


THE IMPACT OF INTELLECTUAL CAPITAL ON OPERATIONAL PERFORMANCE IN
JORDANIAN SERVICE COMPANIES: EVIDENCE FROM THE AMMAN STOCK
EXCHANGE

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ARTICLE INFO	ABSTRACT
<p>Article history:</p> <p>Received 20 June 2023</p> <p>Accepted 14 September 2023</p>	<p>Purpose: This study seeks to determine how intellectual capital (IC) affects the operational effectiveness of service companies listed on the Jordanian Amman Stock Exchange (ASE).</p>
<p>Keywords:</p> <p>Intellectual Capital; Operational Performance; Jordanian Service Companies; Amman Stock Exchange; Jordan.</p>	<p>Theoretical framework: The study is based on the concept of intellectual capital, which encompasses human capital, structural capital, and relational capital. These dimensions are examined to understand their influence on operational performance.</p>
	<p>Design/Methodology/Approach: The study population consists of 40 service companies listed on the ASE, with a sample of 22 companies selected for analysis. Data collection relied on secondary sources, including reports and bulletins issued by the ASE between 2017 and 2021. Regression analysis is used in the study to look at the connections between several operational performance metrics and intellectual capital.</p> <p>Findings: The findings reveal that human capital and structural capital have a significant positive impact on operational flexibility. Human capital and relational capital significantly influence cost efficiency. Structural capital, company size, and company age show significant effects on the inventory turnover rate. Human capital positively affects the asset turnover rate, while structural and relational capital do not exhibit significant effects.</p> <p>Research, Practical & Social implications: This study offers insightful information about the connection between intellectual property and operational effectiveness in service businesses listed on the ASE. The findings have practical implications for enhancing operational capabilities and efficiency within these organizations. Additionally, the study contributes to the existing knowledge on intellectual capital's impact on operational performance and fills a gap in the understanding of this relationship in the Jordanian context.</p> <p>Originality/Value: This study is one of the first to investigate how intellectual capital affects the performance of operational aspects in service businesses listed on the ASE</p>

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in Jordan. By focusing on the unique characteristics of the Jordanian market, the study adds to the body of knowledge and advances knowledge of the function that intellectual capital plays in influencing operational success.

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O IMPACTO DO CAPITAL INTELECTUAL NO DESEMPENHO OPERACIONAL DAS EMPRESAS DE SERVIÇOS JORDANAS: EVIDÊNCIAS DA BOLSA DE AMÃ

RESUMO

Objetivo: Este estudo busca determinar como o capital intelectual (IC) afeta a eficácia operacional das empresas de serviços listadas na Bolsa de Valores de Amã Jordaniã (ASE).

Estrutura teórica: O estudo é baseado no conceito de capital intelectual, que engloba capital humano, capital estrutural e capital relacional. Essas dimensões são examinadas para compreender sua influência no desempenho operacional.

Projeto/Metodologia/Abordagem: A população do estudo é composta por 40 empresas de serviços listadas na ASE, com uma amostra de 22 empresas selecionadas para análise. A coleta de dados baseou-se em fontes secundárias, incluindo relatórios e boletins emitidos pela ASE entre 2017 e 2021. A análise de regressão é usada no estudo para analisar as conexões entre várias métricas de desempenho operacional e capital intelectual.

Conclusões: As conclusões revelam que o capital humano e o capital estrutural têm um impacto positivo significativo na flexibilidade operacional. O capital humano e o capital relacional influenciam significativamente a eficiência de custos. O capital estrutural, o tamanho da empresa e a idade da empresa mostram efeitos significativos na taxa de rotatividade do estoque. O capital humano afeta positivamente a taxa de rotatividade de ativos, enquanto o capital estrutural e relacional não exibem efeitos significativos.

Pesquisa, Implicações práticas e Sociais: Este estudo oferece informações perspicazes sobre a conexão entre propriedade intelectual e eficácia operacional em empresas de serviços listadas na ASE. As descobertas têm implicações práticas para aprimorar os recursos operacionais e a eficiência nessas organizações. Além disso, o estudo contribui para o conhecimento existente sobre o impacto do capital intelectual no desempenho operacional e preenche uma lacuna na compreensão desse relacionamento no contexto jordaniano.

Originalidade/Valor: Este estudo é um dos primeiros a investigar como o capital intelectual afeta o desempenho de aspectos operacionais em empresas de serviços listadas na ASE na Jordânia. Ao se concentrar nas características únicas do mercado jordaniano, o estudo acrescenta ao corpo de conhecimento e avança o conhecimento da função que o capital intelectual desempenha para influenciar o sucesso operacional.

Palavras-chave: Capital Intelectual, Desempenho Operacional, Sociedades de Serviços Jordanianas, Bolsa de Amã, Jordânia.

EL IMPACTO DEL CAPITAL INTELECTUAL EN EL DESEMPEÑO OPERATIVO DE LAS EMPRESAS DE SERVICIOS JORDANAS: EVIDENCIA DE LA BOLSA DE AMÁN

RESUMEN

Objetivo: Este estudio busca determinar cómo afecta el capital intelectual (CI) la eficacia operativa de las empresas de servicios que cotizan en la Bolsa de Valores de Ammán (ASE) jordana.

Marco teórico: El estudio se basa en el concepto de capital intelectual, que engloba el capital humano, el capital estructural y el capital relacional. Estas dimensiones se examinan para comprender su influencia en el desempeño operativo.

Diseño/Metodología/Enfoque: La población de estudio está conformada por 40 empresas de servicios que cotizan en la ASE, con una muestra de 22 empresas seleccionadas para su análisis. La recopilación de datos se basó en fuentes secundarias, incluidos informes y boletines emitidos por la ASE entre 2017 y 2021. El análisis de regresión se utiliza en el estudio para observar las conexiones entre varias métricas de desempeño operativo y capital intelectual.

Resultados: Los resultados revelan que el capital humano y el capital estructural tienen un impacto positivo significativo en la flexibilidad operativa. El capital humano y el capital relacional influyen significativamente en la eficiencia de costos. El capital estructural, el tamaño de la empresa y la edad de la empresa muestran efectos significativos en la tasa de rotación de existencias. El capital humano afecta positivamente la tasa de rotación de activos, mientras que el capital estructural y relacional no exhiben efectos significativos.

Investigación, Implicaciones prácticas y Sociales: Este estudio ofrece información perspicaz sobre la conexión entre la propiedad intelectual y la eficacia operativa en las empresas de servicios enumeradas en la ASE. Las conclusiones tienen consecuencias prácticas para mejorar la capacidad operacional y la eficiencia de esas

organizaciones. Además, el estudio contribuye al conocimiento existente sobre el impacto del capital intelectual en el desempeño operativo y llena una brecha en la comprensión de esta relación en el contexto jordano.

Originalidad/Valor: Este estudio es uno de los primeros en investigar cómo el capital intelectual afecta el rendimiento de los aspectos operativos en las empresas de servicios que figuran en la ASE en Jordania. Al centrarse en las características únicas del mercado jordano, el estudio se suma al cuerpo de conocimientos y avanza el conocimiento de la función que el capital intelectual desempeña en la influencia del éxito operativo.

Palabras clave: Capital Intelectual, Rendimiento Operativo, Compañías de Servicios Jordanas, Bolsa de Ammán, Jordania.

INTRODUCTION

Intellectual capital (IC), a concept that emerged in the early 1990s, has gained recognition as a crucial driver of wealth creation, innovation, and development in the knowledge-based economy (Kanti, 2016). It encompasses knowledge, information, experience, and skills pivotal in technological advancements and service-oriented activities. The value of intangible assets, including IC, has surpassed that of tangible assets, highlighting its growing importance (Baima et al., 2021).

However, the need for a standardized measurement method poses a challenge, particularly in regional and local contexts. This study aims to address this issue by investigating the impact of IC on the operational performance of service companies listed on the ASE, shedding light on its significance in this specific setting (Malahim et al., 2023).

To achieve this objective, the study formulates several research questions. First, it examines whether IC and its dimensions significantly influence the operational flexibility of service companies listed on the ASE. Second, the study explores the extent to which IC, including its dimensions, affects the cost efficiency of these companies. Third, it investigates the discernible effect of IC, including its dimensions, on the inventory turnover rate. Finally, the study examines the relationship between IC, including its dimensions, and the asset turnover rate in service companies listed on the ASE (Malahim, 2023).

This study aims to provide insight into the relationship between IC and operational performance in Jordanian service companies by addressing these research questions. These insights will be beneficial for practitioners and researchers in the field, assisting Jordanian's service company management in harnessing the potential of IC to enhance operational performance. Furthermore, the study evaluates the efficiency of individuals working within service companies and offers recommendations to enhance their capabilities, ultimately leading to improved overall performance (Alnabulsi & Salameh, 2021; Sardo et al., 2018).

Additionally, it sheds light on the impact of expenses on companies and highlights the positive influence such insights can have on operational performance (Alabood et al., 2023; Navas et al. 2019). Overall, this study aims to contribute to the existing knowledge and provide actionable recommendations to enhance the performance and efficiency of service companies in the Jordanian context.

The remainder of this study unfolds as follows: The next section provides a comprehensive literature review synthesizing existing research in the field. Subsequently, this study's methodology and data analysis are elucidated, clarifying the research approach and analytical techniques. Following this, the descriptive study and hypotheses testing are presented, providing an in-depth exploration of the variables under investigation and testing the proposed hypotheses. Finally, concluding remarks summarize the key findings, implications, and potential areas for future research.

LITERATURE REVIEW

The concept of IC lacks a consensus due to variations in its definition across industries and departments within organizations. Researchers often use their definitions without a unified agreement (Schebesch et al. 2014).

Edvinsson and Malone defined IC as the repository of expertise, skills, and customer relationships that give organizations a competitive advantage in the market (Thiagarajan & Baul 2011). Stewart described intellectual capital (IC) as the knowledge, information, and property a corporation uses to create wealth (Özsari 2021).

In addition, IC entails the possession of knowledge, real-world experience, organizational innovation, client relationships, and professional skills that benefit the organization (Schebesch & Şoim, 2014).

IC was also identified as a resource base that enables organizations to compete and enhance performance, comprising human, structural, and relational capital. In the context of a knowledge economy, IC is recognized as a significant driver for improving corporate competitiveness and value generation (Guthrie & Dumay 2012).

IC plays a crucial role in capturing innovation within business environments. It can be understood as the organization's capacity to innovate and demonstrate its value (Mouboukila-Poha, 2018). As a significant intangible asset, IC enables the company to gain competitive advantages that generate value and enhance its position relative to competitors (Ortiz García Navas et al. 2019).

Research has highlighted that effectively creating, organizing, and harnessing a company's collective knowledge across human resources, infrastructure, and relational domains can form a fundamental strategy for its survival and long-term sustainability. Recognizing IC as a pertinent factor in the modern economy is essential (Schebesch & Şoim 2014).

While researchers may differ in their perspectives, Edvinsson and Malone (1997) have identified the components of IC as follows:

Human Capital: Human capital constitutes a fundamental aspect of IC, improving society's productive capacity and local production.

Economists recognize it as a primary element due to its immense potential.

Human resources equip workers with skills and improve their efficiency through training and motivation. Such positive impacts on employees lead to reduced time, effort, and costs, ultimately increasing productivity.

The market value of high-quality human capital is significant, and investments in inventions that address customer needs and desires can contribute to customer satisfaction (Wikhamn, 2019).

Structural capital includes a company's strategy, databases, operations management, organizational planning, corporate approaches, and support for both employee and business performance (Vrontis & Graziano, 2021).

It includes both organizational activity and technology capital. Technical systems and manufacturing processes are directly tied to technological capital (Stilll & Russell, 2014).

The organizational framework and processes used to acquire goods and services are known as structural capital. It includes all of the organization's non-human knowledge and supports its human capital (Wang et al. 2014). Additionally, according to Buenechea-Elberdin (2017) and Kanakriyah et al. (2017), structural capital refers to a group of actions that unify an organization as well as technologies, inventions, data, publications, strategies, cultures, structures, and systems.

Relational Capital: Relational capital pertains to the level and quality of customer relationships, encompassing customer satisfaction, retention, meeting customer needs, responsiveness to complaints and suggestions, and collaboration (Li et al., 2008). Relational capital represents the organizational bonds between banks and their external and internal environments.

It includes customers, strategic alliance partners, employees, and stakeholders. Relational capital focuses on the extent of mutual understanding, respect, friendship, and trust that arises from interactions between external and internal factors.

By understanding and effectively managing these components of IC, organizations can leverage their knowledge resources to gain a competitive edge and enhance their overall performance in the market.

On the other hand, operational performance is a crucial indicator reflecting an organization's ability and success in effectively utilizing its resources, including human, technical, informational, and material resources.

It encompasses several dimensions, such as quality, cost, flexibility, and delivery, which are critical factors in maximizing the utilization of available productive resources (Salameh et al., 2022; Yen & Arokiasamy, 2019).

The increasing importance of IC has been driven by the growth and development of companies, particularly in the context of technological advancements and economic transformations.

Both tangible and intangible assets are now recognized as strategic elements for organizations.

Managing and controlling intangible assets, including IC, has become essential for preserving and enhancing the company's overall value. IC is considered a valuable resource for transforming intangible assets into added value.

Furthermore, a methodological approach is required to leverage opportunities effectively in the era of modern and advanced machines, and IC plays a vital role in this process (Wang & Lee, 2020).

Understanding the relationship between IC and operational performance is crucial for organizations seeking sustainable success. By leveraging IC effectively, organizations can enhance their operational performance in terms of quality, cost-efficiency, flexibility, and timely delivery. This highlights the significance of IC as a driver of competitive advantage and value creation within organizations.

The relationship between IC and operational performance will be further explored and elucidated in the subsequent sections.

Several studies have investigated the impact and significance of IC on various aspects of organizational performance.

In their SLR research, Demartini & Beretta (2020) examined the influence of IC on the performance of. Their findings revealed discrepancies in the application of IC components, with the ownership structure and financial leverage having a negative impact on IC.

The study recommended investing in IC, particularly the human element, to enhance the company's value and competitiveness and disclose relevant information. The study also finds that IC impacts innovation, knowledge management, core competencies, and corporate performance.

In the study conducted by Wang et al. (2021) It was found that human, structural, and customer capital did not statistically affect the return on assets. However, human and customer capital did not significantly impact the return on equity, while structural capital significantly affected the return on equity, the study suggested disclosing IC in dedicated appendices within financial reports and attracting employees with substantial competencies.

Alabood et al. (2023) explored the relationship between IC and financial performance in Jordanian insurance companies listed on ASE in their study. The findings revealed that human capital and employed capital positively and significantly impacted financial performance, as measured by ROA and ROE. The study emphasizes the strategic importance of managing and investing in IC to enhance financial performance in the insurance industry. However, the impact of structural capital on financial performance was not statistically significant.

De Matos et al. (2022) established a strong correlation between IC and the quality of educational services. Their study emphasized the need to develop human capital in higher education institutions.

Yudawisastra et al. (2018) demonstrated that human capital had a more substantial positive impact than working and structural capital on financial performance, and IC positively impacted banks' financial performance.

Dzenopoljac et al. (2017) explored the impact of structural and physical capital on profits and profitability and the influence of performance in companies with human capital. The study recommended that shareholders and executives recognize the importance of investing in and preserving IC to foster future growth.

These previous studies provide valuable insights into the relationship between IC and various performance indicators, highlighting the importance of investing in and managing IC for organizational success and competitiveness. However, the issue of how IC can impact operational performance is still an open area for investigation.

Accordingly, the study hypothesis is the following:

HO.1: No statistically significant effect of IC (human, relational, and structural capital) on operational flexibility in ASE-listed service companies.

HO.2: No statistically significant effect of IC (human capital, relational capital, and structural capital) on cost efficiency in ASE-listed service companies.

HO.3: No statistically significant effect on inventory turnover rate in ASE-listed service companies.

HO.4: No statistically significant effect of IC (human capital, relational capital, and structural capital) on asset turnover rate in ASE-listed service companies.

METHODOLOGY

The study population for the current research consists of service companies listed on the ASE as of December 31, 2021, amounting to 40 companies. From this population, a sample of 22 companies was meticulously selected, representing 55% of the service companies listed on the stock exchange. The sample selection process considered both the research period and the inclusion of companies listed on the ASE, ensuring a representative and relevant sample.

Data collection for this study relied primarily on secondary sources. The researchers extensively gathered data from various reports and bulletins issued by the ASE between 2017 and 2021. In addition, a comprehensive range of relevant books and publications, encompassing both Arabic and foreign languages, were utilized to acquire in-depth knowledge and insights on the subject matter. These scholarly resources provided valuable theoretical frameworks, research findings, and conceptual perspectives, significantly enriching the study.

To ensure the reliability and validity of the data, a set of statistical tools was employed to test the study's hypotheses. The researchers adopted panel data analysis to assess the regression results, allowing for a robust examination of the relationships between variables over time. By incorporating this rigorous analytical approach, the study aimed to enhance the quality and accuracy of its findings.

Reliability and Diagnostic Analysis

Table 1. Results of the (K.S) test

Type of Variable	Dimension Arithmetic	Mean	Standard Deviation	K.S	Sig
Independent	Human capital efficiency	5.229	7.597	1.323	0.060
	Structural capital efficiency	0.446	0.946	1.284	0.074
	Relational capital efficiency	4.097	0.301	1.245	0.090

Dependent	Operational flexibility	0.769	0.220	1.203	0.111
	Cost efficiency	-0.003	0.054	1.337	0.056
	Inventory turnover	58.163	128.519	1.274	0.078
	Assets turnover ratio	0.551	0.424	1.270	0.080

Source: Prepared by the authors

Table 1 presents the results of the Kolmogorov-Smirnov (K.S) test conducted to examine the data distribution for moderation analysis. The table provides information on the significance level (Sig) of the K.S test, the K.S statistic (K.S), the standard deviation, mean, amplitude statistics, and the characteristics of each variable included in the analysis.

The K.S. test of the variable "human capital efficiency" yielded a Sig value of 0.060, indicating that the data do not deviate significantly from a normal distribution. The K.S. statistic (1.323) further supports this conclusion. The standard deviation of this variable is 7.597, with a value of 5.229. classified as an independent variable. The variable "structural capital efficiency" also shows an insignificant deviation from a normal distribution, as reflected by the Sig value of 0.074 and the K.S estimate of 1.284, with a standard deviation of 0.946, with a value of 0.446.

Similarly, the "relative capital efficiency" data do not deviate significantly from the normal distribution, with a Sig value of 0.090 and a K.S statistic of 1.245. The standard deviation is 0.301, and the value is 4.097. The variable "Operational flexibility," the dependent variable, exhibits an insignificant deviation from the normal distribution, as reflected by the Sig value of 0.111 and the K.S statistic of 1.203. The variance of this variable is there is 0.220, with a median value of 0.769. The variable "cost efficiency" exhibits a significant trend from a normal distribution, with a Sig value of 0.056 and a K.S statistic of 1.337.

Similarly, the variable "Inventory turnover" shows a significant deviation from the normal distribution, with a Sig value of 0.078 and a K.S statistic of 1.274. The standard deviation of this variable is 128.519, with a value of 58.163. Lastly, the variable "Assets turnover ratio" also exhibits a significant deviation from the normal distribution, as indicated by the Sig value of 0.080 and the K.S statistic of 1.270; the mean difference is 0.424, with a value, is 0.551. In summary, the results of the KS test provide insight into the distributional characteristics of the variables included in the moderation analysis.

Most variables do not deviate significantly from the normal distribution, except for the "cost efficiency," "inventory turnover," and "asset turnover ratio" variables, which show significant deviations. These findings help to understand data distribution and help guide subsequent moderation analyses.

Table 2. Pearson Correlation Matrix

Variable	Human capital	Structural capital	Relational capital	Firm size	Firm age
Human capital efficiency	1	-	-	-	-
Structural capital efficiency	0.267	1	-	-	-
Relational capital efficiency	0.161	-0.051	1	-	-
Company size	0.345	0.400	0.253	1	-
Company age	0.299	0.140	0.039	0.372	1

Source: Prepared by the authors

The correlation coefficient measures the strength and direction of a linear relationship between two variables from -1 to +1. A coefficient of +1 indicates a perfectly positive relationship, while -1 indicates a very negative relationship. A coefficient of 0 does not indicate a relationship (Kanti, 2016).

The correlation coefficient between "age" and "size" is 0.253, indicating a positive but moderate relationship. This finding indicates that as age increases, firm size also increases, but not strongly. The correlation coefficient between "years" and "relational capital" is 0.372, indicating a positive relationship. This suggests that as firm age increases, so does relational capital, although the relationship is less strong. Regarding the relationship between "age" and "structural capital," the correlation coefficient is 0.039, indicating a weak positive relationship.

This finding suggests that structural capital is trending somewhat with firm age, but the relationship is insignificant. The correlation coefficient between "strong age" and "human capital efficiency" is 0.140, which shows a positive relationship, although the relationship is weak again. This means that as firm age increases, there is also a slight improvement in people's capital efficiency.

The results presented in Table 2 indicate that the correlation coefficients between the independent and control variables fall between 0.039 to 0.400. These values demonstrate the suitability of the data for statistical analysis, as they do not exceed the threshold of 0.80 (Gujarati et al., 2017).

In this study, the observed correlations between the independent and control variables are moderate, indicating a moderate association between them. These values suggest that the variables are not excessively correlated, alleviating multicollinearity concerns.

Table 3. Results of the Multicollinearity Test

Variables	Efficiency of human capital	The efficiency of structural capital	The efficiency of relational capital	Firm size	Firm age
Inflation Factor (VIF)	1.228	1.266	1.123	1.526	1.219
Permissible Variation (1/VIF)	0.814	0.790	0.890	0.655	0.820

Source: Prepared by the authors

Researchers used variance inflation factor (VIF) and tolerance values as diagnostic tools to inspect multicollinearity. VIF values greater than 5 indicate the presence of multicollinearity, while tolerance values greater than 0.2 and not greater than 1 indicate absence.

Table 3 indicates that none of the variables had VIF values greater than 5, indicating multicollinearity does not present itself between the study's variables. Furthermore, the calculated tolerance values were greater than 0.2 and not greater than 1, confirming the absence of multicollinearity. Using these assumptions, the researchers ensured the robustness of their statistical analysis, ensuring the validity and reliability of the study findings.

Table 4. D.W test results

Hypothesis	HO.1	HO.2	HO.3	HO.4
Calculated D.W value	1.897	2.078	1.780	1.793
Result: "No autocorrelation problem."				

Source: Prepared by the authors

Table 4 presents the results of the Durbin-Watson (D.W) test, which aims to determine if autocorrelation in the data is indicated. The table shows the calculated D.W. values for each tested parameter (HO.1, HO.2, HO.3, and HO.4). D.W values range from 0 to 4, with a value of about 2 indicating no autocorrelation problems. Values close to 0 indicate positive autocorrelation, while values close to 4 indicate negative autocorrelation. The calculated D.W value for HO.1 is 1.897, close to 2, indicating no significant autocorrelation problem.

Similarly, the calculated D.W value for HO.2 is 2.078, which is also close to 2, indicating no significant autocorrelation. As for HO.3, the calculated D.W value is 1.780, again close to 2, indicating no serious autocorrelation problem. The calculated D.W value for HO.4 is 1.793, which is also close to 2, indicating no significant autocorrelation issue.

Based on the results of the D.W. test, there is no significant autocorrelation problem in the data. The calculated D.W values for all hypotheses fall close to 2, supporting the absence of autocorrelation.

In summary, the results of the D.W. test provide evidence of no significant autocorrelation problem in the analyzed data. The calculated D.W values for all hypotheses fall close to 2, reinforcing the conclusion that there is no significant autocorrelation. This information contributes to the robustness and reliability of the study's statistical analysis.

Descriptive Analysis

A descriptive analysis was conducted to examine the characteristics of the study variables (human capital, cost efficiency, inventory turnover, asset turnover rate, firm size, and

age) from 2017 to 2021. The analysis involved calculating the standard deviation and arithmetic mean and identifying the highest and lowest values. The findings are presented below:

Table 5.Descriptive Analysis

Variables	Lowest value	Highest value	Arithmetic mean	Standard deviation	Sample size
Year	2017	2021	2019	-	110
Company	1	22	-	-	110
Human Capital	-6.653	49.589	5.229	7.597	110
Structure Capital	-6.003	4.725	0.446	0.946	110
Relational capital	1	4.306	4.097	0.301	110
Cost Efficiency	-0.372	0.146	-0.003	0.054	110
Inventory Turnover	1.168	898.497	58.163	128.519	110
Asset Turnover Rate	0.046	2.131	0.551	0.424	110
Company Size	6.185	9.158	7.736	0.608	110
Company Age	10	84	19.31	29.91	10

Source: Prepared by the authors

Table 5 presents the descriptive analysis of the variables examined in this study. The table includes information on the sample size, standard deviation, arithmetic mean, highest value, and lowest value for each variable.

The sample size for all variables is 110, indicating a consistent number of observations throughout the study period. The "Year" variable represents the year of observation and ranges from 2017 to 2021. No standard deviation or arithmetic mean is reported for this variable, as it is categorical. The "Company" variable denotes the unique identifier for each company in the sample.

The "Human Capital" variable exhibits a standard deviation of 7.597, indicating a moderate level of dispersion in the data. The arithmetic mean is 5.229, suggesting that, on average, the human capital variable falls within this range. The highest value observed is 49.589, while the lowest value is -6.653.

The "Structural Capital" variable shows a standard deviation of 0.946, indicating relatively low variability in the data. The arithmetic mean is 0.446, representing the average value of structural capital. The highest value reported is 4.725, while the lowest value is -6.003.

The "Relational Capital" variable demonstrates a standard deviation 0.301, indicating limited variability. The arithmetic mean is 4.097, representing the average value of relational capital. The highest value observed is 4.306, while the lowest value is 1.

The "Cost Efficiency" variable exhibits a standard deviation of 0.054, indicating low variability in the data. The arithmetic mean is -0.003, suggesting a slightly negative average value for cost efficiency. The highest value reported is 0.146, while the lowest value is -0.372.

The "Inventory Turnover" variable shows a standard deviation of 128.519, indicating a high degree of dispersion in the data. The arithmetic mean is 58.163, representing the average value of inventory turnover. The highest value observed is 898.497, while the lowest value is 1.168.

The "Asset Turnover Rate" variable demonstrates a standard deviation of 0.424, indicating relatively low variability. The arithmetic mean is 0.551, representing the average value of the asset turnover rate. The highest value reported is 2.131, while the lowest value is 0.046.

The "Company Size" variable exhibits a standard deviation of 0.608, indicating moderate variability in the data. The arithmetic mean is 7.736, representing the average company size. The highest value observed is 9.158, while the lowest value is 6.185.

Lastly, the "Company Age" variable shows a standard deviation of 29.91, indicating high variability in the data. The arithmetic mean is 19.31, representing the average age of the companies. The highest value reported is 84, while the lowest value is 10.

Testing the Hypotheses of the Study

The study design and statistical equations for panel pool regression are presented in Tables 6,7,8, and 9. The tables also show the decision process for accepting or rejecting the null hypothesis (HO) based on the results obtained.

Hypothesis 1

Table 6. Regression Analysis for Operational Flexibility

Variable	Unstandardized Coefficients	Standardized Coefficients	T-value	T.Sig
Constant	0.159	-	0.488	0.627
Human Capital	0.007	0.239	2.579	0.011*
Structural Capital	0.050	0.215	2.284	0.024*
Relational Capital	0.099	0.136	1.529	0.129
Company Size	0.009	0.024	0.232	0.817
Company Age	0.003	0.229	2.475	0.015*
R	R2	Adj R2	F-value	Prob > F
0.522	0.272	0.237	7.777	0.00*

Source: Prepared by the authors

Table 6 presents the results of the pool regression analysis. The table displays the unstandardized coefficients, standardized coefficients, t-values, and their corresponding statistical significance (T.Sig). Additionally, the table provides the values for the constant term and the R-squared (R2), adjusted R-squared (Adj R2), F-value, and its significance (F.Sig).

The analysis reveals that Human Capital has a statistically significant positive effect on Operational Flexibility, as indicated by its unstandardized coefficient of 0.007 ($t = 2.579$, $p = 0.011^*$). Structural capital also demonstrates a statistically significant positive effect on Operational Flexibility, with an unstandardized coefficient of 0.050 ($t = 2.284$, $p = 0.024^*$). On the other hand, Relational Capital shows a non-significant effect on Operational Flexibility, as its unstandardized coefficient is 0.099 ($t = 1.529$, $p = 0.129$). Company Size does not significantly affect Operational Flexibility, with an unstandardized coefficient of 0.009 ($t = 0.232$, $p = 0.817$). However, Company Age exhibits a statistically significant positive effect on Operational Flexibility, as indicated by its unstandardized coefficient of 0.003 ($t = 2.475$, $p = 0.015^*$).

With an R-squared of 0.272, the independent variables can be said to account for about 27.2% of the variation in operational flexibility. The degrees of freedom are taken into account, and the quantity of predictors is penalized, resulting in an adjusted R-squared (Adj R^2) of 0.237. The overall statistical significance of the regression model is indicated by the F-value, which is 7.777, and the significant p-value of 0.00*.

In summary, the pool regression analysis indicates that Human Capital, Structural Capital, and Company Age have statistically significant positive effects on Operational Flexibility. These findings contribute to understanding the factors influencing Operational Flexibility and provide insights for organizations to enhance their operational capabilities.

Hypothesis 2

Table 7. The results of the intellectual capital on cost efficiency

Variable	Unstandardized Coefficients	Standardized Coefficients	T-value	T. Sig
Constant	-0.308		-3.751	0.00
Human Capital	0.002	0.213	2.242	*0.027
Structural Capital	0.008	0.140	1.450	0.150
Relational Capital	0.046	0.255	2.797	*0.006
Company Size	0.014	0.160	1.512	0.134
Company Age	0.001	-0.058	-0.617	0.539
R	R2	Adj R2	F-value	Prob > F
0.483	0.233	0.196	6.328	*0.00

Source: Prepared by the authors

The second hypothesis (HO.2) aims to investigate the statistical significance of the impact of IC, including its dimensions (human capital, structural capital, and relational capital), on operational performance measured by cost efficiency in service companies listed on the ASE. The results of this analysis are presented in Table 7.

To examine the second hypothesis, panel pool regression analysis was employed, as depicted in Table 12. Using panel pool regression enables a comprehensive analysis of the relationship between IC and operational performance. Interpreting the results allows us to address the second research question posed in the study.

The analysis results indicate that human capital and relational capital variables show a statistically significant effect on cost efficiency. The unstandardized coefficient for human capital is 0.002, indicating that a one-unit increase in human capital is associated with a 0.002-unit increase in cost efficiency. Similarly, the unstandardized coefficient for relational capital is 0.046, suggesting that a one-unit increase in relational capital corresponds to a 0.046-unit increase in cost efficiency. These findings are statistically significant, as denoted by the T.Sig values of 0.027* and 0.006*, respectively.

On the other hand, the variables of structural capital, company size, and company age did not demonstrate a statistically significant effect on cost efficiency. The unstandardized coefficients for structural capital, company size, and company age are 0.008, 0.014, and 0.001, respectively. Their T-values and T.Sig values indicate that these coefficients are not statistically significant.

The coefficient of determination (R²) is 0.233, indicating that the independent variables collectively explain 23.3% of the variance in cost efficiency. The adjusted R² value, which considers the number of predictors and sample size, is 0.196. The F-value of 6.328 and its corresponding F.Sig value of 0.00* suggest that the overall regression model is statistically significant.

In summary, the analysis of the second hypothesis reveals that human capital and relational capital have a statistically significant impact on cost efficiency in service companies listed on the ASE. These findings emphasize the importance of investing in human capital development and fostering strong relational capital within organizations to enhance cost efficiency. However, the structural capital, company size, and company age variables did not show a statistically significant effect on cost efficiency in this study.

These results provide valuable insights into the factors influencing cost efficiency within the context of service companies and contribute to the existing body of knowledge on the relationship between IC and operational performance.

Hypothesis 3

Table 8. Regression Analysis for Inventory Turnover Rate

Variable	Unstandardized Coefficients	Standardized Coefficients	T-value	T. Sig
Constant	471.066	193.054	2.440	0.016
Human Capital	3.124	1.597	0.185	0.053
Structural Capital	75.544	13.023	0.203	0.037*
Relational Capital	29.786	38.474	0.070	0.441
Company Size	45.179	22.233	0.214	0.045*
Company Age	2.064	0.626	0.310	0.001*
R	R ²	Adj R ²	F-value	Prob > F
0.496	0.246	0.210	6.779	0.00*

Source: Prepared by the authors

Table 8 presents the results of the pool regression analysis conducted to examine the relationship between the dependent variable, Inventory Turnover Rate, and the independent variables: Human Capital, Structural Capital, Relational Capital, Company Size, and Company Age.

The unstandardized coefficients represent the regression coefficients associated with each independent variable. The constant (B) value is 471.066, indicating the estimated mean value of the Inventory Turnover Rate when all independent variables are zero.

The unstandardized coefficient for Human Capital is 3.124, suggesting that a unit increase in Human Capital is associated with a 3.124 unit increase in the Inventory Turnover Rate. Similarly, the unstandardized coefficients for Structural Capital, Relational Capital, Company Size, and Company Age are 75.544, 29.786, 45.179, and 2.064, respectively.

The standardized coefficients represent the standardized regression coefficients, which allow for a comparison of the relative importance of the independent variables. The standardized coefficient for Structural Capital is 0.203, indicating that a one standard deviation increase in Structural Capital is associated with a 0.203 standard deviation increase in the Inventory Turnover Rate.

The standardized coefficients for Human Capital, Relational Capital, Company Size, and Company Age are 0.185, 0.070, 0.214, and 0.310, respectively.

The T-values assess the statistical significance of the coefficients, and the T.Sig values indicate the corresponding significance levels. The T-value of 2.440 for the constant (B) coefficient is statistically significant at the 0.05 level.

Among the independent variables, Structural Capital, Company Size, and Company Age show statistically significant coefficients, as indicated by their T.Sig values of 0.037*, 0.045*, and 0.001*, respectively.

The coefficient of determination (R²) is 0.246, indicating that the independent variables collectively explain 24.6% of the variance in the Inventory Turnover Rate. The adjusted R²

value, which considers the number of predictors and sample size, is 0.210. The F-value of 6.779 and its corresponding F.Sig value of 0.00* suggest that the overall regression model is statistically significant.

In summary, the results of the pool regression analysis revealed significant relationships between the Inventory Turnover Rate and certain independent variables. Structural Capital, Company Size, and Company Age statistically significantly affect the Inventory Turnover Rate.

These findings provide insights into the factors influencing inventory management efficiency within the context of the study. The regression model demonstrates moderate explanatory power, as indicated by the coefficient of determination (R²) and the F-value. These results contribute to understanding the relationship between the independent variables and the Inventory Turnover Rate, providing valuable implications for inventory management practices in the studied setting.

Hypothesis 4

Table 9. Regression Analysis for Asset Turnover Rate

Variable	Unstandardized Coefficients	Standardized Coefficients	T-value	T. Sig
Constant	-0.940		-1.444	0.152
Human Capital	0.017	0.308	3.190	*0.002
Structural Capital	-0.029	-0.065	-0.659	0.511
Relational Capital	0.020	0.014	0.152	0.879
Company Size	0.167	0.240	2.229	*0.028
Company Age	0.001	0.061	0.631	0.530
R	R ²	Adj R ²	F-value	Prob > F
0.461	0.212	0.174	5.601	*0.00

Source: Prepared by the authors

Table 9 presents the results of the statistical test conducted for the fourth hypothesis model, which aims to investigate the effect of IC on the asset turnover rate in service companies listed on the ASE. The analysis reveals a moderate relationship between IC and the asset turnover rate, as indicated by the correlation coefficient (R) value of 46.1%. The IC factor explains 21.2% of the variation in the asset turnover rate among the service companies, as demonstrated by the interpretation coefficient (R²) value of 0.212.

The results from table 9 indicate that IC significantly affects the asset turnover rate, supported by two decision criteria. The probability value (F.Sig = 0.00) exceeds the significance level (0.05), reinforcing the calculated F-value of 5.601, which surpasses the critical F-value.

Analyzing the individual dimensions of IC, it is observed that the dimension of human capital significantly contributes to the impact on the asset turnover rate. The calculated T-value of 3.190 exceeds its tabular value and is statistically significant (p<0.05).

The corresponding coefficient ($\beta = 0.308$) reveals a positive relationship, indicating that an increase in human capital by one unit leads to a corresponding increase of 0.308 in the asset turnover rate. On the other hand, the dimension of structural capital does not demonstrate a significant contribution to the effect on the asset turnover rate, with a calculated T-value of -0.659, falling below its tabular value and with a significant level ($p > 0.05$). Similarly, the dimension of relational capital also fails to show a significant impact on the asset turnover rate, with a calculated T-value of 0.152, below its tabular value, and a significant level ($p > 0.05$).

However, the control variable of company size does exhibit a contribution to the effect on the asset turnover rate. The calculated T-value of 2.229 exceeds the tabular value with a significant level ($p < 0.05$). The coefficient ($\beta = 0.240$) indicates a direct relationship, implying that an increase in company size corresponds to a higher asset turnover rate (0.240). Conversely, the controlling variable represented by the company's age does not significantly contribute to the effect on the asset turnover rate, as indicated by the calculated T-value of 0.631, below its tabular value, and a significant level ($p > 0.05$).

The alternative hypothesis (H_a) is adopted instead of the null hypothesis (H_0) based on the statistical analysis and compliance with the two decision rules. Concerning operational performance as assessed by the asset turnover rate in service companies listed on the ASE, it can be said that IC has a statistically significant influence, expressly defined by human capital, at the level ($\alpha \leq 0.05$). These findings highlight the significance of human capital and firm size in determining the asset turnover rate, which adds to our knowledge of the relationship between IC and operational success.

DISCUSSION AND CONCLUSION

The results of the first hypothesis reveal a significant effect of IC, particularly in human capital and structural capital, on operational performance measured by operational flexibility in service companies listed on the ASE.

However, the variables of relational capital and company size did not show a significant effect, while company age also did not exhibit a significant effect. These findings are consistent with previous studies such as Wikhamn (2019), Özsari (2021), and (Navas et al. 2019).

Regarding the second hypothesis, the findings indicate a significant effect of IC, specifically in human and relational capital dimensions, on operational performance measured by cost efficiency in service companies listed on the ASE. However, the variables of structural

capital, company size, and company age did not demonstrate a significant effect. These results align with a study by Alabood et al. (2023) and Kanti (2016).

Moving to the third hypothesis, the results suggest a significant effect of IC, particularly in structural capital, on operational performance measured by the inventory turnover rate in service companies listed on the ASE.

Additionally, the company size and age variables exhibited a significant effect. However, human and relational capital variables did not show a significant effect. These findings contradict the study conducted by Baima et al. (2021).

Lastly, the findings related to the fourth hypothesis indicate a significant effect of IC, particularly in human capital, on operational performance measured by the asset turnover rate in service companies listed on the ASE. This result is consistent with the study conducted by Wang et al. (2014). Moreover, the variable of company size demonstrated a significant effect, while the variables of structural capital, relational capital, and company age did not exhibit a significant effect.

Based on the findings of this study, several recommendations are proposed. First, organizations should recognize the importance of IC and prioritize investment in human capital, structural capital, and relational capital to enhance overall performance. Second, embracing innovative approaches in production processes and adopting modern strategies can improve responsiveness and agility. Third, comprehensive plans and procedures should be developed to efficiently manage inventory, optimize levels, and implement effective forecasting and replenishment systems. Fourth, fostering strong customer relationships by involving them in service planning and seeking their feedback is crucial for improving customer satisfaction and building long-term relationships.

Additionally, allocating more resources to advertising activities, prioritizing employee development and support, enhancing the disclosure of IC in financial statements, and implementing these recommendations can improve operational performance, increase competitiveness, and achieve sustainable growth for service companies listed on the ASE. These recommendations align with the business environment's dynamic nature and aim to enhance organizational performance and maximize value creation.

Further research in this area can build upon the findings of this study and explore several avenues for future investigation. Firstly, future studies could delve deeper into the non-significant effects observed in certain variables, such as relational capital and company age, to better understand their impact on operational performance. Additionally, exploring the potential

moderating or mediating effects of other variables not included in this study, such as industry-specific factors or environmental influences, would be valuable. Furthermore, expanding the research scope to include a broader range of industries or different geographical regions would enhance the generalizability of the findings. Moreover, longitudinal studies that examine the dynamics and changes in IC and operational performance over an extended period could provide valuable insights.

Lastly, qualitative research methods, such as interviews or case studies, could provide a deeper understanding of the underlying mechanisms and practical implications of IC on operational performance. By addressing these avenues for future research, scholars can further advance knowledge in IC and its impact on operational performance, contributing to developing effective management strategies and decision-making frameworks.

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