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Evaluating the Intellectual Capital of Intensively Tourism-Dependent Countries Between, Prior, and During the COVID-19 Pandemic

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Abstract: The tourism industry has grappled with the challenges posed by the onset of the coronavirus disease (COVID-19) since the start of 2020, experiencing a complete lockdown that profoundly affected travel activities. This viral outbreak had a critical impact on both the financial and non-financial aspects of life, including the intellectual capital (IC) of the tourism and hospitality sectors. However, there is a scarcity of studies addressing this issue within the context of tourism-related businesses. Thus, this paper aims to investigate the changes in the overall IC and its components before and during the COVID-19 pandemic, with a specific focus on understanding the transformation of IC in the tourism industry of Thailand, a country that is highly dependent on tourism. The study involved 37 tourism-related companies listed on the Stock Exchange of Thailand (SET). Organizational data from financial and annual reports published between 2019 and 2020 were collected for analysis. The assessment of value added intellectual capital (VAIC^{TM}) was employed to evaluate the performance of the overall IC and its components during the pandemic. The results, based on the testing of four hypotheses, indicated that most hypotheses were accepted, signifying a substantial transformation in the overall IC performance of tourism-related companies during the pandemic crisis. This transformation was observed in the IC components of physical and human capitals. However, the structural capital was the only IC component that did not experience a significant impact from COVID-19. To comprehend the reasons and effects of the IC transformations during the pandemic, this study delved into the relevant literature. Additionally, the paper includes implications to support firms in preparing for future challenges.

Keywords: intellectual capital; intangible assets; COVID-19; coronavirus; tourism industry; Thailand

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1. Introduction

Regarding the unprecedented pandemic of COVID-19, all industries have con-fronted unexpected and unparalleled challenges. One of the sectors that has experienced a significant impact from the pandemic is the tourism industry [1]. Generally, the tourism industry plays a vital role in global economies, since it empirically contributes to job creation, revenue generation, cultural exchange, local economy growth, and so on [2,3]. However, the emergence of the COVID-19 pandemic in 2019 has brought significant challenges to the tourism industry [4]. The virus outbreak triggered a severe decline in travel, occupancy, and tourism activities [5], and, moreover, it posed a profound impact on the financial performance of businesses operating within this travelling sector. To cope with the impacts

of COVID-19, two broad thematic topics are suggested for research endeavors; those of a financial part (e.g., finance and economic) and a non-financial part (e.g., human resources, education, and marketing) [4].

Amidst these challenging times, the concept of intellectual capital (IC), classified as the thematic topic of non-finance, has been identified as a critical factor that may influence the adaptability, resilience, and endurance of several industries [6,7]. It is suggested as a potential crucial management approach that can overcome the negative consequences of the pandemic, potentially outperforming other conventional business models [5,8]. Moreover, organizations that effectively manage and utilize their IC may better handle the challenges and capitalize on the opportunities emerged from the pandemic. Therefore, regarding the possible significant advantages of IC, there were several studies aiming to investigate the empirical impact of IC on either organizational performance or financial performance before and during the COVID-19 pandemic era. However, the number of studies focusing on this recent topic is still limited in some specific industries, including banking [9], education [10,11], medical [12], telecommunications [13], etc., while, the study on the tourism sector, which directly experienced the impact of COVID-19 pandemic, still remains underexplored [6].

The tourism industry is widely recognized as one of the most significant sectors in the global economy. According to the World Travel and Tourism Council (WTTC), the total economic value of travel and tourism in terms of the world's gross domestic product (GDP) amounts is worth USD 7.6 trillion. This value represents approximately 10.2% of the entire world GDP [14]. During the COVID-19 pandemic era, the WTTC reported that global travel and tourism's contribution to the GDP severely contracted by 49.1% [15]. As mentioned above, IC has been recognized as a key success factor of firms dealing with the crisis during the pandemic era across several industries. Nevertheless, the investigation of its advantages in the tourism sector is still very limited [5]. Therefore, regarding the significance of both the tourism industry and IC, as well as the investigation opportunities in this sector and other relevant sectors, studying the differences of IC before and during the pandemic is highly necessary. The understanding of these phenomena is crucial for organizational executives devising effective and efficient strategies for sustaining businesses during the pandemic crisis, and also to prepare for future unprecedented disruptions.

To fill the gap of the past literature, and to provide valuable insights to countries whose economies are substantially reliant on the tourism industry, this study aims to investigate the differences of the overall IC and its major components between prior and during COVID-19 pandemic eras in the case study of Thailand. The tourism industry of Thailand plays a substantial role in both local and global economies [16]. In 2019, the travel and tourism industry could contribute approximately up to 18.21% of Thailand's GDP, which surpassed the global average rate of 10.40% [17]. Moreover, the high economic values of Thailand's tourism industry were ranked in the top three globally [18]. Hence, understanding the transformation and significance of IC in the tourism industry during the pandemic in the intensively tourism-dependent countries, government administrations, policymakers, tourism practitioners, or even stakeholders would make a better contribution to their strategic plans, investments, and efficient resource allocation.

The contributions of this work are as follows. First, we investigate the transformation of the overall IC from before to during the COVID-19 pandemic within tourism-related industries, and specifically in an intensively tourism-dependent country, which, in this case, is Thailand. This investigation has not been carried out in the past literature, even though the impact of this industry and country could substantially contribute to the global economics. Second, our study also further analyzes the changes of major IC components between prior and during pandemic in the same crucial sectors and country. Unlike past works that investigated different industries such as banking [9], more specific subsectors of tourism like hotels [5], broader areas and types of studied countries, or more limited types of IC [6], this study expands new knowledge and fulfills the previous gaps by studying underexplored areas, more generic sectors, and high impact countries.

The remainder of this study is organized as follows: Section 2 presents the literature review and hypothesis development; Section 3 proposes the research methodology; Section 4 shows the results and discusses the findings; and, finally, Section 6 summarizes the findings and concludes the policy implications, as well as limitations and future work.

2. Literature Review and Hypothesis Development

IC has been acknowledged as a firm's intangible assets which significantly provide competitive advantages [19], and also improve organizational performance [20] through the creativity and competency of human, product, and service innovation, operational effectiveness, and efficiency, and strong relationships with customers and other stakeholders [21]. The contributions of IC to the improvement of organizational performance and the increment of a firms' market values are widely studied and empirically identified across several industries such as banking, technology, and electronics, and so on. Moreover, the empirical advantages of IC are recognized not only in flourishing economies, but also in the financial crisis. Regarding the prevention of crises in this world, most of the past works still mainly explored the significance of IC in normal or non-crisis situations. Nevertheless, because of the current emergence of the COVID-19 pandemic, there are a limited number of recent studies focusing on the investigation of the transformation of IC during the unprecedented crisis.

From our intensive literature reviews, a number of IC studies associated with the COVID-19 pandemic are still very limited. Most works concentrated on exploring the significance of IC contributing to the financial performance or market values of firms from different perspectives, including industries, organization types, and geographies. There are few articles studying the types of firms, such as small and medium enterprises or SMEs, large firms, and non-financial firms. Moreover, to deeply perceive the impact of IC on the financial performance of specific businesses, some works examined IC contributions in the perspective of industrial types. However, the studied areas are still very limited in only four industries, which are banking [9,22,23], tourism [5,6,24], telecommunication [13], and manufacturing sectors [22].

Similar to the concentration of IC studies in a normal situation, there was a low amount of studies in most business sectors, except for the banking industry. To the best of our knowledge, approximately 38% of all related works investigated the significance of IC in this financial-related sector. However, the tourism industry is surprisingly also found as one of the highest-explored areas, even though this sector was less studied pre-pandemic compared to other industries. The attention that is paid to the travelling-related sectors mainly comes from the severe impact and consequences of the COVID-19 pandemic, directly and mostly affecting tourism activities and stakeholders. The first related study [5] explored the relative impact of IC on profitability and employee performance in a specific tourism sub-sector (the hotel industry) in Serbia, which is not an intensively tourism-dependent country. Although the study could bring light to the significance of IC for the hotel sector, it still could not comprehensively expand the knowledge on a broader scope of the tourism industry, as well as in the perspective of an intensively tourism-dependent country. Moreover, the study still could not identify the differences of IC in organizations prior to and during the pandemic crisis. Therefore, from this under exploration, academics and practitioners still could not understand the changes of overall IC and IC components regarding the pandemic crisis, thus they could not properly prepare and cope with the transformations of IC. The second related research [24] examined the effect of IC and entrepreneurial orientation on a firms' performance in hospitality companies during the COVID-19 pandemic era. The study investigated the effects of one IC major component, relational capital, which significantly influences the performance of hotel businesses. Nevertheless, similarly to the first related study, it still delivered limited contributions, especially in the perspectives of intensively tourism-dependent countries and IC changes between crisis and non-crisis periods. The last related study [6] investigated the impact of three major IC elements on the profitability and asset growth of firms in the

tourism industry. This work extensively analyzed the phenomenon of IC contributions in tourism-related firms operating in several EU countries. The findings of this study would support firms in better managing challenges and issues during the pandemic crisis. Nevertheless, the insights and suggestions are still limited by the broad investigation into all levels of tourism-dependent countries (covers high, medium, and low levels) in the European zone. Moreover, similar to the IC-related studies above, this research could still not discover new knowledge related to IC transformation in intensively tourism-dependent countries, specifically the differences before and during the COVID-19 pandemic era.

As presented above, there are a limited number of studies examining the changes of the intangible assets of tourism-related companies both prior to and during the COVID-19 crisis, especially in the intensively tourism-dependent countries. Therefore, to expand the knowledge on this crucial topic, this study aims (1) to investigate the differences of IC before and during the COVID-19 pandemic, and (2) to examine the transformation of the IC components of companies in one of the well-known intensively tourism-dependent countries, which is Thailand. To answer these novel objectives, both the directly and indirectly related studies are reviewed according to the objective; presented below are the developed hypotheses. Based on previous research findings, the initial hypothesis addressing the first objective is formulated as follows:

H1. *The overall IC of tourism-related firms in Thailand before and during the COVID-19 pandemic are statistically different.*

Moreover, to answer the second objective, the investigation of differences is further extended to the major IC components, as shown in the following hypotheses:

H2. *The physical capital of tourism-related firms in Thailand before and during the COVID-19 pandemic are statistically different.*

H3. *The human capital of tourism-related firms in Thailand before and during the COVID-19 pandemic are statistically different.*

H4. *The structural capital of tourism-related firms in Thailand before and during the COVID-19 pandemic are statistically different.*

Generally, IC and its components are broadly regarded as critical drivers for the improvement of organizations' financial performance [25,26], firms' market values, and also for achieving competitive advantages [27] across several industries. In non-crisis situations, there were several findings that identified the IC's positive significance in various industries. Similar to the pandemic crisis period, empirical evidence also highlighted the positive impact of IC to firms' performance; however, there was still a limited number of findings and studied areas. However, past evidence could imply that the greater IC, the better the firms' performance. This phenomenon elucidates the organizational awareness of IC significance and its consequential impact on organizational performance. Therefore, to attain competitive advantage, it is imperative for organizations to judiciously administer and manage IC, in both non-crisis and crisis circumstances. The alterations in intangible assets could induce transformations in the organizational efficiency and effectiveness, influencing its competitive capabilities and its sustainability. Although the recognition of IC changes is highly significant to organizations and certainly requires investigation [28], from the best of our knowledge, there was only one study [29] concentrating on the differences of IC both before and during COVID-19 periods, and the results highlighted that the utilization of IC in these situations was significantly different [29]. Nevertheless, there was other qualitative research, emphasizing the differences of IC during COVID and non-COVID periods, specifically the negative changes of human capital during and after the COVID-19 pandemic from both short-run and long-run impact [30].

Regarding the limited number of related studies presented above, to better support the hypothesis, we further explored other relevant studies, especially the comparisons of IC in both non-crisis and crisis periods, since the pandemic period can be classified as one type of crises. From this literature review, we found two points of investigation which are relevant to our study. One was the exploration of the differences between the overall IC or intangible assets, while another concentrated on comparisons of the IC components themselves. Although there were a limited number of studies in the first direction, the past relevant findings or suggestions [29,31] still supported the first hypotheses highlighting the differences of IC or IC-related impacts between crisis and non-crisis periods. In the current economy, this crisis can lead to the shortage of financial resources, and this directly and negatively affects the investments into non-financial assets or intellectual capital [31,32].

Another objective of the relevant studies aims to investigate the differences in IC major components between crisis and non-crisis periods, and there were several past studies investigating this interesting issue. Most studies focused on the transformations of two IC components, which are physical capital and human capital. The changes and effects of physical capital between crisis and non-crisis periods, supporting the second hypothesis (H2), were widely studied or criticized in several business sectors [33,34], as well as in the tourism industry [35]. Unsurprisingly, in the crisis situation, the capital-employed efficiency of firms significantly declined regarding the reduction or management of financial assets [36,37] and other tangible assets, such as the firms' inventories [38], working capital [34], etc.

Another largely studied IC component is human capital. From the reviews, there were several indications emphasizing the changes of the human capital or human values of firms during economic crisis compared to non-crisis situations in the tourism sector and other industries [39,40]. The negative changes of human capital in the crisis period mainly came from an employee layoff [41,42], as well as a significant decline in the wages of workers [43,44]. Therefore, the findings presented above support the development of the third hypothesis (H3) of our study.

The last component of IC, which was the least explored for differences and changes between crisis and non-crisis periods is the structural capital. There was still a limited number of studies; no study explores this transformation in the tourism sector. From the literature reviews, the changes of the two intangible aspects of structural capital, including intellectual property and relational capital, were mentioned or investigated. First, the change of intellectual property or its values was highlighted in the pharmaceutical industry and in the pandemic crisis [45]. On the other hand, in the crisis period, the values of relationships between firms and other parties, such as the customers [46], had significantly decreased after the non-crisis period.

3. Research Methodology

3.1. Research Framework

This research aims to investigate the differences of IC performance in the intensively tourism-dependent country of Thailand prior to and during the COVID-19 pandemic. Therefore, our study evaluates the performance of the overall IC and IC components through the value added intellectual capital (VAIC^{TM}) in relation to periods both prior and during the COVID-19 pandemic. To demonstrate the hypotheses, a research framework of our study is depicted in Figure 1.

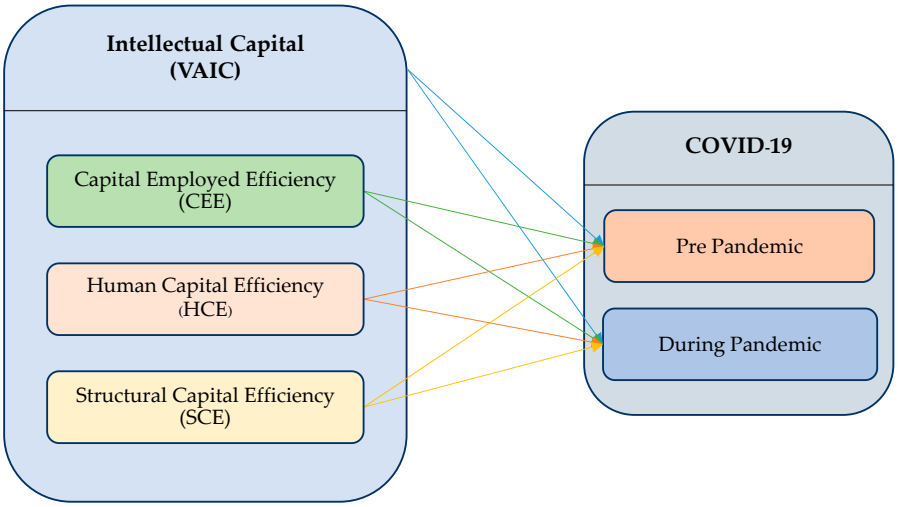

Figure 1. Research framework.

3.2. Sample Selection and Research Method

First, the data of the samples utilized in this research are collected from the listed firms in the tourism sector of the Thai stock market. These companies mainly operated in Thailand, which is the intensively tourism-dependent country at question. Nevertheless, regarding the limited number of firms listed in this sector (13 companies with eligible data), we extended the sample selection to firms listed in the transportation and logistics sector also. Firms in this sector (27 companies with eligible data) are directly related to businesses who partake in tourism-related activities, such as airline companies, airport business operators, etc. Therefore, the sample size for the study is 37 companies (3 companies with ineligible or missing data are excluded from our sample). To examine the IC performance during COVID-19, firms' data between 2020–2021 were used in this study (social and movement measures in Thailand were implemented since 2020). Finally, in this study, there were 74 firm-year observations of samples. Although the sample size seems to be small, this still appears adequate when compared with other studies focusing on the empirical comparisons of two different scenarios for both crisis-related, and non-crisis-related research, such as the studies of Olczak and co-workers [47], Han and Jung [48], or even the studies examining relationships between multiple aspects, such as the research of Al-Dubai [49], as well as Azizan and co-authors [50].

The paired samples *t*-test is a statistical method used to analyze the differences between paired data which are related to each other, such as the differences before and after a test or the differences between two variables measured repeatedly at different times. The underlying principle of the paired samples *t*-test is to test whether the mean of the paired data differs significantly or not by comparing the mean of the paired data to zero. The test utilizes the *t*-test formula in order to calculate the t-statistic and *p*-value, determining whether to reject the null hypothesis that the mean of the paired data is the same. While the *t*-test is robust, being a parametric method, the paired samples *t*-test sets several assumptions. These include the independence of the two sets of data, the normality of the differences, the use of continuous data, and the homogeneity of variances between the paired data. Violating these assumptions may lead to unreliable results, and alternative non-parametric tests like the Wilcoxon signed-rank test can be considered. Therefore, before conducting a paired samples *t*-test, it is crucial to verify these conditions in order to ensure the validity and the reliability of the results. If some assumptions are not met, alternative statistical methods are appropriate and trustworthy for analyzing the data in such situations. Data presentation, i.e., graphical formats and preliminary statistical analyses, can be used in initial hypothesis testing. Additionally, considering the differences in paired data is crucial for a comprehensive analysis. In this paper, STATA software version 14 is a tool used to analyze and visualize data in this study.

3.3. Variable Measurement

This section presents the definitions and measurements of all variables applied in this research. To measure the IC performance for both before and during the pandemic crisis, we applied VAIC^{TM} as proposed by Pulic [51]. VAIC^{TM} is an effective measurement method used to evaluate the efficiency of intangible assets and organizational performance [52]. Moreover, VAIC^{TM} is one of the most widely used IC measurement methods for both academics and practitioners [53]. Therefore, regarding its popularity, the comparisons of the obtained IC results or other related findings would be standard and could benefit to a wide range of academics and practitioners. VAIC^{TM} of Pulic [51] composes three major components, including human capital efficiency (HCE), structural capital efficiency (SCE) and capital employed efficiency (CEE). The calculation of VAIC^{TM} and its components following Pulic's method [51] is presented in equations below:

$$\text{VAIC}^{TM} = \text{HCE} + \text{SCE} + \text{CEE} \quad (1)$$

$$\text{HCE} = \text{VA}/\text{HC} \quad (2)$$

$$\text{SCE} = \text{SC}/\text{VA} \quad (3)$$

$$\text{CEE} = \text{VA}/\text{CE} \quad (4)$$

$$\text{VA} = \text{OP} + \text{HC} + \text{D} + \text{A} \quad (5)$$

where VA is the value added to a particular company, and, originally, it considers the difference between output and input [51]; HCE is known as the value added and the employed human capital (VAHU), and it presents the value added by financial resources invested in employees. HC is the human capital, as measured by the total employee expenditures like wages, incentives, etc.; SCE, or the structural capital value added (STVA), indicates the share of the structural capital in the created value. SC is the structural capital, as measured by subtracting HC from VA; CEE, or value added capital coefficient (VACA), indicates the new value creation from the capital employed. CE is the capital employed, as measured by subtracting the intangible assets from the total assets; OP is the operating profit, as measured by earnings before interest and tax; D is depreciation; and A is amortization. Since the original data obtained from firms' annual reports and financial reports were shown in local currency (Thai baht), for the purposes of presenting data in international standard form, we converted all the presented financial data to US dollars in this paper.

4. Empirical Results

4.1. Descriptive Analysis

Based on the dataset comprising 40 companies, some information is missing. The total number of companies included in the analysis is 37, with 24 being transportation-related companies and 13 being hotel-related companies. Table 1 presents the descriptive statistics for intellectual capital-related variables before and during the pandemic.

For the pre-pandemic period, the mean values for VAIC^{TM}, HCE, SCE, and CEE are 2.994, 2.312, 0.474, and 0.209, respectively. The standard deviations are 1.913, 1.708, 0.506, and 0.253 for VAIC^{TM}, HCE, SCE, and CEE, respectively. The minimum and maximum values, along with the skewness and kurtosis, offer additional insights into the distribution of each variable. Significantly, the skewness and kurtosis values indicate deviations from normality, with positive skewness and kurtosis being observed in some variables.

During the pandemic, the mean values for VAIC^{TM}, HCE, SCE, and CEE are 2.195, 1.795, 0.267, and 0.124, respectively. The corresponding standard deviations are 2.553, 2.156, 0.93, and 0.156. The range of values, as indicated by the minimum and maximum values, reveals the variability within each variable during this period. The dataset also encompasses information regarding the SET (Stock Exchange of Thailand) entry. The average SET entry year for the companies in the dataset is 2548. The earliest and latest SET

entry years are 2518 and 2564, respectively, providing insights into the range of entries across the companies.

Table 1. Descriptive statistics for before and during the pandemic intellectual capital variables.

		Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Pre Pandemic	VAIC^{TM}	2.994	1.913	−0.37	8.43	1.313	4.684
Obs = 37	HCE	2.312	1.708	−0.61	7.35	1.585	5.185
	SCE	0.474	0.506	−0.96	2.63	1.346	11.735
	CEE	0.209	0.253	−0.08	1.56	4.232	23.287
During Pandemic	VAIC^{TM}	2.195	2.553	−4.31	9.36	0.24	4.062
Obs = 37	HCE	1.795	2.156	−5.14	8.32	0.131	6.363
	SCE	0.267	0.93	−1.93	2.71	−0.184	4.078
	CEE	0.124	0.156	−0.37	0.54	0.013	5.081

4.2. Hypothesis Testing

The paired samples *t*-test serves as a statistical tool aimed at evaluating whether the mean difference between paired observations is significantly different from zero, with a specific focus on interventions, such as the COVID-19 pandemic. The validity of its results hinges on key assumptions, including the requirement for interval or ratio data, paired observations, the independence of observations, and the normality of differences. This test presupposes that data are measured at the interval or ratio level, signifying meaningful intervals between scale points. The relatedness of observations within each pair, as seen in pre- and during-pandemic measurements, contrasts with the independence of the pairs themselves. Ensuring a normal distribution of differences is pivotal, with larger sample sizes helping address such deviations. The credibility of the paired samples *t*-test may be compromised if these assumptions are not met, prompting the consideration of alternative statistically sound methods [54].

In examining the normal distribution for the paired samples *t*-test, recommended approaches involve graphical data presentation, numerical tests, and the meticulous examination of the sample size, mean, standard deviations, and paired differences. It is necessary to assess the paired difference variables using tools such as histograms, Q–Q plots (Normal Q–Q plots), and the Shapiro–Wilk test, as presented in Figures 2 and 3, and Table 2, respectively.

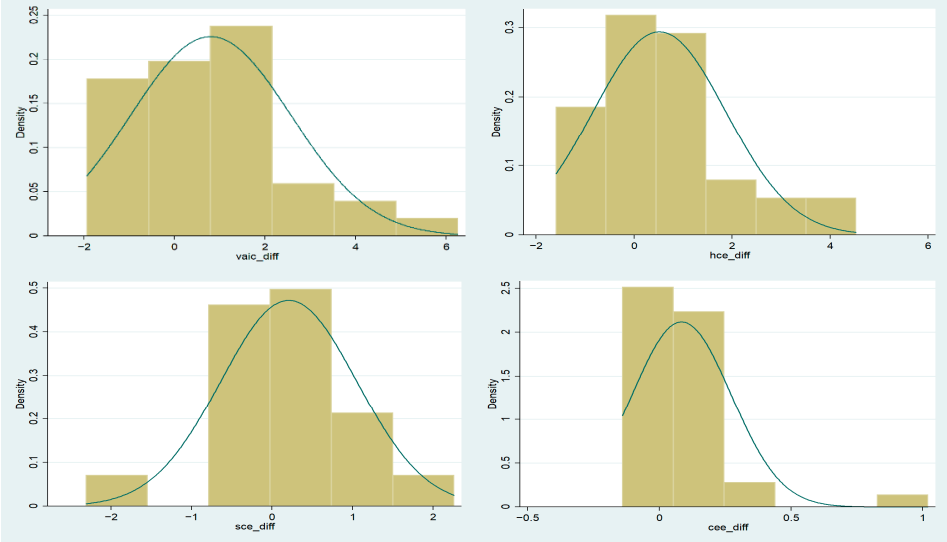

Figure 2. Histogram for paired differences of intellectual capital variables, both before and during the pandemic.

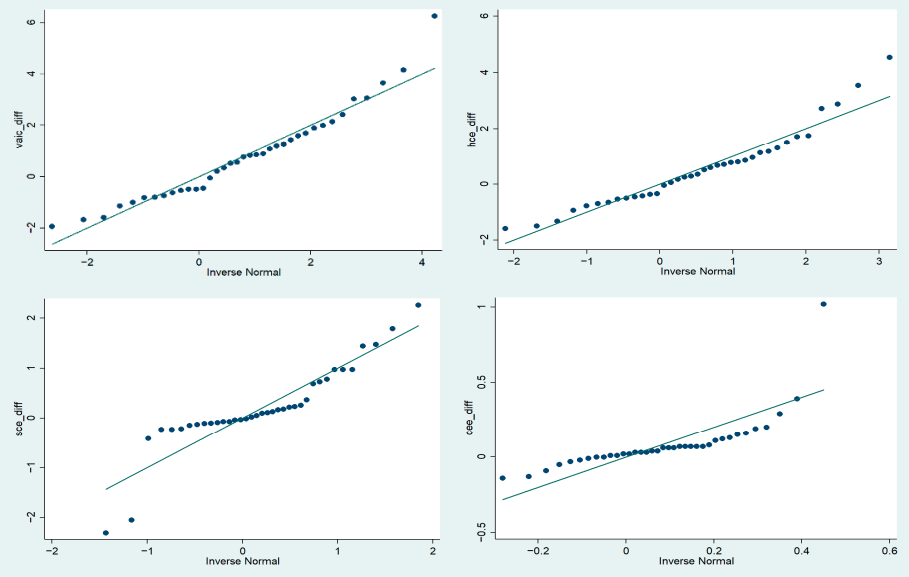

Figure 3. Q–Q plot for paired differences in pre-pandemic and during-pandemic intellectual capital variables.

Table 2. Shapiro–Wilk W test for normal data.

Variable	W	V	z	Prob > z
vaic_2019	0.8560	5.3670	3.5190	0.0000
vaic_2020	0.9720	1.0540	0.1100	0.4560
vaic_diff	0.9490	1.8930	1.3370	0.0910
hce_2019	0.8000	7.4470	4.2050	0.0000
hce_2020	0.8980	3.8040	2.7980	0.0030
hce_diff	0.9390	2.2680	1.7150	0.0430
sce_2019	0.7590	8.9830	4.5980	0.0000
sce_2020	0.9100	3.3500	2.5320	0.0060
sce_diff	0.8720	4.7740	3.2740	0.0010
cee_2019	0.5500	16.7500	5.9030	0.0000
cee_2020	0.9040	3.5710	2.6660	0.0040
cee_diff	0.6460	13.1870	5.4020	0.0000

From Figure 3, each data point representing the difference in VAIC^{TM} between the pre-pandemic and during-pandemic periods mostly follow the straight line, suggesting that the data is approximately normally distributed. This contrasts with the distributions of HCE, SCE, and CEE.

From Table 2, it is observed that the VAIC^{TM} value before the COVID-19 outbreak exhibits a significantly non-normal distribution ($p < 0.05$). However, the VAIC^{TM} value during the COVID-19 outbreak follows a normal distribution ($p = 0.45587$). Nevertheless, the paired *t*-test does not necessitate the assumption that either pre-pandemic variables or during-pandemic variables follow a normal distribution; it only requires that the differences between the two variables have a normal distribution. The results of the Shapiro–Wilk test suggest that, while the differences in VAIC^{TM} may not significantly deviate from normality, the differences in HCE, SCE, and CEE are likely to be significantly non-normally distributed. For the variable "vaic_diff," the W statistic is 0.949, with a corresponding z-value of 1.337 and a *p*-value of 0.091. This suggests that the distribution of differences in VAIC^{TM} may not significantly deviate from normality. As the assumption of normality is

not strongly violated, the paired sample *t*-test is deemed applicable for the further analysis of the differences in VAIC^{TM} between the paired observations.

In contrast, the "hce_diff" variable exhibits a W statistic of 0.939, a z-value of 1.715, and a *p*-value of 0.043. The *p*-value is less than 0.05, indicating a rejection of the null hypothesis of normality. This suggests that the differences in the HCE may significantly depart from a normal distribution. Also, the "sce_diff" variable shows a W statistic of 0.872, a z-value of 3.274, and a *p*-value of 0.001. This indicates a rejection of the null hypothesis, suggesting that the differences in the SCE are significantly non-normally distributed. Similarly, the "cee_diff" variable exhibits a W statistic of 0.646, a z-value of 5.402, and a *p*-value of 0.000, indicating a significant departure from normality for the differences in the CEE. Given the non-normal distribution of data for the HCE, SCE, and CEE and the violation of the normality assumption, the analysis proceeded with the Wilcoxon's signed rank test, an equivalent non-parametric alternative.

Another hypothesis that needs examination is the homogeneity of variances for the IC-related variables. The results of the Levene test for the homogeneity of variances from Table 3 indicate the equality of variances for the pre- and during-pandemic periods of the VAIC^{TM}, HCE, and CEE variables. However, the Levene test results suggest a significant difference in variances for the SCE variable between the two periods, indicating a violation of the homogeneity of variances assumption. In this case, Welch's test emerges as a viable alternative. As a refined version of the *t*-test, Welch's test accommodates unequal variances, ensuring robustness in scenarios where homogeneity assumptions are not met for the SCE variable.

Table 3. Test for the homogeneity of variances.

	Mean (Total)	**Std. Dev. (Total)**	**W0**	**W50**	**W10**	**df (1, 72)**	**Pr > F**
VAIC^{TM} (2019, 2020)	2.594	2.276	3.005	3.215	3.379	1	0.087
HCE (2019, 2020)	2.054	1.949	0.944	1.358	1.299	1	0.334
SCE (2019, 2020)	0.370	0.750	9.747	6.494	9.442	1	0.003
CEE (2019, 2020)	0.166	0.213	0.055	0.066	0.008	1	0.815

Note: W0, W50, and W10 are robust variance test statistics. df(1, 72) represents the degrees of freedom, and Pr > F is the *p*-value associated with each test statistic.

The paired samples *t*-test was employed to examine variations in intellectual capital-related variables (specifically, VAIC^{TM}, HCE, SCE, CEE) between the periods before and during the COVID-19 pandemic. The results, presented in Table 4, demonstrate notable differences in the VAIC^{TM}, HCE, and CEE between the pre-pandemic and during-pandemic periods. However, there was not a significant difference observed in the SCE. Furthermore, the outcomes of the Wilcoxon signed-rank test are provided in Table 5.

Table 4. Paired samples *t*-test.

	Mean1	**Mean2**	**Diff.**	**St. Err.**	**t Value**	***p* Value**
VAIC^{TM} (2019, 2020)	2.994	2.195	0.799	0.291	2.75	0.009
HCE (2019, 2020)	2.312	1.795	0.517	0.224	2.3	0.026
SCE (2019, 2020)	0.474	0.267	0.207	0.139	1.5	0.146
CEE (2019, 2020)	0.208	0.124	0.085	0.031	2.75	0.009

Table 5. Wilcoxon signed-rank test.

Pre Pandemic	During Pandemic	z Value	*p* Value	Effect Size	
				Cohen's d	Hedges's g
VAIC™	VAIC™	2.452	0.0142	0.799	0.291
HCE	HCE	1.976	0.0481	0.517	0.224
SCE	SCE	1.750	0.0801	0.207	0.139
CEE	CEE	3.463	0.0005	0.085	0.031

For H1, the VAIC™, there is a statistically significant difference between the means of "vaic_2019" (Mean1 = 2.994) and "vaic_2020" (Mean2 = 2.195), with a mean difference of 0.799 (p = 0.009). This suggests a significant change in the VAIC™ from 2019 to 2020.
For H2, the CEE, there is a statistically significant difference between the means of "cee_2019" (Mean1 = 0.208) and "cee_2020" (Mean2 = 0.124), with a mean difference of 0.085 (p = 0.009). This suggests a significant change in the CEE from 2019 to 2020.
For H3, the HCE, there is a significant difference between the means of "hce_2019" (Mean1 = 2.312) and "hce_2020" (Mean2 = 1.795), with a mean difference of 0.517 (p = 0.026). This indicates a notable change in the HCE from 2019 to 2020.
For H4, regarding the SCE, no statistically significant difference was observed between the means of "sce_2019" (Mean1 = 0.474) and "sce_2020" (Mean2 = 0.267), with a mean difference of 0.207 (p = 0.146).

In instances characterized by non-normal distribution, the *t*-test retains asymptotic validity for substantial sample sizes, and the Wilcoxon signed-rank test emerges as more resilient, particularly when dealing with limited sample sizes. According to Table 3, the results from Levene's test revealed non-significant statistics for the VAIC™, HCE, and CEE variables, suggesting that no substantial variance differences, and that the Wilcoxon signed-rank test is a robust alternative to the dependent samples *t*-test. However, the Levene's test indicates the homogeneity of variance assumption violations for the SCE, the Welch's *t*-test, or unequal variances *t*-test is more reliable when the two samples have unequal variances to test the (null) hypothesis that two populations have equal means. According to Table 5, the Wilcoxon signed-rank test reveals significant differences in multiple intellectual capital-related variables between the pre- and during-pandemic periods, which is consistent with the results of the paired samples *t*-test. Specifically, a noteworthy distinction is evident in the VAIC™ (p = 0.0142), HCE (p = 0.0481), and CEE (p = 0.0005). These results lead to the rejection of the corresponding null hypotheses, providing robust evidence in favor of substantial variations in these dimensions of intellectual capital over the specified time period. Nevertheless, the analysis does not identify a statistically significant difference in the SCE between the pre- and during-COVID-19 periods (p = 0.0801). Thus, there is insufficient evidence to reject the null hypothesis for the SCE based on the Wilcoxon signed-rank test.

Due to the inequality of variances, a comparison of mean scores between the 'sce_2019' and 'sce_2020' variables was conducted using Welch's *t*-test. The results from Table 6 revealed insufficient evidence to reject the null hypothesis, suggesting no substantial difference in means between the two periods for the SCE variable, aligning with the results from the Wilcoxon signed-rank test. This implies that the SCE may not undergo a significant change between the years 2019 and 2020.

Table 6. Welch's *t*-test for the strategic capital efficiency variable.

	Mean (Combined)	Mean (Diff.)	t Value	df	*p* Value
SCE (2019, 2020)	0.370	0.207	1.188	55.576	0.240

To conclude the significance level of the difference between these two groups, it is necessary to understand the effect size. Cohen's d [55] and Hedges's g [56] are calculated to identify the magnitude of the observed differences beyond statistical significance. Cohen's d measures the standardized difference between the means, providing insight into the practical significance of the findings. On the other hand, Hedges's g, similar to Cohen's d, adjusts for bias in small sample sizes. Both the effect size measures contribute valuable information to the interpretation, indicating not only whether a difference is statistically significant, but also the practical significance or real-world importance of that difference [55,56]. Table 5 reveals a statistically significant difference in the VAIC^{TM} between the pre-pandemic and during-pandemic periods, with a moderate effect size suggesting a substantial impact, consistent with a moderate effect size, indicating a notable change in the HCE. The results also indicate a highly statistically significant difference in the CEE between the pre-pandemic and during-pandemic periods, with a small effect size indicating a meaningful change. Although a trend toward significance is observed with the VAIC^{TM}, HCE, and CEE, the difference in the SCE between the pre-pandemic and during-pandemic periods is not statistically significant, and the effect size is small.

5. Discussion

There is no previous study examining the differences in intellectual capital and its components both before and during COVID-19 pandemic period, especially in tourism and business sectors, although there were critical suggestions highlighting the under-exploration and improvement opportunities in non-financial or intangible thematic areas [4]. One of closest related studies [57] examined how the changes of IC impact the firms' performance both before and after the pandemic crisis. Nevertheless, this study was conducted in a different research context to our research. It still did not focus on comparing the differences of IC and its components. Nonetheless, another group of IC- and COVID-19-related studies still focused on the investigations of the impact of IC to the performance of tourism firms. These works could only present the significant impact of IC on the financial or operational performances of tourism-related firms. Therefore, they still could not highlight the changes of the IC of tourism-related firms in intensively tourism-dependent countries both prior to and during the COVID-19 pandemic era. Therefore, from past findings, it is unclear that the changes in the impact of IC were caused by the transformations of IC and its components or not. To answer these questions, our study examined the changes of the overall IC and its elements both before and during the COVID-19 pandemic. Tests of the study's hypothesis could reflect the transformations of IC from actual situations, and, moreover, the findings derived from such examinations can provide valuable guidance for firms in enhancing their preparedness and management of IC, particularly in the context of pandemics or crises.

The results in Table 5 show that there were significant differences in overall IC performance and almost its components (CEE and HCE) between before and during the COVID-19 pandemic crisis. The following sessions are discussed according to each hypothesis.

5.1. The Overall IC of Tourism-Related Firms in Thailand

During the pandemic situation, the performance of the overall IC was significantly lower than before the COVID-19 period. The obtained results support the first hypothesis of our study. The lower performance of the overall IC came directly from the decline in all its components, including the capital employed efficiency, human capital, and structural capital. This emphasizes the negative impact of the pandemic, not only on the tangible assets, but also the intangible assets of organizations. Since the decrease in the overall IC in the tourism industry have not been examined in other past studies before, we tried to examine other relative studies. Nevertheless, from the best of our knowledge, there was only one relative study researching the differences of IC both before and during the pandemic crisis, and its findings supported the changes of IC utilization between those two different periods [29]. Nevertheless, the reasons for the decrease in the firms' IC during the crisis could not be directly explained by only the overall IC performance, as was similar

to our experience. Therefore, to find the reasons of IC transformation, in this study, we further examined the changes of IC components prior to and during the pandemic periods, as the discussions below following the remaining hypotheses of this study. However, from the results, it is clear that the impact of the pandemic significantly reduced the IC of tourism-related companies. This problem generally happens with most firms in the tourism industry which lack a crisis management and contingency plan [58]. To prepare firms for unprecedented challenges, they should manage and control significant risks by implementing risk management [59], since it was empirically justified for its positive relationship with firms' performance, especially with unforeseen situations [60] like the COVID-19 pandemic.

5.2. The Physical Capital of Tourism-Related Firms in Thailand

From the findings regarding the second hypothesis, the capital employed efficiency during the pandemic period was significantly lower than the pre-COVID-19 situation. Even though there was no past work that similarly studied the difference of the capital employed efficiency between the during-crisis and before-crisis periods, there still were relative findings supporting our results. Particularly, the decrease in the CEE of our study mainly came from the lower operating profits of organizations. There were several past findings highlighting the significant decline in the operating profits of tourism companies during COVID-19 [61], and the most critical impact came from a sharp decline in travel demand [62]. To curb the spread of the virus, the implementation of social measures, lockdowns, and travel restrictions significantly reduced almost all economic activities. Tourism-related businesses, such as accommodations, restaurants, and airlines, canceled or postponed their orders or bookings, leading to a significant reduction in reservations, occupancy rates, and, subsequently, the operating profits of organizations [63]. Moreover, the underutilization of rooms, dining facilities, amenities, and also aircrafts contributed to a decrease in the physical capital efficiency [64]. Many hotels and airlines in Thailand had almost zero demand from oversea guests during the year 2020 due to the travel restrictions [65], which negatively impacted their sale volume, profits, and operating costs. Hence, they decided to downsize their business and that leads to terminating the staff's contract. As can be seen in the case of the Wingspan Service company, a subsidiary of Thai Airways International (THAI), who terminated the employment of approximately 3000 workers during the pandemic [66].

Another reason for the decrease in operating profits is the increased operational costs and other costs of organizations [67]. To comply with the health and safety regulations of government, tourism-related companies had to incur additional activities and costs [68], such as enhanced cleaning protocols, social distancing, and protective equipment for staff. Moreover, investing in technology and renovation is another reason which can affect the increased costs of organizations. To adapt to the changes of consumer or tourist preferences and behaviors according to the pandemic crisis, some automations were adopted by tourism activities [69], such as service robots, online booking systems, contactless check-in processes, and other digital solutions which enhance safety and convenience. Similar to the renovations of organizations' physical spaces and constructions, several tourism firms accommodated social distancing policies and changed customers' behaviors [70,71]. For example, the renovations would involve redesigning seating arrangements [72], installing protective barriers [73], and making physical adjustments to comply with health protocols [74]. COVID-19 has changed the global travel landscape as health and hygiene have become the crucial considerations for travelling. In 2021, the concept of "New Normal travel" [75] was discussed, referring to the emerging tourist demands, such as niche travelling, safety-focused travel, and digitalization trends. Hence, during the pandemic, tourism-related firms in Thailand received less income from the change in demand; at the same time, they were requested to invest more towards the health policy. All these affected organizations via the reduction of the CEE when compared to the normal situation.

As presented above, there were several reasons affecting the decrease in profits and the consecutively reducing CEE of tourism firms. Nevertheless, it is difficult to be fully prepared for this kind of pandemic crisis. Some of the surviving strategies, including retrenchment strategy, persevering strategy, and new technology as well as innovation adoption strategies [58,67,76], can also mitigate those pandemic impacts to the CEE of tourism-related organizations. Government policies play a vital role in providing crucial support, particularly through resource aids and subsidies, which could offer financial assistance and alleviate direct costs of organizations [67,77]. Moreover, the reduction in the capital employed efficiency during the pandemic crisis could come from the decrease in intangible assets or human capital. The reasons for their reductions are presented in the discussion of the first hypothesis above and third hypothesis below.

5.3. The Human Capital of Tourism-Related Firms in Thailand

The findings of the third hypothesis confirmed the changes of human capital during COVID-19 when compared to the pre-pandemic period. To better understand this phenomenon, we have therefore examined past relevant studies. There were several significant factors affecting a decline in the human capital of tourism organizations indicated in several past studies. First, unemployment and job displacement are significant reasons directly reducing firms' human capital [78,79]. Several tourism-related companies were forced to close or reduce their operations during lockdowns and restrictions, leading to widespread job losses in tourism-related companies, such as airlines, hotels, restaurants, travel agencies, and tour operators. Most of the accommodations, restaurants, and airline businesses in Thailand needed to terminate their services due to the restriction policies from the government between 2020 and 2021. Furthermore, within the data announced by Thailand's Labor Ministry, there were around 7.7 million tourism-related workers before COVID-19, then 60% of them were dismissed during the year 2020, and following this, they mostly started a new career and decided not to return to the previous (tourism-related) jobs [80]. Therefore, during the COVID-19 pandemic, job displacement and unemployment can result in the loss of skills and work experience of employees, leading to a decline in human capital [1,81,82]. Moreover, as workers in the tourism industry were confronted with extended periods of unemployment and reduced working hours, there was a high risk of skill erosion [83]. Specifically, in dynamic industries such as the tourism sector, where staying updated with the latest trends and technologies is crucial [84], a prolonged break from work can lead to a decline in skills and expertise.

Second, many tourism-related businesses reduced annual training and development programs for their employees during the COVID-19 pandemic, largely due to the financial constraints and other uncertainties [85,86]. Therefore, the lack of investment in these skill and competency development initiatives can hinder the development and continuous improvement of the human capital of organizations [87]. This obstruction also leads to various problems for a tourism organization, or even the industry at large [88,89]. Generally, there are some key issues associated with a lack of or insufficient investments in skill development, including obsolete skills, reduced innovation, the inability to adapt to change, decreased organizational competitiveness, a risk of skill shortages, incongruity between employee skills, and organizational requirements, etc. According to the Thai Hotels Association (THA), the tourism sector has been challenged with a labor shortage of around 18,000 positions after Thailand started to reopen the country in 2022 [90]. Third, the health impact of employees is another critical factor affecting the human capital of firms [91]. Generally, most workers in tourism businesses directly contact customers, even in the pandemic crisis. Therefore, the physical and mental health of employees are directly and indirectly affected by changes of the working environment, working processes, and customers' behaviors related the COVID-19 pandemic situation [92–94]. It could also lead to increased stress, anxiety, and potential health issues [95], and these health-related challenges and issues can negatively impact the human capital of firms, such as the individual's ability to learn, work, and effectively and efficiently contribute to the company [93].

Another critical factor which affects the decline in human capital in the COVID-19 pandemic is a skill mismatch [96]. The significant shifts in business operations, driven by stringent social measures, have hastened the adoption and transformation of digital technologies. Empirically, these changes have led to a mismatch in skills among employees in the tourism industry [97,98]. One critical issue that contributes to skill mismatch issues is a technological advancement [98]. The development and improvement of technology, specifically responding to the COVID-19 pandemic, has altered several business operations. Automation, artificial intelligence (AI), data analytics, and other advanced technologies have become integral to the tourism industry, and the examples of well-known advanced technology in this service sector are contactless check-in and check-out, cleaning and disinfecting robots, mobile keys, AI chatbots and virtual assistants, unmanned aerial vehicles (UAV) for monitoring and surveillance, etc. For example, Air Asia launched "AVA", AirAsia Virtual Allstar, which is the AI chatbot system, which worked as a 24 h customer support via online platforms; this was applied as the main communication channel during the COVI-19 pandemic, largely due to the reducing of onsite staff, based on the pandemic lockdown policy [99]. Moreover, many firms applied online meeting systems into their business, such as Zoom.com and Google Meet, etc., as well as developed the virtual tour through social media platforms. The Tourism Authority of Thailand (TAT) has launched the virtual tour to remind international tourists about destinations in Thailand [100]. Regarding these new technologies, organizations may find that their employees possess insufficient or unaligned skills when looking at the companies' goals within the pandemic situation. Therefore, this mismatch could reduce employees' skills or the human capital of organizations. To protect organizations and to survive in the pandemic crisis, some changes and solutions affecting the regression of human capital, such as layoffs, unpaid leave, reduced working hours, etc., are unavoidable [58,101]. Nevertheless, some effects could be mitigated through human resource management strategies, and one of the suggested strategies that was significantly and widely accepted by several organizations during the pandemic crisis in tourism-related industries was upskilling training [102,103].

5.4. The Structural Capital of Tourism-Related Firms in Thailand

The analysis results of the last hypothesis showed insignificant differences of SCE prior to and during the COVID-19 period. Although most of the past relevant studies highlighted the decline of SCE during the COVID-19 period, there are some studies emphasizing managerial approaches and firms' outputs that could significantly increase the overall SCE of firms during the pandemic crisis. The successes or improved structural capital mainly derived from innovations, patents, and the licenses of products or services which were created for responding to the pandemic effects [104]. However, the majority of developments remained primarily concentrated in a few industries, notably pharmaceutical and healthcare industries, which have introduced new products, such as drugs, vaccines, diagnostic test kits, etc. In the tourism-related industries, some of the new well-known products or services developed for adapting to the COVID-19 situation were service robots, online booking systems, and contactless or mobile check-in and check-out processes [105–107]. The innovations and new products and services could directly affect the SCE of organizations. Therefore, the improvement of these organizational elements could protect the significant decline of the structural capital of firms, even though there were several findings in past studies that highlighted the problems and issues that negatively impact the structural capital of tourism firms. Nevertheless, the impacts of their transformations (e.g., organizational structure, relationships with stakeholders, reputations, etc.) are not directly included in the financial report of organizations, so they could not significantly impact the decrease in the firms' SCE. However, to better help tourism firms understand past situations and prepare for the future pandemic crises, our study further explores and concludes crucial reasons from past related works that would negatively affect the structural capital of organizations as follows.

The first reason is operational disruption, which is one of the most significant factors affecting the decline of structural capital. The social measures, lockdowns, and disruptions in the business operations of tourism-related activities during the pandemic period affected functions, the operational processes of organizations, and, especially, for their associated documents [59,108]. Several significant work procedures, instructions, and manuals before the pandemic period were useless since these documents were typically created for normal operating situations. Therefore, several documents or operational manuals of organizations must be updated or created [109,110]. There were several crucial reasons for their invalidities, including (1) the health and safety concerns of tourists, (2) new government laws, regulations, and restrictions, especially related to travel and social measures, quarantine requirements, and hygiene protocols, (3) the adaptation of new technologies, and (4) cost-saving strategies. Moreover, the Ministry of Tourism and Sports cooperates with the Tourism Authority of Thailand (TAT), the Ministry of Public Health, the Department of Disease Control, the Department of Health, and the Department of Health Service Support developed the amazing Thailand Safety and Health Administration (SHA) project, which aims to set the standard for the sanitation and safety standards of Thailand's tourism products and services, as well as to develop confidence among international and domestic tourists [111]. Therefore, all tourism-related businesses in Thailand needed to renovate and adjust their organization and their offered services in order to receive an SHA certificate. This increased its trustworthiness from customers and ensured its hygienic focus during the pandemic.

The second reason for structural capital decrease is an organizational restructuring [67]. The downsizing of firm structure directly and negatively affected the changes in organizational size, as well as the managerial structure, employee satisfaction, and, finally, the overall organizational capabilities [112]. This restructuring aims to support the change, as well as the adaptation of organizations to the pandemic crisis [113], since, during the COVID-19 period, tourism firms confronted several unprecedented problems, which directly destroyed their sustainability. Therefore, to cope with these critical challenges, the significant reasons for a firms' restructuring are (1) a substantial decline in travel demand, (2) financial constraint, and (3) operational and digital transformation. The first reason affecting the capital decrease comes from the direct effect of the pandemic crisis which led to a significant reduction in global travel demand [62]. Regarding travel restrictions, social measures, lockdowns, and public health concerns, tourism firms experience a significant decline in their customers and revenue [114]. Therefore, restructuring and downsizing became a necessary response for companies in order to align with the reduced demand in the tourism industry [115].

Moreover, the second reason is directly associated with the financial constraints experienced by organizations. Since most tourism-related firms faced severe financial problems due to the decline in travel demand, coupled with the persistent burden of operational costs, the requirement of organizational downsizing became imperative, since downsizing is a common feature of general cost-cutting strategies during crises [116,117]. From this measure, several companies in the tourism industry implemented layoffs, furloughs, and reductions in work hours in order to control the costs of organizations [118]. The operational and digital transformation is another significant reason for structural capital reduction since several safety protocols and social measures disrupted the normal operations of tourism firms [119]. Compliance with new protocols and regulations led to operational challenges, and, moreover, some changed operations required an adoption of automation technologies [106]. Therefore, most tourism firms downsized their organization structure, and they encouraged their workforce to adapt operations to be more digital and automated. Therefore, from the three crucial reasons above, the restructuring and downsizing of organizations is highly required to ensure the sustainability of organizations, especially when they are faced with several unprecedented challenges, uncertainties, and disruptions in moments of crises.

The third major reason decreasing structural capital is the loss of credibility and reputation [120]. The mismanagement of service cancellation and refunds was a significant problem [121] found in several tourism-related companies during the COVID-19 period, particularly tours, hotels, and airlines [122,123]. The difficulties of cancellations, claims, and refunds, whether due to unclear policies, delays in processing, or inadequate customer support, negatively impacted the credibility and reputation of firms [124]. Meanwhile, ethical concerns were another issue identified for its negative impact to the loss of reputation [125]. There were several unethical issues found in the tourism industry and other industries, including unfair employee treatment [126], price gouging [127], and unethical marketing [128]. From the various problems mentioned above, the treatment of employees during the pandemic was a key ethical issue. Several tourism-related firms made unethical decisions related to redundancy or furloughs without compensation [129]. Price gouging was another key issue, especially in the essential services of the tourism industry during the pandemic [127]. Some companies took advantage of the crisis by inflating the prices of tourism services, and this became a significant ethical concern. The last major reason affecting the credibility and reputation of tourism firms was unethical marketing. Some companies engaged in misleading advertising [130], particularly false safety claims which were misleading tourists and thus putting their health at risk.

The last crucial reason is a decline in the relational capital of tourism firms during the COVID-19 pandemic. Since this capital empirically impacts the performance of tourism-related business in the pandemic crisis period [24], its deteriorations directly affects the firms' performance and profitability. For this reason, tourism firms attempt to protect and efficiently utilize the relational capital in crisis situations. Even though some organizations could navigate the challenges of organizational relationships through effective communication, flexibility, and adaptability, most tourism firms still experienced the decline of relationships during the COVID-19 pandemic due to several reasons, including (1) ineffective communication [131] and (2) limited networking opportunities [132]. One of the significant problems directly reducing the relational capital is ineffective communication, and this issue could negatively impact the relationships of tourism firms for several reasons [133]. For example, unclear communication about travel restrictions, safety measures, and changes in organizational operations could lead to confusion among tourists, and this would negatively impact the relationships with customers. Similarly to ineffective or a lack of communication between suppliers or other stakeholders, tourism organizations experiencing such communication problems cause uncertainty and damages to stakeholders, impacting their relationships with the tourism firms. Another problem that significantly reduced the relational capital of firms is the opportunity to create or strengthen networks among stakeholders [134]. Regarding the social and safety measures and the lockdown policies, networking activities between tourism firms and stakeholders like local businesses, travel agencies, and government entities were significantly limited, and this reduced the strengths of their relationships. Moreover, this problem obstructed opportunities to build relationships with potential partners and other industry stakeholders.

Similar to the transformation of human capital, some of the problems or adaptations of tourism firms attempting to reduce structural capital are unavoidable, such as organizational restructuring, relational deterioration, outdated documents due to new emerging regulations, etc. However, most of the problems related to the structural capital presented above do not directly affect a firms' SCE, and, moreover, their negative effects could be compensated by the dominant impacts or advantages of emerging innovation, new products, or the services of organizations. Therefore, to protect or improve the structural capital of organizations during the pandemic crisis, tourism organizations need to focus on R&D and innovation management strategies which could foster the launch of sustainable innovation and innovative products or services which directly respond to the pandemic [135]. Furthermore, the government could support and facilitate the innovation development of the tourism sector through the integration of dynamic capabilities and resources [136].

6. Conclusions

In this section, three different subsections are divided in order to illustrate the research conclusion, policy recommendations, and the limitations of this study.

6.1. Research Conclusions

This study aims to examine the transformation of the overall IC and its components in the tourism-related industries of Thailand, an intensively tourism-dependent country, both prior to and during the pandemic crisis. Based on a sample of 37 tourism-related companies operating in the top intensively tourism-dependent country, which is Thailand, during two different periods: those prior (2019) and those during the COVID-19 pandemic (2020). The empirical findings show that the overall IC performance before the COVID-19 period is significantly higher than during the pandemic crisis. Specifically, values of all IC components except the SCE were significantly lower than before the pandemic. The impact of the virus directly and significantly decreased not only traditional assets or financial assets, but also the crucial intangible assets of organizations. Therefore, these unexplored findings caution tourism firms to be alert and to critically prepare for unprecedented crises in order to protect and sustain their intellectual capital, since IC could support the creation of competitive advantages and sustainability for organizations.

6.2. Policy and Practical Recommendations

Based on analysis results and findings, we extensively explored past relevant studies in order to provide reasons for IC changes, as well as the preventive guidelines in tourism-related industries. All significant suggestions and implications regarding the hypotheses are presented within the four points below.

First, the overall IC of tourism-related firms would significantly decline during the pandemic crisis. Therefore, to prepare for the maintenance and improvement of overall intangible assets during crises, firms should execute the enterprise's risk management. The detection of all critical risks could support firms in understanding the decline in IC elements, and they could prepare preventive plans or solutions that specifically respond to their own risks in order to protect the decline in the overall IC and its components. On the other hand, to support liquidity and to avoid the solvency of tourism firms in general, government should prepare reserve funds for providing immediate assistance when needed.

Second, the physical capital of tourism-related firms in Thailand was statistically decreased due to the pandemic. This refers to all operation costs that were caused by health-related challenges, hygienic policies, and travel restrictions from the government. Hence, the firms should prepare their funds to handle all expenses that may be caused in such a situation, and this preparation should be based on the renovating of their facilities and/or challenging travel restrictions. Furthermore, the government should announce the assistance policy and provide a subsidiary plan for the tourism enterprises that need to terminate their operations during the pandemic, such as reducing loan interest and tax and increasing the overall IC of the firms.

Third, unemployment and job displacement are not only the main reasons directly reducing firms' human capital but withholding annual training programs and intensifying health and safety policies also impacts the tourism sector's intellectual capital due to this increasing the concern of financial constraints during the pandemic. This leads to a shortage of workforce skills and knowledge. The firms should allocate the financial budget for development and training programs, especially in the digital literacy skills for employees, which could increase the HCE of these organizations. Furthermore, the tourism-related institutions, such as the Thai Hotel Association (THA), the Ministry of Labor, and academic sectors, may collaborate in order to provide the necessary training and important skills for tourism workers, such as information technology literacy and service skills. Nonetheless, the government should create a subsidiary policy for the tourism-related firms that have to handle a high salary expense to solve the redundancy and unemployment rates. This

might increase the tourism-related organization's intellectual capital towards HCE, even during the pandemic.

Fourth, even though the SCE was not significantly changed during this pandemic when compared to the normal situation, the tourism-related companies should pay attention to developing and maintaining a good reputation of the business at all times. To increase the firm's IC towards structural capital and competitive advantages, the tourism enterprises should provide alternative communication channels and develop an innovative product/service for all customers and stakeholders, especially new useful digital technologies, such as data analytics and social media marketing. Nonetheless, the government should offer policies such as low interest loans and financial assistance in order to support the tourism-related industry, based on their affection. These might reduce the downsizing or layoff solution based on the pandemic impact but may also increase the structural capital.

6.3. Limitations and Future Work

This study has some limitations that should be underlined. First, the sample of the study is still limited to one intensively tourism-dependent country, Thailand. Moreover, at the beginning of the study, we planned to examine firms that were only listed in the tourism industry. However, regarding the limited amount of data which directly affected the reliability of the results, we extended the data to another related industry, which is the transportation and logistics industry. Although several companies directly and mainly contribute to tourism-related activities, like airline business, some firms still provide operations that indirectly respond or did not serve tourism-related activities, such as express couriers. Therefore, future research could extend the analysis to include other intensively tourism-dependent countries and regions, only examining the direct tourism-related firms in order to provide a better generalizability of findings. Second, the sample size of the firms' data is limited. Regarding the limited resources, the time of the research project, and also the availability of the data during the study, this research focused on one-year data (2020) from the COVID-19 pandemic period, which is the year that tourism firms enormously experienced the impacts of the crisis. To consider the same length of data for the pre-pandemic period, the study similarly examined one-year data (2019) from before the COVID-19 impact. Therefore, to improve the robustness of the results, there is an improvement opportunity for future research to consider the expansion of data ranges both prior to and during COVID-19 pandemic periods. Moreover, regarding the improvement of data ranges and sizes, other data analysis approaches could be applied in order to provide more beneficial and more robust results. Third, the performance of the IC was measured through the VAIC^{TM}, which was highlighted for its critical flaws. Some past studies criticized its invalidity for assessing intangible assets for both overall and component levels. Nevertheless, despite the wide criticisms of VAIC^{TM}, there are still no improved methods which could properly overcome its fundamental flaws. Therefore, similarly to several past studies, the utilization of VAIC^{TM} for measuring the intangible assets of organizations is unavoidable.

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