

**An Investigation into Remanufactured Toner  
Cartridges versus OEM Cartridges**

**Gursimran Singh, Nikola Radoicic, Riley Marsh, Shruti Kapoor**

**University of British Columbia**

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# An Investigation into Remanufactured Toner Cartridges versus OEM Cartridges

Nikola Radoicic



Gursimran Singh



Riley Marsh



Shruti Kapoor



## **Abstract**

This report uses the triple bottom line analysis to compare OEM and re-manufactured toner cartridges. The companies used in the comparison to represent remanufactured cartridges are Digitech and Laser Valley. Hewlett-Packard represents the OEM cartridges. These companies were selected because many departments on UBC campus currently purchase from them.

In order to analyze the social impact, we used a survey to determine if there was an actual quality difference in between OEM and remanufactured cartridges. Customer service, local impact and the ease of maintenance were also considered. For the environmental impact, a comparison of recycling practices, packaging materials, and shipping methods was conducted. The economic component was determined based off of initial price, shipping fees, and recycling costs.

The results of the triple bottom line analysis recommend Digitech as the company with which UBC should be doing business.

# Contents

<b>1</b>	<b>Introduction</b>	<b>6</b>
<b>2</b>	<b>Methods of Toner Recycling</b>	<b>7</b>
<b>3</b>	<b>Stakeholders</b>	<b>8</b>
<b>4</b>	<b>The Current Status of Printers at UBC</b>	<b>9</b>
4.1	Recycling . . . . .	9
4.2	Printer Manufacturers and Toner Suppliers . . . . .	10
<b>5</b>	<b>Social</b>	<b>11</b>
5.1	Quality . . . . .	12
5.1.1	Method . . . . .	12
5.1.2	Method . . . . .	13
5.1.3	Results . . . . .	14
5.2	Build Quality & Shipping Process . . . . .	15
5.2.1	HP . . . . .	16
5.2.2	Recycled Cartridges . . . . .	16
5.3	Community Impact . . . . .	17
<b>6</b>	<b>Economic</b>	<b>19</b>
6.1	Initial Cost . . . . .	19
6.2	Costs Related to Consumption . . . . .	20
6.3	Recycling Fee . . . . .	21
6.4	Results . . . . .	22
<b>7</b>	<b>Environmental</b>	<b>22</b>
7.1	Recycling . . . . .	23
7.2	Shipping . . . . .	24
7.3	Packaging . . . . .	25
7.4	Results . . . . .	25
<b>8</b>	<b>Conclusion</b>	<b>26</b>

## List of Figures

1	Toner Quality Survey Distribution . . . . .	14
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## List of Tables

1	Initial Average Cost Savings per Cartridge . . . . .	20
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# 1 Introduction

The UBC Vancouver campus has roughly 40,000 students and 15,000 faculty and staff members [16]. Much of the work done on campus still happens on hard copies which are printed at UBC. Unfortunately, there is no department at UBC that regulates the sale and consumption of printers and supplies on campus. As a result, each faculty and staff member manages their own toner purchasing. The purpose of our analysis is to analyse how UBC could most effectively replace spent toner cartridges by looking at the social, economic, environmental impacts (known as a triple bottom line analysis). We will then make an appropriate recommendation on how UBC can optimize their toner filling according to the triple bottom line analysis.

## 2 Methods of Toner Recycling

Toner cartridges can be recycled in three different ways. New cartridges can be ordered directly through the manufacturer (referred to as OEM cartridges), and expended toner cartridges can be sent back to the manufacturer provided they have an established recycling program. Almost all of the printer manufacturers used on campus, including HP, Brother, and Xerox, have a toner cartridge collection / recycling programs in place [8][1][3]. Aside from the manufacturer, used cartridges can be recycled and replaced through a third party service. The replacement cartridges are either compatible cartridges (cartridges which have been manufactured from raw material to mimic OEM cartridges), or they are remanufactured cartridges (cartridges that are assembled from from other recycled cartridge parts). Printer warranties specify that the outside chassis (referred to as the shell or body) must be made by the manufacturer otherwise the warranty of the printer is void. Remanufactured printers use the same shell as an OEM cartridge meaning the warranty of the printer is intact. However, compatible cartridges are made from newly made parts by a third party, and therefore void the warranty of some printers. The legality of compatible cartridges is still in question, since they may be infringing on the patents of the manufacturer[13][12]. Due to the associated legal issues, we did not include them in our analysis.



### **3 Stakeholders**

The decision to recommend a specific toner recycling vendor indirectly affects the entire UBC community; much of UBCs students, staff, and faculty rely on their departments for printing documents. These groups depend on the quality of the toner to stay consistent over time. Students will also care that the cartridges are economically optimized, since they are the ones who are contributing to the purchase of new supplies. The toner recycling process can also have an effect on local businesses, since some of the toner recycling vendors, such as Digitech and LaserValley Technologies, are based out of the lower-mainland and rely on local services and companies for support.

## 4 The Current Status of Printers at UBC

### 4.1 Recycling

There is currently no governing body at UBC which organizes and facilitates the collection, storage, shipping, receiving, and maintenance of toner cartridges on campus. Some departments, such as Electrical and Computer Engineering, Mechanical Engineering, and the Food, Nutrition and Health program have some departmental organization to facilitate this. Many of the humanities (including History, Political Science, English, and Philosophy) do not have a central system for handling toner cartridges. Instead, these departments choose to have faculty members replace and optionally recycle old toner cartridges on their own accord.

The faculties that did recycle the cartridges, primarily ordered from two companies: Digitech and Laser Valley Technologies. Both companies are located in the Greater Vancouver area. Laser Valley Technologies sells OEM, compatible and remanufactured cartridges, while Digitech sells only remanufactured cartridges.

## 4.2 Printer Manufacturers and Toner Suppliers

The distribution on campus is very uneven; roughly 88% of the printers used on campus are Hewlett Packard (HP). The remaining 12% is split between Brother and Xerox. For our analysis, we focused on HP as our OEM recycling candidate, since it would have the biggest impact on the campus results and it would have been outside the scope of this report to suggest improvements that involve the purchasing of new printers for the various departments. To ensure completeness, our analysis involved a comparison between HP, Digitech, and Laser Valley, the main toner cartridge suppliers used by UBC.

## 5 Social

The analysis of social impact is primarily concerned with how the toner recycling decision will directly affect the stakeholders. During our survey, the campus stakeholders (students, staff, and faculty) had concerns that the print quality of recycled cartridges would be worse than that of an OEM cartridge. Common issues raised were that pages would be more faded, smudgy, or misaligned. Our analysis showed that this is a misconception and that there is no discernable difference in quality between pages that are printed with an OEM cartridge to that of compatible and remanufactured cartridges. The quality of the cartridges can also include how often they break down and need to be replaced. The campus staff that maintains the printers has stated that there is no difference in maintenance and repair between OEM cartridges and recycled cartridges.

The second way that the decision could impact the stakeholders is by affecting the non-campus community. Depending on the cartridge replacement method, UBC could choose to support local businesses to a greater or lesser degree. We found that Digitech encouraged the use of local businesses and suppliers more than HP and Laser Valley. Though both of the companies are local businesses themselves, Digitech is very transparent about the fact that they will use local suppliers whenever able.

## 5.1 Quality

Cartridge quality can be understood by looking at 2 different metrics: the quality of the pages it prints (print quality), and the durability of the cartridge itself (build quality). To determine the quality of the pages, we surveyed 130 students, staff, and faculty to determine if there was a difference in perceived quality of the pages. To determine the build quality, we spoke to the UBC staff that regularly perform printer maintenance and order replacements. After speaking to David Chu Chong (the Electrical and Computer Engineering Storekeeper and Departmental Buyer) as well as Perry Yabuno (Mechanical engineering Storekeeper), we have concluded that the cartridge shipping, receiving, replacement process of Digitek and Laser Valley is slightly preferred to that of an OEM, but negligibly different and should not affect the final decision.

### 5.1.1 Method

To determine the quality of the printed pages, we printed the same standard test page, containing text and images, on two HP M451DN printers. One of the printers was filled with OEM toner from HP while the other was filled by Digitek. We asked 130 faculty, staff, and students to pick a statement which best describes their perception of the two pages:.

1. Page A is strongly preferred to Page B.
2. Page A is preferred to Page B.
3. Page A is slightly preferred to Page B.
4. Both pages look the same.
5. Page B is slightly preferred to Page B.
6. Page B is preferred to Page B.
7. Page B is strongly preferred to Page B.

We printed a second set of sample pages which were both from the OEM cartridge as a control for our survey. The survey was made double-blind to avoid an influence from the questioner.

### **5.1.2 Method**

Of the 130 students asked, an overwhelming 107 participants (82.30%) did not see a difference between Page A (printed using an OEM cartridge) and Page B (using a remanufactured cartridge). Of the 17.69% of participants who did not pick this response, all but 3 participants (15.38%) indicated that one of the pages was slightly preferred. For the control question of our survey, 11.53% of people, slightly preferred page A to page B even though they were printed from the same printer using the same cartridge. The similarities indicate that

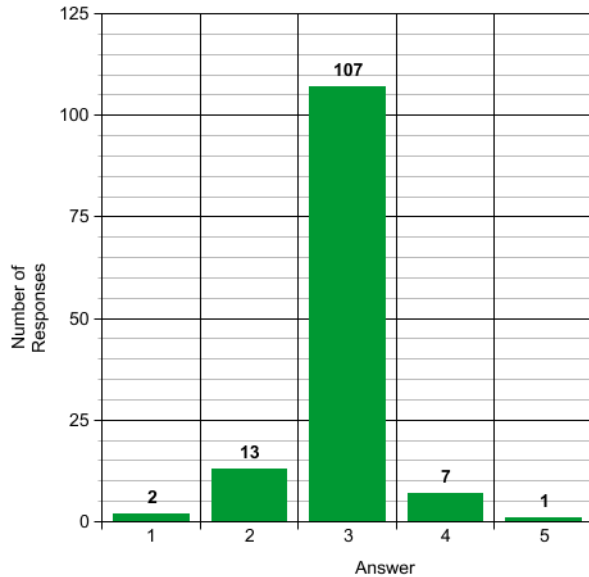


Figure 1: Toner Quality Survey Distribution

the slight preference is negligibly different and should not be seen as difference in preference.

### 5.1.3 Results

Of the 130 students asked, an overwhelming 107 participants (82.30%) did not see a difference between Page A and Page B [1]. Of the 17.69% of participants who did not pick this response, all but 3 participants (15.38%) indicated that one of the pages was slightly preferred. For the control question of our survey, 11.53% of people, slightly preferred page A to page B even though they were printed from the same printer using the same cartridge. The similarities indicate that the slight preference is negligibly different and should not be seen as

difference in preference.

Despite the large number of participants, this survey is small since only one of each cartridge type was used. By only getting samples from two printers, we are not thoroughly testing mechanical issues that could arise from using recycled cartridges which affect alignment. Remanufactured cartridges use moving parts from recycled cartridges that could be worn or damaged in the process [2]. To test for this properly would require testing several cartridges on a wide variety of printers which was infeasible for an analysis of this scale. Digitechs internal testing claims that they have a return rate, mostly due to similar mechanical issues, of only 4% which they claim is lower than industry, though we could not confirm this fact [2]. This helps to address the missing information in our study.

## **5.2 Build Quality & Shipping Process**

Each cartridge replacement method has a different set of procedures to acquire, ship, receive, and install cartridges. The effectiveness of these processes is important for the staff that will be maintaining the printers on campus. We investigated the steps involved for filling cartridges through HP, Digitech, and Laser Valley. To ensure that we accurately represented our stakeholders, we made sure to talk to staff at UBC who have installed both remanufactured



cartridges as well as OEM cartridges. We spoke with David Chu Chong (the Electrical and Computer Engineering Storekeeper and Departmental Buyer) as well as Perry Yabuno. They provided additional insight as to which cartridge replacement method was preferred. While they did not have a strong preference to which method was used, both of them preferred a recycled cartridge rather than to use an OEM, and added that they would prefer to use only one type.

### **5.2.1 HP**

HP has made the recycling of their cartridges easy and requires little work for those who maintain them. They provide prepaid and pre-addressed envelopes, labels and bulk collection boxes for cartridge collection [17]. Cartridges can also be deposited at approved retail stores including Staples of which there is one on campus [17]. Since the cartridges they provide are OEM, compatibility and ease of installation are also not concerns since the product was designed by the manufacturer.

### **5.2.2 Recycled Cartridges**

The process for recycling cartridges is slightly more involved. Both Digitech and Laser Valley pick-up old cartridges from their clients. Though Digitech offers free next-day pick-up of old cartridges, they are more particular with regard to packaging and labeling. This is due to their effort to reduce packaging

waste by recycling the boxes. The added time means that it takes a bit longer to replace and package the older cartridges. Despite this, Dave Chong assured us that the difference is entirely negligible between the two methods [15]. The pick-up service provides added convenience for the IT staff as well.

### **5.3 Community Impact**

All three companies have very different methodologies with regard to their business practices. HP is a large american multinational corporation. Due to their size, they have suppliers that can scale to the level of the demand they receive. As a result, there is little room to help smaller and more local businesses. One way they have managed to help communities, is by partnering with Staples which has local branches within the community. Printer cartridges can be dropped-off at any Staples location to be recycled.

Laser Valley is also more tailored for big business to use efficiently. The price and perceived quality of the toner seems to be their greatest selling point, and are far more secretive about their recycling methodologies. When we contacted them to learn about their suppliers, they were uncooperative and unforthcoming about their process.

Digitech is very focused on community involvement and open about their methodologies. "Wherever possible, we try and use a local supplier or business

to meet our needs”, says Dave McConachie, the President at Digitech. They are clear about their recycling process from start to finish, and are communicative and helpful. This also speaks to Digitech’s superior customer service, which also impacts the stakeholders that must communicate with the company. Both Digitech and LaserValley are local companies, which means that supporting either of them is helping the community.

## **6 Economic**

An important component of the triple bottom line analysis is the economic impact. In the case of toner cartridges, using remanufactured toner cartridges can introduce savings. However, since there is no standard for toner cartridge remanufacturing, there is significant variation between costs due to the variety of methods used [11]. The various remanufacturing costs are reflected in the price of the good. This is why it is essential to include more than one company that produces remanufactured toner cartridges. In order to determine the most cost efficient cartridge type, we conducted an analysis comparing HP OEM, Digitech remanufactured and Laser Valley remanufactured cartridges. These companies are the main suppliers of toner cartridges on UBC campus as reported by the purchasing teams of various departments around campus[6].

### **6.1 Initial Cost**

The most obvious cost associated with toner cartridges is the initial price of the product. To compare the prices from each company, we selected 15 printers commonly used at UBC and compared the price of the required toner cartridges from each company[5][7][6]. The analysis included regular and high yield black toner cartridges. For each cartridge type, the percent difference between each of the three companies was determined. The percent difference

Table 1: Initial Average Cost Savings per Cartridge

Digitech vs HP	Laser Valley vs HP	Laser Valley vs Digitech
28.61%	31.84%	10.14%

*Table comparing the relative cost of toner cartridges from the three manufacturers.*

normalizes the fact that each cartridge is not in the same price bracket, which helps reduce extraneous price differences between cartridges. The average percent differences between companies are reported in the table below; each column shows the cheaper option compared to the more expensive option. For example, the column of Digitech vs HP means that Digitech is 28.61% less expensive on average than HP when purchasing a cartridge.

It is also important to keep in mind the small associated costs of ordering and disposing of toner cartridges, such as shipping. HP ships their client's order from a centralized distribution center and their cost of shipping is dependent on quantity ordered and distance travelled. On the other hand, Laser Valley charges a flat delivery rate of two dollars regardless of order size[6]. Digitech delivers their printer cartridges for free with no minimum order[4].

## 6.2 Costs Related to Consumption

Other costs often associated with goods are related to the number of printed pages per cartridge (yield), and the rate of replacement. In the case of toner

cartridges, yield is consistent between OEM and remanufactured cartridges. This is because when the cartridges are remanufactured, the OEM case is reused[11]. Within the case, there is a finite volume available for toner that is filled to capacity. Therefore, each remanufactured toner cartridge will be able to yield the same number of pages as the OEM version. Regarding the rate of replacement, the cartridges will need to be replaced at the same frequency because they have the same yield. However, if the cartridge fails it will obviously need to be replaced sooner. The only exact success rate provided was from Digitech with a value of 96%[11]. This is very similar to the high success rate of HP OEM cartridges. There is no information provided for the Laser Valley. We are assuming there is no noticeable difference in success rates, and therefore replacement frequency between the companies is the same.

### **6.3 Recycling Fee**

Another cost often associated with toner cartridges is a recycling fee or an initial deposit that is repaid when the cartridge is returned to the manufacturer. Although all of the companies have a recycling program, there are no fees or rebates associated with them. Laser Valley and Digitech both pick up empty toner cartridges free of charge[6][11]. However, to participate in the HP Planet Partners recycling program, the cartridges need to be dropped off at

a specified location or mailed to HP[8]. The transportation of the cartridges could incur small costs.

## 6.4 Results

Due to the information gathered, Laser Valley is the most economic toner cartridge option, due to several reasons. Most noticeably, it had the cheapest initial cost of toner cartridges. While it tied with Digitech in cost savings from empty cartridge pick up, Laser Valley charges a delivery fee unlike Digitech. However, in comparison the the cost of a typical order the two dollar fee is negligible. For example a typical order from the Electrical and Computer Engineering Department is approximately \$270 [6]. Additionally, the 10.14% savings of Laser Valley compared to Digitech outweighs the small delivery fee. In light of this analysis, Laser Valley is the most inexpensive toner cartridge provider of the three companies followed closely by Digitech.

## 7 Environmental

Approximately 375 million ink and toner cartridges thrown out every year[14]. However, remanufacturing toner cartridges offers significant environmental benefits by reusing resources and reducing solid waste that is sent to land-fill and incineration. One of the best solutions to reduce environmental health

impacts from toner and ink production are to reduce the volume of cartridges sent to the garbage utilizing either a recycling or remanufacturing system. As such the environmental impact of UBCs toner provider can have a huge effect.

## 7.1 Recycling

All three of the analyzed companies implement a recycling system. Digitech reuses the components of recycled toner cartridges [11]. After disassembling, cleaning, and inspecting cartridge parts, the components in good condition are reassembled into a cartridge. This remanufactured cartridge is then refilled and tested at least four times before being ready for market. Leftover toner cannot be disposed of in an environmentally friendly way. The toner that stays at the bottom of cartridges is often burned by other recycling plants which is not ecologically sound. Digitech sends this residue to a company in California that uses this material to build speed bumps [11]. This way none of the cartridges recycled through Digitech end up in a landfill. HP also has a recycling program called HP Planet Partners [14]. It does not reuse any cartridge components; rather, old cartridge parts are combined with plastic water bottles to become raw material for new OEM cartridges. As a result, HP cartridges are made from approximately 70% recycled material. This "closed loop" system mean that no cartridges returned to HP enter landfills [14]. Laser Valley states they



have a recycling program; however, they were not transparent regarding their method. They do have a Green Seal certification that a third party granted after paying a fee.

## **7.2 Shipping**

The way that the cartridges are sent from client to manufacturer and back also adds to the environmental impact and varies from company to company. The pickup / delivery method can be controlled by the company itself (as is the case with Digitech and Laser Valley), or it can be shipped using a third party which may be left up to the client. Since HP relies on conventional mail to receive expended cartridges, the environmental shipping cost would depend on the mail carrier. While Canada Post has become ecologically mindful over the past few years [2], the journey of the package relies on other services and businesses which vary and are undeterminable. Unlike HP, Laser Valley and Digitech arrange for pick-ups themselves, which means they can control the method by which cartridges get delivered. Digitech exclusively uses fuel-efficient hybrid cars [11] as opposed to Laser Valley which does not have an open policy regarding the vehicles used.

### **7.3 Packaging**

Another wasteful component of ordering cartridges is the packaging they are sent and arrive in. Both Digitech and Laser Valley use re-usable recyclable packaging to ensure that as little packaging is wasted. To use the old box, they simply place a sticker over the sticker of an existing box. This process necessitates that the clients keep good care of the boxes, but when done successfully almost entirely eliminates the waste caused by excessive packaging: "We still have boxes from our first year of production" says Dave of Digitech[11]. HP, however, uses new packages, though they are made from mostly recycled material. Both solutions help reduce the carbon footprint of the packaging, but the eliminated waste of the recycled toner companies makes it the preferred method of packaging, and the one we would recommend for use at UBC.

### **7.4 Results**

With regards to the environmental impact, Digitech is the most responsible company. They have a recycling policy that creates zero waste and has a minimal waste packaging system. The shipping also has a smaller impact on the environment due to the low emission vehicle used.

## 8 Conclusion

Our analysis into toner cartridge replacement methods has shown that according to the Social, Economic, and Environmental aspects, Digitech provides the most agreeable solution for UBCs needs. Both Digitech and LaserValley are preferred over buying OEM cartridges from the manufacturer. While the economic analysis was slightly in favor of Laser Valley, their lack of environmental transparency coupled with Digitechs community involvement and customer service make Digitech the preferred toner replacement method.

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