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Article

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European Journal of Management and Business Economics (EJM&BE)

Provided in Cooperation with:

European Academy of Management and Business Economics (AEDEM), Vigo (Pontevedra)

Suggested Citation: Usman Ahmad Qadri et al. (2024) : The learning effect on organizational performance during a crisis: A serial mediation analysis with knowledge creation, storage and sharing, European Journal of Management and Business Economics (EJM&BE), ISSN 2444-8451, Emerald, Leeds, Vol. 33, Iss. 1, pp. 37-53,
<https://doi.org/10.1108/EJMBE-03-2021-0107>

This Version is available at:

<https://hdl.handle.net/10419/325557>

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The learning effect on organizational performance during a crisis: a serial mediation analysis with knowledge creation, storage and sharing

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Received 31 March 2021
Revised 16 July 2021
18 September 2021
Accepted 19 October 2021

Abstract

Purpose – The aim of this study is to investigate the serially mediating effect of knowledge management (KM) practices (namely, knowledge creation, storage and sharing) on the organizational learning (OL) and organizational performance (OP) relationships during a crisis.

Design/methodology/approach – Based on theories-of-action, knowledge-based and resource-based theories, this study proposed a sequential mediation model where OL underlying mechanisms through which KM practices have facilitated OP during the crisis. The sample dataset contains 440 responses collected from the managers of the software development companies in Pakistan. The authors used Hayes Process macro with SPSS to test the study hypotheses.

Findings – The results of the study reveal that knowledge creation, storage and sharing serially mediate the relationships between OL and OP. These findings strengthen the argument suggesting that OL plays the key role in KM that helps software companies to mend their performance in times of crisis.

Originality/value – This study contributes to the KM literature in two ways: (1) grounded on the study's proposed framework, organizations can improve and manage their businesses in times of crisis and (2) learn how to generate new knowledge in response to business crises.

Keywords Organizational learning, Knowledge management practices, Organizational performance, Theories of action, Covid-19 crisis, Software development industry

Paper type Research paper

1. Introduction

Learning during a crisis (i.e. Covid-19) is a very difficult and challenging task for a firm. A crisis is usually a kind of event for organizations that cannot be planned (Deverell, 2009; Alles, 2021).



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European Journal of Management
and Business Economics
Vol. 33 No. 1, 2024
pp. 37-53
Emerald Publishing Limited
e-ISSN: 2444-8494
p-ISSN: 2444-8451
DOI 10.1108/EJMBE-03-2021-0107

Although the harmful impact of the crisis on organizations has been studied extensively (Olsson, 2014), limited research has examined how companies can deal with these challenges and learn from a crisis, particularly in the software development industry (Boehm *et al.*, 2020). An organization that actively compacts in an uncertain environment should not only create information and knowledge but also process it well. Similarly, successful organizations are those that adapt to changing environments and thrive despite external factors. Accordingly, software development companies are constantly looking for methods to improve quality and productivity (Gopalkrishna *et al.*, 2012; Nguyen-Duc *et al.*, 2015). Knowledge management (KM) processes, such as knowledge creation, storage and sharing, provide a platform for solving problems efficiently. In addition, many researchers have tried to explain how to develop and implement effective crisis management strategies to improve organizational performance (OP) in times of crisis (e.g. Carroll and Hatakenaka, 2001). Despite the growing interest in KM and OP, insufficient attention has been paid to investigating the role of KM practices (i.e., knowledge creation, storage and sharing) in achieving OP, particularly with the aids of organizational learning (OL). In particular, more empirical studies are needed at the company level to determine what factors could interfere with OP during a crisis. With these lines, while handling crises (e.g. Covid-19), organizations need to process and apply a large amount of new data in a timely manner. They need to develop processes that enable them to achieve their goals effectively (Hu *et al.*, 2021). Accordingly, the study of knowledge creation (KC) and OL is “pursued as independent themes in research [...] and the links between them tend to be forgotten [...] because it is hard to reconcile fundamental assumptions about knowledge, information, environment and learning” (Lyles, 2014, pp. 132–133).

In light of above arguments, this research addresses OL, which has been stated and suggested as a set of organizational values and norms. These days, firms are considered successful if they have the ability to learn and do it quickly. Consequently, this paper adds to extant research by investigating the sequential mediation relationship between OL and OP via knowledge creation, storage and sharing in the software development industry of Pakistan.

2. Literature review and hypothesis development

2.1 Theories

Little is known about how knowledge is encoded in the employees’ minds. According to Argyris *et al.* (1985), people create their own “mental maps,” the way they act in a particular situation. These include how they plan, execute and review their behaviors. In OL, these mental maps guide the employees’ actions rather than their theoretical claims (Argyris *et al.*, 1985; Argyris, 2000). Although very few employees are familiar with the theories or maps they use; theories of action guide them to consider changes in the depth of knowledge. Theories of action are a “mechanism” through which employees associate their thoughts with their actions (Argyris *et al.*, 1985). Argyris and Schon (1974) divided theories of action into two parts that govern employees’ actions that affect OL. Accordingly, “espoused theories are those that an individual claims to follow; theories-in-use are those than can be inferred from action” (Argyris *et al.*, 1985, p. 82). In this study, the authors explain that OL’s theories focus on KC and the use of that knowledge within the organization.

In addition, this study used theories such as knowledge-based view (KBV) and resource-based view (RBV) to describe the KM processes and organizational performance of software companies. The RBV suggests that organizations can improve their performance and use their resources and capabilities to create a competitive advantage (Singh *et al.*, 2019).

2.2 KM practices

Darroch (2005, p. 211) defines KM as a “management function that creates or locates knowledge, manages the flow of knowledge within organizations and ensures that the

knowledge is used effectively and efficiently for the long-term benefit of the organization.” This study uses 3 KM dimensions (namely, knowledge creation, storage and sharing). However, KM varies from study to study. For example, according to [Ode and Ayavoo \(2020\)](#), KM practices are based on knowledge application and use. Early studies of KM such as [Addis \(2016\)](#), focused on the KC process and knowledge transfer with an emphasis on implicit and explicit knowledge. While recent studies identify “knowledge creation, acquisition, sharing and application” as the main components of the KM processes ([Ode and Ayavoo, 2020](#)), others have identified the knowledge creation, transfer, storage and application as the key KM processes ([Al-Emran et al., 2018](#)). The importance of KM for software development companies is incredible. KM helps improve implementation and coordination across the company, which is a challenge for software companies. Furthermore, KM also helps in delivery speed and execution accuracy for software companies ([Khosravi and Nilashi, 2018](#)).

2.3 Hypothesis development

2.3.1 Direct relationship between OL, KM processes and OP. In the times of Covid-19 crisis, the process of learning and KM within organizations is being given much importance ([Velásquez and Lara, 2021](#)). Despite a lot being written about OL, little attention is being paid to KM, which is a big issue. Prior to that, most of OL’s theories were based on the misconception that “the development of knowledge shapes learning” ([Senge, 1990](#)). Later, [Nonaka and Takeuchi \(1995\)](#) expose the fallacy of the idea and state that “a comprehensive view of what constitutes OL has not been developed.” According to [Mehralian et al. \(2018\)](#), OL has the potential to enhance the efficiency of the learning process and KC in software companies. In other words, there are learning process requirements to enhance the quality of software products ([Saha and Annamalai, 2021](#)). Similarly, learning through better information and understanding has led to a change in behavior that helps improve organizational performance ([Ullah et al., 2021](#)). In addition, OL is important to the organization’s customers because it involves meeting and understanding latent needs through new services, products and ways of doing business ([Zhang et al., 2020](#)). Concurrently, OL has proven to be invaluable in improving performance within software companies ([Waheed et al., 2019](#)). Therefore, organizations should use OL to generate new knowledge ([Pasamar et al., 2019](#)). In addition, several prior studies have suggested significant and positive relationships between OL, KM and OP, as shown in [Table 1](#).

Accordingly, companies with technology capabilities and high-level KC are more efficient and can improve organizations ([Abusweilem and Abualoush, 2019](#)). Therefore, knowledge is a key success factor in obtaining competitive advantage in the times of crisis ([Mehralian et al., 2018](#)). According to [Abusweilem and Abualoush \(2019\)](#), KM processes (i.e. KC, knowledge storage [KS] and knowledge sharing [KSI]) that enhance intermediate OP will lead to positive financial performance. Consequently, in the essence of RBV theory, we propose that if a company obtains resources and uses them effectively, it may have a major “strategic advantage” that will increase OP. Thus, we suggested that

H1. (a) OL, (b) KC, (c) KS and (d) KSI are effective in improving OP.

In addition, [Boella et al. \(2016\)](#) stated that the organization’s success is highly dependent on knowledge and KM. From the KM processes, KSI is valuable for organizations as it helps them improve performance ([Obeidat and Zyod, 2015](#)). In addition, it is important for organizations to exchange knowledge as it promotes OL ([Park and Kim, 2018](#)). In other words, [Park and Kim \(2018\)](#) proposed the positive relationship between OL and KSI. Accordingly, one of the important outcomes of KM is KC ([Argote et al., 2003](#)). The value of the KC depends on level of KSI and skills among people across the organization ([Oliveira et al., 2020](#)). Subsequently, KC and KS are two vital aspects of KM that play an important role in creating

Table 1.
Critical synthesis
literature review on OL,
KM and OP

Authors	Research objective	Independent variables	Dependent variables	Mediators	Methodology	Results	Limitations and future studies
Putra and Ruslan (2021)	To analyze the effect of OL on OP	OL	OP	–	This study used the SAQ to collect the data from 221 employees	The results show that OL has a significant positive effect on OP	None reported in this article
Hutagalung et al. (2020)	To determine the effect of OL on teacher performance	OL	Teacher performance	Innovation capability	Used SAQs to the collect the data from 327 samples	The indirect effect of OL on teacher performance via innovation capability	Based on the proposed threshold of this study, future studies should find other variables that may affect teachers' performance
Sahibzada et al. (2020)	To investigate the mediating effect of OL on the relationship between KM processes and OP	KM processes	OP	Creative OL	This study used SAQs to collect the data from 536 administrative and academic staff	This study found the mediating effect of OL on the relationship between KM processes and OP	This study encouraged the replication of this framework in other cultures to correct the findings. In addition, the indirect link between KM processes and OP should be investigated further via some other mediators
Obeso et al. (2020)	To investigate the indirect effect of KM practices on OP via OL	KM	OP	OL	Telephone survey was used to the collect data from employees of 400 SMEs	This study shows that KM practices have an indirect effect on OP via OL	Future research would need to differentiate between different KM practices

(continued)

Authors	Research objective	Independent variables	Dependent variables	Mediators	Methodology	Results	Limitations and future studies
Abusweilem and Abualoush (2019)	To investigate the direct effect of KM processes on OP	KM processes	OP	–	Used SAQs to collect the data from 126 staffs	This study concludes that there is a significant positive relationship between KM processes and OP	None reported in this article
Sawaeen and Ali (2020)	To identify the mediating effect of innovation capacity on the learning orientation and OP links	Learning orientation	OP	Innovation capacity	SAQs collected data from 384 owners of the various corporations	This study found the indirect effect of learning orientation on OP via innovation capacity	Future studies should consider other variables that may affect OP
Zaim <i>et al.</i> (2019)	To investigate the mediating effect of knowledge utilization on the links b/t KM and OP	KM process	OP	Knowledge utilization	This study used SAQs to collect the data from 1,068 employees	This research found the indirect effect of knowledge utilization on the KM-OP relationships	None reported in this article
Wahda (2017)	To identify the indirect effect of OL on OP via KM	OL	OP	KM	This study used SAQs to collect the data from 138 respondents	This study found that KM mediates the relationships between OL–KM	As this study took KM as a mediating variable, it would be interesting to take KM as exogenous or endogenous variables in the future studies

(continued)

(continued)

Table 1.

Table 1.

Authors	Research objective	Independent variables	Dependent variables	Mediators	Methodology	Results	Limitations and future studies
Tseng and Lee (2014)	To investigate the indirect effect of KM capability on OP via dynamic capability	KM capability	OP	Dynamic capability	SAQs and online survey (e-mail) were used to collect the data from 237 respondents	Results indicated that KM capability increases the dynamic capability of the firms, resulting in an increase in OP	This research used a purposive sampling technique; this study suggested that to increase the generalizability of the results, future studies should apply a random sampling technique
Noruzy et al. (2013)	To investigate the relationship between transformational leadership, OL, KM, organizational innovation and OP	Transformational leadership	OP	OL, KM and organizational innovation	This study used SAQs to collect the data from 280 respondents	This study found the significant relationship between constructs	Based on the proposed limits. This study suggested that more studies in this area are required to investigate relationships between these constructs in different organizational setting and culture
Kuo (2011)	To determine the relationship among human resource management, OL, KM capability, organizational innovation and OP	Human-resource management	OP, KM capability and organizational innovation	-	213 surveys were collected from the employees of the technological companies	This study found the significant positive relationship among the variables	This study collected data only from Taiwanese respondents; future studies may apply this framework to other regions or countries whose environment is similar to Taiwan in order to achieve more general results

Note(s): KM = knowledge management; OL = organizational learning; OP = organizational performance; SAQs = self-administered questionnaires; SMEs = small and medium-sized enterprises

organizational value. In KM, KS is a phase to store explicit knowledge. Therefore, most organizations in the software development industry are focused on improving their KSI capability to create new knowledge (Carmeli *et al.*, 2013). This also helps to retrieve knowledge for later usages as well. So, we proposed that

H2. (a) OL, (b) KC and (c) KS are effective in improving KSI activities.

2.3.2 *Serial mediation effect of KC, KS and KSI.* A number of studies (Calabretta *et al.*, 2017) have examined how KC plays a key role in the success and survival of a firm. In addition, Calabretta *et al.* (2017, p. 392) subsumes the KC process “embedding new ideas, cognitive frames, and manners of thinking in organizations require adaptation (i.e., translation) to the specific practices and socio-cultural context of the target organization.” Accordingly, companies can enhance both financial and nonfinancial performance through affected KC methods (Kao and Wu, 2016). Previous research (Sahibzada *et al.*, 2020) proposed the direct relationships between KC, KS and KSI. Contrariwise, none of these studies identified an indirect relationship between them. In addition, Zaim *et al.* (2019), investigate the significant positive association between KM practices and OP. Accordingly, learning has the significant positive effect on KC and KS (Abusweilem and Abualoush, 2019), which in turn lead to increase organizational OP (Kordab *et al.*, 2020). Thus, the following hypotheses are proposed:

H3. (a) KC, (b) KS and (c) KSI mediate the relationship between OL and OP.

H4. (a) KC and KS, (b) KC and KSI, (c) KS and KSI, and (d) KC, KS and KSI serially mediate the relationship between OL and OP.

3. Research design

3.1 Research model and measurement

Based on theory of action, KBV and RBV theories, we proposed that the three mediators – KC, KS and KSI could play the role of sequential mediator between OL and OP. This means that OL affects OP via KC, KS and KSI in a sequential manner (see, Figure 1). Grounded on theoretical framework, the study’s questionnaire was prepared, and four items of OL were measured on a five-point Likert-scale ranging from “1 = strongly disagree to 5 = strongly agree” adapted from the study of García-Morales *et al.*, (2008). Furthermore, this study measured the three processes of KM (namely, knowledge creation, storage and sharing)

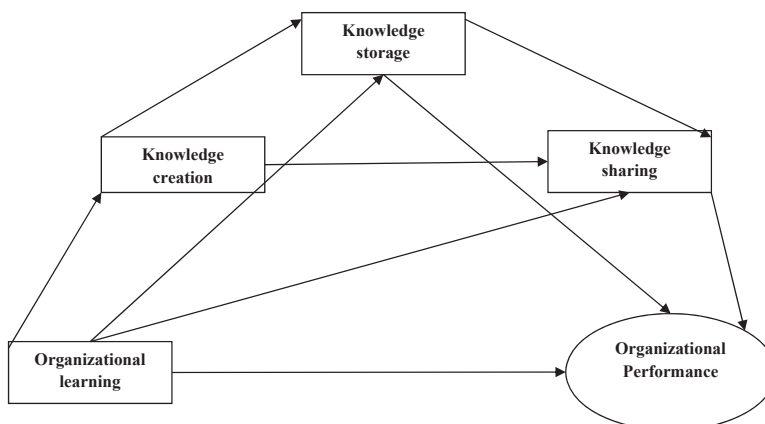


Figure 1.
Research model

through 14 items. In which, five items of KC and six items of KSI were measured through five-point Likert scale adapted from the study of [Lee and Wong, \(2015\)](#) and [Holtshouse, \(1998\)](#). While three items of KS were measured through five-point Likert-scale taken from the study of [Hansen et al. \(1999\)](#), four items of OP adapted from the study [Cho et al. \(2008\)](#) were measured through five-point scale from 1 (poor) to 5 (excellent) (see [Appendix](#)).

3.2 Data collection and sampling

During the second wave of the Covid-19 crisis, we used a self-report cross-sectional survey method to collect the data from the employees of software companies. Through which, we selected 20 companies randomly in the software development industry in Lahore, Multan and Islamabad, which had more than 20 workers. In 20 companies, 17 allowed their employees to participate in the survey. The study survey was written in English because it is the official language of business and higher education in Pakistan. Furthermore, recent research (e.g. [Fatima et al., 2020](#); [Qadri et al., 2020](#)) conducted in Pakistan and published in mainstream journals has demonstrated that the survey format is feasible. Consequently, each study questionnaire was accompanied by a cover letter, which explained the purpose of the study and the volunteer nature of the respondents. Therefore, considering our sample, we did not translate the survey into Urdu. After completing the survey format, we met with lower-, middle- and top-level managers of software companies and asked them to participate in the survey.

In addition, this study used purposive sampling techniques as a data collection strategy because it is less expensive and usually requires less time ([Etikan et al., 2016](#)). We collected the data between October 2020 and November 2020. The data compilation process lasted for four working weeks. Since our research model had five variables and a total of 22 items, the minimum size of the sample required for our study was 110 ($22 \times 5 = 110$). The size of the sample used in our study (i.e. $N = 440$) is larger than the required sample size and therefore adequate enough for analysis and give more reliable results with greater precision and power ([Benner and Waldfogel, 2008](#)).

Consequently, we distributed 610 questionnaires; among them, in which 440 were returned, we selected 425; the rate of response was 72.13%. In the study, we removed 15 surveys that had incomplete answers. Of the respondents, 43% were females. All sampling employees had an average of five years with the company. Of the respondents, 40% belonging to the company have more than 100 employees. The majority of respondents (55%) was lower/first line managers in their companies.

4. Data analysis and finding

4.1 Control variables

This study statistically controlled the effect of gender (1 = Male, 2 = Female), age (1 = 20–35, 2 = 36–50, 3 = 51–65, 4 = 65+), tenure (in years) in the software development company and designation (“1 = first-line manager, 2 = middle manager, 3 = top manager”), we made sure they would not affect other variables of interest.

4.2 Reliability and correlation analysis

The mean, standard deviation, correlation coefficient and discriminant validity values of the study constructs are in [Table 2](#). We have found a positive significant correlation between KSI and KS at ($r = 0.365, p < 0.001$), OL and KS at ($r = 0.379, p < 0.001$), OL and KSI at ($r = 0.678, p < 0.001$), KC and KS at ($r = 0.357, p < 0.001$), KC and KSI at ($r = 0.464, p < 0.001$), and KC and OL at ($r = 0.633, p < 0.001$). In addition, this study uses “Cronbach’s alpha” to assess the scales internal reliability. In this study, [Table 3](#) shows that alpha values of OL is 0.868 for four

	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Software companies ^a	2.449	1.276	1									
2. Age ^b	1.889	0.553	0.381**	–								
3. Gender ^c	1.372	0.484	0.015	0.013	–							
4. Tenure ^d	2.489	0.727	0.062	0.059	–0.009	–						
5. Designation ^e	2.551	0.878	0.080	–0.001	–0.083	–0.017	–					
6. KS	3.083	1.376	0.034	0.021	–0.029	0.037	0.090	(0.783)				
7. KSI	2.922	1.295	–0.048	0.006	–0.061	–0.006	–0.027	0.365**	(0.830)			
8. OL	3.143	1.183	–0.043	0.014	–0.008	–0.015	–0.008	0.379**	0.678**	(0.864)		
9. KC	3.149	1.186	–0.018	0.025	0.017	–0.039	0.033	0.357**	0.464**	0.633**	(0.836)	
10. OP	3.000	1.366	–0.017	–0.061	–0.029	–0.008	–0.063	0.270**	0.612**	0.521**	0.580**	(0.801)

Note(s): * $p < 0.05$, ** $p < 0.001$, SD = standard deviation and “Diagonal elements (italic values) are the square root of the AVE”
^a1 = Small-sized company (21–100 employees), 2 = Medium-sized company (101–200 employees), 3 = large-sized company (200+ employees)
^b1 = 15–30, 2 = 31–45, 3 = 46–60, 4 = 60+
^c1 = Male, 2 = Female
^d1 = Less than 5 years; 2 = 6–10 years; 3 = Greater than 10 years
^e1 = Lower-level manager; 2 = Middle-level manager; 3 = Top-level manager

Table 2.
Means, standard
deviations, correlations
and validity

Constructs	Scale	Factor loadings (λ)	Alpha	MaxR (H)	CR	AVE	MSV
Organizational learning (OL)	OL1	0.685	0.868	0.981	0.876	0.641	0.531
	OL2	0.859					
	OL3	0.866					
	OL4	0.779					
Knowledge creation (KC)	KC1	0.725	0.881	0.893	0.887	0.613	0.494
	KC2	0.766					
	KC3	0.842					
	KC4	0.755					
	KC5	0.821					
Knowledge storage (KS)	KS1	0.837	0.813	0.930	0.816	0.690	0.206
	KS2	0.819					
	KS3	0.499 ^a					
Knowledge sharing (KSI)	KSI1	0.809	0.942	0.977	0.933	0.6990	0.531
	KSI2	0.759					
	KSI3	0.818					
	KSI4	0.860					
	KSI5	0.877					
	KSI6	0.887					
Organizational performance (OP)	OP1	0.722	0.900	0.966	0.921	0.746	0.445
	OP2	0.920					
	OP3	0.897					
	OP4	0.900					

Table 3. Measurement model reliability and validity

Note(s): ^aDeleted, CR = Composite reliability; MaxR(H) = Maximum reliability; MSV = Maximum shared variance; AVE = Average variance extracted; λ = Standardized regression weights

items, KC is 0.881 for five items, KS is 0.813 for two items, KSI is 0.913 for six items and alpha of OP is 0.900 for four items, which is higher than the threshold, as suggested by Nunnally (1978).

4.3 Confirmatory factor analysis (CFA)

In this study, we run confirmatory factor analysis (CFA) through AMOS version 24 to validate the element structure of a set of observed variables and to ensure that what extent our model fits the data. Table 3 shows that regression weights “ λ ” of all items range from 0.685 to 0.920, which are in the acceptable range, as suggested by Truong and McColl (2011). In addition, Table 3 shows that AVE > 0.50, and CR > 0.60 for all the variables; this means there is no “convergent validity” issue in the research. Further, AVE square root was greater than its corresponding correlation elements, as shown in Table 3. These findings show that the CFA model meets the criteria for measuring discriminant and convergent validity. This study assessed the measurement model fit by measuring the CCMIN/DF, GFI, RMSEA, AGFI, CFI and NNFI (TLI). The results indicated that all fit indices met the required criteria for determining the goodness fit of the measurement model, as shown in Table 4.

4.4 Hypothesis testing

To test the research hypotheses, this study used Model 6 of the process macro in SPSS version 24, as suggested by Hayes (2013). Table 5 shows the standardized estimate and standard error with lower and upper bounds of the “confidence interval” derived from bootstrap 5,000 resamples. As shown in Table 5, R^2 is (0.4003) which explained 40.03% of the variance of KC, R^2 is (0.1664) that explained the 16.64% of the variance of KS, (0.4735) 47.35% of the variance of KSI and R^2 is (0.4869) that described the 48.69% of the variance of OP. In addition, Table 2

Table 4.
Fit indices of the
CFA model

Fit indices	Abbr	Recommended values	Scores	Sources
Chi-square/Degrees of freedom (CMIN/DF)	χ^2/df	≤ 3.00	2.516 ^a	Gefen (2000)
Tucker–Lewis index	TLI	≥ 0.90	0.954 ^a	Bentler (1980)
Adjusted goodness-of-fit index	AGFI	≥ 0.80	0.886 ^a	Joreskog and Sorbom (1993)
Goodness-of-fit index	GFI	≥ 0.80	0.919 ^a	Hu (1998)
Root mean square error of approximation	RMSEA	≤ 0.08	0.060 ^a	Joreskog and Sorbom (1993)
Comparative fit index	CFI	≥ 0.90	0.964 ^a	Bagozzi (1998)

Note(s): ^aAcceptable

Direct/Indirect/Total effect	Estimate	Standard error (SE)	BC 95% CI	
			Upper bounds (BC)	Upper bounds (BC)
<i>Indirect effect</i>				
OL → KC → OP	0.251	0.040	0.461	0.650
OL → KC → KS → OP	−0.003	0.005	−0.014	0.006
OL → KC → KSI → OP	0.010	0.013	−0.013	0.038
OL → KC → KS → KSI → OP	0.007	0.003	0.002	0.015
OL → KS → OP	−0.007	0.010	−0.030	0.011
OL → KS → KSI → OP	−0.012	0.005	−0.004	0.025
OL → KSI → OP	0.236	0.032	0.172	0.299
<i>Direct effect</i>				
OL → KC	0.634	0.038	0.560	0.708
KC → KS	0.226	0.066	0.096	0.357
OL → KS	0.297	0.067	0.166	0.428
KC → KSI	0.038	0.051	−0.061	0.138
KS → KSI	0.115	0.037	0.043	0.186
OL → KSI	0.667	0.051	0.566	0.768
KC → OP	0.456	0.053	0.352	0.560
KS → OP	−0.027	0.038	−0.102	0.049
KSI → OP	0.483	0.051	0.383	0.583
OL → OP	−0.035	0.063	−0.159	0.090
Total effect of OL → OP	0.601	0.048	0.507	0.695
<i>R-square</i>				
KC				40.03%
KS				16.64%
KSI				47.35%
OP				48.69%
Note(s): “5,000 bootstrap samples were entered”; BC = Bias corrected; SE = Standard error				

Note(s): “5,000 bootstrap samples were entered”; BC = Bias corrected; SE = Standard error**Table 5.**
Direct, indirect and
total effects of OL
on OP

shows that age and gender, tenure, the software companies and designation were not significantly correlated with the outcomes and predictor variables, therefore not included in the models as covariates.

4.4.1 Direct effect. In Table 5, OL has a positive effect on KC at ($\beta = 0.634$, SE = 0.038; 95% CI = [0.560, 0.708]), KC on KS at ($\beta = 0.226$, SE = 0.066; 95% CI = [0.096, 0.357]), KS on KSI at ($\beta = 0.115$, SE = 0.037; 95% CI = [0.043, 0.186]), OL on KSI at ($\beta = 0.667$, SE = 0.051; 95% CI = [0.566, 0.768]) and KC on OP at ($\beta = 0.456$, SE = 0.053; 95% CI = [0.352, 0.560]). Although

the effect of KC on KSI at ($\beta = 0.038$, $SE = 0.051$; 95% $CI = [-0.061, 0.13]$), KS on OP at ($\beta = -0.027$, $SE = 0.038$; 95% $CI = [-0.102, 0.049]$), OL on OP at ($\beta = -0.035$, $SE = 0.063$; 95% $CI = [-0.159, 0.090]$) were not significant, the effect of OL on OP before mediators inserting was significant at ($\beta = 0.601$, $SE = 0.048$; 95% $CI = [0.507, 0.695]$). Thus, all direct hypotheses are accepted, except H1b and H2b.

4.4.2 Indirect effect. As shown in Table 5, the indirect effect of KC at ($\beta = 0.251$, $SE = 0.040$; 95% $CI = [0.461, 0.650]$) and KSI at ($\beta = 0.236$, $SE = 0.032$; 95% $CI = [0.172, 0.299]$) between OL and OP was significant. But, the indirect effect through KS was not significant at ($\beta = -0.007$, $SE = 0.010$; 95% $CI = [-0.030, 0.011]$). Consequently, H3a and H3c, were accepted, whereas H3b was rejected.

4.4.3 Serial/sequential mediation. In Table 5, the results present that the indirect effect of OL on OP through the serially mediating effect of KC, KS and KSI at ($\beta = 0.007$, $SE = 0.003$; 95% $CI = [0.002, 0.015]$) was significant. It provides support for the serial mediation model. On the other hand, the indirect effect through KC and KS at ($\beta = -0.003$, $SE = 0.005$; 95% $CI = [-0.014, 0.006]$), KC and KSI at ($\beta = 0.010$, $SE = 0.013$; 95% $CI = [-0.013, 0.038]$) and KS and KSI at ($\beta = -0.012$, $SE = 0.005$; 95% $CI = [-0.004, 0.025]$) was insignificant. Therefore, H4d was accepted, whereas H4a, H4b and H4c were rejected.

5. Discussion

5.1 Theoretical contribution

This study extends KM research by investigating the serially mediating effect of KC, KS and KSI between OL–OP relationships. Previous studies have shown that companies face significant difficulties in learning from the crisis (Broekema *et al.*, 2019). In this study, we examine the variables that lead OL out of crises (i.e. Covid-19). We applied “multiple regression analysis” through process macro to test the study’s hypotheses. The study proposes that (1) OL and KM processes have the positive relationship with OP, (2) OL, KC and KS have the significant positive relationship with KSI and (3) KM processes serially mediate the relationship between OL and OP. These theoretical predictions are supported by our empirical findings.

First, the results of hypothesis H1a and H2a show that OL has a positive effect on KSI and OP. Results are consistent with the past studies (Ricciardi *et al.*, 2020; Noruzy *et al.*, 2013). Second, the accepted hypotheses H1b, H2c and H1c show the significant positive effect of KC on OP, KS on KSI and KSI on OP in the software development industry of Pakistan. This result is linked to the findings that companies use information to create context, generate knowledge and make decisions in times of crisis (Sahibzada *et al.*, 2020). The result of H3a and H3c shows the significant indirect effect of OL on OP via KC and KSI respectively. Third, the result of H4d shows that the association between OL–OP is sequentially mediated by KC, KS and KSI. Findings are consistent with the earlier research, where indirect effects of OL on OP via KC, KS and KSI have been reported (Hutagalung *et al.*, 2020; Kordab *et al.*, 2020; Wahda, 2017).

5.2 Practical implications

The study has the following implications: First, by using the proposed framework, organizations can gauge their ability to learn from their experiences in a rapidly changing environment and to gain critical knowledge of how to better perform KM practices to strengthen OP during crises. Second, this study will provide new insights into the managers and policy makers, and how OL and KM work together to enhance OP during crisis. Third, the relationships between OL, KM and OP may provide a guideline as to how firms can enhance their performance by using OL to develop KM. Fourth, understanding the effect of

OL and KM on OP would assist top-, middle- and first-line (lower) managers of the companies to identify their strategies in future development. The companies should be aware that OL and KM are crucial for success to operate in an environment of turbulence and uncertainty.

6. Conclusion

Consistent with our expectations, the findings show that the link between OL–OP is mediated by KC, KS and KSI. This result reinforces the argument that OL and KM play a key role in improving the performance of organizations during the Covid-19 crisis. To tackle the coronavirus crisis, software development companies' managers should consider OL and KM practices significantly when focusing on efforts or planning to improve OP. In addition, for software companies it adds credence to the role played by KM in mediating the link between OL and OP, which potentially enables managers to create and maintain a conducive learning environment. KM is vital because it increases the decision-making capacity of the company. All level managers within the companies should ensure that all technical and nontechnical workers have access to the overall skills available within the companies and a better workforce is developed that are more capable of making quick, informed decisions that benefit the company. During crises (e.g. Covid-19), there is a strong consensus that the core strategic advantage of an organization lies in its ability to learn and respond to challenges. Certainly, more attention needs to be paid to the development of OL to improve OP. This will only be possible when organizations create an environment where employees can learn and share information on a regular basis.

7. Limitations and further research avenues

Despite the promising findings, there are some limitations to this study, which provide opportunities for future research: First, the cultural differences in the companies or among managers that might influence the perceptions of learning and KM practices. In terms of generalizability and attain a broader view, it would be interesting to replicate the research by using the cross-culture samples. Second, this study adopts a cross-sectional approach, but a longitudinal research study would be more appropriate to establish the fundamental paths of the studied variables. Third, from a theoretical viewpoint, this study tests KM as a moderator between OL and OP. Future studies can test the mediating effect between transformational leadership and innovation performance. In addition, the future studies should consider the component variables of KC (i.e. externalization, socialization, combination, and internalization) for obtaining more comprehensive results.

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Appendix

The supplementary material for this article can be found online.

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