

UBC Social, Ecological Economic Development Studies (SEEDS) Student Reports

An Investigation into Paper Towel vs. Electric Hand Dryers

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APSC 261

November 2009

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An Investigation into Paper Towel vs. Electric Hand Dryers

[APSC261 T1D – DIPANJAN]

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11/19/2009

ABSTRACT

In this paper, we will highlight the social preference, economical aspects and environmental aspects of the two subjects in two separate sections, concluding only after comparing the pros and cons of each subject so that we can decide which subject – either paper towel or electric hand-dryer – would be the best choice. Subsequently, we will offer a suggested model and explain the reasons as to why we choose the suggested model, specifically illustrating evidences that advocate the product.

TABLE OF CONTENTS

ABSTRACT	1
LIST OF ILLUSTRATIONS	5
LIST OF TABLES	5
GLOSSARY	5
LIST OF ABBREVIATIONS	5
1. INTRODUCTION	6
2. PAPER TOWEL	6
2.1 Social Preference	6
2.2 Economical Analysis.....	7
2.3 Environmental Analysis	8
2.4 Our Choice	10
3. ELECTRIC HAND DRYER	10
3.1 Economic Analysis	11
3.1.1 Purchasing Cost	11
3.1.2 Maintenance/Disposal Cost.....	12
3.1.3 Overall Economic Evaluation	13
3.2 Social Impact.....	13
3.3 Environmental Analysis	14
3.3.1 Material	14
3.3.2 Transportation.....	14

3.3.3 Power Consumption..... 15

4. COMPARATIVE ANALYSIS 16

4.1 Comparison Basis and Assumptions..... 16

4.2 Economic Impact Analysis 16

4.3 Environmental Impact Analysis 17

4.4 Social Impact Analysis..... 17

4.5 Effectiveness Assessment..... 18

4.6 Overall Assessment 19

5. CONCLUSION..... 19

6. Bibliography..... 20

LIST OF ILLUSTRATIONS

Figure 1 - Total Lumber Harvested for Paper Production

Figure 2 - The Suggested Kimberley's Product

Figure 3 - Total Cost vs. Hourly Usage Frequency on 1 Machine Purchase within 5 Year of Usage

Figure 4 - Total Power Use (in watt) vs. Utility Usage Frequency (use count per hour)

LIST OF TABLES

Table 1 - Unit and Supply Cost of Paper Towel Dispensers

Table 2 - Total Purchase Price for 1 Machine in Different Brand Comparison

Table 3 - Total Purchase Price for 60 Machines in Different Brand Comparison

GLOSSARY

Jet-air	Air flow rate reaching speed of jet
Paper Capacity	The density of the paper that can be packed together
Pulp	A mass of material ready to be flattened and dried to become paper

LIST OF ABBREVIATIONS

Btu – British thermal unit

CS – A Currency Measurement of Siberia

SUB – Student Union Building

1. INTRODUCTION

The purpose of this paper is to address the issue – whether paper towel should be used in the S.U.B instead of electric hand-dryer and vice versa – and to offer a reasonable suggestion based on analysis. The background of this project is for the upcoming construction and implementation of the new S.U.B, which would be a symbol of sustainability with the cost of materials, energy consumption and pollutant emission all minimize to a low and acceptable level. For this reason, the consultants advised students to conduct research as to which materials would be seemingly the best choice to reach sustainability. Our group is assigned with the analysis of whether paper towel is more sustainable than electric hand-dryer or not.

2. PAPER TOWEL

This part highlights the social preference, economical and environmental aspects of using paper towel as a means to dry people’s hands at the new SUB. First we will take a look at the social preference of students in general on the use of paper towel to dry their hands. Then, we will point out some of the economical aspects that advocate or discourage the use of paper towel based on cost analysis. Thirdly, we will discuss some of the environmental aspects to see why paper towel can be a sustainable choice for new SUB while also highlighting its negative impacts towards our biosphere. To wrap up, we will present one model which we think is the best model offered in the market and the reasons as to why we think it is the best.

2.1 Social Preference

A brief survey conducted on UBC students reveals that approximately 90% - 27 out of 30 - of the students prefer paper towels to dry their hands. The following are reasons as to why 90% of those being surveyed chooses paper towel over other hand-drying mechanism. Not only paper towel can effectively dry their hands quickly, paper towel can also wipe off some other chemicals which can otherwise be very difficult to remove. Another reason is that paper towel only wipes off the liquid on top of skin, whereas other options, such as the electric hand dryer, may make hands very dry and fragile. Many also argues that it is more convenient as users do not have to press buttons for several times – like we do with the electric hand drying machines – before they can actually see their

hands actually get dried. Moreover, many agrees on the Internet that hand-drying with paper towels seem to be a better way since it takes less time to actually dry their hands. While there are advocates for paper towels, there are also critics that dislike the use of paper towels. Some argues on the Internet forum that if the paper towel dispenser jams, it takes a longer to pull papers out than to use electric hand dryers to dry their hands. In addition, we figure that paper towel needs to be frequently replaced as one roll of paper is used up rather quickly by students in the current SUB building. At this point, it is very clear that paper towel has a strong social preference compared to other hand-drying methods. However, we must also consider the words of the critics because paper towel is really not a good choice for some of the students.

2.2 Economical Analysis

In addition to social preference, it is important for us to analyze the economical aspects of paper towels. We will illustrate by pointing the average value of a box of paper towels, the shipping cost related, the cost of the towel dispenser as well as the warranty that company usually offers. In general, a 24 rolls of paper towels cost about \$27-50 CS; this variation is due to the materials used, whether the materials used are recycled materials or not and due to the quality of the product. As for the shipping, the cost ranges from 15-20 dollars for 24 rolls of paper towels. Shipping cost may be lower if the paper’s capacity is highly compacted. This indicates that if we buy higher capacity paper towels, which usually cost a bit higher, we can get cheaper shipping.

Dispenser Name	Bunnomatic Thunder Paper Towel Dispenser wall-mounted	VonDrehle 2245 Black Hands Free Paper Roll Towel Dispenser with Motion Sensor	San Jamar Simplicity Hands Free Paper Towel Dispenser	Kimberly-Clark IN-SIGHT® SANITOUCH® 09990 Touch less Hard Roll Paper Towel Dispenser
Actual Product Cost	\$29.20	\$66.99	\$58.40	\$74.99
Shipping Cost	\$12.25	\$0.00	\$8.75	\$0.00
Maintenance	\$0.00	\$0.00	\$0.00	\$0.00

Cost				
Actual Paper Towels Cost (per 12 rolls)	\$25.99 (small ones)	\$26.86 (small ones)	\$59.99 (medium size ones)	\$49.50 (huge size ones)

Table 1 - Unit and Supply Cost of Paper Towel Dispensers

The trade off from an economical stand point is worthwhile if the total cost is a bit lower per 24 rolls of paper towels. If we are to choose paper towels as the way to hand-drying in the new SUB, we must also consider the additional expenses on buying new paper towel dispensers. On average, one normal dispenser costs about 50 dollar, and around 90+ dollars for one that has sensing ability. If we would want students to dump the used paper towels in an attached repository so that the waste can be collected easily later on, there are dispensers with a repository made of stainless steels that would cost 200+ dollars on average. If the new SUB is going to implement 10 or more dispensers, the total extra costs would be at least 500+ dollars for the normal dispensers, 1000+ dollars for the sensing ones, and 20,000 dollars for the ones with a repository. This does not include the disposal fees and taxes. Moreover, the use of paper towels can elevate the maintenance cost associated with cleaning up the mess made by unreliable users. This is because usually users are unwilling to place the used paper towels into the proper recycling container as they are either in a rush or that they think it is too ignoring to do so. Therefore, from the economical perspective, paper towels are quite expensive since the maintenance and replacement costs associated with paper towels can be high. For the warranty of the dispensers, company usually gives a one year warranty that guarantees the product’s functionality. For higher value products, the period may increase to 5 years. In brief, paper towels are very costly compared to other hand-drying mechanism.

2.3 Environmental Analysis

The third and last topic we would like to discuss is the environmental aspects of paper towels. First, we will talk about the inherent risk in using paper towels. In an article that analyzes the corresponding trees being harvested to make papers, the author illustrates that if every American household would use 100 percent recycled paper towels, 544,000 trees would be saved per year. If we surmise about the approximate area of forest that would

be saved, then it would be around 777.1 acres - which corresponds to approximately 3,000,000 meter squares - since in 1 acre there is an average of 700 trees. Figure.1 is also a graph indicating the number of lumbers used for paper production. In another article, "Energy Consumption," which specifically talks about the energy consumption during paper production, the author depicts that in 1973, for every 500 sheets of paper 47,500 Btu of energy is used. (Energy Consumption, @2004) While paper towels do present various negative impacts to the environment, evidence shows that the energy consumption during paper production are getting lower and lower. This is because technology has advanced, and there are other alternatives and choices for materials. For example, recycled paper towels can be reused to create cheaper towels that serve the same purpose. This means that 4500kWh of energy can be saved per ton of papers while 60 lb of pollutant can be avoided. A bar graph statistics also show that compared to before, paper production has reduced 42% of the total energy consumption. Hence, as technology progress, paper towels can be a good choice if energy consumption and the amount of trees that will be harvested are minimized to an acceptable level. Overall, paper towels pose many environmental problems because each manufacturing stages can emit pollutants and consume a lot of energy; technological advances will have to be made before paper towels can become more environmental friendly.

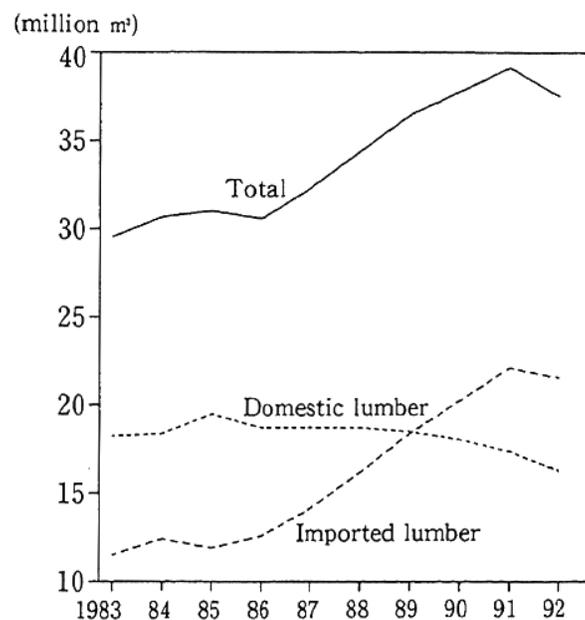


Figure 1 - Total Lumber Harvested for Paper Production

2.4 Our Choice

To conclude, paper towels are socially preferred over other hand-drying mechanisms but they can be very harmful to the environment and can be very costly. The model of the dispenser we wish to present to the new SUB's consultant is "**Kimberly-Clark IN-SIGHT® SANITOUCH® 09990 Touch less Hard Roll Paper Towel Dispenser (KIM09990)**," a dispenser with sensing ability. It is a bit more expensive – it is 75 dollars - than the normal dispenser. However, it is often more beneficial because users do not have to pull a holder several times to get the towels out. Since it is plastic, it is also easy to maintain. As for the paper towel itself, we recommended KIMBERLY-CLARK Scott Kraft Roll Towels as it seems to be the cheapest qualitative paper towels. The price is very decent as well: 49.5 dollars for 12 rolls. Figure 2 shows the product.



Figure 2 - The Suggested Kimberley's Product

3. ELECTRIC HAND DRYER

The proposed electric hand dryers in this report are GXT Extreme Air 155-GXT6, Mitsubishi Electric Jet Towel, and Dyson Company Airblade. We chose these jet-air hand dryers over the conventional ones, because they have improved in both effectiveness and efficiency over the conventional ones. The basic qualification criteria of the electric hand dryers are listed in follow:

- Be able to dry hand within 15 seconds
- Operating noise power level below 100 dB

- Minimal 5 year warranty applied free of charge

In this section, triple bottom line comparison analysis is used, and economic, social, and environmental analysis is performed as follow. The triple bottom line comparison analysis is proven to be an effective way in choosing a superior product that are most beneficial to the environment and community in limited budget offered.

3.1 Economic Analysis

Regardless of sustainability or not, limited resources and funding always leads us to consider budget floor limit when selecting a product to be utilized in a building. In this financial analysis, the life cycle costs are listed and analyzed.

3.1.1 Purchasing Cost

The machine purchase cost consists of the individual price of the hand dryer, tax, shipping, and installation cost. The installation cost is estimated to be at fixed value of 300 dollar per machine regardless of which machine type. The following Table 2 shows the individual pricing on each machine brand and the Table 3 shows the discounted price if estimated 60 hand dryers are needed to be installed in 32 washrooms in new Student Union Building.

Cost\Brand	GXT	Jet Towel	Dyson
Machine Purchase Price (1 machine)	\$355	\$1,500	\$1,599
Tax, Duties and Fees	\$0	\$100	\$191.88
Shipping	\$0	\$20	\$0
Installation	\$300	\$300	\$300
Total Purchase Price (1 machine)	\$655	\$1,920	\$2,090.88
Total During Evaluation Period (15 year)	\$1,965	\$5,760	\$4,181.76

Table 2 - Total Purchase Price for 1 Machine in Different Brand Comparison

Cost\Brand	GXT	Jet Towel	Dyson
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Machine Purchase Price (1 machine)	\$330	\$1,400	\$1,299
Tax, Duties and Fees	\$0	\$100	\$191.88
Shipping	\$0	\$5	\$0
Installation	\$300	\$300	\$300
Total Purchase Price (1 machine)	\$630	\$1,805	\$1,754.88
Total During Evaluation Period (15 year with 1 machine)	\$1890	\$5415	\$3509.76
Total Purchase Price (60 machines)	\$37,800	\$108,300	\$105,292.8
Total During Evaluation Period (15 year with 60 machines)	\$113,400	\$324,900	\$210,585.6

Table 3 - Total Purchase Price for 60 Machines in Different Brand Comparison

In Table 3, Dyson company offers more competitive price than Mitsubishi company when 60 machines are purchased. Overall, GXT ExtremeAir has the most economic advantage as its price is 35 percent of what Jet Towel machines need (American dryer Extreme Air GXT Hand Dryer, 2009) (Extreme Air, 2009) (Products Specification, 2009).

Due to different lifespan each machine has, Airblade needs to be purchased twice while other two needs three purchasing during 15 years evaluation period. The comparative advantage on long lasting product is shown on the pricing when Airblade price is significantly lower than Jet Towel with evaluation period considered.

3.1.2 Maintenance/Disposal Cost

Since all the listed products have 5 year warranty coverage free of charge, the defective part replacements do not need to be worried financially. Currently, most companies are too new to set up disposal departments, therefore local dispose depots are contacted if defective units need to be discarded. After contacting with disposal depots around Vancouver area, they do not charge for hand dryer disposal if the product is shipped to the depot (What We Recycle: Appliances, 2009).

3.1.3 Overall Economic Evaluation

Based on the tables and analysis above, it is clear that GXT ExtremeAir electric hand dryer stands out financially as it is less than half of the cost compared to other two products. Additional costs like electricity billing are based on usage and the following Figure 3 illustrates how the usage frequency affects financial decision (Revenue Requirements Application, 2009).

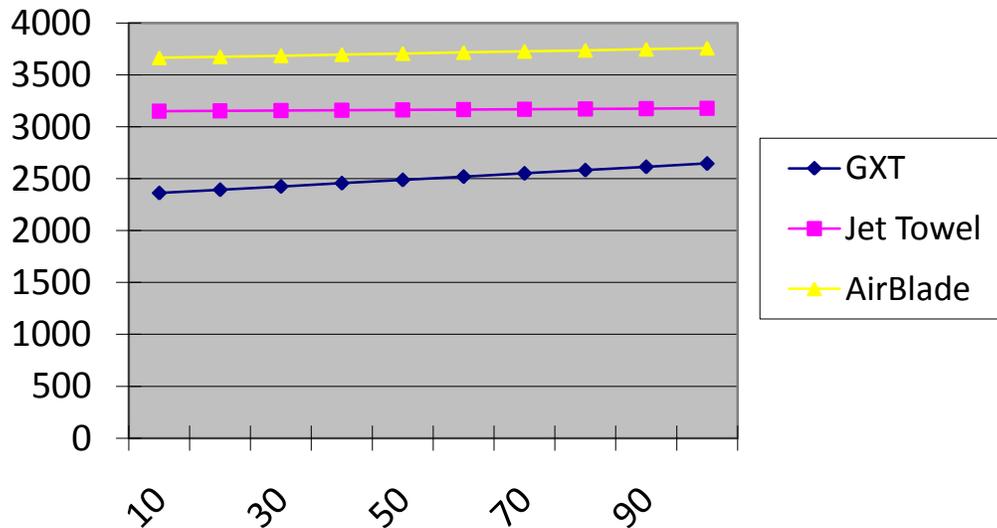


Figure 3 - Total Cost vs. Hourly Usage Frequency on 1 Machine Purchase within 5 Year of Usage

The Figure 3 data is based on the assumption that the machine is used 12 hours daily for 5 years. It is clear that the total cost of GXT Extreme Air hand dryer will be larger than Jet Towel hand dryer in large volume washrooms.

3.2 Social Impact

Though hand drying methods affect our society in terms of sustainability concepts, the amount of influence cannot be quantified directly with any sort of indicator. However, the social impact of the electric hand dryer can be readily evaluated through monitoring human health affect from hand drying methods. All the electric hand dryers listed in this report use constructing materials that do not become airborne. Moreover, there are diverting opinions in terms of whether the electric hand dryers are more bacteria-free than paper towel. This is caused by the lack of cleaning for the hand dryer filter. The Mitsubishi Electric Jet Towel has antimicrobial resin

with bounded inorganic silver compound outer layer and a waste water tank to ensure minimal bacteria growth and safe waste disposal for cleaning employees.

Dyson Company utilizes High Efficiency Air (HEPA) filters which clean air by inertial impaction, diffusion, interception, and sieving (Kayne, 2009). The reported bacteria elimination rate is above 99.9%. The advanced filter design demonstrates superior bacteria elimination and steel constructing materials ensure airborne particle free. Since all three hand dryer machine brands promote bacterial elimination, there is not enough sufficient data to select a superior hand dryer in social analysis.

3.3 Environmental Analysis

The environmental analysis of the electric hand dryers focus on the toxins produced from the product, substances that affects the growth of other species, and land use.

3.3.1 Material

Most of the constructing materials used to build electric hand dryers are steel, aluminum, and other heat resistant materials. To produce these materials and assemble them on the electric hand dryers, factories isolate land area for the heavy metal productions and assembly. These lands will not be able to immediately transform back to agriculture use without laboratory testing on metal residue in land soil due to the metal toxin from the production.

3.3.2 Transportation

After the electric hand dryers are made, they need to be shipped to warehouses and wait for customer orders. The transportation distance is one of the key issues on “carbon footprint” of the product. Due to individual corporation secret, we are not able to calculate the entire transportation route.

The factory warehouse of GXT ExtremeAir is located in Tennessee, US, and the distance between factory warehouse and UBC is 4,783 kilometres [3]. The calculated transportation carbon footprint for Jet Towel is 27.1 kilometres. The Mitsubishi Jet Towel electric hand dryer warehouse is located in Burnaby in British Columbia as

the company sets local office in every province in Canada. Lastly, the Dyson Company Airblade would travel 4,351 kilometres to UBC if it is purchased. Although the distances between warehouses and destination are easy to find, other transportation carbon footprints like assembly parts travel and finish product from company to warehouses are not able to be calculated due to corporation secrets. The above corporation information is obtained through telephone inquiry.

3.3.3 Power Consumption

The power consumption is always one of the targeted properties when selecting sustainable products. Using a power smart product not only saves electricity bill, but also contributes to the environment by conserving resources. The main power consumption types of electric hand dryers are standby power consumption and power utilized per use. The standby power consumption is fixed regardless of how many times the machine is used. On the other hand, the power utilized per use accumulates as more people dry their hand on one machine.

Based on the provided standby and per-use power consumption information of each hand dryer machine on official websites, the power use on watts compared to utility usage frequency is graphed in Figure 4.

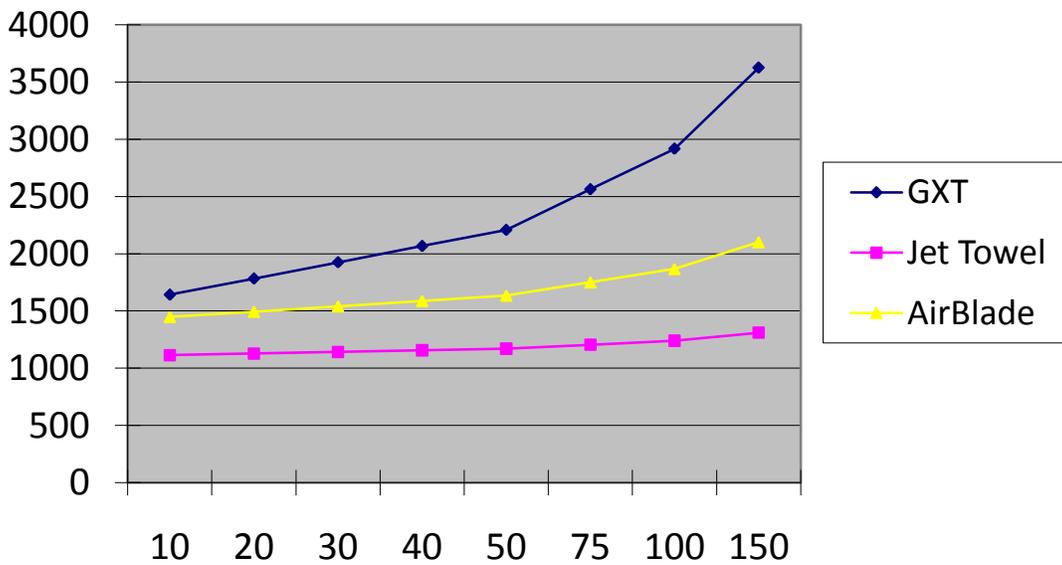


Figure 4 - Total Power Use (in watt) vs. Utility Usage Frequency (use count per hour)

According to the Figure 4, it is obvious that the GXT ExtremeAir electric hand dryer consumes the most power at all time, and its power consumption rate increases as more people use the machine. On the other hand, Mitsubishi Jet Towel hand dryer maintains minimal power consumption to less than 1500 watt per hour even with 150 uses per hour. In terms of environmental consideration and power conservation, Jet Towel hand dryer is considered the most power efficient of all chosen (American dryer Extreme Air GXT Hand Dryer, 2009) (Extreme Air, 2009) (Products Specification, 2009).

4. COMPARATIVE ANALYSIS

4.1 Comparison Basis and Assumptions

Various studies have been found on paper towel and hand dryer. Some of them are outdated since the hand dryer technology has advanced considerably since the late 1990s. Some of them are very biased on a certain choice whether it is due to the interest of the researchers or the company that funded the research. Out of all the studies, we place more attention to studies introduced after 2000, since that's around the time that new generation of hand dryers were introduced into the market. Out of these researches we usually select third party researches, and some cases studies made by hand dryer companies for comparison purposes.

In paper towel analysis we assume that each dispenser use up one large roll per day

4.2 Economic Impact Analysis

From the above economic analysis on both paper towel dispenser and electric hand dryer, we can see that electric hand dryer requires substantially more investment initially, but the maintenance cost is low. Paper towel dispenser is cheaper to invest at the beginning, but it needs continuous investment in supply of paper towels. In a 15 year analysis period for 32 washrooms, 60 Dyson hand dryer will cost \$210585.60. We assume that we do not need 60 paper towel dispensers, since paper towel dispensers are faster. If we run a 15 year analysis for 50 paper towel dispensers, the cost of paper towel supply itself already cost \$271012.50. Not to mention, there are

cost to recycle the paper, cost for the dispensers, cost to hire a janitor to maintain them. Clearly on the economic point of view, electric hand dryers are the better choices.

4.3 Environmental Impact Analysis

Both alternatives require certain amount of power consumption, which in turn creates environmental issues. In the case of paper towel, not only it consumes power to make paper, it also consumes natural resources. According to Figure 4, the power consumption of the electric hand dryers are quite steady. If one tonne of paper cost 4500kWh energy to make, one paper towel would take $4500\text{kWh}/600 = 7500\text{Wh}$ to make. At 150 usage per hour, the Dyson hand dryer uses about 1600Wh. The electric hand dryer uses 5 times less energy comparing to paper towels. Also, we have not included waste on natural resources to produce the paper, transportation to paper recycle sites, and energy consumption of the dispensers with auto-feed features. Of course, if we use recycled paper, the energy consumption may go down significantly, but at best it will be a tie with the hand dryers.

4.4 Social Impact Analysis

People's preference on whether they want to use hand dryer or paper towel is a good indicator. A targeted study (Study of the Consumers' Attitudes to Different Handdrying Systems for European Tissue Symposium, 2008) done by INTERMETRA, an European business & market research group, in 2008 showed that about 63% of the people interviewed like paper towel most. 40% of the people like hand dryers most. Other than hygienic reasons, the biggest factors that influence people's choices also include whether the device is clean and the speed it cleans. The study shows that almost 70% of the people think that paper towel cleans faster than hand dryers. This is not surprising considering most of the first generation hand dryers in use right now take at least 30 seconds to clean the hands, and most of the time, you have to run the hand dryer twice to completely dry your hands.

In the social preference analysis of paper towel, the study shows that most of the people prefer to use paper towel. Although our survey does not have a large sample, it does show some much targeted opinions of the

current students at UBC. We asked around for our friends' opinions, and most of the people that we asked are still thinking in terms of the low-speed early generation hand dryers. When we asked if they want to use the hand dryer if the process would only take about 10 seconds, most of them said yes.

On the service provider aspect, paper towel method is labour intensive and is affected by users' behaviour. Cleaning rubbish bin could be unsafe for employee when used and wet papers are scattered on the floor. On the other hand, utilizing hand dryer needs less maintenance and can provide complete dryness.

The other great factor that plays an important role in the users' preference is their habits. Most of washrooms in UBC facilities are still using paper towels. People use paper towels every day, so a sudden change to hand dryers may not be preferable to certain people.

4.5 Effectiveness Assessment

There are various studies made by universities and institutes to study the effectiveness of hand dryers. Most of the early studies show that hand dryer does not effectively kill bacteria on the hand, but most of these studies are done on conventional warm-air hand dryers.

In 2008, a study (Koerner, 2008) was conducted by the University of Westminster, London, to compare the levels of effectiveness of paper towels, warm air hand dryers and the more modern jet-air hand dryers. The key findings were:

- After washing and drying hands with the warm air dryer, the total number of bacteria was found to increase on average on the finger pads by 194% and on the palms by 254%
- Drying with the jet air dryer resulted in an increase on average of the total number of bacteria on the finger pads by 42% and on the palms by 15%
- After washing and drying hands with a paper towel, the total number of bacteria was reduced on average on the finger pads by up to 76% and on the palms by up to 77%

The above study shows some promising results for jet-air electric hand dryers.

4.6 Overall Assessment

In general, hand dryer brings a number of advantages on both economic and environmental aspects. We have seen in the study shown in above section that the jet-air hand dryers do work. The only area that the battle is still going on is in the social areas, but we believe that it is largely caused by the habit people built up over time and the misconception that electric hand dryers are not very effective. Thus, from the above analysis, we recommend the new SUB to use a jet-air electric hand dryer.

5. CONCLUSION

In this report, we selected several alternatives in each category to make preliminary comparison. When we find the best in each category, we compared between categories using their economic, environmental and social impacts. Hand dryers have been popular with industries for their apparent economies. They require very little maintenance, whereas paper towel stocks need to be replaced, and used paper towels removed. Most of people's preferences on paper towel over electric hand dryers are due to their previous experiences. In this report, we cleared up these confusions by presenting some hard numerical evidence to support the use of electric hand dryers.

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