# Smart Locker Bank Design Optimization for Urban Omnichannel Logistics

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## Extended Abstract

This presentation synthesizes our recent research on optimization based design methods for smart locker banks in the context of omnichannel business-to-consumer logistics and supply chains (Montreuil, 2017). In such a context, goods purchased by consumers are typically delivered to a smart locker bank conveniently located nearby the consumer's home or workplace. Achieving this convenience requires implementing hundreds, even thousands, of smart locker banks across the urban agglomeration. Figure 1 provides examples of such smart locker banks used for B2C purposes.


Figure 1: Illustration of Fixed Smart Locker Bank
(Source: Faugere & Montreuil, 2017a)

As reported in Faugere and Montreuil (2017a), two design approaches are most currently used: the fixed-configuration locker bank and the modular tower based locker bank.

With fixed-configuration locker banks, optimizing the design involves defining the global size of the bank (length and height), deciding which locker dimensions are to be implemented and how many of each dimension, and laying out the lockers across the bank, as illustrated in Figure 2.

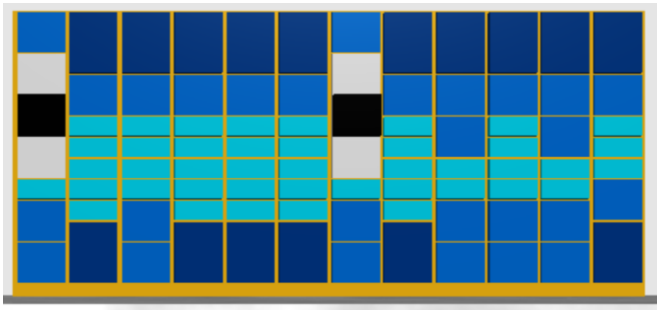

Figure 2: Illustration of Fixed-Configuration Locker Bank Design Optimization
(Source: Faugere & Montreuil, 2017b)

Extending our work from Faugere and Montreuil (2017b), we introduce an optimization model that, given a restricted zone to implement a smart locker bank (e.g. an available space by the wall of a convenient store), maximizes expected revenues generated by serving a set of probabilistic delivery scenarios, taking into account ergonomic costs, service level and utilization constraints, and structure parameters. There are a few alternative contexts for such design optimization: (1) the design of each locker bank is customized for the location in which it is to be implemented; (2) a single design is to be used for all lockers in the urban agglomeration; (3) a limited set of designs are to be implemented, selecting among these the best fitting for each location.

The alternative approach is to have smart locker banks designed exploiting a predefined set of modular towers, as illustrated in Figure 3.

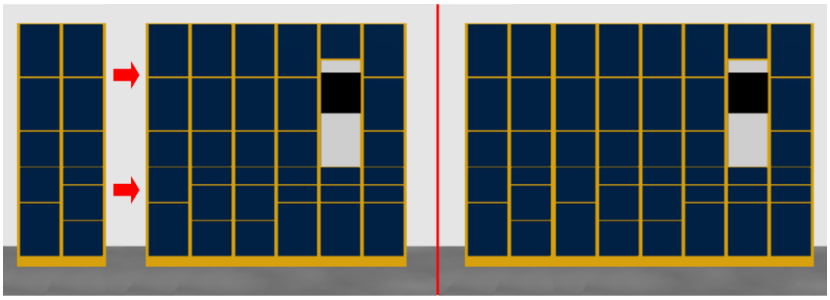

Figure 3: Illustration of a Modular Tower Based Smart Locker Bank
(Source: Faugere & Montreuil, 2017a)

A set of modular towers is to be optimized for the urban agglomeration, from which designs for specific locker banks can be optimized by concatenating selected modular towers. Using this approach, standard modular towers can be purchased, implemented or stored, allowing adapting the design of locker banks on a medium-term basis (e.g. monthly, quarterly or yearly). We introduce optimization models with the same expected revenue maximization objective as the fixed-configuration model, yet adapted to the dynamic modular-tower context, respectively allowing to optimize the set of modular towers and to optimize specific modular tower based locker bank designs.

In the presentation, we further introduce smart locker bank design, its context and the studied approaches. Then we introduce the optimization modeling for both fixed-configuration locker banks and modular-tower based locker banks. We finally provide empirical results and strategic insights, as well as avenues for further research, notably further exploiting the concepts and principles of Physical Internet and Hyperconnected City Logistics (Crainic and Montreuil, 2016).

**Keywords**: Smart Lockers, Last Mile Delivery, Optimization Based Design, Omnichannel Supply Chain, Hyperconnected City Logistics, Physical Internet.

**References**

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