

A Development of An Air Conditioning Cleaning Tray

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Abstract: Recently, the use of chemical solution as a cleaning agent for air conditioners units are widely used nowadays because it is easy to use without needing to dismantle every part of an air conditioner to clean it thoroughly. This research purpose is to develop a product that will achieve the main objectives of this research which is firstly, to identify the risk faced by users of chemical cleaning solution. This objective is analyzed with the help of the literature review and also data collection via Google Form questionnaires. On the basis of the results of the survey, the average respondents based on mean score were agreed (1.00 – 2.40) that they had use a chemical cleaning agent during the cleaning process of their air conditioning unit. They also know the meaning of the corrosive and poisonous symbol on the labelled bottle of the chemical cleaning agent. Secondly, to evaluate the cleaning time using the previous product can be reduced efficiently. The questionnaires of this objectives is asked and the mean score and standard deviation, (M = 1.02, S.D = 0.158) was around (1.00-2.40), meant the average of the respondents agreed on the time and safety risk faced by users of chemical cleaning solution among air conditioning servicing users. Thirdly, is to propose a suitable product to improve the cleaning process and safety. This objective asked in the questionnaires and the mean score and standard deviation mean, (M = 1.08, S.D = 0.267) was around 1.00-2.40, which meant the average of the respondents agreed to the idea of the development of the product which can prevent damage or irritation due to the spill of chemical cleaning agent to the skin or surrounding and to save up the cleaning time of an air conditioning unit. This product is supported by data received feedback on their knowledge on the risk of chemical cleaning agent, cleaning time reduction and also product development. In conclusion, the vendors, servicing technicians and public users agreed on the development of the product to reduce the risk they face with the use the chemical cleaning agent and a product that reduces the time needed to clean an air conditioning unit with the use of a chemical cleaning agent or solution to the air conditioning unit.

Keywords: Air-Conditioning, Chemical, Cleaning, Agent, Cover, Tray, Risk, Experience, Expose, Damage

1. Introduction

The necessities for a particular building to serve its functions are for the building to function and human comfort, and this has always been one of the top priorities of any maintenance controlling authorities. Giving a cool breeze or wind in a warm or poorly ventilated area is one approach to make the inhabitants more comfortable and less stressed out by the hot, stuffy surroundings. Comfort in the built environment is influenced by indoor environmental aspects such as air quality, temperature, and sight and sound. Building occupants place more value on thermal comfort than on visual, auditory, or acceptable air quality comfort. Comparing its effects to those of other indoor environmental factors, it also seems to have a greater impact on the degree of pleasure with the interior environment. [1]

The distribution of heat transfer between radiation, convection, and evaporation relies on the ambient temperature, although the total metabolic rate is essentially independent of temperature. To calculate refrigeration capacity, cooling load alone is insufficient; air changes must also be taken into account. Alternatives to this option include fans, however throughout the years, fans have evolved into air conditioners. As a result, air-conditioning technology are taking humidity effects into greater account. [2] The comfort of feeling a cool breeze is what drives today's strong demand for air conditioners, even though they use far more electricity than a fan would. [3] Where there are air conditioners, which have both electrical and mechanical components, there will also be maintenance. In order to clean the air conditioner unit for maintenance, the technician uses water and a cleaning agent primarily. Initially, the cleaning agent was just soap and water, but over time, the technician needed a more effective cleaner that would reduce the amount of time needed for the scrubbing. The chemical cleaning agent is therefore introduced.

On To effectively remove stains from the coils and other parts, these chemical cleaning agents are quite corrosive. When these corrosive cleaning agents are combined with water, their solvating agent, they become extremely corrosive. [1] As a result, there is a potential that a highly caustic solution will react with its dissolving agent and result in a lot of splashing throughout the cleaning process, hitting things like furniture, the technician, or people in the area. In addition, innovations have been made to ease and lessen the damage caused by this corrosive cleaning agent, such as an air conditioner cleaning cover, where the technician simply covers the air conditioning unit and sprays the chemical cleaning agent, letting it sit and dissolve, then when that time is up and right, removing the cover from the air conditioning unit. This will prevent spills during the cleaning process and save time by not conducting. However, the problem is that the elastic band of the cover will cause splashes when the cover is removed from the air conditioning unit, which hits the technician and cause burning rash and irritation due to its high corrosive content. The surrounding furniture are damaged by the corrosiveness of the cleaning agent.

The existence of a rubber elastic strainer at the front end of the cover, where the rubber elastic band might worsen the splash of chemical cleaner residue while removing the cover, can also make the installation and removal of a fabric air conditioner cleaning cover challenging. On the other hand, a similar product that merely serves as a cover for the air conditioner is excessively exposed because there is no cover around it to stop the chemical cleaning residue from splashing onto the air conditioning technician's workspace, furniture, or other nearby surfaces.

Therefore, the development of a new product, such as this air conditioner cleaning tray, solves this issue and safely channel the corrosive cleaning agent during the cleaning process, preventing damage and injuries to the technician and the surrounding furniture. This new product will also save time by eliminating the need to remove the cleaning agent and clean the tray and the area around it.

1.1 Problem Statement

The cleaning of air conditioner outdoor and indoor units, or its component parts, involves chemical solutions, whether they are alkaline or acid solutions, which may irritate the cleaner's skin and further

damage the nearby furnishings, creating a mess as they clean. This is because the cleaning chemical solution, which combines with water to become caustic, can irritate skin and any nearby furnishings. [3] Because some air conditioners are installed on very high buildings and are heavy to move around for the cleaning procedure, cleaning an air conditioner unit can also be difficult and time-consuming. As a result, this will address the issue and save time because the device may be installed without requiring the removal of the air conditioner from its location. With the aid of a draining hose on the product, this also resolves the issue where chemical residue is typically moved to the drainage system, which may be bad for the environment and prevent generating a mess at the work place.

1.2 Scope

By draining all of the waste cleaning chemical into a container that can be disposed of properly with the use of an easily obtainable material for the product, such as Polyvinyl Chloride (PVC), it is possible to test the Air Conditioning Cleaning Tray's capabilities at home air conditioning units and ensure that cleaning time will be reduced, safety and health risks are avoided, and that it would function as it should. The objectives of this study were as follows.

- a) To identify the risk faced by users of chemical cleaning solution
- b) To evaluate the cleaning time using the previous product can be reduced efficiently
- c) To propose a suitable product to improve cleaning process and safety

2. Methodology

A flow chart is formed as an infographic for the sequence of processes or parts involved in a system or activity. In this study, to determine the pattern of the situation, quantitative approaches were used. Therefore, the research methods and process of the study might be illustrated more clearly and understandably using this flow chart, as shown in Figure 1. This Process flow (Figure 1) for constructing Air Conditioner Cleaning Tray for air conditioner cleaning purposes. This involves the aim of the product development which is to decrease risk and cleaning time by using a chemical cleaning solution. This is in conjunction with the main issue and problem statement which is to identify the risk faced and time of users with the use of a chemical cleaning solution. To construct the product this study, a frame made up of the Poly Vinyl Chloride (PVC) pipe is made. Consequently, a Vinyl Plastic cover is installed to the frame. Finally, the hose is connected at the bottom part of the cover for the drainage of the cleaning residue and chemical cleaning solution. This is to achieve the third objective of the study which is to propose a suitable product to improve the cleaning process and safety. (Figure 1) illustrates a flowchart that might be used to demonstrate the study's research data collection method and product construction procedure more precisely and efficiently

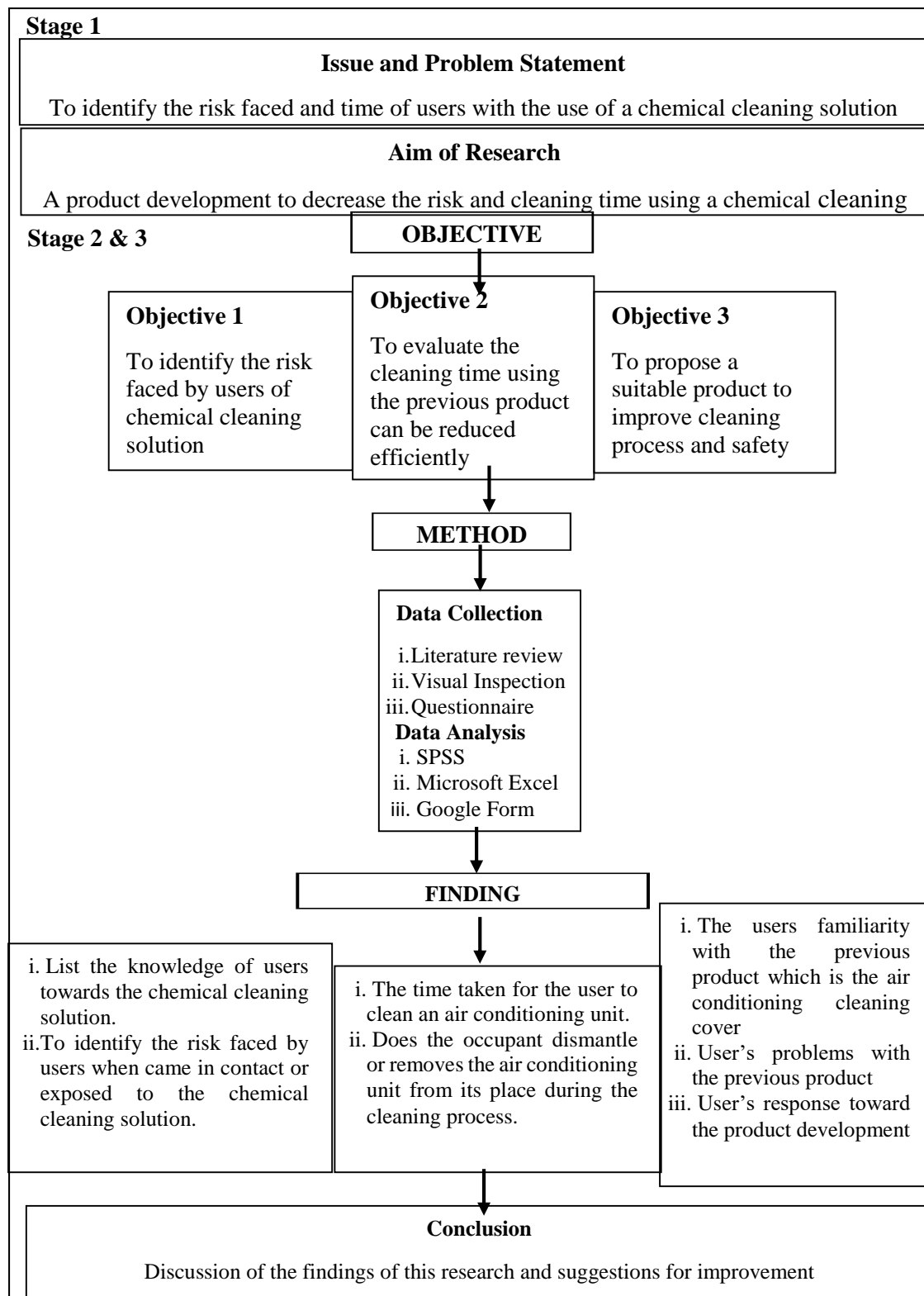


Figure 1: Flow chart for the sequence of this research

2.1 Questionnaires

For this study, the questionnaire design was based on the study's objectives 2 answer selection was used to measure respondent response towards the issue based on objectives 1, objectives 2, and objectives 3.

In order to meet the research objectives, the questionnaire must be competent. So, queries needed in the literature review must be connected to the topic. The questionnaire must be completed in English and contain illustrations of different air conditioning cleaning related types for completion. The responders are unfamiliar with the air conditioning cleaning. The questionnaire was included four significant parts, Part A, Part B, Part C, and Part D, according to Table 1

Table 1: Divided section of the question

Part	Items
Part A	Demographic Factors
Part B	Air Conditioning Chemical Cleaning
Part C	Air Conditioning Cleaning Time
Part D	A Suitable Product For Cleaning Time Saving and Safety

2.2 Data Interpretations

There are many interpretations for the questionnaire responses in this study. The question in Part B, Part C, and Part D is a Likert-scale pattern is rated on a variable depending on the level of agreement shown by respondents who complete the surveys. It may be done by calculating the frequency and percentage and the mean and mean average of the responses to the questions. To determine the variables examined in this study, the guidelines of the mean score have been fixed, as shown in Table 2.

Table 2: Mean score and their description

Mean Score	Description
1.00-2.00	Yes

3. Results and Discussion

In order to offer a solution that might lessen the danger and make it easier for respondents to clean their air conditioning unit, this study attempts to ascertain the extent of the respondents' experiences and risks they had to deal with during the cleaning procedure. By responding to the research question in this sub-topic 1—which is their experience of respondents using a chemical cleaning agent during the cleaning process of an air conditioning unit—the researcher produces a discussion to achieve the research objective of the study.

3.1 Objective 1

According to the research for objective 1, utilizing a chemical cleaning agent is the most efficient and modern technique to clean an air conditioner right now. According to the findings of a survey inquiry, the majority of respondents (mean score: 1.00–2.40) acknowledged that they had used a chemical cleaning agent during the cleaning procedure of their air conditioning unit. Furthermore, they are aware of the significance of the corrosive and dangerous symbol on the label of the chemical cleaning agent bottle. To be more precise, each and every responder indicated that they understood the significance of the corrosive symbol on the chemical cleaning product bottle when asked a question about it. In addition, many respondents reported experiencing skin irritability after coming into contact with the chemical cleaning solution, according to the survey. This is because the human skin releases its own defense mechanism, termed methyl acid, when it comes into touch with a chemical cleaning solution. This causes skin redness and a burning feeling. [4].

3.2 Objective 2

According to the poll results, the majority of respondents said that cleaning their air conditioner takes a lot of time. Additionally, the majority of respondents said that using chemical cleaning agents allows them to complete their cleaning tasks faster. The use of chemical cleaning agents, which reduce cleaning time, and the respondent's statement that the removal or disassembly process of the air conditioning unit, whether it is an outdoor or an indoor unit, is the cause of time consumption, respectively, allow the study to be accomplished. To be more specific, the majority of respondents to the survey indicated that taking an air conditioner out of its spot requires more time for cleaning. In addition, the majority of respondents indicated that they take their air conditioner out of commission while cleaning, which is related to the case of the removal of the air conditioning unit. The study's questionnaire was used to promote its goals. Finally, the majority of respondents said they use a cover or tray during the cleaning procedure to save time and avoid having to remove or dismantle their air conditioner. The goal of evaluating how cleaning time might be decreased effectively is met thanks to the information provided.

3.3 Objective 3

The majority of respondents said they used an air conditioner cover, which was the prior product, throughout the cleaning procedure, according to the results of the questionnaire study. As a result, claiming that the respondents were aware of the preceding product's existence and use. Furthermore, the majority of respondents said yes which demonstrate that target 3 was met. Following that, the majority of respondents said they were exposed to and came into contact with the chemical cleaning agent while removing the air conditioning cleaning cover. Furthermore, the majority of respondents stated that removing the air conditioning cleaning cover caused a problem at work owing to the leaking of the chemical cleaning agent. Finally, the vast majority of respondents agreed that the invention of an Air Conditioning Cleaning Tray could reduce chemical cleaning agent spills on the user and the workplace. The Air Conditioning Cleaning Tray, according to the responders, can minimize cleaning time by eliminating the need to remove and dismantle the air conditioning unit. Finally, the goal was to propose a solution that would improve the cleaning procedure and safety.

3.4 Questionnaires Analysis

The questionnaire of this study was distributed to vendor, servicing technicians and public users involved, and researchers managed to collect data from 40 respondents in the researcher's location. Questionnaire data were obtained and analyzed using SPSS. The method of analysis used is by descriptive tests using frequency, percentage, mean, and standard deviation scores to achieve all objectives of this study

3.4.1 Part A: Demographic Factors

This part is used to verify the respondents' demographic information, including variables such as gender, status, experience in the air conditioning field, job scope, whether a vendor, sales person, management or public users and finally location of the air conditioning unit in order to establish the respondents' credibility and elicit convenient responses.

Table 3: Summary of respondent demographics

		Frequency (<i>f</i>)	Percent (%)
Gender	Male	32	80
	Female	8	20
Status	Company	9	22.5

	Freelance / Self owned company	10	25
	Public Users	21	52.5
Location of Air Conditioning Unit	Home	19	47.5
	Office	5	12.5
	Home and Office	16	40
Work / Job scope	Servicing	13	32.5
	Sales	6	15
	Management	6	15
	Public	15	37.5
Experience in the Air Conditioning related works and field	Less than 1 year	16	40
	More than 1 year	9	22.5
	More than 3 years	9	22.5
	More than 5 years	6	15

Table 3 shows that the majority of the respondents are male. It shows that male respondents were more interested in responding their experience on the risk they faced during cleaning an air conditioning unit with a chemical cleaning agent than the female respondents. The questionnaires were obtained from 32 (80.00 %) male and 8 (20.00 %) female respondents from 40 (100.00 %) respondents.

Additionally, indicates that most respondents in this survey are public users with a frequency of 21 (52.50 %). The lowest is company respondents who answered with a frequency of 9 (22.05%), followed by freelance or self-owned company with a frequency of 10 (25.00 %). The percentage of public users is highest because most is due to respondents faced by themselves at home or carried out self-home cleaning of their air conditioning unit.

Furthermore, the highest respondent is their air conditioning unit is located at home 19 (47.50 %) which is relatable due to most respondents are public users and company usually does servicing at home due to lack of office in the area, and second the highest respondent is their air conditioning unit is located at home and office with 16 (40.00 %) due to freelance and company vendors providing services at home and office. The least is at office with 5 (12.50 %) due to the lack of offices in the area.

Moreover, most respondents' job scopes are public which is 15 (37.50 %), followed by servicing with 13 (32.50 %), followed by 6 (15.00 %) from sale and management. Finally, the majority of respondents that provide feedback in this survey are the ones with less than 1-year experience in the cleaning of an air conditioning unit 16 (40.00 %), followed by more than 1 year and more than 3 years with the same percentage 9 (22.50 %), and lastly, the lowest followed by more than 5 years 6 (15.00 %) which are mainly vendors who are well long establish in the area.

3.4.2 Part B Experience and Knowledge of Chemical Cleaning Solution

This Part B explains in detail respondents' experience and knowledge about air conditioning chemical cleaning solution. The Frequency (f) and percentage (%) of the statement about. This part has 11 questions highlighted to identify the respondent's knowledge and experience with the chemical cleaning agent. Every part of 11 of the question consists of 2 answers. The respondent feedback in the Part B question is shown in Table 4.

Table 4: Respondent feedback in Part B Objective 1 question

i) Air Conditioning Chemical Cleaning	Mean	Std. Deviation
1) Do you clean your air conditioning unit?	1.05	0.221
2) Do you clean your air conditioning unit using soap?	1.50	0.506
3) Do you clean your air conditioning unit using a chemical cleaning agent or solution?	1.18	0.385
4) Do you clean your air conditioning unit by using other than soap and chemical cleaning agent?	1.50	0.506
5) Have you ever been exposed or came in contact with the chemical cleaning solution?	1.38	0.490
6) Do you understand the meaning of this symbol?		
7) Does your chemical cleaning agent bottle consist the previous symbol?	1.15	0.362
8) Have you ever came in contact or exposed to the chemical cleaning solution while cleaning your air conditioner?	1.38	0.490
9) Have you ever felt irritation or burning feeling on your skin after been in contact or exposed to the chemical cleaning solution?	1.35	0.483
10) Have you ever seek medical intentions at the clinic or hospital after been exposed or came in contact with the chemical cleaning solution?	1.60	0.496
11) Is the chemical cleaning agent or solution vital in the cleaning process of an air conditioning unit?	1.25	0.439

The If not properly treated and exposed to or in contact with a large amount of chemical cleaning solution, a chemical cleaning solution can cause injuries ranging from minor to serious[5]. Despite the fact that there are signals warning of the risk, many users and merchants still intend to use it because of its efficient and quick cleaning method. For example, despite the presence of danger warning stickers on a pack of cigarettes, people still choose to sell and buy them because they are a necessity.

In general, the mean score for the statement 1) Do you clean your air conditioning unit, (M = 1.05, S.D = 0.221) ; 2) Do you clean your air conditioning unit using soap, (M = 1.50, S.D = 0.506); 3) Do you clean your air conditioning unit using a chemical cleaning agent or solution, (M = 1.18, S.D 0.385); 4) Do you clean your air conditioning unit by using other than soap and chemical cleaning agent, (M = 1.50, S.D 0.506); 5) Have you ever been exposed or came in contact with the chemical cleaning solution, (M = 1.38, S.D 0.490); 7) Does your chemical cleaning agent bottle consist the previous symbol, (M = 1.15, S.D 0.362); 8) Have you ever came in contact or exposed to the chemical cleaning solution while cleaning your air conditioner, (M = 1.38, S.D 0.490); 9) Have you ever felt irritation or burning feeling on your skin after been in contact or exposed to the chemical cleaning solution, (M = 1.35, S.D 0.483); 10) Have you ever seek medical intentions at the clinic or hospital after been exposed or came in contact with the chemical cleaning solution, (M = 1.60, S.D 0.496); 11) Is the chemical cleaning agent or solution vital in the cleaning process of an air conditioning unit, (M = 1.25, S.D 0.439) was around (1.00-2.40), which meant the average of the respondents were agreed toward the experience and knowledge about air conditioning chemical cleaning solution.

3.4.3 Part C Safety Risk and Cleaning Time of The Previous Product

This part has 8 questions highlighted to identify the time and safety risk faced by users of chemical cleaning solution among air conditioning servicing users. Every questions of the 8 consists of 2 answers selection and consist of graphic images. The respondent feedback in the Part C question is shown in Table 5.

Table 5: Respondent feedback in Part B Objective 2 question

ii) Air Conditioning Cleaning Time	Mean	Std. Deviation
1) Do you take a long time to clean your air conditioning unit?	1.20	0.405
2) Do you need a long time to clean your air conditioning unit?	1.40	0.496
3) Does a chemical cleaning agent or solution saves up your cleaning time?	1.05	0.221
4) Do you remove your air conditioning unit from its place when cleaning?	1.20	0.405
5) Do you dismantle each part while cleaning your air conditioning unit?	1.25	0.439
6) Do you think that removing and dismantling of your air conditioning unit consumes your cleaning time?	1.08	0.267
7) Do you use a cover or tray while cleaning your air conditioning unit?	1.27	0.452
8) Do you want to save up time while cleaning also without removing your air conditioning unit at the same time?	1.02	0.158

Cleaning an air conditioning machine might take a long time, but with the help of a chemical cleaning solution, this time can be reduced by half. However, there are other factors that can affect the cleaning time of an air conditioning unit, including the removal of the air conditioning unit from its original location. This can take some time because the air conditioning unit, especially the outside model, can be fairly hefty. As a result, the removal process necessitates a significant amount of manpower and time. The second step is to dismantle each component of an air conditioning unit. This is because some people want to use soap that can specifically reach and clean specific parts, as opposed to regular soap that can be used for dishwashing, body soap, and vehicle wax soap, which has a low rate of diffusion when breaking down high concentrated piles of dust particles because it is made up of slight eco-friendly molecular built up. [6].

In general, the mean score for the statement 1) Do you take a long time to clean your air conditioning unit, (M = 1.20, S.D = 0.405); 2) Do you need a long time to clean your air conditioning unit, (M = 1.40, S.D = 0.496); 3) Does a chemical cleaning agent or solution saves up your cleaning time, (M = 1.05, S.D = 0.221); 4) Do you remove your air conditioning unit from its place when cleaning, (M = 1.20, S.D = 0.405); 5) Do you dismantle each part while cleaning your air conditioning unit, (M = 1.25, S.D = 0.439); 6) Do you think that removing and dismantling of your air conditioning unit consumes your cleaning time, (M = 1.08, S.D = 0.267); 7) Do you use a cover or tray while cleaning your air conditioning unit, (M = 1.27, S.D = 0.452); 8) Do you want to save up time while cleaning also without removing your air conditioning unit at the same time, (M = 1.02, S.D = 0.158) was around (1.00-2.40), which meant the average of the respondents were agreed on the time and safety risk faced by users of chemical cleaning solution.

3.4.4 Part D Product Development to Reduce Risk and Cleaning Time

This part has 10 questions highlighted to identify product development to reduce the risk of chemical cleaning solution and time taken to clean air conditioning unit among air conditioning servicing users. Every questions of the 10 consists of 2 answers selection and consist of graphic images. The respondent feedback in the Part D question is shown in Table 6.

Table 6: Respondent feedback in Part B Objective 3 question

iii) A Suitable Product For Cleaning Time Saving and Safety	Mean	Std. Deviation
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1) Have you used an air conditioning cleaning cover during your cleaning process?	1.27	0.452
2) Do you have a hard time installing the air conditioning cleaning cover to your air conditioning unit?	1.10	0.304
3) Do you have come in contact or exposed to the chemical cleaning agent while cleaning or during the removal of the cover?	1.08	0.267
4) Does the cover causes a mess during the removal from the air conditioning?	1.13	0.335
5) Does the cover prevents you from being exposed or came in contact with the chemical cleaning solution?	1.35	0.483
6) Does the removal of the cover and residue of the removal process produce a mess at the work place?	1.05	0.221
7) Do you think this product will solve the problems of the exposure and mess caused by the spill of the chemical cleaning agent?	1.05	0.221
8) Do you think the removal and dismantle process can be reduce with the help of this product?	1.05	0.221
9) Do you think with this product the cleaning time can be reduce with the help of this product?	1.02	0.158
10) Do you think this product will prevent damage caused by the spillage of the chemical cleaning solution to the user and furniture during the product removal process?	1.08	0.267

The goal of creating this product is to prevent users from coming into touch with chemicals when cleaning their air conditioning units using a chemical cleaning agent or solution, which could cause damage or irritation to the users and the surrounding workplace. When the chemical cleaning solution or agent is spilled during the cleaning, dismantling, or removal process of the previous product, it might irritate the user and harm the workplace, in addition to leaving a mess at the workplace owing to the previous product's flaw.

In general, the mean score for the statement, 1) Have you used an air conditioning cleaning cover during your cleaning process, ($M = 1.27$, $S.D = 0.452$); 2) Do you have a hard time installing the air conditioning cleaning cover to your air conditioning unit, ($M = 1.10$, $S.D = 0.304$); 3) Do you have come in contact or exposed to the chemical cleaning agent while cleaning or during the removal of the cover, ($M = 1.08$, $S.D = 0.267$); 4) Does the cover causes a mess during the removal from the air conditioning, ($M = 1.13$, $S.D = 0.335$); 5) Does the cover prevents you from being exposed or came in contact with the chemical cleaning solution, ($M = 1.35$, $S.D = 0.483$); 6) Does the removal of the cover and residue of the removal process produce a mess at the work place, ($M = 1.05$, $S.D = 0.221$); 7) Do you think this product will solve the problems of the exposure and mess caused by the spill of the chemical cleaning agent, ($M = 1.05$, $S.D = 0.221$); 8)

Next, do you think the removal and dismantle process can be reduce with the help of this product, ($M = 1.05$, $S.D = 0.221$); 9) Do you think with this product the cleaning time can be reduce with the help of this product, ($M = 1.02$, $S.D = 0.158$); 10) Do you think this product will prevent damage caused by the spillage of the chemical cleaning solution to the user and furniture during the product removal process, ($M = 1.08$, $S.D = 0.267$) was around 1.00-2.40, which meant the average of the respondents were agreed to the idea of a development of a product which can prevent damage or irritation due to the spill of chemical cleaning agent to the skin or surrounding and to save up the cleaning time of an air conditioning unit and response towards the defects of the previous product.

4. Conclusion

In conclusion, the three objectives set at the start of the study were met using quantitative methods such as questionnaires. Furthermore, respondent response for the first aim, identifying the risk faced by chemical cleaning users, indicates that the majority of respondents have experienced the danger and use

the chemical cleaning agent in the cleaning process of their air conditioning unit. Some respondents, however, do not use a chemical cleaning solution and instead use soap.

Following that, the second objective, to determine whether cleaning time can be reduced efficiently, the system shows that majority of respondents had experienced a time-consuming air conditioning cleaning process due to the removal and dismantle process of the air conditioning unit from its location. Furthermore, they express a need for a solution that cut the air conditioning cleaning time without requiring the removal of the air conditioning unit from its location.

Following that, the study's third goal is to recommend an appropriate solution to improve the cleaning process and safety. The average response to part D's first question about fire training said they use a cover or tray during the cleaning procedure of their air conditioning unit. Aside from that, the majority of respondents agreed that installing the prior product, an air conditioner cleaning cover, to the air conditioning unit was difficult. This is also owing to the fact that the old product could only be used on the inside unit of the air conditioner, whereas most service teams clean both the outside and indoor units.

Based on the literature review and questionnaires that have been made for this study, it can be concluded the development of the Air Conditioner Cleaning Tray is suitable to the need of users to clean their air conditioning unit due to the safety factors regarding the product build purpose and also the time reduction for the cleaning time where the product can save to the removal and dismantling of an air conditioning unit from its place.

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References

- [1] Yu, B., Hu, Z., Liu, M., Yang, H., Kong, Q., & Liu, Y. (2009). Review of research on air-conditioning systems and indoor air quality control for human health. *International Journal of Refrigeration*, 32(1), 3–20. <https://doi.org/10.1016/j.ijrefrig.2008.05.004>
- [2] Steimle, F. (1995). Developments in air conditioning. *Bulletin de l'Institut International du Froid*, 75
- [3] Kubota, T., Jeong, S., Toe, D. H. C., & Ossen, D. R. (2011). Energy consumption and air-conditioning usage in residential buildings of Malaysia. *Journal of international Development and Cooperation*, 17(3), 61-69.
- [4] Bikerman, J. J. (1965). FOAMS AND EMULSIONS—FORMATION, PROPERTIES, AND BREAKDOWN. *Industrial & Engineering Chemistry*, 57(1), 56–62. <https://doi.org/10.1021/ie50661a008>
- [5] Basketter, D., Jírova, D., & Kandárová, H. (2012). Review of skin irritation/corrosion hazards on the basis of human data: a regulatory perspective. *Interdisciplinary Toxicology*, 5(2), 98–104. <https://doi.org/10.2478/v10102-012-0017-2>
- [5] Fujioka, N., Hibino, S., Wakahara, A., Kawagishi, T., Taku, K., Mizuno, S., Watanabe, S., Takahashi, H., Hamada, U., Takahashi, Y., & Yonei, Y. (2009). Effects of Various Soap Elements on Skin. *ANTI-AGING MEDICINE*, 6(12), 109–118. <https://doi.org/10.3793/jaam.6.109>