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Knowledge visualization and strategic decision-making outcomes in small and medium-sized enterprises

Abstract:

This paper examines the direct and indirect (through strategic decision-making processes) impacts of knowledge visualization on strategic decision quality and strategic decision commitment in small and medium-sized enterprises (SMEs). SEM methodology was used to test the research model based on data collected from 209 senior managers of manufacturing SMEs that operate in food production in Egypt. The results suggest that knowledge visualization has a significant positive effect on strategic decision-making processes, strategic decision quality, and strategic decision commitment. Additionally, strategic decision quality is dependent on strategic decision-making processes, but decision-making processes do not significantly impact strategic decision commitment. Knowledge visualization through strategic decision-making processes could help organizations in making high-quality decisions. The research adds to theories of Knowledge-Based View (KBV) and rational decision-making by demonstrating that knowledge visualization could be a catalyst for effective strategic decision-making.

Keywords- knowledge visualization, strategic decision-making processes, strategic decision quality, strategic decision commitment, SMEs

1.   Introduction

Strategic decision-making may be challenging for managers in complex and uncertain business environments as decision makers need to consider a variety of external and internal factors influencing this process, including competitors, customers, suppliers, regulations, technology, and resources [1,2]. In this context, [3] identify information overload as one of major challenges for business managers while [4] note that visualization of knowledge could offer significant assistance for the decision makers in dealing with the massive amount of knowledge available. Several visualizing tools have been introduced to help decision-making processes and help managers understand the large databases of customers, products, sales forces, and other relevant information produced by multiple information technology systems [5]. The engagement of information technology systems (e.g., decision support systems, knowledge management systems, learning management systems) in every organizational aspect has attracted scholars to investigate the effectiveness of using graphs (e.g., concept maps, Ishikawa diagrams, function trees) in decision-making [2,6,7].

While a lack of distinction between Knowledge Visualization (KV) and information visualization exists [4], KV is a natural development of information visualization. Information visualization simplifies storing and presenting a large amount of data, particularly the numerical data, and makes it more accessible to all the organizational stakeholders. In contrast, KV enhances the understanding of knowledge among people and gives them an easier way of expressing and transferring what they know [8,9]. In other words, information visualization aims to improve the presentation, access, and retrieval of massive data sets, while KV concerns compressing a large amount of information and connecting new insights to the existing theories, and concepts with the help of analytical frameworks [10].

Having KV capability is important because managers of organizations face an exponentially increasing amount of knowledge, and knowledge overload may result in poor decisions [11].

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While KV can be used to mitigate the adverse effects of knowledge overload in decision-making processes, little research has been conducted so far to investigate the effects of KV on decision-making processes and outcomes [6,12]. Therefore, there is a growing need to examine how KV can assist decision makers [10].

This paper tests the direct and indirect, through Strategic Decision-making Processes (SDMP), impacts of KV on Strategic Decision Quality (SDQ) and Strategic Decision Commitment (SDC) in small and medium-sized enterprises (SMEs). This paper contributes therefore theoretically and empirically to the KV literature [e.g., 3,4,9,13]. It provides new insights by reflecting on how knowledge overload problem can be mitigated through visualizing the available knowledge and what the effects of KV are on SDMP and its outcomes. Furthermore, this research contributes to decision-making literature [e.g., 15,16] that emphasize that decision quality may depend on decision-making processes by investigating the mediating role of decision-making processes in the relationship between KV and decision quality and commitment. Additionally, the study contributes to the empirical examination of the theory of rational choice that depicts decision quality as dependent on decision maker's knowledge of the decision problem, available alternatives, and the consequences of applying each alternative [17], which can be facilitated through knowledge visualization. Finally, as the study is conducted in the context of SMEs, and as SMEs are viewed as mainly focusing on day to day activities and neglecting the startegic orientation [18–21], this study advances our knowledge of strategic decision-making in SMEs, by providing a significant empirical evidence on the impact of knoweledge visulaization on startegic decision-making processes, quality, and commitment in SMEs.

The rest of the paper is organized as follows: the theoretical foundation, conceptual framework and research hypotheses are discussed in the next two sections. The paper then presents research methods and statistical results, followed by a discussion of the study's research findings. Finally, the paper concludes by emphasizing its original contributions, implications, limitations, and future research avenues.

2.   Theoretical background

2.1   *Knowledge-based view of the firm and knowledge visualization*

Knowledge-based view theory considers knowledge as a distinctively unique resource [22], which helps organizations acquire and maintain their competitive advantage [23]. The theory suggests that a firm can compete on its superior ability to apply the existing knowledge and create new knowledge [24]. According to [25], the heart of the knowledge-based view theory is the integration of knowledge, which refers to the way that knowledge can be shared, applied, and combined with the new knowledge. The three pillars of knowledge integration, i.e., sharing, applying, combining [25], can be gained from visualizing that knowledge. According to [26], KV was coined to indicate the use of visual tools to assess, construct, share, and apply knowledge. It is not only aiming to improve the transfer of knowledge among people but also aiming to improve the creation of new knowledge in groups [27]. Thus, successful knowledge integration requires sharing the knowledge between individuals and departments inside the organization [24] that can be aided by KV.

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2.2 Rationality and bounded rationality of decision-making and knowledge visualization

The theory of rational choice is one of the oldest theories of decision-making. It suggests that decision makers have complete knowledge of the decision problem, available alternatives, and the consequences of applying each alternative [17]. Bounded rationality implies that decision makers choices are not only determined by objectives and decision makers knowledge but also by their ability to apply that knowledge and judge the consequences of various alternatives besides balancing the different wants [28]. According to [29], rationality dictates that decision's actors are knowledgeable of all the decision's outcomes and take the decision that maximizes their interest. This entails that models that stem from the rational choice theory can be either descriptive (describing how organizations and people behave] or prescriptive [instructing how organizations and people should behave) [30].
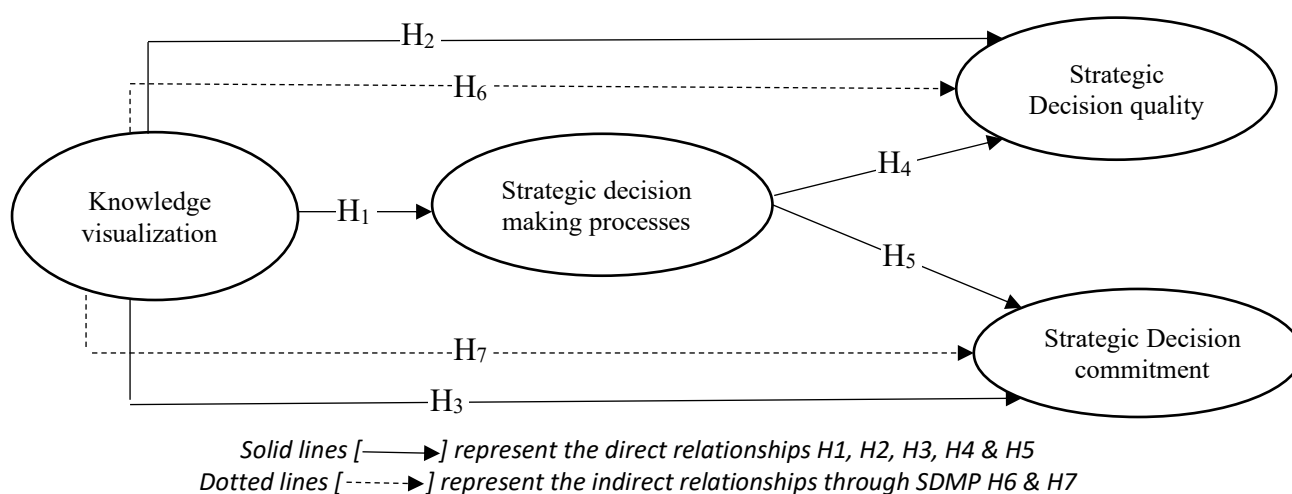
While decision-making is focal to what managers do [31,32], making effective strategic decisions is one of the organizational pillars that help organizations to stand in the increasingly volatile environment [33]. Due to the extensive uncertainty and risk associated with strategic decisions, having and analyzing reliable information is crucial in strategic decision-making [34]. Therefore, the rational choice of an alternative is determined by the degree of information and knowledge that decision makers have [35]. However, as managers frequently face an information overload problem, KV can provide the decision maker with sufficient knowledge required to make a rational decision [2,10,36]. Indeed, KV helps a decision maker understand, interpret, and share the available knowledge [5,27], while mitigating the information overload problem by transforming that massive amount of information into knowledge [26].

3. Conceptual model and research hypotheses

3.1 Conceptual model

The conceptual model for this research illustrates the relationships between the study's four research constructs: Knowledge Visualization (KV), Strategic Decision-making Processes (SDMP), Strategic Decision Quality (SDQ), and Strategic Decision Commitment (SDC) [Figure 1].

Figure 1: Conceptual model

Solid lines [———▶] represent the direct relationships H1, H2, H3, H4 & H5
Dotted lines [------▶] represent the indirect relationships through SDMP H6 & H7

KV refers to the use of graphics to create, share, integrate, and apply knowledge [26,37,38](37)(37). SDMP refer to a series of analytical processes followed to make the right strategic decision [39]. Since SDQ is often perceived as the quality of the decision outcomes, as what is described as a good decision could lead to unfavorable outcomes if it is poorly implemented [40], [41] define SDQ as the perceived likelihood of achieving intended outcomes. [42] assessed SDQ using three indicators: decision effectiveness, decision outcomes relative to expectations, and the perceived overall success of the decision. Finally, SDC refers to organizational members support and commitment towards strategic decision taken by their senior managers [43,44].

While prior studies have tested *individual* hypotheses regarding: (1) the consequences of KV [e.g., 8,38,45,46], (2) the consequences of SDMP [e.g., 10,15,16,47,48], (3) the antecedents of SDQ [e.g., 40,41,49], and (4) the antecedents of SDC [e.g., 50,51], as discussed in sections 3.2 and 3.3, none of the studies investigated the proposed model *as a whole*. The importance of empirically testing the proposed research model, particularly in the context of SMEs, is threefold. First, although strategic decisions represent the heart of managers' job regardless of a firm's size [31,32], they are highly complex processes that require linking and configuration between firm's resources, objectives and outcomes. While KV makes it easier to see links, patterns, and configurations, this research examines simultaneous consequences of KV on various strategic decision outcomes. Second, while the sector of SMEs is the backbone of every economy [52], SMEs frequently focus on day-to-day activities and rarely adopt a strategic orientation [53]. The results of this study may therefore help SMEs recognize the conditions and benefits of strategic decision-making in one model. Third, the fewer resources available for SMEs restrict the information and knowledge processing capabilities of SDMP that may have implications for strategic decisions outcomes in SMEs [48]. The results of this study may therefore indicate to SMEs the importance of KV in solving this problem by demonstrating in one model the positive links between KV, SDMP and strategic decision outcomes.

3.2   The direct effects of KV on SDMP, SDQ, and SDC

KV entails the use of all graphic means to assess, construct, convey, and apply the knowledge [26,37,38]. As such, it plays a fundamental role in boosting decision-making processes and enhancing strategic planning processes [38,45]. However, KV is not a mere transport of knowledge. People who visualize the knowledge to improve their management skills aim to create, and convey experiences, insights, values, perspectives, opinions, expectations, predictions, and attitudes that help someone else to remember and apply these insights correctly [27,54]. Therefore, KV support organizations' managers during all the stages of a strategic decision-making-making process. KV can also enhance the creation and knowledge transfer to other decision makers and stakeholders [10,55].

According to [8] and [36], employing KV has many benefits and solves several problems within organizations. First, KV offers a solution to the information overload problem [46,56] by compressing a large amount of knowledge in an analytical framework or figure [57]. KV enhances decision-making processes by transforming massive amount of row data and information into accessible forms of knowledge that boost each step during decision-making processes through the effective graphics and diagrams [2,4]. Furthermore, KV helps in solving communication problems between the different stakeholders and therefore enhances the effectiveness and efficiency of decision-making processes [27,46,58]. Second, KV offers a systematic transfer of knowledge that increases its speed and quality, improves the comprehension of problems and brings greater insights to the decision maker [38,46]. According to [59] KV helps improving decision quality. The creative power of imagery in KV enables people and groups to create new knowledge. It transforms information into knowledge

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through accessible representation, which enhance managerial judgment [46]. Unlike texts, graphic formats propagate the fast improvement of ideas. According to [5; p.161] "visual representations may make it easier to see patterns and outliers, make certain information more salient and other information less salient, and show detailed information on specific alternatives or provide a context for evaluating focal information; this may improve decision quality". Furthermore, the visual representation of the knowledge has been seen as an essential driver for effective decision-making [3,38,60]. Additionally, three elements affect decision-making quality and each of them can be mitigated through KV, i.e., the lack of accurate and complete knowledge, the lack or limitation of interpreting the knowledge, and the time available for making the decision [2,61–63]. Third, KV enables knowledge to be shared, translated, codified and transferred easily between individuals, groups, and departments, especially between people with different backgrounds, which increase members' commitment to organizational decisions [26,27,46]. Moreover, KV allows for seeing the big picture and can be an effective tool for engaging all executive and organizational members [64,65], which in turn could increase decision commitment. Furthermore, KV highlights the type, meaning, reasons, ways, and scope of the knowledge needed for strategic decision-making, which could increase strategic decision commitment [50].

Several prior studies empirically indicated the likely positive effect of KV on decision-making processes, particularly in the field of science like medicine and biology [66]. For instance, [67] and [68] have reported a significant positive impact of KV on the quality of the decisions. Furthermore, KV significantly informed strategic decision-making and helped authorities to effectively respond to the challenges arising from the COVID pandemic [69]. However, none of the previous studies investigated the impact of KV on decision-making in SMEs context nor its impact on strategic decision-making outcomes.

In view of these arguments, it is postulated that KV can improve strategic decision-making processes, quality, and commitment in SMEs:

H1: KV positively influences SDMP
H2: KV positively influences SDQ
H3: KV positively influences SDC

3.3   The direct and mediating effect of SDMP

SDMP refer to a series of analytical processes followed to make the right strategic decision [39]. Therefore, decision-making is a consequence of continued processes not a single action [38]. Effective SDMP result in high quality and committed decisions [10,15,16,47]. These processes involve matching the available knowledge with organizational resources and needs in the light of institutional mission [70]. Following a rational decision-making processes, starting from analyzing all relevant knowledge and focusing on crucial knowledge inside the extensive amount of knowledge available besides using analytical techniques, helps in making high-quality strategic decisions to which all organization's members commit [15,40]. According to [40] decision quality depends on following structured or defined decision-making processes. Similarly, [49] indicated that the quality of a strategic decision made and implemented is determined by the quality of the processes followed to make that decision. Furthermore, [71] indicated the casual link between decision-making processes and the outcomes of the decision. However, the decision commitment from every individual and every sub-unit inside the organization is dependent on the effectiveness of the strategic decision taken [72] that is determined by the effectiveness of the processes followed to arrive at the strategic decision [15,49].

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To emphasize, both decision commitment and decision quality are desirable outcomes of a strategic decision-making process [44,73]. To analyze decision quality, two research streams have been used. The first stream focuses on the outcomes of the decision [73] and the second stream focuses on the quality of the processes that lead to decision quality [74]. According to [18], while SDMP are shaped according to the antecedents of such processes, the consequences [e.g. decision quality, decision commitment] depend on the following of that processes. Interestingly, decision-making processes can mediate the relationship between KV and SDQ and commitment. The justification for that is quadruple. First, while decision quality is dependent on the decision processes followed [10,15,16,38,40], visual representation of the knowledge enhances decision-making processes [38,45]. Second, decision-making commitment increases by enabling many of the organizational members to see patterns and the big picture during all decision-making processes [51]. KV allows for seeing the big picture and increases organizational members engagement in decision-making processes [64]. Third, according to information processing theory, SDQ is inherent to following rational SDMP [75]. Moreover, decisions will be committed if they are linked to subsequent actions, or the decision makers follow organized decision-making processes [76]. Fourth, it is understood that decision quality and commitment are consequences of collective and interactional decision processes, while KV helps develop and share common ground to support decision-making processes [10,38]. Having said that, the following hypotheses are postulated:

H4: SDMP positively influence SDQ
H5: SDMP positively influence strategic decision commitment
H6: SDMP mediates the relationship between KV and strategic decision quality
H7: SDMP mediates the relationship between KV and strategic decision commitment

4. Research methods

4.1 Sample and data collection

To test the proposed model, a quantitative questionnaire survey was developed and sent by post to 2,024 small and medium sized firms that operate in food production in Egypt. As food industry sector contributes 24.5% to Egyptian GDP and provides 23.2% of employment in Egypt [20,77], it is "the second largest in Egypt in terms of value added, and the largest in terms of industrial employment. It achieved an average growth rate of 20% during the five-year period from 2015 to 2020" [Egyptian Ministry of Trade and Industry, 2021]. The list of SMEs and contact details were obtained from the Egyptian Ministry of Industry and Trade where the list represents the whole country. The questionnaire has been developed in English based on relevant literature (see section 4.2 for details). To avoid translation errors and ensure clarity of measures in Arabic, as well as content and face validity, translation and re-translation technique has been applied [78,79]. In addition, a pilot study involving 15 senior managers and 5 academics has been conducted. The respondents were encouraged to provide feedback on the questionnaire design and wording. Following their feedback, the final questionnaire was conducted in Arabic.

Two hundred and sixty-seven surveys were collected. All returned questionnaires were completed without missing values; however, some of them showed straight-lining where some survey respondents give identical answers to all questions. Therefore, these surveys were eliminated from statistical analysis to have an overall sample size of 209 valid questionnaires. Our sample is adequate for the SEM for the SEM analysis because: 1) it meets Nunnally's [80] rule of thumb of the adequate sample size of a minimum of ten respondents per item (our SEM model contains 21 indicators); 2) it meets Hair et al.'s [81] requirement of a minimum sample

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size of 100-150 to obtain stable maximum likelihood estimation (MLE) solutions. The demographic profile of the sample is shown in Table I.

Table I: Sample profile

|	Item	Frequency	Percentage
Gender	Male	122	58.4%
	Female	87	41.6%
Age	20-29	17	8.1%
	30-39	83	39.7%
	40-49	62	29.7%
	50-59	45	2.2%
	60 or more	2	1.0%
Working experience	0-5	23	11.0%
	6-10	57	27.3%
	11-15	107	51.2%
	16-20	19	9.1%
	20 or more	3	1.4%
Education level	A level	0	0%
	Bachelor	173	82.8%
	Master's degree	19	9.1%
	Doctoral [PhD/DBA]	8	3.8%
	Other	9	4.3%
Position	CEO	121	57.9%
	Middle manager	52	24.9%
	Supervisor	21	10.0%
	Other	15	7.2%

4.2   Measures

The proposed model (Figure 1) and the hypothesized relationships were tested with measures developed from the literature. The constructs' measures are shown in Table II. Regarding KV, a six-item scale ($\alpha = 0.77$) derived from [8] was used to measure the construct of KV synthesized in CARMEN acronym namely: Coordination, Attention, Recall, Motivation, Elaboration, and New insights. The construct of SDMP was measured using a six-item scale ($\alpha = 0.95$) previously used by [80] and originally identified by [81–83]. A six-item scale ($\alpha = 0.93$) derived from [84,85] has been adapted to measure strategic decision quality. SDC was measured using a three-items scale ($\alpha = 0.79$) previously used by [43]. Items were measured using a five-point Likert scale (1= strongly disagree and 5= strongly agree).

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Table II: Measurement items and validity assessment

Constructs	Loading
Knowledge visualization (KV): [α = 0.77, CR = 0.93, AVE = 0.68, MSV = 0.33]	
helps to coordinate the communication of knowledge to workers	0.777
raises awareness and provides focus for knowledge creation and transfer	0.884
improves memorability and thus fosters the application of new knowledge	0.837
energizes viewers to engage in interpretation and exploring the graphics	0.888
improves understanding and appreciation of concepts and ideas as one interacts with them	0.773
reveals previously hidden connections and leads to sudden insights	0.729
Strategic decision making processes (SDMP): [α = 0.95, CR = 0.91, AVE = 0.63, MSV = 0.33]	
the problem is properly identified, and the objectives of the decision are well defined by the decision-makers	0.658
decision-makers actively search for information on potential alternatives	0.835
decision makers carefully weigh the advantages and the disadvantages of these alternatives and the chances of success for each of them	0.774
before a final decision is made, the positive and negative consequences of all alternatives are re-examined	0.845
provisions for implementation of the decision are prepared	0.757
a procedure is defined for a follow up of the decision to judge if the purpose has been achieved or has to be reconsidered	0.795
Strategic decision quality (SDQ): [α = 0.93, CR = 0.94, AVE = 0.71, MSV = 0.22]	
the decision has had a positive effect on the company	0.758
relative to what we expected, the results of the decision were satisfactory	0.826
overall, the group members feel that the decision was appropriate	0.930
decision outcomes covered the maximum range of relevant issues for making the decision	0.943
decision rationale was well structured and reflective of interrelationships and intra-relationships among the relevant issues	0.823
the degree to which the team's decision rationale was expressed clearly	0.717
Strategic decision commitment (SDC): [α = 0.79, CR = 0.90, AVE = 0.75, MSV = 0.15]	
Considering the strategic decisions made by the CEO over the last 12 months:	
I support the strategic decisions	0.797
I support the course of action decided upon	0.897
I support the strategic decisions that were made	0.893

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Figure 2: CFA model
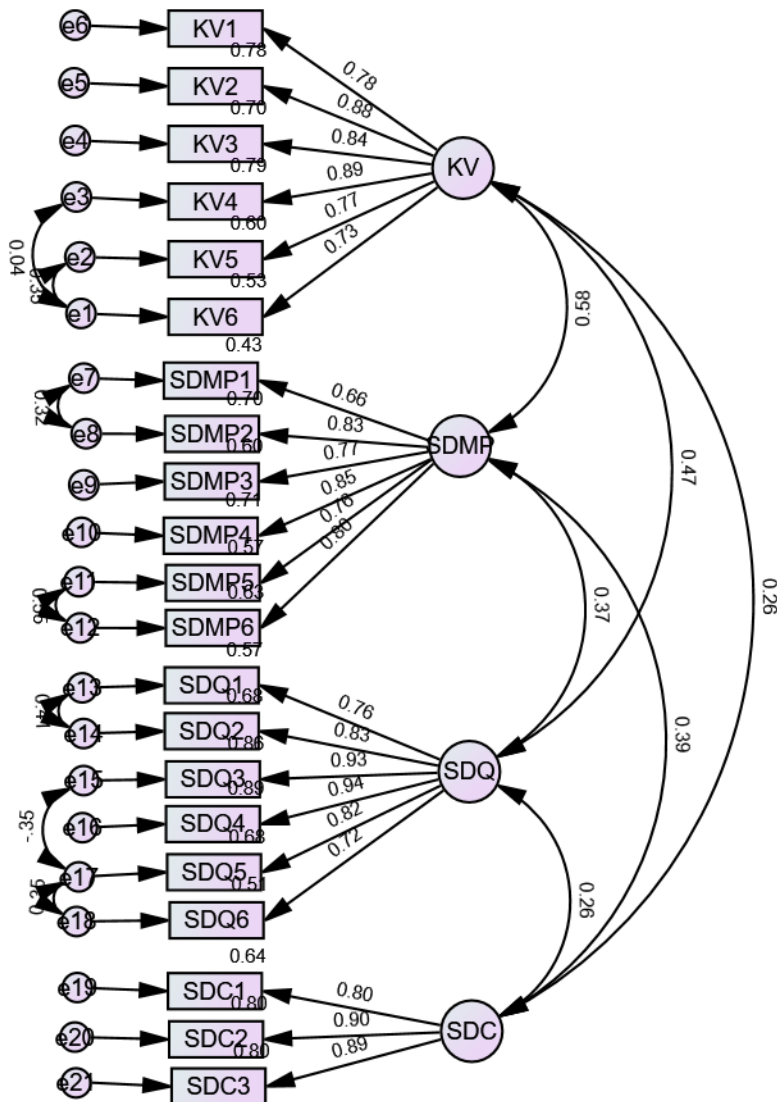
X^2(176, N=209)= 248.224; P=0.000; CMIN/df= 1.41; SRMR= 0.030; RMSEA= 0.044 (REMSA at 90% confidence interval 0.031(lower estimate) and 0.057 (higher estimate)); GFI=0.905; CFI= 0.979; NFI= 0.932; TLI= 0.975; PCFI= 0.825; PNFI= 0.881

Note: KV, Knowledge visualization; SDMP, Strategic Decision Making Process; SDQ, Strategic Decision Quality; SDC, Strategic Decision Commitment

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5. Data analysis and results

5.1 Measurement model

To test the research hypotheses, SEM methodology has been used (AMOS 28 software). Prior to analyzing the data under examination, the measurement model was assessed using the rules of thumb recommended by the literature [86]. As seen in Table II, for all constructs, the Cronbach's α values are above 0.70, the average variance extracted (AVE) are above 0.50, the composite reliability values are above 0.70, and for each variable the loading estimates are above 0.70 (Figure 2). The results indicate a good measurement model fit, meaning that the four constructs' items (KV, strategic decision-making process, strategic decision quality, and strategic decision commitment) have achieved high validity and reliability in this model. The Heterotrait-Monotrait (HTMT) ratio has been used to assess divergent and convergent validity of the research latent variables as recommended by [87]. The results presented in Table III indicate divergent and convergent validity as the HTMT values are below 0.90, in line with the rule of thumb [86].

Table III: Discriminant validity (HTMT-results)

	KV	SDMP	SDQ	SDC
KV				
SDMP	0.569			
SDQ	0.467	0.362		
SDC	0.265	0.382	0.159	

5.2 Structural model

Before testing the research hypotheses and after confirming the reliability and validity of all constructs' indicators, the quality of the structural model was assessed using the coefficient of determination indicator [R^2] and the variance inflation factor (VIF). The determination coefficients R^2 for all the endogenous variables were above 10% [0.341 for SDMP; 0.484 for SDQ; and 0.239 for SDC] [88], which indicate the predictive power of the model. The results of a multicollinearity test, using the recommended variance inflation factor values of VIF< 3.5 [86] indicate that the cutoff values are acceptable for our model predictors. Other model fit indices, Chi-square = 250.865; DF= 177; X^2/df = 1.42; RMR= 0.052; RMSEA= 0.045 (REMSA at 90% confidence interval 0.031(lower estimate) and 0.057 (higher estimate)); RMR = 0.033; CFI= 0.978; GFI = 0.903; AGFI = 0.874; TLI = 0.974; NFI = 0.931, demonstrate acceptable goodness of fit indices.

5.3 Hypotheses testing

The results in Table IV and Figure 3 indicate that KV has a significant direct positive effect on SDMP (β = 0.528, p = 0.000, C. R. = 6.540), SDQ (β = 0.335, p = 0.000, C. R. = 4.305), and SDC (β = 0.265, p = 0.000, C. R. = 4.625). Furthermore, the SDMP have a significant positive effect on SDQ (β = 0.463, p = 0.000, C. R. = 3.580). However, the results indicate that the SDMP have no significant effect on SDC (β = 0.136, p = 0.096, C. R. = 1.665). Regarding the indirect relationships that investigate the mediating effect of SDMP, following Baron and Kenny's three-step approach [89], the results indicate that SDMP mitigate the relationship between KV and SDQ (β = 0.244, p = 0.000) but they do not mitigate the relationship between KV and SDC, and in fact show a negative effect on SDC (β = -0.072, p = 0.51).

Table IV: Hypotheses testing

Hypotheses	Path	β	S.D.	C.R.	*p*-value	*Conclusion*
	Direct impacts of overall quality					
H1	KV ⟶ SDMP	0.528	0.081	6.540	0.000	Supported
H2	KV ⟶ SDQ	0.335	0.078	4.305	0.000	Supported
H3	KV ⟶ SDC	0.265	0.071	4.625	0.000	Supported
H4	SDMP ⟶ SDQ	0.463	0.129	3.580	0.000	Supported
H5	SDMP ⟶ SDC	0.136	0.082	1.665	0.096	Not supported
	Indirect impacts					
		β	lower	upper	*p*-value	
H6	KV ⟶ SDMP ⟶ SDQ	0.244	0.017	0.180	0.000	Supported
H7	KV ⟶ SDMP ⟶ SDC	-0.072	0.171	0.235	0.15	Not supported

Figure 3: Research Structural Equation Model SEM
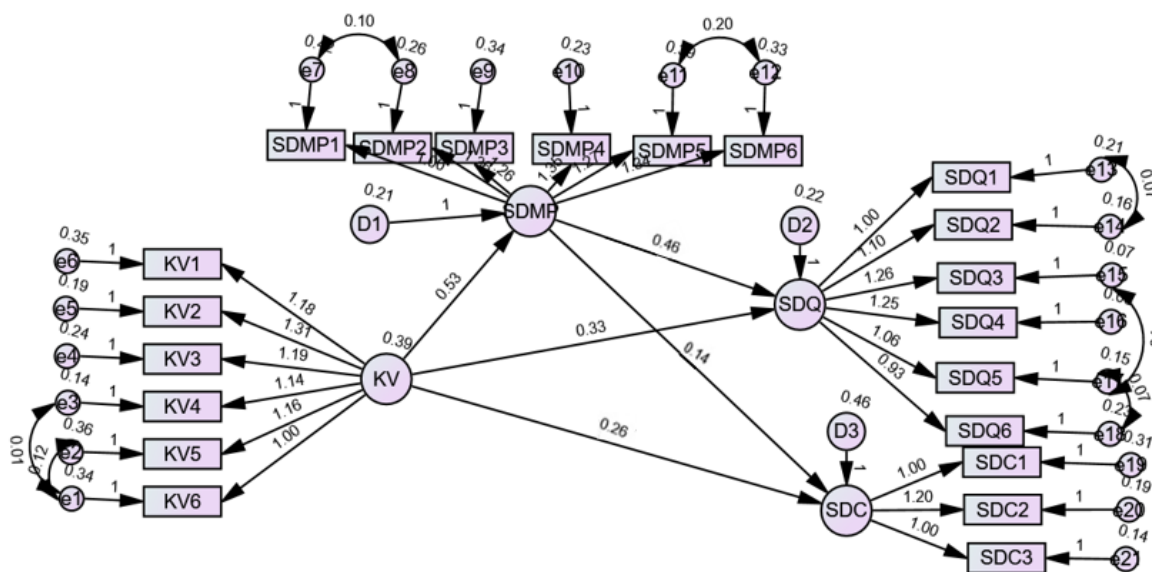
As it can be seen from table IV, the proposed research model shows insignificant and negative paths (H5 and H7), which is inconsistent with the proposed hypotheses. Therefore, these paths were removed from the model and the modified model was retested (Figure 4 & 5). The results of the retested model that excluded the insignificant paths (Table V) show that KV has a significant direct positive effect on SDMP (β = 0.530, p = 0.000, C. R. = 6.559), SDQ (β = 0.342, p = 0.000, C. R. = 4.361), and SDC (β = 0.331, p= 0.000, C. R. = 3.660). Furthermore, SDMP have a significant positive effect on SDQ (β = 0.126, p = 0.007, C. R. = 2.723). Regarding the indirect relationships that investigate the mediating effect of strategic decision-making processes, the results indicate that SDMP mitigate the relationship between KV and SDQ (β = 0.078, p = 0.000). In other words, SDMP partially mediate the KV-SDQ relationship. SEM results shows goodness of fit of the model (Chi-square = 264.887; DF= 178; X^2/df = 1.49; RMR= 0.052; RMSEA= 0.048 (REMSA at 90% confidence interval 0.036(lower estimate) and

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0.060 (higher estimate)); RMR = 0.052; CFI= 0.975; GFI = 0.911; AGFI = 0.899; TLI = 0.970; NFI = 0.972).

Figure 4: Modified conceptual model

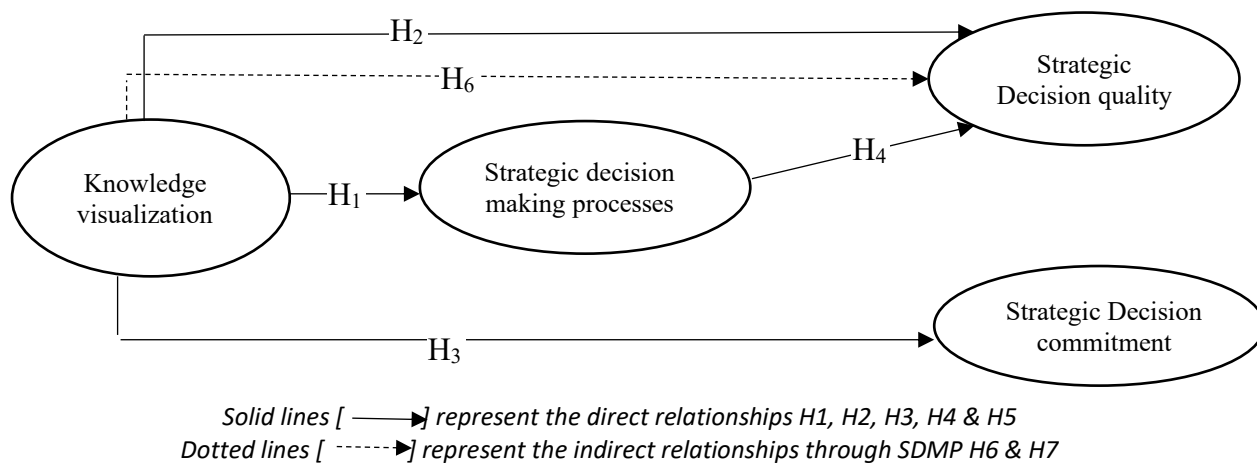Solid lines [──────▶] *represent the direct relationships H1, H2, H3, H4 & H5*
Dotted lines [------▶] *represent the indirect relationships through SDMP H6 & H7*

Table V: Hypotheses retesting

Hypotheses	Path	β	S.D.	C.R.	*p*-value	*Conclusion*
Direct impacts of overall quality						
H1	KV ──────▶ SDMP	0.530	0.081	6.559	0.000	Supported
H2	KV ──────▶ SDQ	0.342	0.078	4.361	0.000	Supported
H3	KV ──────▶ SDC	0.331	0.090	3.660	0.000	Supported
H4	SDMP──────▶ SDQ	0.126	0.083	2.723	0.007	Supported
Indirect impacts						
		β	lower	upper	p-value	
H6	KV─▶SDMP──────▶SDQ	0.078	0.012	0.172	0.000	Supported

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Figure 5: Modified SEM
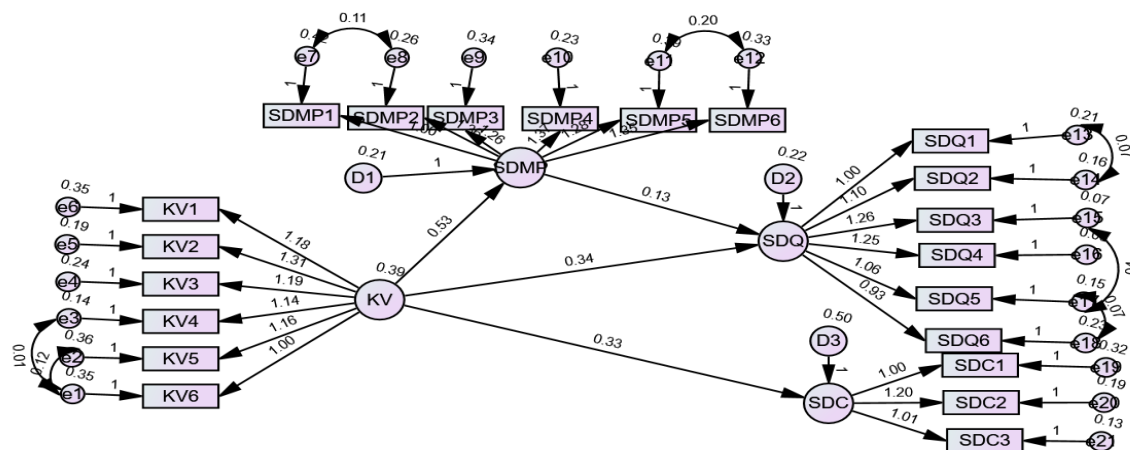
6. Discussion

This study aimed to investigate the impact of KV on strategic decision-making processes, strategic decision quality, and strategic decision commitment. Moreover, it aimed to examine the indirect relationship between KV and SDQ and SDC by incorporating the mediating role of strategic decision-making processes. The model was empirically tested, and the results revealed the following.

Our statistical results do not support the original conceptual model (Figure 2 & 3) as some of the hypothesized relationships have not been supported. Particularly, the results emphasize an insignificant path (H5) and a negative path (H7), which intercept the acceptance and applicability of the whole model despite that literature has pointed out the likely significant positive paths (H5 and H7) based on empirical results that tested these relationships separately. Therefore, the insignificant and negative paths were removed from the model resulting in a new valid and reliable model (Figure 4 & 5) that can be applied by SMEs and provides substantial theoretical contribution. The new model excludes the direct (H5) and indirect (H7) effect of SDMP on SDC and shows that KV significantly and positively enhance SDMP, SDQ, and SDC. Furthermore, SDMP positively contribute to SDQ and mediate the relationship between KV and SDQ.

While our conceptual model (Figure 1), for the first time, has proposed examining the relationships together in one model, the two negative and insignificant paths (H5 and H7) contradict some literature [e.g., 47,72] while other relationships in the model are consistent with some literature [e.g., 15,49].

To elaborate, the results demonstrate a direct and positive relationship between KV and the strategic decision-making process (H1). The current result is aligned with [3] as they indicated that visualization simplifies strategizing. KV helps managers during all strategic processes from planning to evaluation [55]. Similarly, [90; p. 7] stated in their research that "visualization can be considered as a 'visual vehicle of thought' to assist managers in making decisions". Thus, visual representation improves the quality of decision-making processes. "The use of

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maps for visualizing, describing and understanding phenomena and "reality" is not new ……
they provide a valuable visual representation of a phenomenon or "reality" that highlights the relationships among its elements/dimensions" [91; p. 200]. Thus, when KV is created, much inherent information is encoded. When these representations are seen by the decision maker this information is decoded again [5]. Therefore, the positive link between KV and SDMP found in this study is supported by prior research.

The results of this study also show that KV impacts on SDQ and SDC [H2 and H3]. These results match the investigations done by [92], as visualization is a crucial determinant for decision quality. KV assists all organization's members to understand the available knowledge [8], whereas a better understanding of the role of knowledge as value creation can be achieved through knowledge mapping, which leads to appropriate decisions [60].

Furthermore, while the study confirms the positive significant effect of SDMP on SDQ [H4], it does not support the link between SDMP and SDC [H5] within the proposed model [Figure 1]. The empirical evidence concerning H4 aligns with some of the research work done by [15,47,49]. They have indicated that the quality of strategic decisions could be attributed to rational and effective strategic decision-making processes. However, our findings of testing H5 within the research model are contrary to Harrison's [72] findings, as they show an insignificant effect of SDMP on strategic decision commitment. These inconsistent results might be resulting from testing the relationship between SDMP and SDC in isolation from other variables in prior studies, unlike in this research that included H5 within the conceptual model tested in this study [Figure 1]. Additionally, the inconsistent results might be explained by other factors that affect decision commitment, which were not included in this research, such as group decision-making, organizational members' engagement, and leadership style [15,64].

In relation to the indirect relationships, the findings highlighted the mediating effect of SDMP in the relationship between KV and SDQ (H6). These findings are consistent with the previous investigations that indicated the direct link between KV and SDQ [15,47], as well as the direct link between strategic making decision processes and SDQ [15,49]. While the investigation of the indirect link is one of the contributions provided by this study, it is supported by prior research that confirm the direct link. According to [33], if KV is used during decision-making processes, it will lead to decision quality. However, the results of this study did not confirm the role of decision-making processes as a mediating variable in the relationship between decision-making processes and SDC (H7), within the model tested. These findings, however, open the gates to search for different drivers that enhance the commitment with the taken decision which will be highlighted in future research avenues.

7.   Conclusion

7.1   *Theoretical implications*

The results of this study provide several theoretical contributions.

First, this research indicates, for the first time, that the data does not support the original conceptual model [Figure 1] and the hypothesized relationships among the model's construct despite the fact that prior literature indicated significant relationships among individual variables when tested in isolation from the other variables contained in the conceptual model. Meanwhile, this research indicates that the data supports a modified model [Figure 2] that excludes the insignificant and negative paths found in this study. The modified model of impacts of KV on SDMP and its outcomes (Figure 4) that has been validated in this study

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shows, for the first time, the significant simultaneous relationships among the four study constructs (KV, SDMP, SDQ and SDC).

Second, the study extends and complements the literature on strategic decision-making by validating a model that emphasizes KV as an antecedent of strategic decision-making processes, strategic decision quality, and strategic decision commitment. Although [3] indicated that visualization helps managers during all strategic processes by simplifying acquiring, storing, sharing, and evaluating information and knowledge, while [92] noted that decision quality can be maintained through KV, the results of this study extend this knowledge by examining the impacts of KV in one model that has been validated in this study (Figure 4). Hence, our empirical investigation adds a more specific contribution emphasizing the simultaneous direct positive effects of KV on strategic decision-making processes, strategic decision quality, and strategic decision commitment.

Third, our research contributes to the knowledge-based view by testing a model of impacts of KV on SDMP, SDQ and SDC. Specifically, according to knowledge-based view theory, knowledge has been long considered one of the most valuable resources that offer and sustain the competitive edge of the firm which can be created by knowledge sharing [93]. Although KV has been coined to achieve many positive outcomes [26,37,55], our research indicates the positive impact of KV on SDQ that is considered the backbone for the competitive position. It can therefore be concluded that that KV is fundamental in attaining high quality decisions.

Finally, this study contributes to the theory of rational choice by providing a new examination of the relationships between KV, SDMP, and SDQ, shown in the conceptual model [Figure 1], that have been indicated in prior studies on either the direct link between KV and SDMP [3,55,90,91], or the causal link between SDMP and SDQ [15,47,49]. However, this study has been the first attempt to examine the indirect link between KV and SDQ through SDMP as a mediating variable.

7.2   *Implications for practice*

From a practical point of view, managers of SMEs are advised to apply the modified model validated in this research (Figure 4) in their attempts to improve SDQ through KV and SDMP. This research thus yields some important specific recommendations for managers.

First, it is advisable for the organizations and decision makers to visualize the available knowledge. KV will help both newly appointed organizational members as well as the existing members. Visualizing knowledge offers a basement for creating new knowledge and sharing the current knowledge. This transferred knowledge includes skills, experiences, insights, values, perspectives, opinions, expectations, predictions, and attitudes which help someone else to remember and apply these insights correctly [27]. The benefits of effectively applying the visualized knowledge will be translated into high quality committed strategic decisions.

Second, the positive mediating effect of SDMP in the relationship between KV and SDQ provide significant recommendations for organizations, particularly decision makers to employ KV in decision-making processes. As indicated, the quality of the strategic decision is determined by the effectiveness of the processes followed to arrive at the decision [10,15,16,47]. However, sustaining the effectiveness during all decision-making processes do not happen by chance. This study has demonstrated that visualizing knowledge could aid the quality of a strategic decision.

7.3   Limitations and future research

The findings of this study are valuable alongside its limitations that offer new avenues for future research. First, one limitation is that this research has examined the direct and indirect link of KV on strategic decision-making, strategic decision quality and strategic decision commitment. Future research could investigate effects of KV on different outcomes, such as organizational performance. Second, as this research shows that the impact of SDMP on SDC was insignificant within the context of the original model, future research could re-examine the conceptual model (Figure 2) and the modified model (Figure 4) in the same and in different contexts to extend the body of evidence on these relationships. Third, while the statistical outcomes of this research demonstrate an insignificant impact of SDMP on SDC, further research could consider the impact of employees' engagement in SDMP and its impact on SDC as the literature [e.g., 15,64] indicates that engaging in SDMP increase employees' commitment. Finally, although the sample size was adequate for this study, further research could consider larger sample of SMEs or large firms or adopt longitudinal study instead of the cross-sectional design of the current study.

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