Storage Management System of Delivery Vehicle for PT Pos Indonesia (Persero)

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***Abstract*—At present, 70% of shipments which served by logistics services are e-commerce goods weighing 0-4 kg. The speed of delivery and package security become important factors for both couriers and consumers. It is undeniable that vehicles become the key to successful delivery activities. But the challenge so far, the shipments is too large to be sent by a motorbike, but also too small to be sent by car and feared will be damaged or tucked away. The only solution is by implementing a storage management system so that the courier can load, arrange and unload the package from the vehicle easily. This article proposes a design of implementable storage management system for delivery vehicles so that delivery activities done by couriers become more effective and efficient. By analyzing storage requirements, the ideal cargo criteria will be known. After that, storage accessibility study will be conducted to find out more about storage operations on vehicle and its critical dimensions that will become the storage specifications. Through applying gravity principle, a simple shelving system is expected to be a solution for storage management of delivery vehicle.**

***Keywords*—Storage System, Storage Management, Delivery Vehicle, PT Pos Indonesia.**

Table 1.
Types of shipments handled by PT Pos Indonesia

Percentage	Shipments	Goods Detail	
10%	Letters & Documents	Letters Documents	
20%	Non-e-Commerce	Personal Goods Corporate Goods	
70%	e-commerce Goods	Clothes	73.8%
		Cosmetics & Medicines	27.5%
		Electronics	26.3%
		Travel*	23.0%
		Home Appliances	20.1%
		Toys & Hobbies	14.1%
		Medical Equipment	14.1%
		Children Equipment	13.4%
		Automotive	12.8%
		Books	12.1%
		Film & Music	12.1%
		Food & Beverages	9.2%
		Property*	8.0%
		Financial*	5.2%
		IT Services*	4.9%
		EO Services*	4.2%

**Non-physical goods*

I. INTRODUCTION

THE rapid growth of online sales (e-commerce) has resulted in high goods movement activity, especially on urban area (urban goods movement) [1]. At present, 70% of shipments served by logistics services are e-commerce goods [2] where the items weigh 0-4 kg and are package types (not letter or document types). Speed and safety are now an important factor for both couriers and consumers. Therefore, it becomes a challenge for logistics services to carry and arrange packages in vehicles so that the package is not damaged or tucked away.

PT Pos Indonesia (Persero), a State-Owned Enterprise (BUMN) engaged in logistics and courier, and as a national logistics backbone, determines the criteria for packages weighing 0-2 kg for motorcycle. The rest of the criteria are transported by car. The weight of an e-commerce package that ranges from 0 - 4 kg is too large to send using a motorbike, so the remaining option is by car even though it is too small to send using a car. The only solution is by implementing a storage management system so that the courier can load, arrange and unload the package from the vehicle easily. Therefore, the objective of this research is to design and develop an implementable storage management for delivery vehicles so that delivery activities done by couriers become more effective and efficient.

II. METHODS

A. Data Collecting

Data collecting in this research used several sources, they are: stakeholders, existing studies and literature studies. Data collecting is intended to find problems, needs, and opportunities that exist. The problems, needs, and opportunities obtained are then concluded and used as reference in design. The methods used include: *interviews with Head of Delivery Center (DC) of Letter and Packages PT Pos Indonesia Regional Surabaya* and *user observation (courier)*.

B. Study and Analysis

Stage of study and analysis consist of *study and analysis of storage requirements*, which will describe the various types of packages handled by the courier, their dimensions and volume to determine the ideal cargo volume requirements of a vehicle. After the results are known, *storage accessibility study* will be conducted to find out more about storage operations on vehicle and its critical dimensions that will become the storage specifications.

III. RESULTS AND DISCUSSIONS

A. Storage Requirements

PT Pos Indonesia courier handles shipments where 70% of all shipments are e-commerce goods, 20% are non-e-commerce goods (in the form of personal/ public goods and corporate goods), and 10% are letters and documents (Table 1).

After knowing the types of goods delivered, the following analyzes the dimensions and volume of goods to find out storage requirements (Table 2, 3 and 4).

Table 2.
Volume analysis for letters and documents

Goods	Goods Detail	Dimension (cm)	Delivery Target Assumption	Total Volume (cm^3)
Letters & Documents	Letters & Documents (in Envelope)	32 x 46 x 1 (A3)	50	73,680
	Postcard	15 x 10.5 x 0.02	25	
Average Volume (cm^3)				36,840

Letters and documents will be separated from the e-commerce and non-e-commerce packages, because it is feared that they will be tucked and crushed, making them fold or not intact. So, the average volume for the whole package is (e-commerce package and non-e-commerce package):

= (6,000 cm^3 + 15,000 cm^3) / 2

= 10,500 cm^3

With assumptions:

Courier Working Duration = 9 hours

Weight limits per package = 4 kg

The total of package that can be transported = 100 packages

Maximum weight of cargo = 400 kg

The minimum volume of vehicle storage needed is:

= (10,500 cm^3/package x 100 packages) + tolerance ±20%

= 1,050,000 cm^3 + tolerance ±20%

= 1,260,000 cm^3

= **1,260 L**

From the storage volume obtained, the vehicle storage size is obtained, namely (l x w x h): 1,200 mm x 1,050 mm x 1,000 mm. Here is the visualization of the minimum size of the vehicle storage:

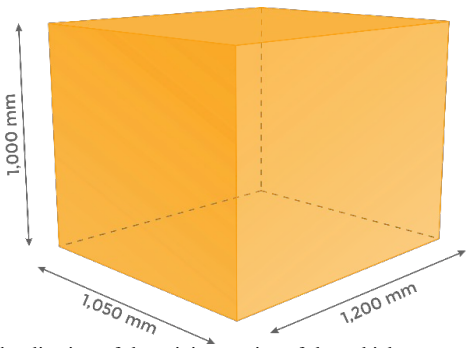

Figure 1. Visualization of the minimum size of the vehicle storage (l x w x h) 1,200 mm x 1,050 mm x 1,000 mm.

Table 3.
Volume analysis for e-commerce packages

Goods	Goods Detail	Dimension (cm)	Total Volume (cm^3)	Average Volume (cm^3)
Clothes	Scarf and Hijab	20 x 5 x 3	20,590	4,120
	Shirts, Pants and Jacket	20 x 10 x 5		
	Shoes	30 x 20 x 17.5		
	Bag	30 x 15 x 15		
	Watch and Accessories	17 x 12 x 10		
Cosmetics & Medicines	Make Up Kit	25 x 15 x 12	5,040	2,520
	Medicines	6 x 6 x 15		
Electronics	HP & Tablet	28 x 17 x 5	20,737	3,456
	Laptop	45 x 31 x 7		
	Mouse	20 x 12 x 4		
	Speaker	17 x 6 x 6		
	Headphone	20 x 18 x 12		
	Camera	18 x 15 x 10		
Home Appliances	Tupperware	27 x 15 x 15	21,720	7,240
	Utensils	25 x 25 x 3		
	Bedsheet	34 x 27 x 15		
Toys & Hobbies	Toys Model Kit	40 x 30 x 15	18,000	18,000
Medical Equipment	P3K Equipment Kit	20 x 12 x 6	1,440	1,440
Children Equipment	Baby Kit	25 x 13 x 6	5,235	1,745
	Milk	12 x 12 x 15		
	Baby Clothes	15 x 15 x 5		
Automotive	Helm	40 x 30 x 30	40,500	20,250
	Automotive Parts	30 x 15 x 10		
Books	Large Landscape Book	32 x 28 x 5	5,712	2,860
	Magazines	22 x 28 x 2		
Film & Music	Film and Music	18 x 14 x 5	4,872	2,440
	Musical Instruments (Melodica)	43 x 14 x 6		
Food & Beverages	Cookies	12.5 x 12.5 x 5	5,512	1,838
	Wrapped Food	23 x 10 x 10		
	Beverages	9 x 9 x 30		
Total Volume (cm^3)				66,000
Average Volume (cm^3)				6,600

B. Gravity Flow Tube Shelving

The system used gravity principle, where an item will fall towards a lower altitude area. Shelves are fixed, they cannot be adjusted in height, but the rack components consist of modular parts that can be removed and added as needed. The components in this storage system include: long pipe (as the main construction), base (as the base of the pipe which is then connected to the floor and to the vehicle ceiling), various joints/ connectors, connecting track modules, modules track adapter (as a connecting roller track module to the pipe), side guide, stopper + label module (for package stop boundaries), and bolts and nuts.

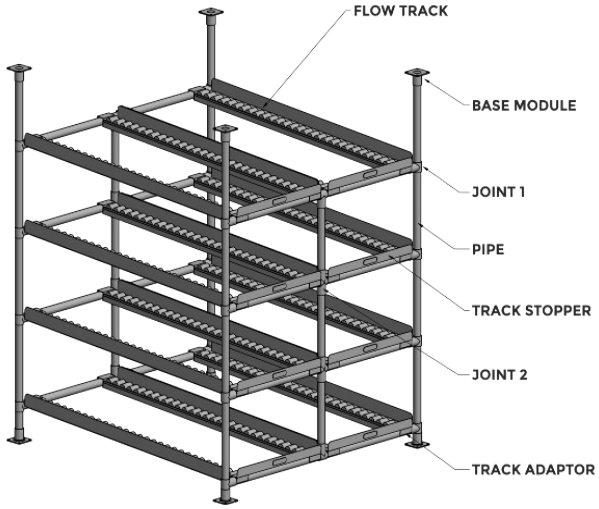

Figure 2. Gravity flow tube shelving system.

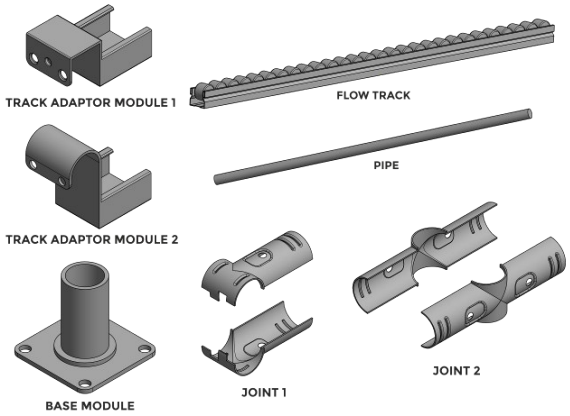

Figure 3. Several modules of storage system, consist of: base module, track adaptor modules, flow track module, joint modules.

C. Storage Accessibility

After the shelving is designed, the following are illustrations of the dimension and accessibility of the courier when loading or unloading the packages. Note that the dimensions are adjusted to the vehicle dimension.

Table 4.
Volume analysis for non-e-commerce packages

Goods	Goods Detail	Dimension (cm)	Total Volume (cm^3)	Average Volume
Non-e-commerce	Personal Goods	40 x 25 x 30*	60,000	30,000
	Corporate Goods	40 x 25 x 30*		
Total Volume (cm^3)				30,000
Average Volume (cm^3)				15,000

**Because the vehicle will replace the motorcycle, the package dimensions are taken from the maximum package size that can be carried by a motorcycle.*

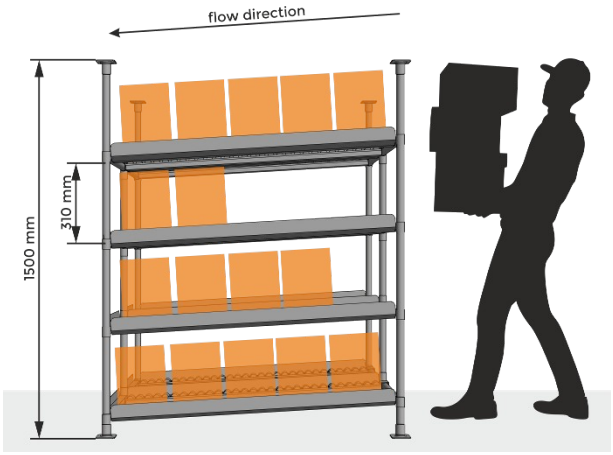

Figure 4. Storage accessibility from the side view

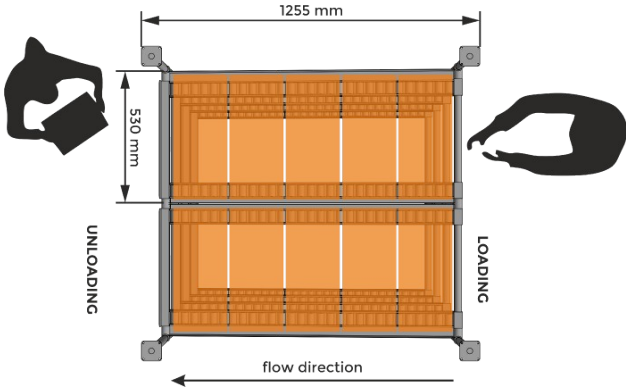

Figure 5. Storage accessibility from upper view.

Courier loads the packages from the shelf which has higher altitude, so that the packages will fall toward the lower altitude. Courier loads the packages from the first order of delivery, so when courier received (unloading) the package, he does not need to look up for the package anymore.

D.Storage Implementation on Vehicle

Figure 6. Implementation of gravity flow tube storage system on a delivery vehicle design. There are two storage systems: front and rear storage. Front storage system can be accessed through two side doors of the vehicle (right or left door), while rear storage can only be accessed through the rear door.

The storage system then implemented into a delivery vehicle specifically designed for PT Pos Indonesia (Persero). Vehicle storage dimensions also already meet the minimum storage dimension criteria that have been obtained in previous results. Storage system can be placed in the front and rear area of delivery vehicle that has been designed. The front area is an area that starts from behind the driver and can be accessed through two side doors (left and right sliding door) of the vehicle, while rear area can only be accessed through rear door (Figure 6).

IV. CONCLUSION

Storage management system in this delivery vehicle design used the principle of gravity. This system consists of modules so that they can be disassembled according to the needs of the vehicle and/ or the packages. By applying the system into the delivery vehicle, it provides convenience for couriers in loading, arranging, and retrieving (unloading) packages from vehicle to provide efficiency and effectiveness. The shelving system also provides separators between packages so that the package is not stacked and damaged.

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[2] Nuraeni, "Jasa Logistik Melesat di Era e-Commerce," *kominfo.go.id*, 2016. [Online]. Available: https://kominfo.go.id/index.php/content/detail/6707/Jasa+Logistik+Melesat+di+Era+e-Commerce+/0/sorotan_media.