PERFORMANCE INDICATORS
OF THE NEW SORTING CENTER

Katarina Mostarac[1], Zvonko Kavran[1], Estera Rakić[2], Filip Tonković[1]

[1]University of Zagreb - Faculty of Transport and Traffic Sciences,
k.mostarac@fpz.unizg.hr; zkavran@fpz.unizg.hr; ftonkovic27@gmail.com
[2]Croatian Post, estera.rakic@posta.hr

Abstract: *New sorting center (NSC) of Croatian Post (HP) was build and opened in 2019. Within the NSC, advanced technologies enable more efficient processing and sorting of shipments and increase postal service quality. Six modern machines improve logistics and postal services' performance and facilitate postal and logistics center processes. Also, the schedule of devices, departments, premises, and places of receipt and dispatch are optimally located. Shipments are received as soon as possible, sent for processing, and prepared for dispatch. This paper analyses the technological and technical indicators of the NSC.*

Key words*: sorting center, letter and parcel machines, logistic operations.*

1. Introduction

The postal sorting center is a facility where shipments are consolidated, processed, sorted, and finally shipped to all areas within a country and abroad. Various postal and logistics processes are performed within the sorting center, which is essential to providing quality postal services. In the Republic of Croatia, the New Sorting Center (NSC) of the Croatian Post was built, in Velika Gorica, near the capital city Zagreb. The location of the NSC is on former military premises. The location is close to the Franjo Tuđman International Airport and close to the Zagreb - Sisak motorway and the Zagreb - Velika Gorica expressway. Most Croatian Post (Management and Administration) employees and delivery vehicles in multiple locations in Zagreb have been moved to the NSC. The construction of the sorting center and the relocation of delivery mail trucks from the city center, closer to larger roads, will optimize the technological phases while reducing congestion in the city centers [1].

Significant investments (350 million HRK) in modern sorting systems have made NSC most modern sorting center in South East Europe [2]. Such technology enables faster and better processing of shipments and packages and speedier delivery. NSC includes technological processes: take over, routing, transport, processing, dispatch to deliver parcels in the national and international market [3]. These processes are complex, with high user requirements, so the technology speeds up all processes within the sorting center with minimum error rate. The NSC's large internal space enables employees' easier movement,

placement of different machines throughout the space and a very well-arranged schedule related to different jobs.

The number of the sorting machines in the new sorting center is currently six, with more planned. The machines are strategically planned and distributed, to allow continuous uninterrupted operation for a period of 24 hours. Sorting systems consists of machines for sorting (letter) shipments and machines for sorting parcels:

- Four machines for automatic sorting of letter items with 240 output bins (Vantage manual machine)
- One machine for automatic sorting of flat shipments with 90 output bins (VariSort machine)
- One machine for automatic parcel sorting
- Central computer system (CCS), with video coding system.

2. Technical and technological indicators of the NSC sorting systems

Technical and technological performance of the NSC will be analyzed through sorting systems characteristics. Sorting systems are generally divided into shipments (refers to letter and flat mail) and parcel sorting systems.

2.1 Sorting of postal shipments

Vantage manual (VM) is a machine for automatic sorting of letter items with 240 output bins. Four VM's have been installed in the NSC, and one in the sorting center in Split. This machine efficiently sorts letter shipments intended for the local and national level, while international mail is also sorted, but in smaller quantities.

The machine has 240 compartments that are divided into four levels. The upper exit compartment height is a maximum of 160 cm so that the shipments are easily accessible to every worker. The two upper compartments are slightly inclined downward at an angle of 10 - 15 degrees. Each compartment's depth is a minimum of 350 mm, and one compartment can hold over 60 shipments. The main characteristics of the VM are shown in Table 1 [4].

Table 1. Vantage machine characteristics

Characteristic	Indicator
Length	16 m
Hight	2,2 m
Width[1]	3,5 m
Width[2]	2 m
Loading weight	320 kg
Minimum operating capacity	42,000 per hour
Sorting accuracy	99.5 %

Although the VM is automated, a worker should still be present during operation, except when the machine runs continuously for 24 hours without stopping for maintenance. The worker starts and stops the machine and assigns sorting functions according to nine sorting centers (see Table 4) located throughout the Republic of Croatia.

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[1] Width at the induction point

[2] Width for transport modules and output bins module

VariSort (VS) is a machine for automatic sorting of flat shipments (flats) with 90 output bins. Flats are items larger than letter items that usually do not fit in the mailbox and are delivered directly to customers. VS sorts shipments that are larger and can be of a different shape. The characteristics of the VS are particular and essential for sorting flat shipments, as shown in Table 2 [4].

Table 2. VariSort machine characteristics

Characteristic	Indicator
Automatic loading width	5 m
Manual loading width	5 m
The transport module and the module with exits for sorted shipments width	2 m
Total length	38 m
Total height	2,5 m
Maximum weight[3]	320 kg
Automatic shipment module nominal/operating capacity	8,000/7,5000 pieces per hour
Manual shipment module nominal/operating capacity	3,000/2,700 pieces per hour

The number of sorted outputs is 90 and divided into two levels. The first 29 output bins are intended for sorting shipments for larger cities. The other 61 output bins are intended for shipments to Zagreb. The box's maximum height stand at the upper exit is 150 cm and must not be higher for easier access. The machine has one automatic and two manual loading modules. VS works with larger shipments, so the sorting speed is slightly lower.

VS has sensors that inform the workers if the compartment is 70% or 100% full. When the compartment is 70% complete, the machine signals the worker to prepare the replacement of the yellow boxes or bags. When the compartment is 100% complete, the worker replaces the boxes or bags with empty ones. In addition to this, the machine also prints labels that contain information about the sorting destinations [4].

2.2 Sorting of parcels

A parcel sorting machine (PSM) automatically sorts parcels and consists of 55 large exit slides and 90 small exit slides. Large parcels weighing up to 30 kg usually come out through large slides, and other smaller packages or flat shipments come out through smaller slides. The machine consists of five inductions through which shipments pass through the machine. On these inductions, scales for weighing and moving shipments are located, a terminal for powering the machine and a terminal for manual shipments sorting. At the top of the machine there are two tunnels through which each shipment passes to scan and determine shipments' dimension. There are also cameras to capture a picture of each shipment.

Each machine's induction has a terminal for starting the machine and a terminal for possible manual sorting by entering the address or just the postal code number. For each sorting, a table is made that defines shipment dimensions and weight that go into large

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[3] Weight that loads one square meter

slides or that can go to the exit for bags and boxes. PSM characteristics are shown in Table 3 [4].

Table 3. Parcel machine characteristics

Characteristic	Indicator
Length	85
Hight	Up to 10 m
Width	45 m
Operating capacity	15,000 parcels per hour
Maximum capacity	16,800 parcels per hour

The difference between VM, VS, and PSM is that this machine sorts parcels and express shipments, but it can also sort some flat shipments and small packages. The value of this machine is 67.5 million HRK. It accelerated parcel sorting, which ultimately increases the quality of services. Shipment characteristics of various sorting system machines is shown in Table 4 [4].

Table 4. Sorting systems shipment characteristics

Sorting system	Characteristic	Indicator
Vantage Manual	Length	127 mm – 285 mm
	Hight	89 mm – 162 mm
	Thickness	0.2 mm – 6 mm
	Mass	2 g – 100 g
Varisort	Length	127 mm – 400 mm
	Height	102 mm – 305 mm
	Thickness	0,5 mm – 35 mm
	Mass	25 g – 1500 g
PSM	Length	130 – 1200 mm
	Hight	80 – 600 mm
	Thickness	10 mm – 600 mm
	Mass	100 g – 30 kg

Optic Code Reader (OCD) enables automatic address recognition. Readability rates of the VM, VS, and PSM sorting systems are shown in Table 3 [4].

Table 5. Vantage, VariSort, and PSM machine OCD readability rates

Characteristic	Performance (%)
Postal code and name, street, and house number	90
Handwritten address	68
Only zip code and name (typing)	98
Only zip code and name (manually)	70
Bar code	99.5

3. Comparison of key performance indicators before and after NSC opened

Frazelle [5] identified performance, cost, and value measures of the logistics system. Furthermore, authors in [3] identified performance indicators in the postal logistics centers. We analyze key performance indicators, mainly: financial, productivity performance, and service quality. Analysis of the key performance indicators before and after NSC was opened is performed

Financial indicators are analyzed through number of workers, before and after NSC was opened. These data are shown in Table 6.

Table 6. Number of sorting center workers

Sorting centre	2017	2020
Other	2	1
Bjelovar	26	26
Gospić	12	0
Slavonski Brod	23	26
Šibenik	16	0
Varaždin	30	0
Zadar	42	46
Osijek	72	63
Rijeka	116	116
Split	138	141
Zagreb	650	528
Total	1127	948

The total number of 179 workers have been reduced in 2020, after the opening of the NSC. If costs are reviewed, Croatian Post reduced workers' costs in sorting centers by 1,363,801 HRK in 2020, compared to 2017. Productivity performance indicators are shown in Table 7.

Table 7. Productivity performance indicators

Characteristics	Previous sorting systems	NSC
Daily machine capacity	800,000 items	1,800,000
Processing time[4]	10 + 10 hours	11 + 7 hours
Sorting level rate	Postal offices (70%) and delivery area (30%)	Delivery area (99%)

It is evident that NSC increased productivity rate at all characteristics of the sorting system. Shipment capacity and sorting level rate have increased, while secondary sorting process is reduced by three hours.

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[4] Primary and secondary sorting

When service quality is concerned, we calculate performance using example of sorting systems before and after the NSC opening. If the daily capacity was 800,000 shipments and the number of shipments on the peak day was 1,200,000, the number of shipments to be sorted the next day was 400,000. If the number of incoming shipments next day was 1,400,000, cumulative number of the unsorted shipments for the third day was 1,000,000 shipments. Quality was severely jeopardized, and quality standards were not met. Since the NSC's daily capacity overseeds the number of incoming shipments, even on peak days, service quality is not endangered. Therefore, quality of the postal services significantly improved since the NSC opening.

5. Conclusion

Croatian Post currently has nine sorting centers, including the postal and logistics center in Velika Gorica, built in 2019. Within the NSC, advanced sorting technologies are implemented, which allow for efficient sorting of shipments and increase the quality of postal service. Six modern sorting systems provide the flawless performance of logistics and postal services and facilitate the processes. In addition, the layout of sorting systems, departments, premises and places of receipt and dispatch are located so that shipments are received, sent for processing, and prepared for delivery as soon as possible. Each of the departments performs tasks and is also connected to other departments to form one completely complex system. Centralization has enabled Croatian Post more efficient procedures that affect entire postal network, with significant savings. Less workforce is needed, where sorting is carried out by the delivery area level. Key performance indicators identified in the paper are related to finance, productivity performance and service quality. All of the analyzed indicators show better performance after the NSC opening.

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INDIKATORI PERFORMANSI NOVOG POŠTANSKOG CENTRA
Katarina Mostarac, Zvonko Kavran, Estera Rakić, Filip Tonković