

# **OUTSOURCED STORAGE AND FULFILLMENT FACILITY TO ENHANCE THE SERVICE CAPABILITIES OF SHOPPING MALL TENANTS**

**Zachary Montreuil**  
**University of North Carolina at Charlotte**

**Mike Ogle, Ph.D.**  
**University of North Carolina at Charlotte**

## **Abstract**

This paper proposes development of an Inventory and Fulfillment Center (IFC) that will provide a new range of outsourced, centralized storage and services for shopping mall tenants. The paper describes the competitive issues faced by shopping mall tenants, the requirements and features of a centralized, outsourced storage and fulfillment facility, and development of an agent-based model in AnyLogic® to demonstrate the concept. The range of research and business challenges introduced by this new concept are also presented.

## **1 Inventory and Fulfillment Services for Shopping Malls**

A new type of retail fulfillment center is described that offers a wider range of services for stores and customers of large, traditional shopping malls. For ease of discussion and reference in this paper, the new type of center will be called an Inventory and Fulfillment Center (IFC). Rather than individual stores depending on their own limited backroom capability for storing items (primarily to restock their shelves), the IFC is a new type of logistics facility that will be located within or near shopping malls. Retail shopping centers, of which malls are a very common form, are the source of the vast majority of consumer sales, plus the majority preferred shopping experience [1].

The main features of the IFC are:

1. Augment or replace a tenant's backroom, storing inventory in a secure area
2. Provide additional inventory replenishment options for tenants
  - Automatic shelf replenishment through sales and inventory tracking
  - Automatic reordering, replenishment of IFC inventory
  - Automatic replenishment of backrooms

- Automatic replenishment intermediate locations (e.g. lockers, containing goods sold to customers or unsold goods repositioned for retailer access)
3. Online customer order fulfillment for stores located in the mall
- Pick-up by customer at IFC customer-facing location for ease of pick-up
  - Pick-up by customer in store to provide cross-selling opportunities
  - Home or other destination-specific delivery for customer convenience

The first two categories of features above are primarily focused on services offered to the mall's tenants. Those features help to reduce the logistics tasks that the store managers and employees must execute to give them time and space to focus on their core competencies of product selection, product purchasing, service, advertising, merchandising and creating a shopping experience for their customers. The features can also help to reduce the out-of-stock (OOS) problem by providing better logistic processes and information visibility.

The last feature is good for both the tenants and the mall customers because it provides support for omni-channel growth which is currently not well developed among the average tenants in shopping malls (primarily due to lack of experience and resources).

The first service category allows the stores to expand the flexibility of their backroom inventory and increase their number of SKUs. It would even be possible to move some items temporarily back to the IFC, then bring them back to the stores (possibly due to seasons or other temporary emphasis on making room for other products).

The second service category provides tenants with the ability to select different types of replenishment options for different types of products. For strong selling or long-term selling products, the automatic replenishment from inventory is a good option because the tenants only have to identify how many items of the product they want in their store. When the IFC detects that the store inventory has reached the minimum inventory level, an order can automatically be created and the items are sent to the store (or even placed directly on the shelf).

The second service can also be used to ensure that before the opening of the store, there is a sufficient inventory of the selected product in the store and placed in a salable position. The replenishment from lockers or other intermediately located inventory may be a good option for stores that are farther away from an IFC, to enable them to reduce the delivery time for recurrent products. It works like the replenishment directly from the IFC, but instead of tracking the store inventory, the IFC tracks the locker inventory.

The last service category is related to offering a better and wider range of service to the customers. When customers purchase a product online from a retailer located in the mall, they will have the opportunity to have their products delivered at their home in a short period of time for a certain price or to pick-up them for a possibly different level of fee at a pick-up station at the mall or in the store. Since this service offers more options to the customers, it is also advantageous to the retailers because it might attract more customers to the shopping mall.

## **2 Advantages of Outsourced Mall Logistics**

The IFC concept is an important addition to shopping malls because tenants have difficulty developing omni-channel retail capabilities to compete with the fast-growing, but still significantly smaller, ecommerce only retailers. From observations of mall operations and interviews with the manager of a large mall in Charlotte, NC, as well as interviews with a small sample of store managers in the mall, stores within a mall operate independently at every logistic step. Many stores are directed and coordinated by a corporate parent that maintains a presence at tens or hundreds of stores at malls across the U.S., in addition to the possibility that they may have a presence in multiple malls in a city or smaller geographic region.

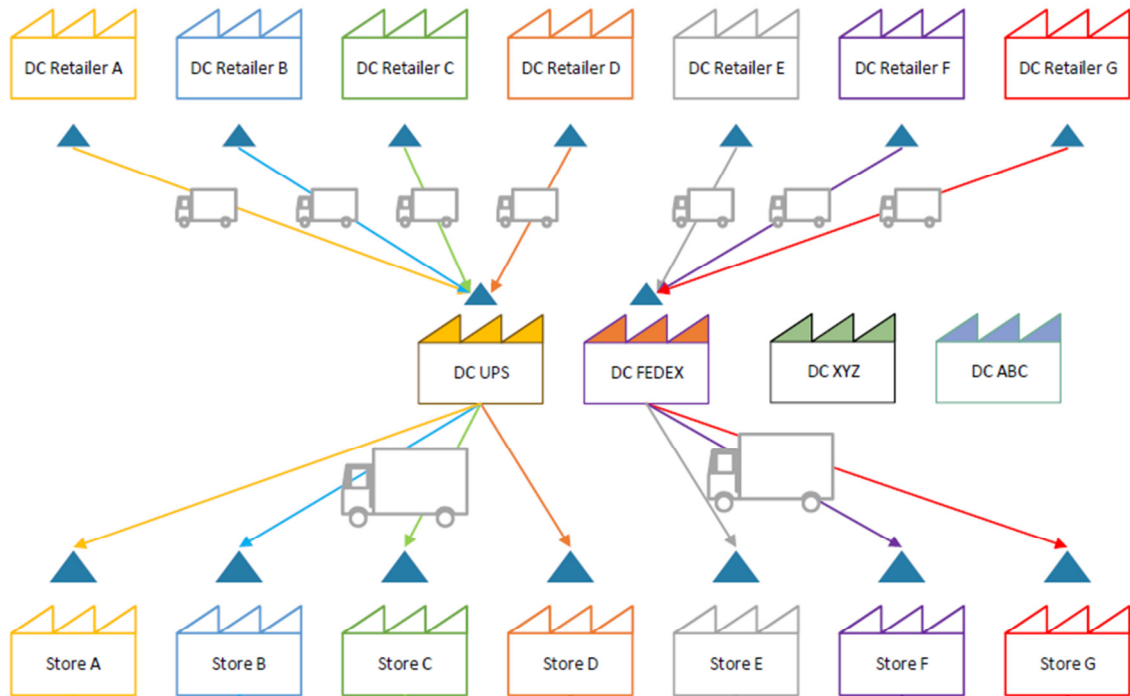
The stores need to keep inventory of many SKUs on the shelves of their small backrooms, set up alternate locations to hold inventory, or delay orders for products (possibly resulting in missed sales). Their products are also delivered at seemingly random times during the day by their selected carriers (such as FedEx, UPS, DHL, LTL carriers, etc.). Those carriers often have employees spending full days at the mall making trips between the docks and the stores because they can only deliver small amounts of boxes on their carts per trip. Some of those trips are even made in the mall corridors during shopping hours. When the deliveries are made during the shopping hours, one of the store employees needs to stop serving the customers to put the products on the shelves or in the backroom. If there are many customers in the store, it results in a diminished customer experience. Also, the dock spaces are limited and not scheduled, so if a carrier's truck is parked at the dock for a long period of time, the other trucks need to either wait until a dock is available or unload from the back without a dock and possibly walk farther to get to the stores.

## **3 Shopping Mall Logistics (Current vs Proposed) and Opportunities**

The current and proposed logistics flows from retailer distribution center sources to the retail stores are illustrated in Figures 1 and 2. As we can see from Figure 1 and from the information provided earlier, each retailer works individually and the carriers need to deliver products individually to each store.

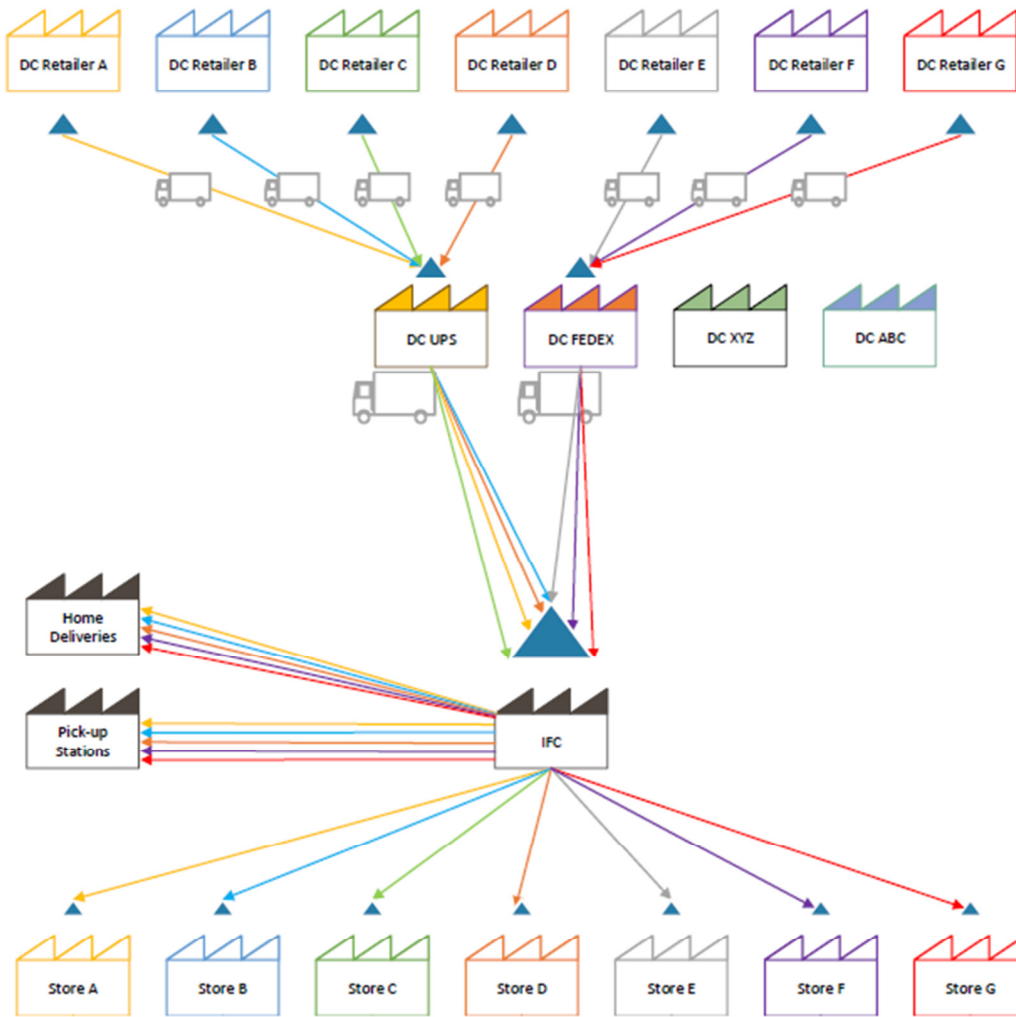
Figure 2 presents some of the opportunities that the IFC offers to the retailers. First, the carriers deliver all the products to a single location, the IFC. The total unloading time can be reduced significantly because the carrier's workers only have to unlock, open, close and lock the door once to drop off items at the IFC rather than unlocking/relocking and making multiple trips using the current, non IFC, method.

Since the IFC can store additional items for each store, possibly responding quickly to expedited orders of items, a higher number of SKUs can be offered in the store, likely leading to a significant increase of sales.



**Figure 1. Current shopping mall logistics from retailer DCs to stores**

The last opportunity shown in Figure 2 is the home-delivery and pick-up options offered for the online orders. Currently, a small percentage of stores inside a shopping mall are able to offer ship-from-store or pick-up at store for their online orders. The main reasons for outsourcing these tasks are the labor required (distracting retail staff away from direct customer service), packing steps required, small inventory levels and space available to fulfill the orders. The IFC will offer to the retailers the possibility of fulfilling their online orders directly at the center using the inventory located in the IFC storage and fulfillment workstations specially designed for that purpose.



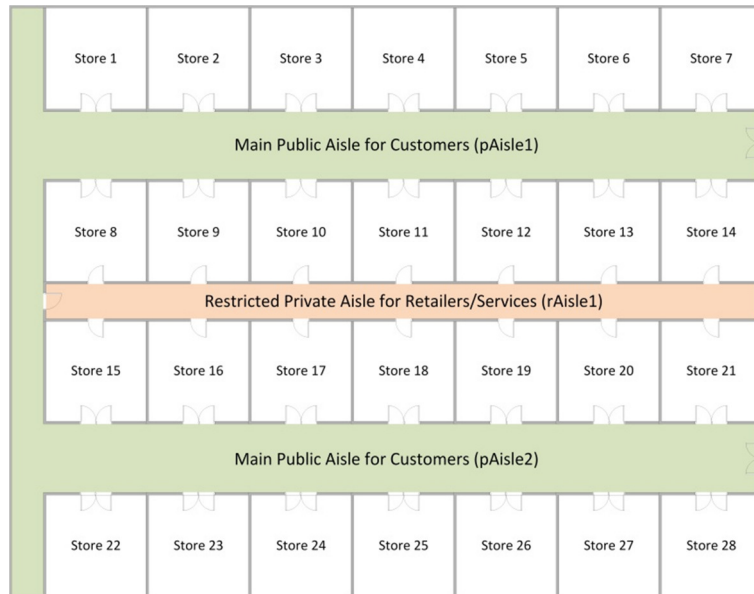
**Figure 2. Shopping mall logistics including the IFC, from retailer DCs to stores**

#### **4 Initial Shopping Mall Model Description**

An agent-based simulation model was created in AnyLogic® of a fictional shopping mall to show how the different elements of an Inventory and Fulfillment Center (IFC) serve the interconnected needs of suppliers, retail stores, and retail customers. This model provides the initial basic experimental structure for future research and more detailed designs. Many assumptions are made regarding scale (primarily number of stores and SKUs), behaviors, operational rules, etc. due to the need for manageable initial model building and execution. However, these assumptions were based on responses provided

during interviews with the general manager of a large upscale, urban mall operated by a national company, plus detailed interviews with several mall store managers.

The current agent-based simulation model only represents product deliveries to the IFC for distribution to the shopping mall stores. Online order fulfillment, IFC/store pickup, and returns are not included but can be added to the model in future research.



**Figure 3: Fictional Shopping Mall – Retailer Layout**

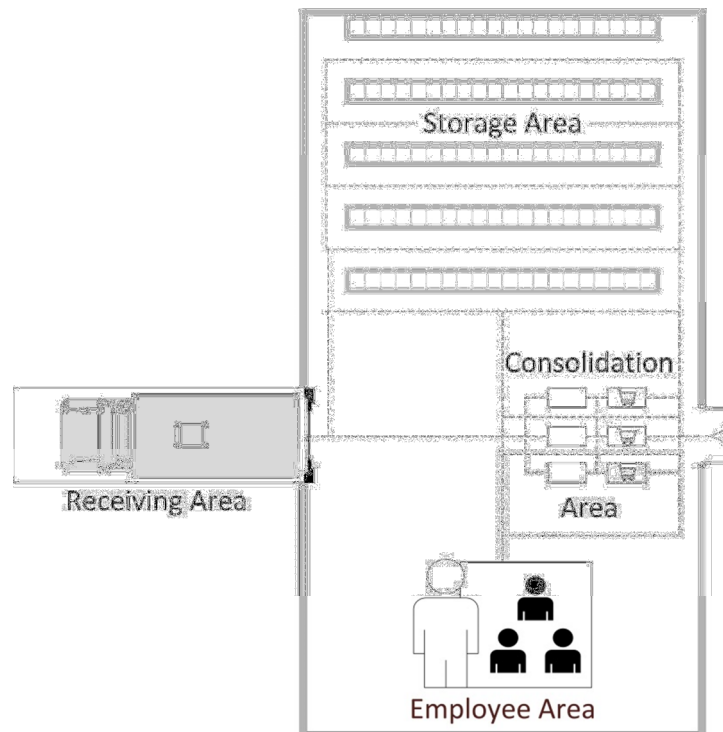
The stores above are all equally sized to simplify the model, using an average store size to provide realistic walking times. For this basic model, every store only has two Stock Keeping Units (SKUs), one with high demand and one with a lower demand. This assumption simplifies the initial model building requirements. It will be a relatively simple modification to scale up the existing SKU structure. Each product is represented as a small box of 20cm x 20cm x 20cm. This assumption was made to simplify the model and the size was considered as a good representative average size of products you will find in a shopping mall. Future work can provide detailed data for large size variations from a small item the size of a fingernail up to the size of large home furniture.

At the beginning of the simulation, every SKU has an initial set of product orders generated using a randomized set of triangular distributions to represent the customer orders coming from each store. Note that each store has either a front entry point (same doors customers) or a backroom access using a private aisle (only for employees of the stores and the delivery agents).

The IFC portion of the shopping mall is illustrated in Figure 4. As found in all warehouses or fulfillment centers, the IFC receives product at a receiving area. The retail tenants order replenishment of product that currently arrives in a single size of

standardized Physical Internet container that for this model will simply be called a “box”. Each box carries a collection of individual items. Every incoming supplier box contains 27 products (3 products x 3 products x 3 products). The model assumes that each box only holds one type of SKU for one store (no mixing of SKUs in boxes). The box size is 60cm x 60cm x 60cm. The receiving area currently assumes infinite box capacity to remove that constraint in the initial model building exercise. Dock allocation is not part of the model and the boxes simply appear in the receiving area as customer order deliveries are made to the facility prior to being moved into storage, then eventually to the retail stores.

From receiving, boxes are moved by employees from the receiving to the storage area. Boxes stay in this area until ordered by a store to fill retail store replenishment orders. The storage area slots are currently a single standardized size that matches the single standardized boxes. The storage area has a fixed 2D footprint, but is assumed to be infinite in height in this early model to allow the initial model to run without storage space constraints. Workers in the current simulation model will slot products in the first available storage slot starting with the lower bins of the closest row. When the first row is filled, the employees store the products at the closest, lowest level slots. When all the bins of a level are filled, another level is created vertically. Again, the model currently assumes that infinite space can be created vertically, but the horizontal footprint is fixed. In addition, slotting considerations are not a focus of this initial model.



**Figure 4: Inventory and Fulfillment Center (IFC) Area**

The consolidation area of the IFC is used to accumulate store replenishment orders (SROs) prior to delivery to the stores. By current default, but not necessarily the best policy, each consolidation lane serves one specific aisle of stores. Each consolidation lane uses a cart to make the deliveries of products from the consolidation area to the stores. Store ordered products accumulate in the carts until ready for the employee to make a delivery to their designated lane. A cart leaves the consolidation area to deliver the products when it has 20 items or when an item in the cart has been waiting for an hour. Unused carts are placed in the consolidation lane waiting for products to be placed in them. The required number of carts and their allocation strategies can be determined during future experimentation

The employee (or worker, the terms used interchangeably in this paper) area is the location where the employees go by default when they don't have any tasks to do (such as receive product, move product to storage, move product from storage to consolidation, move products from consolidation to stores). In this model, employees are used to execute the different tasks in the IFC. Every employee can do all the tasks and they select the oldest tasks in the list (always assumed to be first-in, first-out in this initial model). An appropriate number of employees can then be found using experimentation. Employees hand-carry individual boxes from receiving to storage, plus they unpack boxes and hand carry products to the consolidation area. For store deliveries, they push carts through the facility and return them to the consolidation area.

## **5. Processes Driving Model Execution**

Product orders drive the model, but are generated currently using simple triangular distributions semi-randomly developed as temporary placeholders for the ordering patterns for each SKU of each store. A product order contains three main elements: the store that created the order, the SKU that it ordered, and the product quantity ordered.

An order for a quantity of products is created when the current product inventory in the IFC reaches one-third of its initial quantity. In this model, since the initial quantity is fixed at 27 products for all boxes, the box order is created when a box only has 9 products remaining. Once the box order is created, the box will be delivered the next day or the day after. These values and settings may all be modified to experiment with reorder point logic, quantities, length of delivery time, etc. by adding the behaviors to the agents.

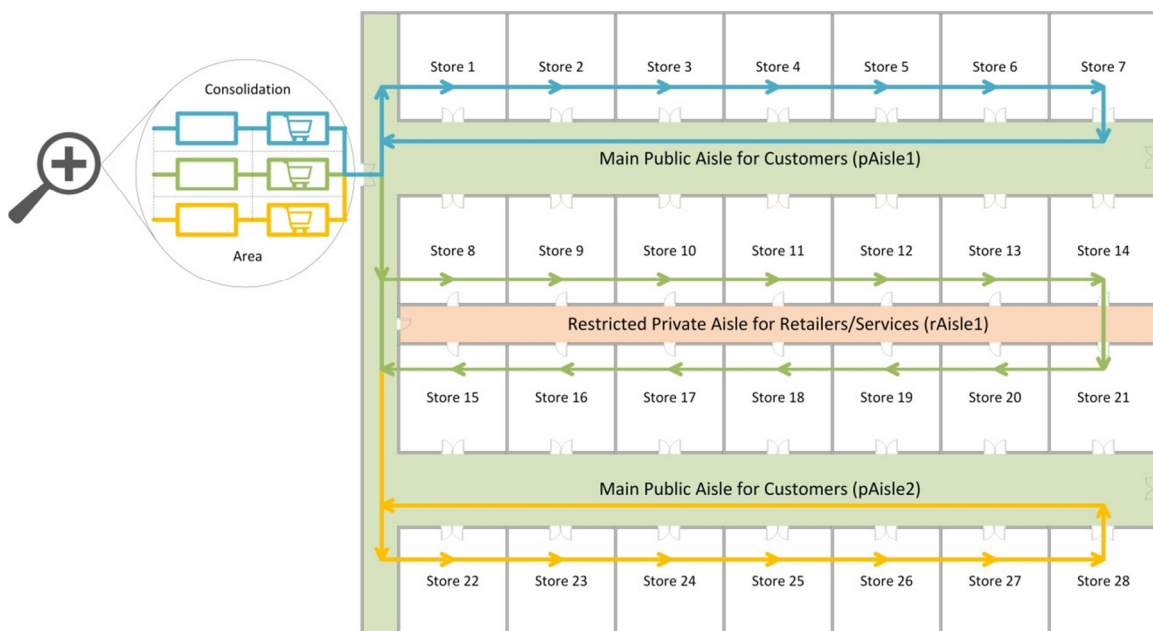
Boxes arrive at receiving according to the currently randomized arrival time and quantity value of the orders. That arrival triggers the first type of task performed by the workers, putaway of products from receipt to storage. No direct receipt to store deliveries can currently be made, but can be added to the model in future work.

The product pick tasks are created when stores generate product orders. The employee must go to the storage bin containing the box that matches the product order to fulfill. The employee takes the right number of products and delivers them to the



consolidation area shown in Figure 4. The worker puts the products in a product delivery cart in the proper consolidation lane that will serve the store that placed the order.

Store delivery tasks are the third type of worker task. A store delivery task is created when a cart in the consolidation area reaches one of two trigger points: either there are 20 total product items or a product in the cart has been waiting for more than one hour. If one of those triggers are fired and a worker is available, the employee goes to the cart and then delivers the products to each store (see Figure 5 below). The deliveries are initially assumed to be made using the simple method of ascending store order within the set of stores preassigned to that consolidation lane. For example, the delivery order of the cart for aisle 1 that has product for stores 1 through 7 will be: 1 – 2 – 3 – 4 – 5 – 6 – 7. Future experimentation and logic can optimize store delivery routes.



**Figure 5: Consolidation Lanes Dedicated to Store Aisles**

## 6. Observations and Research Opportunities

This new IFC model was envisioned and constructed to enable experimentation with the idea that a collection of stores in the mall would be able to comingle their products in a storage area operated by a trusted third-party. In this case, that trusted third party is the mall operating company. Any sufficient collection of retail stores could contract with any trusted third-party to manage their products. It is assumed that retail customers would be willing to pay the mall operator to provide this new set of services to enable them to reduce stock-outs, enable more efficient store pick-up, and enable delivery.

This paper has simply introduced the IFC concept and its many components and parameters, but has not answered any questions regarding levels of input, output, or resources required. The paper has not answered whether the concept is financially viable under any mix of input, output, or resources. The paper has, however, introduced a wide variety of research questions to be answered for continued IFC concept development, such as:

- Obtaining/experimenting with actual or representative store data
- Resource levels/costs for store pick-up, IFC pick-up and omni-channel support
- Dispatching rules for workers and carts
- Dense storage methods (level of automation)
- Reusable bins for storage/transfer of items as envisioned in the Physical Internet [2]
- Multiple, cooperative IFCs within a single facility
- Multiple levels and locations of IFCs in local area tied to Physical Internet
- Direct replenishment of store shelf inventories
- Task prioritization for workers
- Cart capacity, variety of carts
- Routing algorithms and optimization with tasks
- Direct delivery to stores from initial receipt if product inventories are low
- Evaluation of new receipt methods with parcel and LTL carriers

## References

- [1] International Council of Shopping Centers, Inc. "Shopping Centers: America's First and Foremost Marketplace," Available from: <http://www.icsc.org/uploads/research/general/America-Marketplace.pdf>. (cited May 25, 2016).
- [2] Montreuil, B., "Physical Internet Manifesto," Available from: <http://physicalinternetinitiative.org/Physical%20Internet%20Manifesto%20Version%201.11%202012-11-20.pdf>. (cited May 25, 2016).