

Working Desk Partition Design with Copper Coating as One of Covid-19 Office Interception Approach

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Abstract. The spread of Covid-19 continues to be the main focus for all sectors, especially in the office sector, where the health of working employees is the most important thing for the company. Along with a significant increase in the spread of the coronavirus, the availability of appropriate furniture accessories on work desks to support employee performance is very important. The number of companies that do not have the ability to replace furniture according to health protocol requirements is the main factor in this study. So that the flexible partition can be designed according to the principle of the health protocol. The use of copper coating on the partitions and furniture features can support the needs of employees which has an advantage as a material to prevent the spread of the virus. The utilization and quality of materials in workspace furniture will also be increased in accordance with the applicable health protocol regarding the standard of ergonomic dimensions. This study aims to record and analyze interior facilities with the category of desk furniture accessories in the office work area from a design and function point of view related to aspects of comfort and safety for employees.

1 Introduction

The present Covid-19 outbreak, which is spreading rapidly, has a substantial impact on daily life. Activity restrictions and some government policies require some people to have limited activities. The spread of the virus continues to be the main focus for all sectors to find the most optimum prevention so that it does not spread widely. One of them is in the office sector, where the health of working employees is the most important thing for the company [1].

Some companies are still implementing remote work and some are still carrying out WFO (Work From Office) in accordance with the applicable health protocols. However, changes in the work system also have an impact on the health protocols that apply in the work area. Public spaces, especially workspaces, are closed areas that are used by many people simultaneously and for a long period of time require adequate furniture facilities to comply with health protocols [2].

Along with a significant increase in the spread of the coronavirus, the availability of complete furniture accessories on work desks to support employee performance is very important as a form of virus prevention in offices. It is also expected that there will be an optimization of ergonomics in office furniture as support for employee activities so that they remain comfortable and safe. However, unfortunately, the provision of work desk facilities supported by adequate partitions is still not optimized as a form of prevention

in preventing the coronavirus. The current interior design, furniture, and office interior accessories can still be developed into a more integrated design with the concept of social distancing and following applicable government regulations [3].

This study aims to record and analyze interior facilities with the category of desk furniture in the office work area from a design and function point of view related to aspects of comfort and safety for employees. It is hoped that this research can provide appropriate recommendations for the needs of the office sector as a supporter of the work system in the pandemic and post-pandemic era. Therefore, it is necessary to do research to design furniture in office work areas by considering work systems in the pandemic and post-pandemic era. It is also hoped that this research aims to strengthen the function of interior accessories, especially desks for employees, and can be replicated for various workspaces in Indonesia [4].

1.1 Objectives

There are several objectives that are of concern in this study:

1. Many companies do not have the ability to replace furniture according to health protocol requirements
2. Lack of furniture facilities that meet health protocol requirements in the pandemic and post-pandemic era
3. The quality and use of materials in workspace furniture that needs to be improved according to the health protocol

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2 Literature review

2.1 Guidelines for health protocols in the work area

Following the pandemic, the government issued an advisory in accordance with [5] Number HK.01.07/MENKES/328/2020 regarding guidelines for the prevention and control of the coronavirus disease 2019 (covid-19) in office and industrial workplaces in order to support business continuity in the current pandemic situation. Large-scale social restrictions (PSBB) offices or workplaces must implement several additional facilities, namely:

- a. Implementation of hygiene and sanitation in the work environment, such as the use of disinfectants every 4 hours, especially on door handles and stairs, elevator buttons, office equipment, and other public facilities areas.
- b. Improve air quality in the workplace by increasing air circulation and sunlight entering the workspace
- c. Carry out engineering to prevent transmissions such as installing barriers or glass screens for workers
- d. Implementation of physical distancing / keep your distance, put a marker on the floor or poster/banner to remind
- e. Seating arrangement so that it is 1 meter away from the desk/work area

2.2 Circulation in the work area

The need for office space includes two, namely people space (humans) and non-people space (machines or immovable goods). The work area should be measured based on the existing area so that circulation remains optimal. Figure 1 shows the standard work area requirements in general which can be used as a reference in designing office areas.



Fig. 1. Work area standard [6].

2.3 Furniture in the work area

The placement of the furniture in the work area is the most important thing in designing the work area. Furniture in one work area module usually consists of a work desk, work chair, partition, and storage. Figure 2 shows several configurations that can be applied to the existing floor plan depending on the needs of the users of the work area. Furniture needs and configurations follow the number of users who use it, for example, individuals or groups [7].

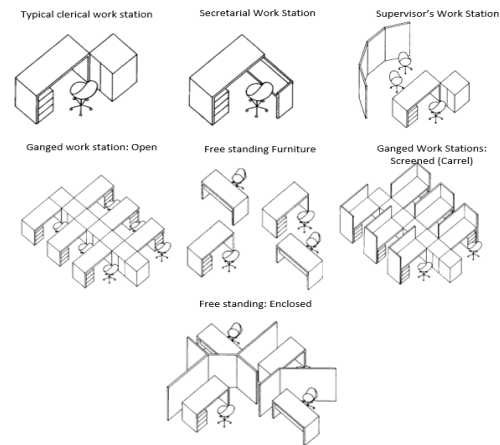


Fig. 2. Furniture configuration in the work area [6].

2.3.1 Workstation

In this discussion, the configuration that is used as a study is a general work zone in groups in an open space. In accordance with health regulations and protocols, it is explained that the circulation zone behind or beside the worktable which is a path for one direction must be at least 100cm apart (as shown in Figure 3). This distance can also be used as a clearance area for rotation of the work chair and access to a storage cabinet if it is behind a work desk.

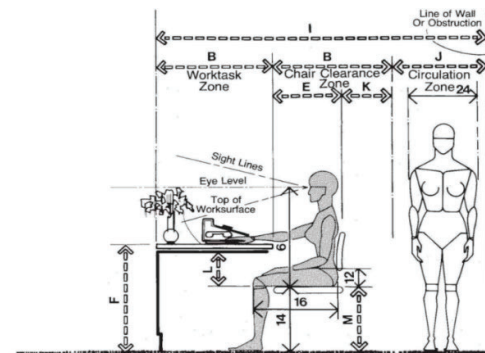


Fig. 3. Basic workstation with circulation area at the back [6].

Meanwhile, if the main circulation path requires more than the width associated with heavy traffic, it is at least 132cm (as in Figure 4).

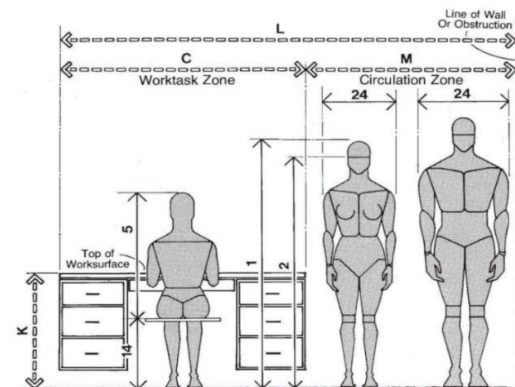


Fig. 4. Basic workstation with circulation area on the side [6].

2.3.2 Storage

For a spacious office space with storage facilities with a drawer system, it requires a distance of 120cm to 170cm from the back of the work desk to the front of the drawer. For the storage position as shown in Figure 5, the best system is a drawer, because a cupboard with swing doors will make it difficult to access the contents of the cupboard.

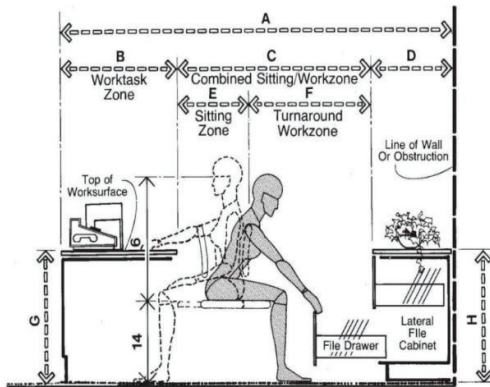


Fig. 5. Workstation with storage area in the back [6].

If the open workspace does not have sufficient area for storage facilities below, then the best alternative is to create vertical storage facilities in front of the user (Figure 6). However, storage suggestions like this one cannot save as much as the one below. The maximum width is only about 35cm. The height can be adjusted according to the user's maximum range.

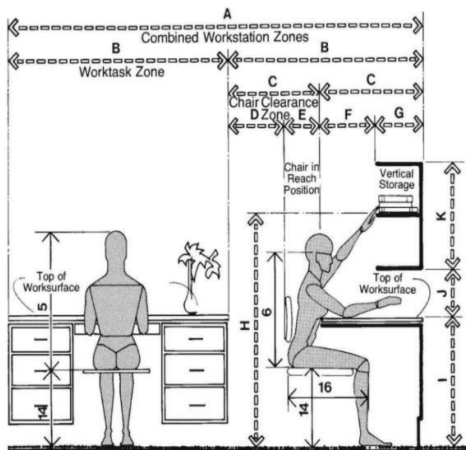


Fig. 6. Workstation with storage area in front (vertical) [6].

If the arrangement or layout of the space makes work desks line up as shown in Figure 7, the height of the storage cabinet can also function as a partition that can protect users from heavy traffic and vice versa. However, the circulation distance must be adjusted to the current health protocol.

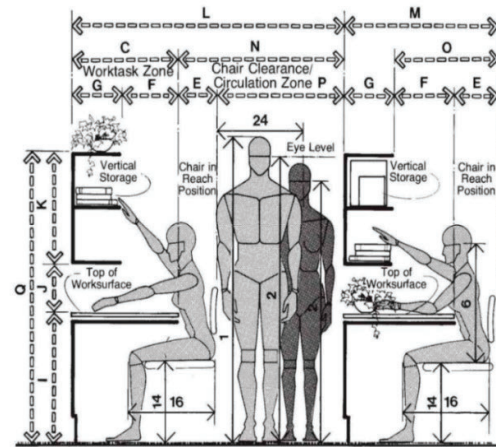


Fig. 7. Workstation with storage area in front (vertical) with circulation [6].

2.3.3 Partition

The development and growth of an open workspace can be supported by many types of partitions. Either in the form of a screen that stands on a table or stands from the floor. This partition functions as a barrier that divides the open space into predetermined parts, thus creating an acoustic system and limited visibility, as well as emphasizing the territory and circulation path in accordance with the spatial layout. The height of the partition is determined by the needs or privacy of the user.

In this discussion, partitions can be a protective barrier for users from other people's droplets and vice versa. Even though you still have to use a mask with a good and correct protocol. What will be developed next is how this partition can be made into a module & design that can be installed on all types of workbenches (Figure 8). Then the discussion about the material also becomes a heavier emphasis, considering its new function as a droplet barrier as well.

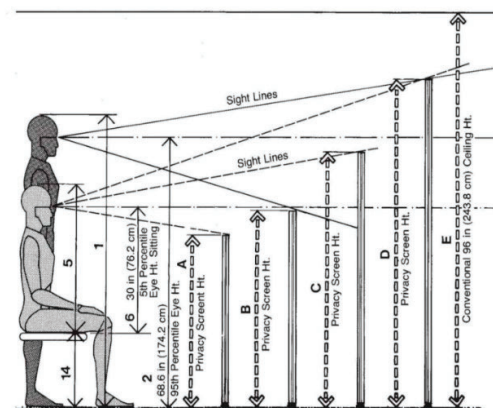


Fig. 8. Partitions with height variants according to anthropometry [6].

3 Methods

All the results of the data collection above will be processed and analyzed according to the fishbone method listed in the fishbone diagram (Figure 9). Considering the aspects in it, such as the user (People), the process of making furniture (Process), the material used (Material), the environment in the office space (Environment), and the results of the design (Design). The results of the analysis will be developed in the form of a proposed design of furniture and accessories in the office space.

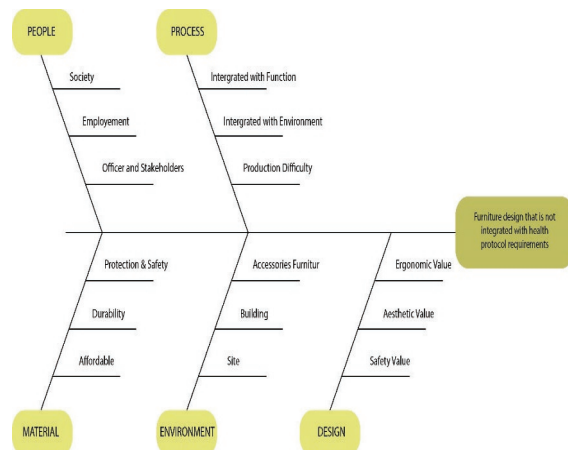


Fig. 9. Fishbone diagram (personal documentation).

4 Data collection

4.1 Materials and finishes

Determination of the material in this partition is also very important, consideration of specifications, dimensions, and thickness are parameters in the manufacture of this partition. Several choices of materials/materials are sought to meet the criteria of the Health Protocol, in terms of material selection, the transparent nature and the plastic material can certainly respond to the needs in terms of aesthetics and function in the manufacture of this divider. We also have to re-examine the use of this plastic base material.

There are 7 types of plastic:

- Acrylic or Polymethyl Methacrylate (PMMA)
- Polycarbonate (PC)
- Polyethylene (PE)
- Polypropylene (PP)
- Polyethylene Terephthalate (PETE or PET)
- Polyvinyl Chloride (PVC)
- Acrylonitrile-Butadiene-Styrene (ABS)

and other plastics (including polycarbonate, polylactide, acrylic, acrylonitrile butadiene, styrene, fiberglass, and nylon). Each plastic is different from the other. Some types of plastic are reusable, while some produce hazardous materials when used repeatedly. Some types of plastic are easy to recycle, and others require more sophisticated and complicated handling in the recycling process [8].

1. Polymethyl Methacrylate or acrylic (PMMA)

Acrylic is a transparent thermoplastic that is used as a lightweight, shatter-resistant replacement to glass. It is best known for its application in optical devices and products. Acrylic is commonly used in sheet form to create acrylic mirrors and acrylic plexiglass. Abrasion-resistant, bullet-resistant, UV-resistant, non-glare, antistatic, and other properties are available in transparent polymers. Acrylic is seventeen times more impact resistant than glass, easier to handle and produce, and has unlimited applications, in addition to being more than glass and polycarbonate sheeting.

2. Polycarbonate (PC)

Polycarbonate is a tough, stable, and transparent engineering material that is as clear as glass while being 250 times tougher. Clear polycarbonate sheet is thirty times stronger than acrylic and is easy to work with, mold, and thermo-form or cold-form. Polycarbonate plastic provides intrinsic design flexibility despite being exceptionally strong and impact resistant. Polycarbonate plastic sheets, unlike glass or acrylic, can be cut or cold formed on site without the need for pre-forming and fabrication. Polycarbonate plastic can be found in a wide range of products, including greenhouses, DVDs, sunglasses, and police riot gear.

3. Polyethylene (PE)

The most common plastic on earth, polyethylene can be produced in a variety of densities. Each different density of polyethylene gives the final plastic unique physical properties. As a result, polyethylene exists in a wide variety of products. Here are four common polyethylene densities:

- Low Density Polyethylene (LDPE)
This density polyethylene is ductile and is used to make products such as shopping bags, plastic bags, clear food containers, single-use packaging, etc.
- Medium Density Polyethylene (MDPE)
Having more polymer chains and, therefore, greater density, MDPE is usually in gas pipelines, shrink films, carrying bags, screw covers, and more.
- High Density Polyethylene (HDPE)
More rigid than LDPE and MDPE, HDPE plastic sheeting is in products such as plastic bottles, water and sewer pipes, snowboards, boats, and folding chairs.
- Ultra-High Molecular Weight Polyethylene (UHMWPE)
UHMWPE is no denser than HDPE. Compared to HDPE, this polyethylene plastic is much more abrasion resistant due to its extreme polymer chain length. Having high density and low friction properties, UHMWPE is in military body armor, hydraulic seals and bearings, biomaterials for hip, knee, and spine implants, and artificial ice skating rinks.

4. Polypropylene (PP)

This plastic material is the second most produced thermoplastic polymer and synthetic plastic in the world. Its wide use and popularity is beyond doubt

because polypropylene is one of the most flexible thermoplastics on the planet. Although PP is stronger than PE, it still maintains its flexibility and will not crack under repeated stresses. Durable, flexible, heat-resistant, acid-resistant, and inexpensive, polypropylene sheets are used to make laboratory equipment, automotive parts, medical devices, and food containers.

5. Polyethylene Terephthalate (PET) (PETE or PET)
 PET is the fourth most often produced synthetic plastic and the most common thermoplastic resin in the polyester family. Polyethylene Terephthalate is easy to recycle and has great chemical resistance to organic materials and water. It is virtually shatterproof and has a strong strength-to-weight ratio. These plastics can be found in garment fibers, food and liquid containers, engineering resin glass fibers, carbon nanotubes, and a variety of other items.
6. Polyvinyl Chloride (PVC)
 PVC is the third most commonly produced synthetic plastic polymer, and it can be made stiff or flexible. Its ability to mix in with other materials is well-known. When PVC sheet is expanded, it becomes a polyvinyl chloride material that may be used to manufacture things like kiosks, store displays, and exhibitions. Construction materials, doors, windows, bottles, non-food packaging, and other items typically contain stiff PVC. A softer and more flexible type of PVC is found in pipe products, electrical cable insulation, clothes, medical tubes, and other related products with the addition of plasticizers such as phthalates.
7. Acrylonitrile-Butadiene-Styrene (ABS)
 ABS is a strong, flexible, glossy, highly malleable, and impact resistant material made by polymerizing styrene and acrylonitrile in the presence of polybutadiene. It comes in a variety of thicknesses ranging from 200 microns to 5mm, with a maximum width of 1600mm. ABS plastic sheeting is extensively used in the automotive and refrigeration industries, as well as in items like as boxes, gauges, and head protection, because to its low production costs.

Acrylic plastic is the most common choice for partition requirements, followed by Polycarbonate and Polyethylene, depending on the nature of the composition, durability, and environmental friendliness.

5 Results and discussion

5.1 Module

Due to some variation on how people works, either they'll be side by side or faces each other, adjustment on its partition will be needed to every modulation (Figure 10). The extendable system is necessity to each modulation to give the maximum function on droplet prevention to both sides [9].

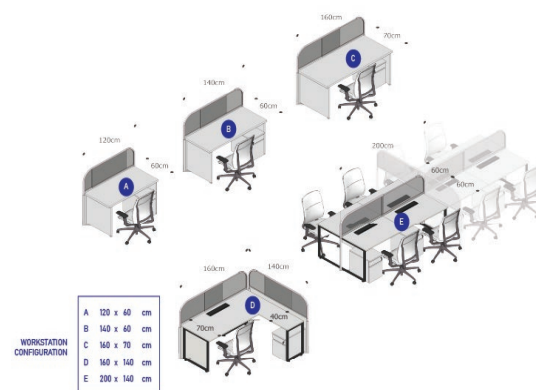


Fig. 10. Partition module (personal documentation).

5.2 Construction detail

The Construction focuses on two important parts, elevation and length. These two major parts play big roles on how the partition should be designed (Figure 11). By controlling these two parts means giving maximum prevention to spreading droplets (Figure 12).

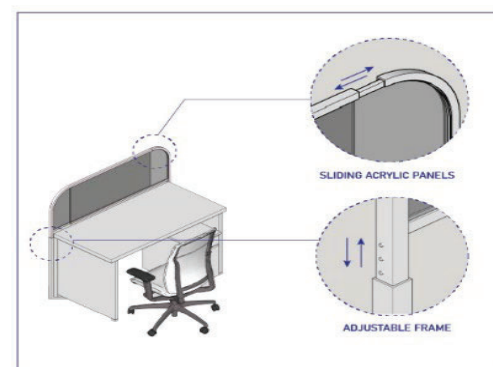


Fig. 11. Construction details for adjustable frame (personal documentation).

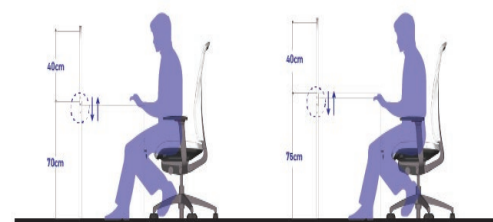


Fig. 12. Adjustable panel height (personal documentation).

5.3 Material

5.3.1 Aluminium frame

Aluminium is an exceptional option for architects, contractors, builders and homeowners considering construction materials. The fact that it is infinitely recyclable and the most recyclable construction material is just one of the many advantages.

Aluminium is durable, resistant to water, rust, and pests, and has a wide range of uses and benefits in building, resulting in stronger and more sustainable structures. Furthermore, aluminium is highly reflective and UV-protective, making it a safe and effective choice [10].

5.3.2 Poly carbonate

To its character, the uses of polycarbonate is material-ready to be coated by Copper Coating. Based on [11], Method of adjusting a polycarbonate surface to improve adhesion of a metal layer and chemically and physically modified surface is electrolessly plated with a primary metal layer. A secondary metal layer is then electrolessly or electrolytically applied on top of the primary metal layer until a metal layer of a desired thickness is attained.

5.3.3 Copper coating

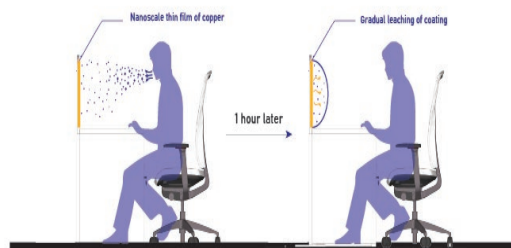


Fig. 13. Copper coating inactivate Covid-19 within 1 hour (personal documentation).

Copper, a Material with Self-Sterilizing Ability the results of this study also remind the ability of copper to self-sterilize. Although the durability of the coronavirus on the surface of this material is quite long, which is up to four hours, it is much faster than plastic and iron materials. Copper has been known since ancient times as an antibacterial material (Figure 13). In ancient times, people used to use copper to sterilize wounds. Copper is also widely used as a material for various equipment. Until now, in India, copper has become a popular material for food and drink containers. In 2008, the United States environmental protection agency, Environmental Protection Agency (EPA), listed more than 300 different copper materials as antibacterial [12].

This makes copper the first solid material to fall into this category. In various studies, copper has become one of the recommended materials for goods in hospitals. However, with the passage of time and the increasing number of material options, such as stainless steel and plastics, copper is increasingly being abandoned. The effectiveness of copper is discussed in a study published in 2011 entitled *Metallic Copper as an Antimicrobial Surface*. The research was carried out by Professors of Microbiology from the University of Nebraska and the University of Arizona, as well as professors of biochemistry from the University of Bern.

The three of them conducted laboratory research related to the resistance of various bacteria on copper surfaces. (Read: Corona Virus Test: Important to Prevent Spread but Difficult to Obtain) In the publication of the

study, the results of the copper test as an antibacterial carried out by various hospitals were also cited. In a 10-week trial at Oak Hospital, Birmingham, England, a comparison of the bacterial contamination of several copper-containing items, namely toilet seats (70% Cu), handles (60% Cu), and slabs for sliding doors (70% Cu) with the same items that use other materials such as plastic, chrome, and aluminium. As a result, the median numbers of bacteria found on copper-containing items were 90% and 100% lower than on the same but non-copper surfaces, respectively. Similar trials in various hospitals have also shown the superiority of copper for recovering from bacteria, for example, trials in clinics in Grabouw, Western Cape, South Africa, and Asklepios Hospital in Hamburg, Germany. Bacterial findings are 60-70% less than in non-copper goods [13].

6 Conclusion and recommendation

Although the number of Covid-19 transmissions has decreased drastically for now, health protocols must still be maintained. This standard will continue to be maintained for a long period of time considering the impact that has occurred since the beginning of the pandemic. Especially in a workspace or office where many people gather. By applying the correct layout and circulation as in previous studies, the next recommendation is to add partitions to each work desk. Partitions that initially only functioned as privacy guards between users, now have increased functions to prevent virus transmission.

The partitions worked on in this study have modules that can be used on all working desks in general. Construction and materials are used in such a way that it can match the size and arrangement of the existing desks. The next development that is added is the use of anti-microbial coatings which are generally used in the health sector such as medical devices or elements in hospitals. Simple construction on a sliding system partition with floor-standing posts that can also be adjusted to the height of the workbench. The material used for the frame is aluminium because it is light and easy to manufacture. Partitions use Polycarbonate because it has a good level of clarity and strength, is easy to shape, and has many color choices. For the selected antimicrobial coating is copper. Copper is the cheapest antimicrobial material compared to other materials. Its application is sprayed in the form of a nano-liquid such as paint so that it covers the entire surface of the field. Thus, this anti-microbial nano layer will paralyze all bacteria or viruses that stick to or fall on this layer.

With this research, it is hoped that the office furniture and accessories can be one of the chain breakers to the virus transmission, so that the office can be a safe place to work for everyone.

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