

Research Paper

Open Access

Denny Syahdinal*, Prijono Tjiptoherijanto, Eka Pria Anas, Manerep Pasaribu

The influence of big data on decision-making in the engineering procurement construction industry in Indonesia

DOI 10.2478/otmcj-2025-0013

Received: March 26, 2025; accepted: September 23, 2025

Abstract: The problems faced by the engineering procurement construction (EPC) industry in Indonesia are related to this research, including the presence of more competitive competitors, ineffective planning and project implementation, and the lack of tools in systematic decision-making (DM). This study attempts to use big data analytic capability (BDAC) to improve the quality of DM to enhance performance and improve competitiveness, insightful and predictive information. This study also aims to close the gap between hierarchical DM and the use of BDAC to increase the chances of winning projects and reducing losses in project implementation. This study was conducted on companies engaged in the EPC industry in Indonesia under the Association of Indonesian National Design and Build Companies (AINDBC). The results of this study indicate that BDAC, as a basis for DM, has a positive influence on firm performance (FP) through the process of selecting formulation and implementation strategies and more efficient use of project budgets. The limitation is that the construct of FP cannot be explained by the formulation strategy, but it can be explained by the implementation of strategy (IS). The difference in the results of this study and previous studies is due to differences in product and market characteristics, which are strategic components of the relationship between marketing strategy and FP. The EPC company can increase speed, accuracy and precision of the strategic DM process by using BDAC. Managers or practitioners, who are pioneers in developing and implementing BDACs, are required to increase the quality of DM.

Keywords: big data analytic capability, decision-making, firm performance, formulation of strategy, implementation of strategy

1 Introduction

The engineering procurement construction (EPC) industry is synonymous with EPC projects and contracts where EPC construction organisations have responsibilities ranging from planning, procurement, construction and commissioning, which are then handed over to the project owner (Marquard and Bahls 2015; PMI 2017; Wagner 2020). Three important factors are of concern in the implementation of EPC construction projects: implementation time, project completion cost and project quality (Bagus 2018; Habibi et al. 2019; Son and Lee 2019). The main characteristics of EPC projects are complex, temporary project organisation design and stakeholders are a part of project activities (Marzouk and El-Rasas 2014; Sun et al. 2021). EPC projects, which are a part of the construction industry, have an important role for a country in increasing its gross domestic product (GDP), through increasing infrastructure development that has an economic and social impact (Pehlivanli 2024).

This research is motivated by the findings and limitations that are found in several journals (Wei and Yang 2010; Kent et al. 2017; Bagus 2018; Nurdiana and Susanti 2020; Wagner 2020; Choi et al. 2021; Ham et al. 2021), which discuss the context in the construction industry in general and the EPC construction industry in particular. From several existing journal articles (Gong et al. 2019; Amiri et al. 2021; Jiang et al. 2021; Kim et al. 2021; Nikjow et al. 2021; Sun et al. 2021), this study attempts to draw a common thread, between the similarity of research findings and similarity in terms of research boundaries. From both aspects, hypotheses are built that are supported by theories from previous research results and described in the form of latent variables. The latent variables chosen

*Corresponding author: Denny Syahdinal, Department of Management, University of Indonesia: Universitas Indonesia, Depok, West Java, Indonesia, E-mail: denny.syahdinal01@ui.ac.id
Prijono Tjiptoherijanto, Eka Pria Anas and Manerep Pasaribu, Graduate School of Management, University of Indonesia, Depok, Indonesia

are the result of a combination of similarity of findings, research limitations with research model simulations that allow them to be supported by existing theory.

Table 1 shows a summary of several previous studies that were used as references in the development of this research. From the classification of these studies, they are divided into two stages: planning and implementation.

The existing decision-making (DM) process is a hierarchical step decision process (Table 2) comprising the following 3 stages: Stage 1 – the marketing unit or strategic business unit (SBU) presents to the proposal steering committee the profile of the customer, the financial condition of the customer, the scope of work and the condition of the land that will be the project location. Stage 2 – the proposal committee evaluates the presentation from

marketing or SBU with the result, whether the project proposal has notes or without notes. Stage 3 – if all the notes have been fulfilled, proceed to the next step, but if there are still notes, it is decided to be not continued or stopped. Stage 4 – the involvement of the board of directors (BOD) and the decision to undertake the project.

2 Literature review

In this research, an attempt is made to synergise among the market-based view (MBV) (Porter 1991; Tallman 1991), resource-based view (RBV) (Peteraf 1998; Barney et al. 2011) and the intelligence-based view (IBV) (Lichtenthaler 2019; Shamim et al. 2019), which can provide a systematic

Tab. 1: Previous research findings

No	Research findings	Stages	Researchers
1	The EPC construction contractor has the responsibility for the entire engineering, procurement and construction work, including the risks incurred due to unbalanced contracts and determination of the winner based on the lowest bid.	Planning	Allas et al. (2017)
2	Characteristics of the EPC construction industry: it is unique in that each project is different from one another for the same business, uncertainty and complexity; there is no standard fit to solve all the problems.	Planning	Koconegoro (2012) and Kent et al. (2017)
3	Type of project tender is the lowest bid, followed by negotiation, ineffective planning and schedule of project implementation and limited materials, equipment & machinery when it will be used.	Planning	Bagus (2018)
4	Project owners tend to transfer project risks to EPC construction contractors by utilising the characteristics of the EPC contract method (LSTK), where the contractor is responsible for the entire project implementation.	Planning	Wagner (2020)
5	The challenges faced by EPC construction companies in implementing digitalisation include corporate culture, organisational capabilities, leadership and expertise.	Planning	Liao et al. (2023)
6	Scarcity of materials, and unavailability of labour and equipment are important factors that cause delays in project completion.	Implementation	Elawi et al. (2016)
7	Delayed project conditions can affect construction costs, EPC project performance and lagging technology used.	Implementation	PMI (2017)
8	The implementation of digital technology in organisations, including EPC construction, will have positive and negative impacts on the DM process.	Implementation	Park et al. (2021)
9	There are three important factors of concern in the implementation of EPC construction projects: implementation time, project completion cost and project quality.	Implementation	Kabirifar and Mojtahedi (2019)
10	Performance measures of EPC projects include on-time completion, cost and quality.	Implementation	Sun et al. (2021)

DM, decision-making; EPC, engineering procurement construction; LSTK: Lump Sum Turkey.

Tab. 2: Existing DM process

Stages	Description	Decision-maker
1	Review and self-assessment; profile client, financial clause, scope of project and land acquisition	SVP marketing or SVP SBU
2	Proposal with noted or without notes	Proposal steering committee
3	Proposal fully complying without notes or still notes (stopped)	Proposal steering committee
4	Go or no-go proposal	BOD and proposal steering committee

Source(s): Author's own creation.

BOD, board of directors; DM, decision-making; SBU, strategic business unit; SVP, Senior Vice President.

framework for assessing the likelihood of companies gaining benefits from the development of big data analytics (BDA) generated by optimisation and efficiency through dimensions in the constructs.

2.1 Big data analytic capability (BDAC) and DM

Big data analytic capability is defined as the competency to provide business insights that use data management capabilities, infrastructure and talent to transform a business into a competitive force (Wamba et al. 2017; Yasmin et al. 2020), and the ability of a company to capture and analyse data towards a generation that is insightful in effectively managing, deploying its data, technology and talent people (Pappas et al. 2020).

Big data analytic capability has data management capabilities that can transform a business into a competitive force (Wamba et al. 2017; Yasmin et al. 2020). One way to become a competitive force begins with a decision based on insightful data (Merendino et al. 2018). This is in line with the opinion that companies can utilise data and then develop it to become successful companies (McAfee and Brynjolfsson 2012; Westerman et al. 2014). They have the power of very large, strategic and valuable data according to their respective business interests (Marr and Ward 2019; Mishra et al. 2019).

Many organisations have adjusted their strategic decisions based on big data because the capabilities of BDA have transformed the data capturing process into a strategic one (Gupta et al. 2021). BDAC provides templates and several matrices that can bridge between DM and its BDA capabilities so that the stability of decisions based on BDA becomes strategic and more important for the quality of the resulting data analytics as a basis for effective DM (Adrian et al. 2017). It is the management of BDA capabilities that affects DM capabilities (Awan et al. 2021). BDA equipped with intelligence and knowledge is called BDAC used for DM (Lichtenthaler 2019; Shamim et al. 2019).

The advantage of BDAC is its ability to analyse big data by handling complicated and complex tasks that are difficult to perform manually (Schildt 2017). The ability to analyse big data encourages the quality of DM in insightful organisations based on data (Awan et al. 2021). Therefore, the success of an organisation depends on the ability of its managers to make the right decisions (Edwards et al. 2000) and quality based on data-based insights, business intelligence and business analytics (Awan et al. 2021). For these reasons, we propose the following hypothesis:

H1: BDAC has a positive influence on DM.

2.2 DM and formulation of strategy (FS)

Decision-making can be defined as a process for obtaining quality information that enables decision-makers to better understand the impact of feedback processes, non-linear relationships between variables, and time delays on the performance of complex systems (Kelso 2008).

In this study, DM is central to insightful and valuable information obtained from MBV (Porter 1980, 1985; Grant 1991) in the form of competitors' position towards the company and winning opportunities. In terms of the RBV by Barney (1986), Makadok and Barney (2001) and Peteraf (1998), it is in the form of the capabilities of existing resources, physical resources, and non-physical resources. In terms of IBV, it is a combination of human resource capabilities with data, information and knowledge (Lichtenthaler 2019; Wamba et al. 2020). It is undeniable that information is an important source of input in DM throughout strategic management (Shrivastava and Grant 1985; Westley and Mintzberg 1989). DM based on big data is categorised as valuable information creativity (Secundo et al. 2022). The quality of big data analysis is an important element for effective DM in the BDA implementation cycle, because it is often used by decision-makers in the DM process (Adrian et al. 2017).

Furthermore, research on the DM process developed towards rational approaches was conducted by Eling et al. (2014), Kahneman and Klein (2009) and Kolbe et al. (2020). In this research, we use three dimensions of DM: rationality, quality and commitment. Rational decision is a DM process that uses information sources that are relevant to the decision and depends on the process of analysing information in determining choices (Dean and Sharfman 1993b). Other researchers suggest that rational decisions generally have a positive influence on the outcome of a decision (Bourgeois and Eisenhardt 1988). The indicators of the use of rational DM are based on cognition, knowledge, and accurate and correct information (Van Riel et al. 2004; Ram and Ronggui 2018).

Previous researchers in the construction industry have emphasised on time planning and project time estimation as part of the formulation strategy (Dunovic et al. 2021). DM results in policy strategies and formulation strategies (Savio and Nikolopoulos 2013). In addition, according to Ding et al. (2018), there is need for a model in DM that is used to select strategies that suit the needs of the organisation. Among them is that DM has connected with all levels, not only hierarchically ranging from strategic, tactical and operational but also complemented by networking (Gartner 2020). For these reasons, we propose the following hypothesis:

H2: DM has a positive influence on FS.

2.3 DM and implementation of strategy (IS)

Savio et al. (2013) stated that IS has an important role in the DM process. According to Song et al. (2018), DM is inherently linked to the strategy to be used. Similarly, Bryson and Roering (1988) convey that decision-makers will select strategies based on the decisions made. The initial method for making decisions is crucial because it concerns those who will implement the strategy (Hickson et al. 2003). Furthermore, decisions can be used to develop and integrate strategies that are essential for the organisation to succeed (Jones et al. 1992; Rusmin et al. 2014). IS can also be defined as a dynamic, iterative and complex process that encompasses various managerial activities in turning strategic plans into reality to achieve organisational goals (Tawse and Tabesh 2021).

The DM process can be utilised to develop and integrate strategies that are critical to organisational success (Savio and Nikolopoulos 2013). A comprehensive DM process fosters the development and integrates decisions towards a more strategic direction (Hitt et al. 2017). According to Tawse et al. (2018), DM affects organisational performance through IS. Additionally, the decision process is also used by the organisation to develop and integrate strategies for success (Liberation and Trope 1998). Given the various considerations, there is a great deal of interest in examining the relationship between DM and an organisation to be successful in implementing strategies, which can motivate the parties involved in IS (Mintzberg 1978; Hey and Knoll 2011; Song et al. 2018). A comprehensive DM process is one that directs decisions towards a more strategic direction (Fredrickson 1985). Similarly, Oyewobi et al. (2016) state that DM affects organisational performance through the IS.

However, success of the IS is a critical factor for organisations in running their business. Implementing an effective strategy is a pivotal stage in an organisation's success and can serve as a potential source of competitive advantage (Hitt et al. 2017). For these reasons, we propose the following hypothesis:

H3: DM has a positive influence on IS.

2.4 FS and IS

Rumelt et al. (1991) state that the initial understanding of strategy is about differentiating the company from its competitors, while the general management task is to adjust and update the company's resources over time, competition and changes that occur. This was further developed

by Alkhafaji (2011). FS can be defined as a process that involves making strategic decisions regarding the organisation's mission, philosophy, goals, policies and methods to achieve organisational goals.

Furthermore, according to Mintzberg (2019), FS is the process of strategy development and includes internal and external analysis of the organisation and industry and defines its goals. Agyapong et al. (2020) stated that the ability of IS is more important than the quality of the strategy itself. Salavou (2015) stated that there are general approaches that have the potential to succeed in outperforming competitors in their industry, including cost leadership. McGee et al. (2016) stated that FS needs to involve various choices as a consideration in implementing the operations strategy, because according to Tawse et al. (2018), there is a difference between what is needed when implementing a strategy and the experience and emotions of other involved parties, so that the company's ability to formulate strategies is more developed than the ability to implement (Mintzberg 1978).

There is awareness from all parties involved in the FS and IS when making a transition from the formulation strategy to the IS to try to jointly overcome the existing problems (Engert and Baumgartner 2016). For this reason, specific factors are needed when making the transition (Lau et al. 2020) with in-depth analysis (Engert and Baumgartner 2016). Conant et al. (1990) indicate that formulation strategy or planning strategy has an influence on IS. Stakeholders believe that better formulation strategies are needed to ensure the success of implementation strategies (Kalyan et al. 2025). However, Coricelli et al. (2018) state that the transition from FS to IS runs successfully when there is involvement of all interested parties in its implementation by accommodating the aspirations of all circles or levels within the organisation. For these reasons, we propose the following hypothesis:

H4: FS has a positive influence on IS.

2.5 FS and firm performance (FP)

Rumelt et al. (1991) state that the initial understanding of strategy is about what distinguishes between companies, differences with their competitors. According to Grant (2001) and Johnson et al. (2008), FS is a process that involves making strategic decisions that are influenced by external and internal factors. If there is a relationship between strategy and FP, it is essentially satisfying stakeholders who can be considered to have

growth, profitability, market value, customer satisfaction, employee satisfaction, social performance and environmental performance (McGee 2006; Santos and Brito 2012).

Therefore, in order to satisfy stakeholders, FS must be based on in-depth analysis by considering external factors. From MBV, competitive advantage from an external factor power perspective is seen, with sources of power coming from market monopolies, barriers to entry and high bargaining power (Tallman 1991; Collis 1994). From previous research as well, it is stated that there is a positive relationship between the development of a comprehensive strategy and FP (Papadakis 1998; Khatri and Ng 2000). Proponents of strategic planning or FS describe the potential to positively impact organisational outcomes, especially FP (Halachmi 1986; Poister et al. 2022).

Other researchers state that the impact of FS on performance produces mixed results (Poister et al. 2022). Furthermore, the impact of various aspects of strategic planning was examined, where there were differences in setting targets, issuing internal analysis results, conducting external analysis and developing actions (Poister et al. 2013, 2022). The results of research by Ateş et al. (2020) and Balogun and Johnson (2005) state that the failure to implement the planned strategy is due to lack of commitment in implementing the strategy. For this reason, it is necessary to create a mechanism that involves components in the organisation so that they have a sense of responsibility in the success of the company's performance (Coricelli et al. 2018).

The diversification strategy, which is part of the strategy formulation, has less significant impact on performance. Likewise, the results of research from Fredrickson and Mitchell (1984) show that there is a negative relationship between FP and a comprehensive strategic formulation when the environment is unstable. There is a significant difference in performance between high diversification and low diversification (Montgomery and Collis 1995). But according to Yukl et al. (2005), there are mixed findings on the relationship between diversification strategy and FP. For these reasons, we propose the following hypothesis:

H5: FS has a positive influence on FP.

2.6 IS and FP

Implementation of strategy can be defined as everything related to various managerial activities in order to implement planning strategies such as the creation of the type of organisational structure, the type and source of

information systems, suitable leadership and the type of control mechanism (Mintzberg and Westley 2010; Alkhafaji 2011). IS can also be defined as a dynamic, iterative, complex process consisting of various managerial activities in turning strategic plans into reality to achieve organisational goals (Tawse and Tabesh 2021).

The IS process is aimed to improve the achievement of the firm's business mission and vision through quality products and customer service (Rani 2019). Effective strategy implementation requires compatibility between the elements that exist within the internal organisation (Venkatraman and Camillus 1984). Implementing an effective strategy is a critical stage of an organisation's success and a potential source of competitive advantage for the organisation (Hitt et al. 2017; Tawse and Tabesh 2021).

Hoskisson and Hitt (2007) and Johnson et al. (2008) stated that the IS needed by an organisation is to improve FP. Furthermore, Pryor et al. (2010) have stated that it is a major challenge in the IS toward coordinating and integrating the activities of participating individuals and functions. According to Johnson et al. (2008) and Sirmon and Hitt (2009), IS is required by an organisation to improve FP. The success of project analysis is widely used in determining the project success factors, including quality improvement, project efficiency and effectiveness (Rehan et al. 2024), where the success of projects in the EPC industry can be synonymous with the success of the firm.

Firm performance is an important topic in strategic management and international management (Chan et al. 2008). FP can be defined as the results and basis that can satisfy stakeholders, which are considered to have growth, profitability, customer satisfaction and performance (McGee et al. 2008; Santos and Brito 2012). The results of the study by Fatima et al. (2024) emphasise that to measure the FP of construction projects, a dimensional approach is needed, involving cost, time and quality.

From the RBV perspective, FP is derived from two organisational capabilities: operational capability and dynamic capability (Eisenhardt and Martin 2000; Helfat and Peteraf 2003). There is a failure in strategy implementation when the strategy has been formulated by top management but not implemented by managers or the strategy is implemented but the results are not satisfactory (Cândido et al. 2015). The manager as a leader in the construction project plays an important role to achieve performance in a project and finally, the accumulation of a project's performance is FP (Imran et al. 2025). For these reasons, we propose the following hypothesis:

H6: IS has a positive influence on FP.

From the explanation about the relationship between latent variables, we have proposed six hypotheses, which are the model of our research, as shown in Figure 1.

3 Research methodology

3.1 Unit analysis of survey

The unit of analysis in this research survey is the EPC company, which include a private company, state owned enterprise and joint venture or foreign investment that have products or services produced by providing enormous impacts and benefits to the community, nation and state, such as electrical energy, fertilisers, motor vehicle fuel and cement.

In addition, in 2021, the construction industry made the fourth largest contribution to Indonesia's national economy at 10.48% of GDP after the industrial sector (18.3%), trade (12.71%) and agriculture (11.39%) <https://www.bps.go.id>.

The development of a survey through a unit of analysis that considers the contribution to a country's economy will have a significant impact on the country's income and the prosperity of its people. EPC companies as units of analysis play a very important role in this research, represented by company leaders or their equivalents, because they are decision-makers who can cause a company to succeed or fail.

Before the research survey was conducted, all questions in this study were checked for sentence and word understanding by two people who were not respondents, but students who had graduated from S3 strategic management Faculty Economic and Business (FEB) UI. The results of their checking changed the sentences and words for better than previously found.

The research questions of this study for each construct are developed based on previous research, including research questions on the BDAC construct by Akter

et al. (2016) and Shamim et al. (2020), the DM construct by Dooley and Fryxell (1999) and Kolbe et al. (2020), the FS construct by Agyapong et al. (2016) and Parnell and Carolina (2010), the IS construct by Cepeda-Carrion et al. (2012) and Pollanen et al. (2017) and the FP construct by Ji-fan Ren et al. (2017) and Wang et al. (2016).

The purpose of survey in this research is to provide scientifically gathered information to work as a basis for our conclusions.

3.2 Samples

The sample of this research was collected from EPC service companies operating in Indonesia, which are members of the Association of Indonesian National Design and Build Companies (AINDBC) as a population. From 116 companies incorporated in AINDBC, 76 companies responded to the research survey. These comprise companies owned by the Indonesian government, multinational companies and private companies.

Company leaders such as BOD and managers who were respondents in this study representing their respective companies were asked to complete the research questionnaire 1 h before the seminar on the use of big data in DM at EPC service companies. The aim of answering questions from company leaders provide answers that are completely factual, without embellishment or bias, and more objective in nature.

3.3 Data collection, procedure and measurement

Respondent data collection in this research survey is the two-stage approach method of survey (Naresh and Satyabhusan, 2016): pre-test stage and main test stage. At the pre-test stage, the research survey was distributed via email dated, 22 November 2022 and the period of data

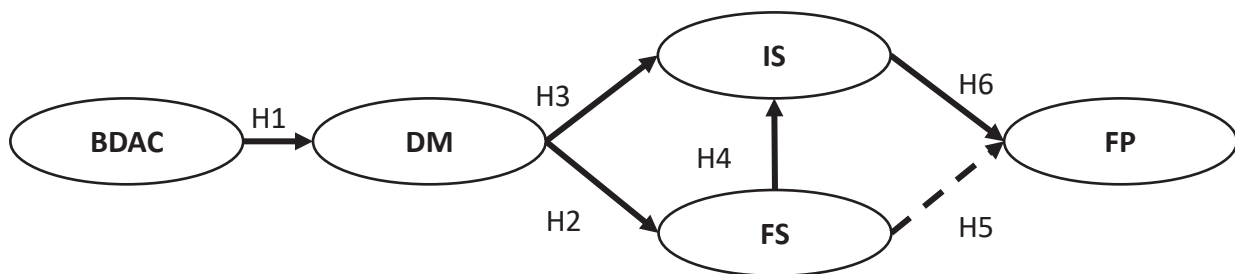


Fig. 1: Source(s): Author's own creation.

collection at the pre-test stage is approximately 4 months. The purpose of conducting a pre-test is to find out how much the respondent understands the questions asked, so that at the main test stage the questions submitted to the respondent are better and more understanding (Presser et al. 2016). Pre-test is also used to detect the level of misunderstanding, ambiguity, bias or doubt or other difficulties that respondents may face (Perneger et al. 2015).

The data collection method begins with creating a questionnaire containing questions related to the dimensions of each construct derived from literature review, previous research results and combined with the objectives of the study. All questions are packaged in the form of surveys to respondents who are members of AINDBC, which are adjusted to the profile of the respondents to be addressed, including company leaders or their representatives with groupings based on positions within the company.

This research questionnaire uses a Likert scale from 1 to 6 (Byrne 2016) as follows: 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = agree, 5 = strongly agree and 6 = very strongly agree. The mean value is the average value of a measurement, and the standard deviation is the average deviation from the mean value of the measurement results. The consideration of reducing the tendency of respondents is to choose neutral ones so that they are smarter in determining their choices.

The purpose of determining the standard deviation is to understand the variation or spread of the data relative to its mean value. If the standard deviation is larger, the data are more varied or further from the average value, and conversely, if the standard deviation is small, the data are closer to the average value. The size of the standard deviation value is influenced, among other things, by the range of measurement scale used and the respondents' perception or understanding of the questions.

The results of data collection at the pre-test stage were obtained from 30 respondents who represented 30 companies or 30 analysis units from 116 companies incorporated in AINDBC or around 25.86%. From the results of data processing on 30 companies, there are several low factor loadings <0.7 . From the results of pre-test data processing using SPSS version 25 (IBM), there are 75 indicators consisting of 57 indicators having positive statements and 18 having negative statements. Of the 18 negative statements, 17 have a Kaiser-Meyer-Olkin (KMO) value <0.05 and Cronbach's alpha <0.5 , where the minimum limit of KMO >0.05 and Cronbach's alpha >0.5 . (Hair et al. 2010).

Furthermore, the second research survey was distributed after making improvements to the editorial of several research statements, especially on their factor loading

values which tend to be <0.5 (Chin 1998; Hair 2010). The distribution of the research survey in the second stage is different from the first stage because it is through google. doc media before the webinar event on the EPC industry on 12 July 2023.

Data processing in this research uses SEM – PLS version. 4.0.9.5 (IBM). This is done by focusing on explaining variance in the dependent variable when examining the model (Pappas et al. 2020). The purpose of using Partial Least Squares - Structural Equation Modeling (PLS-SEM) is to make predictions that maximise the explanation of variance in the dependent variable (Anderson et al. 2019) and develop theory in exploratory research (Sarstedt et al. 2014).

According to Henseler and Chin (2010) and Hair et al. (2019), in measuring a model using Smart PLS, one should go through the two-stage approach. The first approach is through model measurement testing, such as Reliability test is used to measure the internal consistency of items in each category by determining the Cronbach's alpha or composite reliability (CR) value (Lee 2004). This measures how well the items in each category measure the same concept. A Cronbach's alpha or CR value >0.6 indicates that the dataset is acceptable (Kalyan et al. 2025). Cronbach's alpha describes the reliability of the sum (or average) of x measurements, where x measurements can represent x raters, x occasions, x alternative forms or questionnaire items (Bonett and Wright 2015).

Then, validity test refers to the ability of research survey questions to measure how accurately something is being measured (Lee 2004). It consists of convergent validity, which is indicated by a factor loading value of >0.5 , although ideally it should be >0.7 (Chin and Marcoulides 1998; Hair 2010; Sarstedt et al. 2014) and discriminant validity, which is indicated by an average variance extracted (AVE) value of >0.5 (Sarstedt et al. 2014). AVE is a measure used to assess convergent and discriminant validity, which is defined as the variance in the indicator or observed variable that can be explained by the construct of the latent variable (Naresh and Satyabhusan, 2016).

The second approach is structural model testing, such as R^2 , Q^2 , F^2 , variance inflation factor (VIF) and path coefficient, where R^2 is a measure of how strongly the variance within the endogenous variable can be explained by the exogenous variable (Hair 2019). According to Chin (1998) and Henseler and Chin (2010), the values of R^2 are as follows: $R^2 = 0.67$ (substantial), $R^2 = 0.33$ (moderate), and $R^2 = 0.19$ (weak). Q^2 is a measure that describes the accuracy of a prediction due to the relationship between exogenous or endogenous variables in predicting other endogenous variables. The value of Q^2 ranges from -1 to $+1$.

If the value is close to +1, it indicates a strong relationship between exogenous and endogenous variables (Hair et al. 2011), where the value of Q^2 does not reflect the quality of the prediction (Hair et al., 2014).

In addition, F^2 is a measure that describes how strong the relationship is between exogenous variables and endogenous variables. It measures the magnitude of the effect independently of sample size and provides an indication of the relevance of an effect measured based on calculations; the values of F^2 are 0.02 (small), 0.15 (medium) and 0.35 (large) (Cohen and Levin 1989). VIF is a measure used to determine the level of collinearity of each construct. According to Hair (2019) and Sarstedt et al. (2023), the VIF value is considered critical if it is ≥ 5 , there is potential for collinearity if $3 \leq \text{VIF} \leq 5$ and ideally the VIF value should be < 3 . Path coefficients in SEM models are interpreted like standardised regression coefficients.

Furthermore, the coefficient linking the path between the dependent variable and the independent variable measures the expected increase in the dependent variable if the independent variable increases by one standard deviation, while the other independent variables in the regression equation are held constant (Henseler 2017). The coefficients represent the relationship between independent constructs and dependent constructs, with path coefficient values ranging from -1 to +1. Coefficients closer to +1 indicate a strong positive relationship, while coefficients closer to -1 indicate a strong negative relationship (Sarstedt et al. 2014).

In this research, the variables measured among others were BDAC, DM, FS, IS and FP, as shown in Table 3.

3.4 Operational variables

All variables measured in this research are latent or cannot be measured directly or through the perceptions of respondents. In this study, there are six variables that can be defined as operational variables, such as: AIC is the ability of a company to manage organisational resources and implement computer systems capable of performing processes like humans (Mikalef et al., 2021; Agrawal et al., 2019). BDAC is the ability of a company to utilise data so that it can provide added value or insight through the use of technology (Pappas et al., 2018; Akter et al., 2016). FS is the planning process for initial decision-making includes, among other things, the philosophy, mission, and policies for achieving organisational goals that are influenced by internal and external factors. IS is a process for realising what has been planned, including organisational structure and information systems, as well as mechanisms for

controlling their implementation (Tan et al., 2019; Aydiner et al., 2019). FP is the output of a process that meets the expectations of stakeholders (Straub et al., 2020; Ji-fan Ren et al., 2017).

4 Data analysis and results

In conducting this research, in order to get the results to be in line with expectations, it is necessary to evaluate the survey in accordance with the principles of quantitative research recommended by previous researchers. The evaluation survey process is conducted using two approaches. First, evaluating the measurement model by conducting reliability and validity analyses. The second approach involves evaluating the structural model by assessing the R^2 , Q^2 , F^2 , VIF values and path coefficients. The following presents the calculation of the results from both survey evaluation approaches: measurement analysis and structural model analysis.

Figure 2 shows the results of the research model calculations using smart PLS. With a T value > 1.96 and a p value > 0.05 , five hypotheses that are supported (positive) are H1, H2, H3, H4 and H6, and one hypothesis that is not supported (negative) is H5.

4.1 Analysis of measurement model

From the results of data processing on these 76 respondents, there are 49 indicators which have a factor loading > 0.5 (Chin and Marcoulides 1998; Hair 2010; Sarstedt et al. 2014), from 54 of the total indicators, as shown Appendix 1. It refers to validity test, wherein 49 indicators are the full requirement. Therefore, 49 indicators were processed further and 5 indicators were dropped (Chin 1998; Hair 2010; Sarstedt et al. 2014).

The value of Cronbach's alpha and CR in accordance with > 0.6 and AVE > 0.5 (Hair et al. 2019) are shown in Table 4.

4.2 Analysis of structural model

Based on the structural model test as explained in section 3.3, the following are the results of structural model test using the SEM – PLS version. 4.0.9.5:

1. The R^2 value for the variables: DM is 0.217 (low), FS = 0.654 (high), IS = 0.727 (high) and FP = 0.289 (low).
2. The F^2 values for the variables: BDAC $\rightarrow$ DM = 0.071 (small), DM $\rightarrow$ FS = 1.886 (large), DM $\rightarrow$ IS = 0.159

Tab. 3: Variables Measurement

Variables construct	Definition	Second order	First order	Indicators	Reference
BDAC	A company's ability to capture and analyse data leads to an insightful generation that effectively organises, deploys its data, technology and talent.	- Mgmt. capabilities - Technology capability - Talent capability	- Planning - Coordination - Compatibility - Modularity - Technical Knowledge - Rational Knowledge	3 3 3 3 3 3	Wamba et al. (2017), Shamim et al. (2020) and Yasmin et al. (2020)
DM	The process of obtaining quality information that allows decision-makers to better understand the impact.		- Rationality - Commitment - Quality	3 3 3	Child and Hsieh (2014), Elbanna and Naguib (2009) and Kolbe et al. (2020)
FS	A process that involves making strategic decisions regarding the organisation's mission, goals and methods to achieve organisational goals.		- Low Cost Leadership - Market Competition - Marketing Strategy	3 3 3	Agyapong et al. (2020), Liu et al. (2020) and Varadarajan (2020)
IS	Everything related to various managerial activities in order to implement strategic planning.		- Stakeholder Mgmt. - Human Resource Capability	3 3	Moon (2018), Aydiner et al. (2019) and Wang et al. (2020)
FP	Results and fundamentals that can satisfy stakeholders, who are considered to have: growth and performance.		- Financial Performance - Non Financial Performance	3 3	Wamba et al. (2017) and Straub et al. (2020)

BDAC, big data analytic capability; DM, decision-making; FP, firm performance; FS, formulation of strategy; IS, implementation of strategy.

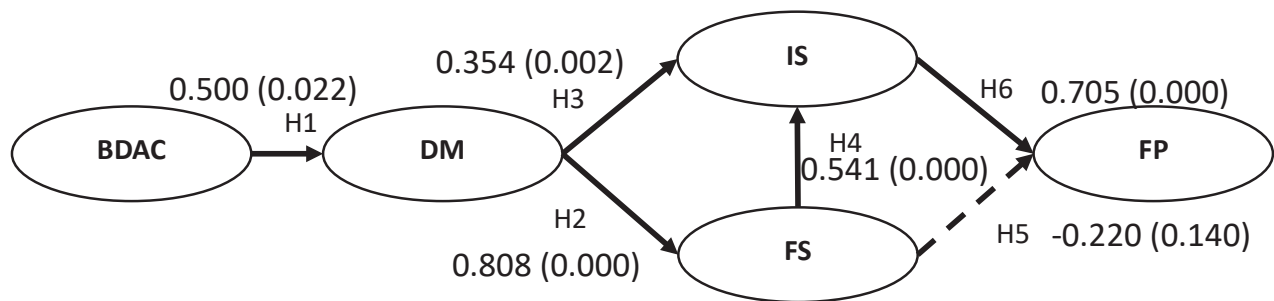


Fig. 2: Note: T – Value >1.96 and p value >0.05.

- (medium), FS → IS = 0.371 (large), FS → FP = 0.021 (small) and IS → FP = 0.221 (medium).
- The Q^2 values for the variables: DM = 0.150 (good), FS = 0.203 (good), IS = 0.333 (good) and FP = 0.217 (good).
 - VIF values for the variables; BDAC → DM = 4.496 (possible collinearity), DM → FS = 1.000 (no collinearity), DM → IS = 2.886 (no collinearity), FS → FP = 3.163 (possible collinearity), FS → IS = 2.886 (no collinearity) and IS → FP = 3.163 (possible collinearity).

Tab. 4: Cronbach's alpha, CR and AVE

Variables	Cronbach's alpha	CR (rho-a)	AVE
BDAC	0.958	0.965	0.661
DM	0.924	0.928	0.656
FS	0.897	0.909	0.562
IS	0.912	0.923	0.517
FP	0.858	0.893	0.603

Cronbach's alpha, CR >0.6 and AVE >0.5. All variables accepted.

AVE, average variance extracted; BDAC, big data analytic capability; CR, composite reliability; DM, decision-making; FP, firm performance; FS, formulation of strategy; IS, implementation of strategy.

Tab. 5: Path coefficients

Variables	Path coefficients	t-value	p-value	Hypotheses	Remark
BDAC to DM	0.466	2.017*	0.022*	H1 (+)	Accepted
DM to FS	0.808	18.744	0.000*	H2 (+)	Accepted
DM to IS	0.354	2.952*	0.002*	H3 (+)	Accepted
FS to IS	0.541	4.577*	0.000*	H4 (+)	Accepted
FS to FP	-0.220	1.079	0.140	H5 (-)	Rejected
IS to FP	0.705	3.725*	0.000*	H6 (+)	Accepted

Five hypotheses are accepted and one hypothesis is rejected.

*Significant if *t*-value >1.96 and *p*-value <0.05.

BDAC, big data analytic capability; DM, decision-making; FP, firm performance; FS, formulation of strategy; IS, implementation of strategy.

Based on the results of the structural test, the model shows that this research model is acceptable and can be continued to a coefficient path analysis test, as in the following paragraph.

This research study includes six hypotheses, of which five are supported by the path coefficient values presented in Table 5, while one hypothesis is not supported. The hypothesis that was not proven involves the FS and FP variables, which have a path coefficient value of -0.220. Meanwhile, other variables are accepted.

Referring to Table 5, all hypotheses are accepted except for H5, which does not prove the effect of strategy formulation on company performance. This indicates that the existing dimensions of the formulation strategy are not able to explain directly to FP. Based on the results of the model measurement test on the formulation strategy construct, the marketing strategy dimension has the highest factor loading of 0.909 with a *t*-value of 42.172 and a *p*-value of 0.000, an AVE value of 0.562 and a Cronbach' alpha value of 0.897.

However, the results of structural tests on the formulation strategy construct on the company performance is constructed with a path coefficient of -0.220, *t*-value 1.079 and *p*-value 0.140. It can be translated that the formulation strategy construct does not have a positive and significant effect on company performance or H5 is rejected. The

effect of formulation strategy on company performance is inseparable from the marketing strategy dimension in the FS construct where the marketing strategy dimension has the highest factor loading (0.909).

The results of this research are in line with the results of other studies which indicate that the diversified strategy, which is part of the formulation strategy, has less significant impact on performance (Rumelt et al. 1991). Likewise, the results of research from Fredrickson and Mitchell (1984) state that there is a negative relationship between company performance and a comprehensive strategic DM process, which is part of the strategy formulation when the environment is unstable.

The rejection of H5 also proves that there are differences in marketing strategies based on the research of Cavusgil et al. (1994), where there is a strategic relationship between marketing strategy and FP supported by a set of potentials that distinguish it from more comprehensive competitors. Then, Shaw (2012) also stated that the potential in question is an internal factor in the form of product characteristics and market characteristics. Market characteristics between mass production and EPC service markets are much different where EPC market conditions are highly dependent on external conditions, including petroleum prices and a stable environment.

Therefore, it becomes clearer that there are differences in product characteristics and market characteristics, which are strategic components of the relationship between marketing strategy and FP. In the EPC industry, the products produced by companies are determined by customers in terms of specifications, quality, time and price. Thus, it can be interpreted in this study that the products produced are not mass-produced but rather specific products, which are very different from mass-produced products (consumer goods). Other research states that the impact of strategic planning on performance yields mixed results (Poister et al. 2013, 2022).

Furthermore, Fatima et al. (2024) examined the impact of various aspects of strategic planning, where there were differences in setting targets, releasing internal analysis results, conducting external analysis and developing actions or behaviours.

5 Discussion

The direct positive effect of BDAC on DM proves that data or big data after being processed into information and knowledge becomes a reference for the DM process to be implemented (Shamim et al. 2019; Wamba et al. 2020; Yasmin et al. 2020). The source of the DM process is valuable data and valuable knowledge; through data analytics capabilities it can carry out processes, utilise technology and use the methods it has (Raghupathi and Raghupathi 2014).

The direct effect of DM to IS are positive and significant, and it can be interpreted that DM based on rationality, quality and commitment has a positive influence on IS (Dooley and Fryxell 1999; Kolbe et al. 2020). This can indicate that DM has a strong basis for implementation strategies, including; rationality based on analytical data (Akteer et al. 2016; Pappas et al. 2020) and the results of the DM process, in the form of targets that need to be implemented and completed. The results of the decision must be accountable in the form of joint commitment where all parties involved will be bound by the decision (Dooley and Fryxell 1999; Kolbe et al. 2020).

The formulation strategy directly has a positive influence on the IS. This proves that the results of this hypothesis are in accordance with previous research conducted by Bharadwaj et al. (1999) and White and Rollings (2021). This also shows that the existing dimensions of the formulation strategy, marketing strategy (Cavusgil et al. 1994; Shaw 2012), low cost leadership (Porter 1980; Kankam-Kwarteng et al. 2019; Islami et al. 2020) and market competition make a positive contribution to the IS (Doz 2017; Harrigan 2019).

However, the results of other studies indicate that the verified strategy, which is part of the strategy formulation, has less significant impact on performance. Similarly, Fredrickson (1985) found a negative relationship between company performance and the comprehensive strategic DM process, which is part of the strategy formulation in unstable environments. There are significant performance differences between high diversification and low diversification (Montgomery and Collis 1995). The results of this hypothesis are in accordance with the findings of previous research (Hitt et al. 2009).

The success of the IS on performance by involving related parties who will carry out the strategy (Santos and Brito 2012) include identification of stakeholder needs, effective information exchange, involvement in the project (Tan et al. 2019) and human resource capabilities (Aydinler et al. 2019). The results of research show that the failure to implement the planned strategy is due to lack of commitment in implementing the strategy (Balogun and Johnson 2005; Keng et al. 2018). For this reason, it is necessary to create a mechanism that involves components within the organisation in order to have a sense of responsibility in the success of the company's performance (Coricelli et al. 2018).

5.1 Theoretical contribution and practical implications

The results of this study have implications for the BDAC to support the calculation and prediction process. The DM needs BDAC to provide a lot of data for calculations and predictions. For BDAC to provide data and information, company managers must prepare, among others, BDA management capability, BDA technology capability and BDA talent capability.

The results of this study also have implications for the quality of DM based on BDAC. In this study, DM has a positive and significant influence on strategy formulation. In the DM process, the commitment dimension is the most significant aspect of this study, reflecting a sense of responsibility for decisions agreed upon by company leaders and involving commitments to parties related to project completion and success. The rationality dimension plays a crucial role in producing decisions that are faster, of higher quality and more accurate. BDAC contributes rationality by providing quality and up-to-date data and information necessary for projects and other purposes. Quality decisions can be used for the next process and are easier to track based on the origin of the data and information flow.

In the IS that has a lot to do with stakeholders, managers must understand the characteristics of each stakeholder so that the project implementation can run according to the specified time and agreed budget. Managers also need to pay attention to the ability of human resources to carry out formulation strategies and implementation strategies based on their qualifications and competencies. The ability of human resources that matches the needs of the company with those of each employee is able to carry out implementation strategies in completing EPC projects to meet the expectations of customers.

The results of this study also have implications for the company's planning stage, which requires dimensions that support the FS. In the formulation strategy, the marketing strategy dimension is a critical dimension for companies in marketing the company's products and services. This conclusion is related to the uniqueness of the products and services of the EPC industry, which is different from other industries. The EPC industry's marketing strategy targets stakeholders involved in project development, such as the project owner and the vendor to enhance effectiveness and precision.

6 Limitation and future research

This research has some limitations in distributing research questioner forms because of separate location, workload of respondents and time, and it was not possible to visit each company spread across Indonesia. Therefore, an online survey was conducted by using a Google Docs form, which made it possible to reach all research samples from various regions within Indonesia's geographical area.

The approach in this research methodology is quantitative, which has limitations in answering research questions where respondents may be biased in answering due to the ambiguity and length of the research questions.

When determining the total number of indicators in the research model, consideration is given to the minimum requirements for the number of indicators in each dimension, the total number of second orders and the total number of constructs. The aim is to avoid respondents not getting bored in filling in a large number of questions so that it can result in respondents filling them in carelessly or not filling them in at all.

For exploratory research on theory, with limitations in the number of research samples and having formative and reflective constructs, the data management should use SEM_PLS with two approaches: measurement model and structural model.

7 Conclusion

This research model proves that the presence of RI 4.0, represented by BDAC has been able to improve the DM process from hierarchical to digital processes (Pappas et al. 2020; Yasmin et al. 2020), where data and information flow through one platform that can be accessed by all stakeholders automatically (Harrison et al. 2019; Eng et al. 2020), making it easier to exchange information and data as a basis for making quick and accurate decisions (Elbanna and Naguib 2009; Cioppi et al. 2015). This is very necessary due to the EPC projects that have a project front-end phase, where only a little information can be known (Dunovic et al. 2021). Speed in terms of fast and accurate DM is a competitive advantage of organisations, including EPC service organisations (Chang et al. 2016; Elawi et al. 2016; Allas et al. 2017).

The results of this study prove that EPC service companies that utilise BDAC (Akter et al. 2016; Yasmin et al. 2020) are supported by the ability to manage BDA (Davenport et al. 2012; Kiron et al. 2014) technological mastery (Wamba et al. 2015; Ransbotham and Kiron 2017) and talented resources (Kiron et al. 2014) can improve faster and more accurate DM (Dooley and Fryxell 1999; Elbanna and Naguib 2009; Cioppi et al. 2015) based on data analytics (Awan et al. 2021). Hence the agreed decision can become a reference for strategy formulation to be elaborated in more detail (Mintzberg 1978; McGee et al. 2016) and then implemented to stakeholders so that the price of the proposal offer is more competitive compared with competitors (Barney 1991; Margaret et al. 2003) in a highly dynamic market environment (Kotnour et al. 1997; Teece 2018).

This research also proves that rational DM in the form of competitive, measurable and more detailed proposal bid prices based on analytical data (Cioppi et al. 2015; Awan et al. 2021). That is an important basis for formulation strategies (Agyapong et al. 2020; Varadarajan 2020). In marketing a competitive proposal price through a marketing strategy, which is a dimension of the formulation strategy construct, the competitive proposal bid price can be accepted by the client or project owner (Peteraf and Barney 2003; Barney 2015). For the acceptance of competitive bid prices, it is also necessary to have a low-cost leadership strategy dimension (Ramaseshan et al. 2013; Herzallah et al. 2017; Agyapong et al. 2020) from the construct of formulation strategy by involving stakeholders, which has a major influence on cost reduction (Dean and Sharfman 1993a; Keng et al. 2018).

This research study has also proven that the research model synergises among MBV-related theories represented

by the dimensions of marketing strategy, low-cost strategy and market competition (Herzallah et al. 2017; Agyapong et al. 2020). For RBV theory represented by human resources capability (Aydiner et al. 2019), human skills (Freeman 1984) and IBV theory are represented by BDAC (Pappas et al. 2018; Yasmin et al. 2020).

This important research describes that the DM construct is central to insightful and valuable information in terms of competitor positioning and winning opportunities (Grant 1991), complemented by the capabilities of resources within the company (Barney 1986; Peteraf 1998). Furthermore, it can also be understood that information and data are important sources in DM throughout strategic management (Shrivastava and Grant 1985; Westley and Mintzberg 1989). It is also supported by relevant dimensions in the DM process, including rationality (Elbanna and Naguib 2009), commitment (Dooley and Fryxell 1999) and quality (Dooley and Fryxell 1999).

References

- Adrian, C., Abdullah, R., Atan, R., & Jusoh, Y. Y. (2017). Factors influencing to the implementation success of big data analytics: A systematic literature review. *International Conference on Research and Innovation in Information Systems, ICRIIS, 17(IJEE)*, 978-1. doi: 10.1109/ICRIIS.2017.8002536
- Agrawal, A. et al. (2019). *The Economics of Artificial Intelligence*. The University of Chicago Press.
- Agyapong, A., Amanor, K., & Poku, K. (2016). Antecedents to the implementation of hybrid strategy in a dynamic business environment – An econometric analysis of business decisions in Ghana. *Journal of Developmental Entrepreneurship*, 21(4), pp. 1-24. doi: 10.1142/S1084946716500254
- Agyapong, A., Zamore, S., & Mensah, H. K. (2020). Strategy and performance: Does environmental dynamism matter? *Journal of African Business*, 21(3), pp. 315-337. doi: 10.1080/15228916.2019.1641304
- Akter, S., Wamba, S. F., Gunasekaran, A., Dubey, R., & Childe, S. J. (2016). How to improve firm performance using big data analytics capability and business strategy alignment? *International Journal of Production Economics*, 182, pp. 113-131. doi: 10.1016/j.ijpe.2016.08.018
- Alkhafaji, A. F. (2011). Strategic management: Formulation, implementation, and control in a dynamic environment. *Development and Learning in Organizations: An International Journal*, 25(2). doi: 10.1108/dlo.2011.08125bae.001
- Allas, T., Erichazan, S., Ramaswamy, & Chui, M. (2017). *Artificial intelligence the next digital frontier?* In McKinsey Global Institute: McKinsey Global Institute. www.mckinsey.com/mgi.
- Amiri, O., Rahimi, M., Ayazi, A., & Khazaeni, G. (2021). Multi-criteria decision-making model for EPC contractor prequalification: A hybrid approach. *International Journal of Building Pathology and Adaptation*, 1. doi: 10.1108/IJBPA-06-2021-0082
- Anderson, R. E., Black, W. C., Babin, B. J., & Hair, J. F. (2019). Multivariate Data Analysis. In CENCAGE (8th ed., Vol. 87, Issue 4). Annabel Ainscow.
- Ateş, N. Y., Tarakci, M., Porck, J. P., van Knippenberg, D., & Groenen, P. J. F. (2020). The dark side of visionary leadership in strategy implementation: Strategic alignment, strategic consensus, and commitment. *Journal of Management*, 46(5), pp. 637-665. doi: 10.1177/0149206318811567
- Awan, U., Shamim, S., Khan, Z., Zia, N. U., Shariq, S. M., & Khan, M. N. (2021). Big data analytics capability and decision-making: The role of data-driven insight on circular economy performance. *Technological Forecasting and Social Change*, 168(March), p. 120766. doi: 10.1016/j.techfore.2021.120766
- Aydiner, A. S., Tatoglu, E., Bayraktar, E., & Zaim, S. (2019). Information system capabilities and firm performance: Opening the black box through decision-making performance and business-process performance. *International Journal of Information Management*, 47(July 2018), pp. 168-182. doi: 10.1016/j.ijinfomgt.2018.12.015
- Bagus, A. L. (2018). Masa depan industri EPC dan tantangan BUMN EPC Tahun 2017. Fakultas Ekonomi Dan Bisnis Universitas Indonesia, 2017, 6. www.lmfebui.com.
- Balogun, J., & Johnson, G. (2005). From intended strategies to unintended outcomes: The impact of change recipient sensemaking. *Organization Studies*, 26(11), pp. 1573-1601. doi: 10.1177/0170840605054624
- Barney, J. B. (1986). Organizational culture: Can it be a source of sustained competitive advantage? *Academy of Management Review*, 11(3), pp. 656-665. doi: 10.5465/amr.1986.4306261
- Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17(1), 99-120.
- Barney, J. (2015). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), pp. 283-301. doi: 10.1177/014920639101700108
- Barney, J., Ketchen, D., & Wright, M. (2011). The future of resource-based theory: Revitalization or decline? *Journal of Management*, 37(5), pp. 1299-1315. doi: 10.1177/0149206310391805
- Bharadwaj, S., Adidam, P., Edison, S., & Menon, A. (1999). Antecedents and consequences of marketing strategy making: A model and a test. *Journal of Marketing*, 63(April), pp. 18-40. doi: 10.1177/002224299906300202
- Bonett, D. G., & Wright, T. A. (2015). Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *Journal of Organizational Behavior*, 36(1), pp. 3-15. doi: 10.1002/job.1960
- Bourgeois, L. J. & Eisenhardt, K. M. (1988). Strategic decision processes in high velocity environments: Four cases in the microcomputer industry. *Management Science*, 34(7), pp. 816-835. doi: 10.1287/mnsc.34.7.816
- Bryson, J. M., & Roering, W. D. (1988). Initiation of strategic planning by governments. *Public Administration Review*, 48(6), p. 995. doi: 10.2307/976996
- Byrne, B. M. (2016). Structural Equation Modeling with Amos: Basic Concepts, Applications and Programming. In Lisa Harlow (Ed.), *Structural Equation Modeling with AMOS*. Routledge Taylor & Francis Group.
- Cândido, C. J. F., Santos, S. P., Cândido, C., & Santos, S. P. (2015). Strategy implementation: What is the failure rate? *Journal of Management and Organization*, 21(2), pp. 237-262. doi: 10.1017/jmo.2014.77
- Cavusgil, S. T., Zou, S., Tamer, C. S., & Zou, S. (1994). Marketing strategy-performance relationship: An investigation of the

- empirical link in export market ventures. *Journal of Marketing*, 58(1), p. 1. doi: 10.2307/1252247
- Cepeda-Carrion, G., Cegarra-Navarro, J. G., & Jimenez-Jimenez, D. (2012). The effect of absorptive capacity on innovativeness: Context and information systems capability as catalysts. *British Journal of Management*, 23(1), pp. 110-129. doi: 10.1111/j.1467-8551.2010.00725.x
- Chang, B. R., Tsai, H. F., Tsai, Y. C., Kuo, C. F., & Chen, C. C. (2016). Integration and optimization of multiple big data processing platforms. *Engineering Computations (Swansea, Wales)*, 33(6), pp. 1680-1704. doi: 10.1108/EC-08-2015-0247
- Chan, C. M., Isobe, T., & Makino, S. (2008). Which country matters? Institutional development and foreign affiliate performance. *Strategic Management Journal*, 29(11), pp. 1179-1205. doi: 10.1002/smj.705
- Child, J., & Hsieh, L. H. Y. (2014). Decision mode, information and network attachment in the internationalization of SMEs: A configurational and contingency analysis. *Journal of World Business*, 49(4), pp. 598-610. doi: 10.1016/j.jwb.2013.12.012
- Chin, W. W. (1998). The partial least squares approach to structural equation modelling. In: Marcoulides, G. A. (ed.), *Modern Methods for Business Research*. Lawrence Erlbaum Associates, Mahwah, NJ, pp. 295-336.
- Chin, W. W., & Marcoulides, G. (1998). *Issues and Opinion on Structural Equation Modeling*. MIS Quarterly, 22(1), vii-xvi. <http://www.jstor.org/stable/249674>.
- Choi, S. J., So, W. C., Jong, H. K., & Lee, E. B. (2021). AI and text-mining applications for analyzing contractor's risk in invitation to bid (ITB) and contracts for engineering procurement and construction (EPC) projects. *Energies*, 14(15), p. 4632. doi: 10.3390/en14154632
- Cioppi, M., Musso, F., & Francioni, B. (2015). Management decision news. *Management Decision*, 53(6). doi: 10.1108/md.2007.00145fab.001
- Cohen, W. M., & Levin, R. C. (1989). Empirical studies of innovation and market structure. *Handbook of Industrial Organization*, 2, pp. 1059-1107. doi: 10.1016/S1573-448X(89)02006-6
- Collis, D. J. (1994). Research note: How valuable are organizational capabilities? *Strategic Management Journal*, 15(Special Issue), pp. 143-152. doi: 10.1002/smj.4250150910
- Conant, J., Mokwa, M., & Varadarajan, R. (1990). Strategic types, distinctive marketing competencies and organizational performance: A multiple measures based study. *Strategic Management Journal*, 11(9), pp. 365-383. doi: 10.1002/smj.4250110504
- Coricelli, G., Diecidue, E., & Zaffuto, F. D. (2018). Evidence for multiple strategies in choice under risk. *Journal of Risk and Uncertainty*, 56(2), pp. 193-210. doi: 10.1007/s11166-018-9278-2
- Davenport, T. H., Fa, L. L., Barth, P., & Bean, R. (2012). How 'Big Data' is different. *MIT Sloan Management Review*, 54(1), 43-46. <http://ez.sun.ac.za/login?url=https://search-proquest-com.ez.sun.ac.za/docview/1124397830?accountid=14049>
- Dean, J. W., & Sharfman, M. P. (1993a). Procedural rationality in the strategic decision-making process. *Journal of Management Studies*, 30(4), pp. 587-610. doi: 10.1111/j.1467-6486.1993.tb00317.x
- Dean, J. W., & Sharfman, M. P. (1993b). The relationship between procedural rationality and political behavior in strategic decision making. *Decision Sciences*, 24(6), pp. 1069-1083. doi: 10.1111/j.1540-5915.1993.tb00504.x
- Ding, J., Chen, C., An, X., Wang, N., Zhai, W., & Jin, C. (2018). Study on added-value sharing ratio of large EPC hydropower project based on target cost contract: A perspective from China. *Sustainability (Switzerland)*, 10(10), p. 3362. doi: 10.3390/su10103362
- Dooley, R. S., & Fryxell, G. E. (1999). Attaining decision quality and commitment from dissent: The moderating effects of loyalty and competence in strategic decision-making team. *Academy of Management Journal*, 42(4), pp. 389-402. doi: 10.2307/257010
- Doz, Y. (2017). The evolution of cooperation in strategic alliances: Initial conditions or learning processes? *Strategic Management Journal*, 17(Evolutionary Perspectives), pp. 55-83. doi: 10.1002/smj.4250171006
- Dunovic, I. B., Prebanic, K. R., & Durrigl, P. (2021). Method for base estimation of construction time for linear projects in front-end project phases. *Organization, Technology and Management in Construction*, 13(1), pp. 2312-2326. doi: 10.2478/otmcj-2018-0026
- Edwards, J. S., Duan, Y., & Robins, P. C. (2000). An analysis of expert systems for business decision making at different levels and in different roles. *European Journal of Information Systems*, 9(1), pp. 36-46. doi: 10.1057/palgrave.ejis.3000344
- Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, 21(10-11), pp. 1105-1121. doi: 10.1002/1097-0266(200010/11)21:10<1105::AID-SM-J133>3.0.CO;2-E
- Elawi, G. S. A., Algahtany, M., & Kashiwagi, D. (2016). Owners' perspective of factors contributing to project delay: Case studies of road and bridge projects in Saudi Arabia. *Procedia Engineering*, 145(480), pp. 1402-1409. doi: 10.1016/j.proeng.2016.04.176
- Elbanna, S., & Child, J. (2007). The influence of decision, environmental and firm characteristics on the rationality of strategic decision-making. *Journal of Management Studies*, 44(4), pp. 561-591. doi: 10.1111/j.1467-6486.2006.00670.x
- Elbanna, S., & Naguib, R. (2009). How much does performance matter in strategic decision making? *International Journal of Productivity and Performance Management*, 58(5), pp. 437-459. doi: 10.1108/17410400910965715
- Eling, K., Griffin, A., & Langerak, F. (2014). Using intuition in fuzzy front-end decision-making: A conceptual framework. *Journal of Product Innovation Management*, 31(5), pp. 956-972. doi: 10.1111/jpim.12136
- Engert, S., & Baumgartner, R. J. (2016). Corporate sustainability strategy – Bridging the gap between formulation and implementation. *Journal of Cleaner Production*, 113, pp. 822-834. doi: 10.1016/j.jclepro.2015.11.094
- Eng, J., Khan, Z., Zia, N. U., Shamim, S., Zeng, J., Khan, Z., et al. (2020). Big data analytics capability and decision making performance in emerging market firms: The role of contractual and relational governance mechanisms. *Technological Forecasting and Social Change*, 161(August), p. 120315. doi: 10.1016/j.techfore.2020.120315
- Fatima, A., Mubin, S., & Masood, R. (2024). Risk-based integrated performance assessment framework for public-private

- partnership infrastructure projects. *Organization, Technology and Management in Construction*, 16(1), pp. 251-274. doi: 10.2478/otmcj-2024-0018
- Fredrickson, J. W. (1985). Effects of decision motive and organizational performance level on strategic decision processes. *Academy of Management Journal*, 28(1), pp. 821-843. doi: 10.1080/0361697920160103
- Fredrickson, J. W., & Mitchell, T. R. (1984). Strategic decision processes: Comprehensiveness and performance in an industry with an unstable environment. *The Academy of Management Journal*, 27(2), pp. 399-423.
- Freeman, R. E. (1984). Strategic management: A stakeholder approach. *Strategic Management: A Stakeholder Approach*. doi: 10.1017/CBO9781139192675
- Gartner. (2020). *The IT Roadmap for Data and Analytics*. Available at <https://www.gartner.com/en/publications/the-it-roadmap-for-data-and-analytics>
- Gong, P., Zeng, N., Ye, K., & König, M. (2019). An empirical study on the acceptance of 4D BIM in EPC projects in China. *Sustainability (Switzerland)*, 11(5), pp. 1-20. doi: 10.3390/su11051316
- Grant, R. M. (1991). The resource-based theory of competitive advantage: Implications for strategy formulation. *California Management Review*, 33(3), pp. 114-135. doi: 10.2307/41166664
- Grant, R. M. (2001). The resource-based theory of competitive advantage.pdf. pp. 114-135.
- Gupta, S., Justy, T., Kamboj, S., Kumar, A., & Kristoffersen, E. (2021). Big data and firm marketing performance: Findings from knowledge-based view. *Technological Forecasting and Social Change*, 171(June), p. 120986. doi: 10.1016/j.techfore.2021.120986
- Habibi, M., Kermanshachi, S., & Rouhanizadeh, B. (2019). Identifying and measuring engineering, procurement, and construction (EPC) key performance indicators and management strategies. *Infrastructures*, 4(2). doi: 10.3390/infrastructures4020014
- Hair, J. F. et al. (2014). Partial least squares structural equation modeling (PLS-SEM) An emerging tool in business research. *Emerald Insight*, 262, 106-121. <https://doi.org/10.1108/EBR-10-2013-0128>
- Hair, J. F. (2019). *A Primer on Partial Least Squares*.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate Data Analysis*. In Pearson Prentice Hall: Vol. Seventh Ed. Pearson Practice Hall.
- Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, 19(2), pp. 139-152. doi: 10.2753/MTP1069-6679190202
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), pp. 2-24. doi: 10.1108/EBR-11-2018-0203
- Halachmi, A. (1986). Strategic Planning and Management ? Not Necessarily. *Public Productivity Review*, 10(2), 35-50. <https://www.jstor.org/stable/3380450>
- Ham, D. H., Jung, W. J., & Park, J. (2021). Identifying key factors affecting the performance of team decision-making based on the analysis of investigation reports issued from diverse industries. *Reliability Engineering and System Safety*, 206(November 2020), p. 107304. doi: 10.1016/j.res.2020.107304
- Harrigan, K. R. (2019). Joint ventures and competitive strategy. *Strategic Management Journal*, 9(2), pp. 141-158. doi: 10.1002/smj.4250090205
- Harrison, J. S., Barney, J. B., Freeman, R. E., & Phillips, R. A. (2019). In J. S. Harrison (Ed.), *The Cambridge Handbook of Stakeholder Theory*. Cambridge University Press. doi: 10.1017/9781108123495
- Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capability lifecycles. *Strategic Management Journal*, 24(10 Special Issue), pp. 997-1010. doi: 10.1002/smj.332
- Henseler, J. (2017). Bridging design and behavioral research with variance-based structural equation modeling. *Journal of Advertising*, 46(1), pp. 178-192. doi: 10.1080/00913367.2017.1281780
- Henseler, J., & Chin, W. W. (2010). A comparison of approaches for the analysis of interaction effects between latent variables using partial least squares path modeling. *Structural Equation Modeling*, 17(1), pp. 82-109. doi: 10.1080/10705510903439003
- Herzallah, A., Gutierrez-Gutierrez, L. J., & Munoz Rosas, J. F. (2017). Quality ambidexterity, competitive strategies, and financial performance: An empirical study in industrial firms. *International Journal of Operations and Production Management*, 37(10), pp. 1496-1519. doi: 10.1108/IJOPM-01-2016-0053
- Hey, J. D., & Knoll, J. A. (2011). Strategies in dynamic decision making – An experimental investigation of the rationality of decision behaviour. *Journal of Economic Psychology*, 32(3), pp. 399-409. doi: 10.1016/j.joep.2011.02.011
- Hickson, D. J., Miller, S. J., & Wilson, D. C. (2003). Planned or prioritized? Two options in managing the implementation of strategic decisions. *Journal of Management Studies*, 40(7), pp. 1803-1836. doi: 10.1111/1467-6486.00401
- Hitt, M. A., Ireland, R. D., & Hoskisson, R. E. (2009). *Strategic Management, Concept and Cases*, In Jack W. Calhoun (Ed.), South Western Cengage Learning (8th ed.). South-Western Cengage Learning.
- Hitt, M. A., Ireland, R. D., & Hoskisson, R. E. (2017). *Strategic Management Competitiveness & Globalization* (12th ed.). Cengage Learning.
- Hoskisson, R. E., & Hitt, M. A., & Ireland, R. D. (2007). *Strategic Management* (7th ed.). Thomson Higher Education.
- Imran, U., Khurshid, M. B., Khan, U., & Access, O. (2025). Technical paper developing a quality index for pavement construction and rehabilitation. *Organization, Technology and Management in Construction*, 17, pp. 24-45. doi: 10.2478/otmcj-2025-0002
- Islami, X., Mustafa, N., Topuzovska, L., & Marija. (2020). Linking Porter's generic strategies to firm performance. *Future Business Journal*, 6(1), pp. 1-15. doi: 10.1186/s43093-020-0009-1
- Jiang, M., Cheng, Y., Lei, T., & Liu, Z. (2021). "Intelligent construction, digital modeling of the future" Internet + BIM service EPC project – Take the exhibition center of national cybersecurity center for education and innovation project as an example. *IOP Conference Series: Earth and Environmental Science*, 719(2), pp. 1-9. doi: 10.1088/1755-1315/719/2/022043
- Ji-fan Ren, S., Fosso Wamba, S., Akter, S., Dubey, R., Childe, S. J., Steven, J., et al. (2017). Modelling quality dynamics, business value and firm performance in a big data analytics environment. *International Journal of Production Research*, 55(17), pp. 5011-5026. doi: 10.1080/00207543.2016.1154209

- Johnson, M. W., Christensen, C. M., & Kagermann, H. (2008). Reinventing your business model. *Harvard Business Review*, 86(12).
- Jones, R. E., Jacobs, L. W., & Van Spijker, W. (1992). Strategic decision processes in international firms. *Management International Review*, 32(3), pp. 219-236. doi: 10.1007/978-3-663-01562-8
- Kabirifar, K., & Mojtahedi, M. (2019). The impact of engineering, procurement and construction (EPC) phases on project performance: A case of large-scale residential construction project. *Buildings*, 9(1), p. 15. doi: 10.3390/buildings9010015
- Kahneman, D., & Klein, G. (2009). Conditions for intuitive expertise: A failure to disagree. *American Psychologist*, 64(6), pp. 515-526. doi: 10.1037/a0016755
- Kalyan, B. H. S., Anandh, S., & Nachiar, S. S. (2025). Predicting stakeholder perspective of alternative dispute resolution in the construction industry using ordinary least square regression. *Organization, Technology and Management in Construction*, 17, pp. 1-23. doi: 10.2478/otmcj-2025-0001
- Kankam-Kwarteng, C., Osman, B., & Donkor, J. (2019). Innovative low-cost strategy and firm performance of restaurants. *Asia Pacific Journal of Innovation and Entrepreneurship*, 13(3), pp. 266-281. doi: 10.1108/apjie-05-2018-0034
- Kelso, S. (2008). Complex decision making. In Springer. *Springer Berlin Heidelberg*. doi: 10.1080/07493878.1990.10641812
- Keng, T. C., Mansor, N., & Ching, Y. K. (2018). An exploration of cost overrun in building construction projects. *Global Business & Management Research*, 10(3), pp. 638-646. <http://search.ebscohost.com/login.aspx?direct=true&db=b-th&AN=133618157&site=ehost-live&authtype=ip,uid>
- Kent, A., Berg, J. Van den, & Sobolewski, M. (2017). 2017 Engineering and Construction Trends. Price Waterhouse Cooper, 12.
- Khatiri, N., & Ng, H. A. (2000). The role of intuition in strategic decision making. *Sage Publications*, 53(1), pp. 57-86. doi: 10.1177/0018726700531004
- Kim, J. H., Choi, S. J., Choi, S. W., & Lee, E. B. (2021). AI and text-mining applications for analyzing contractor's procurement and construction (EPC) projects. *Energies*, 14. doi: 10.3390/en14154632
- Kiron, B. D., Prentice, P. K., & Ferguson, R. B. (2014). The analytics mandate. *MIT Sloan Management Review*, 55(2), 29-33. <http://sloanreview.mit.edu/analytics-mandate>.
- Koconegoro, H. (2012). *Prospects of Engineering Procurement and Construction (EPC) Business for Construction Companies*. Pefindo, December, 3. <http://pefindo.com>.
- Kolbe, L. M., Bossink, B., & de Man, A. P. (2020). Contingent use of rational, intuitive and political decision-making in R&D. *Management Decision*, 58(6), pp. 997-1020. doi: 10.1108/MD-02-2019-0261
- Kotnour, T. G., Teece, D. J., Pisano, G., Shuen, A. M. Y., & Kotnour, T. G. (1997). Dynamic capabilities and strategic management. *Knowledge and Strategy*, 18(7), pp. 509-533. doi: 10.1016/B978-0-7506-7088-3.50009-7
- Lau, N., Hildebrandt, M., & Jeon, M. (2020). Ergonomics in AI: Designing and interacting with machine learning and AI. *Ergonomics in Design*, 28(3), p. 3. doi: 10.1177/1064804620915238
- Lee, D. (2004). Survey research. Reliability and validity. *Library Administration & Management*, 18(4), pp. 211-212. <https://www.proquest.com/scholarly-journals/survey-research-reliability-validity/docview/216638096/se-2?accountid=17242>
- Liao, S., Hu, Q., & Wei, J. (2023). How to leverage big data analytic capabilities for innovation ambidexterity: A mediated moderation model. *Sustainability*, 15, p. 3948. doi: 10.3390/su15053948
- Liberation, N., & Trope, Y. (1998). The role of feasibility and desirability considerations in near and distant future decisions: A test of temporal construal theory. *Journal of Personality and Social Psychology*, 75(1), pp. 5-18. doi: 10.1037/0022-3514.75.1.5
- Lichtenthaler, U. (2019). An intelligence-based view of firm performance: Profiting from artificial intelligence. *Journal of Innovation Management*, 7(1), pp. 7-20. doi: 10.24840/2183-0606_007.001_0002
- Liu, Y., Li, W., & Li, Y. (2020). Ambidexterity between low cost strategy and CSR strategy: Contingencies of competition and regulation. *Asia Pacific Journal of Management*, 37(3), pp. 633-660. doi: 10.1007/s10490-019-09647-3
- Makadok, R., & Barney, J. B. (2001). Strategic factor market intelligence: An application of information economics to strategy formulation and competitor intelligence. *Management Science*, 47(12), pp. 1621-1638. doi: 10.1287/mnsc.47.12.1621.10245
- Margaret A. Peteraf, & Barney, B. J. (2003). Unraveling the resource-based tangle. *Managerial and Decision Economics*, 24(4), 309-323. doi: 10.1002/mde.1126
- Marquard, & Bahl, A. G. (2015). *EPC (Engineering, Procurement and Construction) Others*. December, 2015.
- Marr, B., & Ward, M. (2019). *Artificial Intelligence in Practice* (1st ed.). Wiley.
- Marzouk, M. M., & El-Rasas, T. I. (2014). Analyzing delay causes in Egyptian construction projects. *Journal of Advanced Research*, 5(1), pp. 49-55. doi: 10.1016/j.jare.2012.11.005
- McAfee, A., & Brynjolfsson, E. (2012). Spotlight on big data big data: The management revolution. *Harvard Business Review*, October, 1-9.
- McGee, J. E., Dowling, M. J., & Megginson, W. L. (2016). Cooperative strategy and new venture performance: The role of business strategy and management experience. *Strategic Management Journal*, 16(7), pp. 565-580. doi: 10.1002/smj.4250160706
- McGee, J. (2006). The Blackwell handbook of strategic management. In R. E. F. A. J. S. H. eISBN: Michael A. Hitt (Ed.), *The Blackwell Handbook of Strategic Management* (Vol. 1). doi: 10.1111/b.9780631218616.2006.x
- Merendino, A., Dibb, S., Meadows, M., Quinn, L., Wilson, D., Simkin, L., et al. (2018). Big data, big decisions: The impact of big data on board level decision-making. *Journal of Business Research*, 93(August), pp. 67-78. doi: 10.1016/j.jbusres.2018.08.029
- Mikalef, P., & Manjul, G. (2021). Artificial intelligence capability: Conceptualization, measurement calibration, and empirical study on its impact on organizational creativity and firm performance. *Information and Management*, 58(3), 103434. doi: 10.1016/j.im.2021.103434
- Mintzberg, H. (1978). Patterns in strategy formation. *Management Science*, 24(9), pp. 934-948. Available at <https://www.jstor.org/stable/2630633%0AJSTOR>
- Mintzberg, H. (2019). Managerial work: Analysis from observation. *Managerial Work*, 18(2), pp. 99-112. doi: 10.4324/9780429398599-6

- Mintzberg, H., & Westley, F. J. (2010). *Decision Making: It's Not What You Think*. pp. 89-94.
- Mishra, D., Luo, Z., Hazen, B., Hassini, E., Foroapon, C., Luo, Z., et al. (2019). Organizational capabilities that enable big data and predictive analytics diffusion and organizational performance: A resource-based perspective. *Management Decision*, 57(8), pp. 1734-1755. doi: 10.1108/MD-03-2018-0324
- Montgomery, C. A., & Collis, D. J. (1995). Corporate strategy: A conceptual framework. *Harvard Business School Cases*, 9-391-284, 1-9.
- Moon, M. J. (2018). The pursuit of managerial entrepreneurship: Does organization matter? *Public Administration Review*, 59(1), pp. 31-43. doi: 10.2307/977477
- Naresh, K. M., & Satyabhusan, D. (2016). *Marketing Research An Applied Orientation* (Seventh Ed). Pearson India Education.
- Nikjow, M. A., Liang, L., Qi, X., & Sepasgozar, S. (2021). Engineering procurement construction in the context of belt and road infrastructure projects in West Asia: A SWOT analysis. *Journal of Risk and Financial Management*, 14(3), p. 92. doi: 10.3390/jrfm14030092
- Nurdiana, A., & Susanti, R. (2020). Assessing risk on the engineering procurement construction (EPC) project from the perspective of the owner: A case study. *IOP Conference Series: Earth and Environmental Science*, 506(1), p. 012040. doi: 10.1088/1755-1315/506/1/012040
- Oyewobi, L. O., Windapo, A., & Rotimi, J. O. B. (2016). Relationship between decision-making style, competitive strategies and organisational performance among construction organisations. *Journal of Engineering, Design and Technology*, 14(4), pp. 713-738. doi: 10.1108/JEDT-04-2015-0025
- Papadakis, V. M. (1998). Green is and organizational performance: An empirical examination. *British Journal of Management*, 9, pp. 115-132. doi: 10.1111/1467-8551.00078
- Pappas, I. O., Mikalef, P., Giannakos, M. N., Krogstie, J., & Lekakos, G. (2018). Big data and business analytics ecosystems: Paving the way towards digital transformation and sustainable societies. *Information Systems and E-Business Management*, 16(3), pp. 479-491. doi: 10.1007/s10257-018-0377-z
- Pappas, I. O., Mikalef, P., Krogstie, J., & Pavlou, P. A. (2020). Big data and business analytics: A research agenda for realizing business value. *Information and Management*, 57(1), p. 103237. doi: 10.1016/j.im.2019.103237
- Park, M. J., Lee, E. B., Lee, S. Y., & Kim, J. H. (2021). A digitalized design risk analysis tool with machine-learning algorithm for EPC contractor's technical specifications assessment on bidding. *Energies*, 14(18), p. 5901. doi: 10.3390/en14185901
- Parnell, J. A., & Carolina, N. (2010). Strategic clarity, business strategy and performance. *Journal of Strategy and Management*, 3(4), pp. 304-324. doi: 10.1108/17554251011092683
- Pehlivanli, E. A. (2024). Dynamics of organisational attractiveness and perceived attributes: Evidence from Turkish construction sector. *Organization. Technology and Management in Construction*, 16(1), pp. 275-288. doi: 10.2478/otmcj-2024-0019
- Perneger, T. V., Courvoisier, D. S., Hudelson, P. M., & Gayet-Ageron, A. (2015). Sample size for pre-tests of questionnaires. *Quality of Life Research*, 24(1), pp. 147-151. doi: 10.1007/s11136-014-0752-2
- Peteraf, M. A. (1998). The cornerstones of competitive advantage: A resource based view. *Strategic Management Journal*, 14(3), pp. 179-191. doi: 10.1002/smj.4250140303
- Peteraf, M., & Barney, J. (2003). Unraveling the resource-based tangle. *Managerial and Decision Economics*, 24(4), pp. 309-323. doi: 10.1002/mde.1126
- Poister, T. H., Edwards, L. H., & Pasha, O. Q. (2022). Strategy formulation and performance: Evidence from local public transit agencies. *Public Performance & Management Review*, 36(4), pp. 585-615. doi: 10.2753/PMR
- Poister, T. H., Pasha, O. Q., Edwards, L. H., Public, S., Review, A., August, J., et al. (2013). Transit industry published by: Wiley on behalf of the American Society for Public Administration. *Public Administration Review*, 73(4), pp. 625-636. doi: 10.1111/puar.12076
- Pollanen, R., Abdel-Maksoud, A., Elbanna, S., & Mahama, H. (2017). Relationships between strategic performance measures, strategic decision-making, and organizational performance: Empirical evidence from Canadian public organizations. *Public Management Review*, 19(5), pp. 725-746. doi: 10.1080/14719037.2016.1203013
- Porter, M. E. (1980). Competitive Strategy: Techniques for Analyzing Industries and Competitors. In *Competitive Strategy: Techniques for Analyzing Industries and Competitors* (p. 422). The Free Press. doi: 10.4324/9781912281060
- Porter, M. E. (1985). *Competitive Advantage Creating and Sustaining Superior Performance*. In The Free Press (p. 580). First Free Press Edition.
- Porter, M. E. (1991). Towards a dynamic theory of strategy. *Strategic Management Journal*, 12(2 S), pp. 95-117. doi: 10.1002/smj.4250121008
- Presser, S., Couper, M. P., Lessler, J. T., Martin, E., Martin, J., & Rothgeb, J. M. (2016). Methods for testing and evaluating survey questions. *Public Opinion Quarterly*, 68(1), pp. 109-130. doi: 10.1093/poq/nfh008
- Project Management Institute. (2017). *Project Management Body of Knowledge* (6th ed.). Project Management Institute, Inc. www.PMI.org
- Pryor, M. G., Taneja, S., & Fayol, H. (2010). Henri Fayol, practitioner and theoretician – Revered and reviled. *Journal of Management History*, 16(4), pp. 489-503. doi: 10.1108/17511341011073960
- Raghupathi, W., & Raghupathi, V. (2014). Big data analytics in healthcare: Promise and potential. *Health Information Science and Systems*, 2, p. 3. doi: 10.1186/2047-2501-2-3
- Ramaseshan, B., Ishak, A., & Kingshott, R. P. J. (2013). Interactive effects of marketing strategy formulation and implementation upon firm performance. *Journal of Marketing Management*, 29(11-12), pp. 1224-1250. doi: 10.1080/0267257X.2013.796319
- Ram, J., & Ronggui, D. (2018). Research and development projects: An empirical investigation of project managers' traits. *International Journal of Managing Projects in Business*, 11(4), pp. 913-934. doi: 10.1108/IJMPB-03-2017-0032
- Rani, P. (2019). Strategy implementation in organizations: A conceptual overview. *Management*, 14(3), pp. 205-218. doi: 10.26493/1854-4231.14.205-218
- Ransbotham, S., & Kiron, D. (2017). Analytics as a source of business innovation. *MIT Sloan Management Review*, February(58380), Foundation of Marketing 5th edition.
- Rehan, A., Thorpe, D., & Heravi, A. (2024). Leadership practices and communication framework for project success – The construction sector. *Organization, Technology and Management in Construction*, 16(1), pp. 204-223. doi: 10.2478/otmcj-2024-0016

- Rumelt, R. P., Schendel, D., & Teece, D. J. (1991). Strategic management and economics. *Strategic Management Journal*, 12(2S), pp. 5-29. doi: 10.1002/smj.4250121003
- Rusmin, R., Astami, E. W., & Hartadi, B. (2014). The impact of surplus free cash flow and audit quality on earnings management the case of growth triangle countries. *Asian Review of Accounting*, 22(3), pp. 217-232. doi: 10.1108/ARA-10-2013-0062
- Salavou, H. E. (2015). Competitive strategies and their shift to the future. *European Business Review*, 27(1), pp. 80-99. doi: 10.1108/EBR-04-2013-0073
- Santos, J. B., & Brito, L. A. L. (2012). Toward a subjective measurement model for firm performance. *BAR - Brazilian Administration Review*, 9(Special Issue), pp. 95-117. doi: 10.1590/S1807-76922012000500007
- Sarstedt, M., Becker, J.-M., Cheah, J.-H., Gholamzade, R., & Ringle, C. M. (2023). PLS-SEM's most wanted guidance. *International Journal of Contemporary Hospitality Management*, 35(1), pp. 321-346. doi: 10.1108/IJCHM-04-2022-0474
- Sarstedt, M., Hopkins, L., Kuppelwieser, V. G., & Hair, J. F. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review*, 26(2), pp. 106-121. doi: 10.1108/EBR-10-2013-0128
- Savio, N. D., & Nikolopoulos, K. (2013). A strategic forecasting framework for governmental decision-making and planning. *International Journal of Forecasting*, 29(2), pp. 311-321. doi: 10.1016/j.ijforecast.2011.08.002
- Schildt, H. (2017). Big data and organizational design-the brave new world of algorithmic management and computer augmented transparency. *Innovation: Management, Policy and Practice*, 19(1), pp. 23-30. doi: 10.1080/14479338.2016.1252043
- Secundo, G., Elia, G., Margherita, A., & Leitner, K. H. (2022). Strategic decision making in project management: A knowledge visualization framework. *Management Decision*, 60(4), pp. 1159-1181. doi: 10.1108/MD-02-2021-0196
- Shamim, S., Zeng, J., Shafi Choksy, U., & Shariq, S. M. (2020). Connecting big data management capabilities with employee ambidexterity in Chinese multinational enterprises through the mediation of big data value creation at the employee level. *International Business Review*, 29(6), p. 101604. doi: 10.1016/j.ibusrev.2019.101604
- Shamim, S., Zeng, J., Shariq, S. M., & Khan, Z. (2019). Role of big data management in enhancing big data decision-making capability and quality among Chinese firms: A dynamic capabilities view. *Information and Management*, 56(6), p. 103135. doi: 10.1016/j.im.2018.12.003
- Shaw, E. H. (2012). Marketing strategy: From the origin of the concept to the development of a conceptual framework. *Journal of Historical Research in Marketing*, 4(1), pp. 30-55. doi: 10.1108/17557501211195055
- Shrivastava, P., & Grant, J. (1985). Empirically derived models of strategic decision-making processes. *Strategic Management Journal*, 6(2), pp. 97-113. doi: 10.1002/smj.4250060202
- Sirmon, D. G., & Hitt, M. A. (2009). Contingencies within dynamic managerial capabilities: Interdependent effects of resource investment and deployment on firm performance. *Strategic Management Journal*, 30(13), pp. 1375-1394. doi: 10.1002/smj.791
- Song, G., Sun, L., & Wang, Y. (2018). A decision-making model to support the design of a strategic supply chain configuration. *Journal of Manufacturing Technology Management*, 29(3), pp. 515-532. doi: 10.1108/JMTM-09-2017-0197
- Son, B. Y., & Lee, E. B. (2019). Using text mining to estimate schedule delay risk of 13 offshore oil and gas EPC case studies during the bidding process. *Energies*, 12(10), 25. doi: 10.3390/en12101956
- Straub, D., Suoniemi, S., Meyer-Waarden, L., Munzel, A., & Zablah, A. R. (2020). Big data and firm performance: The roles of market-directed capabilities and business strategy. *Information and Management*, 57(7), p. 103365. doi: 10.1016/j.im.2020.103365
- Sun, C., Wang, M., & Zhai, F. (2021). Research on the collaborative application of BIM in EPC projects: The perspective of cooperation between owners and general contractors. *Advances in Civil Engineering*, 2021. doi: 10.1155/2021/4720900
- Tallman, S. B. (1991). Strategic management models and resource-based strategies among MNEs in a host market special issue: Global strategy (summer). *Strategic Management Journal*, 12, pp. 69-82. doi: 10.1002/smj.4250120907
- Tan, C. D., Zhang, Y., Sun, J., Wang, Z., & Zheng, G. (2019). Key influencing factors for cross-organizational R & D project stakeholder management. In: *IEEE International Conference on Industrial Engineering and Engineering Management, 2019-December*, 651-655. doi: 10.1109/IEEM.2018.8607341
- Tawse, A., Patrick, V. M., & Vera, D. (2018). Crossing the chasm: Leadership nudges to help transition from strategy formulation to strategy implementation. ScienceDirect. <https://doi.org/10.1016/j.bushor.2018.09.005>
- Tawse, A., & Tabesh, P. (2021). Strategy implementation: A review and an introductory framework. *European Management Journal*, 39(1), pp. 22-33. doi: 10.1016/j.emj.2020.09.005
- Teece, D. J. (2018). Business models and dynamic capabilities. *Long Range Planning*, 51(1), pp. 40-49. doi: 10.1016/j.lrp.2017.06.007
- Van Riel, A. C. R., Lemmink, J., & Ouwersloot, H. (2004). High-technology service innovation success: A decision-making perspective. *Journal of Product Innovation Management*, 21(5), pp. 348-359. doi: 10.1111/j.0737-6782.2004.00087.x
- Varadarajan, R. (2020). Customer information resources advantage, marketing strategy and business performance: A market resources based view. *Industrial Marketing Management*, 89(February), pp. 89-97. doi: 10.1016/j.indmarman.2020.03.003
- Venkatraman, N., & Camillus, J. C. (1984). Exploring the Concept of "Fit" in Strategic Management. *The Academy of Management Review*, 9(3), 513-525. <http://www.jstor.org/stable/258291>
- Wagner, R. F. (2020). EPC 4.0: The quest for reducing CAPEX in EPC projects. *Organization, Technology and Management in Construction*, 12(1), pp. 2245-2255. doi: 10.2478/otmcj-2020-0020
- Wamba, F., Akter, S., Edwards, A., Chopin, G., & Gnanzou, D. (2015). How "big data" can make big impact: Findings from a systematic review and a longitudinal case study. *International Journal of Production Economics*, 165, pp. 234-246. doi: 10.1016/j.ijpe.2014.12.031
- Wamba, S. F., Dubey, R., Gunasekaran, A., & Akter, S. (2020). The performance effects of big data analytics and supply chain ambidexterity: The moderating effect of environmental dynamism. *International Journal of Production Economics*, 222(September 2019), p. 107498. doi: 10.1016/j.ijpe.2019.09.019

- Wamba, S. F., Gunasekaran, A., Akter, S., Fan Ren, S. J., Dubey, R., & Childe, S. J. (2017). Big data analytics and firm performance: Effects of dynamic capabilities. *Journal of Business Research*, 70, pp. 356-365. doi: 10.1016/j.jbusres.2016.08.009
- Wang, K., Xu, Y., Wang, C., Tan, M., & Chen, P. (2020). A corrected goodness-of-fit index (CGFI) for model evaluation in structural equation modeling. *Structural Equation Modeling*, 27(5), pp. 735-749. doi: 10.1080/10705511.2019.1695213
- Wang, Z., Sharma, P. N., & Cao, J. (2016). From knowledge sharing to firm performance: A predictive model comparison. *Journal of Business Research*, 69(10), pp. 4650-4658. doi: 10.1016/j.jbusres.2016.03.055
- Wei, P., & Yang, J. (2010). Causes of delay in the planning and design phases for construction projects. *Journal of Architectural Engineering*, 16(2), pp. 80-83. doi: 10.1061/(asce)1076-0431(2010)16:2(80)
- Westerman, G., Bonnet, D., & McAfee, A. (2014). Leading Digital. In Harvard Business Review. Harvard Business Review Press.
- Westley, F., & Mintzberg, H. (1989). Visionary leadership and strategic management. *Strategic Management Journal*, 10(Summer), pp. 17-32. Available at <http://www.jstor.org/stable/2486580>. doi: 10.1002/smj.4250100704
- White, A., & Rollings, M. (2021). *5 Key Actions for IT Leaders for Better Decisions*.
- Yasmin, M., Tatoglu, E., Kilic, H. S., Zaim, S., & Delen, D. (2020). Big data analytics capabilities and firm performance: An integrated MCDM approach. *Journal of Business Research*, 114(March), pp. 1-15. doi: 10.1016/j.jbusres.2020.03.028
- Yukl, G., Chavez, C., & Seifert, C. F. (2005). Assessing the construct validity and utility of two new influence tactics. *Journal of Organizational Behavior*, 26(6), pp. 705-725. doi: 10.1002/job.335

Appendix 1

No.	Indicators	Loading factor >0.5	Cronbach's alpha >0.6	AVE >0.5
1	BCM1 ≤ BDAC compatibility	0.806	0.846	0.765
2	BCM2 ≤ BDAC compatibility	0.923		
3	BCM3 ≤ BDAC compatibility	0.892		
4	BCO1 ≤ BDAC coordination	0.883	0.738	0.659
5	BCO2 ≤ BDAC coordination	0.858		
6	BCO3 ≤ BDAC coordination	0.679		
7	BMD1 ≤ BDAC modularity	0.975	0.948	0.950
8	BMD2 ≤ BDAC modularity	0.974		
9	BPL1 ≤ BDAC planning	0.957	0.914	0.921
10	BPL2 ≤ BDAC planning	0.962		
11	BRK1 ≤ BDAC relational knowledge	0.922	0.786	0.823
12	BRK2 ≤ BDAC relational knowledge	0.892		
13	BTK1 ≤ BDAC technical knowledge	0.950	0.899	0.909
14	BTK2 ≤ BDAC technical knowledge	0.956		
15	DMC1 ≤ DM commitment	0.843	0.885	0.814
16	DMC2 ≤ DM commitment	0.922		
17	DMC3 ≤ DM commitment	0.938		
18	DMQ1 ≤ DM quality	0.904	0.789	0.710
19	DMQ2 ≤ DM quality	0.901		
20	DMQ3 ≤ DM quality	0.709		
21	DMR2 ≤ DM rationality	0.929	0.849	0.869
22	DMR3 ≤ DM rationality	0.935		
23	FCL1 ≤ FS low cost leadership	0.669	0.693	0.620
24	FCL2 ≤ FS low cost leadership	0.892		
25	FCL3 ≤ FS low cost leadership	0.785		
26	FMC1 ≤ FS (market competition)	0.937	0.923	0.867
27	FMC2 ≤ FS (market competition)	0.906		
28	FMC3 ≤ FS (market competition)	0.950		
29	FMS1 ≤ FS (marketing strategy)	0.677	0.790	0.711
30	FMS2 ≤ FS (marketing strategy)	0.898		
31	FMS3 ≤ FS (marketing strategy)	0.932		
32	ISE1 ≤ IS (effective information exchange)	0.890	0.712	0.656
33	ISE2 ≤ IS (effective information exchange)	0.924		
34	ISE3 ≤ IS (effective information exchange)	0.568		
35	ISH1 ≤ IS (human resources capability)	0.544	0.673	0.619
36	ISH2 ≤ IS (human resources capability)	0.868		
37	ISH3 ≤ IS (human resources capability)	0.900		
38	ISI1 ≤ SM (identification stakeholder need)	0.820	0.778	0.690
39	ISI2 ≤ SM (identification stakeholder need)	0.826		
40	ISI3 ≤ SM (identification stakeholder need)	0.847		
41	ISV1 ≤ IS (involvement in project)	0.891	0.803	0.725
42	ISV2 ≤ IS (involvement in project)	0.926		
43	ISV3 ≤ IS (involvement in project)	0.724		

(Continued)

Appendix 1: Continued

No.	Indicators	Loading factor >0.5	Cronbach's alpha >0.6	AVE >0.5
44	FPF1 ≤ FP finance	0.599	0.752	0.672
45	FPF2 ≤ FP finance	0.888		
46	FPF3 ≤ FP finance	0.932		
47	FPN1 ≤ FP non-finance	0.859	0.846	0.765
48	FPN2 ≤ FP non-finance	0.907		
49	FPN3 ≤ FP non-finance	0.857		

AVE, average variance extracted; BDAC, big data analytic capability; DM, decision-making; FP, firm performance; FS, formulation of strategy; IS, implementation of strategy.