

## **Redesign of work methods for sorting incompatibles in a distribution center**

Toya L. Gavin\*, Rishi R. Hinduja\*, and James T. Luxhøj  
Department of Industrial Engineering, Rutgers University,  
96 Frelinghuysen Road, Piscataway, New Jersey 08854-8088

\*Rutgers Undergraduate Research Fellow

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### **Introduction**

Package flow throughout central New Jersey has grown by 7.5% over the past year. One facility for handling packages, the UPS Edison hub, now handles approximately 140,000 packages per day. Upon entering the main facility, packages travel along a primary belt from which they are sorted according to the region of their destination within the country. Packages then go through a secondary sort with more specific allocations to subregions. Upon completion of the sorting process, the packages are loaded onto local or long haul trucks for delivery to specific locations or other UPS hubs. Although system flow is quite efficient throughout the facility, constant assessment is necessary to insure optimal productivity.

We have measured the package flow rates during the twilight sorting period, from 5:00 p.m. to 9:00 p.m., at the Edison, NJ UPS facility. Capacity rates were determined at various points within the facilities (stations), including the primary, secondary, and small sorts. In addition, several of the sorting operations were analyzed using MOST techniques.

We had three main goals:

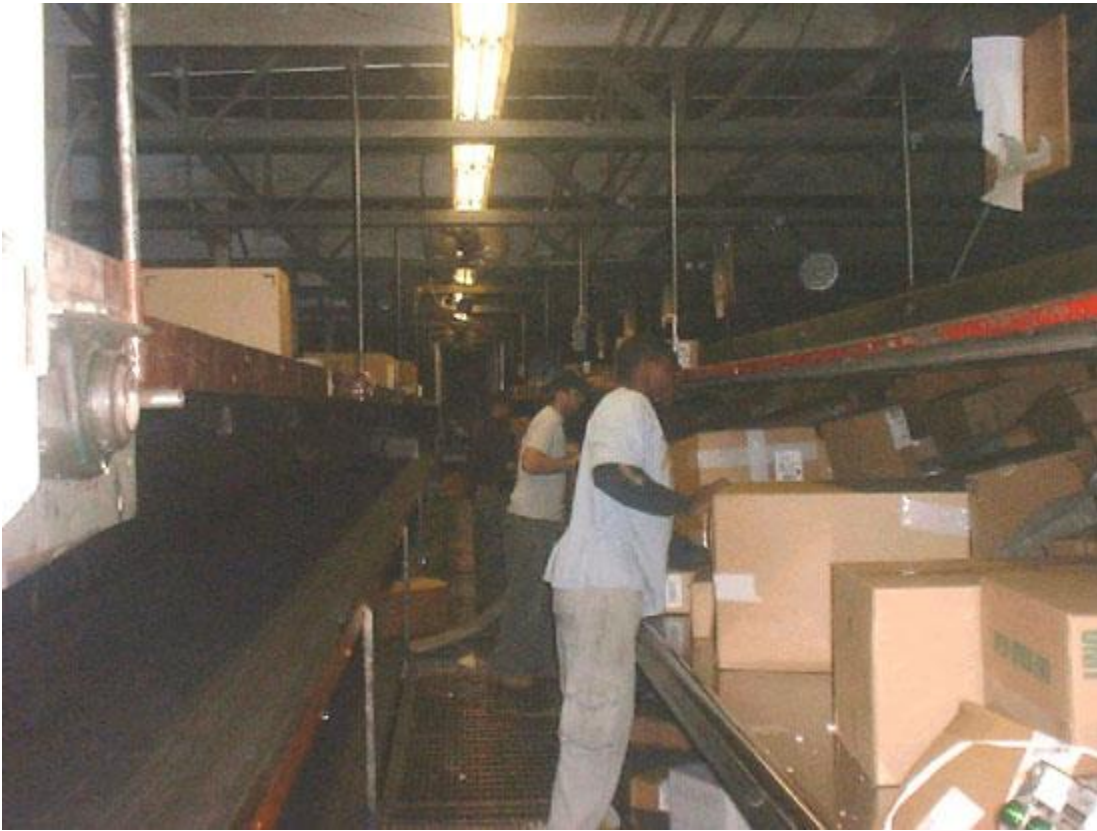
- To determine and analyze capacity rates at three stations, designated "primary sort," "secondary sort," and "small/table sort." These areas are shown Figures 1-3.
- To study facility belt systems in order to determine flow rates and to record sorting operations. We also assessed the efficiency of the physical movements and the sorting techniques that the workers use.
- To provide suggestions for improved workflow.

**Figure 1.** Primary sorting area

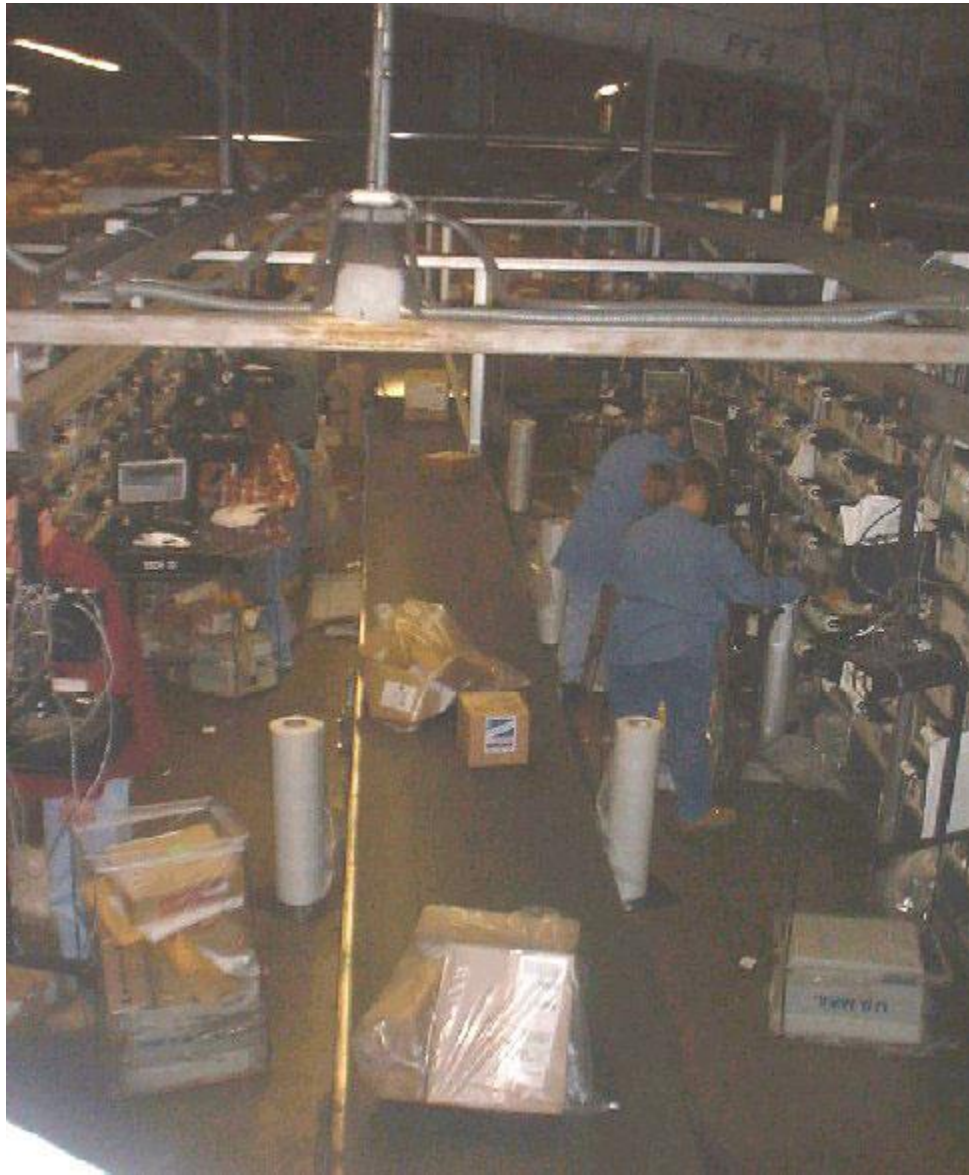
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**Figure 2.** Secondary sorting area



**Figure 3.** Small/table sorting area



### **Methods of analysis**

Sorting at the Edison UPS facility is carried out on a network of belts. Two main areas provide the initial sorting. The High Volume Direct (HVD) system serves as a primary sort and consists of four belts with two attendees per belt. It is set up to handle a large volume of packages directed to regional allocation points. The Low Volume Direct (LVD) serves as a secondary sort and consists of 15 belts with two attendees per belt. It handles a lower volume of packages addressed to less frequented locations.

Flow rates and capacity rates were analyzed for the various belt systems by counting package flows for random 15-minute intervals during the twilight shift over a total period of about 30 hours. In particular, flow rates were obtained for each belt color and broken down further according to belt function: primary/secondary sorts, and high/low volume direct. To standardize the information, flow counts for the (on average) 15-minute intervals were multiplied by four to get an average hourly flow. High and low volume direct belt operations were studied using MOST techniques.

Data concerning small or table sort efficiency operations were also recorded. Specifically, at the small sort operation (also called the table sort), we determined the average number of pieces combined to form an "efficient" package, i.e., a single package of several small objects, having a relatively similar destination.

Finally, we located pinch points and assessed areas of bottlenecking and congestion. A pinch point is any point where sorting errors occur; a bottleneck is a point where congestion results from the linking of several belts.

## **Results**

The entire facility at Edison handles approximately 140,000 packages per day, through the morning, mid-day and twilight shifts. Packages are delivered (inbound and outbound) by individual package cars, tractor trailers, and rail lines. Tractor trailers handle a majority of the flow, comprising approximately 100,000 packages per day or 71.43 % of the total volume. The UPS-Edison hub has 25 load/unload doors for the tractor trailer deliveries, with each door handling roughly 1,000 packages per hour.

The range of package shapes and sizes is endless. In the face of such variety it is not surprising that mis-sorts occur occasionally or that some packages - irregulars - must be treated individually. Mis-sorts and irregulars comprise approximately 2% each of total sorted packages. The mis-sorts are by definition recognized by sorters further down the sorting line, and then re-routed through the system. Irregulars are pulled from the line so an inspector can bill the sender for extra charges.

Our calculation of the volume breakdown (i.e., overall flow rates through the facility) assumes three four-hour shifts, each one with approximately 2 hours for sorting and two hours for loading and unloading packages. The results are as follows: 25,000 packages per hour, which translates to 1,000 packages/door/hour for each of the 25 load/unload doors within the facility.

At the Edison facility packages are sorted on seven main belt systems. Just three primary belts, however, carry a majority of the package flow, approximately 61.6%. Specifically, the brown, the red, and the blue belts carry 23.5%, 19.3%, and 18.8% of the total flow, respectively. Each of these three belt systems is composed of internal sub-units. The brown sorting system is made up of three secondary belts, the red sort



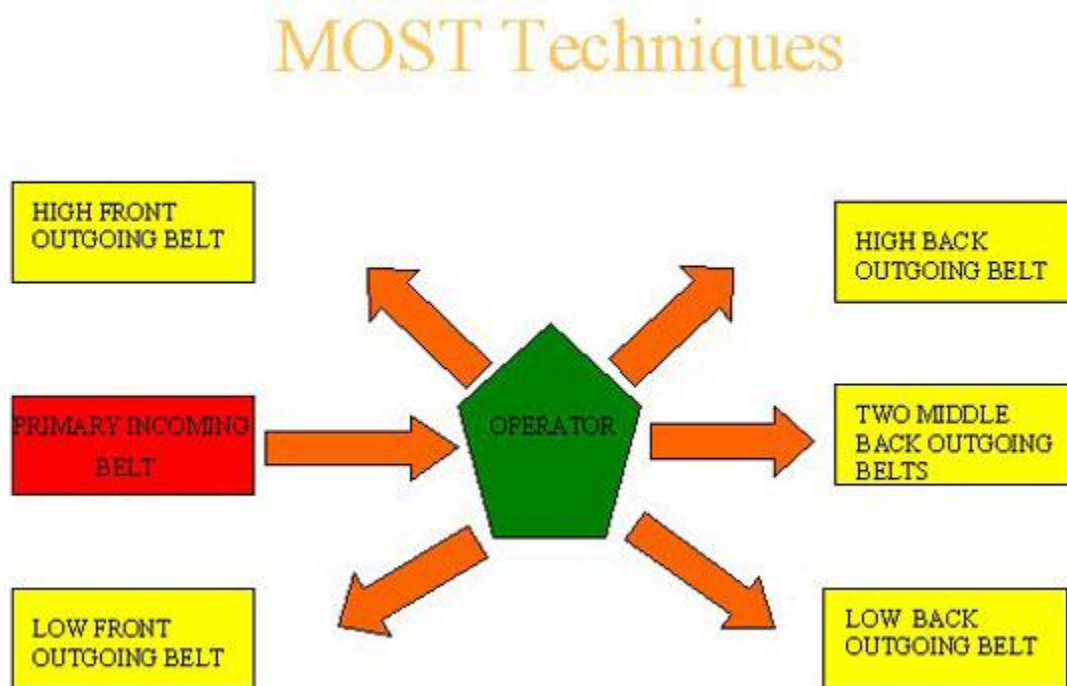
has two secondary sorts, and the blue sort has three secondary sorts. All other sorts handle the remaining 38.4% of total flow.

### **Maynard Operation Sequence Technique (MOST)**

#### **Primary Sort**

The Maynard Operations Sequence Technique (MOST) is a flexible measurement system that establishes normative times for the component tasks of manual work. MOST is widely regarded as a very effective technique for assessing non-uniform work flows. We determined that the MOST technique would be the most efficient way to study the overall capacity of the HVD and LVD belts, where operations are highly variable. In addition, the technique was applied to sub-belts or color-coded belts within the HVD and LVD systems. The primary sort uses HVD conveyors in a seven way split (Figure 4). As the packages enter the facility, they are separated into seven different belts depending on final destination.

**Figure 4**



The basic operations for each worker consist of reaching for a package, looking at the the package to determine the outbound location, and finally placing the package on one of the seven belts. These operations were studied and a MOST analysis of these operations was used to determine the standard times for these operations. The chart below lists the results of this study.

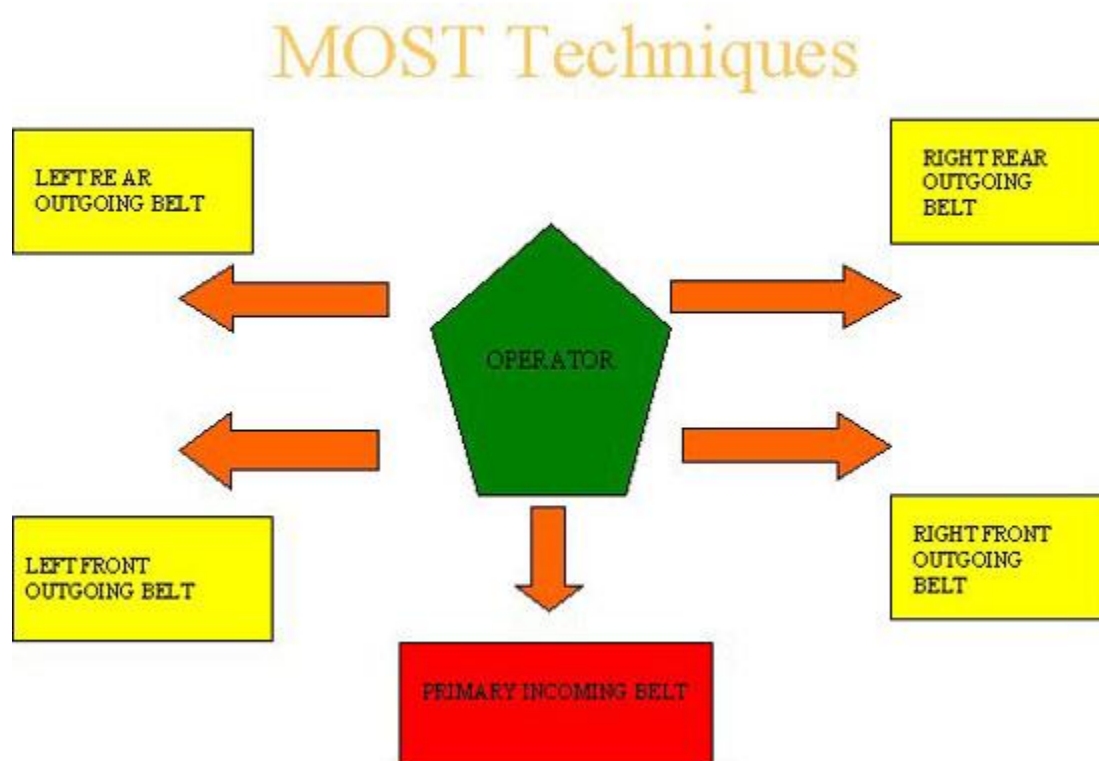
**Table 1.** MOST analysis of primary sort system (see Figure 4)

Outgoing belt location	MOST analysis	Normal time (minutes)	Standard time (minutes)
Front low	A1BOG3A1B6P6A0=17 TMU	0.0102	0.01224
Front high	A1BOG3A1B6P6A0=11 TMU	0.0066	0.00792
Back low	A1BOG3A1B6P6A3=22 TMU	0.0132	0.01584
Back middle (2 belts)	2* (A1BOG3A1B6P6A3)=32 TMU	0.0096	0.01152
Back high	A1BOG3A1B6P6A3=16 TMU	0.0192	0.02304

### Secondary Sort

Following the primary sort, several packages must go through a secondary sort in order to reach the correct outbound location (Figure 5).

**Figure 5**



The secondary sorts consist of low volume direct belts in a four way split manned by a single worker. The operator reaches for and grabs the package, reads the label to

determine outbound location, and places it on one of the four belts. This secondary sort also has an additional element in which the operator will let objects pass that are not meant to go to the outbound doors located on their belts. The results of the MOST analysis on this operation are listed below.

**Table 2.** MOST analysis of secondary sort system (see Figure 5)

Outgoing belt location	MOST analysis	Normal time (minutes)	Standard time (minutes)
Right front	A1BOG3A1B6P6A0=11 TMU	0.0066	0.00792
Right rear	A1BOG3A1B6P6A3=16 TMU	0.0096	0.01152
Left front	A1BOG3A1B6P6A0=11 TMU	0.0066	0.00792
Left rear	A1BOG3A1B6P6A3=16 TMU	0.0096	0.01152
Let pass	7.3 TMU	0.00438	0.00526

### **Conclusion and recommendations**

Capacity Analysis shows that the Edison Facility can sort approximately 25,000 packages per hour. Using MOST analysis, the standard times for the secondary and primary sorts were developed. From these observations we conclude that it would be helpful to have more clearly defined labels on packages and better job aids for outgoing belt locations.

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