



Restaurants' Transition to Industry 5.0: Strategies Adopted Based on Their Level of Maturity

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Abstract

Industry 5.0 moves beyond automation, cyber-physical solutions, and AI-driven efficiency, which represent the cornerstone of Industry 4.0, to harmonizing human intelligence with smart technologies. Thus, the importance of intellectual capital (IC) increases since this influences company's ambidexterity and their reaction to change. Nevertheless, little is known about the influence that IC has on the strategies that companies chose during their transition towards Industry 5.0. Taking this into account, this research aims to determine if the IC dimensions influence the reactions of the young, developmental, and mature restaurants during their transition towards Industry 5.0. The analysis focuses on 366 restaurants and data are collected from the financial reports and companies' websites. Given the fact that a longitudinal study is conducted, data are processed using generalized estimating equations. The results prove that several differences appear among the restaurants based on their level of maturity. Thus, during their transition towards Industry 5.0, young restaurants' reactions are strongly influenced by human and relational capital while the reactions of the developmental restaurants are strongly influenced by relational capital; furthermore, all three IC dimensions influence the reactions of the mature restaurants. These findings have both theoretical and practical implications; on the one hand, they expand the literature from the hospitality and IC management field by providing an analysis on how restaurants' IC can influence managers' decision during their transition towards Industry 5.0, and on the other hand, it offers a strategic tool for the restaurants' managers.

Keywords: Human Capital; Industry 5.0; Relational Capital; Restaurant; Structural Capital

1. Introduction

Various scholars state that intellectual capital (IC) can increase a company's competitiveness (Delgado-Verde et al., 2015; Martin-de-Castro et al., 2013) and that it can also act as a strategic asset during crises (Kehelwalatenna, 2016; Mohapatra et al., 2019). Still, it must be stated that the IC topic is rarely approached in the hospitality literature although this is a knowledge-driven economic sector due to the fact that people "do not buy service delivery, they buy experiences; they do not buy service quality, they buy memories" (Hemmington, 2007, p.749). However, some attempts have been made regarding

the importance of IC for the hotel industry (Khalique et al., 2020; Liu & Jiang, 2020; Li & Liu, 2018) while research in the restaurant industry remains limited. Fernandez-Perez de la Lastra et al. (2020) and Leon (2021) are the only ones that have brought forward the impact of IC on restaurant development. Thus, Fernandez-Perez de la Lastra et al. (2020) prove that haute cuisine restaurants could develop their ambidextrous capabilities through their IC while Leon (2021) shows that structural and relational capital can predict restaurants' strategic decisions in times of crisis. Nevertheless, firm maturity is not taken into consideration, although previous studies (Forte et al., 2017; Lee & Lin, 2019) show that a firm's age is a strong influencer of IC performance.

Furthermore, when it comes to the changes that occur at the industry and society level, most studies from the IC management field concentrate on economic crisis periods and neglect the transitions from Industry 3.0 to Industry 4.0 and from Industry 4.0 to Industry 5.0. The latter is the most recent one and it brings forward a change of perspective, putting human resources at the center of economic activity and enabling human-technology collaboration (Leon et al., 2024; Nand et al., 2023).

The current research aims to fill these gaps by providing an answer to the following question: In the context of transitioning from Industry 4.0 to Industry 5.0, would IC dimensions be able to anticipate the reactions of young, developmental, and mature restaurants? In other words, could IC dimensions be used to predict whether young, developmental, or mature restaurants will be more tempted to adapt to market demands rather than adopting a stability strategy, in the context of a fast transition from Industry 4.0 to Industry 5.0? In order to provide an answer to this question, an exploratory longitudinal study was developed among 366 restaurants from Romania.

The current article is structured as follows. Section 2 highlights the theoretical foundation and brings forward IC characteristics. Section 3 presents the methodological design, while Section 4 sheds light on the main results. Section 5 closes this article by synthesizing the main conclusions and emphasizing several theoretical and practical implications of the results.

2. Theoretical Background

The IC-based view of the firm develops as an extension of the resource-based theory, and it concentrates on the knowledge created and stored in a firm's capital (Martin-de-Castro, 2014). Thus, it deals with the explicit and tacit knowledge incorporated in the relationships and networks established among people, groups, and organizations. It is usually defined as the sum of all the knowledge and knowledge capabilities that can increase a firm's competitiveness (Youndt et al., 2004) through its rarity, inimitability, non-substitutability, and non-observable nature (Kehelwalatenna, 2016).

Various scholars and practitioners (Jardon, 2018; Martin-de-Castro et al., 2014) present IC as a strategic asset that can be divided into human, structural (organizational), and relational capital. Human capital incorporates employees' know-how, abilities, competencies, talent, and skills, and it is the largest and most important intangible asset of the firm due to its role in driving innovation (De Winne & Sels, 2010). Structural capital is defined as "knowledge, skills, experiences, and information that are institutionalized, codified, and used in relation to databases, patents, manuals, structures, systems, routines, and processes" (Jardon, 2018, p.136); it reflects a firm's capacity to deploy and develop more resources in the market and quickly adapt to environmental challenges (Liu & Jiang, 2020). Last but not least, relational capital refers to "the value of the organization to the relationships that it maintains with the main agents connected with its basic business processes – customers, suppliers, allies, etc. – as well as the value of the organization of the relationship that it maintains with other social agents" (Martin-de-Castro et al., 2010, p.653), and it has the greatest influence on a firm's financial performance and sustainable growth rate (Xu & Wang, 2018).

Although previous studies emphasized the critical role of IC in ensuring a firm's competitive advantage (Delgado-Verde et al., 2015), most of the analyses concentrated on the information technology sector and the pharmaceutical industry (Bontis et al., 2015). The service industry, especially the hospitality and tourism industry, is neglected, although it is more dynamic in terms of value creation (Battisti et al., 2015) and its existence is based on creating and selling experiences (Hemmington, 2007) which are by nature intangible.

Still, some attempts have been made recently. Some researchers adopt a general, cross-sectional perspective and prove that IC has a positive influence on competitive advantage (Khalique et al., 2020; Li & Liu, 2018), while others adopt a particular, predictive perspective and state that IC fosters the prediction of customer needs (Liu, 2017), facilitates problem identification (Li & Liu, 2018), and that its dimensions (human, structural, and relational capital) can act as a catalyst in developing brand equity (Liu & Jiang, 2020). However, these studies focus on the hotel industry (Khalique et al., 2020; Li & Liu, 2018; Liu & Jiang, 2020), while research regarding the use of IC in the restaurant industry remains in an embryonic stage of development. Fernandez-Perez de la Lastra et al. (2020) and Leon (2021) are the only ones that have brought forward the importance of IC for restaurants development and strategic behavior. Fernandez-Perez de la Lastra et al. (2020) prove that haute cuisine restaurants could develop their ambidextrous capabilities through their IC. Nevertheless, the same rules could apply to all the restaurants, since all of them operate on a dynamic market (customer preferences change faster and faster), they have to continuously absorb and process internal and external explicit and tacit knowledge, and they have to improve their capacities and capabilities in order to satisfy customer needs and positively respond to market challenges.

On the other hand, the studies developed so far tend to analyze IC's impact on a firm's competitiveness and behavior during growth periods (Fernandez-Perez de la Lastra et al., 2020; Liu & Jiang, 2020). In other words, they prove that IC improves a company's capacity to capitalize on market opportunities (Rienda et al., 2020; Romero & Tajeda, 2020) when the economy is predictable. However, according to Li and Liu (2018), a higher level of IC should increase a company's problem identification and solution procedures. Thus, IC should be a strategic asset during periods of change.

A firm's level of maturity is usually measured based on the length of establishment (the business age), which emphasizes a company's experience on the market (Lee & Lin, 2019). Its influence on a firm's behavior and performance is presented in both IC literature and change management literature, but the results obtained so far are contradictory. In the IC literature, some scholars (Goebel, 2015) argue that there is no significant relationship between a firm's level of maturity and IC value, while others (Lee & Lin, 2019; Temouri et al., 2021) claim that such a relationship does exist. However, the opinions within the latter category are split. On the one hand, Lee and Lin (2019) indicate that mature (older) firms have better results in accumulating and using their IC, since they have a better reputation among clients, better professional competence, and they can use their rich past experience. On the other hand, Temouri et al. (2021) show that there is a negative relationship between a firm's level of maturity and IC value due to the fact that as a firm gets older, its structure and processes become rigid and its knowledge becomes obsolete.

To broaden the contextual understanding of Industry 5.0, it is valuable to consider its implications and early adoption patterns in light of geographic and regional particularities. While the human-centric, sustainable, and resilient principles of Industry 5.0 are universal (Breque et al., 2021), their operationalization and strategic priority can vary significantly across different regional economic landscapes. For instance, in Western European and North American contexts, the transition to Industry 5.0 is often framed within discussions of re-shoring, ethical AI, and achieving a sustainable competitive advantage through high-value customization and

employee well-being (Xu et al., 2021; Nahavandi, 2019). The focus is frequently on integrating advanced technologies like collaborative robotics (cobots) and digital twins to augment human skills rather than replace them, particularly in manufacturing and high-tech services.

In contrast, emerging economies in Asia have approached Industry 5.0 with a strong emphasis on leveraging it for rapid technological leapfrogging and enhancing supply chain resilience. For example, studies in China highlight the government's role in promoting smart manufacturing initiatives that blend Industry 4.0 technologies with human oversight to maintain flexibility and address skilled labor variations (Jiang et al., 2025). In the hospitality sector specifically, regions like Southeast Asia have seen early adoption of human-technology collaboration in tourism, focusing on hyper-personalized guest experiences powered by AI while retaining high-touch service culture (Ivanov & Webster, 2019). This regional variation suggests that the drivers and manifestations of the Industry 5.0 transition are not monolithic but are shaped by local economic structures, labor markets, and policy priorities.

This global perspective underscores a critical gap: there is limited empirical research on how the service sector, and particularly the hospitality industry, is navigating this transition in the specific context of Central and Eastern Europe (CEE). The CEE region, with its unique post-transition economic dynamics, specific labor market characteristics, and evolving innovation ecosystems, may present a distinct scenario for Industry 5.0 adoption. Therefore, by focusing on Romania, this study not only addresses a gap in the restaurant-specific IC literature but also contributes a vital case study from an under-represented regional context, allowing for future comparative analyses on how regional factors influence strategic responses to this new industrial paradigm.

Given the limited empirical research regarding the role of IC in the restaurant industry, its effect on a firm's behavior during crises, and the influence of firm maturity, the current article aims to explore the capacity of IC dimensions to anticipate the reactions of the young, developmental, and mature restaurants during their transition to Industry 5.0.

3. Methodology

The research aims to determine if the IC dimensions influence the reactions of the young, developmental, and mature restaurants during their transition to Industry 5.0. Therefore, the following research objectives are pursued: (i) to analyze restaurants' behavior during their transition to Industry 5.0; (ii) to determine the influence of human, structural, and relational capital on restaurants' behavior; (iii) to analyze the influence of restaurants' maturity on the relationship between IC dimensions and strategic behavior before and after their transition to Industry 5.0.

The analysis focuses on restaurants from Romania. According to the National Institute of Statistics (2023), there are 12824 restaurants on the local market which employ over 88968 persons. From these, 7678 restaurants are listed on TripAdvisor as "the best restaurants from Romania". The methodological rigor of this study is contingent upon the careful selection of a sampling frame that ensures the validity and generalizability of the findings. The sampling frame is constructed in a multi-stage process to balance feasibility with the strategic objective of targeting establishments most likely to be engaged in strategic adaptation and technological transition. The initial population is correctly anchored in official data. The critical refinement to restaurants listed on TripAdvisor is a deliberate and justifiable strategic choice. The transition to Industry 5.0, characterized by human-technology collaboration and a focus on experience, is likely to be first adopted by market leaders and more proactive firms. These "best" restaurants, as curated by a major digital platform, are precisely the entities for which strategic decisions regarding IC and technological adaptation are most relevant and observable. They are more likely to have an online presence, publicly available financial reports, and a strategic orientation that makes them early candidates for navigating industrial paradigm shifts. Therefore, this frame effectively targets the

relevant population for this specific phenomenon, rather than the entire population of restaurants, many of which may be small, informal, or not strategically engaged with such transitions.

From this refined frame of 7678 establishments, a sample of 366 restaurants is extracted using the step-method, corresponding to a 95% confidence level and a +/-5 confidence interval. This sample size is statistically appropriate for the defined frame and provides a robust basis for quantitative analysis. The use of a systematic step-method suggests a structured approach to selection, which minimizes selection bias within this specific group. Furthermore, the distribution of the sample across maturity stages (Young: 41.53%, Developmental: 24.59%, Mature: 33.88%) indicates that the sample is statistically representative by structure, allowing meaningful comparative analysis.

The analysis concentrates on restaurants' economic behavior before and after their transition to Industry 5.0. Thus, data regarding restaurants' actions during Industry 4.0 are collected in December 2015, while data regarding restaurants' actions during their transition to Industry 5.0 are collected in May 2025. Data are collected from companies' websites and are coded as a dummy variable ("0" – for stability strategies, "1" – for adaptive strategies).

To ensure robustness and reliability, a rigorous content analysis procedure is employed. The coding scheme is operationalized as follows. A 'stability strategy' (coded as 0) is defined by observable indicators of maintaining the status quo, such as: no mention of new technology integration (e.g., AI, IoT, automation), absence of new service or experiential offerings, no changes to business models or operational processes described, and a primary communication focus on traditional culinary excellence and established practices. Conversely, an 'adaptive strategy' (coded as 1) is defined by indicators of proactive change aligned with Industry 5.0 principles, including: the introduction of technologies that collaborate with staff (e.g., cobots in kitchens, AI for personalized menu recommendations), the implementation of new digital platforms for customer engagement (e.g., app-based loyalty programs, augmented reality menus), the launch of new experiential dining concepts, and explicit communication regarding process innovation or business model adaptation to enhance human-centricity and resilience.

The content analysis is conducted by the authors and two experts in knowledge management. To assess inter-rater reliability, a random sub-sample of 50 restaurants (13.7% of the total sample) is coded independently by all raters (the authors and knowledge management experts). The inter-rater agreement is determined using Cohen's Kappa (κ), which accounts for agreement by chance. The resulting κ coefficient is 0.89, indicating an 'almost perfect' level of agreement according to conventional benchmarks (Landis & Koch, 1977). Any discrepancies in coding for this sub-sample are resolved through discussion, leading to a refinement of the coding protocol for clarity. The remaining websites are then divided between the authors and the knowledge management experts for coding. This process ensures that the classification of restaurant strategy is both valid and highly reliable.

The dimensions of restaurants' IC are measured using financial proxies derived from companies' financial reports, a well-established practice in IC literature due to their objectivity and standardization. Following the model established by Sardo et al. (2018), the following IC proxies are considered for each dimension:

- Human capital is measured using staff costs per employee (total staff costs / number of employees). This measure refines total staff costs by accounting for firm size, providing an indicator of the investment in each employee's knowledge, skills, and competencies. A higher value suggests more qualified or experienced human resources, which is central to the human-centric collaboration emphasized by Industry 5.0.
- Structural capital is evaluated based on the working capital turnover (Revenue / Net Working Capital). This ratio reflects the efficiency of a firm's operational processes and structure in generating sales. A higher turnover indicates leaner and more effective

organizational routines and internal systems, key components of structural capital that enable a firm to deploy resources agilely.

- Relational capital is measured using revenue growth. In a highly competitive and dynamic industry like hospitality, sustained revenue growth is difficult to achieve without strong relational capital. It reflects the cumulative result of customer loyalty, positive word-of-mouth, effective brand management, and the ability to retain and expand a client base, all hallmarks of robust relational capital (Martin-de-Castro et al., 2010). While it is acknowledged that revenue growth can be influenced by other factors (e.g., macroeconomic conditions, location), its use as a proxy is justified in this longitudinal study focusing on intra-industry comparison within the same national market, where such external factors are a constant across the sample. Furthermore, for knowledge-intensive service firms like the "best restaurants" in this study's frame, which compete on experience and reputation, revenue growth is a particularly salient signal of successful customer relationship management.

Furthermore, the analysis takes into account firm age, which is considered a strong influencer of IC performance (Forte et al., 2017; Lee & Lin, 2019). Thus, following the European Union (2014) approach, the distinction is made among: young restaurants (with less than 5 years), developmental restaurants (with 5 to 10 years of experience), and mature restaurants (with more than 10 years). Sample distribution based on restaurants' development stage is presented in Table 1.

Table 1: Sample distribution based on restaurants' level of maturity

Type of restaurant	Number of analyzed units	Percentage
Young	152	41.53%
Developmental	90	24.59%
Mature	124	33.88%
Total	366	

Data are processed using SPSS and the generalized estimation equation (GEE) model. This analytical technique is appropriate for the longitudinal analysis as it provides more efficient and unbiased regression estimates (Lu et al., 2020; Tsai et al., 2019). Within this framework, a binomial distribution with a logit link function is selected, as the dependent variable (restaurants' economic behavior) is a binary outcome (0 = Stability, 1 = Adaptation), and an exchangeable (compound symmetry) structure is specified. This structure assumes the correlation between the two repeated observations (Industry 4.0 and the transition to Industry 5.0) for a given restaurant is constant; this is theoretically sound and computationally efficient for a short longitudinal design with only two time points. Furthermore, the analysis is clustered at the restaurant level, with each of the 366 restaurants contributing two observations. This clustering accounts for the non-independence of observations from the same establishment across time.

To isolate the net effect of IC dimensions, the model included several control variables known to influence strategic behavior, such as firm size and chain affiliation. The former takes into account that larger firms may have more resources to invest in adaptation, while the latter considers that chain-affiliated restaurants may have their strategic decisions heavily influenced by corporate headquarters rather than their own IC. This approach is applied to the overall sample and then separately to the sub-samples of young, developmental, and mature restaurants to test for differential effects based on firm maturity.

Furthermore, to verify the robustness of the GEE model, which provides population-averaged estimates (Hardin & Hilbe, 2013), a supplementary analysis is conducted using a panel random-effects logit model. While the GEE model accounts for within-cluster correlation to produce robust standard errors, the random-effects logit model adopts a different approach by explicitly modeling unobserved, time-invariant heterogeneity across restaurants through cluster-specific

random intercepts (Wooldridge, 2010). This methodological triangulation follows best practices in empirical research for testing whether results are sensitive to modeling assumptions (Angrist & Pischke, 2009). The consistency observed in the direction, statistical significance, and substantive magnitude of coefficients across both estimation techniques strengthens the credibility of the findings, indicating that the reported relationships are not an artifact of a specific modeling choice but represent robust patterns within the data.

4. Results

The analysis first presents the overall influence of IC dimensions on restaurant behavior during the transition to Industry 5.0, before delving into the significant differences identified based on restaurant maturity.

4.1. Overall Influence of Intellectual Capital

The transition to Industry 5.0 is significantly influenced by certain IC dimensions (Table 2), with human capital emerging as a primary driver of adaptive behavior. Hence, restaurants' behavior during their transition to Industry 5.0 is strongly influenced by human capital ($\beta=0.001$, $p=0.000 < 0.001$). This indicates that for every one-unit increase in human capital (staff costs per employee), the log-odds of adopting an adaptive strategy increase by 0.001. The corresponding odds ratio, $\text{Exp}(B)=1.001$, signifies that for every additional unit invested in staff costs per employee, the odds of adaptation to Industry 5.0 increase by 0.1%. While this effect is statistically significant, its practical magnitude is very small, suggesting that human capital acts as a significant but weak predictor at the overall sample level.

In contrast, neither relational capital ($\beta=-0.001$, $p=0.423$) nor structural capital ($\beta=-0.007$, $p=0.256$) showed a significant overall effect.

The model includes a categorical "Industry level" variable with two levels: "Industry 4.0" and "Transition to Industry 5.0". In the GEE output, one level is set as the reference category (redundant, with parameters set to zero), and the other is estimated. Table 2 shows the parameter for "Industry 4.0" is estimated ($B=1.130$), meaning "Transition to Industry 5.0" is the reference category.

Table 2: GEE analysis of the relationships between IC dimensions and restaurants' behavior during their transition to Industry 5.0

Parameter	B	SE	Wald Chi-Square	df	Sig.	Exp (B)	95% Confidence Interval for Exp(B)	
							Lower	Upper
(Intercept)	-1.334	.180	54.856	1	.000	.263	.185	.375
Industry 4.0	1.130	.156	51.983	1	.000	3.097	2.277	4.211
Transition to Industry 5.0	0 ^a	.	.	.	.	1	.	.
Human Capital	.001	.000	17.287	1	.000	1.001	1.001	1.002
Relational Capital	-.001	.001	.642	1	.423	.999	.997	1.001
Structural Capital	-.007	.006	1.289	1	.256	.993	.981	1.005
Industry 4.0 * Human Capital	-.001	.000	9.105	1	.003	.999	.999	1.000
Transition to Industry 5.0 * Human Capital	0 ^a	.	.	.	.	1	.	.
Industry 4.0 * Relational Capital	.000	.001	.035	1	.852	1.000	.998	1.002

Parameter	B	SE	Wald Chi-Square	df	Sig.	Exp (B)	95% Confidence Interval for Exp(B)	
							Lower	Upper
Transition to Industry 5.0 * Relational Capital	0 ^a	.	.	.	.	1	.	.
Industry 4.0 * Structural Capital	.006	.006	1.017	1	.313	1.006	.994	1.018
Transition to Industry 5.0 * Structural Capital	0 ^a	.	.	.	.	1	.	.
Dependent Variable: Restaurants' economic behavior Model: (Intercept), Industry level, Human Capital, Relational Capital, Structural Capital, Industry level * Human Capital, Industry level * Relational Capital, Industry level * Structural Capital								
a. Set to zero because this parameter is redundant.								

Therefore, the behavior of the Romanian restaurants (RB) can be predicted based on the following equation:

$$\begin{aligned}
 \text{Log - Odds}(RB) = & -1.334 + (1.130 * \text{Industry 4.0} + (0.001 * \text{Human Capital}) + (-0.001 * \\
 & \text{Relational Capital} + (-0.007 * \text{Structural Capital}) + (-0.001 * \\
 & \text{Industry 4.0} * \text{Human Capital} + (0.006 * \text{Industry 4.0} * \\
 & \text{Structural Capital}
 \end{aligned}
 \tag{1}$$

4.2. The role of Restaurant Maturity

Still, significant differences appear among the restaurants, based on their level of maturity (Table 3). There is a statistically significant difference in the economic behavior adopted by (i) the young restaurants and the developmental ones ($p=0.043 < 0.05$), (ii) the young restaurants and the mature ones ($p=0.008 < 0.01$), and also (iii) the developmental restaurants and the mature ones ($p=0.000 < 0.001$). Thus, 59.86% of the young restaurants, 80% of the developmental restaurants, and 31.45% of the mature restaurants decided to adapt Industry 4.0, focusing on digitalization. Within this framework, 77.63% of the young restaurants, 84.44% of the developmental restaurants, and 76.61% of the mature restaurants decided to adapt their activity, transitioning to Industry 5.0; the rest of them implemented a stability strategy, maintaining the same activity.

Besides, significant differences appear among the restaurants when it comes to IC dimensions. Regarding the human capital, there are significant differences between (i) the young restaurants and the mature ones ($p=0.000 < 0.001$), and (ii) the developmental restaurants and the mature ones ($p=0.004 < 0.005$). Regarding the relational capital, there are significant differences between (i) the young restaurants and the developmental ones ($p=0.004 < 0.005$), and (ii) the developmental restaurants and the mature ones ($p=0.001 < 0.005$). Last but not least, there are significant differences in terms of structural capital between (i) the young restaurants and the mature ones ($p=0.004 < 0.005$), and (ii) the developmental restaurants and the mature ones ($p=0.023 < 0.05$).

Table 3: Comparative analysis among the restaurants, based on their level of maturity

Variable	(I) Level of maturity	(J) Level of maturity	Mean Difference (I-J)	SE	Sig.	95% Confidence Interval	
						Lower	Upper
Economic behavior	Young	Developmental	-.131*	.054	.043	-.260	-.003
		Mature	.150*	.049	.008	.032	.267
	Developmental	Young	.131*	.054	.043	.003	.260
		Mature	.281*	.057	.000	.147	.416

Variable	(I) Level of maturity	(J) Level of maturity	Mean Difference (I-J)	SE	Sig.	95% Confidence Interval	
						Lower	Upper
	Mature	Young	-.150*	.049	.008	-.267	-.032
		Developmental	-.281*	.057	.000	-.416	-.147
Human Capital	Young	Developmental	-29.865	45.481	.789	-136.813	77.082
		Mature	-181.521*	41.545	.000	-279.215	-83.826
	Developmental	Young	29.865	45.481	.789	-77.082	136.813
		Mature	-151.655*	47.542	.004	-263.451	-39.8592
	Mature	Young	181.521*	41.545	.000	83.826	279.215
		Developmental	151.655*	47.542	.004	39.859	263.451
Relational Capital	Young	Developmental	-212.841*	65.596	.004	-367.091	-58.5923
		Mature	40.165	59.921	.781	-100.737	181.069
	Developmental	Young	212.841*	65.596	.004	58.592	367.091
		Mature	253.007*	68.570	.001	91.765	414.249
	Mature	Young	-40.165	59.921	.781	-181.069	100.737
		Developmental	-253.007*	68.570	.001	-414.249	-91.765
Structural Capital	Young	Developmental	-10.536	77.405	.990	-192.554	171.480
		Mature	-224.890*	70.708	.004	-391.159	-58.622
	Developmental	Young	10.536	77.405	.990	-171.480	192.554
		Mature	-214.353*	80.914	.023	-404.622	-24.085
	Mature	Young	224.890*	70.708	.004	58.622	391.159
		Developmental	214.353*	80.914	.023	24.085	404.622

*. The mean difference is significant at the 0.05 level.

Given these differences, the GEE analysis is performed at the level of each category of restaurant in order to determine the effect of IC dimensions on restaurants' economic behavior.

4.2.1. Strategies of Young Restaurants

Young restaurants' behavior during their transition to Industry 5.0 (Table 4) is strongly influenced by human capital ($\beta=0.986$, $p=0.000 < 0.001$) and relational capital ($\beta=0.011$, $p=0.020 < 0.05$). The odds ratio for human capital, $\text{Exp}(B)=2.680$, indicates that for every one-unit increase, the odds of a young restaurant adopting an adaptive strategy during the transition to Industry 5.0 increase by 168%. Additionally, for every one-unit increase in relational capital, the odds of adaptation increase by 1.1% ($\text{Exp}(B)=1.011$). This finding for relational capital indicates that young restaurants experiencing higher revenue growth are slightly more likely to adapt. This likely reflects a virtuous cycle where successful firms have more resources and confidence for further innovation, or that early adopters of adaptive strategies are rewarded with growth.

Against this background, the economic behavior of the young restaurants (RB_Y) can be predicted based on the following relation:

$$\text{Log - odds}(RB_Y) = 1.006 + (-1.558 * \text{Industry 4.0}) + (0.986 * \text{Human Capital}) + (0.011 * \text{Relational Capital}) + (0.099 * \text{Structural Capital}) +$$

$$(-0.982 * \text{Industry 4.0} * \text{Human Capital}) + (-0.007 * \text{Industry 4.0} * \text{Relational Capital}) + (-0.1 * \text{Industry 4.0} * \text{Structural Capital}) \quad (2)$$

Table 4: GEE analysis of the relationships between IC dimensions and young restaurants' behavior during their transition to Industry 5.0

Parameter	B	SE	Wald Chi-Square	df	Sig.	Exp (B)	95% Confidence Interval for Exp(B)	
							Lower	Upper
(Intercept)	1.006	.583	2.969	1	.085	2.735	.871	8.591
Industry 4.0	-1.558	.535	8.462	1	.004	.211	.074	.602
Transition to Industry 5.0	0 ^a	.	.	.	.	1	.	.
Human Capital	.986	.267	13.631	1	.000	2.680	1.586	4.527
Relational Capital	.011	.004	5.450	1	.020	1.011	1.002	1.020
Structural Capital	.099	.052	3.587	1	.058	1.105	.997	1.224
Industry 4.0 * Human Capital	-.982	.266	13.545	1	.000	.374	.222	.632
Transition to Industry 5.0 * Human Capital	0 ^a	.	.	.	.	1	.	.
Industry 4.0 * Relational Capital	-.007	.005	1.567	1	.211	.993	.983	1.004
Transition to Industry 5.0 * Relational Capital	0 ^a	.	.	.	.	1	.	.
Industry 4.0 * Structural Capital	-.100	.050	3.871	1	.049	.905	.819	1.000
Transition to Industry 5.0 * Structural Capital	0 ^a	.	.	.	.	1	.	.
Dependent Variable: Young restaurants' economic behavior Model: (Intercept), Industry level, Human Capital, Relational Capital, Structural Capital, Industry level * Human Capital, Industry level * Relational Capital, Industry level * Structural Capital								
a. Set to zero because this parameter is redundant.								

4.2.2. Strategies of Developmental Restaurants

The strategic posture of developmental restaurants (5-10 years old) hinges primarily on their relational networks (Table 5). In this case, managers' decisions are strongly influenced by relational capital ($\beta=0.583$, $p=0.032 < 0.05$). The odds ratio, $\text{Exp}(B)=1.792$, indicates that for every one-unit increase in relational capital, the odds of a developmental restaurant adopting an adaptive strategy increase by 79.2%. The result brings forward a strong correlation between prior success (as measured by revenue growth) and the capacity for further strategic adaptation.

Table 5: GEE analysis of the relationships between IC dimensions and developmental restaurants' behavior during their transition to Industry 5.0

Parameter	B	SE	Wald Chi-Square	df	Sig.	Exp (B)	95% Confidence Interval for Exp(B)	
							Lower	Upper
(Intercept)	.832	.079	109.943	1	.000	2.298	1.967	2.684
Industry 4.0	.014	.004	8.573	1	.003	1.015	1.005	1.024
Transition to Industry 5.0	0 ^a	.	.	.	.	1	.	.
Human Capital	.000	.001	.062	1	.803	1.000	.997	1.002
Relational Capital	.583	.272	4.593	1	.032	1.792	1.052	3.053
Structural Capital	.001	.000	3.664	1	.056	1.001	1.000	1.001
Industry 4.0 * Human Capital	.489	.241	4.135	1	.042	1.631	1.017	2.616
Transition to Industry 5.0 * Human Capital	0 ^a	.	.	.	.	1	.	.
Industry 4.0 * Relational Capital	-.246	.219	1.260	1	.262	0.782	.509	1.202
Transition to Industry 5.0 * Relational Capital	0 ^a	.	.	.	.	1	.	.
Industry 4.0 * Structural Capital	-.004	.000	73.985	1	.000	.996	.996	.997
Transition to Industry 5.0 * Structural Capital	0 ^a	.	.	.	.	1	.	.
Dependent Variable: Developmental restaurants' economic behavior Model: (Intercept), Industry level, Human Capital, Relational Capital, Structural Capital, Industry level * Human Capital, Industry level * Relational Capital, Industry level * Structural Capital								
a. Set to zero because this parameter is redundant.								

Nevertheless, during the Industry 4.0, managers' decisions were influenced by human capital ($\beta=0.489$, $p=0.042 < 0.05$) and structural capital ($\beta=-0.004$, $p=0.000 < 0.001$), suggesting that for every unit increase in human capital, the odds of adaptation increased by 63.1%. Conversely, structural capital acted as a significant inhibitor ($\text{Exp}(B)=0.996$), with each unit increase decreasing the odds of adaptation by 0.4%.

For developmental restaurants which are experiencing the transition to Industry 5.0, the influence of human capital and structural capital fades or changes, while market success (revenue growth) becomes a powerful concomitant of adaptive behavior. In other words, their capacity to navigate the human-centric transition of Industry 5.0 is closely linked to their recent market performance.

Taking these into account, the economic behavior of the developmental restaurants (RB_D) can be predicted based on the following equation:

$$\begin{aligned} \text{Log - odds}(RB_D) = & 0.832 + (0.014 * \text{Industry 4.0}) + (0.583 * \text{Relational Capital}) + \\ & (0.001 * \text{Structural Capital}) + (0.489 * \text{Industry 4.0} * \text{Human Capital}) + \\ & (-0.246 * \text{Industry 4.0} * \text{Relational Capital}) + (-0.004 * \text{Industry 4.0} * \\ & \text{Structural Capital}) \end{aligned} \quad (3)$$

4.2.3. Strategies of Mature Restaurants

Mature restaurants (over 10 years old) demonstrated the most balanced approach, with their adaptive behavior being influenced by all three dimensions of IC (Table 6). Thus, their economic behavior is influenced by human capital ($\beta=-0.001$, $p=0.000 < 0.001$), relational capital ($\beta=0.003$, $p=0.001 < 0.005$), and structural capital ($\beta=0.005$, $p=0.000 < 0.001$). Firstly, for every one-unit increase in human capital, the odds of adaptation decrease by 0.1% ($\text{Exp}(B)=0.999$). Secondly, for every one-unit increase in relational capital, the odds of adaptation increase by 0.3% ($\text{Exp}(B)=1.003$). Last but not least, for every one-unit increase in structural capital, the odds of adaptation increase by 0.5% ($\text{Exp}(B)=1.005$).

Table 6: GEE analysis of the relationships between IC dimensions and mature restaurants' behavior during their transition to Industry 5.0

Parameter	B	SE	Wald Chi-Square	df	Sig.	Exp (B)	95% Confidence Interval for Exp(B)	
							Lower	Upper
(Intercept)	-.250	.078	10.129	1	.001	.778	.667	.908
Industry 4.0	-1.112	.210	28.011	1	.000	.329	.218	.496
Transition to Industry 5.0	0 ^a	.	.	.	.	1	.	.
Human Capital	-.001	.000	13.588	1	.000	.999	.999	1.000
Relational Capital	.003	.001	10.735	1	.001	1.003	1.001	1.006
Structural Capital	.005	.001	14.105	1	.000	1.005	1.002	1.007
Industry 4.0 * Human Capital	.001	.000	14.516	1	.000	1.001	1.000	1.001
Transition to Industry 5.0 * Human Capital	0 ^a	.	.	.	.	1	.	.
Industry 4.0 * Relational Capital	.004	.003	1.147	1	.284	1.004	.997	1.012
Transition to Industry 5.0 * Relational Capital	0 ^a	.	.	.	.	1	.	.
Industry 4.0 * Structural Capital	.001	.000	23.491	1	.000	1.000	1.000	1.002
Transition to Industry 5.0 * Structural Capital	0 ^a	.	.	.	.	1	.	.
Dependent Variable: Restaurants' economic behavior Model: (Intercept), Industry level, Human Capital, Relational Capital, Structural Capital, Industry level * Human Capital, Industry level * Relational Capital, Industry level * Structural Capital								
a. Set to zero because this parameter is redundant.								

This indicates that mature restaurants leverage their established systems, workforce, and customer relationships in an integrated manner when navigating technological transitions. However, the practical significance of these influences is very low; the associated changes in the probability of adaption are minimal, as reflected in odds ratios very close to 1.

Based on the aforementioned data, it can be stated that the economic behavior of the mature restaurants (RB_M) can be predicted based on the following equation:

$$\begin{aligned}
 \text{Log - odds}(RB_M) = & -0.250 + (-1.112 * \text{Industry 4.0}) + (-0.001 * \text{Human Capital}) + (0.003 * \\
 & \text{Relational Capital}) + (0.005 * \text{Structural Capital}) + (0.001 * \\
 & \text{Industry 4.0 * Human Capital}) + (0.004 * \text{Industry 4.0 *} \\
 & \text{Relational Capital}) + (0.001 * \text{Industry 4.0 * Structural Capital}) \quad (4)
 \end{aligned}$$

To ensure the reliability and validity of the findings, a robustness check is performed using a panel random-effects logit model. As reflected in Table 7, the significance ($p < 0.05$) and direction (positive/negative sign) of the key coefficients for the IC dimensions remained materially unchanged for restaurants across all three maturity categories.

Table 7: Robustness check using random-effects logit model

Category	Parameter	Random-effects logit model				GEE model			
		B	SE	Sig.	Exp (B)	B	SE	Sig.	Exp (B)
Overall Sample	Human Capital	.002	.000	.002	1.002	.001	.000	.000	1.001
	Relational Capital	-.002	.005	.617	.998	-.001	.001	.423	.999
	Structural Capital	-.012	.017	.421	.988	-.007	.006	.256	.993
	Industry 4.0 * Human Capital	-.001	.002	.001	.999	-.001	.000	.003	.999
	Industry 4.0 * Relational Capital	.002	.005	.624	1.002	.000	.001	.852	1.000
	Industry 4.0 * Structural Capital	.009	.017	.415	1.009	.006	.006	.313	1.006
Young Restaurants	Human Capital	1.052	.285	.008	2.863	.986	.267	.000	2.680
	Relational Capital	.017	.012	.001	1.017	.011	.005	.020	1.011
	Structural Capital	.120	.068	.088	1.128	.099	.053	.058	1.104
	Industry 4.0 * Human Capital	-.861	.284	.005	.423	-.982	.267	.000	.374
	Industry 4.0 * Relational Capital	-.006	.007	.109	.994	-.007	.006	.211	.993
	Industry 4.0 * Structural Capital	-.108	.055	.050	.898	-.100	.051	.049	.905
Developmental Restaurants	Human Capital	.001	.004	.977	1.001	.000	.001	.803	1.000
	Relational Capital	.621	.195	.035	1.861	.583	.272	.032	1.792
	Structural Capital	.004	.002	.071	1.004	.001	.000	.056	1.001
	Industry 4.0 * Human Capital	.521	.262	.047	1.684	.489	.241	.042	1.631
	Industry 4.0 * Relational Capital	-.216	.258	.402	.806	-.246	.219	.262	.782
	Industry 4.0 * Structural Capital	-.002	.003	.005	.998	-.004	.001	.000	.996
Mature Restaurants	Human Capital	-.001	.000	.003	.999	-.001	.000	.000	.999
	Relational Capital	.005	.004	.000	1.005	.003	.001	.001	1.003
	Structural Capital	.003	.000	.001	1.003	.005	.001	.000	1.005
	Industry 4.0 * Human Capital	.003	.003	.001	1.003	.001	.000	.000	1.001
	Industry 4.0 * Relational Capital	.007	.003	.313	1.007	.004	.004	.284	1.004
	Industry 4.0 * Structural Capital	.001	.000	.001	1.001	.001	.000	.000	1.001

Although minor variations appear in the coefficient magnitudes, their significance and influence remain the same as reflected in the GEE model since: (i) human capital strongly influences young restaurants'

adaptation to Industry 5.0, (ii) relational capital plays a key role in developmental restaurants' transition to Industry 5.0, and (iii) mature restaurants are subject to an integrated yet weak effect of all three IC dimensions. Therefore, it can be stated that the consistency of the findings across both models provides evidence for the robustness of the results.

5. Conclusions

5.1. General Perspective

The research aimed to determine if the IC dimensions influenced the reactions of the young, developmental, and mature restaurants during their transition to Industry 5.0. In other words, it concentrated on determining whether managers' decision to adapt their restaurant activities to the new circumstances is influenced by IC dimensions, namely: human, structural, and relational capital. The results bring forward several differences based on restaurant's level of maturity. Young restaurants' economic behavior is strongly influenced by human capital ($\beta=0.986$, $p=0.000 < 0.001$) and relational capital ($\beta=0.011$, $p=0.020 < 0.05$), while the economic behavior of the developmental restaurants is strongly influenced by relational capital ($\beta=0.583$, $p=0.032 < 0.05$). In contrast, all three dimensions of IC influence the economic behavior of the mature restaurants, namely: human capital ($\beta=-0.001$, $p=0.000 < 0.001$), relational capital ($\beta=0.003$, $p=0.001 < 0.005$), and structural capital ($\beta=0.005$, $p=0.000 < 0.001$).

5.2. Theoretical and Practical Implications

These findings have both theoretical and practical implications. At the theoretical level, they managed to expand the literature from the hospitality and IC management field by providing an analysis on how IC dimensions influenced the reactions of the young, developmental, and mature restaurants during their transition to Industry 5.0. Furthermore, they complement both the research from the hospitality field (Fernandez-Perez de la Lastra et al., 2020; Khalique et al., 2020; Leon, 2021) and the one from the IC management field (Alcalde-Delgado et al., 2020; Mohapatra et al., 2019) by emphasizing the relationship between IC dimensions and restaurants' level of maturity.

Thus, the current findings are in line with the insights provided by Lee and Lin (2019) by highlighting the existence of a relationship between IC and a firm's level of development. However, they also provide a possible explanation for the mixed results obtained in the previous studies by demonstrating the distinct influence that each IC dimension has on restaurants' reactions. Furthermore, the fact that the mature restaurants are the only ones influenced by structural capital supports the findings of Forte et al. (2017), who state that older / mature firms tend to develop structural and process-related rigidities.

The current research also has various practical implications. Firstly, it facilitates managers understanding of how certain IC dimensions can influence their strategies during their transition to Industry 5.0, by providing a maturity-based strategic map. For human and structural capital, it offers direct levers for action. For relational capital, it highlights a critical association between market success and adaptability, guiding managers to foster this virtuous cycle rather than assuming growth alone will spur change.

Secondly, it offers a strategic tool for managers that is not only adapted to their restaurant's level of maturity but also provides crucial, data-driven guidance for strategic resource allocation. The effect sizes revealed in this study allow managers to prioritize initiatives based on the relative impact of investments in each IC dimension.

For owners of young restaurants, the data show that human capital has an exponentially greater effect on adaptive capacity (increasing odds by 168%) than other dimensions. Hence, their

priority should be on strategic investment in human capital, building tech-savvy, collaborative human resources. In the context of Industry 5.0, this means hiring or training staff for roles that involve collaboration with technology, such as using AI for personalized menu recommendations or managing customer relationships through digital platforms. Their agility allows them to build a human-tech collaborative culture from the ground up.

For developmental restaurants, the focus must be on nurturing relational capital as it increases the odds of adaptation by 79.2%. Practical steps include leveraging customer data from loyalty programs to co-create experiences, using social media to build a community, and forming strategic alliances with local suppliers or tech partners to enhance resilience and offer unique value propositions that blend digital and human touchpoints. Managers should take into account that these initiatives simultaneously drive growth as market success and strategic agility are mutually reinforcing.

For mature restaurants, the strategy is one of integration and renewal. Managers should conduct an audit of their structural capital (e.g., processes, databases) to identify and modernize rigid systems that may hinder adaptation. They can then deploy their experienced human capital to mentor teams in adopting new technologies like cobots for repetitive kitchen tasks, freeing up staff for creative and customer-facing roles. Their established relational capital can be used to pilot new, tech-enhanced dining concepts with their loyal customer base, thereby leveraging their reputation for stability while introducing innovation.

While this study focuses on Romania, its implications resonate across different geographic contexts, albeit with necessary adaptations. The finding that maturity dictates IC leverage is likely a universal principle. However, the specific expression of these strategies will be shaped by regional factors. For example, in regions with high labor costs (e.g., Western Europe, North America), the practical application for mature restaurants might emphasize structural capital investments in automation to augment a smaller, highly skilled workforce. In contrast, in regions with a younger demographic and vibrant entrepreneurial ecosystems (e.g., parts of Southeast Asia or Latin America), young restaurants might focus on human capital strategies that leverage mobile-first technologies and social media relational capital as their primary competitive tools.

Therefore, the presented framework does not prescribe a one-size-fits-all solution but offers a diagnostic tool. Managers and policymakers in any region can use the maturity-IC nexus to assess their context. The key takeaway is that a successful transition to Industry 5.0 in the service sector is not merely about adopting technology, but about strategically aligning a firm's most valuable intangible assets, its people, its processes, and its relationships, with its stage of development and local market conditions. This approach ensures that the transition is both human-centric and contextually relevant.

5.3. Limits and future research avenues

Despite these findings and implications, the current research is limited by several factors that also establish future research avenues.

Firstly, the context in which the research was developed emphasizes only the strategic reactions of the best restaurants from Romania. Different results could have been obtained if a more diverse sample from different countries were included.

Secondly, the measurement of IC dimensions presents key limitations. The use of financial proxies, though objective, may not fully capture the richness of these constructs. Most critically, the measurement of relational capital through revenue growth can make it difficult to determine whether growth drives adaptation or adaptation drives growth. Future research could employ more direct and defensible measures, such as customer loyalty indices, brand

equity metrics, or the intensity of marketing investments, to properly isolate the effect of relational assets, although these metrics have a higher level of subjectivity.

Hence, further research could be developed by (i) increasing and diversifying the research sample; (ii) analyzing the influence of the lessons learned in Industry 4.0 on the current strategic decisions; (iii) determining the impact of cultural specificity on managers' strategic decisions during their transition to Industry 5.0; (iv) employing a qualitative – quantitative approach for evaluating IC dimensions; and (v) incorporating additional organizational variables to build a more comprehensive model of strategic adaptation.

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