Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8, 1150-1164
2025
Publisher: Learning Gate
DOI: 10.55214/2576-8484.v9i8.9567

Enabling leagility through IT capabilities and information sharing in Iraqi manufacturing SMEs: Evidence from a PLS-SEM approach

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Abstract: Research on leagility, the integration of lean and agile supply chains, is limited, especially in developing nations, and is primarily qualitative in nature. The impact of IT capabilities and their interplay with information exchange in promoting leagility lacks empirical substantiation. This study investigates the impact of IT capabilities (IT infrastructure, IT human resources, and IT integration) on leagility, along with the moderating influence of information sharing. Utilizing the resource-based approach and resource dependence theory, data were collected from a cross-sectional study involving 381 senior managers in Iraqi manufacturing SMEs. Data analysis was conducted using Structural Equation Modeling with Partial Least Squares (PLS-SEM). The findings demonstrate that IT capacity and its elements have a favorable impact on leagility. Furthermore, information sharing moderates the impact of IT capacity and its components—IT infrastructure and IT integration—on leagility, but not on IT human resources. This study enhances the Resource-Based View (RBV) and Resource Dependence Theory (RDT) by empirically illustrating how internal IT investments and external collaboration collectively promote resilience in resource-limited contexts. The findings emphasize the necessity for Iraqi SMEs to focus on IT integration and personnel development while utilizing information sharing to enhance supply chain agility performance.

Keywords: *Information sharing, Iraq, Leagility, IT capabilities, SMEs, Supply chain management.*

1. Introduction

In an era marked by unprecedented market volatility, supply chain (SC) disruptions, and rapidly evolving customer demands, enterprises worldwide must rethink their operational strategies to ensure resilience and competitiveness. Traditional supply chain models have demonstrated significant vulnerabilities, particularly in the face of global shocks such as the COVID-19 pandemic, which severely affected small and medium-sized enterprises (SMEs) that often lack the resources to absorb such disruptions [1]. In response, the concept of "leagility"—the strategic integration of lean and agile supply chain principles—has gained prominence as a means to achieve both efficiency and adaptability [2, 3].

While leagility has been increasingly discussed in the academic literature, empirical research remains relatively scarce, particularly in developing and emerging markets. A recent systematic review reveals that less than 10% of published studies on leagility focus on the context of developing countries, and only a handful (fewer than five) have specifically examined its antecedents and enablers within Middle Eastern or post-conflict environments such as Iraq [4, 5]. The urgency for such research is underscored by the increasing frequency and severity of supply chain disruptions globally, which have highlighted the need for more robust approaches to resilience and adaptability in logistics and

History: Received: 27 June 2025; Revised: 11 August 2025; Accepted: 15 August 2025; Published: 20 August 2025
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operations [6]. Moreover, the majority of prior studies have relied on qualitative or conceptual analyses, with robust quantitative investigations still lacking in this domain.

In addition, although the critical roles of information technology capabilities (ITC) and information sharing have been recognised as essential for fostering leagility, existing studies have either considered these constructs in isolation or focused primarily on large organisations in mature economies [7, 8]. There is a distinct lack of empirical evidence on how the interplay between IT capabilities (ITC) and information sharing affects leagility in SMEs operating under conditions of resource scarcity, infrastructural limitations, and market uncertainty—conditions that are particularly acute in Iraq. Notably, recent research has highlighted how various organisational factors, such as the quality of work life and job enrichment, significantly impact employee retention and overall firm performance in the Iraqi service sector [9]. These findings underscore the broader need for context-specific management research in Iraq, especially studies that address the challenges faced by SMEs in dynamic and constrained environments. Furthermore, recent data indicate that Iraqi SMEs contribute only 4.08% to the national GDP, significantly below the global average of 34%, underscoring the need for developing evidence-based strategies to enhance their adaptability and resilience [10].

This study addresses these gaps by providing one of the first quantitative analyses of leagility in Iraqi manufacturing SMEs, with a specific focus on the combined effects of IT capabilities and information sharing. By integrating the resource-based view (RBV) and resource dependence theory (RDT), this research advances current understanding in several ways. First, it empirically investigates the extent to which IT infrastructure, IT human resources, and IT integration enable leagility in a resource-constrained, post-conflict setting. Second, it examines the moderating role of information sharing, a factor rarely explored in conjunction with ITC in emerging markets. Third, the study employs Partial Least Squares Structural Equation Modelling (PLS-SEM) on a large sample (n = 381) of senior managers from Iraqi SMEs, providing robust and generalizable findings. Collectively, these contributions offer novel insights for both academics and practitioners seeking to foster resilient and adaptable supply chains in challenging environments.

2. Literature Review

2.1. Theoretical Framework

The RBV and RDT provide a solid theoretical platform for studying how ITC affects the leagility of manufacturing SMEs, with information sharing as a moderating factor. By using valuable, rare, inimitable, and organizationally embedded (VRIO) resources, organisations can gain a competitive edge [11, 12].Strategic resources, including infrastructure, human resources, and integration, help organisations combine lean efficiency with agile response. The RBV demonstrates why IT investments can provide distinct operational advantages, especially in resource-constrained contexts like Iraqi SMEs, where infrastructure inadequacies prevent even basic IT adoption [13]. In this regard, the dynamic capabilities perspective provides additional insight into how IT flexibility enables firms to adapt, integrate, and reconfigure internal and external competencies to address rapidly changing environments [14].

In addition to the RBV, RDT [15, 16] stresses how companies manage external dependencies to decrease uncertainty. RDT emphasises the need for information sharing in SC risk mitigation and supplier coordination for SMEs in unpredictable markets. According to this idea, high-quality SC information flows enhance the leagility of ITC [17]. Studies suggest that SMEs that exchange demand predictions and inventory data with partners have fewer interruptions and more operational flexibility [18].

The integration between RBV and RDT provides a comprehensive platform for SME agility. RBV emphasises internal IT resources as a competitive advantage, whereas RDT emphasises how external collaboration enhances IT and agility. This dual viewpoint fills a gap in the literature by demonstrating that SMEs in weak economies can become resilient through internal technical investments and effective management of external dependencies. The approach extends theory by (1) studying hybrid lean-agile

Edelweiss Applied Science and Technology
ISSN: 2576-8484
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techniques with RBV, (2) applying RDT to digital SCs, and (3) comprehending SME operations in understudied locations like Iraq.

2.2. Leagility

Leagility is SC management's strategic integration of lean and agile principles to meet dynamic market needs [19].Naylor, et al. [2] established the idea, which combines the efficiency and variation reduction of lean systems with the flexibility and adaptability of agile systems to disturbances and client demands. Lean SC emphasises cost reduction and process optimisation, whereas agile SC emphasises flexibility. Strategic inventory and production management allow organisations to balance efficiency and flexibility Naylor, et al. [2].

Businesses face increasingly volatile marketplaces, making adaptability even more crucial. Leagile SCs improve upstream and downstream processes, cost efficiency, product quality, and organisational performance [20]. Leagility research is scarce, especially in emerging countries like Iraq, where industrial enterprises must use lean and agile methods to compete [21]. This study examines the efficiency, effectiveness, responsiveness, and adaptability of Iraqi manufacturing SMES.

2.3. IT Capability

ITC is an organisation's capacity to use IT to improve business operations and strategic decision-making [22]. ITC allows organisations to optimise SC processes, increase data-driven decision-making, and improve stakeholder collaboration [7]. Lean and agile SC require real-time information exchange, demand forecasting, and process automation, which ITC facilitates [8]. ITC influences agility, but research on it is limited, especially in less developed countries. IT infrastructure, human IT resources, and IT integration impact supply chain performance [23] Strong IT infrastructure maintains data flow, trained IT staff maximise system use, and IT integration facilitates cross-functional cooperation. This study fills a literature gap by examining how Information and Communication Technology (ICT) enables Iraqi manufacturing enterprises to become more agile.

2.4. Information Sharing

Organisations optimise procurement, production, and distribution via SC practices [24]. In these practices, information sharing is crucial. SC partners share demand estimates, inventory levels, and production schedules transparently [25]. High-quality information sharing promotes collaboration, decision-making, and SC agility [26, 27]. Information sharing, innovative supplier alliances, and delay methods keep SC lean (cost-efficient) and intelligent. Effective SC management requires the sharing of information to enhance stakeholder visibility and coordination [28, 29].By providing suppliers, manufacturers, and distributors with real-time data, organisations can reduce inefficiencies and stockouts, as well as improve demand predictions Huong Tran, et al. [26]. Quality information sharing improves strategic supplier partnerships, allowing collaborative planning and risk management [30]. Information sharing also helps enterprises postpone product modifications until demand is determined, thereby decreasing inventory costs [31].Thus, a competitive and resilient SC requires strong information-sharing channels.

2.5. Conceptual Framework

Despite growing interest in SC strategies, significant gaps persist in the literature on leagility. First, most studies examine lean and agile practices in isolation, with limited empirical research on their integration as leagility, particularly in developing economies like Iraq [19]. Second, while ITCs are recognised as enablers of SC performance [7], their role in fostering leagility remains underexplored, especially in SME contexts [8]. Third, although SC practices like information sharing are critical for coordination [28, 29] ,their moderating effect on the IT-leagility relationship lacks empirical validation [32]. Finally, existing research predominantly focuses on prominent firms in stable economies,

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neglecting SMEs in volatile regions, such as Iraq, where infrastructural and political challenges demand tailored leagility frameworks [8, 33].

Based on the above gaps, as well as the review of RBV and RDT, the proposed framework in Figure 1 positions IT capabilities, encompassing IT infrastructure, IT human resources, and IT integration, as the independent variable that directly enhances Leagility (the dependent variable). Leagility is operationalised through four key dimensions: efficiency, effectiveness, responsiveness, and flexibility (H1a-c). The framework further introduces information sharing as a moderating variable that strengthens the relationship between ITC and leagility by improving coordination among SC partners and reducing environmental uncertainty (H2a-c). Figure 1 shows the conceptual framework.

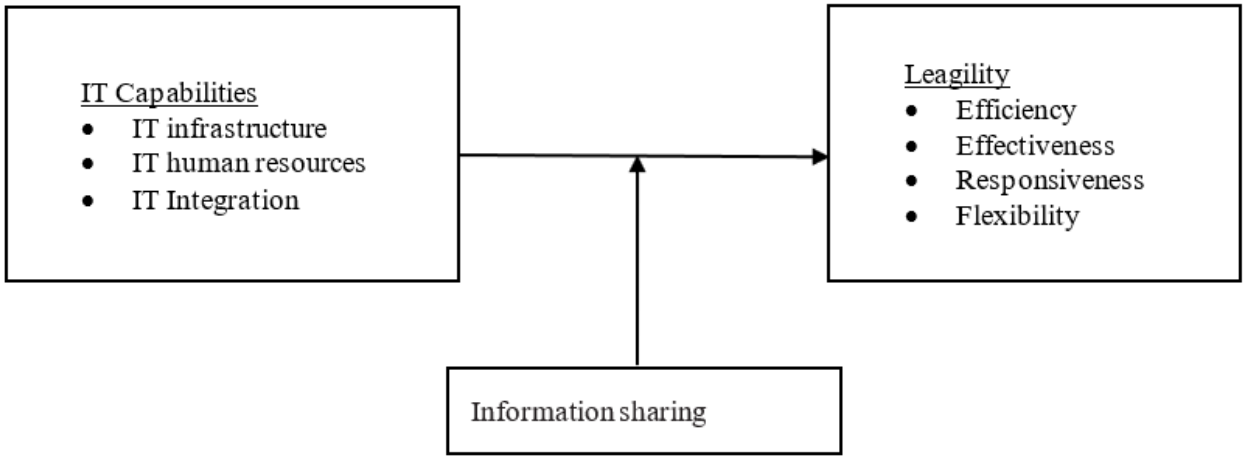

Figure 1.
Conceptual Framework.

2.5.1. IT capabilities and Leagility

The concept of ITC was first introduced by Smith Jr, et al. [34] who defined it as a company's capacity to integrate, assemble, and deploy IT-based resources. Few studies examined the effect of ITC on leagility. Most of prior literature focused on the effect on business performance. For instance, the effect of ITC on business sustainability was found positive in the study of [35]. In the study of Chen, et al. [36] ITC affected positively the SC network capabilities. Studies also indicated that using IT resource effectively will enhance the agile and lean as well as the performance of manufacturing companies in Iran [7, 37]. Therefore, this study proposes that the ITC will have a significant effect on the leagility of manufacturing SMEs in Iraq.

H_1: ITC positively affect leagility of manufacturing SMEs in Iraq.

2.5.2. IT Infrastructure and Leagility

IT Infrastructure has a significant capability to assist organisations to face dynamic change, reengineering their business processes Antoni, et al. [38]. Nuroğlu and Nuroğlu [39] included IT infrastructure as part of ITC and examined its effect on business network governance. The findings showed that IT infrastructure enabled the business network governance. Mao, et al. [23] found that IT infrastructure has a positive impact on the competitive advantage of companies. IT infrastructure was found to have a significant positive effect on SC capabilities [40]. In this study, IT infrastructure is expected to have a positive effect on the leagility of manufacturing SMEs in Iraq.

H_{1a}: IT infrastructure has a positive effect on the leagility of manufacturing SMEs in Iraq.

2.5.3. IT Human Resources and Leagility

IT human resources is related to the staff of an organisation who can address issues related to IT in the organization [41]. IT human resources were found to be a critical factor for SMEs. For instance, IT human resources affected the export performance of SMEs in China [42]. It also positively affected the business performance of companies [41]. Therefore, this study predicts that the effect of IT human resources on leagility will be positive. Thus, the following is proposed:

H_{1B} IT human resources positively affect the leagility of manufacturing SMEs in Iraq.

2.5.4. IT Integration

IT integration is critical for the flow of information, communication and the financial activities of organisations and their partners. Chen [43] found that IT integration has a positive effect on SC agility. Further, IT integration has a positive effect on agility capabilities Sud-on, et al. [44]. Chen and Wu [45] found that IT integration positively affected the competitive advantage of companies. IT integration also affected the interfirm relationship [46]. In this study, the IT integration is expected to affect positively the leagility of manufacturing SMEs in Iraq.

H_{1c} IT integration positively affects leagility of manufacturing SMEs in Iraq.

2.5.5. Moderating Role of Information Sharing

Studies such as Alharbi [47] have emphasised the importance of resilience in enhancing SC performance, particularly in volatile environments. For example, Alharbi [47] found that agility and resilience mediate the effect of leanness on food retailer performance, while Alrajhi [48] highlighted the need for mitigation strategies such as local manufacturing and supplier diversification to enhance pharmaceutical SC resilience. Components of SC practices were also found to be moderating variables. For instance, information quality moderated the effect of SC on SC performance [49]. Information sharing moderated the effect of the interaction of capacity utilisation and inventory efficiency [50]. Therefore, based on the above discussion, this study proposed that information sharing will moderate the effect of ITC and its components on the leagility of manufacturing SMEs in Iraq. The following is hypothesised:

H_{2} Information sharing moderates the effect of ITC on leagility of manufacturing SMEs in Iraq.

H_{2a} Information sharing moderates the effect of IT infrastructure on leagility of manufacturing SMEs in Iraq.

H_{2b} Information sharing moderates the effect of IT human resources on leagility of manufacturing SMEs in Iraq.

H_{2c} Information sharing moderates the effect of IT integration on leagility of manufacturing SMEs in Iraq.

3. Research Methodology

This study adopts a positivist paradigm to statistically examine the relationships between IT capabilities (ITC), supply chain (SC) practices, and leagility in Iraqi manufacturing SMEs. The research tests hypotheses derived from Resource-Based View (RBV) and Resource Dependence Theory (RDT) deductively, aiming to understand how internal resources and external dependencies affect supply chain agility [51] .

A cross-sectional survey design was selected as the most appropriate approach for collecting primary data efficiently from a large pool of SMEs, given the lack of longitudinal databases and the exploratory nature of leagility research in this context [52]. Although longitudinal designs offer stronger causal inference, the dynamic instability and resource constraints of the Iraqi SME sector necessitated a practical, cross-sectional snapshot. The choice of survey data aligns with prevailing practices in supply chain management research in emerging markets.

For statistical analysis, Partial Least Squares Structural Equation Modelling (PLS-SEM) using SmartPLS was employed. This variance-based method is particularly suitable for research that is predictive, exploratory, and involves complex models with formative and reflective constructs, as is the case in this study Hair, et al. [53]. Unlike covariance-based SEM, which is preferable for theory

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8: 1150-1164, 2025
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confirmation and requires large samples and strict normality, PLS-SEM accommodates smaller sample sizes, non-normal data, and complex mediation/moderation structures, thereby justifying its use here.

The study targeted manufacturing SMEs in Basrah—recognised as Iraq's principal industrial region, with 2,355 eligible firms according to the Iraqi Central Statistical Organization [54]. While focusing on a single region supports logistical feasibility and response rates, it limits the generalizability of results to all Iraqi SMEs. This limitation is acknowledged, and future research is encouraged to replicate the study in other regions for broader validation.

Sample size was determined using the Krejcie and Morgan [55] formula, requiring a minimum of 330 responses to achieve sufficient statistical power for SEM analysis [56]. To mitigate non-response bias and ensure representativeness, the target sample was set at 660 SMEs, with senior managers or owners chosen as respondents due to their oversight of strategic SC and IT operations Hassan and Ghazali [57]. However, the final respondent profile was predominantly male (89.8%) and from medium-sized enterprises (57.5% had >29 employees). This demographic skew reflects broader trends in Iraqi industrial leadership but is noted as a limitation regarding the diversity and representativeness of perspectives; it may restrict the transferability of findings to smaller firms and female-led enterprises.

3.1. Questionnaire Development

The survey instrument was constructed in three sections. The first collected demographic data (age, gender, education, business age, sector, staff size). The second assessed the study's constructs using validated multi-item scales, measured on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). ITC was measured using items adapted from Mao, et al. [23] for IT infrastructure, Huong Tran, et al. [26] for IT human resources, and Lee, et al. [46] for IT integration. Leagility dimensions (efficiency, effectiveness, responsiveness, flexibility) were sourced from Kohli and Jensen [58] and Sudon, et al. [59] while information sharing was measured using items from Sundram, et al. [25]. The questionnaire underwent translation and back-translation procedures to ensure semantic equivalence and cultural appropriateness for the Iraqi context. Adaptation involved expert reviews and minor rewording to reflect local terminology and business practices. Content validity, language clarity, and contextual suitability were further evaluated through Expert Opinion Analysis (EOA) with local field specialists [53]. A pilot test (n=30) assessed reliability and comprehension; all scales demonstrated Cronbach's alpha above 0.70.

3.2. Data Collection

The online survey was administered using Google Forms, with contact details obtained from official directories (Iraqi Chamber of Commerce, manufacturing associations, company websites). Personalised invitations and reminders, as well as follow-up phone calls, were used to enhance participation. Of 509 responses received, 91 incomplete cases were excluded, resulting in 418 valid responses. Following data quality checks, 21 cases with >15% missing data and 16 outliers (identified via boxplot analysis) were removed, yielding 381 high-quality responses for analysis.

Given that all data were self-reported and collected from a single source, steps were taken to mitigate and assess Common Method Bias (CMB). Procedurally, the survey assured respondent anonymity and separated measurement of independent and dependent variables. Statistically, Harman's single-factor test was conducted, revealing that no single factor accounted for more than 30% of total variance, indicating CMB was not a major threat [60]. Additional post-hoc tests, such as marker variable analysis, confirmed these results.

Descriptive and inferential analyses were performed using SPSS and SmartPLS. Normality tests (skewness, kurtosis), multicollinearity diagnostics (tolerance, VIF), and reliability/validity assessments (Cronbach's alpha, composite reliability, AVE, HTMT) were conducted following standard protocols. All variables met the thresholds for normality and reliability.

To ensure the robustness of subsequent analyses, researchers conducted thorough multicollinearity assessments, finding all tolerance values well above the 0.20 threshold (ranging from 0.483 to 0.941)

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8: 1150-1164, 2025
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and all VIF values below 5 (ranging from 1.063 to 2.070), indicating no concerning multicollinearity issues. Finally, non-response bias analysis was conducted by comparing early (n = 159) and late (n = 222) respondents using independent samples t-tests, revealing no statistically significant differences across any variable, as shown in Table 1.

Table 1.
Data Examination.

Variable	Normality		Multicollinearity		Non-response
	Skewness	Kurtosis	Tolerance	VIF	Sig. (2-tailed)
First-order variables					
Efficiency	-0.518	-0.255	-	-	0.962
Effectiveness	-0.736	-0.111	0.523	1.912	0.581
Responsiveness	-0.540	-0.222	0.483	2.070	0.068
Flexibility	-0.513	-0.401	0.723	1.384	0.728
IT Infrastructure	-0.420	-0.653	0.828	1.207	0.204
IT Human Resource	-0.754	-0.200	0.634	1.577	0.876
IT Integration	-0.271	-0.902	0.941	1.063	0.994
Information sharing	-0.324	-0.849	0.876	1.142	0.310
Second Order					
Leagility	-0.491	-0.444			
Information sharing	-0.881	-0.712	0.781	1.281	
ITC	-0.771	-0.891	0.633	1.572	

4. Data Analysis

4.1. Profile of Respondents

The respondent profile reveals a representative sample of mid-career professionals from established manufacturing SMEs in Basrah. The majority (90.3%) were aged 30-50 years, predominantly male (89.8%), with 58.5% possessing 8-11 years of professional experience. Respondents primarily held leadership positions (45.1% department heads, 30.7% directors, 22.6% executives), representing medium-sized enterprises (57.5% with >29 employees, 42.0% with 10-29 employees) that had been operational for 11-15 years (73.0%). This demographic composition reflects the typical managerial structure of Iraqi manufacturing SMEs, where experienced male professionals in mid-to-senior roles oversee operations in stable, medium-sized firms. While the gender imbalance (10.2% female) and limited representation of very small enterprises (0.5%) may affect the generalizability of the findings to these specific groups, the sample characteristics strongly align with the study's focus on decision-makers in established SMEs, ensuring the relevance and reliability of responses regarding ITC and information sharing. The predominance of mature firms (73.0% aged 11-15 years) further strengthens the study's ability to examine sustained operational strategies in stable organisational contexts.

4.2. Descriptive Summary of Variables

The study variables demonstrated moderate to high levels of implementation across Iraqi manufacturing SMEs. Leagility components showed consistent moderate performance (mean range: 3.09-3.19), with responsiveness (3.17) and flexibility (3.19) slightly higher than efficiency (3.13) and effectiveness (3.09). ITC averaged 3.05 (moderate), with IT integration (3.18) outperforming IT human resources (3.02) and IT infrastructure (2.99). Information sharing showed the highest overall mean (3.55). Standard deviations (0.99-1.36) indicated moderate variability in responses across all dimensions.

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ISSN: 2576-8484
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Table 2.
Descriptive Statistics of Key Variables.

Variable Category	Sub-Dimension	Mean	Std. Dev.	Interpretation
Leagility	Responsiveness	3.17	1.09	Moderate
	Flexibility	3.19	1.11	Moderate
	Efficiency	3.13	1.12	Moderate
	Effectiveness	3.09	1.12	Moderate
ITC	Human Resources	3.02	1.11	Moderate
	Infrastructure	2.99	1.21	Moderate
	Integration	3.18	1.09	Moderate
Information Sharing		3.55	1.31	High

4.3. Evaluation of the Measurement Model

The measurement model was rigorously assessed using five key criteria to ensure robust construct validity and reliability. First, factor loadings were examined, with items below the 0.70 threshold (e.g., ITHR6, FLX1) removed to enhance construct clarity. Reliability was confirmed through Cronbach's Alpha (α) and Composite Reliability (CR), with all values exceeding 0.70, indicating strong internal consistency (e.g., leagility: $\alpha = 0.956$, CR = 0.956). Convergent validity was established via HTMT values which were below 0.85, confirming distinct constructs. These results collectively validate the measurement model's suitability for hypothesis testing as shown in Table 3.

Table 3.
Assessment of Measurement Model.

Variable	α	CR	AVE	EFF	EFT	FLX	IS	ITG	ITHR	ITI	RES
EFF	0.909	0.909	0.830	-							
EFT	0.860	0.863	0.705	0.752							
FLX	0.903	0.904	0.832	0.629	0.673						
IS	0.907	0.909	0.643	0.122	0.116	0.173					
ITG	0.815	0.83	0.729	0.765	0.605	0.495	0.117				
ITHR	0.907	0.908	0.734	0.744	0.651	0.583	0.068	0.116			
ITI	0.907	0.911	0.787	0.735	0.676	0.563	0.068	0.103	0.702		
RES	0.918	0.918	0.757	0.718	0.799	0.615	0.074	0.107	0.518	0.642	-
				ITC	LEG	IS					
ITC	0.939	0.943	0.606	-							
LEG	0.956	0.956	0.571	0.701							
IS	0.908	0.908	0.615	0.166	0.204	-					

4.4. Evaluation of the Structural Model

The structural model was evaluated based on explanatory power (R^2), effect size (f^2), and path coefficients. The direct effect model explained 62% of leagility variance ($R^2 = 0.620$), indicating moderate to substantial predictive power. The moderating model showed a marginal R^2 increase (to 0.681), suggesting a limited but meaningful interaction effect. Effect sizes (f^2) ranged from small to large: ITC had a large effect ($f^2 = 0.493$), while IT infrastructure ($f^2 = 0.022$) and human resources ($f^2 = 0.193$) showed small to medium effects. The effect size of the moderation paths for IT integration (IS×ITG: $f^2 = 0.03$) and IT infrastructure (IS×ITI: $f^2 = 0.04$) were higher than 0.02. While for IT human resources (IS×ITHR: $f^2 = 0.001$) was negligible, hinting at non-significance. Path coefficients, though not detailed here, were examined for statistical significance ($p < 0.05$) to test hypotheses. Figure 2 shows the structural model.

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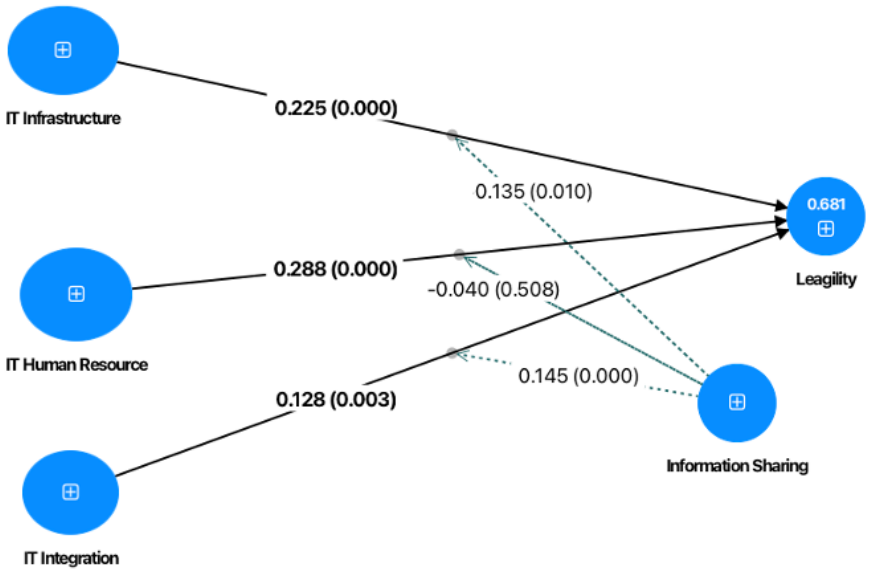

Figure 2.
Structural Model.

The hypotheses of this study included the direct effect of second-order ITC on leagility as well as the effect of its components on leagility, along with the moderating effect of information sharing. Table 4 summarises the direct and moderating effects.

Table 4.
Results of Hypothesis Testing.

H	Path	β	Std.	T	P values	Conclusion
H1	ITC -> Leagility	0.336	0.094	3.587	0.000	Supported
H1a	ITI -> Leagility	0.225	0.046	4.927	0.000	Supported
H1b	ITHR -> Leagility	0.288	0.055	5.240	0.000	Supported
H1c	ITG -> Leagility	0.128	0.043	2.941	0.003	Supported
H2	IS x ITC -> Leagility	0.081	0.032	2.536	0.011	Supported
H2a	IS x ITI -> Leagility	0.135	0.052	2.580	0.010	Supported
H2b	IS x ITHR -> Leagility	-0.040	0.060	0.662	0.508	Rejected
H2c	IS x ITG -> Leagility	0.145	0.038	3.778	0.000	Supported

The findings of hypotheses testing as shown in Table 4 indicated that H1 which is related to the effect of ITC on leagility (β=0.336, $p<0.001$), as well as the effect of components of ITC such as H1a which is related to the effect of ITI on leagility (β=0.225, $p<0.001$), H1b, ITHR on leagility (β=0.288, $p<0.001$), and H1c, ITG on leagility (β=0.128, $p=0.003$) all have significant positive effects on leagility, supporting H1, H1a, H1b, and H1c. For the interaction effects (moderation by IS), H2 shows that IS strengthens the ITC-leagility relationship (β=0.081, $p=0.011$), H2a reveals a positive moderation for ITI (β= 0.135, $p=0.010$), suggesting IS strengthens the effect of ITI on leagility. H2b (IS × ITHR) is insignificant (β=-0.040, $p=0.508$), leading to rejection, whereas H2c indicates IS enhances the ITG-leagility link (β=0.145, $p<0.001$). Overall, most hypotheses are supported, highlighting the varying roles of IT capabilities and IS in fostering leagility.

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5. Discussion of Findings

This study provides robust empirical evidence supporting the significant positive relationship between ITC and leagility in Iraqi manufacturing SMEs, confirming H1. The findings demonstrate that comprehensive ITC serve as a critical enabler for organisations to simultaneously achieve operational efficiency (lean) and market responsiveness (agility). These results align with and extend the RBV by illustrating how IT resources create competitive advantage in challenging economic environments Barney [11]. The analysis reveals that IT human resource emerged as the most influential component, followed by IT infrastructure and IT integration, suggesting that while foundational technology is important, the strategic embedding of IT into business processes and the availability of skilled personnel yield greater impacts on leagility.

The contextual findings from the manufacturing sector offer unique insights into technology adoption in post-conflict environments. Iraqi SMEs, facing chronic infrastructure challenges and skill shortages, demonstrate that even modest IT investments can yield substantial operational improvements when properly integrated with business processes. For instance, basic cloud-based solutions and mobile technologies are being creatively adapted to overcome electricity and connectivity issues, enabling real-time data sharing essential for agile responses to market changes. This aligns with recent studies on technology adoption in fragile states Hashemi Petrudi, et al. [5] but contrasts with findings from developed economies where advanced systems like IoT and AI drive leagility.

The study's examination of information sharing as a moderator yields important insights. While Information sharing significantly amplifies the impact of IT infrastructure on leagility, as well as the effect of IT integration on leagility, but not the effect of IT human resources on leagility. This suggests that in Iraq's context, external partnerships primarily complement physical IT assets rather than human ITC. These findings contribute to RDT by demonstrating how SMEs in constrained environments strategically use alliances to compensate for technological limitations while maintaining core internal competencies.

6. Implications

This section discusses the theoretical and practical implications of this study.

6.1. Theoretical Implications

This research makes several important theoretical contributions to operations management and information systems literature. First, it advances the conceptualisation of leagility by empirically validating it as a unified construct applicable to SMEs in developing economies, challenging the traditional view that sees lean and agile as separate or sequential strategies. The study demonstrates that even resource-constrained firms can pursue simultaneous efficiency and responsiveness through targeted IT investments and SC collaborations.

Second, the research extends the RBV by showing how different ITC components contribute uniquely to leagility. The strong performance of IT integration suggests that in volatile environments like Iraq, the ability to embed technology into customer interactions and decision processes may be more valuable than owning sophisticated infrastructure. This aligns with recent work on digital transformation in emerging markets Aljoghaiman, et al. [61] but provides greater granularity about specific capability configurations.

Third, the mixed results for information sharing effects contribute to RDT by identifying boundary conditions for when external collaborations enhance IT value. The findings suggest that information sharing primarily complements "hard" IT infrastructure rather than substituting for or augmenting "soft" IT, like human skills. This has important implications for how technology-information sharing interfaces can be theorised in different economic contexts.

The study also addresses a significant gap in leagility literature by providing quantitative, hypothesis-driven evidence from an under-researched region. Most existing studies have been qualitative or focused on large firms in developed economies. By employing rigorous PLS-SEM analysis

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8: 1150-1164, 2025
DOI: 10.55214/2576-8484.v9i8.9567

with a robust sample, this research establishes empirically validated relationships that can inform both theory and practice.

6.2. Practical Implications

The findings offer actionable insights for multiple stakeholders in developing economies. For SME managers in Iraq and similar contexts, prioritising IT integration over mere technology acquisition is critical. The strong performance of IT integration suggests that connecting systems with customers and suppliers yields greater leagility benefits than standalone infrastructure. Simple mobile-based solutions that link production with market demand can be particularly effective.

Given Iraq's skills shortage, firms should implement continuous training programs and consider partnerships with vocational institutes to build in-house technical expertise. The direct impact of IT human resources on leagility underscores this priority. SMEs in Iraq are recommended to start with foundational infrastructure (e.g., basic enterprise resource planning (ERP) systems), then build integration capabilities, while simultaneously developing human capital. For policymakers, it is recommended that they develop targeted support programs to address Iraq's specific barriers to IT adoption, such as unreliable electricity and internet connectivity. Subsidised cloud solutions or localised data centres could help overcome infrastructure gaps. They are also recommended to foster industry-academia partnerships to build IT talent pipelines. Technical education programs should emphasise practical skills relevant to SME needs, such as system integration and data analytics. Policymakers are also suggested to create incentives for SC digitisation. The moderating effect indicates that IT infrastructure is more effective when combined with collaborative practices. Policy measures could encourage SME participation in digital SC platforms.

Technology developers are advised to design technology transfer programs that take into account local constraints. The findings suggest that appropriate technology (rather than cutting-edge solutions) yields the best results when properly implemented. Support benchmarking initiatives that allow Iraqi SMEs to learn from peers in similar contexts. The study reveals considerable performance variation, indicating information-sharing could drive improvement.

7. Conclusion

This study makes significant contributions to the understanding of how manufacturing SMEs in challenging environments, such as Iraq, can achieve leagility through ITC and information sharing. The findings demonstrate that ITC collectively explain a large portion of leagility variance, with integration being the most impactful component. This highlights technology's pivotal role in facilitating both efficiency and responsiveness, even in resource-constrained environments. Information sharing played a moderating role, primarily enhancing the value of IT infrastructure and integration rather than substituting for internal capabilities. This suggests that Iraqi SMEs should view partnerships as complements to, rather than replacements for, internal IT development. The RBV and RDT provide complementary lenses for understanding leagility, the former explaining core internal capabilities and the latter illuminating how external collaborations help overcome resource constraints.

While providing valuable insights, this study has several limitations that suggest directions for future research. One of the limitations is the focus on manufacturing SMEs in Iraq; while providing depth, it limits generalizability to other sectors or regions. Iraq's unique post-conflict environment may not represent all developing economies. The cross-sectional design of this study captures a snapshot in time but cannot assess how leagility capabilities evolve. Longitudinal studies could reveal important dynamic effects, especially in volatile environments. The reliance on manager self-reports may introduce bias, particularly for performance-related constructs. The study focuses on IT and information sharing factors but excludes other potentially important influences on leagility, such as organisational culture or government policies. The operationalisation of leagility, while validated, represents one possible conceptualisation. Alternative frameworks might yield additional insights.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8: 1150-1164, 2025
DOI: 10.55214/2576-8484.v9i8.9567

Building on this study's findings and limitations, several promising research directions emerge. Replicating this research in other post-conflict or developing countries could help identify universal principles versus context-specific factors in achieving leagility. Further research are recommended to track firms over time because it could reveal how leagility capabilities develop and how critical transition points (e.g., major IT investments) impact performance trajectories. Further studies are also recommended to examine how particular technologies (e.g., mobile platforms, blockchain) contribute to leagility in resource-constrained environments, which could guide investment priorities. Exploring how informal networks, tribal affiliations, or regulatory environments influence leagility strategies could provide a deeper understanding of the context. Future studies are recommended to investigate how leagility contributes to organisational resilience in volatile markets, and this could extend both theoretical and practical implications. Further studies are recommended to conduct qualitative research to uncover the specific practices and routines that enable effective IT deployment in challenging environments.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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ISSN: 2576-8484
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Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8: 1150-1164, 2025
DOI: 10.55214/2576-8484.v9i8.9567