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Is information quality a key factor in improving competitive advantages and performance of engineering, procurement and construction companies?

Abstract. The study examines the effect of information quality on competitive advantage and company performance. This is a survey study conducted in engineering, procurement and construction (EPC) companies in Indonesia throughout the year 2020. Out of 189 questionnaires submitted to 63 EPC companies, 96 questionnaires from 49 companies were returned and processed.

The unit of analysis is the organization, and the directors of the company are the respondents. The research instrument was built based on the operationalisation of variables developed by previous research. The research results are explained descriptively and verified by using structural equation modelling (SEM). The data were processed with the use of the LISREL 8.8 statistical software.

The results showed that information quality had a significant positive effect on the company's competitive advantage, but did not have a significant effect on the company's performance. Information quality can have a positive impact on the company's performance when mediated by the company's competitive advantage. Other findings show that the company's competitive advantage has a significant impact on its performance. The findings indicate that EPC companies in Indonesia need information quality to create corporate excellence. A competitive advantage can also improve the company's performance. EPC companies should invest heavily in IT, because information quality is the biggest determining factor in increasing their competitive advantage and performance, particularly as the application of artificial intelligence technology can be an alternative solution in the increasing competitiveness with the global EPC firms.

Keywords: Information Quality; Competitive Advantage; Company Performance; EPC Companies

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Чи є якість інформації ключовим фактором у покращенні конкурентних переваг та ефективності діяльності інженерних, закупівельних і будівельних компаній?

Анотація. У роботі розглянуто вплив якості інформації на конкурентні переваги та результати діяльності компанії. Дослідження виконано шляхом опитування представників інженерних, закупівельних та будівельних компаній в Індонезії у 2020 році. Одиницею аналізу виступає організація, у той час як респондентами є директори компаній. Інструмент дослідження був побудований на основі операціоналізації змінних. Результати дослідження подаються на рівні описових пояснень та перевіряються за допомогою моделювання структурних рівнянь. Дані були оброблені за допомогою статистичного програмного забезпечення LISREL 8.8. Результати аналізу показали, що якість інформації має значний позитивний вплив на конкурентну перевагу компанії, але на результати діяльності компанії впливає несуттєво. Якість інформації може позитивно вплинути на результати діяльності компанії, якщо вона пов'язана з конкурентними перевагами компанії. Дослідження показує, що конкурентні переваги компанії мають значний вплив на результати діяльності компанії. Авторами було визначено, що інженерні, закупівельні та будівельні компанії в Індонезії потребують якості інформації для створення корпоративної досконалості. Конкурентні переваги також можуть покращити результати діяльності компанії.
Ключові слова: якість інформації; конкурентні переваги; продуктивність компанії; інженерні, закупівельні та будівельні компанії.

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Является ли качество информации ключевым фактором повышения конкурентных преимуществ и эффективности инженерных, закупочных и строительных компаний?

Аннотация. В работе рассмотрено влияние качества информации на конкурентное преимущество и эффективность компании. В основе исследования лежит опрос, проведенный в инженерных, закупочных и строительных компаниях в Индонезии в 2020 году. Единицей анализа является организация, в то время как респондентами выступают директора компаний. Инструмент исследования был построен на основе операционализации переменных. Результаты исследования имеют описательный характер и проверяются при помощи моделирования структурных уравнений (SEM). Обработка данных была осуществлена путем использования статистической программы LISREL 8.8. Результаты проведенного анализа показали, что качество информации имело существенное положительное влияние на конкурентное преимущество компании, однако значительного влияния на результаты деятельности компании оно не имело. Качество информации может положительно влиять на результаты деятельности компании, если оно связано с конкурентным преимуществом компании. Результаты исследования показывают, что конкурентное преимущество компании оказывает значительное влияние на ее результаты. Авторами было установлено, что инженерным, закупочным и строительным компаниям в Индонезии качество информации необходимо для достижения корпоративного совершенства. Конкурентные преимущества также могут улучшить работу компании.
Ключевые слова: качество информации; конкурентное преимущество; эффективность компании; инженерные, закупочные и строительные компании.

1. Introduction

In the last few decades, the government of Indonesia has begun to focus on carrying out development in the industrial sector. Industrial sector jobs require providers of goods and services to specialize, because of the high complexity of this project (Gunarso & Sungkono, 2018; Gao et al., 2021). According to Kabirifar and Mojtahedi (2019), construction projects generally involve multiple tasks that are so complex and fragmented that they must be carried out by multiple professionals and non-professionals in the life cycle of the project, which includes engineering, procurement and construction (EPC) phases that must be supported by technology information to compete with other EPC companies. According to the study by Bagus (2018), the development of the EPC industry in recent years has faced difficulties due to the decline in global project demand. The oil and gas sectors are an example of this; low oil prices have forced the delay or termination of most major energy projects. Although prices are slowly recovering, most oil companies are still cautious about spending capital on new projects. The construction industry, meanwhile, is faced with a process dilemma that causes the company's performance to be poor, including lack of quality information owned by the company (Bagus, 2018; Zhang & Gong, 2021).

To face an increasingly competitive market, EPC companies with limited resources require new strategies to capture markets. PricewaterhouseCoopers (PwC, 2017) noted that, in recent decades, there have been very large migrations related to EPC project contracts from lump-sum to turnkey contracts, in which the EPC company bears the overall risk of project costs in ensuring the project's operational readiness. EPC company clients in both the private and public sectors prefer to play it safe in calculating the actual cost of the project and also benefit from greater competition for price quotes, which leaves greater room for negotiation. For this reason, EPC companies must use information technology (IT) to develop new strategies to capture markets (Putra, & Winoto, 207; Adeleke et al., 2019; Lee & Chong, 2021). According to Boyer and Lewis (2009), the best strategy is to continue to improve the company's IT competence to maintain competitiveness and continued profitability. Global competition requires EPC companies in Indonesia to prepare innovative new strategies. One of the strategies, according to PwC (2017), is to build a digital cooperation platform to strengthen the quality of company data and information. This is reinforced by Mulyani (2019), who noted that any data can be used as input to produce information. Data can be in the form of material for discussion, decision-making, calculation or measurement. Information is the result of data processing that provides meaning and benefits. Quality information is the result of data processing and related facts that are processed to suit the needs of its users. This can help users in making decisions (Djanegara et al., 2018; Mulyani, 2019). Information quality is inseparable from the quality of the information system used by the company (Mulyani et al., 2019; Gao et al., 2021).

According to Alrayes (2015), data quality and systems play a central role in company performance. Given the importance of system and data quality, the application of a technology digitalization strategy becomes a necessity in an increasingly competitive environment. Does this apply also to EPC companies? Previous studies (Al-Mamary et al., 2014; Alrayes, 2015; Argyropoulou et al., 2018; Azemi et al., 2018; Makau et al., 2017; Nyaboga & Mwaura, 2011; Gao et al., 2021) have not provided specific empirical evidence when discussing the correlation between information quality and both competitive advantage and EPC company performance. For this reason, this study is necessary to present empirical evidence of the influence, both direct and indirect, of information quality on competitive advantage and EPC company performance in Indonesia.

2. Hypothesis Development

The strong relationships found to theory and empirical studies of the research variables are illustrated a framework for developing research hypotheses, as shown in Figure 1. Several studies have proven these relationships. Nyaboga and Mwaura (2011) found that information systems using raw data input will produce quality data products, which are used in corporate decision-making to stay competitive. Lee and Chong (2021), and Azemi et al. (2018) concluded that the quality of information produced can improve the decision-making process so that companies can continue to compete. Al-Mamary et al., (2014) explained that systems using modern technology can present information to users in a format that is easily understood and can be used effectively to overcome the competition. The following hypothesis can be proposed:

H1: Information quality has a positive influence on company competitive advantage.
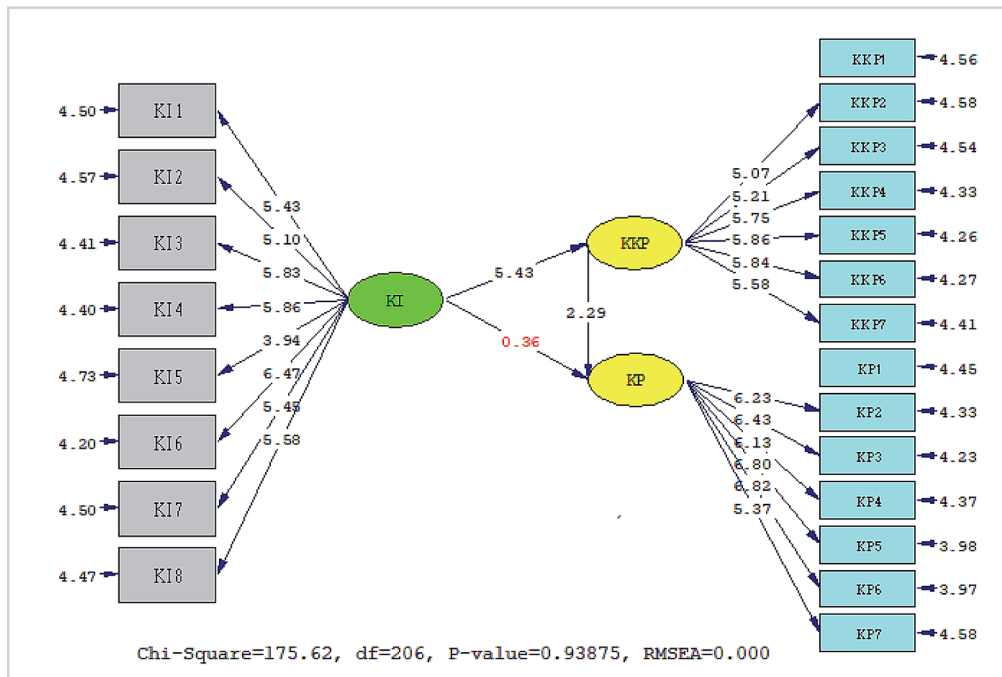
Figure 1:
Full Model-Loading Factors
Source: Compiled by the authors

Research on the influence of information quality and firm performance has tended towards the conclusion that the two variables have a positive correlation. Dunk (2004) found that better information quality has been recognized in previous studies as a supporting factor in increasing company productivity and performance. Sami (2011) showed that organizations are increasingly aware of the importance of having quality information in overcoming environmental uncertainty. These findings indicate that information quality is an important factor in improving company performance. Makau et al., (2017) concluded that companies need to align their supply chain practices with the level of information quality to achieve improved business performance. Argyropoulou et al., (2018) concluded there is a strong correlation between information quality and organizational performance according to both financial and non-financial measures. The following hypothesis can thus be proposed:

H2: Information quality has a positive influence on EPC Performance.

Majeed (2011) found that competitive advantage has an impact on organizational performance in educational institutions in Kenya. Al-Rfou (2012) found that when companies face high competition, they try to satisfy their customers by producing high quality products, which leads to a higher level of organizational performance (Sar, 2017; Gao et al., 2021; Lee & Chong, 2021). Potjanajaruwit (2018) showed that competitive advantage has a significant influence on organizational performance, both directly and indirectly through the use of IT. It can thus be hypothesized that:

H3: A company's competitive advantage has a positive influence on EPC performance.

Dunk (2004) found that better information quality has been recognized in previous studies as a factor that can support increased organizational productivity and performance. Redman (1998) explained that the impact of poor data and information quality can lead to a decline in corporate competitive advantage. Argyropoulou et al. (2018) concluded that there is a relationship between information quality and organizational performance in both financial and non-financial measures. Azemi et al. (2018), and Zhang and Gong (2021) concluded that information quality is an important aspect in information management because it will determine the quality of information produced and developed in an organization. It can thus be hypothesized that:

H4: Information quality has a positive influence on EPC Performance through the company's competitive advantage.

3. Research Methodology

This research is a quantitative study using a survey approach conducted with 49 EPC companies in Indonesia. The research respondents were the companies' boards of directors. Data were collected using a questionnaire instrument using a purposive sampling technique. Data

were based on 8-point ordinal rating. Statements compiled started from the statement «worst» to «very good», and the results were then converted into five categories. The research results are explained descriptively and verified. Mean scores, standard deviations and respondents' demographics are presented, while the correlation between variables is assessed to prove the research hypotheses. Verification analysis or inferential statistical analysis uses a modelling concept approach called structural equation modelling (SEM). Data is processed using LISREL 8.8 statistical software.

4. Resulted and Discussion

4.1. Profile of Respondents

The data collection process was carried out for 30 days. The questionnaire form was sent electronically via email, then the respondents sent back the completed questionnaire. There was no face-to-face process in collecting the research data. Of the 189 questionnaires submitted to 63 EPC companies, 96 questionnaires from 49 companies were returned, and all of them could be processed. The response rate was 77.8%. This data is sufficient for analysis according to Cooper and Schindler (2014), who found that, with a return rate of 30%, the questionnaire can be declared good.

Respondents who participated in this study (see Table 1) included managing directors ($n = 54$; 56%), operations directors ($n = 6$; 6%), finance directors ($n = 18$; 19%) and business directors ($n = 18$; 19%) of EPC companies. In terms of gender, the majority of respondents are men ($n = 89$; 93%), while there were only 7 women respondents (7%). Based on age, most were aged over 40 years ($n = 88$; 92%), there were only 8 respondents aged 23-40 (8%). In terms of level of education most respondents held a Bachelor's degree ($n = 60$; 63%), while a third held a master's degree ($n = 32$; 33%) and 4 respondents had completed a doctorate (4%). Around one third of respondents had worked for 21-30 years ($n = 32$; 34%), under 10 years ($n = 31$; 32%) and 10-20 years ($n = 30$; 31%), while the remaining 3 respondents (3%) had worked for more than 30 years.

4.2. Descriptive Statistics

The descriptive analysis of the variables in this study used the average score categorized into five interval scales. The research variables have good average scores (see Table 1); for information quality, the average score is very good (6.69 of a scale of 8), with a standard deviation of .88. Competitive advantage showed a good average score (6.51 from a scale of 8) with a standard deviation of .82, while EPC performance also showed a good average score (6.41 from a scale of 8) with a standard deviation of 1.13.

4.3. Instrument Validity and Reliability

Validity testing measures whether or not the research instrument is valid (Riadi, 2018). The validity test results in this study (see Table 2) show the results of the factor loading values for the indicators. If these values are greater than .50, the indicators can be considered good in measuring their latent constructs (Riadi, 2018). In this case, all three variables met this criterion, shown in Table 2.

Meanwhile, to test reliability (see Table 3), we measured construct reliability (CR) and variance extracted (VE; Riadi, 2018). The CR and VE values of each variable are: information quality, .91 and .57; competitive advantage, .92 and .63; and EPC performance: .95 and .87, respectively. All variables have composite reliability with CR values and VE values that meet the rule of thumb of .70 and .50, respectively (Riadi, 2018; Zhang & Gong, 2021).

Table 1:
Descriptive Statistics and Variable Scoring

No	Variables	Mean Score	Standard deviation	Criteria
1	INFORMATION QUALITY [KI]	6.69	.88	Very good
2	COMPETITIVE ADVANTAGE [KKP]	6.51	.82	Good
3	EPC PERFORMANCE [KP]	6.41	1.13	Good

Note: Criteria score: (1) 1.00-2.40, Worst; (2) 2.41-3.80, Bad; (3) 3.81-5.20, Fair; (4) 5.21-6.60, Good; (5) 6.61-8.00, Very good.

Source: Data processed (2020)

4.4. Goodness of Fit Model Testing

Before testing the structural model, the model in the study was first tested for the Goodness of Fit Index (GOFI; Riadi, 2018) to determine whether the proposed model is compatible with the sample data. If there are more than five GOF indicator values accepted, then the model is declared fit. Another measure can be seen from the absolute value of the fit index from the value of the chi-square or RMSEA model accepted (Riadi, 2018; Zhang & Gong, 2021). The test results in Table 4 show that the values of NFI, NNFI, CFI, IFI, RFI and GFI are greater than or equal to .90, indicating the compatibility of the model. The RMSEA value of .0000 is smaller than .08, and the chi-square value for the p-value .9387 is greater than 0.5. That is, the suitability of the model is very fit. The SRMR value of .07 is greater than .05, indicating that this model is incompatible, and AGFI has a value less than .90, indicating the incompatibility of that model.

Based on a combination of measurements for the whole model, it can be concluded that the model in this study is fit. Structural testing was then undertaken to examine the relationship of exogenous latent variables to endogenous latent variables. The test results later determine whether the research hypotheses are accepted or rejected (see Table 3).

4.5. Research Hypothesis Testing

To test the research hypotheses, SEM can illustrate the value of the loading factors between latent variables. This study uses a 95% confidence level and a 5% error tolerance, with one-tailed hypothesis testing; the critical value used for the t-count is 1.64. The LISREL results are shown in Figure 1, and Figure 2 shows that one hypothesis is rejected and one hypothesis is accepted. A summary of the results of hypothesis testing is shown in Table 4. The results of the measurement of the path coefficient for LISREL show that *EPC company competitive advantage* is only affected by *backward integration* with the calculation results of KKP = .54 * BI + .30 * FI, Errorvar. = .37, R^2 = .63. Meanwhile, together *EPC company competitive advantage* is influenced

Table 2:
Instrument Validity and Reliability Test Results

Indicator	*SFL ≥ .50	**CR ≥ .70	***VE ≥ .50	Result	Indicator	*SFL ≥ .50	**CR ≥ .70	***VE ≥ .50	Result
KI		.91	.57	**Reliable**	**KKP**		.92	.63	**Reliable**
KI1	.79			Valid	KKP1	.70			Valid
KI2	.72			Valid	KKP2	.79			Valid
KI3	.64			Valid	KKP3	.79			Valid
KI4	.78			Valid	KKP4	.78			Valid
KI5	.86			Valid	KKP5	.84			Valid
KI6	.78			Valid	KKP6	.87			Valid
KI7	.69			Valid	KKP7	.76			Valid
KI8	.74			Valid					
KP		.95	.87	**Reliable**					
KP1	.67			Valid					
KP2	.90			Valid					
KP3	.72			Valid					
KP4	.82			Valid					
KP5	.85			Valid					
KP6	.65			Valid					
KP7	.74			Valid					

Note: *SFL = Standardized Factor Loading; **CR = Construct Reliability; ***VE = Variance Extracted.

Source: Data processed (2020)

Table 3:
Goodness of Fit Index Results

No	Measurement Indicators	Critical Value	Estimation value	Conclusion result
1	Chi-square	*p-value* ≥ .05	0.9387	Fit
2	RMSEA	RMSEA ≤ .08	0.0000	Fit
3	NFI	NFI ≥ .90	.91	Fit
4	NNFI	NNFI ≥ .90	.95	Fit
5	CFI	CFI ≥ .90	.97	Fit
6	IFI	IFI ≥ .90	.97	Fit
7	RFI	RFI ≥ .90	.91	Fit
8	SRMR	SRMR ≤ .05	.07	Not Fit
9	GFI	GFI ≥ .90	.95	Fit
10	AGFI	AGFI ≥ .90	.84	Not Fit

Source: Data processed (2020)

Table 4:
Summary of Hypothesis Testing

No	Path	Hypotheses Testing		Coefficient of Effect (R^2)			Hypothesis Conclusion
		Path Coefficient	Critical Value	Direct	Indirect	Total	
	Study 1 (direct effect)						
1	KI → KKP	5.43	1.64	.92		.92	Accepted
2	KI→ KP	.36	1.64	.14		.14	Rejected
3	KKP → KP	.29	1.64	.98		.98	Accepted
	Study 2 (mediation effect)						
4	KI → KKP → KP	7.45	1.64	.14	(.14*.98)= .14	.28	Accepted

Source: Data processed (2020)

by *backward integration* and *forward integration* by 63%. This can be seen from the value of R-Square (R^2) generated at .63. With structural equation values: KKP = .92 * KI, Errorvar. = .15, R^2 = .85, and KP = .98 * KKP + .14 * KI, Errorvar. = .28, R^2 = .72.

The results of testing the structural model as shown in Table 4, can be explained as follows. The first hypothesis shows that the information quality (KI) path coefficient score for competitive advantage (KKP) of 5.43 is greater than the critical value of 1.64. At the 95% confidence level and α = 5%, then the null hypothesis is rejected and H1 is accepted, and it can be concluded that the coefficient of the direct effect of KI on KKP is significant with a coefficient of R^2 at .92. That is, the first hypothesis which states that there is a positive and significant influence of information quality on competitive advantage ***can be accepted***. The second hypothesis shows that the path coefficient score of the information quality (KI) variable against EPC performance (KP) is .36 smaller than the critical value of 1.64. At the 95% confidence level and α = 5%, then the null hypothesis is accepted and H2 is rejected, and it can be concluded that the coefficient of KI's direct influence on KP is not significant with a coefficient of determination R^2 at .14. That is, the second hypothesis which states that there is a positive and significant influence of information quality on EPC performance is ***rejected***.

For the third hypothesis, the competitive advantage (KKP) variable path coefficient for EPC performance (KP) of 2.29, which is greater than the critical value of 1.64. At the 95% confidence level and α = 5%, the null hypothesis is rejected and H3 is accepted, and it can be concluded that the coefficient on the direct influence of KKP on KP is significant with a coefficient of determination
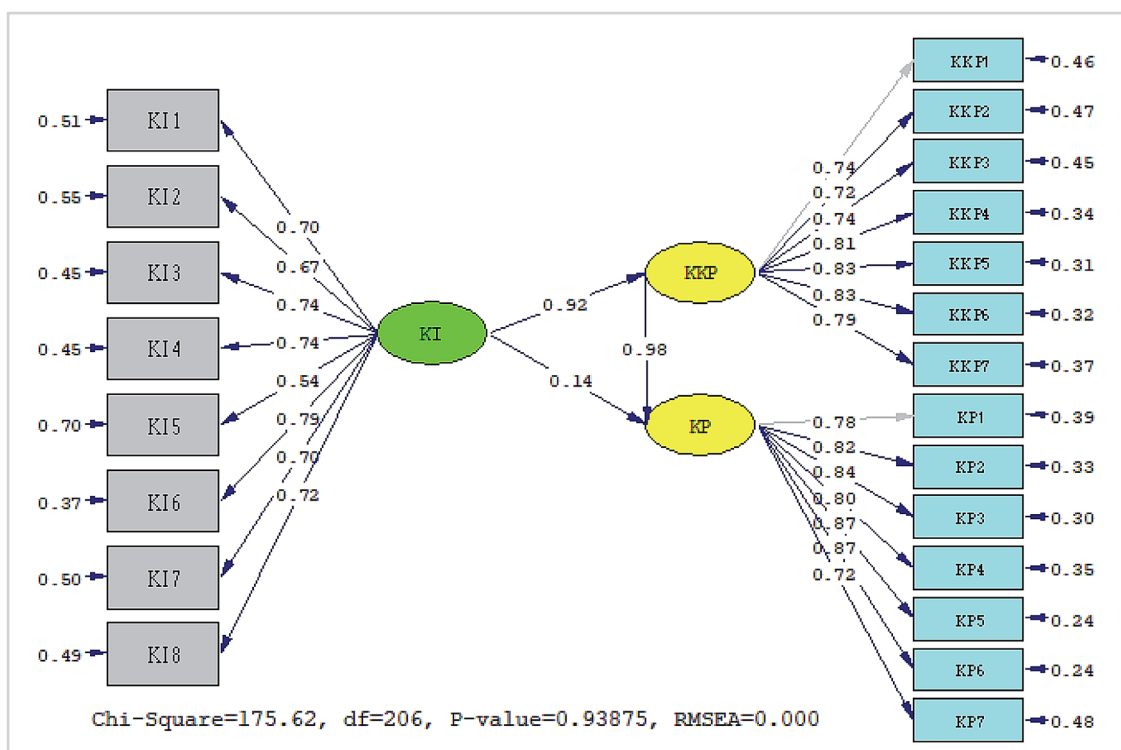

Figure 2:
Full Model: Path Coefficients
Source: Compiled by the authors

R^2 of .98. That is, the third hypothesis, which states that there is a positive and significant influence competitive advantage on EPC performance, *can be accepted*. For the fourth hypothesis, the path coefficient score of the information quality (KI) variable against EPC performance (KP) through competitive advantage (KKP) is 7.45, which is greater than the critical value of 1.64. At the 95% confidence level and α = 5%, the null hypothesis is rejected and H4 is accepted, and it can be concluded that the coefficient of indirect effect of KI on KP through KKP is significant with a coefficient of determination R^2 of .28. That is, the fourth hypothesis, which states that there is a positive and significant influence of information quality on EPC performance through competitive advantage, *can be accepted*.

5. Conclusion

Information quality has a major impact on a company's competitive advantage. Quality information about project specifications is needed by the EPC company so that the results of its engineering can be more reliable. Internal and external information must be obtained quickly and systematically, so that all aspects can be calculated and the risks mitigated to encourage improved performance. Information quality has a positive influence on company performance through the company's competitive advantage. Information quality is important for companies to maintain high quality work results, which will in turn affect the company's competitive advantage and have a positive effect on improving the company's financial and non-financial performance. Empowering information sources with backward integration makes it possible to see the actual external information needed, which is important for EPC companies. High quality information is needed when entering into a binding agreement during the proposal period with subcontractors and suppliers, as this will ensure more competitive pricing. EPC companies must have the courage to invest heavily in IT, because information quality is the biggest determining factor in increasing a company's competitive advantage and performance, particularly as the application of artificial intelligence technology can be an alternative solution in the increasing competitiveness of global EPC.

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