Modelling the operational maturity challenges faced by online food ordering and delivery enterprises during Covid-19 lockdown in Oman: A Fuzzy Interpretive Structural Modelling Approach

Abstract

Purpose: This research aims to ascertain the various operational maturity challenges faced by the online food ordering and delivery enterprises (OFODE), their nature and their interactive relationships. In particular, we aim to i) identify the most relevant operational maturity challenges faced by the OFODE during the Covid-19 lockdown in Oman b) explore and establish any likely structural relationship among these challenges and, c) put them into logical clusters.

Design/methodology/approach: Experts helped to reduce the eighteen initially identified maturity challenges to thirteen most pressing ones. Mutual relationships, dominance of interactions and their classifications were explored using Fuzzy Interpretive Structural Modeling (FISM) and Fuzzy MICMAC analysis.

Findings: The study of situation specific operational maturity challenges convinced us to propose a distinct FISM model that depicts the relationship among these challenges. Keeping commissions and fees reasonable emerges as the challenge which all other challenges seemingly culminate into. One of the most important situation specific challenges (i.e. customer confidence about infection free delivery) emerges as a linkage challenge which aggravates as well as is aggravated by certain challenges.

Research limitations/implications: Besides enriching literature, the proposed model has implications for practitioners particularly when the similar lethal waves are experienced anywhere. The number of respondents, subjective approach, specific context as well as the geographical area coverage are the key limitations.

Originality: This study is the first known scientific effort which attempts to model the operational maturity challenges faced by the OFODE during covid-19 lockdown period. The authors employed the FISM modelling approach to forge these interrelated challenges into a structural model.

Keywords: Food delivery challenges, online food ordering, operational maturity challenges, Covid-19 Lockdown, FISM, Fuzzy MICMAC

1. Introduction

Rising population of working women class, dual career couples, employed millennials (Senthil *et al.*, 2020), growing consumerism, and changing lifestyles have left so little time with professionals that, at times, they struggle to even dine-out. Offering online services through websites and mobile apps, online food ordering and delivery enterprises (OFODE) emerged as a potential platform for customers. OFODEs deal only with the prepared and ready to consume meals. Customers access OFODEs' platforms to search restaurants, their locations, their cuisines, explore menus with images and descriptions, make comparisons, customize their orders (Thoti *et al.*, 2023); thereby avoiding several phone-order miscommunications, and saving transportation cost, efforts and time. Besides, they might avail various promotional schemes, place orders, schedule the delivery, opt for either online payment or cash on delivery (Sharma and Waheed, 2018), and even choose the contactless delivery (Thoti *et al.*, 2023). For instance, Uber Eats launched their contactless delivery services during Covid 19. No physical contact was ensured by delivering the food parcel at customers' doorstep against a cashless payment (Huang *et al.*, 2023). Given their insignificant additional cost, consumers find OFODE as a boon. Online food ordering services are equally helping restaurant businesses to reduce their costs, adapt their delivery system, and reach the customers who may not come in person (Goh *et al.*, 2017). Acting as a link between customers and businesses, online food ordering market emerges as an essential part of the economy.

Covid-19 and its community transmission forced most of the countries to impose partial or complete lockdowns (Idris *et al.*, 2023; Wignjadiputro *et al.*, 2020). In Oman, lockdowns included temporary closing of borders, implementation of curfews, limitation of inter-city movement, closure of public places and dine-in sections of restaurants, which convinced consumers to try online food ordering and delivery services. Oman, occupying the fourth position among GCC countries (Oman Observer, 2021) in terms of online food delivery services, has giant online food delivery players like Talabat 'Akeed', 'Daleel 1010', 'Geeb', 'TM' and 'Mojeeb'. These enterprises offer services which are very much similar to the leading western players like Doordash, SkipTheDishes, Uber Eats, GrubHub etc (Griesbach *et al.*, 2019). Given their high health risk awareness (Fattah *et al.*, 2021), Omani consumers registered relatively more concerns about infection free hygienic delivery during Covid-19 period. However, there was a reported shift among Omani consumers towards consuming local and healthier diets (Hassen *et al.*, 2021).

Highlighting the various lifestyle changes, physical inactivity and psychological issues, Ismail *et al.* (2020) reported the number of consumers taking five meals a day increased thrice in Middle East and North African (MENA) region. The average food purchasing as well as food waste increased in Oman as individuals stayed at home during the temporary Covid-19 lockdowns (Alazaiza *et al.*, 2022).

During the temporary Covid-19 lockdown, all online food delivery providers faced the challenge of adhering to physical distancing norms, maintaining the hygiene, and ensuring the safety of customers as well as employees. Idris et al. (2023) explored the factors like convenience, trust, customer satisfaction etc. for their contributions in the increased demand of OFODEs. Koay *et al.* (2022) argued that maintenance of meal quality and hygiene affected the customers' level of satisfaction and loyalty. The pandemic induced novel operational challenges are related to demand volume (Amicarelli *et al.*, 2021), coordination among customers, delivery persons and restaurants, customer confidence about infection free hygienic delivery, required huge infrastructural networks, and trustworthiness of the delivery persons etc. Idris *et al.* (2023) highlighted that unavailability of the delivery personnel was also a big challenge in Brunei during Covid-19, however, in Oman, this was not a significant issue.

Covid-19 tested the mettle and maturity of OFODEs' operational procedures and practices. Despite being in vogue for more than a decade, these OFODEs struggled to cope up with the emerging novel challenges which led to an enquiry whether they are so developed, accomplished, independent and versatile to handle any calculated risks and uncertain scenarios. In particular, the variables like unexpected demand shift, unexpected demand volumes, heightened customer expectations, expanded regulatory requirements, associated risks at personal and community levels etc. highlighted the partial fragility of OFODEs operating everywhere including Oman. The interconnected and interdependent nature of these variables, where one or more of such variables was influenced by or influencing the other related variable(s), vitiated the situation. Dearth of scientific literature pertaining to the operational maturity challenges made it inevitable for the research community to identify, ascertain, assess and highlight such challenges so that OFODEs are better prepared with an adaptive coping mechanism. This convinced us to explore, identify and examine the various operational maturity challenges that OFODEs faced during Covid-19. Building on the literary evidences and expert opinions, the broader aim was to synchronize,

synthesize, and propose a structural model of potential operational maturity challenges faced by OFODEs amid Covid-19. Puram *et al.*, (2021) used the grounded theory approach to identify and synthesize the potential challenges faced by the riders who work for more than one OFODEs. The researchers pointed out that for improving operational efficiency, the OFODEs can't ignore the challenges faced by riders on operational, customer, technological, and organizational frontiers. Review of literature revealed that many researchers studied the supply chain maturity issues in past (e.g. Söderberg and Bengtsson, 2010; Frederico and Martins, 2014, Frederico, 2020), however, there was no study examining the operational maturity challenges for OFODE. Farah *et al.* (2022) have also highlighted the need to explore and study various aspects of online food delivery platforms particularly in the context of emerging markets like middle eastern markets. Thus, this research attempts to a) identify the most relevant operational maturity challenges encountered by OFODEs during the temporary Covid-19 lockdown in Oman b) explore as well as establish structural relationship among these challenges and, c) classify them into dependent, independent, autonomous and linkage challenges. We have employed Fuzzy Interpretive Structural Modelling (FISM) and Fuzzy MICMAC analysis to accomplish the stated objectives. The information gleaned from this research proffers a broader understanding of the operational maturity challenges that Covid-19 posed for these OFODEs. The outcomes of this study might help OFODEs in formulating better solutions and strengthening their resilience. The remaining sections of this research include theoretical background, research method, data analysis and interpretation, findings, discussion and conclusions, and implications and limitations of the study.

2. Theoretical background

Covid-19 changed the schedules and activities of individuals and corporations. People exhibited different protective behaviors viz. precautionary, proactive, reactive and rehabilitative. Furthermore, government-imposed restrictions also determined the domain of individual actions. For instance, the temporary lockdown redefined the way essentials like food items were sold in marketplace (Wui Lun & Quoquab, 2023; Alazaiza *et al.*, 2020). Home takeaways and home delivery of packaged food were only options those days. Social media also played a key role in augmenting the demand of online food ordering during Covid-19. Enhanced usage of online food ordering applications (Principato *et al.*, 2020) showed how online food ordering was defining the new normal (Idris *et al.*, 2023; Lau and Ng, 2019). The unprecedented demand hike for OFODEs

was not devoid of challenges. The key operational maturity challenges identified by different researchers under pandemic situations include timely delivery, pricing, increased demand, confidence in infection-free delivery, maintenance of food quality, traditional family values, payment options (Pandey *et al.*, 2022), coordination among restaurants, delivery persons, and customers, intensive competition, required huge infrastructure networks, expected special offers, increased number of specific needs groups, and trustworthiness of delivery persons. Table I briefly defines these operational maturity challenges.

Literature is overwhelmed with studies pertaining to the various aspects of OFODEs in the context of Covid-19. The major themes covered by the researchers include 'assessing the shift in the buying patterns (Laguna *et al.*, 2020)', 'surging OFODEs demand vis-à-vis environmental health (Wui Lun & Quoquab, 2023)', 'impacts of online food delivery on environment (Li *et al.*, 2023)', 'change in the family values vis a vis food habits (Bracale and Vaccaro, 2020; Senthil *et al.* 2020)', 'online food delivery technology and family food traditions (Pandey et al., 2022; Aiswarya & Ramasundaram, 2023)', 'online food delivery services and Halal supply chain principles (Samori *et al.,* 2023)', 'determinants of the usage of food ordering apps (Idris *et al.*, 2023; Bacao and Zhou, 2020)', 'future challenges of marketing online-to-offline (Rosario, 2023)', 'factors affecting online food delivery service quality (Koay *et al.,* 2022)', and 'factors affecting customer satisfaction and loyalty towards online food delivery (Ganapathi and Abu-Shanab, 2020; Prasetyo *et al.*, 2021)'. Some researchers emphasized on specific aspects like 'services features of OFODEs' portals and apps (Ganou et al., 2022; Pal et al., 2021)', 'food quality (Lau and Ng, 2019; Dsouza and Sharma 2021)', 'timely delivery (Lau and Ng, 2019; Dsouza and Sharma, 2021)', 'secure payment methods (Koay *et al.,* 2022)', and 'perceived trust of service (Singh *et al.*, 2020)' etc. The quality of food generally means taste, freshness, and cleanliness (Ganapathi and Abu-Shanab, 2020), however, any suspicion about an infection free food delivery makes the whole process questionable (Singh *et al.*, 2020). To ensure the infection free quality food delivery, companies used disposable packaging, cutlery with the meals and personnel protectives which ultimately brought an impact on environmental sustainability (Wui Lun & Quoquab, 2023). It motivates health and eco-customers to prefer family baked foods over any OFODEs served food for health and socio-cultural factors (Aiswarya & Ramasundaram, 2023). In particular, health conscious customers were found abstaining from using such platforms (Huang, 2023). However, at the same time, businesses may also consider the innovative alternatives like online-to-offline

food service delivery (Yang *et al.*, 2021), drone delivery (Shankar *et al.*, 2022) or robot service restaurants (El-Said and Al Hajiri, 2022). Alternatives like online-to-offline food service delivery coupled with a customer centric approach has all the potential to build a strong reputation and thus, enhanced customer loyalty (Rosario, 2023). Ganou *et al.* (2022) also argued that benefits of such service platforms convince customers to try whereas their features like 'ease of use' convince them to reuse.

It is observed during review of literature that researchers mainly focused on driving forces, determinants, or factors influencing the usage of OFODEs, and satisfaction and loyalty of customers towards them. For instance, Koay *et al.* (2022) found that maintenance of meal quality and hygiene, reliability of delivery persons, assurance, security and system operations had significant impact on customers' satisfaction about OFODEs during Covid-19. They further explained that consumers assess the quality of assurance in terms of delivery person's agility, delivery accuracy, reasonable and fair fees, and non-cancellation of accepted orders. Prasetyo *et al.* (2021) observed that affordability of online food delivery services had a direct significant impact on their actual usage during Covid-19. Some studies focused on the features of such portals whereas some others focused more on the actual delivery side. However, to the best of our access, we couldn't find a single study which focused on the operational maturity challenges faced by OFODEs during Covid-19. Furthermore, we couldn't find any study even in the context of Gulf Cooperation Council (GCC) nations including obviously Oman which identifies such challenges and examines a likely confounded relation among them.

All in all, past studied failed to touch upon the new operational maturity challenges that OFODEs faced during Covid-19 period. It convinced us to address the stated research gap. Thus, this study focuses on identifying the different operational maturity challenges and establishing any likely confounded relationship among them. When the existence, direction as well as strength of structural relationship among selected variables is unclear, researchers may use FISM (Joshi *et al.*, 2009; Faisal *et al.*, 2017; Das *et al.*, 2020; Sharma *et al.*, 2021). In FISM, researchers incorporate the fuzzy set theory principles into existing binary approach of Interpretive Structural Modeling (ISM) wherein experts are requested to report their perceived relationships on a 0-1 continuous scale (Faisal *et al.*, 2017). It may be viewed as the strength of various relationships (Melewar *et al.*, 2013) or the dominance of interaction (Joshi *et al.*, 2009). It helps the researchers in being more proximate to the reality. Besides contributing to the extant literature, the outcomes of this

study are expected to benefit the OFODEs inside and outside Oman. The next section elaborates the selection, justification, and execution of FISM and Fuzzy MICMAC analysis.

3. Research Method

This section explains various steps that are followed to accomplish the stated research objectives.

Developed by J. Warfield in 1973, Interpretive Structural Modelling (ISM) is employed to model and analyze the complex socioeconomic systems. Based on experts' knowledge and experience, a complex and vague problem is decomposed into many related challenges so that a vivid multilevel structured model is developed. ISM helps researchers in exploring the existence and direction of such relationships, however, it remains silent about the strength of specific interactions and relationships (Abbas *et al.*, 2022). This limitation of ISM is addressed by the FISM. Rather than restricting the respondents to answer in terms of existence or non-existence of relationship(s), it offers them a continuum (0-1) to reflect their perceived dominance of specific relationship(s). On this continuum, the closer a response is to zero (0), the weaker is the relationship, and vice versa (Abbas *et al.*, 2021). The researchers may also use this interpretive framework to exhibit only the relationships or interactions having a specific degree of strength (e.g. 0.7 and above) (Joshi *et al.*, 2009), considering all other interactions and relationships as no relationship. The idea is to refine the decision making by winnowing these challenges such that only critical and meritorious ones are retained. In brief, FISM helps in exploring the existence, direction, and strength of specific relationships between challenges whereas Fuzzy MICMAC analysis complements it by offering a fair classification into distinct categories namely autonomous, independent, dependent and linkage challenges.

The experts' subjectivities involved in this process make it interpretive whereas the hierarchical portrayal of the established links makes it a modelling approach. The relative ease of administration and interpretations might have convinced researchers like Sharma *et al.* (2021), Das *et al.* (2020), Sharma *et al.* (2018), Faisal *et al.* (2017), Joshi *et al.* (2009) to prefer FISM over other similar approaches like rough set theory, neutrosophic set theory or intuitionistic fuzzy set theory etc., to conduct similar studies in different contexts. The fuzzy set theory aims at enhancing the robustness of proposed ISM model (Sharma *et al.*, 2021). Apart from the process flow diagram and a fuzzy scale (0-1), there is no mathematical formulation or equation involved in FISM and FMICMAC.

The steps generally followed in FISM methodology include the identification of challenges, establishment of contextual relationships, construction of a structural self- interaction matrix (SSIM), development of an initial reachability matrix, establishment of final reachability matrix, development of a fuzzy direct reachability matrix (FDRM), level partitioning, drawing of a directed graph (Diagraph) and FISM, and FISM model reviewed (Figure I). The Fuzzy MICMAC analysis usually complements it in classifying these challenges. The next section explains the various steps used in analysis and interpretation phase.

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4. Data Analysis and Interpretation

This section deals with organization, transposition, presentation, and analysis of primary data gathered through interviews. It elaborates various steps of FISM methodology as used here and briefly interprets the results.

(1) *Identification of challenges:* We explored and refined the operational maturity challenges faced by OFODEs during Covid-19 related temporary lockdown imposed in Oman. Review of extant literature led to the identification of common and routine operational challenges faced by OFODEs. These challenges are discussed in Section 2 and are presented in Table I. Afterwards, we approached four (4) experts from industry who worked with OFODEs in different managerial roles. They were directly involved in the coordination between the customers, delivery persons, and restaurants, and have extensive knowledge on competition in the industry. After obtaining their informed consent, their expert opinions were recorded. Likewise, we consulted with three (03) academicians who had at least five years of relevant professional experience. Utmost caution was exercised to avoid redundancies and ensure exhaustiveness. The experts were provided with the operational definitions of these challenges. With their valuable inputs, an initial list of eighteen (18) challenges was refined and reduced to thirteen (13) most pressing and contextually relevant challenges (Table I). In addition to the challenges mentioned in Table I, the initial list of operational challenges also included 'preference of cash on delivery option', 'concerns about halal status of food',' frequent order cancellation requests', 'excessive power and network cuts', and 'worst and broken roads. For instance, in the light of Samori *et al.,* (2023), 'concerns about halal status of food' was initially included, however, experts didn't endorse it as a pressing challenge in

the context of Oman. Simply, on the majority vote counts (Sushil, 2018), these factors were eliminated.

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(2) *The contextual relationships:* We examined these thirteen operational maturity challenges for likely mutual contextual relationships. This study is based on three online video interviews and four completed structured questionnaires. This sample size, though rather meagre, was considered appropriate in the light of previous similar studies (Khatwani *et al.*, 2015; Abbas *et al.*, 2022; Jabeen *et al.*, 2018).

(3) These contextual relationships, emerged from majority's opinion (Sushil, 2018), were substituted by alphabetic symbols. These symbols were used for constructing a structural self-interaction matrix (SSIM). In SSIM (Table II), the contextual relationship is represented by a corresponding alphabet, O, V, A, and X for "no relationship", "forward unidirectional relationship", "backward unidirectional relationship" and "bidirectional relationship" respectively. At this stage, we considered only one part of the responses that was related to the existence of relationship.

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(4) Initial reachability matrix (Table III) was developed from SSIM by converting alphabetical symbols of relationships ("O", "V", "A" and "X") into binary numbers. Thus, all cells of SSIM having "O" and "A" were replaced by "0 (Zero)", whereas, the cells containing "V" and "X" are replaced by "1(One)".

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(5) Afterwards, the initial reachability matrix was checked for transitivity. As per transitivity rule, if A is related to B, and B is related to C, then A will eventually be related to C. This process resulted in the establishment of final reachability matrix. For incorporating fuzzy set theory, crisp binary numbers of final reachability matrix were converted into perceived corresponding fuzzy numbers. In second round of interviews, the responses were solicited on the basis of the given schedule (Table IV) so as to obtain the fuzzy direct reachability matrix (Table V).

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Since we were more interested in learning about stronger interactions only, the weaker interactions were deemed null (Table VI).

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(6) The fuzzy direct reachability matrix was partitioned into various levels. The non-zero elements (stronger interactions) of FDRM (Table VI) were used to obtain the reachability set and antecedent set for all the challenges. The reachability set for a given challenge included itself alongside others which it aggravated, whereas the antecedent set for a given challenge included itself alongside others which aggravated it. Afterwards, an intersection set of these two sets was obtained such that common elements of reachability and antecedent sets became its members. The challenge(s) for which reachability and intersection sets were exactly same, obtained the topmost level in FISM hierarchy. Above their level, such challenges cannot aggravate any other challenge. Therefore, such challenges were excluded for the next level of partitioning. This iterative process continued till all challenges were leveled. The emerged levels helped us to draw diagraph and FISM model. In this case, Table VII-XII exhibit various iterations showing various levels of emerging hierarchy.

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(7) In the light of relationships evident in Table VII-XII, a diagraph, containing no transitive links, was drawn which was converted into a FISM. We depicted ‘full interaction (1)’, ‘very high interaction (0.9)’, and ‘high interaction (0.7)’ through arrows of different thickness. Thus, final FISM model (Figure II) connected various challenges with such unidirectional and bidirectional arrows. An arrow connecting challenge ‘m’ and challenge ‘n’, pointing from ‘m’ towards ‘n’, depicts that challenge ‘m’ aggravates challenge ‘n’. The thickness of this arrow (as per Table XIII) depicted the strength of interaction between ‘m’ and ‘n’. In this model, challenges occupying the lowest level had a ‘aggravate’ sort of bearing with the other challenges at the subsequent higher level in hierarchy.

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(8) Based on the dominance of interaction among these challenges, their deriving power and dependence, Fuzzy MICMAC analysis was carried out. It helped us in classifying these challenges into four different groups namely autonomous, independent, dependent and linkage challenges (Figure III). The autonomous challenges were characterized with weak driving power and weak dependence, and thus, they appeared quite disconnected from the system.

The dependent challenges (keeping commissions and fees reasonable, intensive competition, variety of offers sought by customers, and ever increased demand volume) had weak driving power but strong dependence, whereas the linkage challenges (maintenance of temperature during transit, building and maintaining customer confidence about infection free hygienic delivery, and huge infrastructural networks required) had strong driving power and dependence. Any action on one of the specific linkage challenges generally affects others, and ultimately, experiences a reflexive effect on itself. The independent challenges (on-time delivery, increased number of specific needs groups, and traditional family values) were characterized with strong driving power and weak dependence. Such challenges must be dealt with utmost caution as they affect other challenges appearing at the top of FISM hierarchy. The proposed FISM model is reviewed for any likely conceptual inconsistency, and the modifications are introduced with the help of experts, if required.

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5. Findings, discussion and conclusions

This research examined the structural relationship among various identified operational maturity challenges that OFODEs faced during temporary Covid-19 lockdown period in Oman. We also incorporated the degree of dominance of interaction among these challenges while modeling structural relationship among them. The proposed FISM model shows that ‘increased number of specific needs groups’, ‘traditional family values’, and ‘customer confidence about secure transaction’ lie at the bottom of hierarchy. The increasing number of lifestyle related ailments convince individuals to switch to their traditional values (eg. late night outings with friends, morning exercises etc.). However, their unaltered day time activities further aggravate

such ailments. This finding corroborates with Singh *et al.* (2020) who emphasized upon the proven benefits of adopting traditional lifestyle and value system. In this vein, Aiswarya and Ramasundaram (2023) also examined how home cooking evasion affects the food, health, culture and societal bonds. On the contrary, shift in family values vis a vis food habits (Bracale and Vaccaro, 2020; Senthil *et al.* 2020) was found as a driver of OFODEs. Some customers are so influenced and attached to existing transactional practices that they usually find it insecure to adopt modern ways. Furthermore, online banking fraud cases further strengthens their belief in traditional banking system. We concur with Gupta and Duggal (2020) and Koay *et al.,* (2022) who argued that controlling consumers' risk and perceptions might convince them to use OFODEs to certain extent. Even those consumers who use any food delivery app may hesitate to recommend it to others for potential transactional security concerns (Belanche *et al.,* 2020).

'On-time delivery', 'maintenance of temperature during transit', and 'building and maintaining customer confidence about infection free hygienic delivery' occupy the next higher level in the hierarchy. Among these, the first two challenges are all time challenges. In other words, the bottom level challenges aggravate them. For instance, an increased number of specific needs groups would aggravate the challenge of delivering on right time and in the right condition (particularly desired temperature). Being hungry, if diabetic customer places an online order, the company has to ensure a timely delivery, failing which the customer may suffer any severe medical circumstances. Furthermore, maintenance of temperature during transit as well as customers' confidence about infection free hygienic delivery determines the quality of food. Food quality (Suhartanto *et al.,* 2019; Dsouza and Sharma 2021) and on-time delivery (Lau and Ng, 2019; Gupta and Duggal, 2020) act as two important determinants of customer satisfaction and loyalty toward OFODEs.

Before Covid 19, customers were usually concerned about apparent cleanliness. However, an infection free food delivery became as important as cleanliness now. The belief in traditional value system (Principato *et al.*, 2020; Pandey et al., 2022) and home baked/cooked food further substantiated the power of abstinence. Furthermore, a delayed delivery aggravates the temperature maintenance issues, customers' skepticism about hygiene and infection.

'Coordination among customers, delivery persons and restaurants', 'huge infrastructural networks required', and 'trustworthiness of the delivery persons in crowdsourcing mechanism' occupy the subsequent joint spot in hierarchy. It is quite convincing that as pressure for on time

food delivery with desired temperature increases, it augments the challenge of mutual coordination, required infrastructure as well as trustworthiness of delivery persons. In the presence of contract delivery persons like Ubereats (Griesbach *et al.,* 2019), customers' concern about the delivery of an infection free food further intensifies these challenges. This finding is in line with Gupta and Duggal (2020) who considered trust, improper and late delivery, and infection free hygienic food concerns as psychological risks assumed by the consumers. Consumers exhibiting high-perceived threat and less perceived benefits of OFODEs are less likely to order food through OFODEs (Mehrolia *et al.,* 2020). At times, lack of required infrastructure leads to the poor level of coordination, whereas at some other points of time, poor level of coordination reflects some sort of infrastructural inefficacies and inadequacies. The challenge of inadequate infrastructure may lead to poor coordination that ultimately affects the credentials of delivery persons also. On the contrary, if the delivery persons engaged through a crowdsourcing mechanism prove not be trustworthy, again company infrastructural challenge soar up.

In addressing the challenge of infrastructural inadequacy or coordination or trustworthiness of delivery persons, the companies have to make significant financial commitments. Since capacity expansion decisions are generally irreversible in short run, it intensifies the level of competition. With enhanced set of competencies, the companies are capable of offering many lucrative offers and services. As a result, there would be an increase in demand volume. In the studied circumstances, the temporary lockdown scenario had restricted the food-hoppers to just limited options (pay and pick, drive-through, online food ordering). Customers find the latter to be more appealing for many apparent advantages viz. saving efforts, time and cost, opportunity to avail many offers, opportunity to order something even from the farthest location with an insignificant additional cost etc. (Sharma and Waheed, 2018; Gupta and Duggal, 2020).

During initial days, there were some panic purchase instances as well which contributed to unprecedented excessive demand. This challenge contradicted the findings of Yang *et al.* (2020) who argued that a unitary increase in new COVID-19 cases per day led to more than a unitary decline in stay-at-home orders in US. It might be due to excessive skepticism about likely food borne transmission in US. However, other studies in Taiwanese context (Chang and Meyerhoefer, 2020) and Scandinavian context (Andersen *et al.*, 2020) reported an increase in the number of consumers as well as sales volume at an agri-food e-commerce platform. These researchers attributed this hike in demand to be responsible for changed consumer behavior as there was no

lockdown situation in Taiwan. Hobbs (2020) also highlighted the struggle of mainstream food supply chains in responding to the unprecedented demand shock resulting from Covid-19 related abrupt behaviors. Food choices, particularly during quarantine period, have affected the rate of incremental demand across product categories (Bracale and Vaccaro, 2020). As a temporary measure, such unprecedented demand situations may be handled using the Doordash approach of 'bonus pay' so that another likely problem of labor shortage may timely be avoided (Griesbach *et al.*, 2019).

These challenges, particularly the pressure of intensive competition, further adds up to the challenge of variety of offers sought. These offers work as the rewards for loyal and repeat customers, and the sources of attraction for newcomers. This finding is in line with Troise *et al.* (2020) who believed that online food delivery companies respond to competitive calls by launching various promotional offers and discounts. Taylor, Jr, S. (2021) believed that campuses looking to roll out a mobile-food ordering app for their students might better consider certain loyalty programs to increase their adoption and usage. However, increased pressure related to such offers results in a pressure on the company to charge only reasonable commissions. This finding supports the outcome of Li *et al.* (2020) who noted that OFODEs had largely been criticized for their high commissions.

Like MICMAC analysis (Sreenivasan and Suresh, 2022), the Fuzzy MICMAC analysis classifies these challenges into four broader categories. The autonomous challenges namely 'coordination among customers, delivery persons and restaurants', 'trustworthiness of the delivery persons in crowdsourcing mechanism', and 'customer confidence about secure transaction' are of moderate degree as they neither usually drive nor are driven by other challenges. These OFODEs may continually monitor and encounter them. Zhao and Bacao (2020) also observed that among many other factors, consumers' perceived trust also played a very crucial role in shaping their continuance intention of using food delivery apps during COVID-19. Pillai *et al.* (2022) believed that in addition to consumers' perceived trust, perceived benefits, perceived risks and online persuasion practices influence their intention to use such apps.

The dependent challenges viz. 'keeping commissions and fees reasonable', 'intensive competition', 'variety of offers sought by customers', and 'ever increased demand volume' didn't drive many other challenges, however, these were driven by related challenges. Simply put, OFODEs need to take caution more about the challenges that aggravate this group. 'Maintenance

of temperature during transit', 'building and maintaining customer confidence about infection free hygienic delivery' and 'required huge infrastructural networks' strongly aggravate other challenges and are aggravated by other related challenges. Closely knitted together, a change in one challenge affects the other one and vice-versa. For instance, if required infrastructure is not in place, the undesired temperature of food items may lead customers to cast doubts about the maintenance of hygiene. The timeliness and temperature were beholden to influence the traditional beliefs. Increased number of specific needs groups were most concerned with infection-free delivery as Covid-19 had been seen more lethal for individuals who suffered from pre-existing ailments. Thippareddi *et al.* (2020) also highlighted this concern of foodborne transmission of coronavirus. These OFODEs need to be extra careful in handling such challenges.

The independent challenges viz. 'on-time delivery', 'increased number of specific needs groups' and 'traditional family values' were strong in driving the other challenges. For instance, stronger belief in traditional family values would aggravate the challenge of building and maintaining customer confidence about infection free hygienic delivery. It puts pressure on OFODEs to ensure high levels of performance, failing which, they may experience customers' defection. Thus, the extent of control over such challenges by OFODEs would definitely be helpful for them in handling other related and driven challenges.

The major findings of this study may be summed up as follows. The proposed FISM model shows that 'increased number of specific needs groups', 'traditional family values', and 'customer confidence about secure transaction' occupying the bottom of hierarchy aggravate the next higher-level operational maturity challenges namely 'on-time delivery', 'maintenance of temperature during transit', and 'building and maintaining customer confidence about infection free hygienic delivery'. The first two challenges were perennial kind of challenges. In any case, these challenges drive others ('Coordination among customers, delivery persons and restaurants', 'huge infrastructural networks required', and 'trustworthiness of the delivery persons in crowdsourcing mechanism'), occupying subsequent higher level in hierarchy. The argument, increased pressure for timely food delivery with desired temperature augments the challenge of mutual coordination, required infrastructure as well as trustworthiness of delivery staff, holds water. Addressing the concerns pertaining to infrastructural inadequacy or poor coordination or trustworthiness of the delivery persons, OFODEs have to make significant financial commitments which intensifies the level of competition. With enhanced set of competencies and many lucrative offers, OFODEs may

succeed in raising the demand volume. In this scenario, customers start seeking variety of offers, which ultimately pressurizes OFODEs to charge only reasonable commissions. For instance, SkipTheDishes (Canada) reduced its fees to support the struggling restaurant industry (Goddard, 2021). Besides, certain provincial governments in Canada also introduced ceiling limits on such fees. Fuzzy MICMAC analysis reveals that 'coordination among customers, delivery persons and restaurants', 'trustworthiness of the delivery persons in crowdsourcing mechanism', and 'customer confidence about secure transaction' are of autonomous nature whereas 'keeping commissions and fees reasonable', 'intensive competition', 'variety of offers sought by customers', and 'ever increased demand volume' are of dependent nature. 'Maintenance of temperature during transit', 'building and maintaining customer confidence about infection free hygienic delivery' and 'required huge infrastructural networks' are classified as linkage challenges whereas 'on-time delivery', 'increased number of specific needs groups' and 'traditional family values' emerged as independent challenges.

6. Implications and limitations of the study

When considering how all thirteen operational maturity challenges affected one another during the unprecedented Covid-19, the challenge to keep fees and commissions reasonable was found as the most dependent challenge. In general, building and maintaining customer confidence in infection-free delivery is expected to be the foremost concern, however, the experts think otherwise. In fact, customers may pay reasonably higher amount against a degree of assurance about hygienic food. The financial strain caused by slowdown of economic activities during Covid-19 related partial lockdown was enough for common men to prudently spend every single penny. Thus, for achieving their various commercialization objectives, the first and foremost thing for OFODEs was to contain the fees and commissions. Now when the situation has almost eased out, this operational maturity challenge for OFODEs may be reassessed.

Furthermore, these enterprises need to pay even higher degree of attention to their customers, address their riders' challenges, expand their infrastructural capabilities, and streamline their processes and communication systems to reduce errors and timely deliver quality foods. Any kind of negligence at these fronts have economic, social as well as environmental ramifications. For instance, inadequate communication systems causing frequent errors in receiving orders, disseminating it to the kitchen staff, preparing delivering a wrong parcel or at a wrong location, or

at a wrong timing may cause customer dissonance which may result in loss of revenue in short run and the loss of goodwill and trust in the long-run. However, employing appropriate measures for these situations may improve the trustworthiness of delivery persons, customer confidence in infection-free delivery, and trust about a secure transaction. It will eventually appeal traditional customers having low or no reliance on online transactions, the customers with lifestyle ailments, and those who are adherent to traditional family values to embrace online food ordering. As a result, OFODEs would be in a better position to exploit any arising market opportunity particularly during post Covid-19 era.

Since pandemic caused global consumers to exhibit the most viable consumption patterns, OFODEs proved themselves as one of the most preferred options. Thus, given the generic set of expectations from such OFODEs, the challenges highlighted in this study have limited global implications for cultural and socio-religious gaps. In particular, those OFODEs willing to expand beyond MENA region, certain additional challenges like 'concerns regarding Halal status of food' may become operational. In addition to this, these findings may not be equally beneficial for the online food ordering and delivery platforms owned and managed by food giants like KFC, McDonald, Pizza Hut, Brooklyn, Subway etc., for they have one and the same objective and unity of command. Furthermore, ceasing of Covid-19 transmission and mass-vaccination of global population has induced consumers' resumption towards dining-out mildly, affecting the OFODEs. The geographical coverage (Oman), operational coverage (leaving the company owned online delivery platforms like KFC, Pizza Hut, McDonald etc.), actual delivery type (personal), number of responses (seven), and adoption of a purely subjective approach comprise the key limitations of this study. Thus, future researchers may examine the generalizability of this study by expanding its scope, and validate this model using an objective approach. Its replication in different regions may clarify how other aspects like socio-cultural bonds, local infrastructure, economic and environmental issues might impact and modify these findings. In the current post Covid-19, a comparative study between current dine-in operations and pure home delivery operations, or between the OFODEs platforms and the company owned online delivery platforms using innovative methodological approaches or mixed method research approaches may add value to the extant literure.

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References

Abbas, H., Asim, Z., Ahmed, Z. and Moosa, S., (2021), "Exploring and establishing the barriers to sustainable humanitarian supply chains using fuzzy interpretive structural modeling and fuzzy MICMAC analysis", *Social Responsibility Journal,* https://doi.org/10.1108/SRJ-12-2020-0485.

Abbas, H., Mehdi, M., Azad, I. and Frederico, G.F., (2022), "Modelling the abstract knots in supply chains using interpretive structural modelling (ISM) approaches: a review-based comprehensive toolkit", *Benchmarking: An International Journal,* https://doi.org/10.1108/BIJ-08-2021-0459.

Aiswarya, Balachandar, and Gurusamy Ramasundaram (2023). "Online food delivery technology and family food traditions: A sociocultural perspective." *Journal of Information Technology Teaching Cases*: 20438869221150826. https://doi.org/10.1177/204388692211508.

Alazaiza, M.Y., AbdelFattah, F.A.M., Al Maskari, T., Bashir, M.J., Nassani, D.E., Albahnasawi, A., Abushammala, M.F.M. and Hamad, R.J., (2022), "Effect of COVID-19 pandemic on food purchasing and waste generation during the lockdown period in The Sultanate of Oman". *Global Nest Journal,* Vol.24, No.1, pp.59-64.

Ali, I., Nagalingam, S., and Gurd, B. (2017), "Building resilience in SMEs of perishable product supply chains: enablers, barriers and risks", *Production Planning & Control,* Vol. 28, No. 15, pp. 1236-1250.

Amicarelli, V., Lagioia, G., Pamfilie, R., Grosu, R.M. and Bux, C., (2021), "Food Delivery Platforms During the COVID-19 Pandemic", In: R. Pamfilie, V. Dinu, L. Tăchiciu, D. Pleșea, C. Vasiliu eds. 2021. *7th BASIQ International Conference on New Trends in Sustainable Business and Consumption.* Foggia, Italy, 3-5 June 2021. Bucharest: ASE, pp. 158-164.

Andersen, A. L., Hansen, E. T., Johannesen, N., and Sheridan, A. (2020), "Pandemic, shutdown and consumer spending: Lessons from Scandinavian policy responses to COVID-19", Working Paper *arXiv preprint arXiv:2005.04630*.

Bacao, F., and Zhou, Y. (2020), "What factors determining customer continuingly using food delivery apps during 2019 novel coronavirus pandemic period?", *International Journal of Hospitality Management.* 91, p.102683.

Belanche, D., Flavián, M. and Pérez-Rueda, A. (2020), "Mobile apps use and wom in the food delivery sector: The role of planned behavior, perceived security and customer lifestyle compatibility", *Sustainability*, Vol.12, No.10, p.4275.

Bracale, R. and Vaccaro, C. M. (2020), "Changes in food choice following restrictive measures due to COVID-19", *Nutrition, Metabolism and Cardiovascular Diseases*, Vol. 30, No. 9, pp. 1423-1426. https://doi.org/10.1016/j.numecd.2020.05.027.

Chang, H. H. and Meyerhoefer, C. D. (2020), "COVID-19 and the Demand for Online Food Shopping Services: Empirical Evidence from Taiwan", *American Journal of Agricultural Economics*. doi: 10.1111/ajae.12170.

Das, S. K., Azmi, F. T., and James, P. S. (2020), "Factors Influencing Employees' Perception of Human Resource Practice: A Fuzzy Interpretive Structural Modeling Approach", *Jindal Journal of Business Research*, Vol. 9 No.1, pp.41-55.

Dsouza, D., and Sharma, D. (2020), "Online food delivery portals during COVID-19 times: an analysis of changing consumer behavior and expectations", *International Journal of Innovation Science*. Vol.13 No.2, pp.218-232.

El-Said, O. and Al Hajri, S., (2022), "Are customers happy with robot service? Investigating satisfaction with robot service restaurants during the COVID-19 pandemic", *Heliyon*, Vol.8 No.3, p.e08986.

Eskyte, I., Lawson, A., Orchard, M. and Andrews, E., (2020), "Out on the streets–crisis, opportunity and disabled people in the era of Covid-19: reflections from the UK", *Alter*, Vol.14 No.4, pp.329-336.

Faisal, M. N., Jabeen, F., and Katsioloudes, M. I. (2017), "Strategic interventions to improve women entrepreneurship in GCC countries", *Journal of Entrepreneurship in Emerging Economies*. Vol.9 No.2, pp.161-180. http://dx.doi.org/10.1108/JEEE-07-2016-0026.

Farah, M.F., Ramadan, Z. and Kanso, J., (2022), "Satisfying the online food crave: The case of online food aggregators", *International Journal of Consumer Studies*, *46*(4), pp.1413-1427.

Fattah, F.A.M.A., Dahleez, K.A., Mohamed, A.H.H., Okour, M.K. and Alawi, A.M.M.A., (2021), "Public health awareness: knowledge, attitude and behaviors of the public on health risks during COVID-19 pandemic in sultanate of Oman", *Global Knowledge, Memory and Communication*, Vol.71 No.1/2, pp.27-51.

Frederico, G. F. (2020), "In Times of Coronavirus, Maturity in Supply Chain Management Really Matters!", Supply Chain Management Review, https://www.scmr.com/article/in_times_of_coronavirus_maturity_in_supply_chain_management_really_matters, Accessed on June 2020.

Frederico, G. F. and Martins, R.A. (2014), "Performance Measurement Systems for Supply Chain Management: How to Manage its Maturity", *International Journal of Supply Chain Management*, Vol. 3, No. 2. pp.24–30. Available in: https://ojs.excelingtech.co.uk/index.php/IJSCM/article/view/924/pdf

Ganapathi, P. and Abu-Shanab, E. A. (2020), "Customer satisfaction with online food ordering portals in Qatar". *International Journal of E-Services and Mobile Applications (IJESMA)*, Vol. *12*, *No.*1, pp. 57-79.

Ganou, E., Karavasilis, G., Vrana, V. and Kehris, E., (2022), "Online Food Ordering and Delivery Applications: An Empirical Study of the Factors Affecting Intention to Reuse", In *Transcending Borders in Tourism Through Innovation and Cultural Heritage* (pp. 961-975). Springer, Cham.

Goddard, E., (2021), "The impact of COVID-19 on food retail and food service in Canada: A second assessment", *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, *69*(2), pp.167-175.

Goh, S. Ng, S. Wong, S. and Chong, L. (2017), "Outsourcing to Online Food Delivery Services: Perspective of F&B Business Owners". *Journal of Internet Banking and Commerce*, Vol. 22, No. 2, pp. 1-18.

Griesbach, K., Reich, A., Elliott-Negri, L. and Milkman, R., (2019), "Algorithmic control in platform food delivery work", *Socius*, *5*, p.2378023119870041.

Gupta, V. and Duggal, S. (2020), "How the consumer's attitude and behavioral intentions are influenced: A case of online food delivery applications in India", *International Journal of*

Culture, Tourism and Hospitality Research. Vol.15 No.1, pp.77-93. DOI 10.1108/IJCTHR-01-2020-0013.

Hassen, Tarek Ben, Hamid El Bilali, Mohammad S. Allahyari, Hazem Al Samman, and Soroush Marzban. (2021), "Observations on Food Consumption Behaviors During the COVID-19 Pandemic in Oman", *Frontiers in public health* Vol.9. https://doi.org/10.3389/fpubh.2021.779654

Hobbs, J. E. (2020), "Food supply chains during the COVID-19 pandemic", *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie,* Vol. 68 No. 2, pp.171-176.

Huang, H. L. (2023). "Challenges for contactless online food delivery services during the COVID-19 pandemic in Taiwan: Moderating effects of perceived government response". *Evaluation and Program Planning*, Vol. *97*, 102249, pp. 1-11.

Idris, Nabilah, Mohamad Nur Farihin Abu Bakar, Yusrina Yakub, Dhabitah Arabi, and Mohammad Nabil Almunawar (2023). "Online Food Delivery Services During COVID-19: A Case Study in Brunei Darussalam." In *Handbook of Research on Artificial Intelligence and Knowledge Management in Asia's Digital Economy*, pp. 335-365. IGI Global.

Ismail, L.C., Osaili, T.M., Mohamad, M.N., Al Marzouqi, A., Jarrar, A.H., Zampelas, A., Habib-Mourad, C., Jamous, D.O.A., Ali, H.I., Al Sabbah, H. and Hasan, H., (2021), "Assessment of eating habits and lifestyle during the coronavirus 2019 pandemic in the Middle East and North Africa region: a cross-sectional study", *British Journal of Nutrition*, Vol.126 No.5, pp.757-766.

Jabeen, F. and Faisal, M.N. (2018), "Imperatives for improving entrepreneurial behavior among females in the UAE: an empirical study and structural model", *Gender in Management: An International Journal*, Vol. 33 No. 3, pp. 234-252.

Joshi, R., Banwet, D. K., and Shankar, R. (2009), "Indian cold chain: modeling the inhibitors", *British Food Journal*. Vol. 111 No.11, pp.1260-1283.

Kaur, P., Dhir, A., Ray, A., Bala, P.K. and Khalil, A. (2020), "Innovation resistance theory perspective on the use of food delivery applications", *Journal of Enterprise Information Management*, Vol. 34 No.6, pp.1746-1768. https://doi.org/10.1108/JEIM-03-2020-0091

Khatwani, G., Singh, S. P., Trivedi, A., and Chauhan, A. (2015), "Fuzzy-TISM: A fuzzy extension of TISM for group decision making", *Global Journal of Flexible Systems Management*, Vol. 16, No. 1, pp. 97–112.

Koay, K. Y., Cheah, C. W., and Chang, Y. X. (2022), "A model of online food delivery service quality, customer satisfaction and customer loyalty: a combination of PLS-SEM and NCA approaches" *British Food Journal*. https://doi.org/10.1108/BFJ-10-2021-1169

Laguna, L., Fiszman, S., Puerta, P., Chaya, C., and Tárrega, A. (2020), "The impact of COVID-19 lockdown on food priorities. Results from a preliminary study using social media and an online survey with Spanish consumers", *Food Quality and Preference*, Vol. 86, 104028. https://doi.org/10.1016/j.foodqual.2020.104028.

Lau, T., and Ng, D. (2019), "Online Food Delivery Services: Making Food Delivery the New Normal", *Journal of Marketing Advances and Practices*, Vol. 1, No. 1, pp. 62-77.

Li, C., Mirosa, M. and Bremer, P. (2020), "Review of Online Food Delivery Platforms and their Impacts on Sustainability", *Sustainability,* Vol. 12, No. 14, p.5528.

Mehrolia, S., Alagarsamy, S., and Solaikutty, V. M. (2020), "Customers response to online food delivery services during COVID-19 outbreak using binary logistic regression", *International Journal of Consumer Studies.* Vol.45 No.3, pp.396-408. doi:10.1111/ijcs.12630.

Melewar, T.C., Alwi, S., Gorane, S.J. and Kant, R. (2013), "Modelling the SCM enablers: an integrated ISM- fuzzy MICMAC approach", *Asia Pacific Journal of Marketing and Logistics*. Vol.25 No.2, pp.263- 286.

Oman Observer (2021), "Online food delivery booms in Sultanate", https://www.omanobserver.om/online-food-delivery-booms-in-sultanate/ Accessed on March 30, 2021 at 10:57 GST.

Pal, D., Funilkul, S., Eamsinvattana, W. and Siyal, S., (2021), "Using online food delivery applications during the COVID-19 lockdown period: What drives University Students' satisfaction and loyalty?", *Journal of Foodservice Business Research*, pp.1-45. https://doi.org/10.1080/15378020.2021.1964419.

Pandey, S., Chawla, D. and Puri, S. (2022). "Food delivery apps (FDAs) in Asia: an exploratory study across India and the Philippines". *British Food Journal*, Vol. *124, No.* 3, pp.657-678.

Pillai, S.G., Kim, W.G., Haldorai, K. and Kim, H.S. (2022). "Online food delivery services and consumers' purchase intention: Integration of theory of planned behavior, theory of perceived risk, and the elaboration likelihood model". *International Journal of Hospitality Management*, Vol. *105*, p.103275. https://doi.org/10.1016/j.ijhm.2022.103275.

Prasetyo, Y.T., Tanto, H., Mariyanto, M., Hanjaya, C., Young, M.N., Persada, S.F., Miraja, B.A. and Redi, A.A.N.P., (2021), "Factors affecting customer satisfaction and loyalty in online food delivery service during the COVID-19 pandemic: Its relation with open innovation". *Journal of Open Innovation: Technology, Market, and Complexity*, Vol.7 No.1, p.76.

Principato, L., Mattia, G., Di Leo, A. and Pratesi, C. A. (2021), "The household wasteful behaviour framework: A systematic review of consumer food waste", *Industrial Marketing Management,* Vol. 93, pp.641-649.

Puram, P., Gurumurthy, A., Narmetta, M. and Mor, R.S., (2022). "Last-mile challenges in on-demand food delivery during COVID-19: understanding the riders' perspective using a grounded theory approach". *The International Journal of Logistics Management*, Vol.33, No.3, pp.901-925.

Rizou, M., Galanakis, I. M., Aldawoud, T. M., and Galanakis, C. M. (2020), "Safety of foods, food supply chain and environment within the COVID-19 pandemic", *Trends in food science & technology,* Vol. 102, pp. 293-299.

Rosario, Albérico Travassos. (2023). "Future Challenges of Marketing Online-to-Offline (O2O)." In *Marketing and Advertising in the Online-to-Offline (O2O) World*, pp. 1-27. IGI Global.

Samori, Z., An'nahari, N.A.L., Sahri, M. and Nor, N.A.M. (2023). "From the chef's kitchen to your doorstep: Implementation of halal supply chain management for online food delivery services". *International Journal of Asian Social Science,* Vol. *13, No.* 1, pp.14-28.

Shankar, A., Jebarajakirthy, C., Nayal, P., Maseeh, H.I., Kumar, A. and Sivapalan, A., (2022). Online food delivery: A systematic synthesis of literature and a framework development. *International Journal of Hospitality Management*, Vol. *104*, p.103240.

Senthil, M., Gayathri, N., and Chandrasekar, K. S. (2020), "Changing Paradigms of Indian Foodtech Landscape-Impact of Online Food Delivery Aggregators", *International Journal on Food System Dynamics,* Vol. 11, No. 2, pp.139-152.

Sharma, A., Abbas, H., and Siddiqui, M. Q. (2021), "Modelling the inhibitors of cold supply chain using fuzzy interpretive structural modeling and fuzzy MICMAC analysis", *Plos one*, Vol.16 No. 4, e0249046.

Sharma, R.K. (2021), "ISM and fuzzy logic approach to model and analyze the variables in downstream supply chain for perfect order fulfillment", *International Journal of Quality and*

Reliability Management, Vol.38 No.8, pp.1722-1746. ahead-of-print. https://doi.org/10.1108/IJQRM-09-2020-0294

Sharma, K., and Waheed, K. A. (2018), "Consumption of online food app services: An exploratory study among college students in Dubai", *Middle East Journal of Business*, Vol.13, No.4, pp.4-11.

Singh, A., Banerjee, P., Anas, M., Singh, N. and Qamar, I., (2020), "Traditional nutritional and health practices targeting lifestyle behavioral changes in humans", *Journal of Lifestyle Medicine*, Vol.10 No.2, p.67.

Singh, S., Kumar, R., Panchal, R., and Tiwari, M. (2020), "Impact of COVID-19 on logistics systems and disruptions in food supply chain", *International Journal of Production Research*, Vol.59 No.7, pp.1993-2008. https://doi.org/10.1080/00207543.2020.1792000.

Söderberg, L. and Bengtsson, L. (2010), "Supply chain management maturity and performance in SMEs", *Operations Management Research*, Vol.3, pp.90-97. http://dx.doi.org/ 10.1007/s12063-010-0030-6

Sreenivasan, A. and Suresh, M. (2022), "Modeling the enablers of sourcing risks faced by startups in COVID-19 era", *Journal of Global Operations and Strategic Sourcing*, Vol. 15 No. 2, pp. 151-171. https://doi.org/10.1108/JGOSS-12-2020-0070.

Suhartanto, D., Helmi Ali, M., Tan, K. H., Sjahroeddin, F. and Kusdibyo, L. (2019), "Loyalty toward online food delivery service: the role of e-service quality and food quality", *Journal of Foodservice Business Research*, Vol. 22, No. 1, pp. 81-97, DOI: 10.1080/15378020.2018.1546076.

Sushil (2018), "How to check correctness of total interpretive structural models?" *Annals of Operations Research*, Vol.270 No.1/2, pp.473-487.

Taylor, S. (2021), "Campus dining goes mobile: Intentions of college students to adopt a mobile food-ordering app", *Journal of Foodservice Business Research*, Vol. 24, No. 2, pp. 121-139.

Thippareddi, H., Balamurugan, S., Patel, J., Singh, M. and Brassard, J. (2020), "Coronaviruses–Potential human threat from foodborne transmission?", *Lwt*, 110147.

Thoti, K. K., Sathiswaran, A., Yusuff, Y. Z. B. M. I., & Merican, R. M. B. A. R. (2023). Online Food Delivery Apps' Impact as Third-Party Logistics Providers on Malaysian Restaurants' Business Models. *resmilitaris*, *13*(2), pp. 5470-5482.

Troise, C., O'Driscoll, A., Tani, M. and Prisco, A., (2020), “Online food delivery services and behavioural intention–a test of an integrated TAM and TPB framework”, *British Food Journal*. Vol.123 No.2, pp.664-683.

Wignjadiputro, I., Widaningrum, C., Setiawaty, V., Wulandari, E. W., Sihombing, S., Prasetyo, W. A., ... and Subuh, M. (2020), “Whole–of–society approach for influenza pandemic epicenter Containment exercise in Indonesia”, *Journal of Infection and Public Health*, Vol. 13, No.7, pp.994-997.

Wui Lun, W.L. and Quoquab, F. (2023), "As Food Delivery Business Is Skyrocketing, So Is Our Environmental Disaster", Crowther, D. and Quoquab, F. (Ed.) Socially Responsible Plastic (Developments in Corporate Governance and Responsibility, Vol. 19), Emerald Publishing Limited, Bingley, pp. 75-87. https://doi.org/10.1108/S2043-052320230000019005.

Yang, F.X., Li, X., Lau, V.M.C. and Zhu, V.Z., (2021), “To survive or to thrive? China’s luxury hotel restaurants entering O2O food delivery platforms amid the COVID-19 crisis”, *International Journal of Hospitality Management*, Vol. 94, p.102855.

Yang, Y., Liu, H., and Chen, X. (2020), “COVID-19 and restaurant demand: early effects of the pandemic and stay-at-home orders”, *International Journal of* Contemporary *Hospitality Management*, Vol.32 No.12, pp.3809-3834. DOI 10.1108/IJCHM-06-2020-0504

Zhao, Y., and Bacao, F. (2020), “What factors determining customer continuingly using food delivery apps during 2019 novel coronavirus pandemic period?”, *Int J Hosp Manag*. 2020 Oct;91:102683. doi: 10.1016/j.ijhm.2020.102683. Epub 2020 Sep 9. PMID: 32929294; PMCID: PMC7480677.

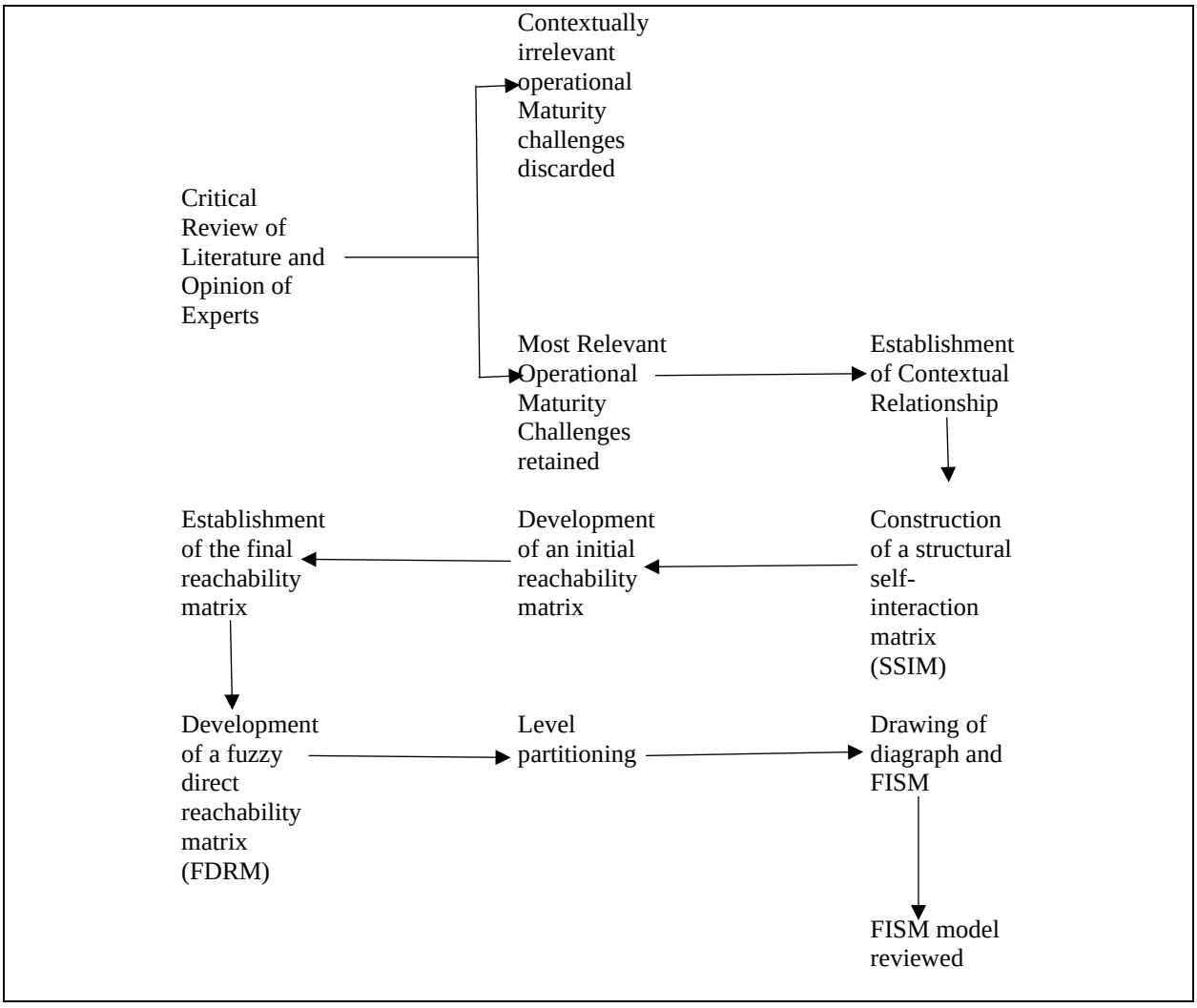

Figure I The FISM Process (Adapted the process proposed by Joshi *et al.*, 2009)

Table I The operational maturity challenges faced by the online food delivery companies during lockdown period

Id	Challenge	Operational definition
C_1	On-time delivery	On-time delivery refers to fulfillment of customers' order in a timely manner. Ref. Gupta and Duggal, 2020
C_2	Maintenance of temperature	It refers to the maintenance of the required temperature during transit period so that the order is delivered in a desired and acceptable state. Ref. Rizou *et al.*, 2020
C_3	Reasonable commissions and fees	It refers to the challenge of keeping commissions and fees reasonable so that there is an optimal tradeoff among various competing goals of such companies. Ref. Li *et al.*, 2020; Koay *et al.*, 2022; Yang *et al.*, 2021
C_4	Coordination	As a challenge, it refers to the streamlining of communications among restaurants, customers and delivery persons. Ref. Ali *et al.*, 2017
C_5	Customer confidence about infection-free hygienic food delivery	It refers to challenge of building and maintaining the consumers' trust that uses all the available means to ensure the infection free hygienic food delivery during this testing time. Ref. Gupta and Duggal, 2020; Rizou *et al.*, 2020; Yang *et al.*, 2021, Koay *et al.*, 2022
C_6	Intensive competition	As a challenge, it refers to the degree of competition which the company faces from other competitors. The restaurants owned home delivery channels also add to it. Ref. Ali *et al.*, 2017
C_7	Infrastructural requirements	This refers to the huge amount of physical, electronic and human resources that is required to ensure the smooth business functioning especially during this period. Ref. Hobbs, 2020; Singh *et al*., 2020
C_8	Variety of offers sought	This refers to the special discounts and coupons that customers expect from online food delivery companies like Talabat, Akeed etc. Ref. Kaur *et al.*, 2020; Pandey *et al*., 2022
C_9	Increased number of specific needs groups	Specific needs groups comprise of those individuals who suffer from various lifestyle related ailments like diabetics, the morbidly obese, cardiovascular issues and psychological instabilities etc. In addition to requiring some sort of customization, such customers are usually volatile also in terms of their demand. Ref. Eskyte *et al.*,2020
C_{10}	Trustworthiness (of delivery persons)	It refers to the extent to which the delivery persons can be trusted by customers as well as by online food delivery companies in terms of their conduct. Ref. Gupta and Duggal, 2020, Zhao and Bacao, 2020; Taylor, 2020; Koay *et al.*, 2022
C_{11}	Traditional family values	As a challenge, it refers to the emphasis on home cooked meals and local dishes. Ref. Bracale and Vaccaro, 2020; Principato *et al.*, 2020; Pandey *et al*., 2022
C_{12}	Customer confidence in secure transactions	This means the degree to which customers find it safe to pay online. Ref. Gupta and Duggal, 2020; Belanche *et al.*, 2020; Taylor, 2020; Koay *et al.*, 2022
C_{13}	Exorbitant demand	It refers to the extraordinary increase in the overall demand due to physical distancing measures, closure of dine-in facility, ban on gatherings etc. Ref. Yang *et al.*, 2020; Hobbs, 2020; Amicarelli *et al.*, 2021

Table II Structural self- interaction matrix (SSIM)

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
C_1	-	X	O	A	X	A	V	O	A	X	O	O	V
C_2		-	O	A	X	A	V	O	A	X	O	O	A
C_3			-	O	O	A	O	A	O	O	A	O	A
C_4				-	A	V	X	O	A	X	O	O	A
C_5					-	O	V	O	A	A	A	O	V
C_6						-	O	V	A	A	A	O	X
C_7							-	V	A	X	O	O	A
C_8								-	A	O	A	A	A
C_9									-	O	X	X	O
C_{10}										-	O	O	O
C_{11}											-	X	V
C_{12}												-	V
C_{13}													-

Table III Initial Reachability Matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
C_1	**1**	1	0	0	1	0	1	0	0	1	0	0	1
C_2	1	**1**	0	0	1	0	1	0	0	1	0	0	0
C_3	0	0	**1**	0	0	0	0	0	0	0	0	0	0
C_4	1	1	0	**1**	0	1	1	0	0	1	0	0	0
C_5	1	1	0	1	**1**	0	1	0	0	0	0	0	1
C_6	1	1	1	0	0	**1**	0	1	0	0	0	0	1
C_7	0	0	0	1	0	0	**1**	1	0	1	0	0	0
C_8	0	0	1	0	0	0	0	**1**	0	0	0	0	0
C_9	1	1	0	1	1	1	1	1	**1**	0	1	1	0
C_{10}	1	1	0	1	1	1	1	0	0	**1**	0	0	0
C_{11}	0	0	1	0	1	1	0	1	1	0	**1**	1	1
C_{12}	0	0	0	0	0	0	0	1	1	0	1	**1**	1
C_{13}	0	1	1	1	0	1	1	1	0	0	0	0	**1**

Table IV Scheme for the degree of perceived dominance of interaction (adopted from Joshi *et al.*, 2009)

Dominance of interaction	**No**	**Very low**	**Low**	**Medium**	**High**	**Very high**	**Full**
Grade	N	NL	L	M	H	VH	F
Value on the scale	0	0.1	0.3	0.5	0.7	0.9	1

Table V Fuzzy Direct Reachability Matrix (FDRM)

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
C_1	-	0.9	0	0	0.9	0	0.7	0	0	0.3	0	0	0.9
C_2	0.9	-	0	0	0.7	0	0.9	0	0	0.9	0	0	0
C_3	0	0	-	0	0	0	0	0	0	0	0	0	0
C_4	0.5	0.5	0	-	0	0.9	0.9	0	0	0.7	0	0	0
C_5	0.7	0.9	0	0.7	-	0	0.9	0	0	0	0	0	0.9
C_6	0.5	0.3	0.3	0	0	-	0	0.9	0	0	0	0	0.9
C_7	0	0	0	0.7	0	0	-	0.9	0	0.7	0	0	0
C_8	0	0	0.9	0	0	0	0	-	0	0	0	0	0
C_9	0.5	0.9	0	0.3	0.9	0.7	0.3	0.9	-	0	0.9	0.9	0
C_{10}	0.5	0.3	0	0.9	0.3	0.9	0.7	0	0	-	0	0	0
C_{11}	0	0	0.9	0	0.7	0.9	0	0.9	0.9	0	-	0.9	0.3
C_{12}	0	0	0	0	0	0	0	0.3	0.9	0	0.9	-	0.3
C_{13}	0	0.3	0.9	0.3	0	0.7	0.5	0.7	0	0	0	0	-

Table VI FDRM-Revised (after excluding the weaker interactions)

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	**Dr.**
C_1	-	0.9	0	0	0.9	0	0.7	0	0	0	0	0	0.9	4.4
C_2	0.9	-	0	0	0.7	0	0.9	0	0	0.9	0	0	0	4.4
C_3	0	0	-	0	0	0	0	0	0	0	0	0	0	1.0
C_4	0	0	0	-	0	0.9	0.9	0	0	0.7	0	0	0	3.5
C_5	0.7	0.9	0	0.7	-	0	0.9	0	0	0	0	0	0.9	5.1
C_6	0	0	0	0	0	-	0	0.9	0	0	0	0	0.9	2.8
C_7	0	0	0	0.7	0	0	-	0.9	0	0.7	0	0	0	4.2
C_8	0	0	0.9	0	0	0	0	-	0	0	0	0	0	1.9
C_9	0	0.9	0	0	0.9	0.7	0	0.9	-	0	0.9	0.9	0	6.2
C_{10}	0	0	0	0.9	0	0.9	0.7	0	0	-	0	0	0	3.5
C_{11}	0	0	0.9	0	0.7	0.9	0	0.9	0.9	0	-	0.9	0	6.2
C_{12}	0	0	0	0	0	0	0	0	0.9	0	0.9	-	0	2.8
C_{13}	0	0	0.9	0	0	0.7	0	0.7	0	0	0	0	-	3.3
Dep.	2.6	3.7	3.7	3.3	4.2	6.0	5.1	5.3	2.8	3.3	2.8	2.8	3.7	

Table VII: Level Partitioning (Iteration I)

Variables	Reachability	Antecedent	Intersection	Level
1	1,2,5,7,13	1,2,5	1,2,5	
2	1,2,5,7,10	1,2,5,9	1,2,5	
3	3	3,8,11,13	3	I
4	4,6,7,10	4,5,7,10	4,7,10	
5	1,2,4,5,7,13	1,2,5,9,11	1,2,5	
6	6,8,13	4,6,9,10,11,13	6,13	
7	4,7,8,10	1,2,4,5,7,10,12	4,7,10	
8	3, 8	6,7,8,9,11,13	8	
9	2,5,6,8,9,11,12	9,11,12	9,11,12	
10	4,6,7,10	2,4,7,10	4,7,10	
11	3,5,6,8,9,11,12	9,11,12	9,11,12	
12	9,11,12	9,11,12	9,11,12	
13	3,6,8,13	1,5,6,13	6,13	

Table VIII: Iteration II

Variables	Reachability	Antecedent	Intersection	Level
1	1,2,5,7,13	1,2,5	1,2,5	
2	1,2,5,7,10	1,2,5,9	1,2,5	
4	4,6,7,10	4,5,7,10	4,7,10	
5	1,2,4,5,7,13	1,2,5,9,11	1,2,5	
6	6,8,13	4,6,9,10,11,13	6,13	
7	4,7,8,10	1,2,4,5,7,10,12	4,7,10	
8	8	6,7,8,9,11,13	8	II
9	2,5,6,8,9,11,12	9,11,12	9,11,12	
10	4,6,7,10	2,4,7,10	4,7,10	
11	5,6,8,9,11,12	9,11,12	9,11,12	
12	9,11,12	9,11,12	9,11,12	
13	6,8,13	1,5,6,13	6,13	

Table IX: Iteration III

Variables	Reachability	Antecedent	Intersection	Level
1	1,2,5,7,13	1,2,5	1,2,5	
2	1,2,5,7,10	1,2,5,9	1,2,5	
4	4,6,7,10	4,5,7,10	4,7,10	
5	1,2,4,5,7,13	1,2,5,9,11	1,2,5	
6	6,13	4,6,9,10,11,13	6,13	III

7	4,7,10	1,2,4,5,7,10,12	4,7,10	
9	2,5,6,9,11,12	9,11,12	9,11,12	
10	4,6,7,10	2,4,7,10	4,7,10	
11	5,6,9,11,12	9,11,12	9,11,12	
12	9,11,12	9,11,12	9,11,12	
13	6,13	1,5,6,13	6,13	III

Table X: Iteration IV

Variables	**Reachability**	**Antecedent**	**Intersection**	**Level**
1	1,2,5,7	1,2,5	1,2,5	
2	1,2,5,7,10	1,2,5,9	1,2,5	
4	4,7,10	4,5,7,10	4,7,10	IV
5	1,2,4,5,7	1,2,5,9,11	1,2,5	
7	4,7,10	1,2,4,5,7,10,12	4,7,10	IV
9	2,5,9,11,12	9,11,12	9,11,12	
10	4,7,10	2,4,7,10	4,7,10	IV
11	5,9,11,12	9,11,12	9,11,12	
12	9,11,12	9,11,12	9,11,12	

Table XI: Iteration V

Variables	**Reachability**	**Antecedent**	**Intersection**	**Level**
1	1,2,5	1,2,5	1,2,5	V
2	1,2,5	1,2,5,9	1,2,5	V
5	1,2,5	1,2,5,9,11	1,2,5	V
9	2,5,9,11,12	9,11,12	9,11,12	
11	9,11,12	9,11,12	9,11,12	
12	9,11,12	9,11,12	9,11,12	

Table XII: Iteration VI

Variables	Reachability	Antecedent	Intersection	Level
9	9,11,12	9,11,12	9,11,12	VI
11	9,11,12	9,11,12	9,11,12	VI
12	9,11,12	9,11,12	9,11,12	VI

Table XIII Notations

Degree of dominance	Symbols
Full (1)	
Very High (0.9)	
High (0.7)	

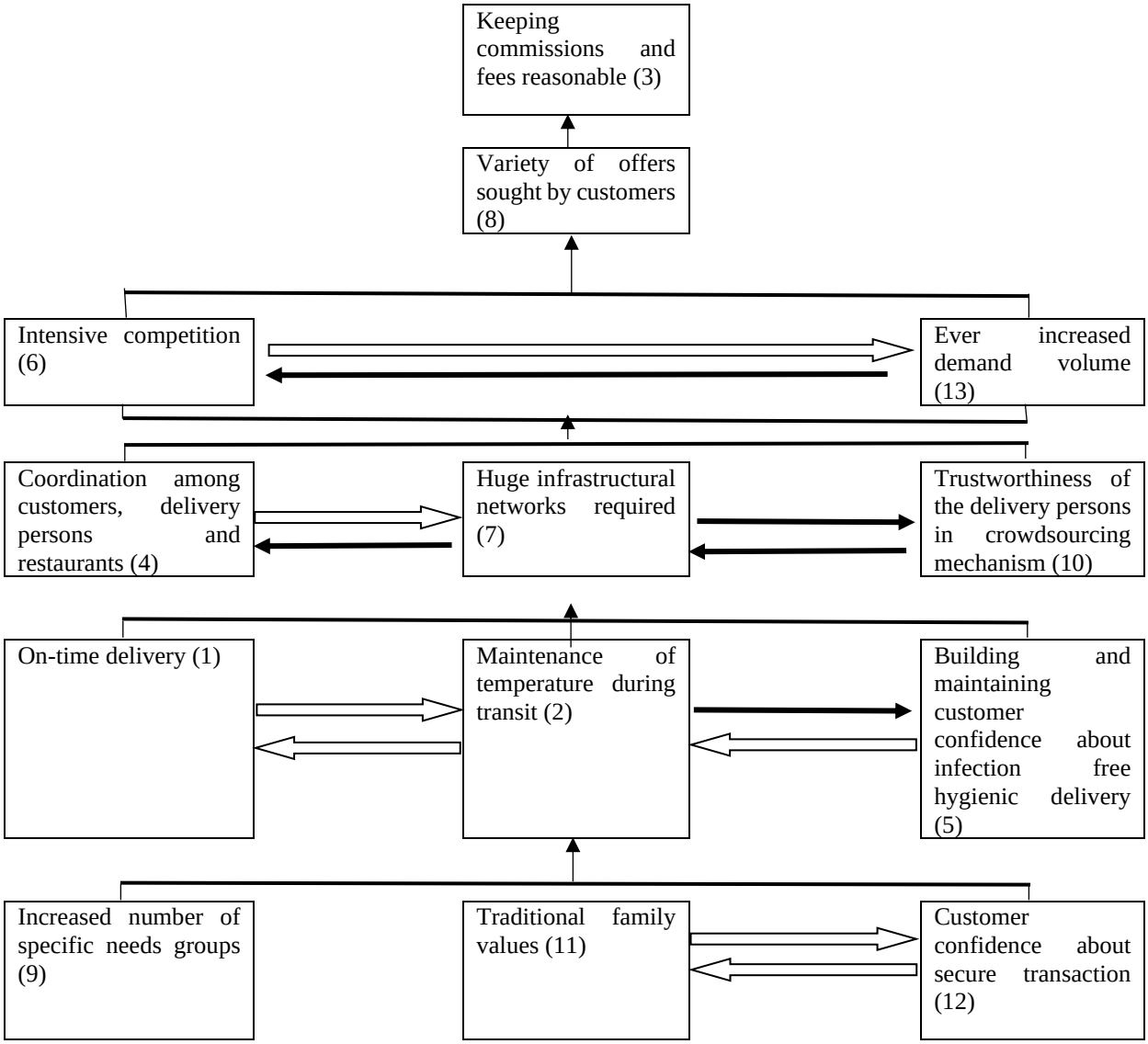

Figure II Fuzzy Interpretive Structural Model for the Operational Maturity Challenges faced by online food delivery enterprises during Covid-19 lockdown period in Oman

Driving Power																
	7.0															
	6.5						9,11									
	6.0															
	5.5										5					
	5.0		**Independent**								**Linkage**					
	4.5						1			2			7			
	4.0															
	3.5							4,10		13						
	3.0						12						6			
	2.5															
	2.0												8			
	1.5		**Autonomous**								**Dependent**					
	1.0									3						
	0.5															
		0.5	1.0	1.5	2.0	2.5	3.0	3.5		4.0	4.5	5.0	5.5	6.0	6.5	7.0
		Dependence														

Figure III Fuzzy MICMAC Analysis