Application of revenue management in capacity planning of postal services: conceptualizing and empirical simulation of capacity management

Ahmad Teymouri [ateym089@uottawa.ca]
Ph.D. Candidate, Telfer School of Management, University of Ottawa

Pavel Andreev
Associate Professor, Telfer School of Management, University of Ottawa

Amir Khataie
Adjunct Professor, Telfer School of Management, University of Ottawa

Craig Kuziemsky
Full Professor, Telfer School of Management, University of Ottawa

Abstract

The popularity of e-commerce has significantly increased the volume of parcels delivered through the postal services network. The shift toward digital communication (e.g., e-mail) and purchasing (e.g., online shopping) channels have turned capacity management into a serious challenge for postal organizations. Most of the developed solutions focus on process improvements and optimization through improving cost performance indicators but not the revenue. To address the postal service capacity management problem this study reconsiders traditional capacity management approaches and then develops, and empirically validates through simulation a conceptual revenue management model. The proposed model improves capacity allocation while maximizing postal organizations expected revenue.

Keywords: e-commerce parcel, postal services revenue management, capacity planning and control

Introduction

The parcel delivery value chain is rapidly evolving and increasing in complexity. One of the reasons for this trend is the impact of e-commerce as it is anticipated that almost 940 million people will spend annually over $1 trillion on online shopping by 2020 (Universal Postal Union, 2016). All these online purchases are then delivered to customers through postal delivery services. As a result, postal services around the world are facing challenges related to declining letter-mail (LM) and constantly growing parcel volumes. In addition, the customers require faster, more affordable, and better tracked service.

Postal services have been seriously impacted by these changes. On one hand, LM, advertisement mail, and publication (e.g. magazine subscriptions) volume have declined.

On the other hand, e-commerce and online shopping has dramatically increased parcel delivery volume (Figure 1). Unlike LM, e-commerce parcel delivery is highly competitive as new and existing players fight for a bigger share of the market.

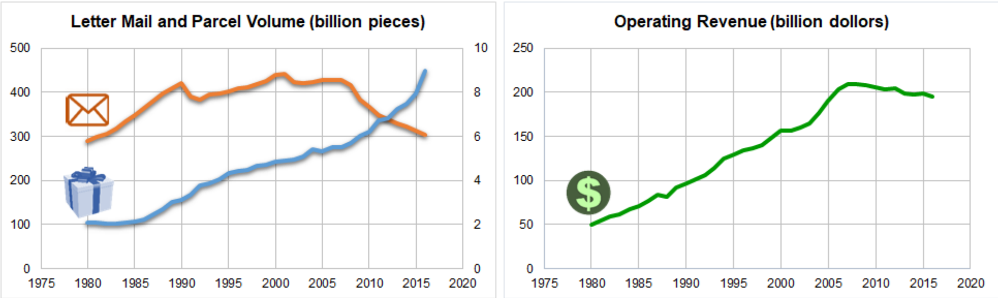

Figure 1:Postal service volume and operating revenue (1975 - 2016)
Source: Universal Postal Union (2018) - http://www.upu.int/en.html

Postal services have been extensively using their processing and delivery infrastructure on order to be competitive and meet requirements of the new reality. The traditional postal organization value chain was simply based on LM including: (1) collection, (2) sorting, (3) transportation, and (4) delivery. The main characteristics of the traditional value chain were limited competition (sometimes represented by one monopolized postal organization), low service expectations, easier service standard management, and more volume visibility for postal services' capacity. E-commerce explosion introduced a continuous growth of parcel volume going through the postal organizations' network that was not initially designed for such volumes. Hence the value chain has been chaining to be more dynamic, competitive, complex, and diversified. Parcels have become a major source of revenue for postal organizations replacing traditional LM that traditionally was a fundamental of postal business model. Therefore, a transition from LM value chain to parcel value chain is necessary since they are different (USPS-Office of Inspector General, 2015).

Employing the traditional LM value chain for parcels leads to a serious challenge of capacity management for postal services. Capacity is a specific level of work that a system can complete over a specific period of time. Managing capacity limitations in a peak time and the idle capacity in non-peak is a complex task for postal services. Moreover, managing the capacity issues without sacrificing the service level creates a considerable cost pressure in transportation and downstream sort and delivery processes of the postal service value chain (The Conference Board of Canada, 2013). A simplified view of the postal service value chain is shown in Figure 2.

To cope with LM and parcel challenges, postal services have been using parcel performance solutions such as streamlining operations, parcel networks improvement, and transportation optimization. The current solutions for the capacity management challenge focus on increasing efficiency of the collection and delivery (e.g., induction and transportation productivity) and processes (i.e., fewer mis-sorts). However, these solutions are temporary because of fast annual growth rate and expensive due to the high direct and indirect cost of advanced equipment. Although these initiatives have helped postal services to remain financially profitable, most of them are driven by technology and need a lot of investment (e.g., buying faster computerized parcel sorting equipment, building new or expanding existing processing facilities). Hence, most of the developed models for the capacity management are related to improving indicators of operational performance rather than the revenue of postal services (Accenture, 2015b).

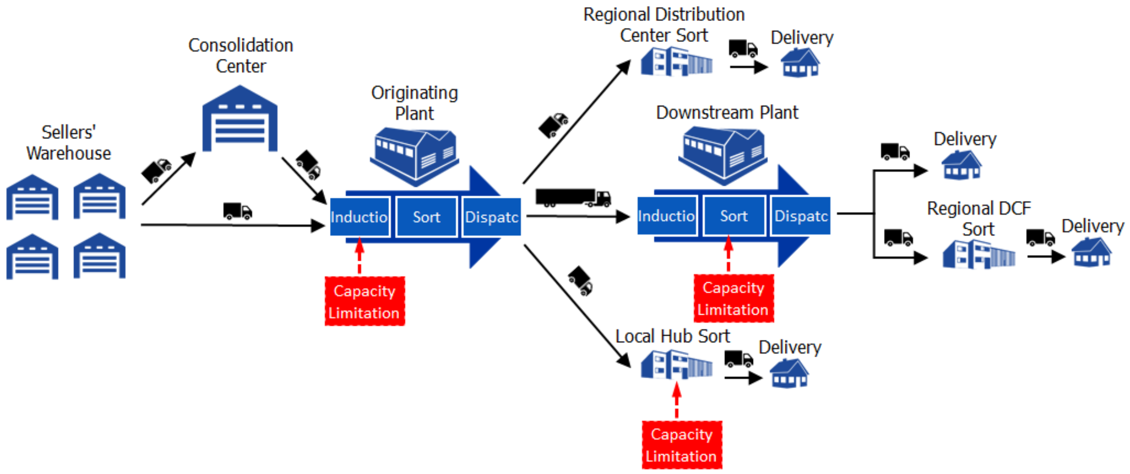

Figure 2: Postal services' value chain (Teymouri, Khataie, Andreev, & Kuziemsky, 2017)

This study aims to reconsider traditional approaches for the application of revenue management in postal services by answering the following research question: "*how to improve the allocation of the existing processing capacity for large volume online retailers/sellers while maximizing the expected revenue for postal services?*" This research contributes to the capacity management theory by developing a revenue management model for postal services. The proposed model helps postal organizations to level the inducted daily volume to the originating and downstream plants while improving their capacity allocation and maximizing expected revenue. We empirically validate the proposed model with simulation. We limit our solution to Large Volume Mailers (LVMs) that provide majority of the daily volume. The successful application of revenue management in other service industries, such as airlines (Hu, Wei, & Xia, 2010), hotel (X. L. Wang, 2012), car rentals (Y. Wang, Meng, & Du, 2015) and healthcare (Stanciu, Vargas, & May, 2010) is the main motivation of this research.

Background

Postal services deliver messages, information, and items to all individuals and businesses in any urban or rural regions. They are not only responsible for delivering mail to different destinations but also should meet the obligations and standards set by the governments or Universal Postal Union (UPU). Postal services around the world face thee major global trends; 1) downward trend of LM volume, 2) upward trend of parcel delivery because of rapid advance in e-commerce, and 3) revenue growth in a competitive market and weaker economic conditions.

Postal services' strategy shows that they identified and executed three key priorities to mitigate the LM (decline) and parcel (growth) volume risk: (1) focusing on the core business, (2) developing the parcels business opportunity, and (3) expanding carefully retail, logistics, and delivery networks. As a first priority for many postal services, LM still generates a big part of their revenue and provides more cash for future investments. In the second priority, they take the grow parcel opportunity and offer reasonable price to increase their share market. A second priority is that successful postal services are growing their logistic business to include upstream and downstream processes as a diversification strategy. They are using more complicated value chain compared with the past as shown earlier in Figure 2. In order to understand how to approach the parcel capacity problem of postal services, a scoping literature has been conducted. In our review, we followed the systematic approach presented by Kitchenham (2004) consisting of three main steps; (1) planning the review: it includes literature categorisation, search engine selection, and keywords, (2) conducting the review: it covers three layers of screening (type, text, and reading abstract and content), and (3) reporting the results: it includes qualitative and quantitative synthesis. In our review, we conduct two types of search. First, peer review and publications, for the credibility of the papers we use four core databases of journal and conference papers: Web of Science, IEEE Xplore, SpringerLink, and ABI/INFORM. Second, we reviewed postal services background, business trend, and prediction. For the second part, we use ABI/INFORM Trade and Industry, postal services and business consultants' technical reports, annual reports, and white papers. In the planning the review, we found 963 and 235 papers in part one and two respectively according to the keywords and queries of the search. After applying three layers of screening, 106 papers of the first part and 73 papers of the second part have been selected.

Existing solutions related to postal parcel capacity problems fall into one of the two approaches (1) Operation Management (OM) and (2) Supply Chain Management (SCM).

OM covers process improvement solutions which focus on piece per hour (pph) of machines' (Bard, Desilva, Feo, & Wert, 1993), facility layout and man-hour (Q. Wang, Batta, & J. Szczerba, 2005), operation shift, productivity rates (Lisec & Rusjan, 2011), process cost (Mizutani & Uranishi, 2003). SCM focuses on induction and delivery solutions which emphasize transportation modes and containers' capacity (McWilliams, 2009), induction capacity, hub and depot location (McWilliams & McBride, 2012), routing optimization and trucks utilization (Wasner & Zapfel, 2004). Postal services apply OM theories as main principals of designing their operation. They consider design parameters are taken into account when designing parcel processing operating systems such as automate where justified, segregate by size, minimise the distance travelled, minimise handling, include multiple input areas, allow a constant supply of parcels, balance the volume flow, apply loose loads, incorporate off-load of brick loaded trailers, build a variable speed system that is expandable. In the literature, five main solutions have been defined by OM; (1) efficiency or optimizing resource inputs and output of goods and services, (2) lead time or minimizing throughput-time and reducing delays, waiting time, and idle time, (3) cost or minimizing cost of production, (4) effectiveness or satisfying customers' expectations with producing the right kind of goods and services, and (5) quality or ensuring to meet pre-set quality specifications (Lynn & Mahesh, 2004).

From a SCM perspective, having shorter lead times to satisfy due dates is a strategic competitive advantage. Lead time also plays a coordination role to accomplish fast and reliable delivery since it is related to the total time (min, hour, or day) required to complete an operation or process or must elapse before another action (Rao, Swaminathan, & Zhang, 2005). Postal services' supply chain is a cross functional approach responsible for the relocation of products such as LM and parcels between different facilities including processing plants, depots, and post offices. The postal industry approaches the evolution of SCM from two perspectives: cost and coordination.

Current OM and SCM solutions have three major disadvantages for the postal industry (Table 1). First, these solutions are usually short-term and temporary. For example, due to a considerable variation and growth in e-commerce parcel volume, optimization solutions are not permanent solutions. Second, they require investment which usually are expensive. For, example, improving productivity and efficiency of the processing line with technology needs investment in advanced equipment (e.g., sorter) and systems. Finally, in some cases, it is not feasible to apply these solutions due cost limitation or resource availability. For example, expansion of processing facility especially in major town is not feasible because of lack of available lands.

Table 1: E-commerce parcel volume capacity management solutions in postal industry

Solution Category	Solution Focus	short-term	Expensive	Not Feasible
Operation Management and Process Improvement	Machines' performance, facility layout, man-hour, operation shift, productivity rates, etc.	X	X	
Supply Chain Management and Transportation	Transportation modes, container types, facility location, trucks utilization, etc.	X	X	
Other such as Marketing Management	Mass production sale, sale promotions, customer behavior, etc.		X	X

Revenue Management Solutions

Revenue Management (RM) is an approach that helps companies to generate more revenue and increase the profitability of their business from the existing capacity. RM contains strategies, methods, and tools to maximize the revenue through capacity allocation for different customers with different prices (Cheraghi, Dadashzadeh, & Venkitachalam, 2010). Revenue management research was initiated by American Airlines in 1970 when perishable capacity of seat allocation became the main limit of different demand classes.

The first area of RM research was related to probability of passengers showing up for the flight. Statistical models with different level of complexity were developed by Sanchez (1970) and Littlewood (1972). For overbooking problem in multiple fare classes, a heuristic model in Belobaba's Ph.D. research (1987) and a static formulation (McGill & Van Ryzin, 1999) were developed. Weatherford, Bodily, and Pfeifer (1993) addressed the booking arrival problem for two classes of passengers through a stochastic model. In 1994, Weatherford developed a complex formulation for simultaneous allocation decisions when the demand is normally distributed with a linear mean operated by price. Talluri and van Ryzin (2001) analyzed RM problem of capacity control under customer choice. A stochastic approximation method was developed to compute optimal protection levels when the demand distribution is discrete (Kunnumkal & Topaloglu, 2010).

From profitability perspective, RM has helped industries which have some or all of six characteristics in their business; (1) Perishability, (2) Demand Fluctuation, (3) Fixed Capacity, (4) Marginal Cost, (5) Market Segmentation, and (6) Reservation System. For example, RM helped small airlines with low cost fares to start competing on price with big airlines. Also, other industries such as hotels, air/sea/rail cargo and car rentals, restaurants, TV broadcasting, and healthcare have started applying RM.

RM has received considerable attention in service industries specifically airlines, hotels, rental cars, broadcasting, etc. There are very limited studies that show RM application in postal industry. The current studies suggested to improve the revenue through managing the cost inherent in postal services' processes and business strategy (Dodgson et al., 2004). It is mainly because of characteristics of postal services and their value stream. The factors required to optimize the capacity utilization while maximizing the revenue in postal services are more complicated. This study attempts to close the gap in the literature.

Conceptualizing Revenue Management Model for Postal Services

We consider the typical situation of postal service delivery. For the sake of simplicity, we assume that the system has two postal processing centers and two customers (LVMs). Processing centers have capacity C_1 and C_2, respectively. Customers warehouses are located near location 1 and they prefer to send their volume to this center. The Customer one customers pay p_1 and the customer two pays p_2 for each parcel where $p_1 > p_2$. Also, p_i' is discounted price when customer i by-passes the volume to another center. The typical arrival pattern of the volume from customers to an originating sort operation is divided into two windows in a day; period 1 from 00:00 am to 4:00 pm and period 2 from 4:00 pm to 11:59 am. Let V_{ij} be the volume of customers i $(i = 1,2)$ in the period j $(j = 1,2)$. The total demand of each customer is computed by $D_i = \sum_{j=1}^{2} V_{ij}$ $(i = 1,2)$. Therefore, $\mathcal{W}_{ijl} = p_i V_{ij}$ is the revenue contribution of each customer, in each location in the period j. For simplicity, $\mathcal{W}_i = p_i V_i$ is a realization of $\mathcal{W}_{ij}$ for customer i. The customer's demands are random, but historical data provides an estimation of the distribution of demand for each customer. Customers arrive in a random order and should be served based on a first-come-first-served basis regardless of the amount of their volume. For expected value of the revenue contribution of customers, there are two possibilities; (1) $\mu_{i|w_1>w_2} = E[\mathcal{W}_i|\mathcal{W}_1 > \mathcal{W}_2]$ and (2) $\mu_{i|w_1<w_2} = E[\mathcal{W}_i|\mathcal{W}_1 < \mathcal{W}_2]$, $i = 1,2$. Also, the probability that $\mathcal{W}_1$ is greater than $\mathcal{W}_2$ is presented by θ and $\mathcal{W}_2$ is greater than $\mathcal{W}_1$ by $1 - \theta$. Let $E[\mathcal{W}_i] = \mu_i$ be the expected value of revenue contribution of customer i. Therefore, the revenue contribution of customer i is computed by Equation (1).

Equation (1):

$$E[\mathcal{W}_i] \equiv \mu_i = \theta\mu_{i|w_1>w_2} + (1-\theta)\mu_{i|w_1<w_2}$$

Let x be the protected/allocated level of capacity units reserved for customer one. The main question for postal services is how much of their capacity should be reserved for the customer who pay more (p_1) and another customer who pays less (p_2) to maximize the revenue? This question becomes more important when the customer demands are random. In order to approach the problem, we develop three possible scenarios:

- Scenario 1: The individual customer demand in each customer is less than the available capacity, but the total demand is greater than the available capacity. Therefore, $P[D_1 < C_1] = 1$ and $P[D_2 < C_1] = 1,$ but $P[D_1 + D_2 > C_1] = 1$.
- Scenario 2: The demand of the customer one (which pays a higher price) is less than the available capacity, but the customer two (which pays a lower price) is greater than the available capacity. Therefore, $P[D_1 < C_1] = 1$ and $P[D_2 > C_1] = 1$.
- Scenario 3: The demand of the customer one (which pays a higher price) is greater than the available capacity, but the customer two (which pays a less price) has lower demand than the available capacity. Therefore, $P[D_1 > C_1] = 1$ and $P[D_2 < C_1] = 1$.

Obviously, in scenario 3, all the capacity of processing centre one (C_1) is allocated to the customer with higher price (p_1) since it generates maximum revenue. This paper solves the scenario 1 while scenario 2 is out of the scope of this paper.

In scenario 1, since the customer demands are less than the available capacity, the total revenue contribution of both customers can be computed by Equation (2):

Equation (2):
$R(x) = p_1 \min\{D_1, x\} + p_2 \min\{D_2, C_1 - x\} + p_2' \{D_2 - \min\{D_2, C_1 - x)\}$

Since expected value of a probability distribution of X can be computed as an integral equation of its probability density function, Equation 2 should be solved for x. Unique x^*, that maximizes $E[R(x)]$ should satisfy the condition of Equation 3:

$$E[R(x)] = p_1 E[\min\{D_1, x\}] + p_2 \mathrm{E}[\min\{D_2, C_1 - x\}] + p_2' \mathrm{E}[D_2 - \min\{D_2, C_1 - x)]$$

$$= p_1 \int_0^x y f_1(y) dy + p_1 \int_x^\infty x y f_1(y) dy + p_2 \int_0^{C_1 - x} y f_2(y) dy + p_2 \int_{C_1 - x}^\infty (C_1 - x) y f_2(y) dy + p_2' D_2 - p_2' \int_0^{C_1 - x} y f_2(y) dy - p_2' \int_{C_1 - x}^\infty (C_1 - x) y f_2(y) dy$$

Equation (3):
$p_1 P[D_1 > x^*] = p_2 P[D_2 > C - x^*] + p_2' \{D_2 - (C_1 - x^*)$

As mentioned earlier, there is a probability θ that $w_1$is greater than w_2 and there is a $(1 - \theta)$ that $w_1$is less than w_2. The total expected return is given by summation of both situations times its probability as shown in Equation 4 and by solving $\frac{E[R(x)]}{dx} = 0$ as shown in Equation 5:

Equation (4):
$E[R(x)] = \theta R(x | w_1 > w_2) + (1 - \theta) R(x | w_1 < w_2)$

Equation (5):
$\theta p_{1|w_1 > w_2} P(D_1 > x^*) - \theta p_{2|w_1 > w_2} P\ (D_2 > C_1 - x^*) + \theta p'_{2|w_1 > w_2} P\ (D_2 > C_1 - x^*) + (1 - \theta) p_{1|w_1 < w_2} P(D_1 > x^*) - \theta p_{2|w_1 < w_2} P\ (D_2 > C_1 - x^*) + \theta p'_{2|w_1 < w_2} P\ (D_2 > C_1 - x^*) = 0$

The capacity allocation model (Equation 5), helps postal services to balance their capacity between their different facilities. This model maximizes the revenue by protecting defined capacity $x^*$for each customer in center 1. Any volume more than the defined capacity should be sent to centre 2. In the section below, we use simulation to validate the developed model.

Empirical Study of Capacity Allocation Model

We employed the Oracle Crystal Ball simulation package, 11th edition to illustrate that the simulation output supports the theoretical one. The simulation model represents the real situation of customer demand arrival patterns. Customers can arrive at the same time or in a very small inter-arrival time sequence. When a customer truck arrives at the postal service’s plant, a part of the available capacity gets assigned to the customer. The model computes the potential revenue generated by this customer. It continues until there is no available capacity. According to the generated revenue through the simulation, the model computes and protects a capacity for each customer.

A dataset of thirty six-month period demand data, from January 2012 to December 2014, was used to test this model. The data has been extracted for two customers. It includes postal order/ticket number, ticket time, ticket date, and volume. The initial data consisted of 15,981,053 tickets of parcel obtained over 858 weekdays. Since data has been extracted from the shipping label system, it was complete without missing values. However, to eliminate the seasonality effect (e.g., Christmas Holiday sales), three months of the high season demand (November, December, and January) have been excluded.

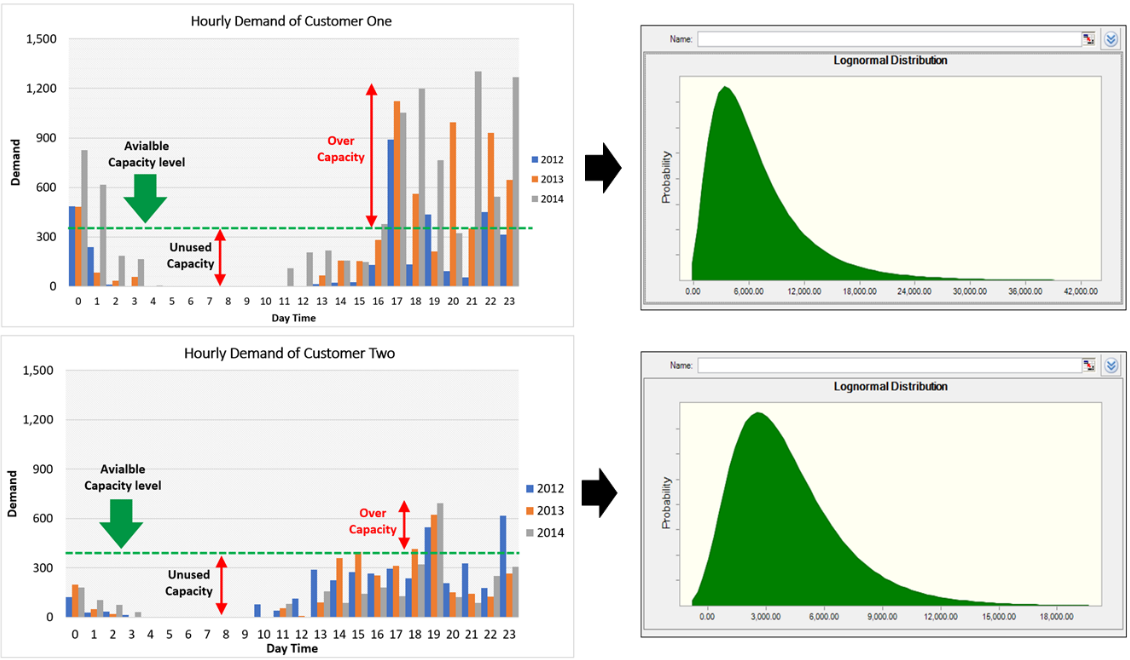

Figure 3: Hourly demand distributions of two customers

Figure 3 shows the hourly demand of two customers. It shows uneven demand distribution in 24 hours of processing plant. Specifically, unused capacity between 2:00 to 15:00 and overcapacity between 16:00 and 1:00. As discussed earlier this is mainly because of dynamic nature of online shopping. A lognormal distribution is fitted for both customer demand.

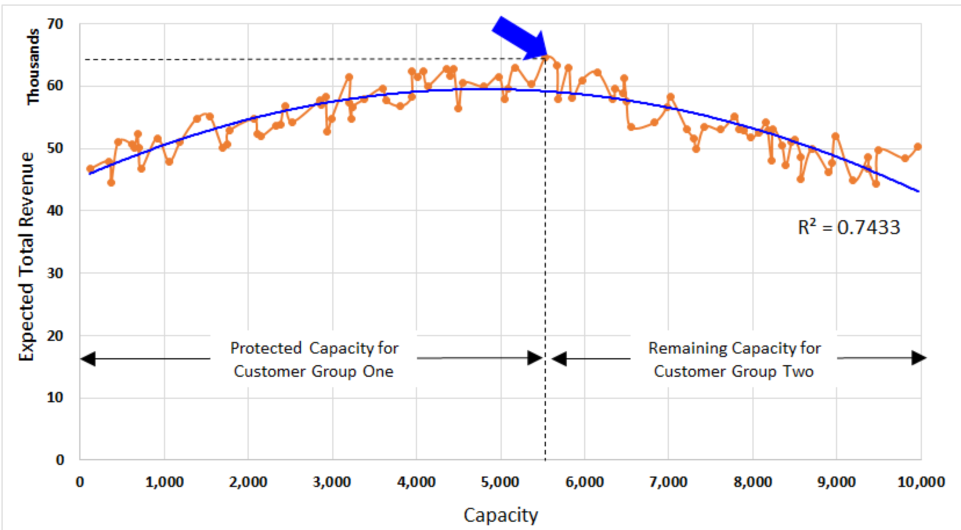

Figure 4: Protected Capacity Level and Expected Total Revenue in three years (ETR)

The capacity of the parcel processing machine C_1 = 10,000 parcel/day. According to the historical data, the price per piece for the customer one has a triangle distribution with minimum value of \$4.25, peak value of \$5.36, and maximum value of \$6.71 and for the customer two, minimum value of \$7.11, peak value of \$8.57, and maximum value of \$9.08. As shown in above graph, our historical data for customer one and customer two fits into lognormal distribution with mean 6,887 and 4,135 parcels per day respectively. Simulation-based optimization results plotted in Figure 4. The X axis is the protected capacity for the customer one and the Y axis (left) represents Expected Total Revenue (ETR). As shown, at the protected capacity of 5,534 parcel per day (55% of the capacity C), ETR is maximized (\$64,527). Our simulation shows a polynomial trend with coefficient of determination of 74% can be fitted to the simulated ETR.

Conclusion

Postal services face a challenge of capacity management for the parcel volumes due to the growth of online shopping. Optimization models have traditionally been applied to improve processes (both operation and transportation) including increase in inefficiency and decrease in costs. However, most of the developed models focus on improving the operations performance indicators and not considering revenue. In this paper we propose to employ revenue management application for the postal industry capacity challenges.

Incorporating stability in the revenue management is a topic that has not received much attention in postal services. In order to optimize revenue, we developed a model that determines a protected capacity level for each e-commerce customer according to the value that they generate. The conceptual RM model developed in this study aims to reconsider the capacity management models that address the peak window and low business margin issues. The model represents a theoretical approach of how a postal organization can increase the density of committed items in tight time windows of sort by applying revenue management concepts. The proposed model load-levels the demand and creates a continuous flow of the volume across the network, which reduces the overall delivery costs and provides better customer experience. The proposed model optimizes processing capacity utilization since it assigns available capacity to one of the customers to avoid unused capacity. It also maximizes the revenue contribution of each e-commerce customer based as shown in the Figure 4. Finally, it supports decision making process to avoided huge and unnecessary capital investments due to capacity limitation of postal services.

This study emphases on allocating available (fixed) capacity to postal services' LVM customers (two classes). The research contributes to revenue management and capacity planning by (1) employing mathematical approach relied on big data analyses that establish applications of revenue management techniques within the postal service industry (2) developing a mathematical model to manage a random demand of deferent class of customers while keeping available capacity.

References

Accenture. (2015a). *Achieving High Performance in the Postal Industry Accenture Research and Insights.*

Accenture. (2015b). *Adding Value to Parcel Delivery*. Retrieved from

Bard, J., Desilva, A., Feo, T., & Wert, S. (1993). DESIGN OF SEMI-AUTOMATED MAIL PROCESSING FACILITIES. *IIE Transactions*, *25*(4), 88-101. doi:10.1080/07408179308964307

Cheraghi, S., Dadashzadeh, M., & Venkitachalam, P. (2010). Revenue Management In Manufacturing: A Research Landscape. *Journal of Business & Economics Research, 8*(2), 63-72.

Dodgson, J., Rodriguez, J. M., van der Veer, J. P., Gibson, S., Hernandez, J., & Veronese, B. (2004). *Economics of postal services: final report - a report to the european commission dg-markt*. Retrieved from
Hu, Q. Y., Wei, Y. H., & Xia, Y. S. (2010). Revenue management for a supply chain with two streams of customers. *European Journal of Operational Research, 200*(2), 582-598. doi:10.1016/j.ejor.2009.01.006
Kunnumkal, S., & Topaloglu, H. (2010). A stochastic approximation algorithm for making pricing decisions in network revenue management problems. *Journal of Revenue and Pricing Management, 9*(5), 419-442. doi:10.1057/rpm.2010.27
Lisec, A., & Rusjan, B. (2011). Multi-level postal network for improved efficiency: A case study of Slovenian post. *African Journal of Business Management, 5*(29), 11676-11685. doi:10.5897/ajbm11.1781
Lynn, B., & Mahesh, G. (2004). Constraints management
What is the theory? *International Journal of Operations & Production Management, 24*(4), 350-371. doi:10.1108/01443570410524631
McGill, J. I., & Van Ryzin, G. J. (1999). Revenue management: Research overview and prospects. *Transportation Science, 33*(2), 233-256. doi:DOI 10.1287/trsc.33.2.233
McWilliams, D. L. (2009). A dynamic load-balancing scheme for the parcel hub-scheduling problem. *Computers & Industrial Engineering, 57*(3), 958-962. doi:10.1016/j.cie.2009.03.013
McWilliams, D. L., & McBride, M. E. (2012). A beam search heuristics to solve the parcel hub scheduling problem. *Computers & Industrial Engineering, 62*(4), 1080-1092. doi:10.1016/j.cie.2012.01.001
Mizutani, F., & Uranishi, S. (2003). The Post Office vs. Parcel Delivery Companies: Competition Effects on Costs and Productivity. *Journal of Regulatory Economics, 23*(3), 299-319. doi:10.1023/A:1023368327735
Rao, U. S., Swaminathan, J. M., & Zhang, J. (2005). Demand and Production Management with Uniform Guaranteed Lead Time. *Production and Operations Management, 14*(4), 400-412. doi:10.1111/j.1937-5956.2005.tb00229.x
Stanciu, A., Vargas, L., & May, J. (2010, 5-8 Dec. 2010). *A revenue management approach for managing operating room capacity.* Paper presented at the Simulation Conference (WSC), Proceedings of the 2010 Winter.
Teymouri, A., Khataie, A., Andreev, P., & Kuziemsky, C. (2017, 10-13 Dec. 2017). *Application of revenue management in supply chain of postal services.* Paper presented at the 2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM).
The Conference Board of Canada. (2013). *The Future of Postal Service in Canada*. Retrieved from
Universal Postal Union. (2016). *Research on Postal Markets - Trends and Drivers for International Letter Mail*. Retrieved from
USPS-Office of IInspector General. (2015). *RETHINKING THE PARCEL DELIVERY VALUE CHAIN-A RECAP OF THE INTERNATIONAL ROUNDTABLE*. Retrieved from https://www.uspsoig.gov/sites/default/files/document-library-files/2015/rarc-ib-15-005_rethinking_the_parcel_delivery_value_chain_0.pdf
Wang, Q., Batta, R., & J. Szczerba, R. (2005). Sequencing the processing of incoming mail to match an outbound truck delivery schedule. *Computers and Operations Research, 32*(7), 1777-1791. doi:10.1016/j.cor.2003.11.029
Wang, X. L. (2012). Relationship or revenue: Potential management conflicts between customer relationship management and hotel revenue management. *International Journal of Hospitality Management, 31*(3), 864-874. doi:10.1016/j.ijhm.2011.10.005
Wang, Y., Meng, Q., & Du, Y. (2015). Liner container seasonal shipping revenue management. *Transportation Research Part B, 82*, 141-161. doi:10.1016/j.trb.2015.10.003
Wasner, M., & Zapfel, G. (2004). An integrated multi-depot hub-location vehicle routing model for network planning of parcel service. *International Journal of Production Economics, 90*(3), 403-419. doi:10.1016/j.ijpe.2003.12.002