An integrated waterfall–DEMATEL–fuzzy TOPSIS approach to post-COVID-19 customer demand resilience: Evidence from fast-fashion MSMEs

Abstract

Purpose: The purpose of this paper is to analyze the resilience of customer demand management post-COVID-19, using fast-fashion MSMEs as an example. Precisely, this paper investigates how waterfall project management can enable stakeholders to build survival operations managerial decisions.

Design/methodology/approach: Based on interviews and surveys with ten fast-fashion operations experts, and an integrated waterfall DEMATEL Fuzzy TOPSIS methodology of the fuzzy multi-criteria decision making (FMCDM), we explored and prioritized the enablers of resilience management in fast-fashion retail area.

Findings: Results reveal that the highest priority enabler is maintaining customer loyalty. Other enablers are associated with e-commerce endorsement, customer-focused assortment, and flexible store operations.

Research /implications: The findings of this paper will enable fast-fashion MSMEs to develop effective actions and prioritize the operations efforts to foster the post-pandemic recovery.

Originality/value: Despite the importance of the resilience project and the changing fast-fashion customer patterns with covid, only a handful of research has explored how resilience can be managed in this field. This research thus can help close this gap for operations resilience research and retail context

Key words: COVID-19, customer demand resilience, waterfall, project management, fuzzy TOPSIS, fast-fashion MSMEs,

1. Introduction

Amid COVID-19, retail operations have experienced a challenging period. Unexpected disruptions have led to the shutdown of several factories and businesses, which created a recession in commerce and industry sectors (Donthu and Gustafsson, 2020) and a significant bullwhip effect (Zighan, 2021). Around 75% of companies have faced disruption in their supply chains within the US (Fernandes, 2020). In China, retail sales and industrial output fell by 20% and 13.5%, respectively (Fernandes, 2020). In addition to the economic aspect, the pandemic had a social impact on several lifestyle features (Abu-Rayash and Dincer, 2020). Further, a study conducted on a sample of 30 countries showed that the gross domestic product (GDP) decreased by a 2.8% median and the pandemic costs decreased from 2.5% to 3% of the global GDP for every additional outbreak month (Fernandes, 2020). This has impacted brand investments and consumer expenditure (Belhadi *et al*., 2021, Kumar and Managi, 2020), leading to a global outbreak.

Post-COVID-19 resilience is an important topic for research because of the critical impact of the pandemic on consumer behaviour and purchase patterns (Remko, 2020). This topic needs to be addressed analytically, while considering scientific qualitative and quantitative approaches. Therefore, it is necessary to conceptualise operational policies to foster an understanding of customer demand resilience. Understanding the volatile COVID-19 environment and customer demand patterns can help retailers manage crises, mainly in rapidly changing markets like fast-fashion.

Fast-fashion MSMEs is chosen as a case study because of the quick responsiveness of the market and its continuous adaptation during the COVID-19 lockdown, through its adoption of intensive online channels. This has emerged as customer expenditure and demand-altered patterns, which have affected fast-fashion retail brand sales such as Zara (Shabir and AlBishri, 2021). Other retail fields are beyond the scope of this study, as the operations resilience pattern differs among consumption goods. We assess the resilience aspects based on the associated literature through five axes: elasticity, amplitude, hysteresis, malleability, and damping (Ponomarov and Holcomb,2009). Furthermore, by relying on existing studies on waterfall project management (Thesing *et al*., 2021), we analyse the resilience of managing customer-based fast-fashion operations according to this project management methodology.

The main advantage of using the waterfall model in demand elasticity management is its step-by-step approach for analysis. In fact, customer demand elasticity during the pandemic has been changing, depending on several factors, such as lockdown policies and product availability with interrupted flow. Operations retailers must make rapid and proactive decisions to adapt to these uncertainties. The five phases of the waterfall model are sequentially dependent on each other. This means that each step depends on the previous step. The maintenance phase presents the steps to control the actions and strategies taken after verification. They are tested and verified after implementation and execution. Before operation, the actions and strategies under study are designed based on the requirements analysis that must be implemented. Among the multiple-criteria decision-making (MCDM) methods, the decision-making trial and evaluation laboratory (DEMATEL) is suitable because it helps assess the impact and influence of the alternatives through comparison, by assessing the cause–effect relationships between them. Hence, we use it for the cause–effect analysis between the waterfall phases. However, the input data of the assessments are obtained from experts. As the judgement of a group may be vague, and to ensure a robust decision system, we combine it with the fuzzy technique for order of preference by similarity to ideal solution (TOPSIS), to rank the resilience factors.

Recent studies show the importance of resilience during the post-COVID-19 period on supply chain management (Ivanov, 2020, Golan *et al*., 2020, Ivanov and Dolgui, 2020, Remko, 2020). When examining resilience from a project management perspective, most research focuses on how it is an enabler to flexible management. However, few studies focus on the role of project management on resilience (Crawford *et al*., 2013; Karlsen and Berg, 2020) and none focus on this topicpost-COVID-19. The weak management of inception for project management stages causes risky and poor project performance (Belling, 2020). This is the motivation for our study, which suggests that the abovementioned niche is occupied by bridging resilience and project management for customer demand.

Hence, our study aims to investigate the role of the waterfall project management approach in managing customer demands during the post-COVID-19 pandemic, for resilient fast-fashion retail management. Specifically, we outline the following research questions (RQs):

- RQ1: What are the requirements for resilient customer demand management post-COVID-19 for fast-fashion MSMEs? How can we design resilience management enablers and then implement, validate and maintain them after the pandemic?
- RQ2: What are the cause–effect relationships between the waterfall phase and the rank of importance for each of the factors, to manage resilience in fast-fashion MSMEs?
- RQ3: What is the ranking of the founded enablers and how are they useful for fast-fashion retailers during recovery decisions?

This study makes the following contributions:

- We provide practical recommendations on how fast-fashion retailers can manage resilience, following the post-COVID-19 period.
- The present study makes a novel and early effort to address the role of the waterfall model in enhancing post-COVID-19 resilience, thus advancing the literature on project management.

The remainder of the paper is organised as follows: a theoretical background and review of the associated literature are presented in Section 2. The steps of our research methodology are described in Section 3. The case study is outlined in Section 4. The results are presented and discussed in Section 5. Finally, the managerial implications and concluding remarks are presented in Section 6.

2. Theoretical background and literature review

Following the COVI-19 pandemic, global supply and operations network have been facing several challenges, such as questioning global sourcing decisions (Koerber and Schiele 2021),sustainable partners risk for collaborated network organizations (Badulescu *et al*. 2021) and startups sourcing risks (Sreenivasan and Suresh 2021). and due to reduced economic growth, stakeholders are more focused on saving capitals then investing (Donthu and Gustafsson 2020). For retailers, this means working on the operations management processes for retail, rather than seeking new openings. Precisely, a huge gap between demand and supply has been noticed for goods distribution (Kumar *et al*. 2020). Western countries were around two months behind the Chinese outbreak, before the worldwide spread due to globalization and related trades (Fernandes, 2020). As a result, operations management stakeholders are in a severe crisis management stage, deciding on the strategic financial decisions to catch up amidst the pandemic. We trust that pandemic circumstances have impressed different supply chain aspects (Hajiagha *et al*. 2021), stimulating unprecedented research openings, to get new operations apprehension, specifically on resilience management.

Resilience has been defined first in the psychology literature, before being broadly used in several contexts, mainly disaster recovery. This is due to the strength of resilience methods in ecosystems restitution after perturbation (Westman, 1978, Clapham, 1971, Ponomarov and Holcomb 2009). Furthermore, it embraces the inescapable change within the system, and fosters adjustments on new circumstances and modalities (Dovers and Handmer 1992, Ponomarov and Holcomb 2009). From a supply chain perspective, resilience is a pillar in supply chain risk management, recognized by its significant impact on supply vulnerability despite unpredictable volatility (Ponis and Koronis 2012). The need for resilience for the supply chain has emerged a few years ago. Back in September 1999, a destructive earthquake rattled Taiwan, generating a dramatic supply disruption for firms such as IBM, Apple and Dell, hence more focus has been on supply chain post-2001 (Bhamra *et al*. 2011).

Investigating the role of project management on supply chain resilience implicates contemplating project management functions and resilience aspects. Project management has been successfully used for multi-disciplinary sophisticated tasks (Stuckenbruck 1988). The main reason behind this success is the definition of work requirements; resources and most importantly the regulation of divergence from the plan (Munns and Bjeirmi 1996). Therefore, this organization feature has triggered researchers and practitioners to the role of project management in post-disaster restitution (PDR) (Hidayat and Egbu 2010). In this context, if we benchmark post COVID-19 period with post-disasters ones our review has revealed insightful

implications from the existing literature. Zobel *et al*.(2021) have suggested a novel approach to assess the system resilience. The proposed approach evolves a decision-making system which enhances flexibility and consistency. However, this paper is based on the assumption that the system under disruption will recover to the initial state after a period of time, which is not a valid assumption for post-COVID 19 area in operations management. The economic and social recovery patterns are still uncertain, since the witnessed circumstances of this unprecedented outbreak are still varying.

Sospeter *et al*. (2020) contributed to the associated body of knowledge by providing the challenges of project management for PDR. These findings help in disruption recovery; however they lack in process elasticity that we seek in resilience literature. The evaluation of project management and resilience in literature has been mainly influenced by team management and organizational perspectives. Our bibliographical review designated that supply chain perspective is limited in this literature field. Table I conceptualizes a comparative analysis between the associated papers.

[Insert Table I here]

By examining Table I, we can observe that literature on project management has principally focused on prospecting organizational resilience without stressing supply chain functions in-depth, such as customer demand. It has been proven that demand and supply functions overlap, and demand management should be integrated into a customer demand centered supply chain (Jüttner *et al*. 2007). This integration is crucial for an efficient supply chain management (Lloret *et al*. 2009). Thus, our first contribution is to investigate customer demand resilience in a project management framework. The basis for the combination of the waterfall model and resilience aspects is justified by the sequential feature of this approach, in line with the sequential change of customer demand within the pandemic. Since post-pandemic is a risky period, we specifically investigate the role of the waterfall project management approach. In a risky post-pandemic stage, the use of this methodology is proven by the fact that the waterfall project management approach is secure and featured a low-risk tolerance (Belling 2020). It is a plan-driven method, with less need for innovation (Belling 2020), which is adequate for fast-fashion processes adaptation post-pandemic. Thus, our second contribution is to endorse the body of knowledge about the application areas of the waterfall model.

In addition, one most striking difference between our paper and the existing body of knowledge on project management and resilience is our focus on the post-COVID-19 period. In fact, this pandemic is a unique opportunity to get market behaviour changes understanding (Talwar *et al*. 2021). Hence our third contribution is to provide relevant post-pandemic insights on fast-fashion retail. To the best of our knowledge, no prior study has undertaken the role of the waterfall project management approach for customer demand resilience, with a focus on fast fashion MSMEs.

To summarize, the connotation of waterfall project management and customer resilience can be analyzed by depicting the enablers' investigation. To ensure proper customer demand resilience management, the organizational metrics of teams and processes should be controlled. Such application would enable efficient decisions at each operations stakeholder level.

3. Methodology

Figure 1 outlines the methodology used in this paper. The waterfall model, which was first introduced by Walter Royce (Royce 1987) has been widely used for project management (Thesing *et al*. 2021, Chandrachooodan and Radhika 2020). Waterfall methodology enables a goal and plan-oriented project, for clearly early defined goals (Thesing *et al*. 2021). In the next sections we describe the DEMATEL and Fussy-TOPSIS which are combined with Waterfall in the integrated approach used in this paper

[**Insert Figure 1 here**]

3.1 DEMATEL

Being first introduced by the Geneva Research Centre of the Battelle Memorial institute in 1971, DEMATEL is the multi criteria decision making method enables visualizing the causal relationships between different variables in the system (Zaho *et al*. 2021). Its calculations steps are described as follows (Wu *et al*. 2008):

Step 1: Calculating the average matrix of criteria as the direct-relation n*n matrix, where a_{ij} is the degree to which the criterion i affects the criterion j as outlined in equation (1)

$$A = [a_{ij}] \qquad i,j = 1, \ldots, n \tag{1}$$

Step 2: Calculating the normalized relationship matrix D by using equations (2) and (3)

We define k as: $k = \frac{1}{\max\limits_{1 \le i \le n} \sum_{j=1}^{n} a_{ij}}$ (2)

Then $D = k*A$ (3)

Step 3: Calculating the influencing matrix T, by using equation (4) where I is the identity matrix

$$T = [t_{ij}] = D * (I - D)^{-1} \tag{4}$$

Step 4: Calculating causal parameters D and R by using equations (5) and (6)

$$D = [\sum_{j=1}^{n} t_{ij}]_{n*1} \tag{5}$$

$$R = [\sum_{i=1}^{n} t_{ij}]_{n*1} \tag{6}$$

Step 5: Drawing the cause-effect after calculating:

- Prominence: (D+R) which reflects the importance of the criterion
- Relation: (D-R). If positive, the factor belongs to the cause group; if negative, the factor belongs to the effect group

3.2 Fuzzy TOPSIS

TOPSIS method was first introduced by Hwang and Yoon (1981) and later extended by Chen (2000) with triangular fuzzy numbers (Nădăban *et al*. 2016), thus the fuzzy TOPSIS method which has been used in this paper to identify and prioritize the enablers of waterfall project management that can contribute to customer demand resilience management after COVID-19. The choice of this method is justified by the dominant uncertainty about the post-COVID-19

period, which induces decision making uncertainty, hence the use of a fuzzy method. It is combined with TOPSIS for ranking (Samaie *et al*. 2020). Fuzzy TOPSIS has been widely used in FMCDM systems (Ertuğrul *et al*. 2008).Recent applications of TOPSIS for COVID-19 research include Husain *et al*. (2021) for circular economy implementation, Majumder *et al*. (2020) for risk factors of COVID-19 death, Naeem *et al*. (2020) for assessing curing methods from COVID-19 and Albahri *et al*. (2021) for multi-laboratory characteristics analysis. We outline the following steps:

Step 1: Define the decision-making committee formed by K experts
Step 2: Identify the waterfall enablers
Step 3: Weighting the criteria (waterfall phases) and alternatives (enablers) by the experts, with the defined linguistic variables, and aggregate the fuzzy weighting.
We consider a problem with n alternatives A and m decision criteria.

$$i \in (1, \dots, n)\ ; j \in (1, \dots, m)$$

We nominate the fuzzy weights of the kth decision-maker (expert) as:

$\tilde{x}_{ijk} = (a_{ijk}, b_{ijk}, c_{ijk})$ (7)

$\widetilde{w}_{ijk} = (w_{ijk1}, w_{ijk2}, w_{ijk3})$ (8)

While: $\tilde{x}_{ij}$: aggregate fuzzy weighting of each alternative

$\widetilde{w}_j$: Aggregate fuzzy weighting of each criterion

Then: $\tilde{x}_{ij} = (a_{ij}, b_{ij}, c_{ij})$ (9)

Knowing that: $a_{ij} = \min_k \{a_{ijk}\}$ (10)

$b_{ij} = \frac{1}{K} \sum_{k=1}^{K} b_{ijk}$ (11)

$c_{ij} = \max_k \{c_{ijk}\}$ (12)

And: $\widetilde{w}_j = (w_{j1}, w_{j2}, w_{j3})$ (13)

Knowing that: $w_{j1} = \min_k \{w_{jk1}\}$ (14)

$w_{j2} = \frac{1}{K} \sum_{k=1}^{K} w_{jk2}$ (15)

$w_{j3} = \max_k \{w_{jk3}\}$ (16)

Then the decision matrix is defined as: $\widetilde{D} = \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \cdots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \cdots & \tilde{x}_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ \tilde{x}_{m1} & \tilde{x}_{m2} & \cdots & \tilde{x}_{mn} \end{bmatrix}$ (17)

And the weights vector is defined as: $\widetilde{W} = [\widetilde{w}_1, \widetilde{w}_2, \dots, \widetilde{w}_n]$ (18)

Step 4: Normalize the decision matrix $\tilde{R} = \left[\tilde{r}_{ij}\right]_{mxn}$ (19)

Where: $\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*}\right)$ (20)

And: $c_j^* = \max_j c_{ij}$ (21)

Then the weighted normalized decision matrix is: $\tilde{V} = \left[\tilde{v}_{ij}\right]_{mxn}$ (22)

Where: $\tilde{v}_{ij} = \tilde{r}_{ij}\ (.)\ \widetilde{w}_j$ (23)

Step 5: Calculate Fuzzy Positive Ideal Solution (FPIS: A^*) and Fuzzy Negative Ideal Solution (FNIS: A^-)

$A^* = (\tilde{v}_1^*, \tilde{v}_2^*, \dots, \tilde{v}_n^*)$ (24)

$A^- = (\tilde{v}_1^-, \tilde{v}_2^-, \dots, \tilde{v}_n^-)$ (25)

Where: $v_j^* = \max_i v_{ij3}$ (26)

$v_j^- = \min_i v_{ij1}$ (27)

Step 6: calculate the distances of each alternative from FPIS and FNIS:

$d_i^* = \sum_{j=1}^{n} d_v(\tilde{v}_{ij}, \tilde{v}_j^*)$ (28)

$d_i^- = \sum_{j=1}^{n} d_v(\tilde{v}_{ij}, \tilde{v}_j^-)$ (29)

And calculate the closeness coefficient: $CC_i = \frac{d_i^-}{d_i^* + d_i^-}$ (30)

Thus, the ranking of alternatives is founded. It is determined depending on the associated closeness to the ideal solution. The highest CC_i value, the better the alternative A. The alternative with the highest closeness to the ideal solution is the best alternative. We synthesize the equations used for calculations during each step in a flow chart diagram (Figure 2). The equations not cited in this flow chart are used for mathematical definition purposes and not for calculations.

[**Insert Figure 2 here**]

4. Case study

In this study, we focus on the fast-fashion MSMEs. Hence, a committee of ten decision-makers experts in this field were selected and involved in both qualitative and quantitative analysis. The qualitative analysis is associated with the enablers' identifications, while the qualitative part is linked to their ranking. For this purpose, ten experts were involved, including textile buyers, store managers and retail managers. The semantic saturation level was reached (Wilson, 2003). These experts are precisely working in the supply chain and in operations department in fast-fashion brands. Each of them has a minimum of ten years of experience, including at least five years of industrial experience in the fast-fashion field.

First, we identify the main criteria of enablers, as well as the resilience aspects through the literature. In order to manage the customer demand resilience post pandemic, we align the five phases of the waterfall model to the five aspects of resilience (Serhiy *et al*. 2009). We adapt the Components of resilience (Serhiy *et al*. 2009) to the customer demand management (Table II). We restricted this research to one matching only between each waterfall phase and resilience aspects. Hence we formulate the open questions that we asked the experts (Table II). The questions are listed in a structured interview. The list of questions is outlined in Appendix 1.

[**Insert Table II here**]

5. Results and discussions

In this section, we outline the results of this study. First, we describe the enablers identified. Second, we present the ranking of Waterfall phases founded with DEMATEL. Third we depict the ranking of resilience enablers founded with Fuzzy TOPSIS. Each result is supported and validated with relevant literature. Finally, we test the results robustness with sensitivity analysis.

5.1 Resilience enablers

With the support of the literature and experts' opinions, we formalize the enablers presented in Table III. A total of 24 enablers are identified. These enablers are not comprehensive since we do not examine them in general, but precisely for post-COVID-19 period which is still ongoing. In Table III , the supporting literatures provide arguments about consumer behaviors and perception, to validate the formalized enablers.

[**Insert Table III here**]

5.2 Ranking of Waterfall phases

The DEMATEL results are listed in Table IV, and Figures 3 and 4. The calculation results of prominence levels and cause–effect using equations (4), (5), and (6) are shown in Table IV. In Figure 3, we visualise the causal distribution of the waterfall phases. Thereafter, in Figure 4, we demonstrate the cause–effect relationship diagram according to the influencing waterfall phases that were captured. The requirements, verification, and maintenance phases are classified as cause phases. Design and implementation are classified as effect phases for post-COVID-19 resilience. Based on prominence, the ranking of the waterfall phases reveals that requirements area top priority, followed by design, verification, maintenance, and finally, implementation.

[**Insert Table IV here**]

[**Insert Figure3 and 4 here**]

The requirements of resilience are ranked as a top priority for managing the post-pandemic period, with an R+C score value of 4,24. In fact, when studying resilience during the COVID-19 period at an early stage, Rosenberg (2020) classifies resilience resources into three elements: individual, community and existential. The first two points are supported by the findings of Marshall *et al.* (2021), highlighting the need for quick decisions to be taken in practice, in factors such as relieving the panic of employees who are losing their jobs following the economic crisis. In addition to social support, the third point emphasises the post-pandemic impact at individual and organisational levels. This includes the requirement of collecting holistic and reliable data (Trump and Linkov, 2020) and enabling decision-makers to perform efficient analyses and draw conclusions on resilience policies.

The design phase of resilience is ranked second, with an R+C score value of 3,79, followed by the verification and maintenance phases, which tied third with R+C score values of 3,76each. Indeed, crisis periods such as the COVID-19 pandemic are uncertain, and their impact patterns are variable. Therefore, the design of operational systems for resilience is crucial. This supports the statements of Linkov *et al.* (2021), enhancing the importance of resilience through design strategies, such as endorsing modular system engineering and ecosystem diversity. Such diversity strengthens the pillar of the global market network, with partners serving as backups in case of flow disruptions with other partners. For instance, in New Zealand, Fath *et al.* (2021) reveal that small and medium enterprise (SME) exporters with strong operating international market relationships were maintaining their resilience during the COVID-19 period. Golgeci *et al.* (2020) also shed light on the maintenance of global value chain resilience. They argued that social and relational capital can maintain tacit knowledge and contribute to a socially cohesive global value chain network.

The implementation phase of resilience is ranked fourth, prioritised with an R+C score value of 3,64. In fact, the new normal post-pandemic is leveraged by reviving the economy and jumpstarting industrial sectors (Berawi, 2020). This transition triggered the implementation of operational adaptations pulled by market changes. The change in customer demand motivated researchers to develop methods that measure supply chain resilience. Moosavi and Hosseini (2021) develop a simulation-based method by prepositioning backup suppliers and extra inventory. Their study recommends a set of policies, such as securing back stock for essential

products and setting backup suppliers for less important items. Such policies may foster the implementation of resilience in the post-pandemic period.

5.3 Ranking of enablers

After identifying the waterfall resilience enablers, fuzzy TOPSIS is used for the ranking. With the decision committee's involvement, the importance of the criteria (i.e., the waterfall phases) and alternatives (or enablers) are defined. This ranking is performed using the linguistic variables and triangular fuzzy numbers shown in Table V. After each expert weighs the criteria and alternatives, we formalise the decision matrix defined in equation (11) and normalise it using equations (14) and (15).

[**Insert Table V here**]

After obtaining the fuzzy positive and negative ideal solutions, we calculate the distance (d*) of each alternative from FPIS (A*) using equation (22). Thereafter, the closeness of the 24 enablers (or alternatives) are calculated using equation (24), as indicated in Table VI. Once the closeness coefficients are obtained, the next step is to rank these coefficients to obtain the prioritised ranking of the enablers. The results of this ranking are shown in Figure 5.

[**Insert Table VI and Figure 5**]

The investigation of enabler rankings reveals the priority of actions to be taken by fast-fashion retailers. Thus, we discuss and validate relevant findings in the literature.

The R2 enabler is ranked as the most significant enabler for resilience post-COVID-19. It is aligned with the consumer's purchasing power, due to the economic crisis caused by the pandemic. This conforms with the findings of previous studies, stating that under certain conditions, e-payments can provide a lower selling price than cash payment (Xu *et al.*, 2020, Roggeveen and Sethuraman, 2020). Fast-fashion retailers are advised to reduce the assortment of accessories (e.g., bags, belts, etc.) for men and women, as customers will be more rational in their purchases and tend to buy only necessary clothing items. It is also advised that payment facilities be provided in physical stores, such as through instalments, for shopping convenience during this recovery period. This crisis period could create positive impact on the brand's image and increases customer loyalty.

R3 is ranked as the second most important enabler, enhancing the importance of product pricing and market analysis. This supports the findings of Eger *et al*. (2021), who reveal that during the pandemic, consumers' retail brand choice was determined based on convenience of purchase, quality and availability. Zhang *et al*. (2020) stress that cost and trust are among the factors that stimulate purchase intentions during a pandemic. For instance, sets kids' products that include multiple clothing items as one outfit that can be worn in various combinations are not advised during this period, as consumers are more selective in their purchase for only the items that they need.

The third important enabler is R1, which corresponds to online marketing. Sheth *et al.* (2020) emphasise that the lockdown and pandemic period will generate new purchasing habits that are oriented toward information technology channels. Fast-fashion retailers are advised to enhance e-commerce platforms.

The fourth important enabler is R6, which is associated with the requirements of impulse sales. It has been proven that the phenomenon of impulse buying behaviour during a pandemic has developed during its duration (Thakur *et al*., 2020). Furthermore, consumers tend to make

mobile purchases during the pandemic, which stimulates emotional change that boosts impulsive buying (Zhang *et al*., 2020). Pantano *et al*. (2020) stress that customers can substitute their regular retailers with competitors that provided a better assortment during the emergency period. To maintain a balance between impulse purchases and economic crises, fast-fashion retailers are advised to deliver more mid-season products. These items could be used in autumn-winter and spring-summer periods, providing more profitability and use than heavy and thin clothing items.

The fifth important enabler is M2, which is associated with customer loyalty. It is ranked as the most important enabler for post-COVID-19resilience. In correlation with the literature, Mason *et al*. (2020) find that customer satisfaction levels decreased during the pandemic. Hence, fast-fashion retailers are advised to manage customer loyalty resilience by adapting the assortment for customer groups of men, women and children, as per the circumstances of each group according to the 'new normal'. For instance, as men are more responsible for their families, they sacrifice their own purchases to prioritise those of their kids. Therefore, fast-fashion retailers are advised to reduce men's product quantities and ranges. In addition, as most schools adopt hybrid or distance learning modes, fast-fashion retailers are advised to reduce the back-to-school products, depending on the education government of the country that the fast-fashion brand is operating from.

The sixth most important enabler is M4, which is maintaining sales by working with resellers. This corresponds to extant studies (Tarki *et al*., 2020, Pantano *et al*., 2020) stating that maintaining and attracting new customers during the COVID-19 crisis period is more complex than during regular periods. Fast-fashion retailers are advised to reinforce their assortment with long-lasting products, such as denim for men and women. In addition, as social events are restricted by social distancing, fast-fashion retailers are advised to minimise parties and special events clothes and endorse a more casual range for both men and women.

The seventh most important enabler is I4. Consumers perceive the maintenance of hygiene measures post-pandemic as more important. This is supported in the literature, where it has been found that store hygiene is one of the biggest challenges caused by COVID-19 (Kohli *et al*., 2020). In addition to store hygiene, fast-fashion retailers are advised to focus on new-born clothing items, in terms of hazardous-chemical-free fibres and colours that are used in production, as consumer childcare health awareness increased during the pandemic and is more demanding than before.

The remaining enablers are also important and must be managed efficiently. Most are associated with product implementation, sales staff flexibility, and customer-focused actions. After the COVID-19outbreak, consumers developed new habits (Sheth, 2020). Therefore, fast-fashion retailers should involve all operation teams to lead the movement that was created by customer behaviour changers after the pandemic.

5.4 Sensitivity analysis

To test the validity of the results, we perform a sensitivity analysis. Fuzzy multi-criteria decision-making (FMCDM) inputs are changed, to observe output variations. We also vary the weights in the weighted decision matrix and check the enabler ranking changes. A set of eight experiments are conducted. In each experiment, we vary the weight of the three enablers. The ranking of each experiment is outlined in Table VII. Among the eight experiments, several changes are observed. Most enablers maintain the same ranking. Hence, the results are validated.

[Insert Table VII here]

6. Conclusion and implications

With the impact of COVID-19, and the induced consumer's panic buying (Islam *et al*. 2021), adaptation to market changes has become crucial for retailers. To ensure the resilience of customer demand management, fast-fashion retailers require a robust project management approach. Suppliers and retailers should be in line with new consumers needs and implement customers focused changes (Eger *et al*. 2021). In this paper, twenty-four enablers of resilience are identified considering the five waterfall phases as project management priority criteria. A fuzzy TOPSIS approach has been used to prioritize the post-COVID-19 resilience enablers in fast-fashion retail. Findings reveal that maintaining customer loyalty is the top prioritized enabler for customer demand resilience management post-pandemic. The majority of enablers are dealing with strong e-commerce and suitable assortment and pricing offer with the new normal.

Several practical implications can be induced by our research. The findings of this paper can support fast-fashion MSMEs to manage customer demand resilience post-pandemic. Resilience is crucial in the ongoing operations environment. The paper also improves our knowledge of the various enablers for customer demand management. The prioritization of enablers will help fast-fashion stakeholders to take effective action plans in the presence of changing consumer behaviors. Firms need to integrate project management approaches in their retention planning for being resilient and competitive in the market. Resilience should be designed considering the customer's demand perspective.

Furthermore, theoretical implications could be drawn from this study. By shedding light on the role of the waterfall project management approach in customer demand resilience, researchers can be stimulated to investigate more project management approaches for resilience management. The ranking of enablers can motivate academics to examine long term resilience strategies, as per the current post-pandemic figures. The findings can also contribute in validating integrated project management of resilience framework while ensuring customer satisfaction with the new normal post-pandemic.

However, this paper has some limitations that should be pointed out. As stated in section 4.1, this research is restricted to one waterfall-resilience matching. Future research can investigate other enablers with another matching, such as the requirements of amplitude and malleability, design of damping and others. In addition, the experts involved in this study are Moroccan; hence findings cannot be generalized as the perspective of retailers from other nationalities might be different. Future research could replicate the proposed analysis on other nationalities of the decision committee. Furthermore, the size of experts considered in this study is ten. Future research can expand it to a bigger size and analyze the potential variations in experts 'opinions. A promising future research area also can investigate other FMCDM methods for the same research and compare the relevant findings.

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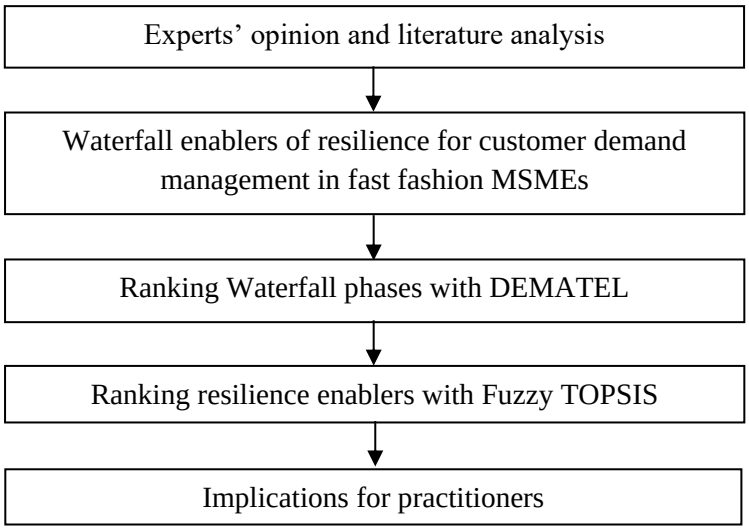

Figure 1. Methodology

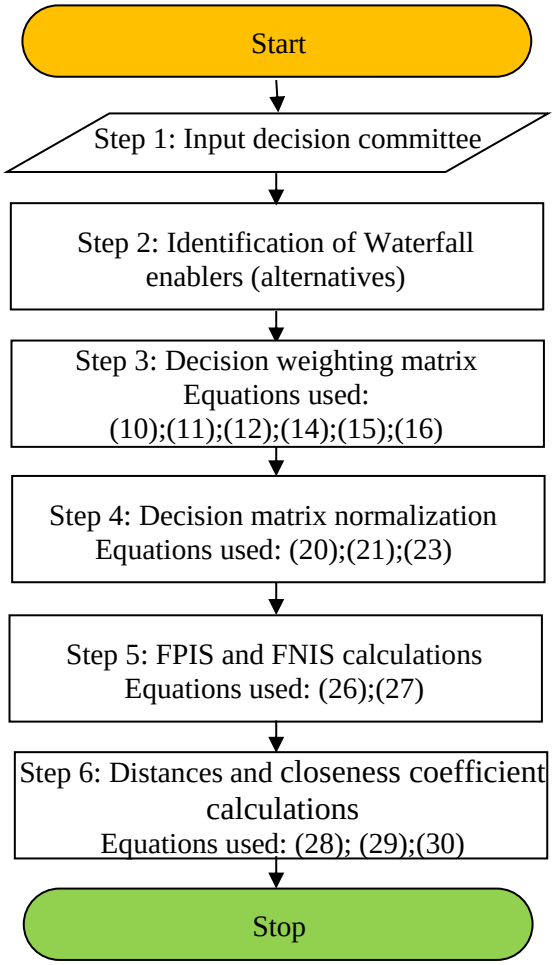

Figure 2. Flow chart of the steps and equations used for calculations

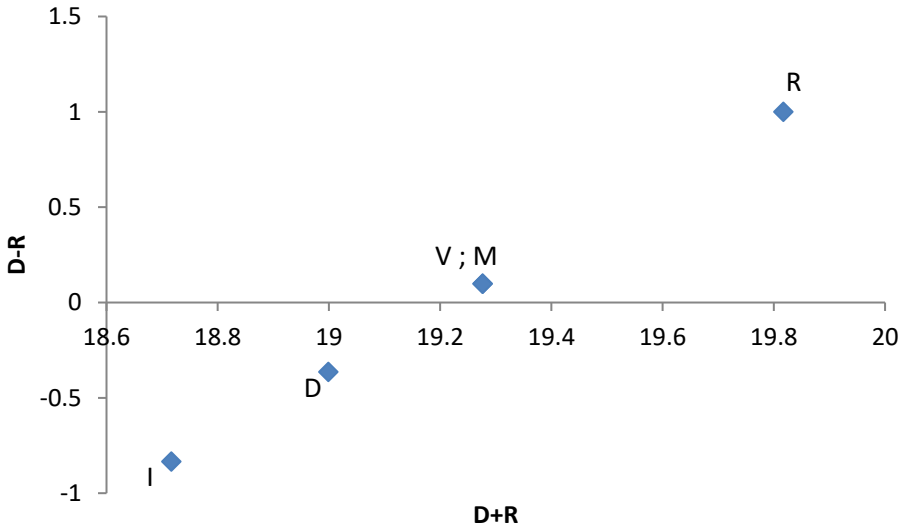

Figure 3. The causal Diagram

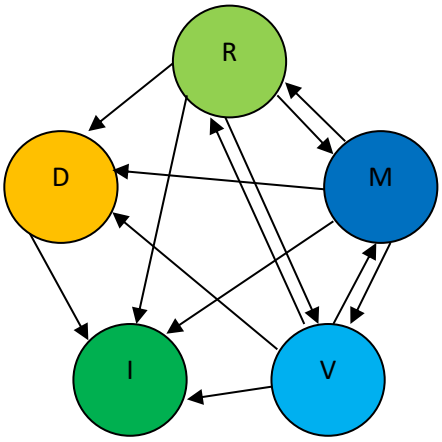

Figure 4. Cause effet Relationship Diagram

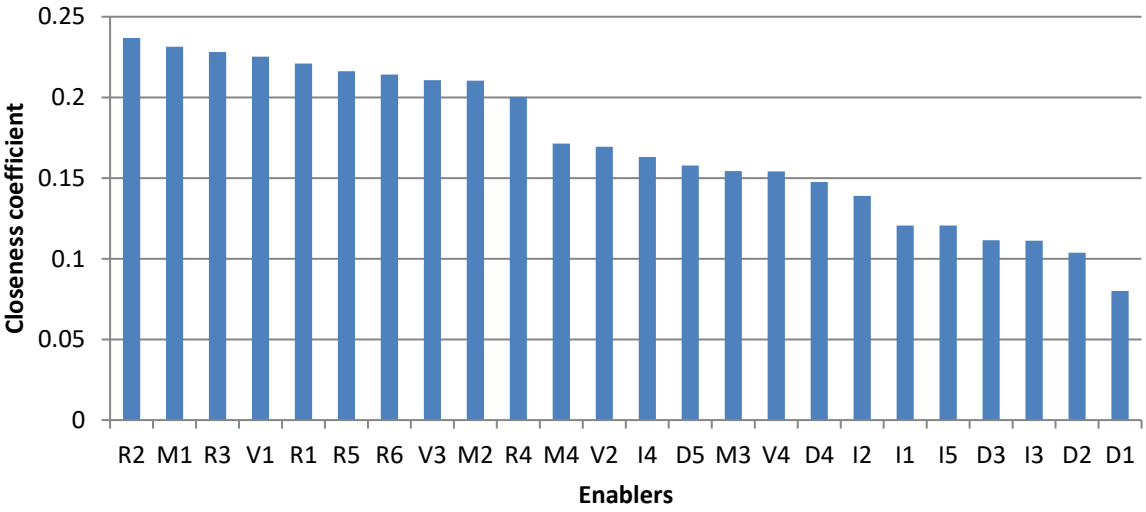

Figure 5. Enablers ranking.

Table I. Review of research stream on resilience and project management

Paper	Objective of the study	Perspective	Application industry/service	Type
Karlsen and Berg 2020	Study the impact of project manager's signature strengths on project team resilience	Team management	General / All organizations	Research paper
Naderpajouh et al. 2020	Study the role of projects for resilience of the society to obtain effective leadership in project societies	Interdisciplinary approach	General	Research paper
Shishodia et al. 2019	Find out the factors impacting supplier's resilience to compute suppliers' resilience scores	Project driven supply chain	Construction	Research paper
Prasad et al. 2019	Examine disaster resilience from project management standpoint and investigate how community groups can be exploited for disaster resilience	Operations management, disaster management, and organizational behavior	General	Case study
Stoddard et al. 2019	How to develop libraries' collections with agile project management approach for resilience	Team management and organizational approach	Libraries	Case study
Blay 2017	Identify antecedents and consequences of resilience in projects	Organizational approach	General	Research thesis
Crawford et al. 2013	Understand the role of project management in disaster resilience	Stakeholder management	General / All institutions	Research paper
This study	Investigate the role of waterfall project management on resilience customer demand	Customer demand driven supply	Fast-fashion	Research paper

Table II. Questions asked to the experts

Waterfall phases	**Resilience aspects of customer demand**	**Open questions**
Requirements	Elasticity: quickness of restitution of customer demand stable state after crisis	Q1
Design	Amplitude: the impact area from which customer demand operations will return to normal state	Q2
Implementation	Hysteresis: the extent of differences between degradation and recovery of customer demand	Q3
Verification	Malleability: difference between original state of customer demand before disruption and state reached after recovery	Q4
Maintenance	Damping: the way by which the customer demand restitution is adapted by any circumstance that change the normal restitution	Q5

Table III. Enablers and supporting literature

Waterfall phase	Enabler	Description	Supporting literature	Reference
Requirements	R1	Reinforcing online advertising and marketing	During the COVID-19 period, new demographic customer groups, such as old and less digitally consumers have started using e-commerce	Eger et al. (2021)
	R2	Providing customers opportunities of payment options such as instalment, for the affordable shopping experience	Several payment options enhance customer satisfaction for online shopping	Sanyala and Hisamb (2019)
	R3	Because of the economic situation, customers will be very sensitive to prices. Since the price elasticity in fast fashion is very high, retailers should provide the best prices in the market.	One of the reasons behind customers' choice of fast-fashion products, is their feature of affordable prices	Joung (2014)
	R4	Impulse selling will help to cover-up	Due to the fear generated by the COVID-19 crisis, impulse purchase behaviour has grown for consumers	Eger et al. (2021); Ahmed et al. (2020)
	R5	Keep on adopting the hygiene standards and health security aspects, like using sanitizers, ventilating the stores, reduce the exposed quantities of textiles, enlarge the passages to allow a smooth passage for customers and avoid over-crowded stores	Proper hygiene at the store must be adopted by grocery stores to deliver a clear message customer's safety is a priority	Shamim et al. (2021)
	R6	Adapt the assortment to the new economic and social situation: less trendy items, more basics	Customer's purchase has been focused on the basic needs, due to the economic impact of COVID-19	Eger et al. (2021).
Design	D1	Being too close to customers and listening to their suggestions, by providing them with the right support with the new normal post COVID-19	The new operating system induce d by COVID-19 will generate collaborative relationships	Lee and Trimi (2021)
	D2	Integrate sustainable aspects into retailer's offerings, such as putting labels of 'environmentally friendly' for example, to consolidate the image of the brand	During the lockdown, customers have shown more intention to purchase sustainable products	Alexa et al. (2021)
	D3	Retailers should avoid crowded stores (closing the doors when the store is full,	Customers need seeding visible signs and barriers when	Arora et al. (2020)

		proposing promotions during mornings and no one when there is no rush hours) would help to make customers more comfortable	shopping in the stores after COVID-19	
	D4	After this pandemic, many customers will be more rational than ever, which means they will buy only necessary and basic products.	People will reevaluate what is important in prioritizing life after the pandemic experience	Lee and Trimi (2021)
	D5	Attracting a new range of customers, by trying to get a new market share. For instance, customers who used to look for high range fashion might become a new potential if fast-fashion retailers adapt the offer	Customers satisfaction levels and purchase behaviour have been influenced by the COVID-19 pandemic	Mason et al. (2020)
Implementation	I1	Reinforce team training to manage the new normal	Continuous training of staff is crucial for consistent in organizational development for competitive advantage	Hollenbeck et al. (2004)
	I2	The assortment should contain more basics and retailers should avoid very trendy items since a big part of the customers will either buy less fashion or choose long-lasting items	Customers shopping interests have been on basic products due to the economic crisis of COVID-19	Eger et al. (2021).
	I3	Develop material unfavorable to the virus	Proper fabrics must be manufactured derived from the textile filtration science and the pandemic figures	Beesoon et al. (2020).
	I4	Sterilize products returned to the store to satisfy the customers	The fear and distress caused by COVID-19 will change individuals' lifestyles after the pandemic	Koçak et al. (2021)
	I5	Implementation of fast-fashion products with extended lifetime	Due to the ecological negative impact of fashion productions, this factor is supported by the environmental need to increase products lifetimes and decrease customers frequent purchasing	Niinimäki et al. (2020)
Verification	V1	Retailers should analyze macroeconomic figures, such as unemployment and inflation rates, to get a clear idea of how the business will be after the pandemic	Macroeconomics shows that spending will decrease	Stiglitz (2020)
	V2	Global market analysis	Understanding the uncertainties associated with the pandemic global impact	Song and Zhou (2020)

			will enable effective prediction of restoration post COVID-19	
	V3	Local market analysis for effective forecasting for post-pandemic market changes	Microeconomics reveals that the pandemic will impact production and consumption patterns	Stiglitz (2020).
	V4	Benchmarking with figures of other business, by analyzing customer's behaviour in similar sectors of fast fashion	The pandemic will be a catalyst for all economies impacting customer behaviours	Mason et al. (2020).
Maintenance	M1	Developing the business on web stores since online purchases are now more blooming than ever	Online shopping has been crucial for customers	Hashem (2020).
	M2	Work on customers loyalty, by providing gift cards and similar, because after COVID-19, customers will be less loyal.	Until normal after COVID-19 is reached, and even later, retailers should reform customers wellbeing and satisfaction during crisis times	Pantano et al. (2020).
	M3	Retailers should have flexible management to maintain the new normal in retail stores in terms of human resources and logistics management to be able to adapt to any unexpected crisis	New habits will appear for customers mainly for technology use	Sheth (2020).
	M4	Retailers can also work with resellers during the time of crises	Online retailers as resellers can be better pure marketplaces	Chen et al. (2020).

Table IV. Relation and influence matrix

	R	D	I	V	M	Ri	ci	Ri+Ci	Rank	Ri-Ci	Cause/ effect
R	1.88	2.14	2.16	2.12	2.12	10.41	9.41	4.24	1	-2.12	cause
D	1.86	1.73	1.93	1.90	1.90	9.32	9.68	3.79	2	-1.90	effect
I	1.79	1.84	1.68	1.82	1.82	8.94	9.78	3.64	4	-1.82	effect
V	1.94	1.99	2.01	1.78	1.97	9.69	9.59	3.76	3	-1.78	cause
M	1.94	1.99	2.01	1.97	1.78	9.69	9.59	3.76	3	-1.97	cause

Table V: Linguistic variables

Linguistic variables	Triangular fuzzy numbers
Very weak (VW)	(0; 0; 0.2)
Weak (W)	(0.1; 0.2; 0.4)
Moderate (L)	(0.3; 0.4; 0.6)
Strong (S)	(0 .5; 0.6; 0.8)
Very strong (VS)	(0.7; 1; 1)

Table VI: Fuzzy TOPSIS results

Alternatives	d*	d-	CCi
R1	1,70591372	0,4839077	0,22098044
R2	1,75675662	0,54531337	0,23687958
R3	1,68281971	0,49749372	0,22817532
R4	1,7730047	0,44425968	0,20036387
R5	1,74084269	0,4803471	0,21625667
R6	1,72900773	0,47106263	0,21411253
D1	2,00626999	0,17445152	0,07999716
D2	1,97083205	0,22810816	0,1037355
D3	1,94009503	0,24337899	0,11146411
D4	1,8778053	0,32501282	0,1475441
D5	1,83617198	0,34414144	0,15784035
I1	1,92752126	0,26438608	0,12061919
I2	1,97199633	0,31834782	0,13899563
I3	1,94565678	0,24337899	0,11118091
I4	1,95280632	0,38056975	0,16309833
I5	1,92752126	0,26438608	0,12061919
V1	1,68915832	0,4911551	0,22526812
V2	1,83971285	0,37527767	0,16942631
V3	1,73534635	0,46321341	0,21068948
V4	1,8556916	0,33808283	0,15411011
M1	1,67576742	0,504546	0,23140985
M2	1,74504946	0,46493727	0,21038012
M3	1,85202481	0,33808283	0,15436813
M4	1,81481178	0,37527767	0,17135267

Table VII. Sensitivity analysis results

Experiment number	Definition of the variation in the weighted decision matrix	Initial weight	Experiment weight	Ranking
1	Weight of R1 for R criteria	(0,25; 0,48; 0,8)	(0,32; 0,53; 0,77)	R2>M1>V1>R1>R3>R5>R6>V3>M2>R4>M4>V2>I4>D5>M3>V4>D4>I2>I1>I5>D3>I3>D2>D1>
	Weight of R2 for R criteria	(0,35; 0,6; 0,8)	(0,38;0,62;0,74)	
	Weight of R3 for R criteria	(0,25; 0,52; 0,8)	(0,23;0,49;0,81)	
2	Weight of R4 for R criteria	(0,15; 0,4; 0,8)	(0,17; 0,44; 0,79)	R2>M1>R3>V1>R1>R6>R5>V3>M2>R4>M4>V2>I4>D5>M3>V4>D4>I2>I1>I5>D3>I3>D2>D1
	Weight of R5 for R criteria	(0,15; 0,51; 0,8)	(0,13; 0,48; 0,82)	
	Weight of R6 for R criteria	(0,25; 0,44; 0,8)	(0,22; 0,47; 0,79)	
3	Weight of D1 for D criteria	(0,09; 0,16; 0,36)	(0,11; 0,15; 0,34)	R2>M1>R3>V1>R1>R5>R6>V3>M2>R4>M4>V2>I4>D5>M3>V4>D4>I2>I1>I5>D3>I3>D2>D1>
	Weight of D2 for D criteria	(0,03; 0,16; 0,48)	(0,06; 0,15; 0,49)	
	Weight of D3 for D criteria	(0,09; 0,2; 0,48)	(0,1; 0,19; 0,51)	

4	Weight of D4 for D criteria	(0,09; 0,28; 0,6)	(0,13; 0,26; 0,57)	R2>M1>R3>V1>R1>R5>R6>V3>M2>R4>M4>V2>D5>I4>M3>V4>D4>I2>I1>I5>D3>I3>D2>D1>
	Weight of D5 for D criteria	(0,15; 0,32; 0,6)	(0,18; 0,31; 0,64)	
	Weight of I1 for I criteria	(0,15; 0,24; 0,48)	(0,19; 0,21; 0,5)	
5	Weight of I2 for I criteria	(0,09; 0,256; 0,6)	(0,1; 0,226; 0,61)	R2>M1>R3>V1>R1>R5>R6>V3>M2>R4>M4>V2>I4>D5>M3>V4>D4>I2>I1>I5>D3>I3>D2>D1
	Weight of I3 for I criteria	(0,09; 0,2; 0,48)	(0,16; 0,19; 0,45)	
	Weight of I4 for I criteria	(0,21; 0,4; 0,6)	(0,24; 0,42; 0,56)	
6	Weight of I5 for I criteria	(0,15; 0,24; 0,48)	(0,17; 0,18; 0,55)	R2>M1>R3>V1>R1>R5>R6>V3>M2>R4>V2>M4>I4>D5>M3>V4>D4>I2>I5>I1>D3>I3>D2>D1
	Weight of V1 for V criteria	(0,15; 0,54; 0,8)	(0,12; 0,58; 0,79)	
	Weight of V2 for V criteria	(0,25; 0,36; 0,64)	(0,21; 0,33; 0,69)	
7	Weight of V3 for V criteria	(0,15; 0,46; 0,8)	(0,24; 0,48; 0,87)	R2>M1>R3>V3>V1>R1>R5>R6>M2>R4>M4>V2>I4>D5>M3>D4>I2>V4>I1>I5>D3>I3>D2>D1
	Weight of V4 for V criteria	(0,15; 0,3; 0,64)	(0,07; 0,26; 0,59)	
	Weight of M1 for M criteria	(0,25; 0,54; 0,8)	(0,32; 0,51; 0,82)	
8	Weight of M2 for M criteria	(0,25; 0,42; 0,8)	(0,27; 0,38; 0,87)	R2>M1>R3>V1>R1>R5>M2>R6>V3>R4>M4>V2>I4>M3>D5>V4>D4>I2>I1>I5>D3>I3>D2>D1
	Weight of M3 for M criteria	(0,15; 0,3; 0,64)	(0,18; 0,26; 0,69)	
	Weight of M4 for M criteria	(0,25; 0,36; 0,64)	(0,26; 0,28; 0,7)	

Appendix 1. Survey questionnaire

Q1. What are the requirements to be done in retail SMEs to come back to the stable state of purchase and consumer desire to buy as it was before COVID-19

Q2. How can we design ''back to retail MSMEs after COVID-19'' from consumer perspectives?

Q3. Consumer preferences in terms of fashion models and purchase behaviours can change after the COVID-19 period. How can we implement actions in the retail store, to manage the eventual change?

Q4. How can we test and verify that consumer's purchase quantities might be different after COVID-19?

Q5. How can we maintain a new normal in retail MSMEs sales after COVID-19?

Q6. What are your recommendation per customer age group?

Q7. Please assess the importance of each factor you cited by choosing one of these:

- Very weak
- Weak
- Moderate
- Strong
- Very strong