Research Paper

Information Technology, Dynamic Capabilities, and Strategic Planning in the Oil and Gas Supply Chain

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Abstract

Uncertainties, including the COVID-19 epidemic, and variations in demand affect the oil and gas sector. Owing to the reliance on various suppliers, oil and gas projects require effective supply chain management. Ineffective management can result in overspending, delays, and legal issues. This study examined how supply chain management is affected by changes in the sector. This study investigated the connections between Information Technology, strategic planning, dynamic management competencies, and Managerial Performance in oil and gas projects. Purposive sampling was used in the study, with managers or heads of supply chain departments as the target audience. Partial least squares structural equation modeling (PLS-SEM) was used to evaluate the data obtained from an online survey and test the proposed correlations between the research variables. The findings demonstrated that management performance was positively impacted by strategic planning and Information Technology through the increased dynamic capacities of managers. This study contributes by combining Information Technology, strategic planning, and dynamic capabilities into a unified model. Results shed light on how supply chain management is impacted by changes in the sector. Useful recommendations are provided for businesses looking to enhance supply chain performance despite difficulties.

Keywords: *Dynamic Managerial Capability; Information Technology; Strategic Planning; Supply Chain Manager Performance*

INTRODUCTION

The oil and gas sector has encountered noteworthy obstacles in the past few years, including demand volatility and disruption of global supply chains caused by the COVID-19 outbreak (Barbosa et al., 2020; Michie, 2020). Because oil and gas projects depend on a variety of suppliers for equipment, services, and raw materials, effective supply chain management is essential (Chima & Hills, 2007; Yusuf et al., 2014). Project delays, cost overruns, quality problems, and legal hazards can result from ineffective management (Chima & Hills, 2007; Yusuf et al., 2014). Oil and gas firms must plan strategically, build dynamic capabilities, and use Information Technology to enhance supply chain performance to meet these difficulties (Behl & Dutta, 2019; Rosin et al., 2020).

The functions of Information Technology (Sanders & Premus, 2005; Sangari et al., 2015), strategic planning (Gunasekaran et al., 2001; Lummus et al., 1998), and dynamic capacities (Sunder et al., 2019; Teece, 1997) in supply chain management have all been studied in previous studies. However, because these ideas have mostly been researched independently, there is a knowledge vacuum about how their combination can affect managerial effectiveness in the oil and gas sector.

By investigating the connections among strategic planning, Information Technology, dynamic managerial competencies, and Managerial Performance in the context of oil and gas supply chain management, this study seeks to close this gap. This study adds to the body of information already in existence and offers insights into how oil and gas companies can enhance their supply chain performance in the face of industry problems by combining these ideas into a single empirical model. This study's central research question is: How can Information Technology, strategic planning, and dynamic managerial competencies affect Managerial Performance in the context of oil and gas supply chain management?

This research aims to explore the effects of industry shifts on supply chain management in

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oil and gas firms, with a particular emphasis on the potential connections between Information Technology, strategic planning, dynamic managerial capacities, and Managerial Performance. This study uses partial least squares structural equation modeling (PLS-SEM) to evaluate the data gathered through an online survey and uses a purposive sample strategy aimed at supply chain managers.

LITERATURE REVIEW

Dynamic Managerial Capabilities (DMC)

Since the groundbreaking studies by Teece (1997) and Sunder et al. (2019), Dynamic Managerial Capabilities (DMC) have received a great deal of attention in the strategic management literature. According to Helfat et al. (2007), DMC is the ability of managers to add to, expand, or alter an organization's resource base. When it comes to supply chain management, DMC helps businesses stay competitive by allowing them to adjust to shifting conditions (Defee & Fugate, 2010). DMC is crucial for improving supply chain performance, resilience, and agility, according to recent empirical research (Beske et al., 2014; Chowdhury & Quaddus, 2017; Dubey et al., 2019). According to these studies, supply chain management (SCM) benefits from DMC in several ways, eventually boosting organizational performance. From the explanation above, the following hypothesis is formulated:

H1: Dynamic Managerial Capabilities positively related to Managerial Performance through Strategic Planning.

Strategic Planning in Supply Chain Management (SP)

An essential element of efficient supply chain management is strategic planning. It entails creating and carrying out long-term plans and projects to enhance the performance of the supply chain (Gunasekaran et al., 2001; Lummus et al., 1998). Strategic planning in supply chain management increases customer satisfaction, lowers costs, and improves coordination (Kumar & Banerjee, 2012; Sabet et al., 2017). Additionally, empirical research has shown that strategic planning improves a company's success in the oil and gas sector (Grant, 2003; Kunadhamraks & Hanaoka, 2008). These results suggest that supply chain performance as a whole and Managerial Performance are positively impacted by strategic planning. Based on the previously mentioned explanation, we formulate the hypothesis as follows:

H2: Strategic Planning positively related to Managerial Performance.

Information Technology in Supply Chain Management (IT)

The use of Information Technology (IT) in contemporary supply chain management is essential. Information Technology (IT) makes information flow smoother, increases visibility, and makes it easier for supply chain participants to collaborate (Sanders & Premus, 2005; Sangari et al., 2015). According to empirical research, supply chain performance and IT adoption are positively correlated (Li et al., 2009; Subramani, 2004; Vickery et al., 2003). IT has been recognized as a key facilitator of supply chain integration and optimization in the oil and gas sector (Chima & Hills, 2007; Sangari et al., 2015). According to these studies, IT affects supply chain and Managerial Performance directly and favorably. It also has an indirect impact through its effects on DMC and strategic planning. Based on the previously mentioned explanation, we formulate:

H3: Information Technology is positively related to Managerial Performance.

Information Technology Moderation

Information Technology (IT) has a direct influence on Managerial Performance as well as other dimensions; however, moderating roles in various interactions within supply chain management have also been investigated. According to Baron et al. (1986), a moderating variable is one that modifies the direction or strength of the association between an independent and a dependent variable.

Numerous scholarly inquiries have explored the moderating influence of Information Technology on the correlation between organizational capabilities and performance. For example, Tippins and Sohi (2003) discovered that the association between organizational learning and business performance is moderated by IT expertise. Similarly, IT capabilities have been shown by Fink and Neumann (2009) to reduce the impact of strategy alignment on organizational agility.

The moderating role of IT in supply chain management has also been studied. According to Singhry (2015), supply chain collaboration and operational performance are mediated by IT. Similarly, Kim et al. (2005) demonstrated that the impact of supply chain integration on company performance is mitigated by flexible IT infrastructure.

On the basis of this literature, it is possible to suggest that IT may also moderate the links in the oil and gas industry between strategic planning, Managerial Performance, and dynamic management capabilities (DMC). In particular, the following theory is proposed:

H4: Information Technology moderates the relationship between Strategic Planning and Managerial Performance.

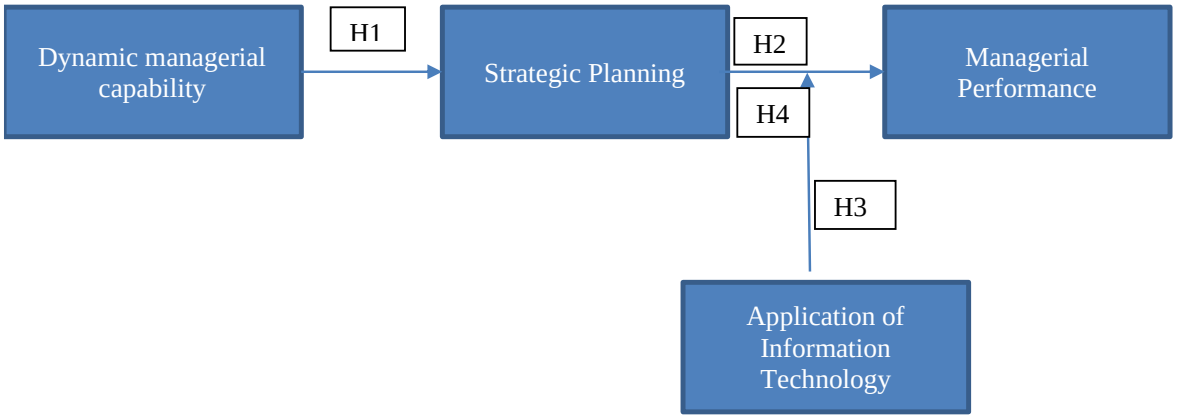

Figure 1. Proposed research models

Integration of Concepts and Causal Relationships

With an emphasis on the oil and gas sector, the literature study examined the fundamental ideas of Information Technology (IT), Strategic Planning (SP), Dynamic Managerial Capabilities (DMC), and Managerial Performance (MP) in the context of Supply Chain Management. The review also examined the moderating function of IT and any causal links between these constructs**.** According to these assumptions, DMC directly and favorably influences Strategic Planning (H1), which in turn enhances management effectiveness (H2). IT will both directly impact Managerial Performance (H3) and regulate the Management Performance-Strategic Planning link (H4).

A gap in the current research is filled by the integration of these ideas and the analysis of their causal links; up until now, the majority of the literature has concentrated on the separate impacts of DMC, IT, and Strategic Planning on supply chain management. The objective of this study is to offer a more focused knowledge of the factors influencing Managerial Performance in the oil

and gas sector by putting forth a model that considers these constructs and their interactions based on the supplied route coefficients.

RESEARCH METHOD

Research Design and Data Collection

To investigate the connections between Information Technology (IT), Strategic Planning, dynamic managerial capabilities (DMC), and Managerial Performance in the oil and gas sector, this study used a quantitative research design and survey methodology. Because the survey method is a suitable means of gathering information on the constructs of interest and evaluating the suggested hypotheses, it was selected (Creswell & Creswell, 2017; Fowler, 2013).

An online survey was used to gather data from Indonesian supply chain managers working in the oil and gas sector. Managers and executives working in supply chain management for oil and gas businesses comprised the target demographics. Those who fulfilled the following requirements were chosen for participation using a purposive sample technique: (1) Working as an executive or manager in an oil and gas company at the moment; (2) Having an active role in supply chain management (Saunders et al., 2019).

Data Sufficiency

There were 150 valid responses in all, which is considered adequate for the statistical analysis carried out in this investigation. The sample size satisfies the minimum requirement of 100–150 observations for partial least squares (PLS) analysis and structural equation modeling (SEM) analysis (Kline, 2018; Sarstedt et al., 2020). Furthermore, a power analysis using G*Power 3.1(Erdfelder et al., 2009) showed that, for the suggested study model (Cohen, 1992), a sample size of 150 is sufficient to detect medium effect sizes (f2 = 0.15), with a power of 0.80 and an alpha level of 0.05.

Data Measurement

Redesigned scales from earlier studies were used to measure the constructs in this study. A 7-item scale derived from Defee and Fugate (2010) was used to measure DMC; a 5-item scale adapted from Gunasekaran et al. (2001) was used to measure Strategic Planning; a 6-item scale adapted from Li et al. (2009) was used to measure IT; and a 5-item scale adapted from Tsai and Tsai (2010) was used to measure Managerial Performance. Every item was scored using a 5-point Likert scale, with 1 denoting "strongly disagree" and 5 denoting "strongly agree."

Construct Validity was Assessed Using Convergent and Discriminant validity

Average variance extracted (AVE) was used to assess convergent validity; values greater than 0.5 indicated satisfactory convergence (Fornell & Larcker, 1981). The Fornell-Larcker criterion, which demands that the square root of each construct's AVE be higher than its correlations with other items, was used to evaluate discriminant validity (Hair et al., 2019; Sarstedt et al., 2020).

Reliability

Composite reliability (CR) and Cronbach's alpha were used to evaluate the measurement scales' dependability. The proposed criterion of 0.7 was exceeded by both Cronbach's alpha values (ranging from 0.78 to 0.89) and CR values (ranging from 0.82 to 0.91) (Hair et al., 2019; Nunnally & Bernstein, 1994). These findings suggest that the internal consistency and reliability of the measuring scales utilized in this investigation are sufficient.

Data Analysis

A software for partial least squares structural equation modeling (PLS-SEM) called SmartPLS 3.0 was used to analyze the data (Henseler et al., 2016). When conducting exploratory research or when the data do not adhere to the stringent assumptions of covariance-based SEM, PLS-SEM is an appropriate method for analyzing intricate interactions between latent variables (Hair et al., 2019). Two steps were used in the analytical process: (1) measuring the model and (2) assessing the structural model (Hair et al., 2019).

FINDINGS AND DISCUSSION

Descriptive Statistics

Table 1 displays the respondents' demographic characteristics. An equal distribution of managers from five distinct jobs made up the study sample: 20% of the managers were store managers, 20% were procurement managers, 20% were planner managers, 20% were QA/QC managers, and 20% were IT managers. The bulk of responders (93.51%) were men, (84.24%) were over 35 years of age, and (96.67%) had a degree, indicating that men with extensive education and experience hold the majority of managerial positions in the company.

Table 1. Profile of the Respondents

Gender	Age	Education	Position	Gender %	Age %	Education %	Position %
Male	>35	Degree	Store Manager	93,51	84,24	98,67	20
Female	>35	Senior High School	Procurement Manager	3,9	84,24	1,33	20
Male	>35	Degree	Planner Manager	93,51	84,24	98,67	20
Male	>35	Degree	QA/QC manager	93,51	84,24	98,67	20
Male	25-35	Degree	IT Manager	93,51	7,27	1,33	20

Source: Author's own work based on survey results

Table 2 shows that the data validity and reliability test results can provide an in-depth picture of the quality of the measurement instruments used in the study. This study focuses on four main variables, namely DMC, SP, MP, and IT, each with several indicators. The outer loading results show that each needle has a high contribution in representing the measured variable, with a consistent value above the threshold of 0.6, indicating good construct validity.

Internal consistency or instrument reliability is measured through Cronbach's Alpha, rho_A, and Composite Reliability (CR). High values for each variable (DMC, SP, MP, and IT) indicate that the corresponding indicators have a high level of internal consistency, with Cronbach's Alpha and rho_A values exceeding 0.8 and high CR values. Therefore, it can be concluded that the measurement instruments in this study are reliable for measuring the desired construct. Besides, Average Variance Extracted (AVE) provides information on the extent to which the total variability of indicators can be explained by the constructed being measured. A significant AVE value (above 0.5) for each variable indicates that the construct is capable of covering most of the total variability of its indicators (Fornell & Larcker, 1981).

Table 2. Descriptive Analysis

Variables/Indicators	Outer Loading	Cronbach's Alpha	rho_A	CR	AVE
DMC		0.841	0.849	0.88	0.513
DMC1	0.728				
DMC2	0.826				
DMC3	0.688				
DMC4	0.62				
DMC5	0.727				
DMC6	0.765				
DMC7	0.64				
MP		0.839	0.846	0.879	0.51
MP1	0.648				
MP2	0.679				
MP3	0.705				
MP4	0.784				
MP5	0.682				
MP6	0.727				
MP7	0.767				
SP		0.84	0.853	0.88	0.512
SP1	0.612				
SP2	0.746				
SP3	0.799				
SP4	0.726				
SP5	0.675				
SP6	0.669				
SP7	0.765				
IT		0.848	0.871	0.886	0.567
IT1	0.69				
IT2	0.758				
IT3	0.74				
IT4	0.667				
IT5	0.87				
IT6	0.777				

Source: Author's own work based on PLS-SEM analysis.

Overall, the validity and reliability test results imply that the measurement instruments used in this study have good validity and reliability. By implication, the data obtained from these instruments can be relied upon for further analysis, providing a solid basis for interpreting research findings. These results provide additional confidence in the validity and reliability of the instrument following rigorous research standards.

Hypothesis Testing

Partial least squares structural equation modeling was used to assess the study hypotheses (PLS-SEM). For each proposed association, Table 2 displays the path coefficients, t-values, p-values, and significance levels. All four theories are supported by the findings. Strategic Planning significantly improves Managerial Performance (H2: $\beta = 0.457$, $p < 0.001$), DMC significantly improves Strategic Planning (H1: $\beta = 0.619$, $p < 0.001$), IT significantly improves Managerial Performance (H3: $\beta = 0.306$, $p < 0.001$), and IT significantly moderates the relationship between Strategic Planning and Managerial Performance (H4: $\beta = 0.174$, $p < 0.01$).

Table 3. Hypothesis Testing Results

Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
DMC -> SP	0.619	0.63	0.039	15.833	0
Moderating Effect TI in relationships SP -> MP	0.174	0.171	0.059	2.942	0.003
SP -> MP	0.457	0.458	0.069	6.617	0
IT -> MP	0.306	0.318	0.08	3.804	0

Source: Author's own work based on PLS-SEM analysis

The empirical model with standardized path coefficients and their significance levels is shown in Figure 2. The model explained 74.8% of the variance in Managerial Performance (R^2 = 0.748) and 62.5% of the variance in Strategic Planning (R^2 = 0.625). According to Sarstedt et al. (2020), these numbers show that the model has significant explanatory power. Stone-geisser Q^2 values for Managerial Performance (Q^2 = 0.558) and Strategic Planning (Q^2 = 0.452) are both larger than zero, indicating the predictive usefulness of the model (Hair et al., 2019).

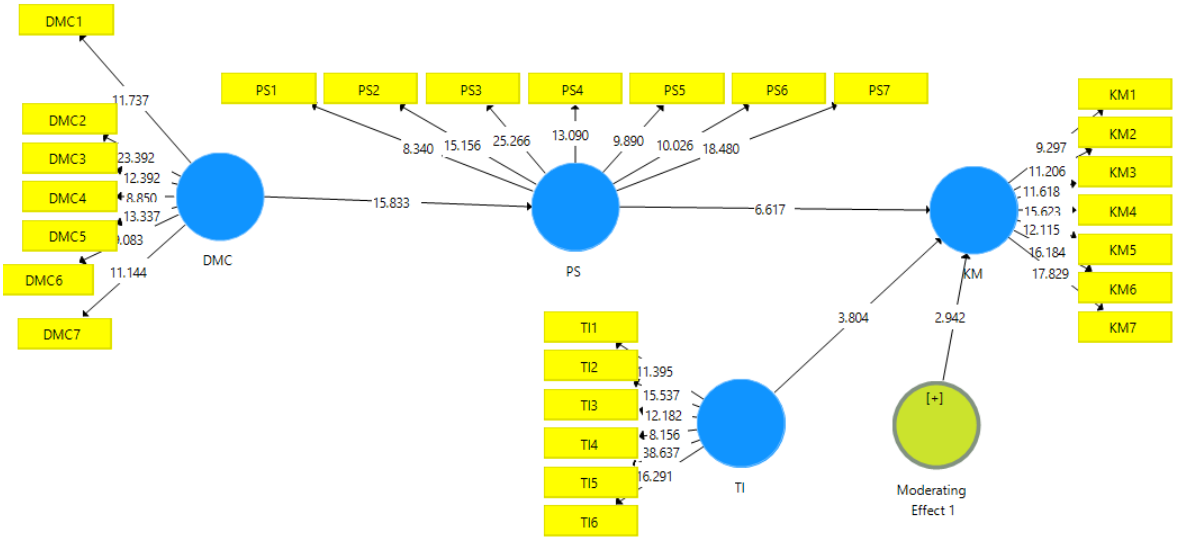

Figure 1: Empirical Model with Path Coefficients and Significance Levels

Discussion

The study's conclusions offer empirical support for the interactions between DMC, IT, Strategic Planning, and management effectiveness in the oil and gas sector. Hypothesis (H1) posits that DMC has a positive impact on Strategic Planning, which is consistent with other studies emphasizing the function of dynamic capabilities in allowing organizations to modify their approaches in reaction to evolving circumstances (Defee & Fugate, 2010; Sunder et al., 2019; Teece, 1997). According to this research, oil and gas organizations with greater DMC levels are more adept at creating and conducting successful strategic plans.

According to an earlier research (Miller & Cardinal, 1994; Schwenk & Shrader, 1993), formal planning processes improve decision-making quality and organizational outcomes. This finding is consistent with the strong impact of Strategic Planning on management performance (H2). As a respondent stated:

"Strategic Planning is crucial for our company to stay competitive in the oil and gas industry. It helps us align our resources and make informed decisions to achieve our long-term goals." -- Planner Manage

This outcome emphasizes the crucial role of Strategic Planning in directing managerial decisions and the distribution of resources in the oil and gas sector. The idea that technology plays a crucial role in helping managers absorb information, communicate effectively, and make educated decisions is supported by the direct influence of IT on Managerial Performance (H3) (Bharadwaj, 2000; Melville et al., 2014). This study emphasizes the necessity for oil and gas companies to make IT investments and use them to support managerial duties and boost productivity.

By highlighting the complementing function of technology in boosting the efficacy of organizational processes, the moderating effect of IT on the connection between Strategic Planning and management performance (H4) expands on earlier studies (Powell & Dent-Micallef, 1997; Tippins & Sohi, 2003). This research implies that when firms have higher IT adoption and integration levels, the influence of Strategic Planning on Managerial Performance is greater.

Overall, the study's findings show the interaction between organizational resources (IT), capabilities (DMC), and processes (Strategic Planning) in influencing Managerial Performance, which supports the resource-based view (Barney, 1991) and the dynamic capabilities framework (Teece, 1997). The findings also show how IT may improve the efficacy of knowledge-intensive activities like Strategic Planning, which supports the knowledge-based view (Grant, 1996).

CONCLUSIONS

The purpose of this study was to investigate how Information Technology (IT), Strategic Planning, and dynamic managerial capabilities (DMC) affect Managerial Performance in the oil and gas sector. The results offer factual proof for the proposed connections between these constructs.

According to the study, DMC significantly improves Strategic Planning (H1). According to Teece (2007), organizations in the oil and gas industry that have greater levels of DMC—a measure of managers' capacity to see, grasp, and reorganize organizational resources—may find it easier to create and carry out strategic plans. Strong DMC makes managers better at seeing opportunities, adjusting to shifting market conditions, and coordinating organizational resources to meet strategic goals. This result emphasizes the significance of managerial capabilities in forming Strategic Planning procedures and is consistent with the dynamic capabilities framework (Teece, 1997).

Moreover, the research findings indicate that management performance is significantly enhanced by Strategic Planning (H2). This suggests that managers make better decisions, use resources more effectively, and perform better overall when they have well-thought-out and implemented strategic plans. Managers who engage in Strategic Planning create roadmaps for accomplishing organizational goals, prioritize activities, and set clear goals. The efficacy and efficiency of managerial actions are improved by this systematic approach to management, which eventually improves performance. According to earlier studies (Miller & Cardinal, 1994; Schwenk & Shrader, 1993), Strategic Planning improves organizational performance. This result agrees with that study.

Additionally, the study discovered that IT significantly improves management performance (H3). This shows that by giving managers access to timely, accurate, and pertinent information, the adoption and use of cutting-edge IT systems and tools can directly increase management performance. Managers can handle vast amounts of data, carry out complex analysis, and make well-informed decisions more quickly and efficiently thanks to IT. This research bolsters the idea that IT is an important organizational resource that can improve managerial skills and spur productivity gains (Bharadwaj, 2000; Melville et al., 2014).

Additionally, the study found that the relationship between management performance and Strategic Planning is strongly moderated by IT (H4). This result suggests that when firms have higher levels of IT adoption and integration, the influence of Strategic Planning on Managerial Performance is stronger. Technology is a complementary resource that improves the efficiency of Strategic Planning procedures by enabling communication, cooperation, and information tracking. Strong IT systems that facilitate Strategic Planning enable managers to track progress, convey plans more effectively, and make data-driven adjustments as needed. This result builds on other studies by emphasizing IT's synergistic role in enhancing the advantages of Strategic Planning for management success.

Theoretical Contribution

By combining the ideas of DMC, Strategic Planning, and IT into a single model, this study fills a research gap that has been noted in other studies (Brusset, 2016; Silvestre, 2015). By emphasizing the interaction between organizational resources, capabilities, and processes in influencing Managerial Performance, the findings expand upon the resource-based paradigm (Barney, 1991) and the dynamic capabilities framework (Teece, 1997). The study also contributes to the advancement of the knowledge-based view (Grant, 1996) by highlighting how IT can improve the efficiency of knowledge-intensive procedures like Strategic Planning.

In addition, the study adds to the expanding corpus of knowledge regarding the use of dynamic capabilities in the oil and gas sector (Shuen et al., 2014; Wan & Yiu, 2009). The results offer empirical evidence in favor of the significance of DMC in helping businesses modify their approaches and enhance performance despite market unpredictability and volatility.

Practical Contribution

This research has numerous pragmatic ramifications for managers and decision-makers operating within the oil and gas sector. Initially, the results highlight how crucial it is to cultivate and support DMC to improve managerial effectiveness and Strategic Planning procedures. According to Teece (2007), managers must concentrate on enhancing their abilities to perceive, grasp, and reorganize organizational resources in response to shifting market conditions.

The study also emphasizes the importance of Strategic Planning in boosting management effectiveness. Companies that produce oil and gas ought to make investments in formal planning procedures that coordinate organizational resources and activities with long-term goals. Strategic Planning should involve managers actively, and they should ensure that plans are successfully conveyed and carried out throughout the company.

Third, the results highlight how crucial IT integration and investments are to enhancing managerial effectiveness. IT systems, infrastructure, and capabilities that help managers quickly access, evaluate, and act upon pertinent data should be given top priority by oil and gas firms. Organizations should match their IT investments with their strategic priorities to maximize performance outcomes, as IT has a moderating effect on the relationship between Strategic Planning and management performance.

In summary, this research contributes to our comprehension of the variables influencing management effectiveness in the oil and gas sector. The results offer significant perspectives for managers who aim to augment their companies' DMC, IT, and Strategic Planning procedures to boost productivity within a progressively intricate and ever-changing business milieu.

LIMITATION & FURTHER RESEARCH

There are many limitations to this study that need to be recognized and addressed in subsequent investigations. First, the cross-sectional survey design makes it difficult to draw

conclusions about causality. This suggests that longitudinal research is necessary to examine the changing linkages between DMC, IT, Strategic Planning, and Managerial Performance. Second, concentrating on a single business in Indonesia would restrict how broadly the results can be applied, necessitating further study to determine whether the suggested approach can be used in other sectors and nations. Third, biases and measurement errors may arise from the use of subjective measures of managerial effectiveness, emphasizing the necessity for the inclusion of objective performance indicators in future research.

To obtain a better knowledge of how DMC, Strategic Planning, and IT manifest and interact in reality, future studies could use qualitative research techniques such as case studies or in-depth interviews (Kachouie et al., 2018; Mei et al., 2023; Wang et al., 2015; Widianto et al., 2021). By offering deep, contextualized insights into the intricate phenomena being studied, qualitative research aims to enhance and supplement quantitative findings. Further research could examine how potential mediating or moderating factors, such as organizational culture, leadership philosophies, or environmental dynamism, influence the relationships between the constructs under study. This would provide a more thorough understanding of the circumstances in which IT, DMC, and Strategic Planning are most effective in influencing Managerial Performance.

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