

# Designing “Fashion” into Uniform for Taipei City Public Cleaner Team

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**Abstract.** There are nearly 7,000 street cleaners in Taipei city and their uniform is part of the city color; however, what they wear everyday for work is neither highly impressive nor fully functional. This workwear re-designing project is developed by adopting design thinking as a premise for the improvement of the uniform of Taipei’s cleaner team to enhance the overall image and to improve the street cleaners’ work efficiency and safety. The project requires involving multiple perspectives and conducting analyses of tremendous amount of data collected through discussions with the citizens from Adaptive City with topics ranging from sustainable environment and public issues to core social values. By integrating design thinking into this project, various perspectives can be introduced while more and more core design values can be verified. In a hope to make design an idea publically recognized and a value widely accepted as well as to highlight everyday aesthetics and quality city life, the study will create comfortable workwear with emblematic color combinations, adopting proper promoting strategies, applying innovative procedures, and eventually refreshing certain specific occupational image.

**Keywords:** Design thinking, Adaptive City, core design values, Taipei City Public Cleaner Team, innovative procedures.

## 1 Introduction

As a leading cultural city that offers frequent large-scale exhibitions and commercial activities, Taipei is often the first choice in traveling destination for foreign guests and tourists. With abundant foreign travelers, "a neat city appearance" is often the impression implanted in the minds of the numerous travelers traveling in and out of this city. The maintenance of city appearance and the reason why urban streets and alleys can uphold their cleanness is mainly due to the front line cleaning personnel of the city, who are dedicated diligently to their posts and work hard to maintain a clean environment. In Taipei City, more than 7,000 cleaner team members shuttle between the urban lanes and alleys day and night, while these unsung heroes work hard quietly, their professional work image has yet to be respected by many. Changing the uniform and equipment of the city’s cleaner team will indirectly change the impression that a city projects; thinking and implementing the enhancement of the professionals’ specialized

equipment is an urban action to transform the living environment of Taipei. Considering and implementing design thinking as a premise to seriously improve the overall image of the cleaners and cleaning work of the Taipei City Public Cleaner Team is a positive force in fashion design, with a hope to further enhance city branding of Taipei City through the transformation of costume design.

Yellow is the main color of the Taipei City Public Cleaner Team’s original uniform, trolleys, and the body of the garbage truck. The color of the clothing is dark and dull; despite the fact that there were brighter yellow polo shirts between 2007 and 2011, the cleaner team has become invisible in the city considering how Taipei City is flooded with the color yellow (taxis, school buses, and reflective signs etc.) [ 1 ] . Furthermore, heavy and bulky cleaning equipment as well as cold and bland cleaning tanks has imperceptibly made the phrases “voiceless, petty, rustic equipment, lack of aesthetics” equivalence of the cleaner team. With an analysis of environmental color, this study intends to explore the core issues of what the cleaner team needs at work through design thinking and from the viewpoint of user needs; with an integration of fashion design and through the image enhancement of the cleaner team uniform design, a modern look for the environment and Taipei City’s Cleaner Team will be created.

## 2 Literature Review

To carry out this study, it is necessary to understand how job uniforms present professional images at work. What are the important needs and what are the functions, safety or technical indicators required? Therefore, literature review includes literatures relevant to the topic, examples of international applications, and practical needs for the design of domestic cleaning personnel’s uniforms. Since ancient times, dress codes and provisions are created due to different levels of social status, implying coercion, restriction, and unification as well as a sense of taming through power. Modern workplace also has unified format based on common practice, for example uniforms for cooks, bank tellers, flight attendants, pilots, or business workplace. The uniform itself requires good quality and color; not only can it convey organization image externally, creating benign interaction with external environment, but also internally express a unified spirit of promise and identification. Its function and effectiveness is basically divided into external and internal (Chunmei Chen, 2000). In other words, a person identifies with the various messages delivered by the uniform about the group and activity; it also reflects the spirit of the workers and professionals. For example, when companies require employees to wear uniform to work, once the employees put on the uniform, they immediately realize they are on duty, in their working positions or environment. As social critic Fussell[4] vividly stated in his work *Uniforms with deep moral revealing the social language of uniforms*; from external and internal point of views, it has the following substantial symbolic meanings: (1) disciplined, integrated, and equal; (2) teamwork and image; (3) shared disgrace and honor, mutually identifying with each other; (4) being in line with the spirit of professional services. Obviously, uniform demonstrates psychological and material need, both in internally and externally. Color, style, and material/texture are the three main elements of costume design. The composition of clothing includes colors, materials, function, structure and aesthetic form (Cheng Lee, *An Introduction to Clothing*, 2007)[1]; since job uniforms

are the clothing for work, the importance of material and function is self-evident, increasing efficiency, cohesion, and protection of job safety. However, different jobs and posts have dissimilar functional requirement for clothing styles. The main concern for the functional design of the style is that the structure of cutting should meet the requirement of the work and environment; it should reflect the features of the job and to accommodate body movements and human factors. Among the many factors, the design shall not go astray from functionality; if the style of the uniform becomes irrelevant to the specific functionality of a certain content, regardless how innovative and outstanding the style is, it may become worthless.

In addition to the above design principles, “A Study of Official Uniform in Taiwan Street Cleaners” (Yuting Tsai, 2008, page 9)[5] points out that government administrative units and systems have their specific image and organizational regulations and requirements which are different from the group uniforms in general private corporation systems; the former has a stronger emphasis on the presentation of government symbols and have certain restrictions on design flexibility and budget. Therefore, as this study focuses on the cleaner team members of Taipei City’s Department of Environmental Protection, government budget must be taken into considerations to better meet the requirements of the cleaner team members.

## **2.1 International Examples**

Analyzing the information on official cleaner team websites from foreign countries, the cleaner team uniforms from western countries such as Paris in France, Berlin in Germany, Russia, Copenhagen in Denmark, Barcelona, and London in UK adopt three or more vibrant and eye-catching color combinations. The uniforms have particular emphasis on the use of high-tech standard and safety function materials; the reflective stripe design also complies with the European regulation on safety function. While meeting needs of human nature, the uniforms convey a sense of fashion, bestowing the wearer a professional and confident image as being safe, comfortable, and energetic in their work. Of course, the professional image and appealing appearance presented by the styles of job uniforms will not be homogenous; the overall consideration combines various factors such as color, fabric, function, style, and environment. Uniform design, whether it is the pattern structure or outline detail, affects the aesthetics. Cleaner team uniform reflects not only the beauty of the wearer, but also the beauty of the industry, the environment, and the professional services, causing a high level of impact on the public's perception and self-identification of the workers and professionals.

## **2.2 Improving the Design Specifications and Requirements of Domestic Cleaner Team Uniform**

The design of cleaner team uniform involves factors and constraints from numerous aspects and is in fact a perfection of the innovative design of system engineering. Hence, a better and deeper understanding of the need of the work and the industry will result in a more thoughtful and humane design in the functionality of the clothing. Empirical data from the Taipei City Department of Environmental Protection indicates that cleaners have clearly expressed that the basic requests for the janitorial workwear

are comfort, elasticity, and durability. Over the past years, nevertheless, money has been spent on altering the style while the material remains non-sweat absorbent and airtight. Failings such as winter coats being unable to keep warm and leaking rain-coats are not improved. The biggest issue in the past is budget constrain, being unable to satisfy the need in material quality for all design items. Related design specifications and requirements that need to be improved are summarized as follows in Table1.

**Table 1.** Cleaner team uniform enhancement design need

<div>item</div> <div>Content</div>	cleaner workwear	Work hat	Reflective work vest	Reflective conical hat	Raincoat
<b>Direction of design</b>	Comfortable, breathable, safe, visually pleasing, and discernable.	Matches the overall design of the work-wear.	Matches the overall design of the work-wear.	The style matches the overall design of the work-wear.	Interweave water-proof reflective cloth and mesh through high frequency provide breathability efficacy.
<b>Design element</b>	Light and compact/with a visual effect of “high efficiency of environment relief”	Matches the overall design of the work-wear.	Matches the overall design of the work-wear/with high visibility of alertness.	Local elements	high visibility of alertness.
<b>Design material</b>	Eco-friendly, recycle, reuse. Alteration of material.	Comply with the material and production standards of European regulation EN471-Class2.	Comply with the material, water-proof, and breathability standards of European regulation EN471-Class2.	Comply with the material, water-proof, and breathability standards of European regulation EN471-Class2.	Enhance durability – water-proof and breathability.
<b>Design colors</b>	Expect low key for the overall color tone; safety concern for the colors.	New adjustments; expect further low key.	Look forward to adjustment.	Look forward to adjustment.	Look forward to adjustment.

Source: Taipei City Department of Environmental Protection(2013)

### 2.3 Practical Problems and Needs for Cleaner Team Uniform

In terms of empirical experience, cleaners from different categories and nature of work are invited to actually try on the clothes, pants, coats and hats for summer and winter to understand their reaction in the areas of comfort, breathability, stretch and elasticity, washing effect, the position and depth design of the pockets, and straight pants with wide cut to reach a better understanding of the actual issues in wearing and use. The clothing problems and needs from the fitting stage and initial communication and interview with the cleaners since 2012 are organized in Table 2.

**Table 2.** Practical questions in the cleaner team uniform enhancement design

Safety	Comfort	Function	Material	Image
Move toward safe colors	Poor comfort.	Poor breathability.	Web design material easily gets hooked to other things at work.	Maintain professional image.
Reflective stripes need to meet European regulation	Poor elasticity.	Poor performance in sweat-absorption	Color of the reflective stripe vest fades after cleaning.	Willing to wear tidy uniforms.
Safety level setting for the washing fastness of the reflective stripes.	Heavy clothes; difficult for movements.	Water leaks easily into the cuffs of the raincoat.	Decrease the quantity of workwear offered; increase the material quality of the workwear.	Enhance the environmental quality of the city.
Safe workwear	Unfitting pocket position	Poor friction for the pants	Use of eco-friendly materials	Visually pleasing image

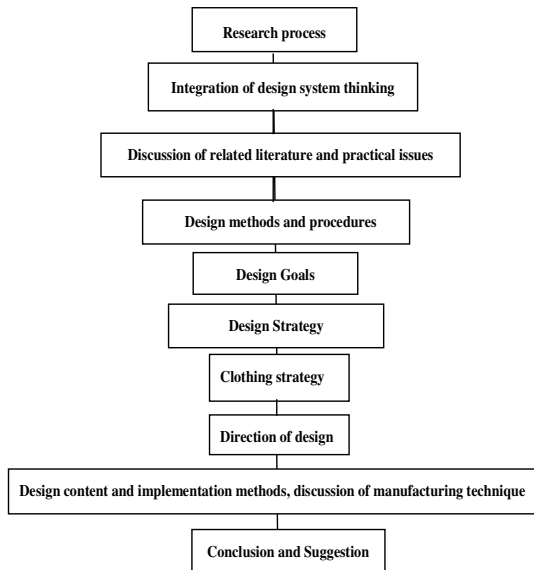
Summarizing the information and data in Tables 1 to 3, the study concludes that safety and comfort are most important in terms of the needs in workwear uniforms. The requirement of the materials mostly include elasticity, moisture wicking, breathability, ability of staying warm, stain proof, and washing fastness; the material must be improved and the focus should be on quality, not quantity. Of course, the overall image must be professional, visually appealing, and being acceptable by the general public. Based on the composition and function of the uniforms as well as the content of improvement requirement, the research information is organized into three main categories including material, appearance, and design as shown in Table 3.

**Table 3.** Content of the composition and functional requirements of cleaner uniform

Items	Content
Material (function)	1. Comfort / fabric elasticity / breathability / increase the proportion of cotton, cotton 55% and recycled polyester 45% / eco-friendly material 2. Safety technology indicators / color fastness / levels of reflection / certified / washing fastness and durable functional fabric / improvement in technical indicators change in fabric weaving method 3. windproof / warm / water pressure resistant material / wind coats need to be waterproof / coats must be water pressure resistant (2,500 ~ 3,000 mm)
Appearance (cutting)	1. Production method and details of the cuff / pocket size must meet practical needs. 2. Cutting must be suitable for work while being stylish and fashionable. 3. Emphasize tailoring design, quality, comfort, and aesthetics.
Design (direction)	1 Color and image / dyeing requirements / color differential value ( $\Delta E$ is lower than 2.0) 2. The design must consider functions in wearing and material, tying in wit style and aesthetic features. 3. Reflective stripes, distinguishing colors, safety, and visual image. 4. Workwear for winter or rainy days must be easy to wear and use; must also be stylish with appealing design.

### 3 Methodology

Based on the above literature and examining through the perspectives of mankind and humanity, design thinking is integrated into the design strategy development for the cleaners’ clothing, focusing on the color, material, appearance, and sense of design. Considering the needs of workers as the starting point of fashion design, an in-depth analysis is carried out regarding the cleaner team members’ way of work and a discussion is conducted about the clothing needs in different categories of professional cleaners’ working environment. The design thinking of the clothing is further discussed, searching for the workers’ core need at work and to analyze the environment relationship through the process of exploring the requirement regulation of uniform design and through step by step contemplation of the issues. Through extensive discussion, actual problems are discovered and uniform design needs as well as problems that need to be improved are further understood through inductive analysis by inviting experts and scholars for consultation and related institutions for workshops and seminars. Finally, uniform design strategy that meets the need of human nature and directions as well as methods for improvement can thus be proposed. The implementation sequence is developed based on natural and cultural environment, color and environmental analysis, experience observing, cleaner team work, theme setting, elements, design, graphics, proofing, testing with cleaners participation, and future design plan.



For the Research process from Integration of design system thinking to discussion of related literature and practical issues that includes the analysis of international cases Information collection and integration of workwear design specifications and requirements, then development of design methods and procedures which are observation

of experience, design the survey of interdisciplinary experts, workshops and seminars with related institutions. Next on is design goals comply with material improvement, professional image, and acceptance of the general public.

For the design strategy of Color, material and system engineering start from Natural and cultural environment analysis, furthermore experience and observe the work of the cleaner team. Further clothing strategy and direction of design particular emphasis with safe, certified, comfortable, washing fastness and durability, visual image, appealing appearance and easy to use and wear. The final step of design content and implementation methods, discussion of manufacturing technique are design and implementation, pattern make production, testing and correction, sample production, testing with cleaner involvement and future design and planning.

## **4 Results and Discussion**

### **4.1 Design Strategy**

User-centered core thinking is implemented through design thinking and the perspective of use based on human needs is adopted from the very beginning; through examining the role of material in the work of the cleaner team, systematic design method, steps, and design strategy can thus be induced by discussing the need. Cleaners have responded that while the style has changed each year, the material has not improved; they hope the design this year can satisfy their long existing simple and consistent needs: safe, comfortable, enhancement of moisture wicking function, and significant improvement in the material. The research design goals of this study, therefore, are material improvement, professional image, and acceptance of the general public. Design strategies include color strategy, material strategy, and systems engineering strategy.

Since the current clothing for the cleaners is fairly colorful, it has a lower effect of recognition among the workers and professionals from various fields of work. However, bright colors not only serve an alerting function, they are also used to unify the overall direction of design, design content and method, and investigation of manufacture technique; it can also enhance professional images to become recognizable. Therefore, this study starts with “color and environment” from the very beginning, exploring the safety of “human” at work, exclusive recognition color, professional image, and stylish appearance. For example in Taiwan, postman wears green, police wears blue, and fireman wears orange, showing that recognizable images of colors have a great impact on the image and recognition of workers and professionals. As a result, in order to study the professional image represented by cleaner team members and the hues of workers and professionals in the colors, one must start with the workwear colors to observe the details of human, human in work, as well as human and environment. The color theme is decided by considering various issues including image pictures of the workers/professionals, hues of the workers/professionals, analysis of the workwear colors, workers/professionals and the environment, a comparison of the cleaner uniform’s old and new color combination. A polling is thus held to choose

between monochrome or two-tone to create the color theme. Two sets of color themes are generated while one will eventually be chosen to be the final dye color for the proofing.

**Color Strategy.** The color strategy emphasizes safety at work, professional image, and an exclusive color recognition system.

1. To change the current equipment colors of the cleaner team and to propose a new color strategy enabling cleaners to become sparkling embellishments of Taipei to create a fresh and professional image.
2. Seven sets of color combinations are proposed in the workshops based on the principles of high saturation, environment connection, and prevention of similarity with other professions. Two directions of color combination are thus selected as Group A and Group B to match the characteristics of the fabric[ Figure 1-3 ]. A meeting is held to determine the final set of color.

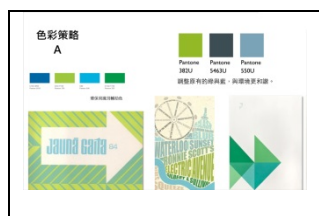


Fig. 1.

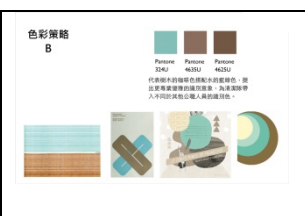


Fig. 2.

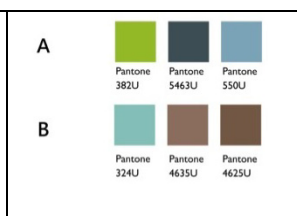


Fig. 3.

Group B is the ultimate selection for color combination and proportion to be used for the dye color and design for the final proofing.

**Material Strategy.** Next, material strategy, which is choosing eco-friendly, quality, and optimized material and exploring material technique standards and manufacturing technique: considering the role that the material will play in the life of clothing, tactile quality created by the material, possibility of manufacture; the choice of various materials will determine design features and precision, carrying out the purposes of optimization and detailing. In terms of material use such as function, eco-friendliness, specifications, ingredients, or post processing, there will be various technical standards of the needs due to different styles and items.

**System Strategy.** Systematic design must start from innovative design process: improvement of new product design, improvement of craftsmanship, improvement and functions, materials and organizational improvement, color adjustment, and improvement of working methods. Issues that must be taken seriously not only include color consideration (safety), changing of the material, design and improve perspectives, but also changing of the contract method as well as taking into account the conflict between quality and funding.




**Design Strategy.** The main focuses of the design strategies include improvement of the material, quality over quantity, and professional image; the main features are eco-friendly, comfortable, safety, and uniqueness; the directions of design include safe, certified, comfortable, wash fastness and durable, visual image, appealing appearance, easy to use and wear. Since the budget for belts is too low and users do not necessarily need it, sleeve covers design that team members often use are thus proposed. A poll is conducted regarding the consideration of quality and quantity and the cleaners’ final resolution is to reduce the number of items in order to use quality fabric. The costume design for the cleaners is mainly based on practicality, safety, and comfortable material. Increase of the material durability level brings greater convenience for the cleaner team members at work while extending the length of use. The selected materials are characterized by moisture absorption and wicking which would not become clammy under blazing sun; it conforms to European EN471 safety standard while the overall luminance area of the clothing is increased.

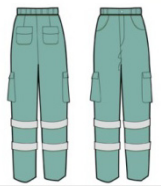






Simplicity is the main focus for the raincoat design and related details include reducing seam lines, two piece clothing, and water proof pockets on the pants. On the other hand, stretch denim will be used for the pants and the problem of shallow pockets will be resolved. The design of the conical hat is planned to be integrated with the work hat; the material will be improved and detachable cloth will be attached to the rear for sun-blocking while the vest will adopt zipper design for easy wearing. It is crucial to design suitable pattern make; a good pattern make and look will influence job safety, efficiency, comfort and aesthetics, it will further have an impact on appearance and fashion image design. Through systematic design thinking, overall professional image building, improvement in clothing function and fashion aesthetics, and a unique sense of professionalism will be generated, in addition to comfort and safety, when cleaners put on their uniforms.

Uniform Design Result for Taipei Cleaners

Table 4. Result of cleaner uniform enhancement design in this study

content item	ues of practical need for cleaner uniform	Result of cleaner uniform enhancement design	Material and function standard/indicators
Tops	Material needs to be better, breathable and easy to dry is ideal, better in keeping warm, monochrome-based, low-key for a professional presen- tation, great moisture wicking function, improvement in material quality, material improvement is missing in each year’s alteration of style.		Tops-aquatimo + polyester, Pants-cotton 75%/ T23%/OP2%
			Moisture absorption, quick-drying, breathable, cool, antibacterial

**Table 4.** (continued)

Pants	Non-elastic material creates inconvenience for movements. The material should be light, be able to keep warm, and easy to clean. The location of the pockets provides low functionality.		Summer : 93%nylon/7%OP, 210g/y+ European standard reflective stripe Witer: 90%nylon 10% spandex, 216G/M2+ European standard reflective stripe
			Anti-UV, moisture absorption, quick drying, durable, and elasticity.
Coat	Cannot shield against wind, collar get stained easily and is hard to clean, need to be better in keeping warm, the color is too ugly.		Coat + fleece vest 100% polyester, 110g/m2
			Water repellency, windproof, Anti-UV, breathable, quick drying, and light weight.
Wind jacket	The material is waterproof and windproof; can be used as a rain-coat if the rain is not too heavy, need to be warm, tend to be heavy in weight.		100% polyester, 110g/m2
			Water repellency, windproof, anti-UV, breathable, quick drying, light in weight.
Raincoat	one-piece is suggested which makes it easier to put on and take off when it is warm sweeping, breathable material is crucial, waterproof tapes fall off extremely easily, prevent water seepage, high-frequency sealing should be used.		Raincoat-water pressure 3000mm, poly- 500x94/200Dx200D
			Windproof, water- proof, breathable, durable.
Reflective vest	Bad pattern make, Velcro or front-opening are better, adjust the vests to fit better		100%polyester, 150g/y
			breathable, lightweight, non-absorbent, high visibility, Level EN471-2
Work hat	Breathable is crucial, the brim of conical hats can be bigger and wider, girth/size of head need to be adjustable.		100%nylon,155g/m2, 5000mm+5000g/m2
			Waterproof, breath- able
Gloves	None		92% aquatimo, 8%OP
			Elastic, anti-UV, breathable

**Table 4.** (continued)

Additional notes for clothing	The emphasis should be on quality, not quantity; the clothing should be durable and practical; material selected should be non-shrinking; allowing team members to have suitable sizes.	<ol style="list-style-type: none"><li>1. Insulation feature meets the standard of FTTS-FA-010 TYPE A infrared textiles.</li><li>2. Moisture absorption, wicking, and quick-drying features meet the standard of FTTS-FA-004.</li><li>3. Cool feeling features qualifies for FTTS-FA-019 Instant</li><li>4. Cool feeling textile standard (heat flow <math>\geq 0.14</math>)</li><li>5. Wet and dry friction: level 4</li><li>6. Water repellency meets the standard of FTTS-FA-011</li><li>7. Water repellency textiles standard (Level 80).</li><li>8. Anti-UV features matches FTTS-FA-008</li><li>9. UV textile standard (level C)</li><li>10. Raincoat - pressure 3000mm, poly 500x94 / 200Dx200D</li></ol> <b>Improvement of material; focus on quality, not quantity; professional image.</b>
In terms of proofing, the priority can be given to the actual color and material, proving an authentic experience for the judges, team members, and the general public.		

The most important segment in design enhancement is the improvement of the janitorial uniforms' material perception. Unlike designs in the past which have a tendency of being restricted by budget concern, the proposed design puts a stronger emphasis on functionality and comfort. The environment and four seasons of Taiwan are characterized by hot and steamy summers and cold and damp winters, which are greatly different from Western countries. In terms of design, clothing details include detachable sleeves, sun-blocking equipment, the combination of wind jacket and coat, and removable inner-layer fleece vests. The tailoring takes into consideration mid-age body shape and the average size of the cleaners with matching overall color scheme Large quantity of cheap outfit was purchased in the past; this study hopes that the current funding can be used for texture quality improvement, comfort, and convenience, lowering the replacement rate. The study hopes to resolve the problems in clothing material, being unable to absorb sweat and keep warm, as well as worksite danger resulting from non-fitting and unsuitable clothing. Cleaner team members have long criticized how Taipei citizens seem to ignore their existence, through design enhancement, the public's perspective of seeing Taipei City Public Cleaner Team as social minority is expected to change.

## 5 Conclusion and Suggestion

Through material technique indicators and discussion of manufacturing technique, this study hopes to contribute to creating the connection between design and industry. The study has conducted several practical wearing experiences to explore the actual needs, also creating innovative stylish feeling generated by the need from empirical design. In the process, testing experience specifically enhanced the interaction and communication between the government and the general public. Cleaner team is like a city

business card, becoming an image of city branding; fresh and energetic, the new image of the uniform will improve the look of the cityscape, increasing work efficiency, winning and creating stronger sense of self-identification of the cleaners in the workplace.

In the past, the budget for each cleaner was NT\$3,600, which was for ten items of equipment including summer tops and pants, coats, wind jacket. This situation of having numerous items of low quality has long been criticized by the cleaner team. In this design project, from the discussion of materials and manufacturing technique, initial patterns make design to sample production as well as testing and revision, not only cleaners are arranged to participate in the actual testing experience, the general public are also invited to try out the clothing and join the experience. Most people agree and identify with the color scheme, green hills and blue waters, emerald blue lakes, and earth tone colors are preferred combinations of the general public. However, some people suggested that the main color light turquoise get stained easily. Considering the fact that the cleaner team spend long hours outdoor with trash and dirt, the clothing material must be cleaned easily while demonstrating water fastness and durability. Regarding this problem, the percentage of blue in light turquoise will be raised while increasing the evaluation technical indicators. The overall costume design has gained great acceptance and identification among the cleaner team. Finally, everyone reached a resolution to choose quality over quantity: reduce the number of items and use the best, more durable, and safer quality material. This will not only present and deliver a professional image of the workers and professionals as well as a sense of fashion aesthetics, but the durability, comfort, and popularity of the great design and quality will reduce unnecessary waste of resources in changing the workwear every year. This study suggests fulfilling the expectation of apparel change for all members in the future. In terms of purchase strategy, two-year budget can be adopted to gather enough fund to purchase great quality and design, this is also the most expected positive impact in the integration of design thinking into government policy.

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