

# Uncertain Supply Chain Management

homepage: [www.GrowingScience.com/uscm](http://www.GrowingScience.com/uscm)

## Fog computing-based logistic supply chain management and organizational agility: The mediating role of user satisfaction

Nader Mohammad Aljawarneh<sup>a\*</sup>, Mohamad M. Taamneh<sup>a</sup>, Nouh Alhndawi<sup>a</sup>, Khaled Abed AlQader Alomari<sup>a</sup> and Fawzieh Masa'd<sup>a</sup>

<sup>a</sup>Business administration department, Jadara University, Jordan

### CHRONICLE

#### Article history:

Received November 8, 2020  
Received in revised format  
January, 28, 2021  
Accepted March 28 2021  
Available online  
April 6 2021

#### Keywords:

Supply chain management  
Fog Computing  
Organizational agility  
User satisfaction

### ABSTRACT

Although fog computing-based logistic supply chain management (Fog computing-based LSCM) is an emerging technology that proved a high impact on services and products, little research has focused on fog computing-based LSCM. Drawing on the Kano model and organization's theory this paper investigates the effect of fog computing-based LSCM on organizational agility. And the role of user satisfaction as mediator between fog computing-based LSCM and organizational agility. A quantitative approach was used, a questionnaire was designed for data collection, Cronbach's Alpha test was performed on a pilot study to examine the internal consistency of questionnaire items. Fog computing-based LSCM was studied based on Supply chain awareness, Connectivity and Logistics, Integration Process, Seamless Supply Chain, Integration of Processes. Data was collected from a random sample of 550 employees of Al-Hassan industrial city in Jordan. Building on the proposed model, Researchers show that fog computing-based LSCM has a positive impact on organizational agility, fog computing-based LSCM has a positive impact on user satisfaction and finally user satisfaction mediates the relationship between fog computing-based LSCM and organizational agility. Implications for the model are discussed.

© 2021 by the authors; license Growing Science, Canada.

## 1. Introduction

In the era of business globalization, computing has become a vital element of survival for organizations (Aljawarneh & Atan, 2018). It represents a key feature of competitiveness that guarantees sustainability in the global economy (Aljawarneh et al., 2020). In the light of the technological challenge facing global organizations is the ability of organizations to achieve user satisfaction, which has become a requirement to enter global markets (Alsafadi et al., 2020). Organizations are experiencing increasing interest in achieving user satisfaction (Al-Omari et al., 2020). It has gained high interest among researchers and practitioners worldwide (Alshare et al., 2020). In recent years, many researchers from the field of business administration as well as other related fields have addressed different aspects of the topic to attain reasonable results for organizations to achieve their goals. Several studies have shown that the greater user satisfaction the fewer errors and conducted mistakes in organizational processes (Violante et al., 2019). Also, more the user satisfaction, more productivity, effectiveness and performance efficiency. User satisfaction is considered the primary factor in the planning process in successful organizations (Bi et al., 2019; Violante et al., 2019). To assess user satisfaction, several measures have been developed. One of the most widely used measures is the one developed by, the Japanese scholar, Noraki Kano in (1984). This measure is considered one of the best tools to assess user satisfaction (Berger, 1993). Accordingly, to achieve user satisfaction, it is required to transform from traditional management style to what is called organizational agility (Mahafzah et al., 2020). In classical management styles: workers in organizations are considered as machines, authority is distant, there is a difficulty of communication between workers, and dictatorial approaches are used in directing individuals within the organization (Alomari et al., 2020). Therefore, international organizations began to look at organizational agility as the only

\* Corresponding author

E-mail address: [n.jawarneh@jadara.edu.jo](mailto:n.jawarneh@jadara.edu.jo) (N. M. Aljawarneh)

way to get rid of these useless management methods in the light of developments and innovations (Tajeddini & Darvishmotevali, 2019).

In this paper, to achieve organizational agility, researchers adopted the model developed by Burns and Stalker (1961). The main features of this model are flexibility, decentralization, and ability to adapt in changing environments. Whereas the classical mechanical model is suitable for stable environments. The success of the organizational agility model requires cooperation between individuals in the organization, satisfaction with the work they do, the delegation of them and the sharing of knowledge (Cooper, 1983).

Fog computing-based LSCM has an important effect in achieving organizational agility (Aljawarneh et al., 2020). Supply chain management (SCM) is a concept that was developed in the 1980s. It proved to be an effective management approach. It is based on reducing the stocks of joint companies participating in the same supply chain (Aljawarneh & Al-Omari, 2018). It is the method of managing the total cost of transportation and distribution operations according to Heckert & Miner (1940). This concept was further developed by performing SCM using Fog Computing, and hence the new concept of fog computing-based LSCM was introduced.

The importance of this new concept is the utilization of fog computing, which is characterized by mobility. It is a multi-layered model that allows reaching a chain of computing resources everywhere (Tajeddini & Darvishmotevali, 2019). It, also, helps distributing applications and services with high storage capabilities. Therefore, fog computing provides viable and fast solutions through the flow of massive information and feedback (Iorga et al., 2018). This high flexibility and capability of fog computing makes it an appropriate solution for analyzing large datasets in a timely manner within the Internet of Things (IoT) to allow organizations to conduct comparisons, predict opportunities, and make critical decisions. Henceforth, fog computing-based LSCM has an effective impact in achieving organizational agility (Alzoubi et al., 2020).

All of this is only viable due to rapid response and the ability to exchange large amounts of information and knowledge between internal and external users. In addition to its ability to work in volatile environments that are witnessing developments in an accelerated manner. Thus, fog computing-based LSCM is considered the appropriate solution for smartphone applications that may need effective computing resources (Iorga et al., 2018; Chalapathi et al., 2019).

Nevertheless, some studies reported some concerns and limitations of using fog computing. Among these are concerns related to privacy and information security (McCathie & Michael, 2005). Other studies revealed that fog computing-based LSCM was not effective in exchanging information, impacts negatively on improving business operations, difficult to use, inflexible, its higher cost and hence economically ineffective (Xie & Ma, 2014). Finally, this study aimed to investigate the mediating role of user satisfaction in relationship between fog computing-based LSCM and organizational agility and to provide a model for improving services to the final customer.

## 2. Literature review & Hypotheses

### 2.1 SCM Development

SCM is the management of the flow of goods and services and includes all processes that transform raw materials into final products. It involves the active streamlining of a business's supply-side activities to maximize customer value and gain a competitive advantage in the marketplace.

**Table 1**

Different schools for the concept of SCM

Evolution stage	Key authors	Main ideas
Supply chain awareness	Houlihan (1987), Jones and Riley (1985), Novack and Simco (1991), Oliver and Webber (1982)	Recognizes the chain of functions through which materials flow from suppliers to end users. Maintains that this chain of functions should be managed.
Linkage/logistics	Scott and Westbrook (1991), Turner (1993)	Deals with the actual linkages among the functional areas, such as suppliers, production, and distribution. The focus is on how the sequence of functional linkages can be exploited for competitive advantage.
Information	Towill, Naim and Wikner (1992)	Emphasizes the bilateral information exchange between supply chain members.
Process integration	Cooper and Ellram (1993), Ellram and Cooper (1990)	Focuses on the integration of the key business processes, regardless of the configuration of functional areas, to satisfy ultimate customers.
Seamless supply chain (relational and process integration)	Childerhouse (2002), Stevens (1989)	Stresses holistic inter- and intra-organizational integration in terms of both processes and relationships.

Source: Adapted from Bechtel and Jayaram (1997); Croom et al. (2000); and Halldórsson, Larson and Poist (2008)

### 2.2 Fog Computing Model

Fog Computing is a multi-layered model that enables access to a common chain of computing resources everywhere. This model facilitates the deployment of distributed applications and services. It consists of a set of physical or virtual linking points between smartphones and central cloud services. These points are called Fog Nodes. Fog Computing is characterized

by reducing the response time to/from supported applications, providing smartphones with efficient computing resources, and providing the ability to connect to the central services network whenever the need arises.

### 2.3 Organizational Agility

Organizational agility, response speed, or strategic agility emerged from the organization's theory. This theory is concerned with the study of organizational structures, which consists of a set of theories (Al-Da'abseh et al., 2018). The model that organizational agility emerged from was the organic or digital (dynamic) model. It was created by Prinz and Stalker in (1961) as an appropriate model in changing and complex environments, where the classical mechanical model does not suit such environments. The developed model is characterized by decentralization, flexibility, ability to adapt to environments, and ability to adapt to changing circumstances. In addition, it is characterized by being less hierarchical and dedicated to jobs. For the success of this model, individuals within the organization must cooperate, authorities must be granted, and everyone should participate (Al-Jawarneh, 2016). Furthermore, horizontal communication must be widespread. This model helps cope with marketplace competition and technological developments in a fast-varying world of today.

### 2.4 User Satisfaction

User satisfaction emerged from Kano theory for customer satisfaction (Kano Model and Analysis of Customer Satisfaction). This analysis was constructed in (1984) by the Japanese scholar Nurhaci Kano. Up to date, this model is considered as an efficient tool for characterizing products based on the perception of customers and its impact on customer satisfaction. This model describes the non-linear relation between product performance and customer satisfaction. The motivation behind proposing this model was the intensive competition between organizations and the difficulty of retaining customers and meeting their needs. Therefore, this model divided product features into four classes: threshold attributes, performance attributes, excitement features, and indifference features (Aljawarneh et al., 2020).

### 2.5 Fog computing-based LSCM & organizational agility

Several studies have been conducted in recent years that addressed organizational agility and its importance towards the success of businesses. Increasing organizational agility will lead to increases the ability to proactively respond to unexpected environmental changes, commitment to continuous transformation and agile include changes at all levels of the organization and its structure, through its leadership dynamics and decision-making, up to the skills and personal relationships of individuals who implement the agile mission (Appelbaum, Calla, Desautels & Hasan, 2017). Cloud computing flexibility and integration were two crucial factors in improving organizational agility (Liu, Chan, Yang & Niu, 2018). Organizational agility is crucial in innovating successful products for the organization, as this enhances the Fuzzy Front End (FFE) in developing new products, the agility of the new product team can be enhanced through the support of higher management and organizing learning, innovation positively manages the impact of organizational agility on overall FFE management (Hoonsopon & Puriwat, 2019). Study by Ravichandran (2019) found that Companies that have powerful capabilities of information systems and generous investment on IT could create platforms that enable them to be more flexible, the company's innovative capability has a positive relationship with organizational agility. Furthermore, companies with higher innovative capabilities were more capable to utilize their digital platforms to enhance agility, the results indicated that organizational agility has a strong positive impact on the company's performance (Ravichandran, 2018). A Study also found that Self Services Business Intelligence (SSBI) plays a crucial role in empowering marketing agility through providing better understanding of supply and demand, increasing access to information, fast responding for requests, and increasing access to navigation behavior between supply and demand, also agility of operational modification through redefining the existing hierarchical structure, employees' empowerment, and providing equal access to data at the organization. The results provided a materialistic proof of the role of SSBI in empowering organizational ability (Bani-Hani, Deniz & Carlsson, 2017). Thus, the following hypothesis was proposed:

**H<sub>1</sub>:** *Fog computing-based LSCM has a positive impact on organizational agility.*

### 2.6 Fog computing-based LSCM & user satisfaction

In a study by Omary and Kalinga (2017), the authors sought to identify the factors that affect user satisfaction of using the electronic management information system (eLMIS) used by the ministry of health in Tanzania. The authors developed a mixed sequential research model. The results showed that the most influencing four factors on user satisfaction were: quality of information, quality of the system, perceived benefit, and facilitation conditions (Al-Da'abseh et al., 2018). In (2018), Davcev and others carried out a study in an aim to employ the state-of-the-art technology, systems and services related to information and communication technology, like Cloud/Fog and Internet of Things (IoT) to empower the food supply chain. In addition to applications and cooperation services inside the agricultural food supply chains. In order to enhance transparency, information flow and management capacity, allowing better interaction of farmers with other elements of the supply chain, especially the consumer. The study provided value chains with better performance by proposing a new food-on-demand business model based on new food quality standards (QoE), bridging the gap between subjective experience and objective criteria based on quality standards. The authors presented an administrative program to raise awareness of fresh food products (FFP). The study was conducted on a group of 30 students from Skopje University. This study showed

that the majority of students were aware only of some aspects of common FFP without deeper knowledge of quality. Thus, the following hypothesis was proposed:

**H<sub>2</sub>:** *Fog computing-based LSCM has a positive impact on user satisfaction.*

### *2.7 User satisfaction & organizational agility*

Organizational agility defined as the organization's ability to adapt to a complex, rapidly changing, and uncertain environment (Goldman, Nagel & Preiss, 1995; Joroff, Porter, Feinberg & Kukla, 2003; Shafer, 1997). It's a factor demonstrating how organizations do their work in order to outpace competitors in a changing environment (Doz, Doz & Kosonen, 2008). It's the ability to produce products in the right place at the right time and at the right price (Roth, 1996). It's knowledge-based work through knowledge management (Banyhamdan et al., 2020). It is used to search for opportunities in a dynamic environment. It does not depend on adaptation only, but rather on utilizing every opportunity in changing environments and gaining a position through competencies within the organization that grow only through their satisfaction and innovations (Chamanifard, Nikpour, Chamanifard & Nobarieidish, 2015). Organizational agility is the ability to change processes in response to unconfirmed requests in an uncertain environment (Salih & Alnaji, 2014). Many international organizations consider organizational agility as an element of organizational survival and competitive advantage (Sharif, Ollier & Hajeer, 1999; Lin, Chiu & Chu, 2006), through the ability to allocate resources and make good use of these resources in existing and emerging environments (Hemel & Rademakers, 2016). A study has identified three dimensions of organizational agility: decision-making, practice, and sensing, the organizational agility works as a link between business efficiency and the speed of companies' information circulation. It affects the decision-making process because it provides comprehensive information and knowledge to improve organizational agility (Lee, Kim & Park, 2011; Park, 2011; Lu, Mishra, Jain & Ramamurthy, 2011; Mikalef & Pateli, 2017).

Previous studies indicated that there is a positive relationship between user satisfaction and organizational agility, it is important that workers within an organization or users retain a level of satisfaction. On the other hand, adopting old principles of bureaucratic-based management and classic schools of management, will never lead to user satisfaction. To achieve user satisfaction, organizations must adopt a flexible model in the conduct of operations and decision-making within the organization (Masa'd, 2020). Furthermore, user satisfaction can also be achieved through involving users in the flow of operations and procedures, spreading organization culture among users, work in a one team spirit, benefit from others' experiences, and through developing the organization structure in a way to make it more flexible and easier to deal with, in addition, the organization become capable of achieving inside and outside environment integration (Tajeddini & Darvishmotevali, 2019; Samantra, Datta, Mishra & Mahapatra, 2013; Deodhar, Kupfermann, Rosen & Weiss, 1994; Horabadi, Farahani & Salimi, 2015). User satisfaction is defined as a set of feelings that are affected by the interaction of a set of factors toward a particular situation (Rico, Sayani & Field, 2008). User satisfaction is not only achieved through results, but also through experience (Osborne, Radnor & Nasi, 2013; Ahmad & Yekta, 2010; Al-Bourini et al., 2020).

Agile organizations tend to establish creative organizational structures to keep pace with developments. This increases the ability of such organizations to be more productive in a competitive dynamic environment with high value to user satisfaction (Qin & Nembhard, 2010). Agile practices stimulate users, which positively affects their satisfaction and increases their productivity (McHugh, Conboy & Lang, 2010). Thus, the following hypothesis was proposed:

**H<sub>3</sub>:** *User satisfaction has a positive impact on organizational agility.*

### *2.8 User satisfaction, fog computing-based LSCM & organizational agility*

User satisfaction has been placed as a mediating factor between supply chain management based on fog computing and organizational agility because user satisfaction is a very important component of effective management. This leads to knowing their different directions and aspirations towards their work, and on the other hand, it leads to identifying the problems that hinder their work. So, these problems can be avoided and resolved to increase the productivity and the quality of outcomes (Audran, 2011; Tyilana, 2005). User satisfaction has received great attention from managers because it motivates them, which in turn affects their productivity and interaction (Alwagfi et al., 2020). Also, it contributes to improving their mental and physical health. User satisfaction is one of the factors that leads to increased efficiency in the performance of organizations (Daft, 2000). The more individuals are loyal to the organization, the more progressive the organization is. User satisfaction is the attitude of employees towards their job and leads to a reduction in the turnover of the organization (Masa'd & Aljawarneh, 2020). It affects the creation of a positive atmosphere in the organization and reduces absenteeism and reduces complaints (Pandey & Khare, 2012; Middleton, 2017; Stiles & Kulvisaechna, 2003; Anderson & Sullivan, 1993; Fornell, 1992; Van Ree, 2008). Satisfaction is considered the focus in the process of planning various activities in successful organizations, through customers' feedback. Customer satisfaction is the degree of knowledge of the effectiveness of companies in providing products that meet his needs, desires, and expectations. This can be measured by either being satisfied or dissatisfied with the service provided by comparing the actual performance with expected value (Lipskaya, Jarus & Kotler, 2011). Thus, the following hypothesis was proposed:

**H<sub>4</sub>:** *User satisfaction mediates the relationship between fog computing-based LSCM and organizational agility.*

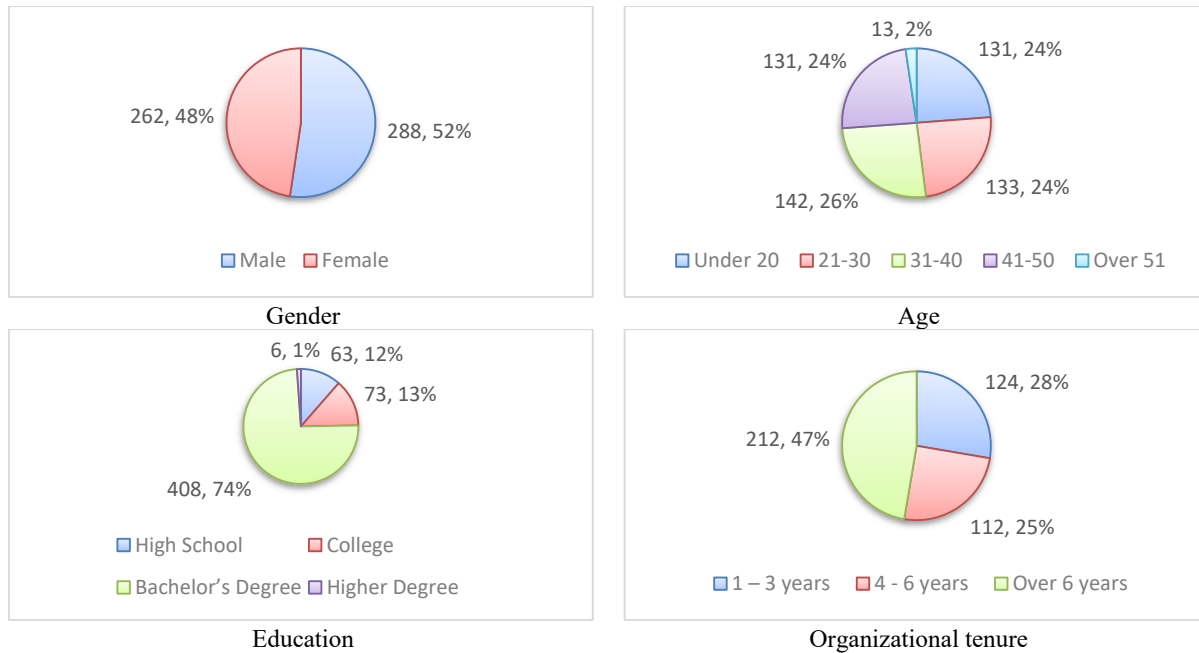
### 3. Methodology

The study employed the quantitative analytical method for its suitability (Babbie & Earl, 2010; Brians, 2011; McNabb, 2008; Singh, 2007; Buttermann et al., 2008). To achieve the goals of the study and examine the hypotheses, the descriptive survey approach was used. For the purposes of data collection, a questionnaire was designed which consisted (22) items divided into (3) domain: fog computing-based LSCM, organizational agility, and User Satisfaction. The items of the questionnaire were prepared based on related literature, theories, and specialized books; (Appelbaum, et al., 2017; Liu, Chan, Yang & Niu, 2018; Hoonsopon & Puriwat, 2019; Davcev et al., 2018, Lee et al., 2011; Pandey & Khare, 2012; Middleton, 2017; Chen & Chuang, 2008). To examine the internal consistency of the questionnaire items and paragraphs, Cronbach's Alpha test was performed on a pilot study sample of 25 users different from the 550 respondents. The results of this test were as shown in Table 2.

**Table 2**  
Internal consistency and stability test (Cronbach's Alpha)

Domain	$\alpha$
Supply Chain Management based on fog computing	.70
Organizational agility	.82
User Satisfaction	.86
Overall	.88

As can be seen from Table 2, Cronbach's coefficients were above the acceptable and respectable value of (0.7) according to Nunnally's guidelines (1978) for every domain and for the overall items. The study population consists of employees of Al-hassan industrial city in Jordan, referred to as users. For data collection purposes, the questionnaire was distributed electronically to a random sample of 670 users. Complete responses were successfully collected from 550 users. Table 3 shows the demographic distribution of participants.



**Fig. 1.** Sample distribution according to demographic variables

*Statistical Analysis:* In this study the software package (PLs) for statistical analysis was used to conduct the required analysis.

### 4. Results

The collected data was then analyzed using statistical analysis techniques to reveal results. First, the statistical means and standard deviations were calculated for responses in every domain of the questionnaire. Table 4 portrays the results for the fog computing-based LSCM domain. As it can be seen from Table 3, the means range between 3.30 – 4.28. It was the highest for " Fog computing-based LSCM provides information at the required time ", and lowest for " Fog computing-based LSCM provides accurate information for decision-makers". The overall mean for Fog computing-based LSCM domain was 3.75.

**Table 3**

Mean, SD for Items of fog computing-based LSCM

No.	Items	Mean	SD	Rank	Degree
1	Fog computing-based LSCM is easy to learn.	4.17	0.77	2	High
2	Fog computing-based LSCM is characterized by high reliability.	4.03	0.84	3	High
3	Fog computing-based LSCM characterized by flexibility in use.	3.58	1.01	5	Medium
4	Fog computing-based LSCM provides information at the required time.	4.28	0.75	1	High
5	Fog computing-based LSCM provides accurate information for decision-makers.	3.30	0.63	10	Medium
6	Fog computing-based LSCM provides information constantly.	3.49	0.89	9	Medium
7	This company delivers services at the earliest	3.59	0.82	6	Medium
8	Conducting transactions correctly and rapidly is very common with this company.	3.65	0.78	8	Medium
9	This company provides value-added information along with its products/services.	3.57	0.69	7	Medium
Domain Overall (Fog computing-based LSCM)		3.75	0.25		High

By the same way, the statistical mean and SD for responses in the "organizational agility" domain, as shown in Table 4.

**Table 4**

Mean, SD for Items of organizational agility

No.	Items	Mean	SD	Rank	Degree
1	We could rapidly respond to customers' needs	3.63	0.98	3	Medium
2	We could rapidly adapt service production to demand fluctuations	3.33	0.68	6	Medium
3	We could rapidly cope with problems from suppliers, partners, and environment	3.53	0.76	8	Medium
4	We rapidly implement decisions to face market changes	3.54	0.68	5	Medium
5	We continuously search for forms to reinvent or redesign our organization	3.98	0.68	1	High
6	We see market changes as opportunities for rapid capitalization	3.68	1.07	2	High
Domain Overall (organizational agility)		3.62	0.39		Medium

Table 4 shows that the statistical means range between 3.33 – 3.98. It was highest for "We continuously search for forms to reinvent or redesign our organization", but the lowest mean was for "We have the ability to rapidly adapt service production to demand fluctuations". The overall mean for "Organizational agility" was 3.62.

**Table 5**

Mean, SD for Items of user satisfaction

No.	Items	Mean	S. D	Rank	Degree
1	I thought the system was easy to use.	4.29	0.68	1	High
4	I felt very confident using the system.	3.75	0.94	2	High
3	I found the various functions were well integrated.	3.74	0.70	3	High
5	People would learn to use this system very quickly.	3.73	0.88	4	High
2	I would need technical support to use this system.	3.36	0.51	8	Medium
6	I found the system cumbersome to use.	3.35	0.66	6	Medium
Domain Overall (User Satisfaction)		3.70	0.31		High

Table 5 shows that the means range between 3.36 – 4.29. The highest value was for "I thought the system was easy to use", and the lowest mean was for "I found the system cumbersome to use". The overall domain means for "user satisfaction" was 3.70.

#### 4.1 Exploratory Factor Analysis

To verify the psychometric properties of the questionnaire, Exploratory Factor Analysis was performed. Table 6 illustrates the orthogonal rotation matrix of the first domain paragraphs, i.e. (fog computing-based LSCM).

**Table 6**

Orthogonal rotation matrix for items in fog computing-based LSCM

No	1	2	3	4	5	6	7	8	9
Loading	0.573	0.685	0.482	0.715	0.650	0.574	0.755	0.817	0.729

(Determinant)= 0.001, (KMO) = 0.512, (Bartlett's Test) = 1095.657, (Sig.) = 0.000

It is clear from Table 6 that loadings ranged between 0.482 – 0.817. All values in the table exceed the value (0.4). Furthermore, the rotation matrix determinant is 0.001 and exceeds the value of zero. As for the value of the Kaiser-Mayer-Okin test (KMO), it equals 0.512 it exceeds 0.50, and this value is acceptable if it ranges between 0.8-0.9. Bartlett's Test value was 1095.657 at the significance level of 0.000.

**Table 7**

Orthogonal rotation matrix for items of organizational agility

No	1	2	3	4	5	6
Loading	0.741	0.737	0.791	0.691	0.858	0.484

(Determinant) = 0.008, (KMO) = 0.653, (Bartlett's Test) = 557.508, (Sig.) = 0.000

The same analysis was performed on the second domain organizational agility. Table 7 shows the results of the orthogonal rotation matrix. It is clear from Table 7 that the range between 0.488 – 0.808, and they all exceeded the value 0.4 It is further obvious that the rotation matrix determinant was 0.008, which exceeded the value of zero. As for the value of the KMO, it came to 0.693, which exceeded 0.50, and this value is acceptable if it ranges between 0.8-0.9. Finally, it is clear from Table 8 that Bartlett's Test has reached 2135.835 at the significance level 0.000 which is less than 0.05. Finally, the results of the Exploratory Factor Analysis on the third domain user satisfaction is shown in Table 8.

**Table 8**  
Orthogonal rotation matrix for items in user satisfaction

No	1	2	3	4	5	6
Loading	0.877	0.698	0.736	0.770	0.923	0.873

(Determinant) = 0.005, (KMO) = 0.685, (Bartlett's Test) = 2135.835, (Sig.) = 0.000

It is clear from Table 8 that the loadings ranged between 0.698 – 0.923, and they all exceeded the value (0.4). As can be seen in Table 8, the value of the matrix determinant was equal to 0.005 which exceeded the value of zero. In addition, KMO was 0.685 which exceeded 0.50. Finally, Bartlett's Test result was 2135.835 at the significance level 0.000 which is less than 0.05.

4.2 Normal Distribution Test

Before linear regression analysis can be performed to examine the study hypotheses, the collected data has to possess a normal distribution. Therefore, it was first required to carry out the normal distribution test, the results are shown in Table 9.

**Table 9**  
Normal distribution test using Shapiro-Wilk Test

Domain	Shapiro-Wilk Test	Sig.
Fog computing-based LSCM	0.92	0.18
Organizational agility	0.80	0.32
User Satisfaction	0.90	0.18

It can be seen from Table 9 that all study variables possess the normal distribution, as indicate the values of Shapiro-Wilk test and the corresponding level of significance values. Accordingly, and since all computed significance level values were greater than 0.05, then the null hypothesis is accepted. The null hypothesis states that: There is no statistically significant difference between the distribution of the variable values and the normal distribution. In other words, the values of the variables in the study follow the normal distribution.

4.3 Hypotheses Test

To examine the first three main hypotheses of the study, simple linear regression tests were performed. While the fourth main hypothesis was tested using (SMARTPLS). Next is an elaboration on these results. To examine the first hypothesis, simple linear regression analysis was used. The results are shown in Table 10.

**Table 10**  
Fog computing-based LSCM on organizational agility

	R	R <sup>2</sup>	T	p
Fog computing-based LSCM on organizational agility	0.144	0.021	3.414	0.001

As can be seen from Table 10, statistical analysis showed the presence of statistically significant impact of fog computing-based LSCM on organizational agility, with a correlation coefficient of R = 0.144. Furthermore, the adjusted correlation coefficient R<sup>2</sup> was 0.021, which means that 2% of changes in the organizational agility results from changes in the fog computing-based LSCM. As a result, the first hypothesis was accepted.

To examine the second hypothesis, simple linear regression analysis was used. The results are shown in Table 11.

**Table 11**  
Fog computing-based LSCM on user satisfaction

	R	R <sup>2</sup>	T	p
Fog computing-based LSCM on user satisfaction	0.141	0.020	3.326	0.001

As can be seen from Table 12, statistical analysis showed the presence of statistically significant impact of fog computing-based LSCM on user satisfaction, with a correlation coefficient of R = 0.141. Furthermore, the adjusted correlation coefficient R<sup>2</sup> was 0.020, which means that 2% of changes in the user satisfaction results from changes in the fog computing-based LSCM. As a result, the second hypothesis was accepted.

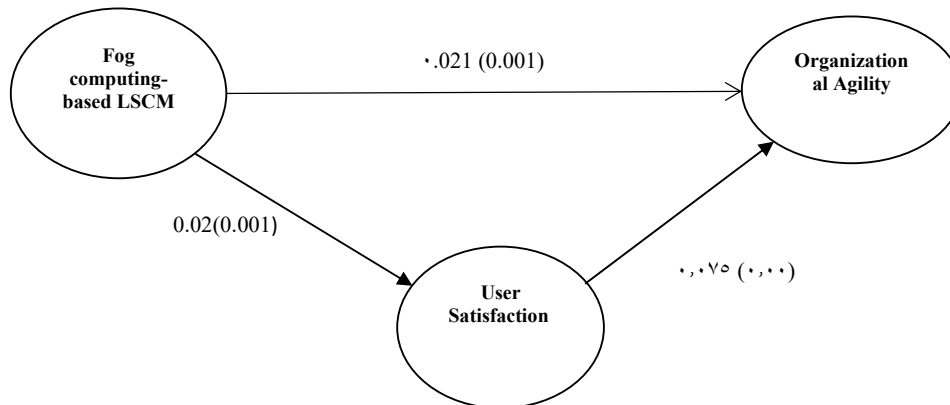
To examine the third hypothesis, simple linear regression analysis was used. The results are shown in Table 12.

**Table 12**

User satisfaction on organizational agility

	R	R <sup>2</sup>	T	Sig.
user satisfaction on organizational agility	0.275	0.075	6.689	<b>0.000</b>

As can be seen from Table 12, statistical analysis showed the presence of statistically significant impact of user satisfaction on organizational agility, with a correlation coefficient of  $R = 0.275$ . Furthermore, the adjusted correlation coefficient  $R^2$  was 0.075, which means that 7.5% of changes in the organizational agility results from changes in the user satisfaction. As a result, the third hypothesis was accepted. To examine the fourth hypothesis, (SMARTPLS) was used. the results are show in Fig. 2.



**Fig. 2.** user satisfaction between fog computing-based LSCM and organizational agility

As can be seen from Fig. 2, user satisfaction has a effect on the relationship between fog computing-based LSCM and organizational agility in both tracks. In the first direct path, the significance of  $\beta$  in the direct path was 0.14 and the value of T was 3.414 with a significance level of 0.001 that is less than 0.05.

In the second indirect track, the significance of  $\beta$  in the non-successive path were 0.10 and 0.18, respectively. Moreover, the values of T were 3.326 and 6.689 with a level of significance equal to 0.000 for both tracks that is less than 0.05. As a result, the fourth hypothesis was accepted.

## 5. Results Discussion

The reported results above indicated that all four hypotheses proposed in this study were accepted. As for the first hypothesis, the statistical analysis emphasized that results showed that fog computing-based LSCM has a positive impact on organizational agility. To this end, this result agrees with (Hoosopon & Puriwat, 2019; Ravichandran, 2018; Musa & Vidyasankar, 2017; Bani-Hani, Deniz & Carlsson, 2017), which showed that the use of fog computing-based LSCM improves organizational agility. They have shown that this was achieved through the speed response to changing demands and providing massive information databases that support the decision making process. As for the impact of fog computing-based LSCM on user satisfaction. The statistical results supported this hypothesis as was shown in the previous section as well. The obtained results agree with results reported in (Omary & Kalinga, 2017; Davcev, Kocarev, Carbone, Stankovski & Mitreski, 2018). These studies claimed that the services fog computing-based LSCM provides for users includes but not limited to quick response to requests and desires and being close to customers' needs through users' feedback and interaction with users. This way, quality of products, quality of information and quality of the systems can be guaranteed, as well as perceived usefulness. All of this agrees with the result we obtained which indicated that the use of fog computing-based LSCM positively impacts user satisfaction.

Moreover, the statistical analysis proved that there is an important impact of user satisfaction on organizational agility. In fact, the results supported the acceptance of the third hypothesis. Achieved results agree with similar results reposted in (Chamanifard, 2015; Qin & Nembhard, 2010; McHugh et. al, 2010; Tajeddini & Darvishmotevali, 2019; Samantera, Mishear & Mahpatra, 2013; Rosen, 1994; Horabadi, Farahani & Salimi; 2015; Fayezi & Zomorrodi, 2015). These results indicated that it is important to have a level of satisfaction for workers inside the organization as well as users of the software systems the organization uses. This satisfaction helps in creating values for the organization and increases its ability to compete. These studies concluded that by achieving user satisfaction, organizational agility can be achieved. Which agrees with the obtained results found in this study.



Finally, the analysis showed that the user satisfaction plays an important mediating role in the relationship between fog computing-based LSCM and organizational agility. This result agrees with results obtained by several previous studies, among which (Luthans, 2011; Tyilana, 2005; Chiaturo & Harrison, 2008; Lavani, 2012; Daft, 2000; Middleton, 2017; Steles & Kulvisaechana, 2003). These studies showed that user satisfaction is an important factor in effective management. These studies emphasized that, though user satisfaction individual feelings inside and outside the organization can be identified. In addition to identifying their different perceptions and aspirations towards their work. Furthermore, user satisfaction can guide to identifying the problems and hinders they might face in their work and possible ways to address these problems and avoid them. Henceforth, it helps in increasing productivity and accomplishing outcomes. Overall, user satisfaction leads to increased efficiency of performance in organizations, affects establishing a positive atmosphere in the organization, and reduces absenteeism and complaints. This confirms the effective impact of user satisfaction in mediating the relationship between fog computing-based LSCM and organizational agility.

## 6. Contributions

This paper contributes highly to companies that aim to use digital services in the new era of information technology and IoT. Among the key contributions researchers have accomplished is the results proved that the use of fog Computing can be very powerful in providing decision-makers in organizations with very accurate information that enhances process in supply chain management. In addition, results proved that fog Computing in supply chain management can be very powerful in increasing user satisfaction. Furthermore, the results emphasized that achieving user satisfaction can be accomplished through the organizational ability to quickly adapt to changes in demand fluctuations, and that user satisfaction plays an important role as a mediator between fog computing-based LSCM and organizational agility.

**Limitations and Restrictions:** The results of this study are bound to the objectivity of targeted respondents. Some users show reluctance to respond to the study as it came in the middle of the pandemic, we are all living (Coronavirus). In addition, some companies pose some restrictions on the participation of their employees. Finally, it is believed that some companies are not ready to employ Fog computing because of the lack of the proper technological infrastructure.

## References

- Ahmad, Z. A., & Yekta, Z. A. (2010). Relationship between perceived organizational support, leadership behavior, and job satisfaction: An empirical study in Iran. *Intangible Capital*, 6(2), 162-184.
- Ai Sharif, F., Ollier, W. E. R., & Hajeer, A. H. (1999). A rare polymorphism at position- 28 in the human RANTES promoter. *European Journal of Immune-Genetics*, 26(5), 373-374.
- Al-Bourini, F. A., Aljawarneh, N. M., Bourini, I., Almaaitah, M. F., & kader Alomari, K. A. (2020). Directing Strategic Decision and Perceived Faculty Performance Using PLS Analysis and Monte Carlo Simulation in Jordanian Private Universities. *Journal of Talent Development and Excellence*, 12(3s), 2235-2252.
- Al-Da'abseh, T., Aljawarneh, N., & Shwiyat, Z. (2018). Marketing Mix Strategies and Its Impact on Organizational Performance Efficiency in the Jordanian Company for Investment and Supply-Safeway: An Empirical Study. *Invention Journal of Research Technology in Engineering & Management*, 2(2), 14-23.
- Al-Jawarneh, N. M. S (2016). Case Study: Business Management School at the Turkish Republic of North Cyprus and how Strategic Thinking and Planning Can Improve the Performance of the Organization to Maintain Stable between Competitors.
- Aljawarneh, N. M. S., & Atan, T. (2018). Linking Tolerance to Workplace Incivility, Service Innovative, Knowledge Hiding, and Job Search Behavior: The Mediating Role of Employee Cynicism. *Negotiation and Conflict Management Research*, 11(4), 298-320.
- Aljawarneh, N. M., Abd kader Alomari, K., Alomari, Z. S., & Taha, O. (2020). Cyber incivility and knowledge hoarding: Does interactional justice matter?. *VINE Journal of Information and Knowledge Management Systems*.
- Aljawarneh, N. M., Sokiyna, M., Obeidat, A. M., Alomari, K. A. K., Alradaideh, A. T., & Alomari, Z. S. (2020). The Role of CRM Fog Computing on Innovation and Customer Service Quality: an Empirical Study. *Marketing and Management of Innovations*, 2, 286-297.
- Aljawarneh, N., & Al-Omari, Z. (2018). The Role of Enterprise Resource Planning Systems ERP in Improving Customer Relationship Management CRM: An Empirical Study of Safeway Company of Jordan. *International Journal of Business and Management*, 13(8), 86-100.
- Alomari, K. A. K., Aljawarneh, N. M., Alomari, Z. S., Albdareen, R., & Alawneh, A. (2020). Innovations in Knowledge Management Perspectives: An Empirical Study in the Jordanian Commercial and Islamic Banks. *Marketing and Management of Innovations*, 4, 102-119
- Al-Omari, Z. S., Aljawarneh, N., Davut, S., & Salah, A. (2018). The Impact of Marketing Mix Elements on Forming Mental Images about Islamic Banks in Jordan: An Empirical Study. *OFFICIAL*, 12, 54.
- Al-Omari, Z., Alomari, K., & Aljawarneh, N. (2020). The role of empowerment in improving internal process, customer satisfaction, learning and growth. *Management Science Letters*, 10(4), 841-848.
- Alsafadi, Y., Aljawarneh, N., Çağlar, D., Bayram, P., & Zoubi, K. (2020). The mediating impact of entrepreneurs among administrative entrepreneurship, imitative entrepreneurship and acquisitive entrepreneurship on creativity. *Management Science Letters*, 10(15), 3571-3576.

- Alshare, F., Aljawarneh, N., Alomari, K., Alomari, Z., Albdareen, R., AAlwagfi, A., & Alradaideh, A. (2020). Factors influencing cellular device purchase decisions in Jordan. *Management Science Letters*, 10(11), 2501-2506.
- Alwagfi, A. A., Aljawarneh, N. M., & Alomari, K. A. (2020). Work Ethics and Social Responsibility: Actual and Aspiration. *Journal of Management Research*, 12(1), 26-36.
- Alzoubi, K., Aljawarneh, N. M., Alsafadi, Y., Al-Radaideh, A. T., & Althahat, S. (2020). Role of Cloud Computing in Service Quality, Information Quality & Low Costs: An Empirical Study on Jordanian Customs. *International Journal of Academic Research in Business and Social Sciences*, 10(6), 522–532.
- Anderson, E. W., & Sullivan, M. W. (1993). The antecedents and consequences of customer satisfaction for firms. *Marketing Science*, 12(2), 125-143.
- Appelbaum, S., Calla, R., Desautels, D. and Hasan, L. (2017), "The challenges of organizational agility: part 2", *Industrial and Commercial Training*, 49(2), 69-74.
- Audran, A. (2011). Strategic agility: a winning phenotype in turbulent environments. (Master of Science in Management, Economics and Industrial Engineering), Politecnico Di Milano, Scuola di Ingegneria dei Sistemi. p 43
- Babbie, E. R. (2010). *The Practice of Social Research*. 12th ed. Belmont, CA: Wadsworth Cengage.
- Bani, H., Deniz, S., & Carlsson, S. (2017). Enabling Organizational Agility Through Self-Service Business Intelligence: the case of a digital marketplace. In *PACIS 2017 Proceedings*, 148.
- Banyhamdan, K. M. T., Aljawarneh, N. M., Alomari, M. A., Almasarweh, M. S., Harafsheh, I. M., & Alwagfi, A. A. (2020). Impact of Human Capital in Quality and Strategic Excellences. *International Journal of Advanced Science and Technology*, 29 (7), 11702-11710.
- Bi, J. W., Liu, Y., Fan, Z. P., & Cambria, E. (2019). Modelling customer satisfaction from online reviews using ensemble neural network and effect-based Kano model. *International Journal of Production Research*, 57(22), 7068-7088.
- Brians, C. L. (2011). *Empirical Political Analysis: Quantitative and Qualitative Research Methods*. 8th ed. Boston, MA: Longman.
- Buttermann, G., Germain, R., & Iyer, K. N. (2008). Contingency theory “fit” as gestalt: An application to supply chain management. *Transportation Research Part E: Logistics and Transportation Review*, 44(6), 955-969.
- Chalapathi, G. S. S., Chamola, V., Vaish, A., & Buyya, R. (2019). Industrial Internet of Things (IIoT) Applications of Edge and Fog Computing: A Review and Future Directions.
- Chamanifard, R., Nikpour, A., Chamanifard, S., & Nobarieidishe, S. (2015). Impact of organizational agility dimensions on employee’s organizational commitment in Foreign Exchange Offices of Tejarat Bank, Iran. *European Online Journal of Natural and Social Sciences: Proceedings*, 4(1), 199.
- Chen, C. C., & Chuang, M. C. (2008). Integrating the Kano model into a robust design approach to enhance customer satisfaction with product design. *International Journal of Production Economics*, 114(2), 667-681.
- Cooper, D. (1983). Tidiness, muddle and things: commonalities and divergences in two approaches to management accounting research. *Accounting, organizations and Society*, 8(2-3), 269-286.
- Daft, R. L. (2000). *Organization theory and design*. South.
- Davcev, D., Kocarev, L., Carbone, A., Stankovski, V., Mitreski, K. (2018). Blockchain-based Distributed Cloud/Fog Platform for IoT Supply Chain Management Proc. of the *Eighth International Conference On Advances in Computing, Electronics and Electrical Technology - CEET 2018*
- Deodhar, D., Kupfermann, I., Rosen, S. C., & Weiss, K. R. (1994). Design constraints in neuronal circuits underlying behavior. *Flexibility and Constraints in Behavioral Systems*. Greenspan RJ, Kyriacou CP.
- Dominici, G., & Palumbo, F. (2013). How to build an e-learning product: Factors for student/customer satisfaction? *Business Horizons*, 56(1), 87-96.
- Doz, Y., Doz, Y. L., & Kosonen, M. (2008). *Fast strategy: How strategic agility will help you stay ahead of the game*. Pearson Education.
- Fayezi, S., & Zomorodi, M. (2015). *Supply chain management: Developments, theories and models*. 10.4018/978-1-4666-9639-6. ch018.
- Fornell, C. (1992). A national customer satisfaction barometer: The Swedish experience. *Journal of Marketing*, 56(1), 6-21.
- Goldman, S. L., Nagel, R. N., & Preiss, K. (1995). *Agile competitors and virtual organizations: strategies for enriching the customer* (Vol. 8). New York: Van Nostrand Reinhold.
- Hemel, C. V. D., & Rademakers, M. F. (2016). Building customer-centric organizations: Shaping factors and barriers. *Journal of Creating Value*, 2(2), 211-230.
- Hoonsopon, D. & Puriwat, W. (2019). "Organizational Agility: Key to the Success of New Product Development," *IEEE Transactions on Engineering Management*, 1-12.
- Horabadi, Farahani, A., & Salimi, F. (2015). The Study of the Relationship between Employees’ Empowerment and Organizational Agility: A Case Study in Azarab Industrial Company. *European Online Journal of Natural and Social Sciences: Proceedings*, 4(1(s)), pp-1067.
- Iorga, M., Feldman, L., Barton, R., Martin, M. J., Goren, N. S., & Mahmoudi, C. (2018). *Fog Computing Conceptual Model: Recommendations of the National Institute of Standards and Technology*. NIST Special Publication 500-325
- Joroff, M. L., Porter, W. L., Feinberg, B., & Kukla, C. (2003). The agile workplace. *Journal of Corporate Real Estate*, 5(4), 293-311.

- Lee, H. H., Kim, H. D., & Park, J. S. (2011). Optimal design of a high-agility satellite solar array module with genetic algorithm. *In Proceeding of the 2011 KSAS Fall Conference* (pp. 620-625).
- Lin, C. T., Chiu, H., & Chu, P. Y. (2006). Agility index in the supply chain. *International Journal of Production Economics*, 100(2), 285-299.
- Lipskaya, L., Jarus, T., & Kotler, M. (2011). Influence of cognition and symptoms of schizophrenia on IADL performance. *Scandinavian Journal of Occupational Therapy*, 18(3), 180-187.
- Liu, S., Chan, F.T.S., Yang, J. & Niu, B. (2018). Understanding the effect of cloud computing on organizational agility: An empirical examination. *International Journal of Information Management*, 43, 98-111.
- Lu, B., Misra, M., Jain, M., & Ramamurthy, S. (2011). U.S. Patent Application No. 11/851,339.
- Mahafzah, A. G., Aljawarneh, N. M., Alomari, K. A. K., Altahat, S., & Alomari, Z. S. Impact of customer relationship management on food and beverage service quality: The mediating role of employees satisfaction. *Humanities & Social Sciences Reviews*, 8(2), 222-230.
- Martin, A., O'Donohue, W., & Dawkins, S. (2011). Psychological capital at the individual and team level: Implications for job satisfaction and turnover intentions of emergency services volunteers'. *In Proceedings of the 2011 ANZAM Conference*, 6th-9th December (pp. 1-17).
- Masa'd, F., & Aljawarneh, N. (2020). Administrative creativity and job performance: An Empirical Study at Jadara University. *International Journal of Psychosocial Rehabilitation*, 24.
- Masa'd, F., (2020). The Effect of Human Resource Management Practices on Organizational Intelligence in Jordanian Commercial Banks. *Palarach's Journal of Archaralogy of Egypt/Egyptogy*, 17(6), 1395-1410
- McHugh, O., Conboy, K., & Lang, M. (2010). Motivating Agile teams: A case study of teams in Ireland and Sweden. *In International Research Workshop on IT Project Management*.
- McNabb, D. E. (2008). *Research Methods in Public Administration and Nonprofit Management: Quantitative and Qualitative Approaches*. 2nd ed. Armonk, NY: M.E. Sharpe.
- Middleton, M. (2017). The impact of job demands and job resources on the burnout and engagement of trade union representatives (Doctoral dissertation, Stellenbosch: Stellenbosch University).
- Mikalef, P., & Pateli, A. (2017). Information technology-enabled dynamic capabilities and their indirect effect on competitive performance: Findings from PLS-SEM and fsQCA. *Journal of Business Research*, 70, 1-16.
- Musa, Z., & Vidyasankar, K (2017). A Fog Computing Framework for Blackberry Supply Chain Management. In the Proc. *The 8th International Conference on Emerging Ubiquitous Systems and Pervasive Networks. Procedia Computer Science 113 (EUSPN 2017)*, pp. 178–185.
- Omary, Z. D., & Kalinga, E. A., (2017). Assessing Users' Satisfaction with Tanzanians' Public Health Supply Chain Electronic Logistic Management Information System. *Journal of Health Informatics in Developing Countries*, 11(2).
- Osborne, S. P., Radnor, Z., & Nasi, G. (2013). A new theory for public service management? Toward a (public) service-dominant approach. *The American Review of Public Administration*, 43(2), 135-158.
- Pandey, C., & Khare, R. (2012). Impact of job satisfaction and organizational commitment on employee loyalty. *International Journal of Social Science & Interdisciplinary Research*, 1(8), 26-41.
- Qin, R., & Nembhard, D. A. (2010). Workforce agility for stochastically diffused conditions—A real options perspective. *International Journal of Production Economics*, 125(2), 324-334.
- Ravichandran, T. (2018). Exploring the relationships between IT competence, innovation capacity and organizational agility. *The Journal of Strategic Information Systems*, 27(1), 22-42.
- Rico, D. F., Sayani, H. H., & Field, R. F. (2008). History of computers, electronic commerce and agile methods. *In Advances in Computers* (Vol. 73, pp. 1-55). Elsevier.
- Roth, A. V. (1996). Achieving strategic agility through economies of knowledge. *Strategy & Leadership*, 24(2), 30-36.
- Salih, A. A., & Alnaji, L. (2014). Impact of strategic thinking and strategic agility on strategic performance: A case study of Jordanian insurance industry companies. *International Review of Management and Business Research*, 3(4), 1871.
- Salman, A. (2012). The Scientific and Technology Analysis Approach to the Art Work and Architecture of Al Haram Al Shrif in Makkah. *International Journal of Computer Science Issues (IJCSI)*, 9(4), 349.
- Samantra, C., Datta, S., Mishra, S., & Mahapatra, S. S. (2013). Agility appraisal for integrated supply chain using generalized trapezoidal fuzzy numbers set. *The International Journal of Advanced Manufacturing Technology*, 68(5-8), 1491-1503.
- Shafer, R. A. (1997). *Creating organizational agility: The human resource dimension*.
- Sine, W. D., Mitsuhashi, H., & Kirsch, D. A. (2006). Revisiting Burns and Stalker: Formal structure and new venture performance in emerging economic sectors. *Academy of Management Journal*, 49(1), 121-132.
- Singh, K. (2007). *Quantitative Social Research Methods*. Los Angeles, CA: Sage.
- Stiles, P., & Kulvisaeachana, S. (2003). Human capital and performance: A literature review. *DTI*.
- Tajeddini, K., & Darvishmotevali, M. (2019). Understanding organizational agility: Evidence from the hotel.
- Tyilana, X. E. (2005). The impact of motivation on job satisfaction amongst employees of a national broadcaster (Doctoral dissertation, University of Johannesburg).
- Van Ree, E. (2008). Reluctant terrorists? Transcaucasian social-cemocracy, 1901–1909. *Europe-Asia Studies*, 60(1), 127-154.
- Violante, M. G., Marcolin, F., Vezzetti, E., Ulrich, L., Billia, G., & Di Grazia, L. (2019). 3D Facial Expression Recognition for Defining Users' Inner Requirements—An Emotional Design Case Study. *Applied Sciences*, 9(11), 2218.



© 2021 by the authors; licensee Growing Science, Canada. This is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).