Queuing at eCycle Services

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PEARSON CASES IN SUPPLY CHAIN MANAGEMENT AND ANALYTICS

The case is reprinted from The Supply Chain Management Casebook by Chuck Munson

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with Janice Eliasson and Brent Snider

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Reprinted from *The Supply Chain Management Casebook* (ISBN: 9780133367232) by Chuck Munson.

Queuing at eCycle Services

Janice Eliasson[†] **and Brent Snider**[‡]

The Issue

Kevin Johansson, the owner of eCycle Services, has just returned from vacation to find a $30,000 "waiting fee" invoice from the city: *"Thirty thousand dollars—are you kidding me? That was our entire profit last month—this cannot be right! I can understand the idea behind charging us while their trailers are at our facility, but $30,000 in just one month is absurd. I'm going to call the city right now and tell them they have made a massive mistake."*

Background

Located in Vancouver, British Columbia, eCycle Services is an electronic waste (e-waste) recycler that focuses on recycling cathode-ray-tubes (CRTs) that are found in older televisions and computer monitors. The owner, Kevin Johansson, started the business just over a year ago after previously working at another e-waste recycling business. After bidding and winning one of the CRT recycling contracts with the City of Vancouver, Kevin started the business by renting warehouse space and a single loading dock in an industrial area. The continued growth of CRT recycling is creating challenges for this small business working in the reverse supply chain industry.

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Manufacturers have switched to producing LED, LCD, and Plasma displays for televisions and computers for their performance advantages, reduced energy consumption, and supply chain benefits. The older CRT design required a large box size and weight (a 20-inch unit weighs approximately 50 pounds), creating significant supply chain costs compared to the much thinner and lighter new display technologies. Recognizing the hazardous contents of CRTs (such as lead and phosphors), most governments have legislation in place prohibiting CRTs from going to landfills. For example, the United States Environmental Protection Agency has established recycling requirements for CRTs since 2001, and the European Union's Waste Electrical and Electronic Equipment (WEEE) Directive, implemented in 2003, includes regulations for CRT disposal.

As more and more consumers replace their CRT televisions and computers, demand for CRT recycling continues to grow. Governments now provide e-waste drop-off locations, and more and more businesses now accept e-waste as well. While these locations collect the e-waste (product acquisition), it still must get transported (reverse logistics) to a recycling facility (such as eCycle) where it can be inspected, disassembled, and sorted (see Exhibit 1). Although some e-waste recyclers choose to simply remarket their e-waste to foreign countries for recycling, eCycle only uses reputable recyclers for their e-waste components who adhere to the highest environmental standards. Where possible, components of e-waste are reused or reconditioned before finally being remarketed. For example, the copper, wire, and circuit boards from CRTs can be resold, while leaded CRT glass can even be broken down and used in road construction. The result is a typical reverse supply chain process (Exhibit 2).

In an effort to achieve their landfill "waste diversion" targets, the City of Vancouver currently provides a small fleet of trucks (and trailers) to accomplish the "reverse logistics" portion of the CRT-related reverse supply chain. Companies like eCycle have contracted with the city to recycle CRT products, including the responsibility for unloading the city trailers. In an effort to keep their limited number of trailers moving, the city has recently instituted a clause in such contracts stipulating that the time a city trailer is at a contracted recycling facility (either waiting or being unloaded) will be charged out at a rate

of $60 per hour. On the inbound side, eCycle currently operates an eight-hour day (five days a week) to match the city working hours.

Exhibit 1 Example of an e-waste recycling facility.

Picture Source: http://www.recyclinglives.com

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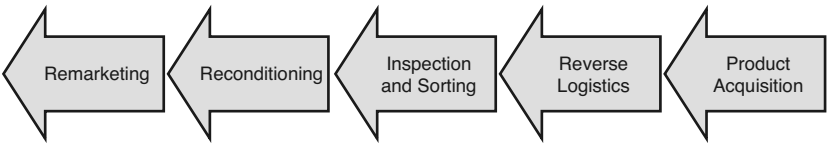

Exhibit 2 Reverse supply chain process.

Until recently, eCycle had been receiving two city-owned e-waste trailers per day, but that has now increased to an average of three per day (Poisson arrival pattern). The current unloading crew of two employees is able to safely unload the trailers at a rate of four trailers per day (exponentially distributed). The weight of the CRTs requires workers to use carts/dollies to adhere to workplace safety regulations. The unloading crew employees are paid an industry average rate of $24 per hour (including benefits).

A month ago, Kevin hired Aidan Wallace, a recent business school graduate, as a business analyst to help him handle the growth of the business. Since starting, Aidan has been busy seeking new markets for reselling the components from the CRTs; however, Kevin hopes that Aidan's business degree will help in all areas of the business. With Aidan in place, Kevin was finally able during the past two weeks to take his first vacation in over a year.

Today

Returning from vacation this afternoon, Kevin dropped by on his way home from the airport to check on things and look through the pile of mail sitting on his desk. Aidan was busy working on a spreadsheet when he suddenly heard Kevin yelling:

Kevin: "Thirty thousand dollars—are you kidding me? That was our entire profit last month - this cannot be right! I can understand the idea behind charging us while their trailers are at our facility, but $30,000 in just one month is absurd. I'm going to call the city right now and tell them they have made a massive mistake."

Aidan: "Hold on, maybe you should ask the guys unloading the trailers if it could be true. Maybe there are lots of trailers waiting because we are not unloading them fast enough."

Kevin: "No way—I recall my unloading guys saying they can easily unload four city trailers a day and I trust they are doing just that. If we are only having three trailers arrive per day, we should have more than enough capacity to unload the trailers. In fact, they should have some time each day when they are doing nothing!"

Aidan: "I'm not so sure about that, and it is just after 4:30 p.m. so the city offices are already closed. Why don't you drop by the loading dock tomorrow morning and ask the guys how long the city trailers are waiting? I remember calculating queuing and waiting times while earning my business degree. I'll look it up and run some numbers this evening. We can meet tomorrow right after lunch and then decide what to do about that invoice."

Kevin: "Sounds like a plan. I still don't believe that the $30,000 bill is correct. But, I guess with this new city policy of charging us while their trailers are at our facility, we might as well investigate ways to speed things up. Renting that second dock next door has got to be less than $30,000 a month!"

Aidan: "You've got that right. Maybe we can just hire more people to help unload. I bet that would be cheaper than having those trailers wait."

Kevin: "Good idea. Why don't you do some of that spreadsheet 'sensitivity' analysis you are always talking about on different-sized unloading crews?"

Aidan: "I could do that. I guess that as we increase the crew size, we should be able to unload the trucks faster and faster."

Kevin: "Yes, but only up to a point. I remember helping a friend move into a new place and we eventually had so many people helping to unload that we started banging into each other and having to wait. Just because two guys can unload four trailers a day, it does not mean that six guys could unload 12 trailers a day. It would probably be more like eight trailers a day. So let's assume that each additional employee would result in one extra trailer being unloaded per day."

Aidan: "Good point. I think they call that 'diminishing returns.' I'll include that concept in my 'sensitivity' analysis."

Kevin: "Great. But don't bring me a huge spreadsheet tomorrow; I just want to see the data summary and maybe a graph or two."

Aidan: "Okay, I promise to keep it clear."

Kevin: "Be sure to run some numbers related to that $30,000 invoice from the city. I want to have some solid data to back me up when I call them tomorrow. I'm sure we owe them something for their trailers waiting, but it can't be $30,000!"

Aidan: "I'm pretty sure I can calculate the waiting time and cost using that queuing stuff. I'll have those numbers for you tomorrow morning. Go home and get some rest."

Aidan returned to his desk and made the following list of questions for which he needed to find answers.

1. How long are the city trailers waiting on average per day/week/month? (At $60 per hour, the waiting cost can be determined.) Could the $30,000 invoice for last month possibly be accurate?
2. What are the current costs of the unloading "system" (trailers versus employees) per day/week/month?
3. How would increasing the crew size impact the total costs? What is the optimal crew size?
4. What would the new monthly bill from the city be using the optimal crew size? Sensitivity analysis on the optimal solution:
   - *Wage rate*—up to what hourly wage rate should eCycle stay with the optimal crew size?

- *Truck waiting rate*—up to what hourly trailer waiting rate should cCycle stay with the optimal crew size?
- *Arrival rate*—what is the optimal crew size if the number of trailer arrivals increases?

5. What are some other process improvement alternatives that are worth investigating further?

The Analysis

Assume you are Aidan Wallace and that you need to analyze the current situation and develop some improvement alternatives prior to meeting with Kevin tomorrow morning. Use queuing theory and a spreadsheet to determine answers to the questions just listed.