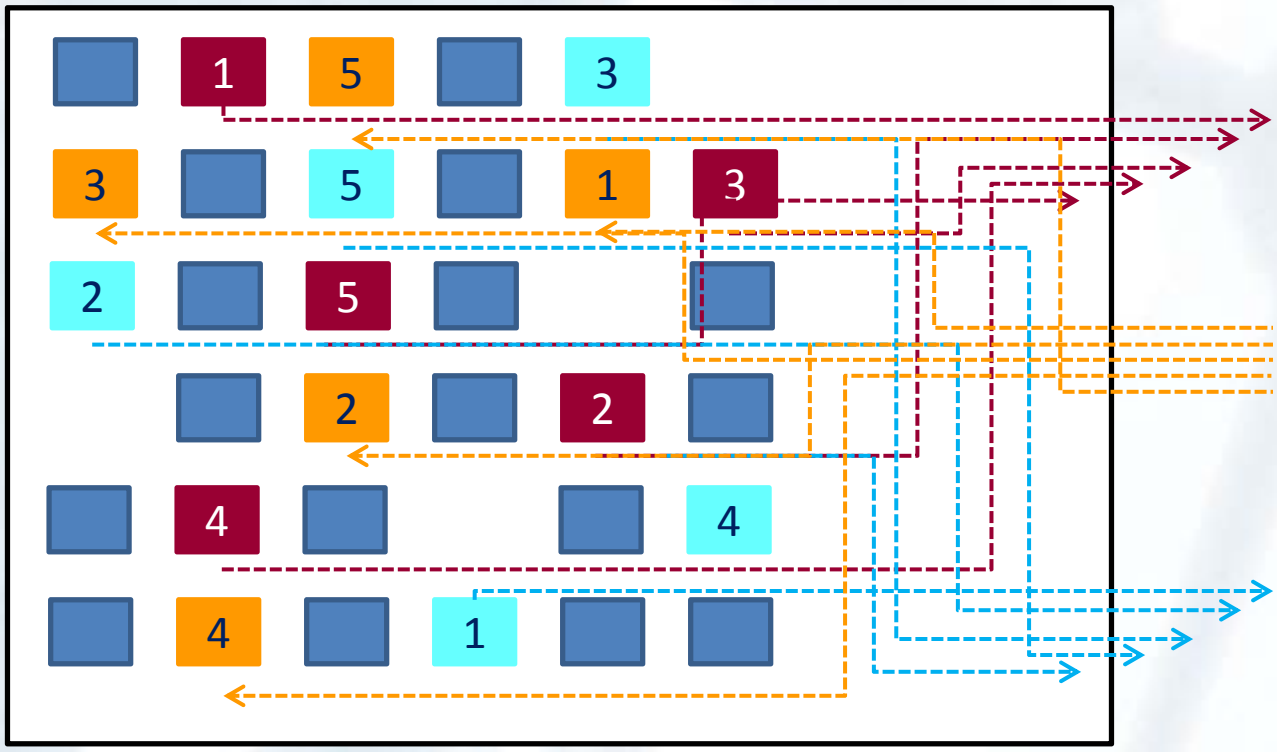


Robot palletizing

Biggest challenge to system throughput

Batching for customer orders

Sequencing with autonomous robots



Output sequence 1

5 4 3 2 1

Input sequence 1

1 2 3 4 5

Output sequence 2

5 4 3 2 1

Mini-load / carousel pick and sequence

Mini-load cranes & shuttles

Carousel

Sort and merge systems

Mixed SKU goods to person item picking

Mixed SKU case / tote palletizing truck loading

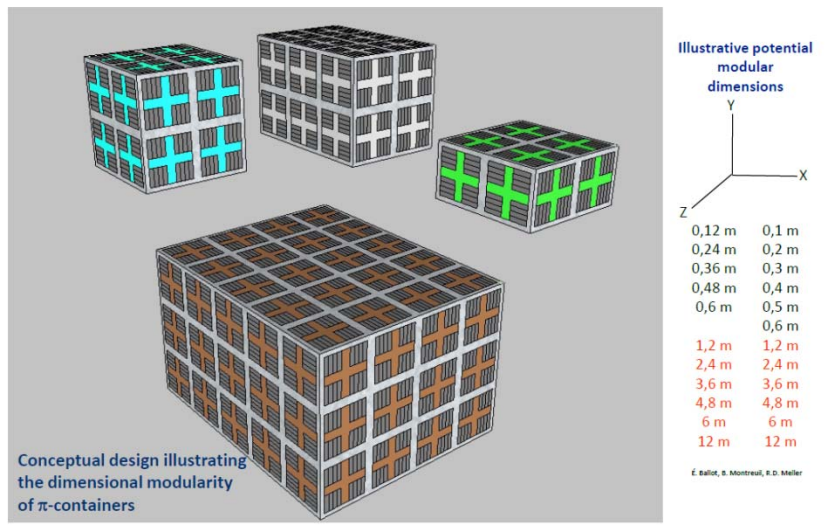
Autonomous mobile robot pick and sequence

2D or 3D roaming with
direct pick to output station

Mixed SKU goods to
person item picking

Mixed SKU case / tote
palletizing truck loading

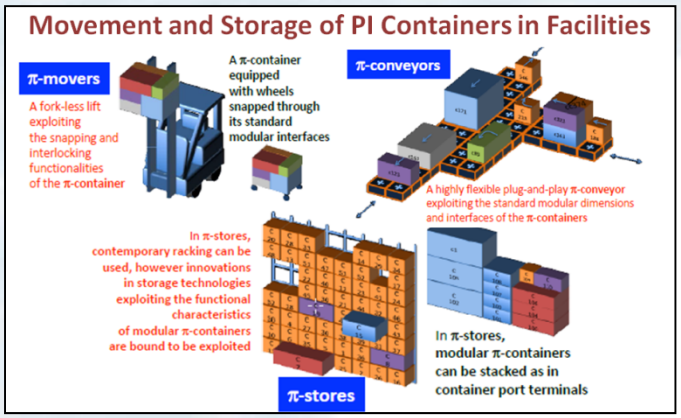
Best in class storage density?



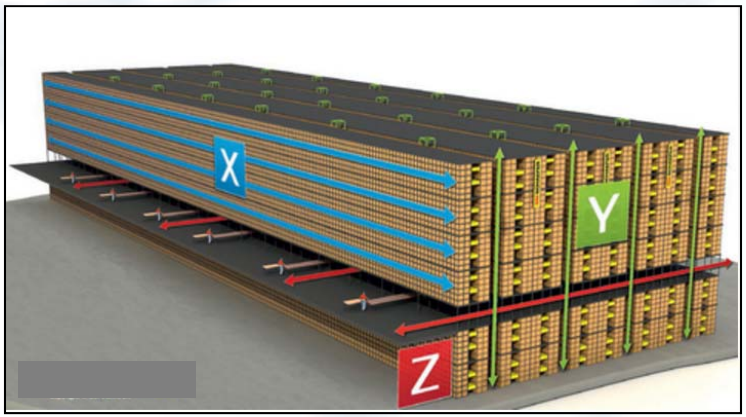
Physical internet storage

Variable spacing storage

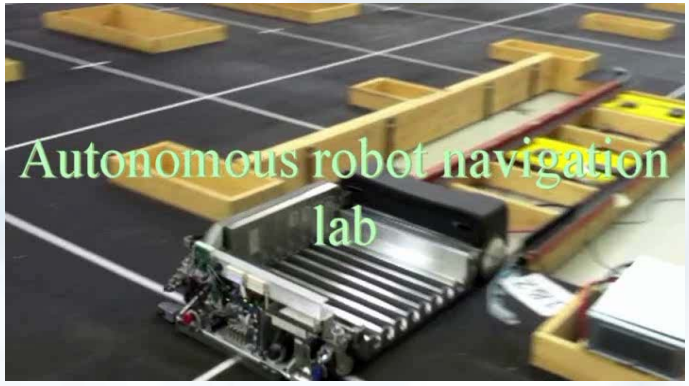
Best in class automated sequencing?



PI automation concepts

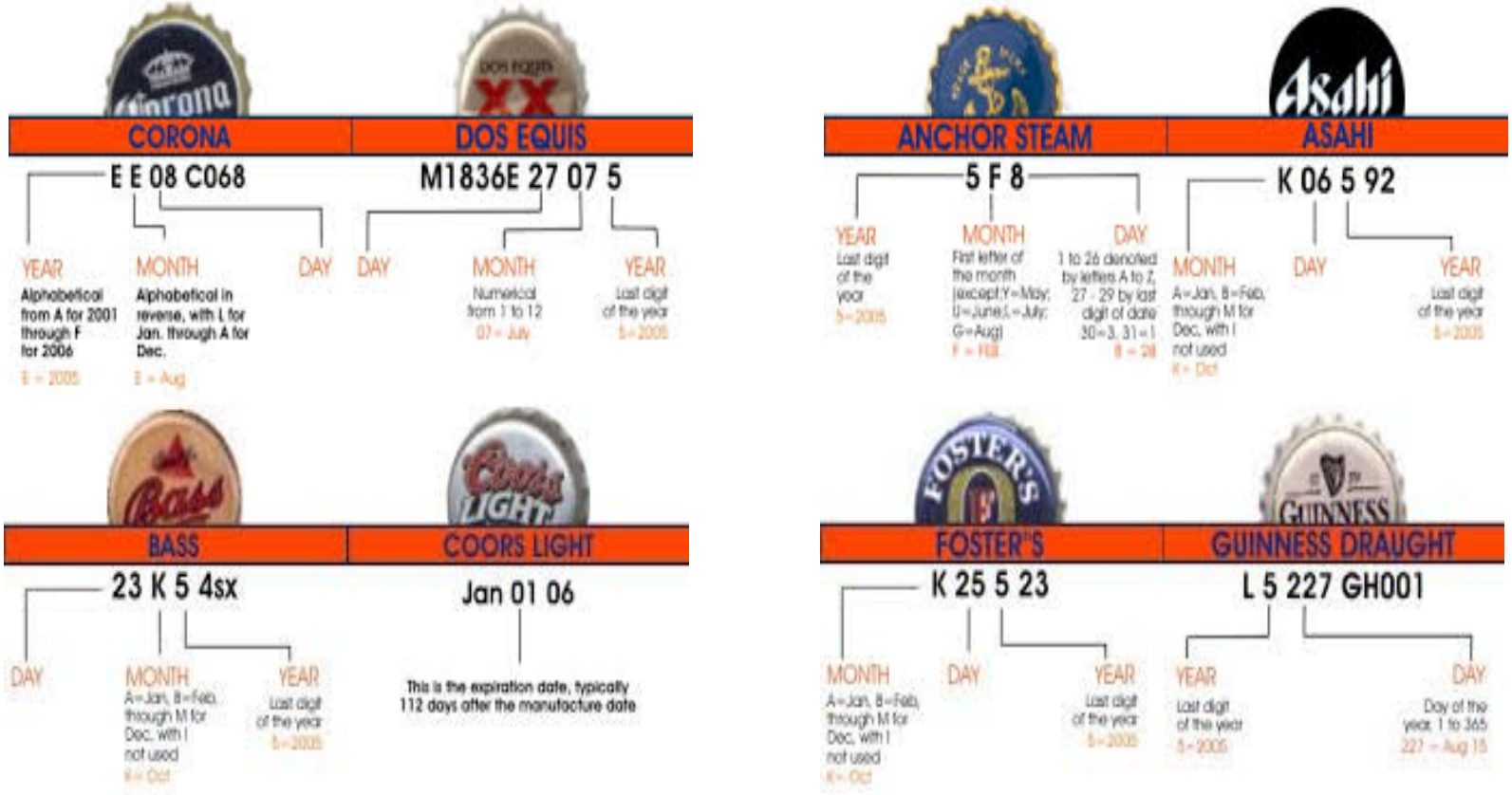


Automated “matrix” system



Automated mobile robot system

Lack of standards creates manual intervention and can lead to mistakes (date code example)



Some efforts are underway to provide guidelines in an attempt to help minimize the wide variation.

In November of 2014, GS1 provided guidelines however they are a long way from being adopted as a standard.

Making some progress (a step toward standardization) - for now it is

1 INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The purpose of the ***North American Industry Guidance for Standard Case Code Labeling*** is to provide best practice guidelines for industry-wide adoption of a common standard for case-labeling information for finished products in the grocery and foodservice sectors. Adoption of the guidance offered in this document is voluntary and will be determined by the trading partner relationship.

In addition to key definitions and descriptions for core elements for case-label information for extended product attributes in human-readable and machine-readable formats, this document offers "how to" guidance and recommendations for implementing GS1-128 barcodes for product case labeling taking into consideration common business practices and various supply chain processes. These guidelines have been developed with input and participation from all segments of industry through a collaborative process. The following trade associations and industry groups have participated in or followed the development of these guidelines:

- Canadian Federation of Independent Grocers (GFIG)
- Food and Consumer Products of Canada (FCPC)
- Food Marketing Institute (FMI)
- Grocery Manufacturers Association (GMA)
- International Dairy Deli Bakery Association (IDDBA)
- International Dairy Foods Association (IDFA)
- International Foodservice Distributors Association (IFDA)
- International Foodservice Manufacturers Association (IFMA)
- Meat and Poultry B2B Data Standards Organization (mpXML)
- National Association of Chain Drug Stores (NACDS)
- National Association of Convenience Stores (NACS)
- National Grocers Association (NGA)
- Produce Marketing Association (PMA)

The proposed guideline for date codes (a good start)

GS1 US GS1 Canada

NORTH AMERICAN INDUSTRY GUIDANCE FOR STANDARD CASE CODE LABELING
R1.1 — NOV 10 2014

Part 2 – How to read the date

GS1 Standards provide guidance on how to convey date and time in human-readable format. This includes using the ISO 8601 Date Time global standard for human-readable date format. Date information is expressed as "YYYY-MM-DD" in which:

- YYYY = four-digit year
- MM = two-digit month
- DD = two-digit day of month

Example: Best Before 2010-06-29, Best Before/Meilleur Avant 2010-06-29

Example: In the sample barcode below, June 29, 2010 is shown as 2010-06-29.

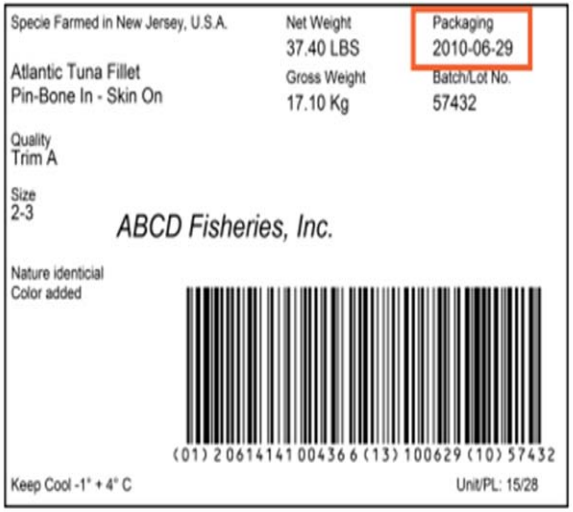


Figure 1. Example of human-readable text on label

Sample GS1-128 Barcode:

Figure 3. Sample GS1-128 barcode with GTIN (01), Production Date (11), and Batch/Lot Number (10)

Establishing standard date code format would be a great step, much more to be done

Product packaging variation creates significant challenges when trying to design warehouse automation

Full corrugate box

Partial (odd shaped) corrugate box & shrink wrap

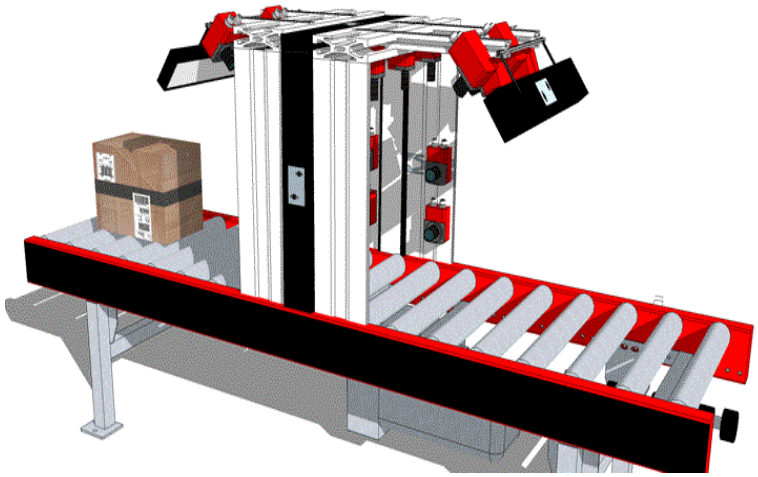
Corrugate tray & shrink wrap

Shrink wrap

Different configurations of the same SKU

Odd shaped case (not cubic)

Some solutions becoming readily available (6 sided scanners, wavelength filtering cameras, etc.)



Note: Although this drawing is depicting reading cases, the technology also exists for reading pallets

Scanning bare cases and reading barcodes is not as challenging as attempting to read wrapped pallets of product (trying to read the barcode through the plastic) however, there are some companies attempting to address this by utilizing cameras that filter light of specific wave lengths.

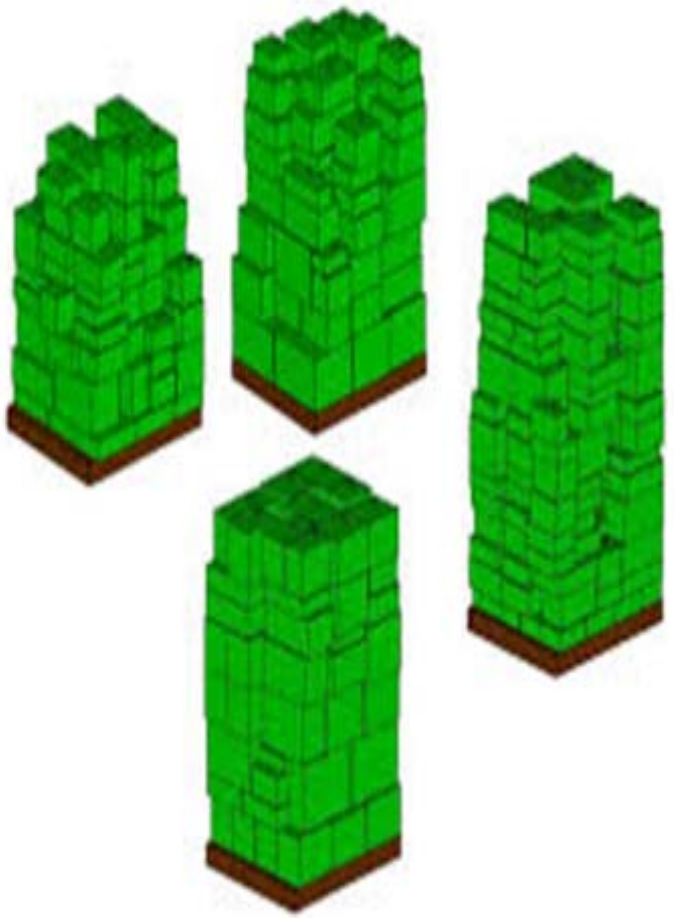
Not all manufacturers are following the suggested guideline, thus requiring manual intervention to properly capture the information. The use of RFID attached to, or embedded in, the pallet/case is a potential solution but a majority of manufacturers are currently unwilling to incur the expense of using RFID.

Many SKUs arrive in different packaging from different manufacturers and/or manufacturing locations, often arriving in different configurations (ex: 1 layer of 12 soup cans vs 2 layers of 6 cans) these are referred to as variants or daughter SKUs. Some SKUs have up to 8 different variants active at the same time, with up to 40% of the SKUs having at least one variant.

Product packing variation drives significant challenges with cubing pallets and thus cubing out trailers

Other challenges that drive less than optimal cube of pallets:

- Caustic products cannot be stacked on top of food
- Fragrant products cannot be placed next to tea or other consumables that could absorb the fragrance
- Not all cases have the same weight bearing properties
- Not all cases have the same stability
- Some products are top heavy and thus difficult to convey and stack
- Some products do not have a flat top surface
- Irregular surface area / packaging can render some SKUs very difficult to stack other products on top of them
- Some liquid products cannot be stacked on their sides or upside-down



Note: Although these challenges are not unsurmountable, from an engineering standpoint, they are driven by extreme pressure to minimize packaging costs to improve ultra-low margins.

Automation attempts to create standard “units” out of dissimilar cases/objects (trays, totes, pods, etc.)

Trays

Totes

Pods

Boxes

… all are attempts to standardize the shapes of dissimilar products.

Unfortunately, many challenges still exist and need to be overcome

- Lack of collaboration (different business units, within the same company, refer to the same SKU with different numbers and don't share inventory)

- Lack of avenues to share loads/expenses, etc. (companies do not have financial systems to properly allocate the expenses with respect to mixed loads, some 3PLs provide this service)

- Security of information vs. readily available information (many homegrown systems will not securely communicate with other homegrown systems of their competitors)

- Lack of inventory sharing (company A has product company B needs to fill and order)

- Lack of a good way to share / distribute margin on a delivered physical object (if inventory is shared, competing companies often have difficulty determining how to properly allocate holding fees, opportunity costs, etc.)

- A capitalistic economy drives companies to differentiate themselves to drive revenue growth and retain and/or grow market share. Many attempt to do this through innovation (this includes the automated system providers) which currently makes common nodes throughout the Physical Internet challenging at best