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Importance of Understanding the Purposes of Manufacturing of Masks and Its Engineering Implications during the Coronavirus Pandemic

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Abstract

Coronavirus pandemic is one of the most crucial problems in recent decades. Many states have adopted a set of measures to prevent the spread out of the coronavirus. At the forefront of them are the preventive measures for the personal protection. Besides, the obligation to wear masks continuously outside the home, during the gatherings. The questions arose from the importance of understanding the purposes of the use of masks, their manufacturing repercussions during the pandemic. In this research, I tried to answer these questions and others through the use of a survey. Which dedicated to knowing the aspects of masks, the order of their priorities, in addition to the most significant specifications people require. The results of the survey were used with the House of Quality to come out with the manufacturing priority for specifications that enable manufacturers to use and direct their manufacturing resources. The results of this research show that (89%) of the respondents emphasize on the importance of the comfortableness feature of the use of the mask. (75%) of the respondents confirmed that they have confidence more in the masks that are approved by the local authorities as an advantage in the masks that they want to buy. The face tightness specifications have obtained the highest specification ratio (24.8%).

While the mask material ratio reached (24.3%) as a preferred option for respondents in masks during the Coronavirus pandemic. Therefore, this paper sheds light on the importance of understanding the manufacturing purposes of masks, and their engineering effects.

Keywords: Mask, N95 respirator, House of Quality, Quality Function Deployment, COVID-19

Introduction

The COVID-19 epidemic began in the city of Wuhan in Hubei Province, China [1]. Since then, this virus has spread and continues to be strongly infested all over the world. For the third time in as many decades, zoonotic coronavirus has crossed species to infect human populations [2]. Its great spread out, which has caused great effects on the level of individuals and societies in general. This virus infected a large group of people and caused fear and panic all over the world. The current COVID-19 outbreak, indicating that new pathogen variants emerged from coronaviruses related to a very diverse variety of severe acute respiratory syndromes. They are originating from bats through high genetic recombination ability and close coexistence [3]. Which increased efforts to prevent this virus in various ways. This virus also caused many different health problems that appear day after day through ongoing research in this area, and through the announcement of the World Health Organization from time to time, the crisis now unfolding could also become a historic opportunity to strengthen the WHO. Reforms must start with recognizing the global public good achieved by the WHO [4]. On the other hand, this virus has caused many economic problems as a result of the great losses suffered by the economies of countries.These problems have compounded by the long quarantine imposed on most of the countries worldwide, which caused the cessation of business. Countries have tried to deal with this virus through their best practical experiences during the past months. They are taking preventive measures to control the disease and working closely with health experts to contain it.

As research continues on the disease, countries advise to not panic and not pay heed to rumors about the virus [5]. One of these measures, the use of masks continuously when people leaving the house, and this is what leads us to the subject of this research. Although there are millions of viruses, only a few have identified to date. As a result, these viruses cause many diseases such as the transmitted diseases through breathing, such as influenza, SARS, polio, measles, watery root. The new COVID-19 has widespread human to the human risk of transmission. The first 41 cases infected with coronavirus have studied for its features. The non-specific clinical features of COVID-19 include dry cough, fever, and malaise. Upper respiratory tract symptoms are infrequent [6]. This virus is contagious among humans, there is no vaccine available yet at the time of publication of this research in June 2020, while there are many attempts to produce and adopt a vaccine. COVID-19 virus prevention methods differ in types, as washing hands with soap can kill viruses, covering the nose and mouth when coughing or sneezing prevents the virus from spreading. As well, not touching the surfaces expected to exist in the virus, reduces the chances of transmission of the virus to the body. The approach of people with cough or fever can cause spray containing the virus to transmit to a healthy human body. Therefore it is preferable to maintain an appropriate distance to prevent the transmission of COVID-19 infection. One way to stop COVID-19 virus transmission, for example, the way of work such as many duties assigned to direct team members and guides them on their roles and infection prevention measures. A core group of doctors, who are familiar with the isolation processes, serve as coordinators. In the initial phase, the emphasis was on identifying and isolating imported cases [7]. As there is no effective vaccine and treatment against COVID-19, the preventive measures at the workplace should include personal preventive measures (wearing a face mask, hand hygiene, other personal precaution) and organizational measures (Good ventilation, social distancing at work, COVID-19 testing for workers if adequate resources) [8]. Organizational measures include cleaning with soap or detergent and water to remove germs, dirt, and impurities from surfaces or things. For the sake of reducing their numbers and the risk of infection, while noting that it does not kill germs.

Disinfection also kills germs that are usually found on surfaces or things, using chemicals. This process may not necessarily lead to cleaning dirty surfaces or removing germs. Sterilization reduces the number of germs on surfaces or objects to a safe level, and this process reduces the risk of the infection spreading. Cleaning and disinfection of surfaces and things that are touched a lot is necessary, in educational institutions, for example, must follow the standard procedures for cleaning and routine disinfection, which usually means a sterilization of surfaces and things that are touched daily, such as offices, work surfaces, doors, computer keyboard, laboratories, and toilets. Also, the immediate cleaning of dirty surfaces and objects is required if they are contaminated with body fluids or blood, using gloves and other standard precautions to avoid contact with the liquid. For daily cleaning operations, the influenza virus usually can live and potentially infect a person for up to 48 hours after settling on surfaces, but influenza viruses are relatively fragile, so standard cleaning and disinfection practices are sufficient to remove or kill them. Special cleaning and disinfection operations are not always recommended, including wiping walls and ceilings, and the use of air deodorants, as these operations, can irritate the airways, throat, and skin and cause serious side effects. Also, following safety guidelines on cleaning products and disinfectants is one of the important procedures in cleaning and sterilization operations, such as washing surfaces with a household cleaner to remove germs, or rinsing with water. Disinfection requires that the cleaning product remains on the surface for a certain period, for 3 to 5 minutes. Sterilization wipes are used on electronic items that are frequently touched. On the other side, strict quarantine measures are important in stopping the transmission of COVID-19 for example, in China even for people who have not contracted COVID-19 [8]. Concerning the dealing with waste, the supply chains and logistics under pandemic conditions have to meet the increasing demand for resources like throat and nasopharyngeal swap testing kits to conduct the corona test, personal protective equipment (PPE) and disinfectants. Most of these items are disposable and eventually find their way to the medical waste stream that should be dealt with as a medical waste which should be managed properly to mitigate the infection risks [9].

Some measures advice to avoid touching used tissues and other waste when emptying the wastebaskets. Washing hands with soap and water after emptying the wastebaskets. Full suit for workers in the medical field likely to have access to viruses is necessary. This type of dress contains a long-sleeved shirt, an eye protector, gloves, and a medical mask. In addition to patients who have to wear a medical mask while they are in contact with workers in the medical fields. Powered air-purifying respirators (PAPRs), reusable elastomeric respirators, and filtering face piece respirators represent different methods of filtering out aerosols in the air. A PAPR, which costs about USD 1400, contains a battery-powered high-efficiency particulate air filter that delivers clean air into a hood or a full-face mask and blows off exhaled air. The hood is either hard or tight-fitting or loose [10]. The face protector, which is used for protection, is ideal for protection from infection by spitting and to protect the mucous membranes only from the virus-carrying viruses that collide with the walls of the cap, but the presence of a space between the mouth and the wall of the face protector may cause virus infection to others. Reusable elastomeric respirators, which typically cost <USD 100, are used more commonly in the heavy industry than health care. Such devices are defined by the ability to filter out oil or non-oil particulate. They may either cover the lower half of the face and require additional eye protection or cover the entire face [10]. Masks help to reduce the spread of viruses when coughing or sneezing, small drops may be released into the air. It may cause infection in those around them or the adhesion of viruses on surfaces and walls or suspend in the air for a relatively short period, thus wearing masks could ensure that no infection is transmitted from person to person. Infection preventive and control (IPC) - WHO measures that may reduce the risk of exposure include use of face masks covering coughs and sneezes with a flexed elbow, regular handwashing with soap or disinfection with hand sanitizer containing at least 70% alcohol, maintaining a distance of 1.5 to 2 meters; and refraining from touching eyes, nose, and mouth with hands [11].

Background

Prevention is the current strategy to limit the spread of cases. Isolation of patients for control of disease is necessary. For diagnosis and clinical care doctors and nurses should wear Personal Protective Equipment (PPE) which includes face protection, goggles and mask or face shield, gloves, gown or coverall, head cover, rubber boots. WHO has declared some basic recommendations that must be followed as preventive measures [12]. The mask is a device to protect the respiratory system or to prevent the transmission of droplets full of viruses through the respiratory system from one person to another. They differ in types and shapes, including industrial, medical, and others. The masks must ensure that the normal breathing process is sufficiently performed. Thus, the masks should work to balance the filtration and breathability. Medical or surgical masks are flat or folded masks that connect with the ears using a rope to fix them and increase the effectiveness of the non-transfer of harmful substances to the respiratory parts. The surgical masks are based on filtering drops greater than three micrometers. These masks designed to protect wearers from microorganisms' transmission and fit loosely to the user's face. Although surgical masks cannot prevent inhalation of small airborne particles but can protect users from large droplets and sprays [13]. It is only recommended for patients to reduce the spread of infection, or to people who are directly in close contact with people with the virus, this masks must be changed every four hours or after it gets wet. Another type of surgical masks, which is characterized by its effectiveness infiltration of droplets. It is intended for health workers who have direct or frequent contact with confirmed cases. The effectiveness of this type does not prefer if it is exceeded four hours. In the case of industrial respirators such as N95, they used to prevent users from inhaling small airborne particles and must fit tightly to the user's face [13]. They filter materials up to a size of (0.075) micrometer, in addition to solid materials that may reach a filtering rate of (95%).

These respirators are tight and non-loose, as there are no spaces between the face and the mask, to allow viruses to penetrate through the nose or mouth. They contain a filter, which helps filter the air from pollutants, viruses, and bacteria, and prevents them from entering the respiratory systems. N95 respirators may play a limited role in low-resource settings, where there are a finite number of N95 respirators, or it may be unaffordable [13]. In the case of the COVID-19 pandemic, fabric masks manufactured with different and various criteria appeared to be used by the public and in public places throughout the day. The National Academies of Sciences reviewed the evidence for the effectiveness of homemade fabric masks in preventing the spread of influenza and severe acute respiratory syndrome coronavirus [14]. Fabric masks are inexpensive, easy to make, and it's easy to find manufacturer instructions. Masks can also be made from easily available materials, such as dense cotton fabrics. The cup type mask had a lower change rate of breathing resistance than the folding mask. Furthermore, the cotton mask had a lower change rate of breathing resistance than the nonwoven fabric mask [14]. The masks alone are not sufficient to protect against infection. Rather, it should be used in conjunction with the measures of social distance, personal hygiene, and frequent washing of hands. One of the most important specifications of masks is that it passes a filtering test for the masks layers and their shape, which should not allow the entry of solids and liquids particles. The tensile strength of the bands, the maximum accumulation of carbon dioxide inside the masks are also tested to ensure a balance between filtration and respiration. The direct surgical mask has a low/moderate filter performance with lower levels of airflow resistance, while the high heat and humidity can cause moisture to condense on the outer surface, which consequently impairs respiratory heat loss and imposes an increased heat burden. The factors that reduce the discomfort of heat on the face are nasal breathing [15]. Medical masks are approved by conforming to the requirements of some international standards such as (ASTM F2100) or (EN 14683), in tests like for bacterial filtration efficiency, sub-micron particulate filtration efficiency, resistance to penetration by synthetic blood, differential pressure, and flammability.

In the United State, five elements are tested to standardize their quality: fluid resistance to synthetic blood, particulate and bacterial filtration efficiency, breathing resistance (pressure drop), flammability, and biocompatibility. Most surgical masks are composed of three layers: an outer fluid-repelling layer, a middle layer serving as a high filter, and an inner moisture-absorbing layer. Surgical masks without this three-layer feature cannot provide adequate protection [16]. The N95 respirator has undergone tests like fluid resistance, viral and bacterial filtration efficiency, ventilation, respiration, and biocompatibility. This mask has the highest percentage of filtration compared to other types of masks. It does filter at least 95% of the airborne particles but is not oil resistant. While the cloth mask, have many types of fabrics that come in its manufacture. The best of these fabrics are cotton but within special specifications. Such as making them from two layers of thick cotton with several threads of not less than 180 threads, in addition to materials such as fine wool, rubber bands are also used in the manufacture of other respirators. One of the biggest challenges in manufacturing masks in the current period is the great leap in demand for masks under the COVID-19 pandemic, to the extent that local production in some countries is unable to meet the demand, so import was resorted to in some countries. High demand for traditionally manufactured devices, challenged by global demand and limited production, has resulted in a call for additively manufactured (3D printed) equipment to fill the gap between traditional manufacturing cycles [18]. The manufacture of masks is linked to the production of medical equipment, especially masks in general. The lack of raw materials to manufacture masks in some countries, such as fine wool and rubber bands from local factories, weakens their ability to the manufacturing of masks. This type of rapid, crowd-sourced, design, and production resulted in new challenges for regulation, liability, and distribution [17].

Research Objectives

This study aims to understand the purposes of using masks in the light of the COVID-19 pandemic crisis and the need for certain types of masks to be used more than the available masks/ respirators for use in specific situations such as industrial or medical respirators. It also aims to provide a framework to understand the changing requirements and interventions of manufacturing masks and to disclose the manufacturing/ engineering requirements arising under the pandemic of COVID-19 to come out with emerging industrial/ engineering inputs to manufacture masks of continuous daily use.

Research Methods and Materials

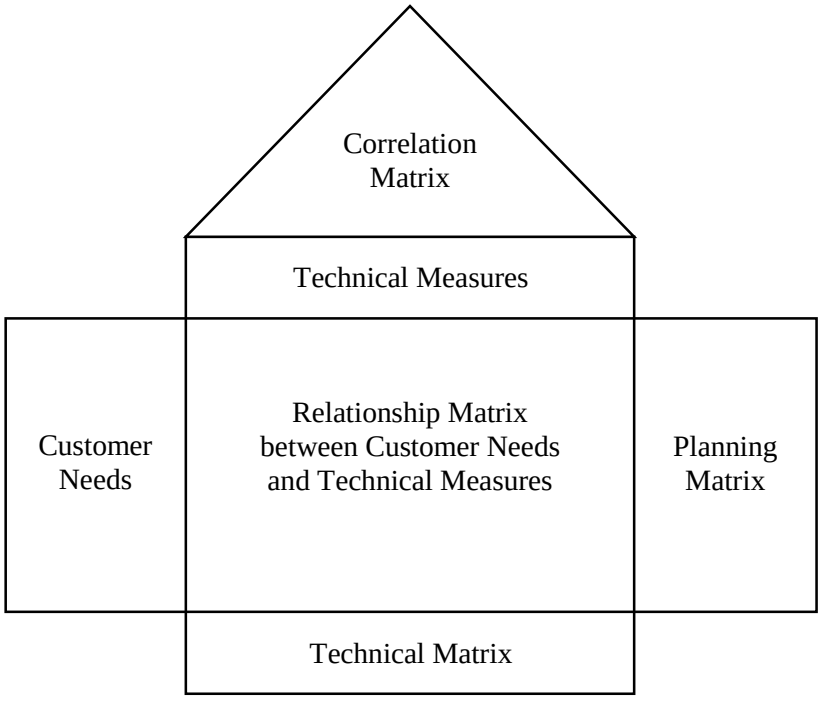
The work in this research starts to answer the research questions about the difference between the manufacturing purposes of the available masks. As well, the purpose of using masks, and the reasons for the unavailability of the exact needs. Such as COVID-19 virus prevention. A survey has designed to identify the elements that motivate people to choose the type of masks and understand how people respond to these questions. The first part was devoted to knowing the nature of the included sample, including sex, age, and country, due to the different health measures in each country and their difference in general. The second part was devoted to the knowledge of the respondent's understanding of the nature of the COVID-19 pandemic, how to deal with it and adherence to health measures and requirements, ...etc, through three questions devoted to the spread of the virus and the importance of masks to limit this spreading. Then, I moved on to inquire about how respondents dealt with the masks they use to protect themselves and reduce infection with the COVID-19 virus. In the next part, the questions have asked about the advantages of the masks they wish to acquire and their evaluation of these features by choosing only three of the total features offered to them, such as comfort in clothing, price, multiple-use, and international brands. In the last part, they have asked to evaluate the importance of specifications, such as the quality approved mask, the strength of filtering,

layers in the mask, face tightness when wearing, the material of the mask itself, the pore openings in the masks and weight of the mas. The options varied between answering "Yes" or "No" and "I don't know" in some questions and multiple choice of last questions such as choosing three of the total options to disclose the importance of the item in question. Moreover, by necessity at the end of the survey, the open question was developed. For the sake of knowing the opinions regarding the research topic and other concerns. The electronic survey has distributed among 14 cities in Saudi Arabia and Sudan, according to the quarantine imposed at the time.

Quality Function Deployment (QFD) was used as a tool to link features with industrial specifications as it is also called matrix product planning, decision matrices, and customer-driven engineering. QFD has rarely been applied to innovative wearable technology, even though it is a useful tool for converting consumers' needs into technical characteristics. QFD is utilized worldwide as a handy method to improve the quality of products in a systematic process [18]. These are processes to define customer requirements and convert them into engineering specifications for products. The need for QFD to communicate effectively with customers to enhance the success of the companies' productions and to make the company divisions work together such as design, quality, manufacture, production, marketing, and sales to produce the customer perceived value. The most important benefits of QFD are focus on customers by converting customer needs into technical specifications, analysis of competing products for the same product, reduce development time and reduce costs by focusing on product features in addition to documentation and construction. The QFD is comprised of four sets of matrices. The first matrix House of Quality (HoQ) translate (i) customers' requirements into technical requirements, (ii) technical requirements into parts 'characteristics, (iii) these characteristics into key process operations and (iv) key process operation into production requirements, according to the four steps of the QFD approach [19]. In this paper, I will limit the research to the first part of the QFD, as it summarizes in the House of Quality.

HoQ is one of the tools of quality function deployment (QFD) that allows us to analyze various aspects related to the needs of customers, the voice of customers, and the technical characteristics (voice of engineers) of a product or service [19]. HoQ is used both as a stand-alone tool and as an integrated tool in the larger design processes [20].

Figure (1): House of Quality



As it appears in the figure (1), the left side of the HoQ figure appears realistic insights from customers' expectations and needs regarding masks, with the aim of identifying all the features of the masks and the main design features with a view to assessing them from the targeted group. The main features have been chosen based on the main features on the market, such as Surgical Mask and N95 Respirator. There is a planning matrix on the right side which aims to prioritize design features and compare similar masks for the same proposed product. In the upper part, Technical Measures which are known as "HOWs", the main specifications are involved in the production of the mask, meaning how to manufacture the mask. To understand the relationship between mask features and mask specifications, the middle section relationship matrix between customer needs and technical measures was used. The triangle at the top of the quality house shows the matrix of technical connection between all specifications of the mask industries, and represents the link between the individual technical specifications and sometimes expresses the extent of cooperation between different departments of the mask production, meaning that, the strong relationship necessitates the departments to work closely. Finally, the technical matrix uses the lowest HoQ figure to arrange the technical characteristics of the masks according to the need to improve quality. The merger of correlations between "WHATs" and "HOWs" and a list of design features priorities the technical matrix based on customer desire derived from the associated survey.

At the bottom of the House of Quality figure, importance weighting is calculated using the customer's evaluation of importance by respondents, while assessing the correlation between features and specifications by using the following equation:

$$\text{Importance Weighting} = \sum_{i=0}^{n}(Importance\ by\ Respondents\ X\ Specification\ Ranked\ Value) \text{ -- (1)}$$

To calculate the relative importance weighting below the house of quality, I have used the value of importance weighting for each specification. The sum of these values was calculated to extract the ratio of each specification through the following equation:

$$\text{Relative Importance weighting} = \frac{Importance\ Weighting\ X\ 100}{\sum \text{Importance Weightings}} \quad \text{--- (2)}$$

These results of calculating the total of the sums of each column when it multiplied by the importance weighting are useful for ranking each of the specifications. Specifically, for determining where we need to allocate the majority of the resources to produce the masks. A comparison of a surgical mask and N95 respirator is made for six features. Those were selected and evaluated by respondents in the survey in a separate table, to clarify the difference between the two types and the purposes of each one of them.

Results

The sample of size represents a total of (61) respondents to the survey, as it appears in Table (1). The percentage of respondents varied between (79%) for males and (21%) for females. The ages of the respondents were divided into three categories: more than (40 years), (20-40 years), and less than (20 years) at rates (18%, 80%, 2%), respectively. The geographical distribution of the surveyed represents cities, were in two countries, Saudi Arabia and Sudan, with rates of (30% and 70%), respectively.

Table (1): Profile of the Survey Respondents

Profile of the Respondents	Type	Number	Percentage
Gender	Male	48	79%
	Female	13	21%
Age	More than 40 years	11	18%
	Between 40 and 20 years	49	80%

	Less than 20 years	1	2%
Country	Saudi Arabia	18	30%
	Sudan	43	70%

In Table (2), the results of understanding the survey questions allocated to realizing what was occurring about the COVID-19 pandemic. Questions were like the method of spreading, were (59%) of the sample confirmed that the COVID-19 virus spread through breathing, as was prevalent among the public at the beginning of this epidemic, compared to (26 %) that does not know the method of spreading the disease. That (80%) of the respondents confirmed that the masks limit the transmission of the COVID-19 virus. Only (38%) affirmed that they used the mask, compared to (56%) who did not use the mask because it was not available at the beginning of the crisis. Concerning prior knowledge of types of masks and their specifications, (43%) of respondents confirmed that they had prior knowledge of types and specifications of masks, compared to (26%) who had no idea of the types and specifications of masks. Certainly, (69%) of the respondents heard advice and tips regarding the use of appropriate masks/ respirators, compared to (23%) who did not hear any advice. (43%) of the respondents confirmed that they acted themselves and purchased a mask to protect themselves from the COVID-19 virus.

Table (2): Understanding the relation of corona pandemic and the masks

Survey Questions	Percentage		
	Yes	No	NA
1.Coronavirus is spread by breathing	59%	15%	26%
2.The use of masks limits the spread of the virus	80%	2%	18%
3.I have used masks to prevent coronavirus	38%	7%	56%
4.I have prior knowledge of types and specifications of masks	43%	26%	31%
5.I heard tips for using the appropriate masks	69%	23%	8%
6.I acted individually to use masks to reduce risks	43%	52%	5%

To find out the left part of the HoQ, which is "Customer Needs", the results of the evaluation of features were as shown in Table (3). Which clarifies a list of the advantages of the masks based on the interests of the customers. They evaluated each feature and select the importance to appear as a percentage of choosing from the total of the participating sample. Meaning that (89%) of the sample participating in the survey confirmed that the comfort in using the mask is very important compared to other features in the survey. While (77%) of them emphasized the importance of the price of the mask. (56%) of them stressed the importance of using it more than once. Among the rest of the characteristics of the mask, the importance of fame of the brands has evaluated by (18%) only.

Table (3): Importance of the Features of the Masks

What are the features that are important to you in the mask?	Percentage
Comfort when using	89%
The suitable price	77%
The possibility of use more than once	56%
Global brand	18%

To find out the highest part of the HoQ. The importance of specification is evaluated by respondents. The result was as shown in Table (4). The respondents preferred purchasing approved mask from the specialized authorities at a rate of (75%), which reflects the importance of the masks reliability. While (56%) of them emphasized the importance of the strength of filtering and layers in the masks. In contrast to the weight of the mask, whose importance was evaluated by only (10%). (51%) of the respondents stressed the importance of tightening masks in the face. Compared to an importance rate of (30%) for the material of the mask itself. Finally, respondents evaluated the importance of the pore scale in the mask at a rate of (25%).

Table (4): Importance of the Specifications of the Masks

What specifications is important to you in the mask?	Percentage
Approved mask from the specialized authorities of quality	75%
The strength of filtering and layers in the mask	56%
Face tightness when wearing	51%
The material of the mask itself	30%
The pore opening in the masks	25%
Weight of the mask	10%

In Table (5), the specifications of the masks were linked and classified based on the customers' classification with the features that customers require and put it in importance so that it shows you a distinctive evaluation of the corresponding specification. Here, the correlation of specifications with each other shows whether these relationships are strong or weak. This is according to the Body Ranking System; when the relationship is strong, the evaluation is made with (9) scale. when it is average, it evaluates with (3) scale, when it is weak, it evaluates (1) scale, and when there is no relationship, the rating is (0) scale. According to the explained method and the equation for calculating relative importance weighting equation no. 1 and 2. Face tightness got the highest percentage (28.4%) Followed by (24.3%) for the Mask material compared to the strength of filtering which got (18.2%) followed by (16.4%) for Authorities Approve. As the lowest percentage acquired by the Mask Weight, which shows the importance of directing the available resources to meet the required specifications from the clients and their emphasis.

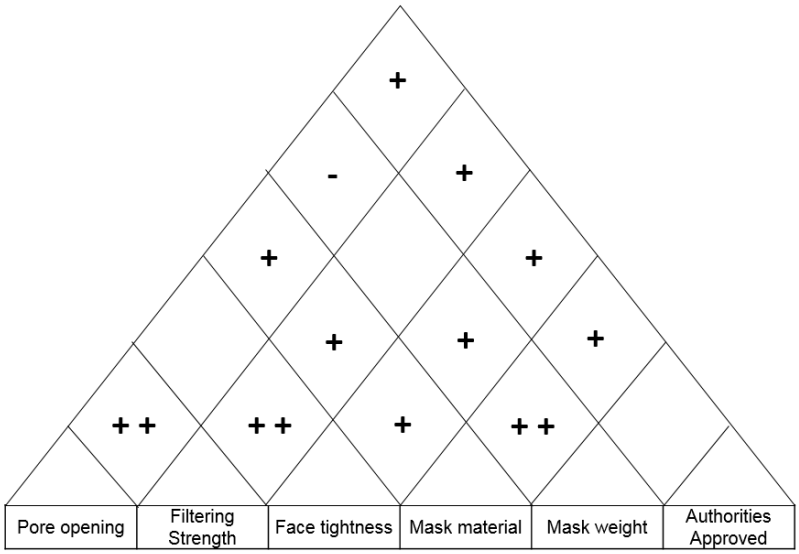
Table (5): Relationship Matrix between Customer Needs and Technical Measures

Specifications of the Masks / Features of the Masks	Importance by Respondents	Pore opening	Strength of filtering	Face tightness	Mask material	Mask weight	Authorities Approve
Comfort when using	9	0	1	9	3	1	0
The suitable price	8	1	3	0	3	0	3
The possibility of use more than once	6	3	3	0	3	0	3
Global brand	2	0	1	1	1	1	3
Importance Weighting	-	26	53	83	71	11	48
Relative Importance weighting	-	8.9%	18.2 %	28.4 %	24.3 %	3.8%	16.4 %

The Figure (2) Correlation Matrix - Roofing ranking system, it shows the strong positive relationship between the characteristics as (++), the positive relationship with (+) and the negative relationship with (-) and the strong negative relationship with (-), when there is no relationship, there is no sign. The strong relationship between Pore opening and Strength of filtering appears in figure (2). There is a strong relationship between the Strength of filtering and Face tightness. There is also a strong relationship between the Mask material and Mask weight.

The only negative relationship that appears between the weight of the masks and the openings, when the pore opening increased, the weight of the masks decreased.

Figure (2): Correlation Matrix including the Roofing Ranking System



Within the framework of the last part, which is the base of the HoQ "Technical Matrix", the result of the comparison was that the N95 Respirator excels in most features of the masks such as pore opening and its purpose, the strength of filtering and face tightness. While the Surgical Mask excels in some features like Mask weight. Moving to the approval of the mask by the authorities, the masks were approved by different bodies. The N95 respirator was approved by The National Institute for Occupational Safety and Health (NIOSH) unlike the Surgical Mask, which was approved by the Food and Drug Administration (FDA). Taking into account the goal of using the mask and respirator.

Table (6): Partial Technical Matrix

Specification	Surgical Mask	N95 Respirator
Pore opening	Fluid resistant and provides the wearer protection against large droplets, splashes, or	Reduces wearer's exposure to particles including small particle

	sprays of bodily or other hazardous fluids. Protects the patient from the wearer's respiratory emissions.	aerosols and large droplets (only non-oil aerosols).
Strength of filtering	Does NOT provide the wearer with a reliable level of protection from inhaling smaller airborne particles and is not considered respiratory protection	Filters out at least 95% of airborne particles including large and small particles
Face tightness	Loose-fitting	Tight-fitting
Mask material	Non-Woven, Without Elastic	Non-woven fabric
Mask weight	5 grams	100 grams
Authorities Approve	Cleared by the U.S. (FDA)	Evaluated, tested, and approved by(NIOSH)

Discussion

In the context of this study and affirming the importance of masks to limit the spread of COVID-19 virus. (80%) of the respondents confirmed that the use of a mask restricts the spread of the COVID-19 virus. Despite updating reports regarding the use of masks, especially from the World Health Organization [21]. Confirming the need for these types of research on masks, (57%) of the respondents confirmed that they do not know the types of mask and their characteristics. This is what I have gone through in the research to not offering masks for evaluation by the respondents. As confirming their question in the survey about the features and specifications of masks they need to protect themselves against the COVID-19 virus. The most important feature of the masks was the comfort when using a mask which appears as (89%) of the total respondents. Face mask comfort is key to public compliance with infection control measures [22].

Although, there are different masks display in the market they used for different purposes not related to daily use for the public for the prevention of Coronavirus. People feel using a face mask is uncomfortably humid and inconvenient for inhalation [22]. As an example of that, the masks which used to protect from chemical fumes because it is not comfortable to use daily. To enhance the comfort feature in the use of the masks, it constituted (24.8%) as a ratio relative importance weighting for the face tightness specification, as the greater the adhesion to the face, the more comfortable the use of the masks and the lower the virus's ability to respiratory passages. While mask material got (24.3%) as a specification of the mask, which interferes with the comfort feature when using the mask. Within the ambiguity and fear of infection with the COVID-19 virus. The approval of the quality of the mask from the local authorities was a factor of confidence among the respondents. As (75%) of the respondents select it as the standard required for them to ensure the reliability of the approved mask. Because the virus did not leak through the filter, the filtering strength also constituted an estimated percentage for the preference for the filter strength specification of the mask, as it reached (56%) of the total respondents. While both surgical masks and N95 respirators are worn for self-protection, they have different intended uses. Surgical masks do not prevent inhalation of small airborne particles and fit the face loosely while N95 respirators can do so by fitting tightly to the wearer's face and fulfill strict filtration requirements [23]. As the masks specifications are related to each other. The approval of the quality of the mask is correlated with some specifications required by respondents. Such as the strength of the filtration, the tightness of the mask. This varies depending on the filtration capability, meaning that an N95 respirator filters at least 95% of airborne particles. Despite this difference, both the surgical mask and the N95 respirator are tested for fluid resistance, filtration efficiency, flammability, and biocompatibility under the NIOSH and FDA regulations [24]. This type of mask for protection with the presence of other downsides of this type in daily use such as suffocation and the difficulty of wearing it on an ongoing basis to limit the spread of the COVID-19 virus and its sensitivity to the oil.

During the COVID-19's pandemic crisis at the time of the implementation of this research, the vision was not clear regarding how the virus spread, when the world knew about the coronavirus a mass movement started, and governments and related organization incorporate to control the spreading of this virus. Strategies such as quarantine the infected cities and separating infected peoples from others can reduce the velocity of spreading a virus. Tell that moment, and to capture the spreading network of disease, each individual is considered as a node in the network and the people who are in contact with each other, a link will connect them in the network [25], and this is what justifies (26%) of the respondents answered not knowing how the disease spread. Moreover, (63%) of the respondents were unable to obtain masks, as the comments confirm in answering the open question at the end of the s. Note that approximately (80%) of the respondents were male and between the ages of twenty to forty years. The global brands of masks did not constitute a great concern for the respondents due to their lack of availability in a way that attracts respondents to evaluate the experience of some of them, as it achieved (18%) only as an important feature of the total respondents. The mask weight specification did not attract respondents, as only 10% of respondents voted for this specification, despite its importance and correlation with other specifications, such as mask material, openings, and other specifications. For the lack of respirators, whether medical or N95, with the onset of the outbreak of COVID-19 disease between March and April 2020, customer evaluation of medical masks and N95 respirator with the QFD parts were discussed in another research.

Conclusion

The study focused on the importance of listening to the customer's voice to meet his needs for advanced products according to the emerging conditions and crises. It also provided a summary of understanding the purposes of using masks in light of the COVID-19 pandemic crisis and the need for certain types of masks that are used for long periods of time during the day and according to the measures followed by some countries.

It also provided a brief comparison of some types of masks that people resorted to and adapted to because there are no suitable alternatives dedicated to increasing virus protection and used throughout the day. The study also attempted to provide a framework to understand the changing requirements, interventions for manufacturing respirators, and to reveal requirements arising under the pandemic of COVID-19. On April 3, 2020, the Center for Disease Control (CDC) in the United State issued an advisory that the general public has to wear cloth face-masks when outside, particularly those residing in areas with significant Severe Acute Respiratory Syndrome Coronavirus community transmission [26]. With the use of medical, industrial and cloth masks and the unavailability of the masks, this remains the current temporary solution to reduce the possibilities of virus transmission between people, and to meet the implementation of measures by some health countries that require individuals to wear masks of any kind and shape. But the individual options remain in protecting himself by choosing the best available mask, according to his desire, from the features available in the masks. All these in light of updated talk about the use of masks to reduce the risk of infection from COVID-19, which issued by the World Health Organization. However, it appeared clear that some positive results for the society of wearing masks, due to the decrease in cases of infection. Moreover, a small number of positive results of SARS-CoV-2 in some recovered patients have been reported [27]. In conclusion, the challenges of manufacturing and production of masks and the requirements of countries regarding their quality, especially in light of this pandemic, remain the biggest problem to meet the high demand for masks in most countries of the world. Assuming that two-thirds of the people in China must wear a mask every day, the daily demand for masks will reach 900 million. However, masks must be changed every day, which will create a substantial demand for masks in China. Masks are currently in short supply, especially in hospitals, and it is therefore difficult for the public to buy masks at drugstores [28]. With the continued ambiguity about the future of the development of COVID-19 virus and its spread among countries and the effects resulting from it and the measures that may be taken

which necessitates the great need for more detailed and varied studies in the manufacture of masks or other protective equipment to prevent the spreading of COVID-19 virus.

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