INTERNATIONAL JOURNAL OF BUSINESS, 26(1), 2021 ISSN: 1083-4346

Exploring the Role of Knowledge Management and Cognitive Capability for Business Model Change in the Indonesian Oil and Gas Industry

Edi Hamdi[a], Rofikoh Rokhim[b], Yanki Hartijasti[c], Siti Yasmina Zubaedah[d]

[a]*Graduate Student of the Faculty of Economics and Business, Graduate School of Management, Universitas Indonesia*
hamdi.tebet@gmail.com

[b,c,d] *The Faculty of Economics and Business, Graduate School of Management, Universitas Indonesia*
rofikohrokhim1@gmail.com
yankihartijasti@yahoo.com
s.yasmina@ui.ac.id

ABSTRACT

The increasing importance of capability that drives business model change has triggered many firms to revisit the way they manage their resources. Cognitive levels of firm's manager have been acknowledged as the basis of capability building for business model change, however the benefit of utilizing firm's knowledge management effectively for improving cognitive capability is not yet explored especially when the business is knowledge-intensive. This research focuses on literature review of knowledge management, cognitive aspect, resource orchestration, and business model change. Furthermore, with the context of Indonesian oil and gas industry, this research investigates the role of knowledge management to resource orchestration which in turn affects capability to change business model. This research demonstrates the effect is fully mediated by cognitive capability. Finally, this research suggested firms shall develop systematic knowledge management and using manager's cognitive effectively to orchestrate their resource and be ready to change their business model.

JEL Classifications: L840, M150, O310, P180

Keywords: business model change, knowledge management, cognitive capability, resource orchestration, Indonesian oil and gas industry

I. INTRODUCTION

The ultimate goal of business firms is to manage value by taking advantage of company resources and capabilities through the competencies of its managers (Baert, Meuleman, Debruyne, & Wright, 2016; Sirmon, Hitt, & Ireland, 2007). To manage value, a firm should use a business model that will increase the chance of achieving a sustainable competitive advantage (Teece, 2010; Zott, Amit, & Massa, 2011). Value itself is understood as a beneficial value created by the firm, delivered to the customer, and exchanged in the form of monetary or any other transactional compensation to the firm who created it (Garcia-Castro & Aguilera, 2015).

Maximizing value through resource management has recently becoming more challenging for oil and gas firms. The oil and gas industry have been widely acknowledged as one of most complicated businesses as it deals with many complexities and uncertainties (Shuen, Feiler, & Teece, 2014; Yusuf, Gunasekaran, Musa, Dauda, El-Berishy & Chang, 2014). Due to the nature of high-velocity markets and the pace of technological change, firms in the oil and gas industry need to transform their business model constantly in order to manage value effectively. In addition, the capability to change and adapt will improve organizational and operational aspects of the business (Shuen et al., 2014) therefore firms need to embed the necessary capabilities for initiating business model changes and consistently increase value.

When exposed to business changes that require business model changes, firms need to develop their capabilities and initiate strategic activities at the organizational level. This is best achieved by orchestrating their resources and assets simultaneously, which will include adjusting their business models (Sirmon, Hitt, Duane, Brett, & Gilbert, 2011). However, knowledge needed to synchronize resource management processes and business models is not well understood, especially when subjected to the rapid changes in a business environment (Kang, Morris, & Snell, 2007; Bridoux, Smith, & Grimm, 2013) as volatile as the oil and gas industry.

Moreover, resource management highly depends on a manager's mental ability (Sirmon et al., 2007; Chesbrough, 2010). Cognitive capability aspects to tackle changes in the business model have been studied extensively (Tikkanen, Lamberg, Parvinen, & Kalunki, 2005; Martins, Rindova, & Greenbaum, 2015), including on how the logic of business models is understood by managers (Malmstrom, Johansson, & Wincent, 2014). This mental ability is also responsible to align a business strategy when multiple and simultaneous activities occur (Peteraf & Reed, 2007). A closer look on the role of managers' mental ability in synthesizing knowledge and manage resources would provide deeper insights on the link between knowledge and resource management for increasing value.

There is a need to consider and evaluate whether changes in a business model are capability-driven or just copying available successful model (Bock, Opshal, George, & Gann, 2012; Foss & Saebi, 2017). When such complex organizations as oil and gas firms undertake business model changes, there is a question of the main driver that enable those changes. Despite the acknowledged importance of firm capabilities in business model change, there are very few empirical studies exploring business model changes from an organization's capability perspective.

The presented research extends the Resource-Based View and organizational theory of behavioral perspective by focusing on the role of knowledge management and

cognitive capability for business model changes. In order to answer the research question on the enablers of capability to change business model, this research encompasses two particular areas. First is to test whether knowledge management can positively affect resource orchestration activities, while taking into account the manager's cognitive capability. Second, whether knowledge management together with effective resource orchestration activities would lead to the capability of business model changes. The findings discussed in this article provide new perspectives to understanding what kinds of capabilities are needed to prepare a firm's readiness for business model changes, in particular in the context of a knowledge-intensive industries.

II. LITERATURE REVIEW

A competitive advantage will be sustainable when competitors are unable to imitate a firm's valuable resources (Andersen, Jansson & Ljungkvist, 2016), whereas the ability to manage these valuable resources is the firm's key success factor (Zubac, Hubbard, & Johnson, 2010). Due to the variability of the manager's cognitive capability in valuing the resources, firms will have different strategies and performances (Kunc & Morecroft, 2010; Nason & Wiklund, 2015).

Emphasizing the need to respond to business environment changes, the literature review below focuses on knowledge and resource (orchestration) management, the cognitive aspect, and business model changes. Available frameworks are extended and analyzed contextually in a knowledge-intensive industry setting, which are exposed to external dynamic changes as the case for the Indonesian oil and gas industry.

A. Knowledge Management and Resource Orchestration Framework

Knowledge management can be understood as an effort to identify, optimize, and manage intellectual assets to create value and gain a competitive advantage (Abu-Bakar, Yusof, Tufail, & Virgiyanti, 2016; Mao, Liu, Zhang, & Deng, 2016). A firm's previous experiences and knowledge developed unique historical stocks (Roper & Hewitt-Dundas, 2015) and provided business capabilities as well as distinct competences. Those experiences and knowledge typically are in the form of tacit knowledge, which needs to be managed through a dynamic and complex codification process (Echajari & Thomas, 2015).

Knowledge management activities cover knowledge creation, transfer, storage, and application (Martelo-Landroguez & Cepeda-Carrión, 2016). These activities can be seen as an integrated process which also takes place through the steps of activities which mainly map the structure, define the purpose and ensure knowledge management functionality (Geisler, 2006). Many researchers have emphasized that the effectiveness of knowledge management, as a systematic asset, will drive the achievement of firms to an advantageous position within their industry (Cricelli & Grimaldi, 2008). However, there are challenges when capturing value from the knowledge when constrained by a firm's organizational context (Schiuma, Carlucci, & Lerro, 2012) and the limitation of a manager's cognitive abilities (Helfat & Peteraf, 2015).

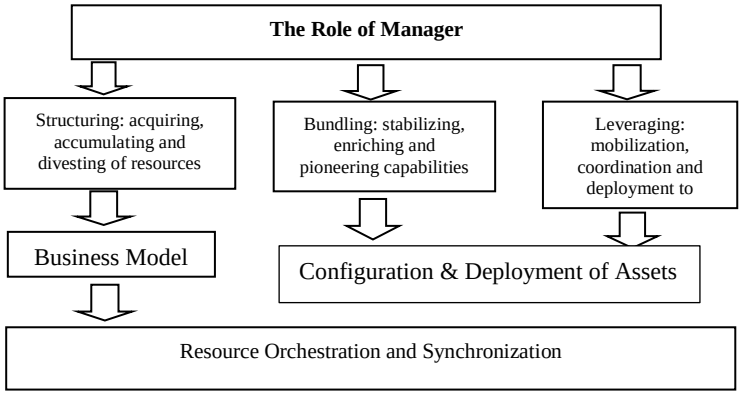
Knowledge has been seen as a strategic asset for organization in Resource-Based View of strategic management researches as it becomes a very valuable resources and potentially to be a source of competitive advantage (Zubac et al., 2010; Sirmon et al.,

2007). A firm's resource management is basically considered as a series of activities of structuring a portfolio of resources, bundling resources to form capabilities, and using activities to leverage capabilities for value creation (Sirmon et al., 2007). Structuring activities consist of acquiring, accumulating, and divesting resources, whereas bundling refers to stabilizing, enriching, and pioneering capabilities. Furthermore, the leveraging action is represented by the activities of mobilizing, coordinating, and deploying capabilities to derive benefit from market opportunities. Leveraging requires very complex coordination because it needs engagement with parties outside of the firms (Bridoux et al., 2013). Those complexities of resource management certainly demand a higher level of knowledge in order to increase the understanding and consequences of many aspects (Hatch & Cunliffe, 2006).

An advanced framework of resource management called resource orchestration refers to optimum asset utilization through resource management (Sirmon et al., 2011). The framework requires a manager to manage physical and intangible resources (such as knowledge) simultaneously. Despite its breakthrough concept, the framework raised some concerns on an empirical basis, including synchronization between resources because typically they are may not be ready-to-use and are not always compatible with each other (Galbreath, 2005). The overall orchestration is a contingent process and focuses on managing value creation and, at the same time, be able to capture value (Ireland & Webb, 2007).

The resource orchestration concept does not explain the processes of business model change; the framework only indicates that design business model activities are in parallel with resource structuring activities. This creates a question regarding what mechanism to anticipate a business model change when the resource value is not yet known during the resource structuring. On the other side, the management of the firm shall be considered as an action process on the resources (as differentiated from the role of resources) and all strategic management processes shall have their own dynamic dimensions (Hitt, Ireland, Sirmon, & Trahms, 2011). Therefore, it is obvious that the designing or changing business model is a dynamic and as a capability-development process. The extended version of the framework adopted from prior works can be viewed in following Figure 1 and explain the important role of manager in orchestrating resources by deploying his knowledge through-out the processes.

Figure 1
Extended Framework of Resource Orchestration (adopted from Sirmon et al., 2011)

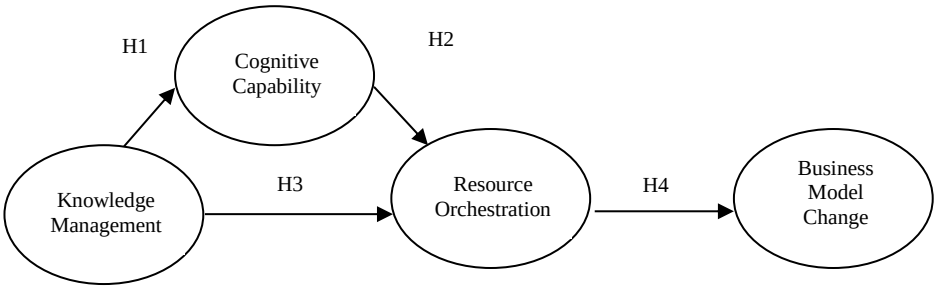


B. Cognitive Processes and Business Model Change

Resource conceptualization is one of the managerial cognitive processes (Kunc & Morecroft, 2010) related to the decision to acquire and develop resources with an expected future value. The processes emphasize cognitive ability to perceive strategic values through an appraisal future firm competitiveness (Helfat & Peteraf, 2015). Firms should mitigate the limitation of their manager's cognitive capability by developing foresight and estimation of a resource's future value through continuous learning (Kunc & Morecroft, 2010). This is because information for appraising the future value of certain resources are not always available. Resource conceptualization starts with information collection using cognitive capability to filter information for decision making. Due to bounded rationality, managers may not have complete information about future events, options, and consequences (Teece, Peteraf & Leih, 2016).

Cognitive capabilities are responsible for determining strategies and providing continuous alignment when starting multiple related activities (Peteraf & Reed, 2007). A business model is regarded as a cognitive structure related to how firms understand their objectives to deliver value (Tikkanen et. al., 2005). It explains the logic of a business by representing the underlying mechanism (Comberg & Velamuri, 2017) and as integrated capabilities that allow value creation and capture (Chesbrough, 2010; Casadesus-Masanell & Ricart, 2010). In this regard, complex cognition aspect can be viewed as knowledge structures (Helfat & Peteraf, 2015) and a knowledge-based analogical reasoning is seen as the ability to benefit from the available knowledge in a mental model to provide an interpretation of other subjects (Martins et al., 2015) which both can be used for designing and changing business models. The combined version of frameworks can be seen in Figure 2.

Figure 2
Combined Framework of Resource Conceptualization and Business Model (adopted from Kunc & Morecroft, 2010 and Helfat & Martin, 2014)



Managers struggle with the complexity for making a decision for strategic aspects of value conceptualization which impact to the ability to change a firm's business model due to their limitations of information processing routines (Marcel, Barr, & Duhaime, 2011). This may occur due to subjective representations gained from experiences and differences in cognitive capability across firms because a cognitive context emerges from an individual and between individuals' unique social interactions (Nadkarni & Barr, 2008).

Business model changes may be seen through the lens of processes to change the model, which in turn will lead to a deeper understanding of a business model as a system (Clauss, 2017). Knowledge management can provide strong support through the systematic understanding of the overall situation and identifying the potential value of each resource to ensure the effectiveness of any business model change (Schmidt & Keil, 2013).

C. Challenges in Indonesia Oil and Gas Industry

The oil and gas industry are an industry whose firms are knowledge-intensive and focus on problem-solution activities by capturing value from knowledge assets (Gottschalk, 2007; Aslesen & Isaksen, 2007). The characteristic of such firms is their resource management being heavily influenced by knowledge and their manager's cognitive level (Løwendahl, Revang, & Fosstenløkken, 2001). Technical service firms in the oil and gas industry commercialize their knowledge to solve the end-user's problems through the creation, articulation, transfer of high-technology knowledge, and focus on creating problems-solutions that cannot be easily captured and imitated by competitors (Gottschalk, 2007; Garcia, Lessard, & Singh, 2014). The firms, globally and locally, have been challenged by the turbulence of industries. The structure of this industry has been significantly changed due to the turbulence of oil prices (Al-Fattah, 2013; Yusuf et al., 2014, Amadeo, 2018). As a consequence, the changes of an industry's business model affect an existing firm's business model.

Dynamic changes in the Indonesian oil and gas industry has been indicated by a major decline of revenue in the overall services of firms in the Indonesia oil and gas business. Recent policy changes that have taken place in the new government administration by the introduction of a gross-split mechanism also created a significant change to the nation's industry landscape, which calls for high efficiency in operations and the development of new oil and gas fields (Kurniawan & Jaenudin, 2017; Pangalila, 2015). A significant drop in has put the firms in a more challenging situation and forced them to revisit their business strategies, including to change business model. Table 1 below provides a list of challenges in the oil and gas industry applicable at the local and global levels.

Table 1
Challenges in the Oil and Gas Industry

Challenges	Dynamics
• Oil Price	Fluctuation of oil prices (BP, 2017)
• Market	Emerging alternative energy such as battery storage will change market demand (McKinsey, 2017)
• Technology Development	A lack of capability in mastering appropriate technology will affect the operational and business scheme (Shuen et al., 2014)
• Investment & Operation Risk	Environmental risk (Shuen et al., 2014) and business risk due to uneconomical pay-back (Garcia et al., 2014; Sunaryadi, 2016)
• Infrastructures	Infrastructure for investment is not established (Sunaryadi, 2016)
• Oil and Gas Reserves	Frequent failure of new developments due to over-estimation of reserves (Sumanto & Ratnasari, 2017)
• Regulation	Changes in the contractual scheme (such as from a production sharing contract to gross-split) (Kurniawan & Jaenudin, 2017)

III. HYPOTHESES FORMULATION

There is a need to manage internal and external knowledge (Schiuma, Carlucci, & Lerro, 2012), furthermore, knowledge management is expected to mitigate the limited capability of managers in processing abundant information and knowledge which is called as a bounded rationality situation (Bolisani & Bratianu, 2018; Kim & Anand, 2018). Knowledge management, once available in systematic form, provides information and a comprehensive understanding of similar situations experienced by other firms (or even other industries) and can be used as a basis for analogy in decision making

Firms should consider options in exploring new knowledge, exploiting existing knowledge, or combining it in the context of their needs (Hashai, 2016). Nevertheless, the learning mechanism begins with a simplification by using a manager's initial thinking and proceeding with more complicated knowledge (including from various sources) when firms go further with specialization. Moreover, mapping and connecting different kinds of knowledge to become a useful resource for firms is essentially mapping the cognition or mental model in its detailed form (Heikka & Natti, 2018; Baskerville & Dulipovici, 2006). Systematic knowledge management can further enhance this when a firm innovates to produce many ideas (in an abstract form) by connecting various articulated knowledge to become a new concept (Chen & McQueen, 2010). Taken together, these arguments lead to the first hypothesis as follows:

H1: Systematic Knowledge Management is positively associated to manager's cognitive capability

High level of cognitive will facilitate an understanding of opportunity recognition (Gaglio, 2004) and decision making (Shepherd, Williams, & Patzelt, 2014), which are important for any stage of resource allocation. Several aspects of cognition such as attention, perception, problem-solving, and reasoning will be dominant during structuring activities, while communication will be dominant in bundling and leveraging activities (Helfat & Peteraf, 2015). Cognition itself can be regarded as a knowledge structure that leads to an understanding that the activities related to use knowledge will provide a basis for further capability development (Helfat & Martin, 2014).

Experience in a specific context may help a firm to orchestrate resources better; however, it may create problems when the new resources are not aligned with the established mental model which was built on past experience (Danneels, 2010). A manager's dominant logic refers to a firm's logic as created by the firm's founders, therefore the development of the firm's cognitive capability (represented by its managers) can be considered as a set of processes. In addition, managerial cognition itself is not only shaped by previous experience, but it is built-up with the interactions in internal and external networks (Teece & Leih, 2016).

In the oil and gas business, firms tend to drive the cognitive and behavioral capabilities of their managers to foster innovation and at the same time manage their competencies, organizational structure, as well as firm culture (Shuen et al., 2014). This is especially important when the business is considered to be a mature business, as evident to Indonesia, which was formerly an oil producing country and now has become a net oil importing country (Partowidagdo, 2009). The role of cognitive processes focusses on an organization's routine in a dynamic way, which evolves from one form to another and

needs to be highlighted and emphasizes the ability to integrate a capability and mindset to create value in order to manage one's resources effectively, including possible effects on the environment and long-term business (Feiler & Teece, 2014; Garcia et al., 2014). Taken together, these arguments lead to the second hypothesis:

H2: The cognitive level of a firm's manager is positively associated to resource orchestration activities.

Knowledge management and resource orchestration should be initiated comprehensively, updated, open to external knowledge, and starts when a firm creates a collection of its individual knowledge and experience, then combines them collectively to form organizational knowledge (Lanza, Simone, & Bruno, 2016; Jensen & Clausen, 2017). Prior to becoming useful for the organization, knowledge needs to be discussed, made explicit, and be articulated, however, highly specialized knowledge is tacit (Im, Vorhies, Kim, & Heiman, 2016) and contextual (Nonaka & von Krogh, 2009). Knowledge resources initially possessed by an individual, leveraged on organization level, mobilized, and further developed during resource coordination for an effective orchestration (Chirico, Sirmon, Sciascia, & Mazzola, 2011). Furthermore, firms should manage the flow and define the sharing of knowledge when extending capabilities, whether for exploration or exploitation (Yun, Jung, & Yang, 2015).

Knowledge-intensive firms in the oil and gas business have relied on their ability to utilize their knowledge by focusing on complementary know-how and physical assets in the context of changing business challenges. Empirically, there are cases of rising oil prices in which firms with a large amount of technological knowledge will undertake a new route of business by managing and advancing its resources (Helfat & Martin, 2014). When knowledge is mapped and connected systematically, any knowledge generation will empower the effort in managing resources (Chen & McQueen, 2010; Mustafha & Werthner, 2008). The power of knowledge will lead to an integrated process for superior firm performance through the effective management of resources (Becker, 2004). Taken together, these observations lead to the third hypothesis:

H3: Knowledge management is positively associated to firm's ability to orchestrate its resources.

Organizational capability is associated with the ability to use a collection of a firm's resources and the resource's state of being would be dependent on the unique stage of the firm itself (Sirmon et al., 2011). Therefore, it is obvious that the dynamics of resource management can determine the subsequent steps of a firm's capability development. Furthermore, firms which have strong processes in bundling resources for developing new capabilities that will be able to move quickly to create a new business or new market (Yi, Li, Hitt, Liu & Wei, 2016) as they are able to become flexible in their strategies.

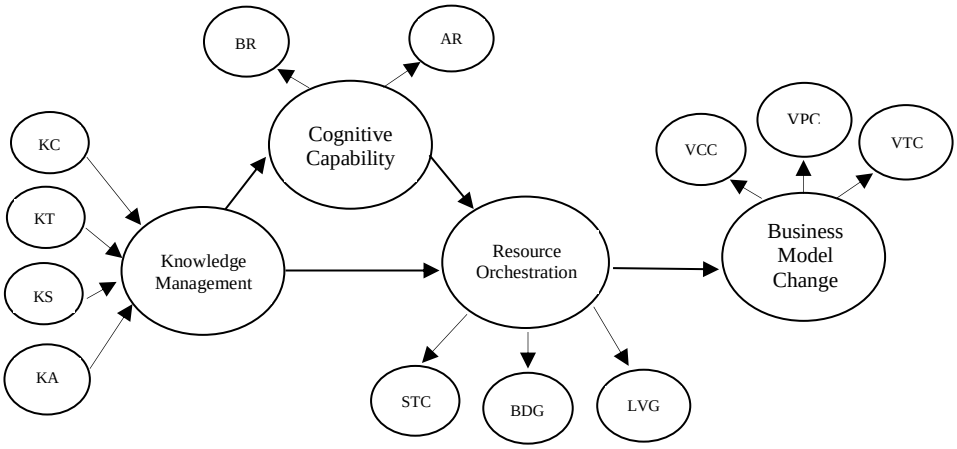
As certain capabilities may not be valuable to firms due to their specific contexts (Helfat & Peteraf, 2015), capabilities may need to be integrated with their compatible counterparts. Once a set of configured capabilities has been created as a result of successful resource orchestration, it can be further developed in the dynamic sensing of an opportunity and seizing it appropriately by revisiting its business model (Augier & Teece, 2007). Furthermore, a set of capabilities when considered in a dynamic condition will

have its own direction of benefits in accordance to the direction of change. Such a direction, in turn, will affect the overall strategic change of the overall business (Shuen et al., 2014; Yi et al., 2016). Taken together, these observations lead to the next hypothesis:

H4: Configuration of capabilities as a result of resource orchestration is positively associated to firm's ability to change its business model.

All of the hypotheses above can be presented in the following research model in Figure 3 below.

Figure 3
Research Model



IV. RESEARCH METHODOLOGY

The data for this research was retrieved from questionnaires distributed to 50 technical services firms in the Indonesian oil and gas industry. Table 2 provides a description of the firms sampled in this research.

Table 2
Description on Sample Firms

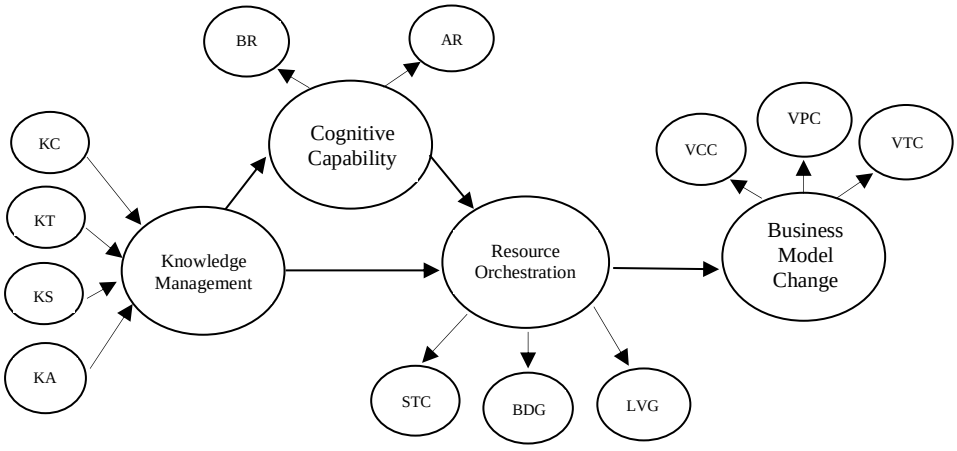
Type of Technical Service	Number of samples	Main Service Description
Oil and Gas Consultancy-based	27 firms	Design, operation, maintenance and testing
Oil and Gas Supplier and Manufacturing-based	13 firms	Fabrication design, manufacturing and supply equipment
Oil and Gas Construction-based	10 firms	Integrated services from front-end design, detail design, procurement, installation and construction

The measurement models are created by referring to other scholar's measurements relevant to this study. Knowledge management processes uses measurements from Martelo-Landroguez and Cepeda-Carrion (2016) who investigated the dimension of knowledge creation (KC), knowledge transfer (KT), knowledge storage/retrieval (KS), as well as knowledge application (KA) in the Spanish knowledge-intensive industrial sectors. Measurement for the cognitive capability refers to Roehrich, Grosvold, and Hoejmose (2014) with their study on firms in the UK. They examined the constraint of bounded rationality (BR), such as a lack of resources, knowledge, transparency, and clear processes in producing non-optimum decision-making. Another measurement for cognitive capability is analogical reasoning (AR) as proposed by Martins et al. (2015) based on their study when interpreting cognitive aspects that used pattern recognition, judgments, and capabilities to compare various information for specific purposes.

In relation to resource orchestration, the measurement models refer to research on structuring (STR) activities (Chadwick, Super, & Kwon 2013), bundling (BDL) activities (Yi et al., 2016), and leveraging (LVG) activities (Wang, Liang, Zhong, Xue & Xiao, 2012) which have been used for various empirical cases of knowledge-intensive firms in China and South Korea. For business model changes, measurement of business model changes has been developed in three dimensions, *i.e.*, value creation changes (VCC), value proposition changes (VPC), as well as value capture changes (VTC) as proposed by Clauss (2017).

Because this study explores the roles of knowledge management, the 2nd order for knowledge management is using formative indicator types to consider its processes, and the use of this formative type has been substantively relevant in explaining the theoretical basis (Becker, Klein & Wetzels, 2012). The other constructs use a reflective indicator type for both the 1st and 2nd orders. The complete research model with the indicator measurements is presented in Figure 4 below.

Figure 4
Research Model (Full Model with Measurements)



The presented research indicates that the existing theories for the relationship between knowledge management, cognitive capability, resource orchestration, and

business model are very limited. Most of the existing studies do not systematically discuss the power of knowledge as an antecedent of a business model change and do not explain any clear relationship nor provide empirical evidence. Existing studies only focused on the increasing importance of innovation and knowledge that may lead to business model changes (Foss & Saebi, 2017), implementation of new ways in acquiring knowledge (Foss, Laursen & Pedersen, 2011), knowledge flow which is structuring the articulation of communication (Musthafa & Werthner, 2008) and knowledge in relation to mitigation for changes (Hock & Clauss, 2016).

In terms of cognitive capability, very few conceptual papers are available that argue the cognitive roles for business model changes, which still lack a strong empirical basis (Martins et al., 2015, Tikkanen et al., 2005, Chesbrough, 2010). Therefore, this presented research has been considered to be an exploratory research that is typically not intended to provide a full confirmation but rather to extend existing theories (Hair, Ringle, & Sarstedt, 2011).

For the exploratory research, the Partial Least Squares of Structural Equation Modeling (PLS-SEM) is recommended due to its capability to predict key target constructs in the development of a theory (Hair, Sarstedt, Pieper, & Ringle 2012; Clauss, 2017). The Partial Least Squares (PLS) methodology is a type of Structural Equation Model (SEM) with variance-based technique employing a principal component-based estimation approach that is suitable for an exploratory type of research characterized by non-normal data distribution and a low number of sample (Hair, Hult, Tomas, Ringle, & Sarstedt, 2014). The PLS-SEM methodology has been used extensively in the strategic management field, in particular to investigate complex organizational knowledge management and organizational capability as is the case for this presented research (Hair et al., 2012; Wilden & Gudergan, 2014).

In relation to the sample size when using PLS-SEM, requirements for the sample size should be a minimum of 10-times the number of predictor variables that influence a criterion variable or the largest number of formative indicators (Hair et al., 2014). In this presented research, this leads to a minimum sample size of 40 observation units as there are four formative indicators for measuring the knowledge management construct. In addition, minimum sample size is based on the significance level, the expected minimum R^2, as well as the maximum number of arrows pointing at a construct. By taking a significance level of 5% and sample size is 50 the expected minimum R^2 is 0.34 (Hair et al., 2014). Furthermore, it is recommended to commence a comprehensive review of raw data (Hair et al., 2014; Garson, 2016). This includes an examination of missing values (not more than 5%) and absolute skewness and a kurtosis number which should be not more than 3 (Clauss, 2017) to mitigate the high degree of non-normal data distribution.

V. RESULTS AND DISCUSSIONS

PLS-SEM evaluation is started with the assessment of the measurement model by examining relationships between indicators, followed by assessment of the structural model to confirm which relationship is consistent (Garson, 2016). As part of the measurement model assessment, the systematic evaluation of PLS-SEM for a reflective indicator model (as the case for all 1st orders in this presented research) is to check the internal consistency in the form of composite reliability (CR), convergence validity, and discriminant validity (Hair et al., 2014). The assessment of CR is required to avoid having

multiple indicators be minor wording variants of each rather than be distinctive measures by ensuring the value of CR must not be equal to or more than 0.95 (Garson, 2016).

The convergent validity is evaluated by assessing the outer loading and the average variance extracted (AVE) while the outer / factor loading estimates should be higher than 0.5 and ideally 0.7 or higher. Furthermore, the main assessment is to ensure that AVE is above the threshold of 0.5, meaning that the factor should explain at least half of the variance of the respective indicators (Garson, 2016). For this presented research, the minimum AVE is 0.51, while the minimum factor loading is 0.61. Table 3 below is a summary of CR and AVE of each 1st order construct.

Table 3
Summary of Composite Reliability (CR) and Average Variance Extracted (AVE)

Construct (Reflective)	**CR**	**AVE**
Cognitive Capability	0.906	0.521
Resource Orchestration	0.931	0.511
Business Model Change	0.941	0.503

The discriminant validity is evaluated by investigating the cross loading, Fornell-Larcker, and HTMT (Heterotrait-Monotrait) ratio criterion. In this presented research, all cross loading and Fornell-Larcker numbers show that all constructs in the research model have discriminant validity. However, many recent studies suggest that cross loading and Fornell-Larcker are not suitable for PLS-SEM due to the low rate of capability to detect discriminant validity and recommend instead to use only a hetero-trait mono-trait (HTMT) criterion not greater than 0.9 (Henseler, Ringle, & Sarstedt, 2015). By following the recommendation, the results of this presented research show that the requirements for HTMT were fulfilled, as depicted in Table 4 below.

Table 4
Discriminant Validity Test

Construct Relation	**HTMT Ratio**
Cognitive Capability to Business Model Change	0.70
Knowledge Management to Business Model Change	0.67
Knowledge Management to Cognitive Capability	0.79
Resource Orchestration to Business Model Change	0.90
Resource Orchestration to Cognitive Capability	0.78
Resource Orchestration to Knowledge Management	0.70

For the knowledge management construct with formative indicators, the evaluation was carried out by checking the critical levels of collinearity indicated by the variance inflated factor (VIF), which should be less than 5 followed by significancy of weight checking (Hair et al., 2011; Henseler, Ringle & Sinkovics, 2009) and to interpret the formative indicator's absolute and relative contribution. The result of this presented research shows that no VIF is greater than 5 and with all 1st order indicators, t-values is above 1.96 (a significance level of 5%). With these results, all indicators of formative

measurement models in this research are valid and reliable. The weight for formative knowledge management is described in Table 5 below.

Table 5
Weight for Formative Measurement

Dimension of Knowledge Management Process	Weight	t-values (sig level 5%)
Knowledge Creation	0.233	6.30*
Knowledge Transfer	0.289	7.81*
Knowledge Storage	0.250	5.72*
Knowledge Application	0.444	10.24*

Note: *significant based on a significance level of 5%

For a structural model evaluation, bootstrapping with a 2-tailed, 5% significance and a subsample of 1000 with a no-sign method (Hair et al., 2014; Henseler et al., 2009) was performed in order to check the significance level, as shown in Table 6 below. The tabulation indicates that all hypotheses are supported except for the hypothesis of direct relation between knowledge management to research orchestration (third hypothesis) as the t-value is less than 1.96 (with a significance level of 5%).

Table 6
Significance Test

Path	**Path Coefficient**	**t-values / p-values**
H1: Knowledge Management to Cognitive Capability	0.72	9.05 / 0.00*
H2: Cognitive Capability to Resource Orchestration	0.52	3.57 / 0.00*
H3: Knowledge Management to Resource Orchestration	0.26	1.54 / 0.13
H4: Resource Orchestration to Business Model Change	0.78	19.21 / 0.00*

Note: *significant based on a significance level of 5%

Another evaluation for the structural model is to check R^2 of endogenous variables which represents the amount of explained variance that should be maximized (Hair et al., 2014). Endogenous latent variables R^2 with values 0.75, 0.5, and 0.25 are considered to be substantial, moderate, and weak respectively (Henseler et al., 2009). The presented research indicates an R^2 of 0.74, 0.52, and 0.54 for business model change, cognitive capability, and resource orchestration, respectively, which proves that the minimum requirement amount of R^2 for 50 samples (*i.e.*, shall be more than expected minimum of 0.34 as indicated earlier) has been fulfilled as described in Table 7 below:

Table 7
R^2 Results

Construct	**R^2**
Cognitive Capability	0.52
Resource Orchestration	0.54
Business Model Change	0.71

A mediation analysis is required when a researcher wants to investigate and discuss the theoretical established direct effect of an independent variable to a dependent variable and the indirect effect between those variables with the presence of mediating variables (Hair et al., 2014). There is a mediator analysis procedure (Preacher & Hayes, 2008) that emphasizes the significancy of a direct effect prior to including the mediator. The analysis proceeded by checking the significancy of the indirect effect and determined the level of mediation by taking into account the variance accounted for (VAF) as the portion of the indirect effect to the total effect.

The only prerequisite of the mediating effect is the significancy of the indirect effect, and it is not necessary to commence a significancy check of the direct effect before and after the inclusion of the mediating variable. Furthermore, full mediation effect takes place when the indirect effect is significant while the direct effect (with the presence of the mediator) is insignificant (Nitzl, Roldán, & Cepeda-Carrion, 2016). This, however, is different to the argument by Hair et al. (2014) that focuses only on how much the mediator variable absorbs the initial significance of the direct effect by defining the level of full, partial (when VAF is between 20% and 80%), and no mediation.

This presented research model indicates the possible mediator from the cognitive capability in bridging the indirect effect from knowledge management and resource orchestration, which has its own direct effect. Initially, when the cognitive capability was excluded, the relationship between knowledge management and resource orchestration was significant, followed also by the significant result of the indirect effect. Table 8 indicates the mediation analysis steps of this research model in which the VAF is 48%, hence it is partial mediation based on Hair et al. (2014) but due to the insignificancy of the direct effect (when the mediating variable is included) the full mediation is concluded (Nitzl et al., 2016). The presented research follows full mediation conclusion means that the effect of knowledge management on resource orchestration is completely transferred by cognitive capability.

Table 8
Mediation Analysis

Step	**Result**
Significance of direct effect without mediating variables	6.29*
Significance of indirect effect	3.09*
Variable Accounted For (VAF)	48%
Significance of direct effect with mediating variable	1.54

Note: *significant based on a significance level of 5%

To indicate the disctinctive contribution from each dimension of any construct, a tabulation of the highest weight or loading factor is presented in Table 9 below. In general this indicates that a specific variable has more contributions than the others and should be interpreted for relevant managerial implications.

The empirical results of this presented research show positive influence of knowledge management on a manager's cognitive capability, which leads to a further influence on resource orchestration and business model change. As knowledge management does not have a direct significant influence on resource orchestration, the role of cognitive capability as a full mediator between knowledge management and

resource orchestration has been acknowledged. In this sense, the managerial implication of this mediation can be reflected to a firm's strategy that a systematic knowledge management shall be organized to enhance the cognitive capability level of managers. This suggestion is relevant to mitigate practical overflow information, complexity, time constraint, to support decision-making so that resource orchestration activities will commence effectively and efficiently. The tendency to only copy what other firms or competitors have in their business model is strongly not recommended as they may have different levels of resource arrangement, different levels of cognitive capability (of their managers), as well as different levels of knowledge.

Table 9
Highest Contribution for Each Construct

Dimension	Related Construct
Knowledge Application (KA)	Knowledge Management
Analogical Reasoning (AR)	Cognitive Capability
Structuring (STC)	Resource Orchestration
Value Creation Change (VCC)	Business Model Change

Cognitive capability aspects will determine the successful levels of firms when pursuing promising strategic opportunities that can be measured by the ability of managers to make a decision toward a change (Teece & Leih, 2016; Gavetti, 2012). Managers with strong cognitive capability will control their mental model when pursuing substantial gains and take risks objectively (Frederick, 2005). The strong cognitive level of firms can be detected if their management frequently revisits their organizational structure, revises the vision, as well as takes the risk of a new journey despite the challenges that lie ahead (Helfat & Peteraf, 2015).

In the context of the presented research, the successful implementation of knowledge management for technical service firms is believed will improve a firm's performance when challenged by competition and the reduction of profit margins. As tabulated in Table 9, the highest contribution of knowledge application implies that the Indonesian oil and gas industry is an applied (technology-based) industry, in which the application of knowledge is more important as compared to other aspects of knowledge management. This is supported by Ramanigopal (2012) who argued that the competition in the oil and gas industry in developing countries is in the direction of a technological application and the use of timely knowledge by the proper resources. Furthermore, analogical reasoning contributes more than bounded rationality, which means that the availability of knowledge to be used as a source of analogy is an important aspect for the implementation of business model change and resource management. The power of analogy has been used extensively in making strategies, especially when firms face novel opportunities and threats (Gavetti, Levinthal, & Rivkin, 2005). The managerial implication of this situation calls for the firm's ability to do networking and have active participation in the industry's technical or business forum to enrich the firm with abundant information about the market and competitors' actions.

Structuring resources contributes highest for resource orchestration, indicated that firms should prioritize identifying resources, acquiring from the market, developing internally, and divesting the low use of resources when necessary (Sirmon et al., 2007).

For oil and gas businesses, this is relevant because firm must assess not only which opportunities create the highest potential value, but which ones are possible considering the actual owned resources (Feiler & Teece, 2014). Moreover, value creation change does have a higher loading as compared to value proposition change and value capture change, which has an effect on managerial implication that firms should define the change by what means they create value using their own resources, capabilities, as well as organizational processes (Achtenhagen, Melin, & Naldi, 2013).

The presented research follows Cepeda-Carrion, Cegarra-Navarro & Cillo (2019) who advised that sample size of PLS-SEM study shall take into account AVE and path-coefficient, indicated in Table 3 and Table 6, as well as considering size of sample and population in order to support this exploratory study. To check whether small sample size may deliver non-significant results of a direct effect and lead toward a full mediation effect (Rucker, Preacher, Tormala & Petty, 2011), a sample size sensitivity analysis has been carried out. The tabulation of Table 10 below indicates the significance is still far from the threshold, *i.e.* 1.96 for a significance level of 5%, therefore a stable and convergent result is already achieved.

Table 10
Sample-Size Sensitivity Test of Significancy

Path	Sample Size			
	42	**44**	**46**	**48**
H1: Knowledge Management to Cognitive Capability	7.86*	8.73*	8.39*	8.10*
H2: Cognitive Capability to Resource Orchestration	3.94*	4.02*	4.20*	3.40*
H3: Knowledge Management to Resource Orchestration	1.14	0.84	1.00	1.42
H4: Resource Orchestration to Business Model Change	18.83*	16.55*	16.4*	16.2*

Note: *significant based on a significance level of 5%

VI. CONCLUSION AND RECOMMENDATIONS

The theoretical mapping and empirical study discussed above indicates the strong role of knowledge management to affect resource orchestration through a cognitive capability, which in turn affects positively the capability for a business model change. Having systematic knowledge assets as a result of knowledge management alone is not sufficient enough to ensure a proper business model change. The readiness of firms to change their business model should be focused on the development of a manager's cognitive capability and the ability to orchestrate the resources by structuring the resources, building up the capabilities, and leveraging those capabilities in market opportunities.

The structure of knowledge has been understood as the cognition aspect and the knowledge asset has been considered as the major driver for value creation, which is the core of any resource management activities (Helfat & Peteraf, 2015). Therefore, the mediating effect of the cognitive capability for the relationship between knowledge management and resource orchestration is theoretically supported. In light of the effect to the resource orchestration, systematic knowledge will stimulate the creation of new and novel capabilities (Sirmon et al., 2007). Furthermore, as an organization is able to manage knowledge and share value, the organization is able to adjust the way they interact with other parties and establish maximum benefits of value through business model change

(Mustafha & Werthner, 2008) while making sure that the resources have been orchestrated effectively.

This research provides opportunities for future research in terms of the exploration of certain types of capabilities that are able to mediate between resource orchestration and business model change. Essentially, a business model change is the manifestation of a dynamic capability, which consists of sensing an ability prior to seizing opportunities and furthermore reconfiguring the business architecture (Teece, 2018). Therefore, future research should investigate the role of the sensing capability as antecedents to resource orchestration and business model change.

This research did not take into account exogenous changes and only uses the process of generative cognition. Future research may consider the influences from perceived business uncertainty which can be explored from the rate of change and complexity (Hatch & Cunliffe, 2006). As scholars in strategic management have now shifted their interest of organizational capability research to the role of how the cognitive capability aspect can influence organizational routines, this emerging stream provides a new perspective on the role of organizational structures which are built from their routines. Furthermore, this gives an understanding of the importance of knowledge management as it provides an accumulation of distinctive competences due to the utilization of practices in a systematic manner through the continuous learning and development of employees' cognitive strengths (Wilden, Devinney, & Dowling, 2016).

As a closing remark, this study addresses the posed research questions by providing evidence that knowledge management can have a significant role on the business model change if it is mediated by a manager's cognitive capability. Furthermore, the significance of manager's cognitive capability in knowledge management activities will positively affect resource orchestration, which ultimately contribute positively to the capability of changing a business model. This research gives a contribution to the academic literatures as well as provides practical and beneficial recommendations for the Indonesian oil and gas industry. The firms in the oil and gas industry need to manage the knowledge effectively to become a systematic asset, as well as ensure the use of the knowledge is aimed to maximize value creation and empowering their managers' cognition in the context of organization-level capability development. When these mechanisms are in-place and in-used effectively, firms shall be ready to adjust their business models to anticipate any changes in the business environment.

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