

# A Study on the Perceived Marketability of ShoeVid-19 as an Effective Disinfecting Shoe Rack

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**Abstract**— Many studies have shown that the soles of our shoes can carry bacteria and viruses such as COVID-19 which could impose health risks toward ourselves and many other people. In line with this, the researchers thought of a solution to this problem by creating a smaller, portable, and more affordable shoe rack that not only disinfects but also deodorizes shoes. Also, the perceived marketability of the proposed shoe rack which is known as “Shoevid-19” when it is available in the market was determined. To determine if the product is acceptable and valid, 251 respondents were considered who actively participated in the study. Structural Equation Modeling (SEM) was utilized to determine the correlation and acceptance of the results toward the recommended acceptable values provided by the parameters and the Technology Acceptance Model (TAM). Based on the results, it shows that the ShoeVid-19 shoe rack and its innovations received positive feedback from the respondents as the values were accepted based on the parameters provided. Thus, it can be concluded that this product can have high marketability and a promising demand once it is available in the market.

**Keywords-** marketability; COVID-19; disinfects; Structural Equation Modeling (SEM); Technology Acceptance Model (TAM)

## I. INTRODUCTION

Towards the end of 2019, a virus deemed as severe acute respiratory syndrome started to spread from Wuhan in China to the different countries around the world and became a global pandemic [1]. Many were left with no choice but to stay inside of their homes and go out only when it is necessary. This was the time when people gave importance to disinfection and sanitation as a way of surviving the outside world.

The main form of transmitting the virus is through the respiratory droplets coming from an infected person [1]. This pandemic brought us a lot of changes may it be in our way of transportation or communication with other people. Aside from that, people cannot avoid going out of their homes and doing various essential matters. As dangerous as it is,

frontline workers are still going out of their house risking their health for them to be able to generate income to provide for their needs [2]. As such, this scenario led many families to be infected by the virus through direct contact with the infected family member and/ or indirect contact on the surfaces which the infected family member has touched [3].

According to a study conducted by the New England Journal of Medicine, not only does the COVID-19 virus survive on various surfaces after a day but also, it shows that our shoes can carry the virus for a minimum of five (5) days. That is why it was suggested by medical experts to leave our shoes outside our house in order not to transfer the virus inside our house making our family members more susceptible to the virus [4].

However, even if we leave our shoes outside our home, many people are seen to be uncomfortable wearing them the next day knowing that their shoes could have been carrying the virus and if it does, they would be there for at least 5 days [5]. As such, the researchers have seen this problem and thought of finding a solution so that people would not only need to leave their shoes outside just to avoid the virus to get into their homes but also would allow them to feel a sense of safety and convenience as they use their shoes every day. The objective of the product that we have thought of is for people to be safe from the virus and remove their feeling of being uneasy with their shoes.

It was stated in an article featured in Research and Markets that due to the pandemic, there has been an increase in the demand for disinfectants around the world, especially in various medical facilities. Moreover, as many people became more concerned about their health and hygiene, the demand for disinfection equipment increased allowing the demand for UV disinfection equipment to surge as well [6].

The key factors that made the market for UV disinfection equipment to develop and increase are the following: (1) investors that aims for expansion of producing disinfectants, (2) growth of demand for an effective yet safer way of eliminating bacteria and viruses from surfaces and water, and (3) need for cleaner wastewater facilities treatment [7].

Considering the health and safety issues discussed, the researchers aim to take part in the innovation of Shoevid-19. It is a shoe rack that functions not only as shoe storage but could also disinfect the shoes from bacteria and viruses.

## II. METHODOLOGY

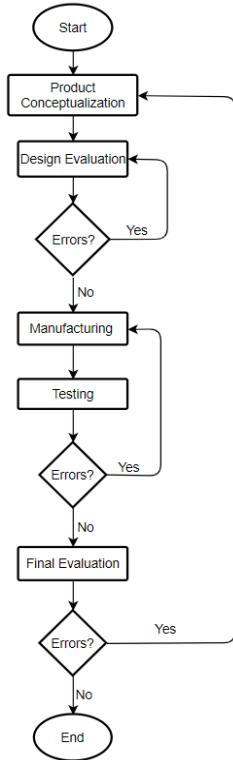


Figure 1. Conceptual Framework.

As seen in Fig. 1, the conceptual framework of the study considered a flow of phases which were considered by the researchers starting from the conceptualization until the final evaluation of the product. These phases were discussed thoroughly together with their corresponding results in the next chapter.

### A. Phase 1: Product Conceptualization

Because of the pandemic brought by COVID-19, people are worried that they might carry the bacteria and viruses into their homes. The clothes that they wear every day are cleaned after they are used however their shoes are not. To subside their worry, the researchers have created this innovative product called Shoevid-19. The primary concern for the design of the product is the size, quality, portability, and affordability. Many disinfecting shoe racks in the market today are expensive and space-consuming due to their huge sizes as seen in Fig. 2.



Figure 2. Existing Disinfecting Shoe rack [8].

As such, the researchers innovated the existing product and converted it to be as small and light as possible (as seen in Fig. 3) to reduce the production cost of a single unit and make it more portable. Moreover, Shoevid-19 has three UV lamps positioned overhead of each of the panels and it also contains a deodorizer on each panel which is not available in most of the existing shoe racks available in the market today. The additional deodorizer will eliminate any odor or foul-smelling odor on the shoes accumulated from the outside.



Figure 3. Innovative Design of the Product.

As the researchers selected the materials for the product, various factors were considered initially such as quality, cost, and availability. It is of utmost importance to consider these factors as they will determine the cost for a single product to be produced as well as its overall quality. Compared to the existing product in the market, Shoevid-19 has a rechargeable battery along it making it portable and energy-saving. Also, the body of Shoevid-19 is made from polycarbonate plastics which is low-cost, durable, and heat-resistant with low light absorption. Polycarbonate plastics are also easily processed which makes them available at a low-cost. In summary, Table I provides the summary of the comparison of an existing product in comparison to ShoeVid-19.

## B. Phase 2: Design Evaluation

This phase features the effectiveness, cost-efficiency, and feasibility of the product to the end-consumers through the evaluation of various factors based on the Technology Acceptance Model (TAM) such as perceived usefulness, perceived ease of use, attitude toward using, and intention to use. To evaluate these factors, the researchers conducted an online survey.

### 1) Data Collection

The researchers distributed a survey to various groups of people within different ranges of age with occupations ranging from being a student, employed, self-employed, or unemployed. Convenience sampling was used in selecting the respondents for the study as it is the easiest and simplest way of gathering data given the limited conditions. The summary of the demographic profile of the respondents is stated in Table I.

### 2) Development of the Questionnaires

The questionnaires used were based on various studies that used the TAM in verifying and accepting their technological products based on UV disinfection, similar to the product presented in this study. The questionnaires were subdivided into four parts and each part is based on the factors used which consisted of at least five questions each, respectively. All questions are answerable using a 5-point Likert scale ranging from “strongly agree” to “strongly disagree”.

### 3) Structural Equation Modeling (SEM)

This study follows SEM as a model to evaluate and provide a systematic solution to the problem. The factors used in the SEM framework were based on the factors used in the Technology Acceptance Model (TAM).

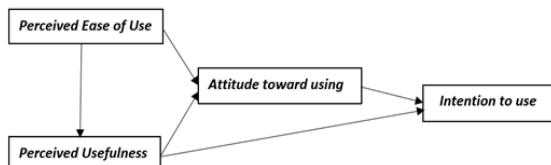


Figure 4. SEM Framework.

As seen in Fig. 4, the framework was subdivided into four factors used to evaluate the perceived marketability of the product, ShoeVid-19.

## C. Phase 3: Manufacturing

To manufacture the shoe rack, it was based upon the result of the design evaluation if it met the criteria of being effective, cost-efficient, safe, and feasible. As soon as these

criteria are satisfied, the researchers initialized the manufacturing process of the shoe rack.

## D. Phase 4: Testing

For this phase, the researchers tested if the manufactured product functions accurately and effectively as stipulated in the design evaluation. If it does not function correctly, there will be revisions in the manufacturing stage as it does not produce the appropriate end-result.

## E. Phase 5: Final Evaluation

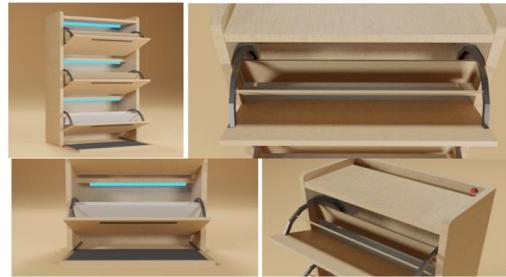


Figure 5. Final Design of the Product.

The final phase features the overall effectiveness and safety of the product once it is available to be used by the end-consumers. The product should function efficiently and reach at least the standard limits provided by the quality control agencies and other supporting bodies to make sure that it is safe and effective.

TABLE I. SUMMARY FOR THE COMPARISON OF THE PRODUCTS

	Foshan Shunde Zhongkang Disinfection Cabinet	Proposed Disinfecting Shoe Rack (ShoeVid-19)
Price	P 7,500 - P 14,000	P 4,000 - P 5,000
Material Used	Stainless Steel	Polycarbonate Plastic
Disinfection	Uses UV Light for disinfection	Uses UV Light for disinfection
Size	Huge/ Heavy	Lightweight/ Smaller size
Additional features	Ozone disinfection for additional sterilization	Deodorizer to eliminate unpleasant smell in the shoes
Number of UV lights	Has only 1 UV light for the entire cabinet	Has 3 UV light, one for each rack

## III. RESULTS AND ANALYSIS

### A. ShoeVid-19

Shoevid-19 is a 3-layer shoe rack that has a built-in ultraviolet light to eliminate viruses and bacteria on shoes

and a deodorizer for the shoes to have a pleasant smell. Using ultraviolet light causes a problem in choosing the base of the shoe rack because ultraviolet light could cause degradation to materials especially to polymers. As such, polymers such as plastic are one of the most used materials in the world that destroys nature when not disposed of properly. Using a type of plastic that could be reusable is one method to help the environment. Considering these issues, the chosen material for the product is polycarbonate plastic. According to [9], polycarbonate plastic could be reused using glycerol which is a reagent that could give 98% monomer recovery. Also, polycarbonate is resistant to ultraviolet light. It is also lightweight which gives it's portable function and resistance to high impact that would give it more durability [10]. And added UV stabilizers to enhance its weathering resistance.

In addition to its durability, this product also uses rechargeable batteries, so it is cost-effective because users do not need to buy batteries every time the power runs out. This additional feature also gives it another advantage as it is environment-friendly since batteries destroy the environment due to the toxic chemicals it contains [11]. By lessening the usage of batteries, it would help lessen the toxic materials thrown into the environment that is toxic to humans as well. Furthermore, ShoeVid-19 uses an on and off switch and a sliding mechanism to open and close the layers of the shoe rack so users would find it easy to use.

The product also offers a customizable feature in terms of the deodorizer. Consumers can choose the scent of their choice from our range of available scents such as vanilla, lavender, and chamomile. The researchers designed this product to be accessible to all people by making it available at a low price yet offers high quality and satisfaction for its purpose.

#### B. Survey Results

251 respondents responded to the survey and as seen in Table II; the greatest number of respondents are students who are female aged 18-21 years old. Most respondents have a monthly household income of 40,000 and above and are willing to pay 3,000 to 4,000 pesos for the product.

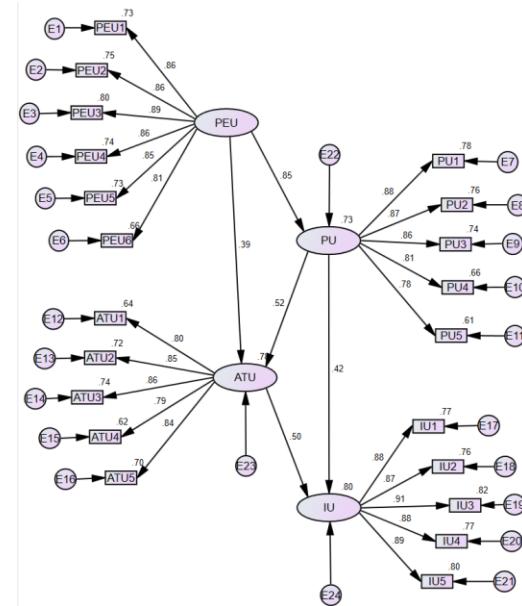
TABLE II. DEMOGRAPHICS OF THE RESPONDENTS (N=251)

Description	Category	N	%
Age	Below 18	28	11.2
	18-21	190	75.7
	22-30	18	7.2
	31-40	3	1.2
	41-50	9	3.6
	51 and onwards	3	1.2
Gender	Male	109	43.4
	Female	126	50.2

LGBTQ+	16	6.4	
How much are you willing to pay for the product?	P 3,000-P 4,000	160	63.7
	P 4,001-P 6,000	59	23.5
	P 6,001-P 8,000	13	5.2
Occupation	Student	223	88.8
	Employed	19	7.6
	Unemployed	4	1.6
	Self-employed	5	2
Monthly Household Income	Less than P 8,000	53	21.1
	P 8,001-P 20,000	42	16.7
	P 20,001-P 30,000	44	17.5
	P 30,001-P 40,000	30	12
	P 40,001 and onwards	81	32.3

#### I) SEM Model

Fig. 6 shows the initial structural SEM model while Fig. 7 shows the final structural SEM model.



As seen in Fig. 7, the loading factors fit because they are all greater than 0.7 which is the loading acceptable fit.

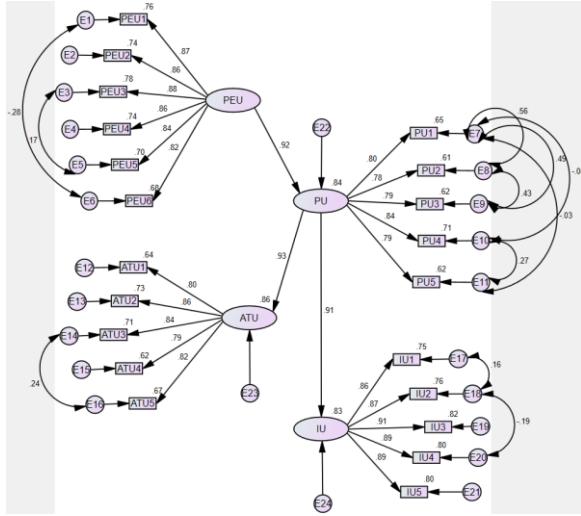


Figure 7. Final Structural model results.

TABLE III. LIST OF FACTORS, QUESTIONS, AND FACTOR LOADINGS

Indicator	Factor	Item	Loading (>0.70)
PEU	Perceived ease of use	Learning to use this product would be easy for me [12].	<b>0.87</b>
		The technology used by this product should be easy to understand and use [13].	<b>0.86</b>
		The technology used by this product has a simple operation [13].	<b>0.88</b>
		You want to use the technology for this product that is easy to maintain [13].	<b>0.86</b>
		Using the product would require less time and effort.	<b>0.83</b>
		I would find the product easy to assemble.	<b>0.82</b>
PU	Perceived usefulness	Using UV light can effectively kill pathogens such as viruses and bacteria.	<b>0.80</b>
		I find UV disinfecting equipment to be effective and helpful in preventing the spread of viruses [14].	<b>0.77</b>
		Using UV radiation can effectively remove viruses and bacteria on shoes [15].	<b>0.78</b>
		I find this equipment to be useful in the house [16].	<b>0.84</b>
		I find shoe racks as common household items used for storing shoes to achieve a clean and organized area.	<b>0.80</b>

ATU	Attitude towards use	I prefer to use the featured shoe rack rather than the ordinary shoe racks in the market [17].	<b>0.80</b>
		I found that the various functions in this system were well integrated [17].	<b>0.85</b>
		I would always like to use this product [17].	<b>0.84</b>
		Using the featured shoe rack would allow me to accomplish tasks quickly [18].	<b>0.79</b>
		The shoe rack is compatible with the shoes that I own [18].	<b>0.82</b>
IU	Intention to use	I intend to use a shoe rack with UV lights to eliminate viruses.	<b>0.87</b>
		I increase the occurrences of using this product amidst the pandemic due to its beneficial results.	<b>0.88</b>
		Using a shoe rack with UV lights and deodorizer at home makes me feel safe.	<b>0.90</b>
		I'd love to utilize a shoe rack with a deodorizer since it makes my shoes smell good and it is very easy to use.	<b>0.89</b>
		I will use a shoe rack with UV lights to sanitize and protect my family from illnesses brought by bacteria and viruses especially COVID-19.	<b>0.89</b>

The research model, as shown in Fig. 4, was evaluated using structural equation modeling (SEM). Table III indicates the factor and operational variable also as items wherein its correlation is labeled as factor loading. It also entails the variance of the variable in that specific factor. In SEM analysis, the loading factor should be higher than 0.7 for the variance to be sufficient. Results in Table III show that all indicators from different factors are significant.

### C. The goodness of Fit Measures of SEM and Parameter Estimates

Analysis of overall model fit illustrates to what extent the empirical data corresponds to a structural model. Wherein, the Root Mean Square Approximation Error (RMSEA) is an indicator that determines the overall model fit. Comparison of indices, on the other hand, is aimed to evaluate the fit between the target and baseline model. Baseline models are typically expected to be a bad model fit therefore serves as a comparative value. During which, an improvement in the results of the interest model is based on the findings from the baseline model. Based on model comparisons, commonly used measures are the Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Incremental Fit Index (IFI), Tucker Lewis Index (TLI), and Comparative Fit Index (CFI) [19].

TABLE IV. GOODNESS OF FIT AND PARAMETER ESTIMATES

Goodness of Fit Measures of SEM	Parameter Estimates	Minimum Cut-off	Recommended by
Normed Chi-Square ( $\chi^2 / df$ )	Initial:3.022 Final:2.302	<3.00	[20]
Goodness of Fit Index (GFI)	Initial:0.816 Final: 0.864	>0.80	[21]
Adjusted Goodness of Fit Index (AGFI)	Initial:0.769 Final: 0.820	>0.80	[21]
Root Mean Square Error of Approximation (RMSEA)	Initial:0.090 Final: 0.072	<0.08	[22]
Incremental Fit Index (IFI)	Initial:0.932 Final: 0.958	>0.90	[23]
Tucker Lewis Index (TLI)	Initial:0.922 Final:0.950	>0.90	[23]
Comparative Fit Index (CFI)	Initial:0.931 Final: 0.958	>0.90	[23]

As shown in Table IV, the normed chi-square is 2.302 which is less than the minimum cut-off thus suggesting that the model is acceptable [22]. For the (GFI) and (AGFI) is higher than the minimum cut-off thus indicating a good fit. The RMSEA which determines the badness of the fit index shows a value lower than the accepted value which specifies a good result. The (IFI), (TLI), and (CFI) show acceptable results, therefore, indicating that the structural model fits the observed data.

TABLE V. DIRECT, INDIRECT, AND TOTAL EFFECTS WITH THEIR P-VALUE ON THE FINAL SEM MODEL

Model Path	Direct Effect	P-Value	Indirect Effect	P-Value	Total Effect	P-Value
PU→PEU	0.917	0.009	No path	-	0.917	0.009
IU→PEU	No path	-	0.834	0.006	0.834	0.006
ATU→PEU	No path	-	0.852	0.006	0.852	0.006
IU→PU	0.909	0.009	No path	-	0.909	0.009
ATU→PU	0.929	0.011	No path	-	0.929	0.011

As seen, Table V shows the direct, indirect, and total effects among selected paths. The results show that “attitude towards using” has the highest effect on “perceived usefulness having ( $\beta=0.929$  &  $p=0.011$ ) next, “perceived usefulness” towards “perceived ease of use” having ( $\beta=0.917$  &  $p=0.009$ ) then “intention to use” towards “perceived of usefulness having ( $\beta=0.909$  &  $p=0.009$ ). Also, “attitude

towards use” has the highest indirect effect on “perceived ease of usefulness having ( $\beta=0.852$  &  $p=0.006$ ). The model path that has the least indirect effect is “intention to use” also towards “perceived ease of usefulness” having ( $\beta=0.834$  &  $p=0.006$ ).

#### D. Discussion

In general, the study revealed that Filipino consumers are more likely interested and finds the product, ShoeVid-19, overall useful and effective for disinfecting their shoes. The innovation added by the researchers in designing the product was largely accepted and given positive feedback as provided by the SEM model. The questions provided which featured the innovation of the product had the highest loading factors compared to other questions. As such, this shows that the innovation highlighted for the product allows it to be more marketable and advantageous to the side of the consumers.

Table III shows that all variables in all factors are significant. Thus, the product is feasible based on the perceived marketability of the product. Moreover, the factor that greatly influences the perception of consumers is the 'The Intention to Use' as it has the highest loading factor. Therefore, having the highest average among all the factors, suggests that the consumers are most likely to buy the product to gain the advantages offered by the product. Additionally, factors: Perceived Ease of Use, Perceived Usefulness, and Attitude Towards Use, also affects consumer's perception. Having these factors proven to be significant, implies the following: (1) the product is not difficult to understand, learn, and operate, (2) consumers believe that using the innovative product will improve their performance task, and (3) Filipino consumers have favorable feelings or positive perspective towards the product's usefulness.

This study suggests that the perceived marketability of Filipino consumers towards ShoeVid-19 is overall favorable. The possibility of future investors that (1) aims for expansion of producing innovative UV storage, and (2) addresses the demand for an effective, affordable, and compact UV storage is significantly considerable.

#### IV. CONCLUSION

Amid the threat that confronts us brought by this COVID-19 pandemic, there are measures that results to further study and research. Thus, the ultimate goal of the ShoeVid-19 product - a shoe rack with UV light and deodorizer - is a timely global innovation because there is a global COVID-19 crisis. This intends to help people as one of the effective means to disinfect viruses and bacteria because shoes can carry a deadly COVID-19 virus that continues to shake the world.

While anticipating the medical breakthrough to combat our paranoia on this crisis, innovation on a shoe rack with UV light and deodorizer is timely and can make waves that can penetrate the global market.

This study was validated by the 251 Filipino respondents. Moreover, the SEM model was utilized to evaluate if the product is acceptable to consumers and provide a systematic evaluation of the effectiveness and marketability of the product. As supported by the SEM model, the study revealed the highest loading factor of 0.90 is under IU which indicates that “Using a shoe rack with UV lights and deodorizer at home makes me feel safe”. Hence, this means that the innovations presented by the product, especially the addition of the deodorizer did not only make its function better but also marketable to the end-users. Furthermore, all indicators used for the factors of the model were all positively significant, particularly intention to use, attitude toward use, perceived usefulness, and perceived ease of use.

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