Reverse Logistics Performance in the Thai Automotive Industry

Presented by

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Agenda

- Introduction
- Research framework
- Methodology
- Data Analysis Results
- Discussions and conclusions
- Contributions of the research
- Limitations and suggestions for future research

Introduction

- There are several types of product returns:

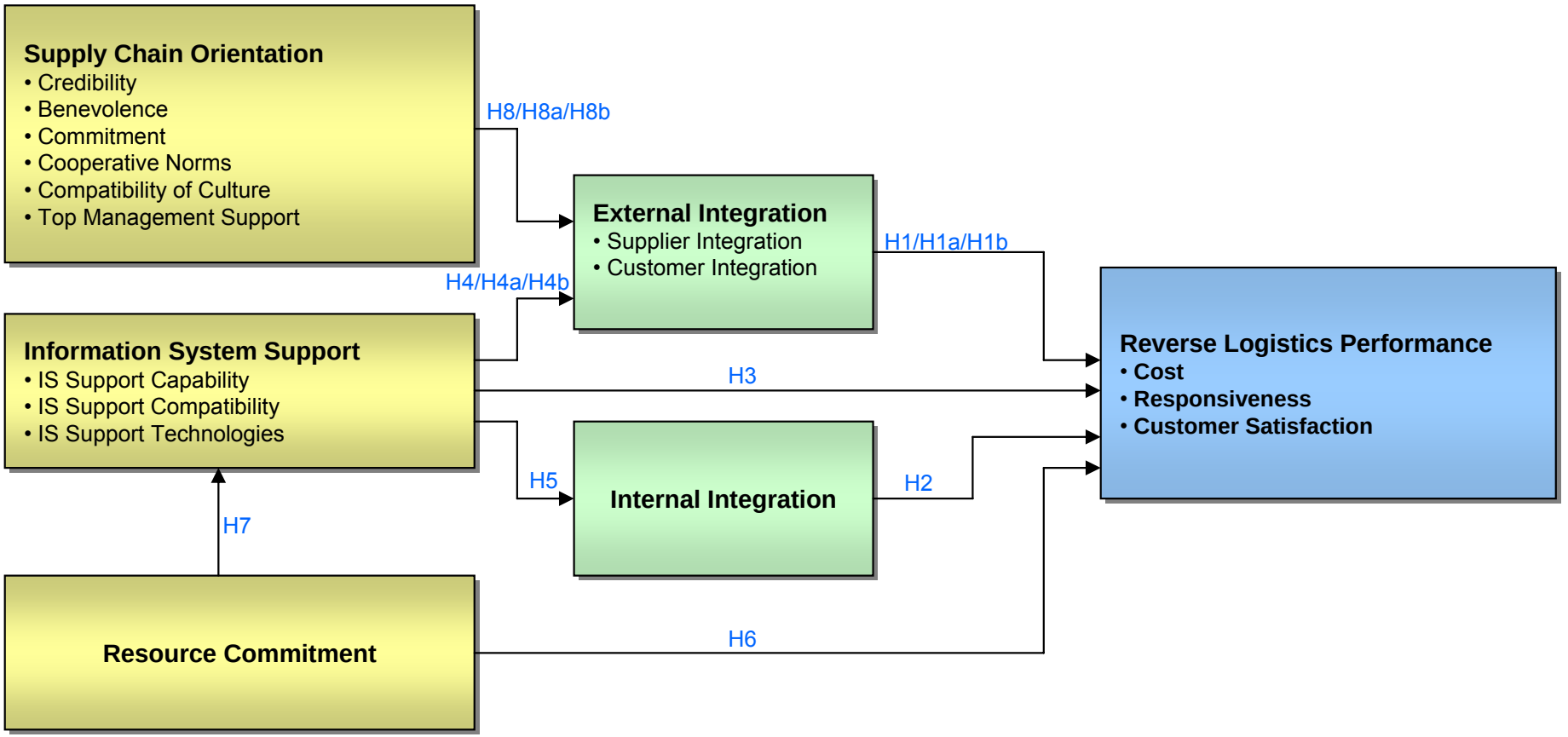
	Supply Chain Partners	End Users
Products	Stock balancing returns End of life/seasons Faulty order processing	Defective/unwanted products Warranty returns Recalls Environmental disposal issues
Packaging	Reusable totes Multi-trip packaging Disposal requirements	Reuse Recycling Disposal restrictions

- Due to the changing business environment, reverse logistics becomes an increasingly important part of the supply chain

Main Research Question

What are the important factors that influence reverse logistics performance and how do these factors affect the performance of reverse logistics process?

Research Framework



Methodology

- Sampling Procedure: Simple Random Sampling
- Target Sample Size: 224 Samples
- Target Respondents
  - First-tier supplier firms in the Thai automotive industry
  - Respondents who involve with operations management that focuses on work flows across many departments including purchasing, production, logistics, or marketing and sales
- Responses: 234 Completed & Usable Questionnaires
  - Collected during June to September 2006
  - 243 were initially collected, but 9 was incomplete and discarded

Data Analysis Results

- Check for Non-Response Bias
  - Means comparison of all constructs reported by early respondents (n=126) and late respondents (n=108)
  - No difference was found between the two groups
- Respondent Profile
- Item Analyses
  - Reliability & item-to-total Analyses
  - EFA
  - CFA
- SEM Analysis:
  - Model 1: Main Hypotheses Testing
  - Model 2: Sub-Hypotheses Testing
  - Model 3: Alternative models

Respondent Profile

Respondents	Top Management	Middle Management	Operation	
	7.26%	80.77%	11.97%	
Tier of Service	1st-Tier Suppliers	1st & 2nd Tier Suppliers	Others	
	38.03%	61.11%	0.86%	
Average Product Returns	Less than 2%	2% to 5%	More than 5%	
	32.90%	53.85%	13.25%	
Reasons for Product Return	Defective Product	Incorrect Product Specification	Faulty Order Processing	Recycling and Others
	51.01%	24.31%	22.05%	2.63%
Ownership Structure	Foreign	Thai	Foreign Majority Joint Venture	Thai Majority Joint Venture
	42.73%	21.37%	17.95%	17.95%
Nationality of Shareholders	Japanese	European	American	Others
	72.83%	8.70%	5.98%	13.04%
Sales Volume	Less than 100 M	100M – 500M	501M-2000M	More than 2000M
	27.35%	42.73%	21.80%	8.12%

Mean Comparison of Product Returns Based on Firm Size

	Small Firms	**Large Firms**	**Mean Difference**[b]
Average Product Returns[a]	2.81 (2.09)	1.93 (0.98)	0.89*** (4.44)

Notes:

a The average product return was measured in percentage (%); Standard Deviations are shown in parentheses

b Mean Differences were tested by independent *t*-test; *t*-value is illustrated in italic parentheses

* $p < .05$; ** $p < .01$; *** $p < .001$

Mean Comparison of Product Returns based on Other Characteristics

Average Product Returns [a]

Ownership Structure									
Thai-Owned	**Thai Majority JV**	**Foreign Majority JV**	**Foreign-Owned**	**Difference[b]**					
2.71 (1.58)	2.17 (1.53)	2.81 (2.03)	2.00 (2.00)	1.07					
Nationality of Foreign Shareholder									
Japanese	**European**	**American**	**Others**	**Difference[b]**					
2.54 (2.08)	2.60 (1.66)	1.49 (1.04)	2.50 (1.19)	0.99					
Sales Volume									
<50M	**50M-100M**	**101M-200M**	**201M-500M**	**501M-1,000M**	**1,001M-2,000M**	**2,001M-3,000M**	**>3,000M**	**Difference[b]**	
2.57 (1.75)	3.12 (1.80)	2.47 (2.04)	2.73 (2.38)	2.45 (1.52)	1.88 (1.01)	2.09 (1.02)	2.12 (1.39)	1.04	
Product Category									
Engine	**Drive-train**	**Steering**	**Suspen-sion**	**Brake**	**Wheel**	**Tire**	**Body Work**	**Interior**	**Elec-tronics**	**Raw Mat.**	**Difference[b]**
2.24 (1.78)	2.54 (1.43)	2.61 (1.85)	2.21 (1.21)	1.48 (0.83)	3.00 (1.00)	2.33 (1.53)	3.00 (1.70)	3.03 (2.61)	2.31 (1.65)	2.53 (1.66)	1.376

Notes:

a The average product return was measured in percentage (%); Standard Deviations are shown in parentheses

b Mean Differences were tested by one-way ANOVA; *F*-value is presented

* $p < .05$; ** $p < .01$; *** $p < .001$

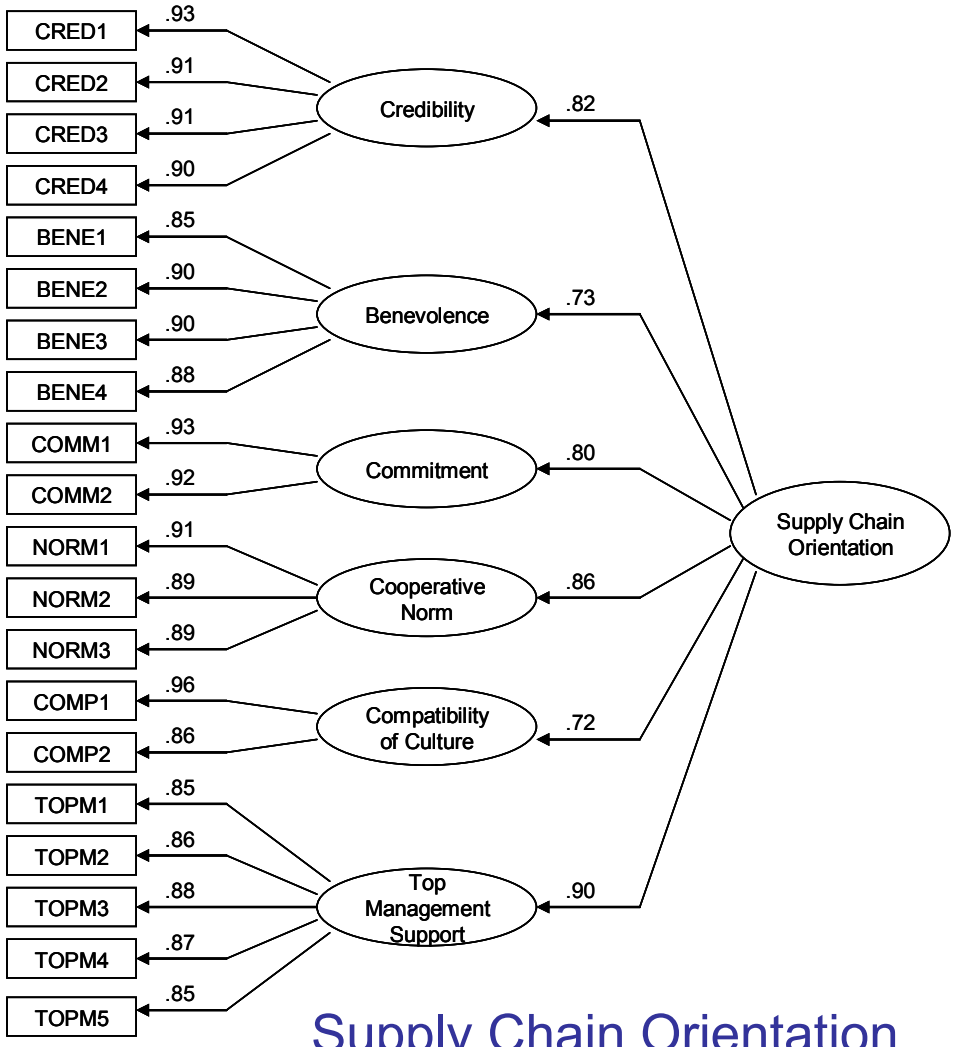
Item Analyses

- Reliability & item-to-total Analyses
  - All constructs illustrate high reliability
  - Deleted ISTECH4 (The use of EDI to assist with the returns handling) due to low correlation with other items

Construct	α	
	Pretest	Samples
- Supply Chain Orientation	.899	.962
- Information System Support	.824	.963
- Resource Commitment	.788	.904
- External Integration	.926	.985
- Internal Integration	.788	.970
- Reverse Logistics Performance	.921	.975

- Exploratory Factor Analysis
  - All constructs are loaded as proposed
  - Factor Loading >.5 - Variance extracted varied from 83.09% to 89.35%
  - KMO measure varied from .935 to .980 - Bartlett's test: p<.000

Confirmatory Factor Analysis



Supply Chain Orientation

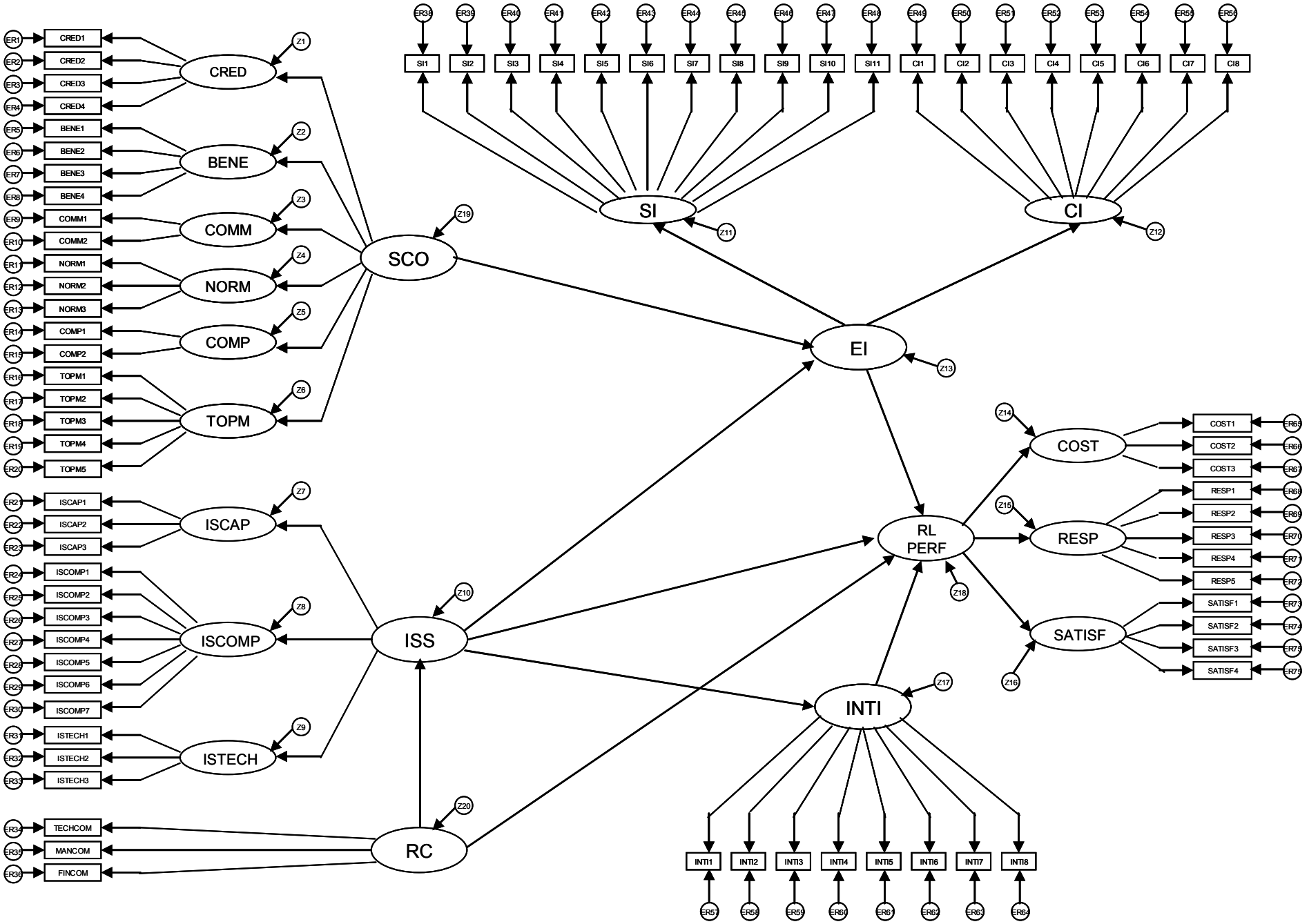
The result of CFA is satisfactory and consistent with that of EFA

- All parameter estimates are high and significant ($p<.05$)
- AVE > .50
- Construct Reliability (α) > .60
- All fit indices exceed .90

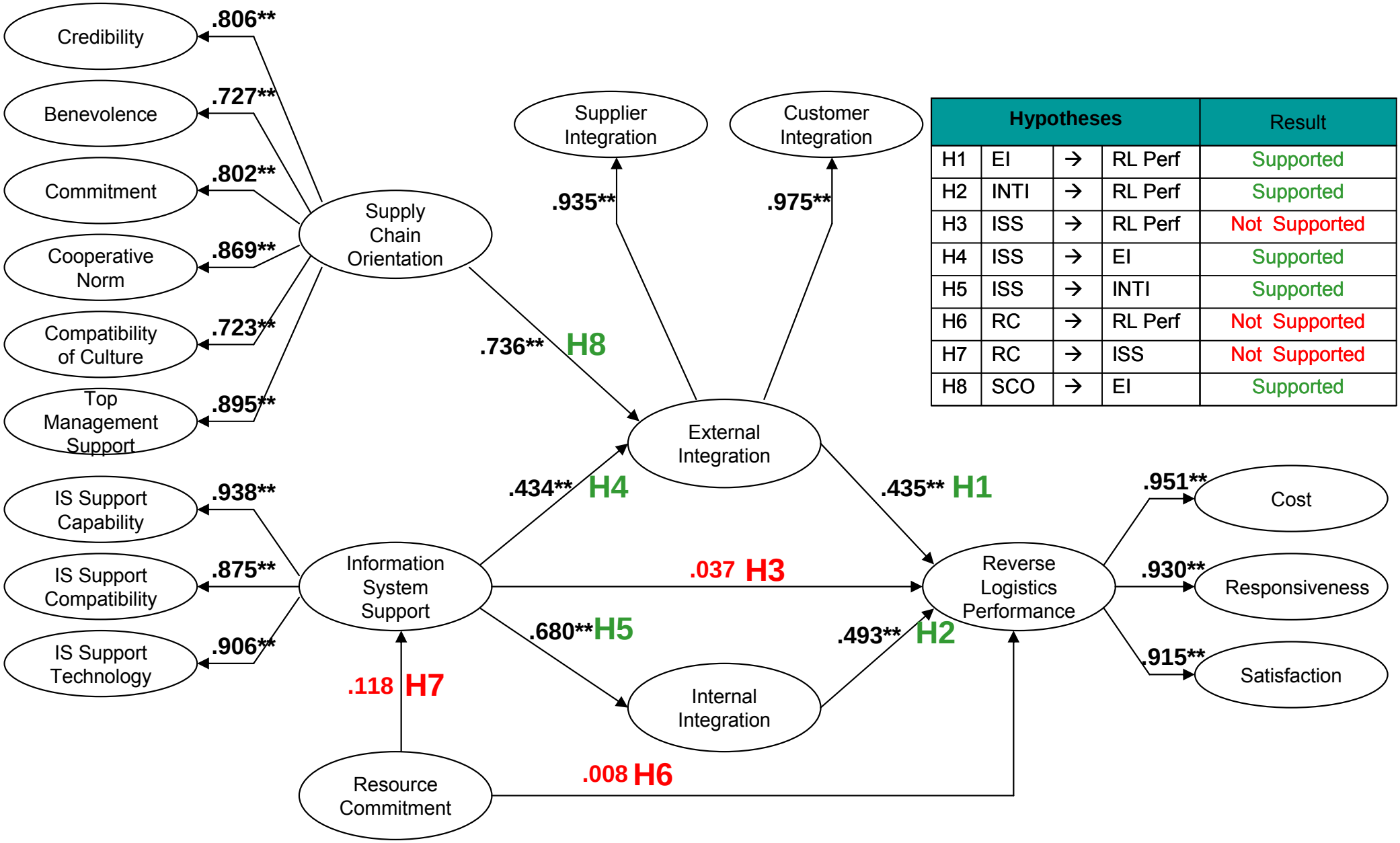
- CFA is also done for:
  - Information System Support
  - Resource Commitment
  - External Integration
  - Internal Integration
  - Reverse Logistics Performance
- No modification is required

$\chi 2 = 298.50$, DF = 164, $p = .000$; $\chi 2/DF = 1.82$; RMSEA = .059; IFI = .971; TLI = .967; CFI = .971; AVE = .73; α = .98

AMOS Graphical Model



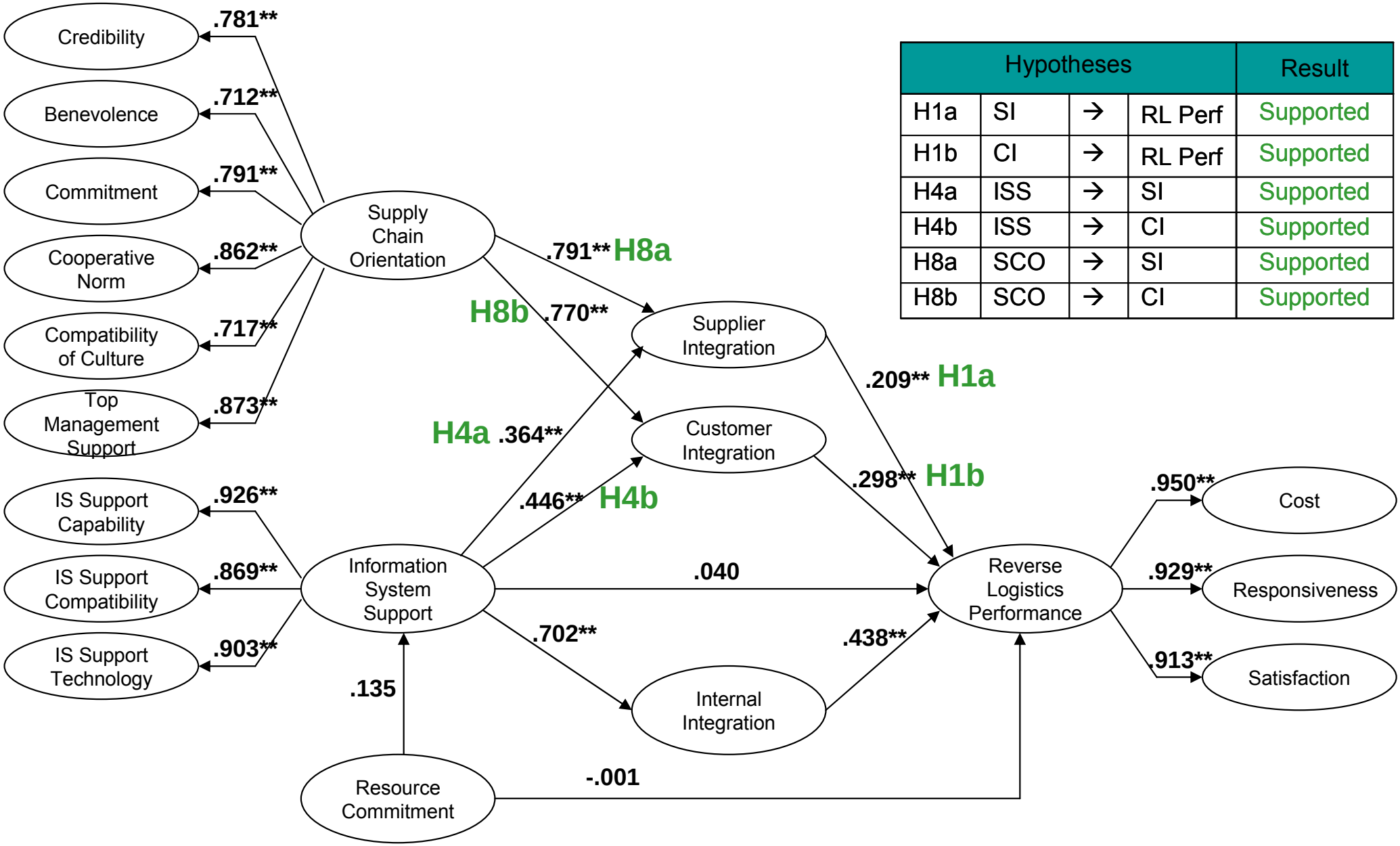
Model 1: Main Hypotheses Testing



Hypotheses				Result
H1	EI	→	RL Perf	Supported
H2	INTI	→	RL Perf	Supported
H3	ISS	→	RL Perf	Not Supported
H4	ISS	→	EI	Supported
H5	ISS	→	INTI	Supported
H6	RC	→	RL Perf	Not Supported
H7	RC	→	ISS	Not Supported
H8	SCO	→	EI	Supported

Fit Indices	x2/ df	IFI	TLI	CFI	RMSEA	R^2 =.600
Recommended Level	<3.00	>.90	>.90	>.90	<.08	
Hypothesized Model Fits	1.74	.917	.914	.917	.056	

Model 2: Sub-Hypotheses Testing



Hypotheses				Result
H1a	SI	→	RL Perf	Supported
H1b	CI	→	RL Perf	Supported
H4a	ISS	→	SI	Supported
H4b	ISS	→	CI	Supported
H8a	SCO	→	SI	Supported
H8b	SCO	→	CI	Supported

Fit Indices	x2/ df	IFI	TLI	CFI	RMSEA	R^2 =.590
Recommended Level	<3.00	>.90	>.90	>.90	<.08	
Hypothesized Model Fits	1.78	.913	.909	.912	.058	

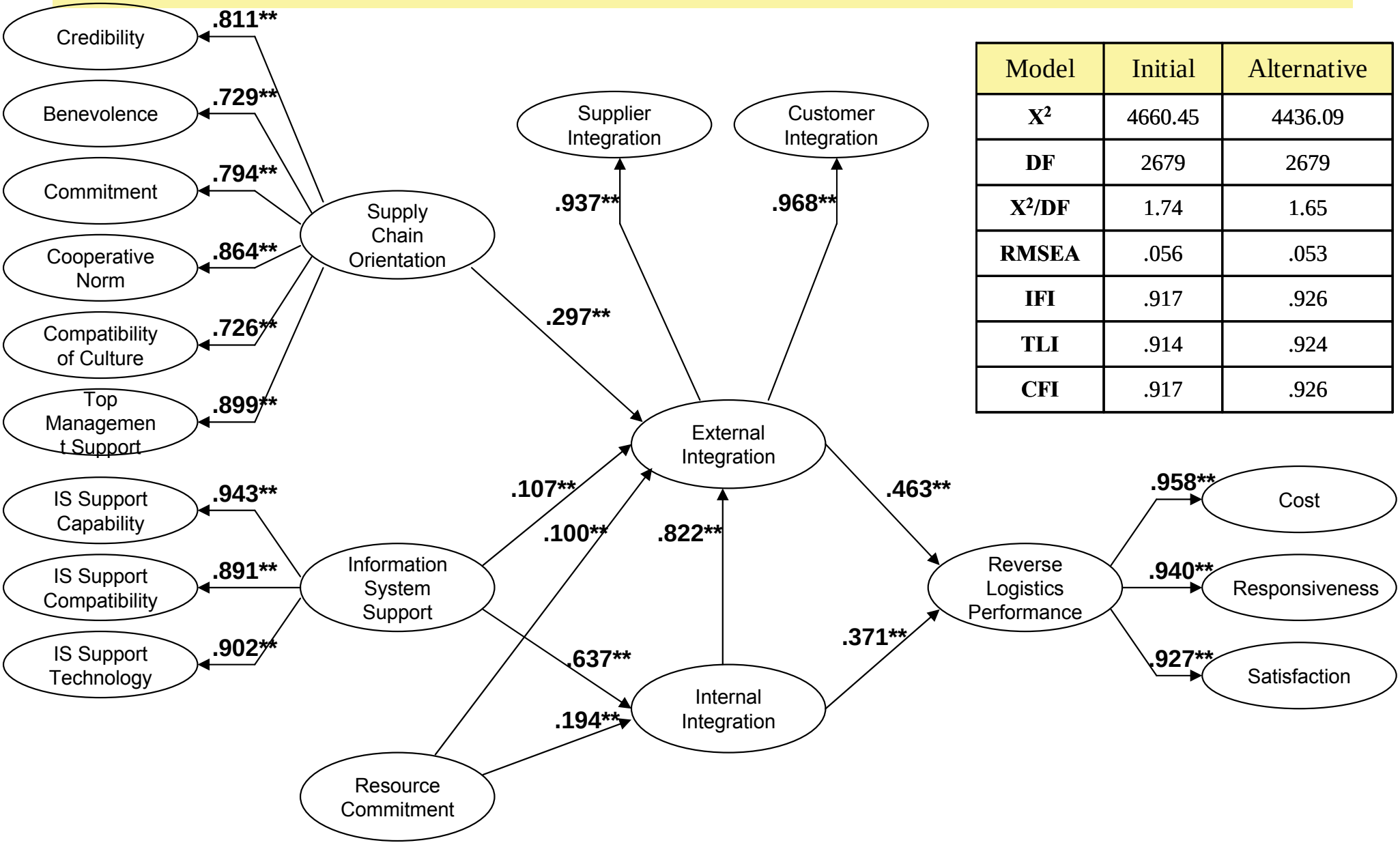
Summary of Hypotheses Testing Results

Hypotheses				Result
H1	External Integration	→	Reverse Logistics Performance	Supported
H1a	Supplier Integration	→	Reverse Logistics Performance	Supported
H1b	Customer Integration	→	Reverse Logistics Performance	Supported
H2	Internal Integration	→	Reverse Logistics Performance	Supported
H3	Information System Support	→	Reverse Logistics Performance	Not Supported
H4	Information System Support	→	External Integration	Supported
H4a	Information System Support	→	Supplier Integration	Supported
H4b	Information System Support	→	Customer Integration	Supported
H5	Information System Support	→	Internal Integration	Supported
H6	Resource Commitment	→	Reverse Logistics Performance	Not Supported
H7	Resource Commitment	→	Information System Support	Not Supported
H8	Supply Chain Orientation	→	External Integration	Supported
H8a	Supply Chain Orientation	→	Supplier Integration	Supported
H8b	Supply Chain Orientation	→	Customer Integration	Supported

Alternative Model

- The original model was modified based on:
  - SEM analysis of the original model
  - Modification indices suggested by AMOS
  - Theoretical support
- Thus, the modification was done by:
  - Remove relationships that were not statistically significant
  - Based on Stevens (1989), add relationship between Internal Integration and External Integration
  - Based on comments gathered during in-depth interviews, add relationships between
    - Resource Commitment and External Integration
    - Resource Commitment and Internal Integration

Model 3: Alternative Model

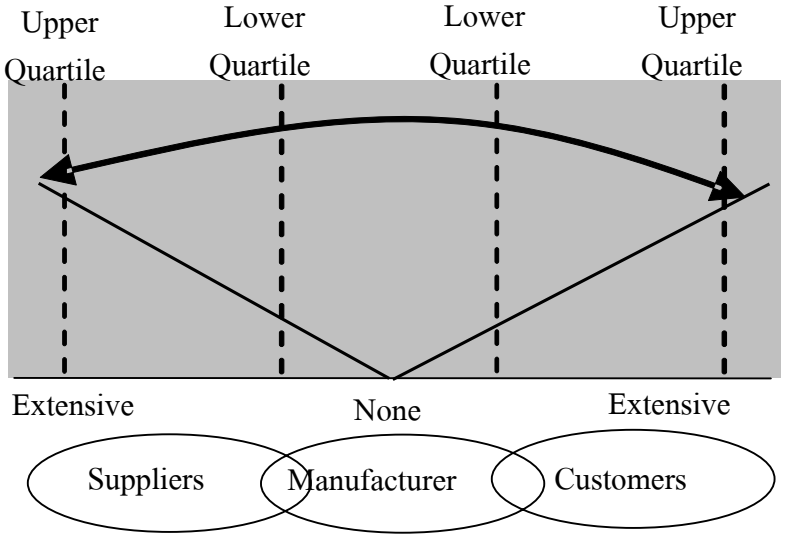


Model	Initial	Alternative
X^2	4660.45	4436.09
DF	2679	2679
X^2/DF	1.74	1.65
RMSEA	.056	.053
IFI	.917	.926
TLI	.914	.924
CFI	.917	.926

Fit Indices	x2/ df	IFI	TLI	CFI	RMSEA	R^2 =.664
Recommended Level	<3.00	>.90	>.90	>.90	<.08	
Hypothesized Model Fits	1.65	.926	.924	.926	.053	

Major Research Findings

- Direct impact of External Integration and Internal Integration on reverse logistics performance
- Importance of both Customer Integration and Supplier Integration on reverse logistics performance
  - Consistent with “Five Arcs of Integration” framework proposed by Frohlich and Westbrook (2001)



Major Research Findings

- The significant indirect impacts of Information System Support and Resource Commitment on Reverse Logistics Performance
- The role of Information System Support and Resource Commitment on External Integration and Internal Integration
- The role of Supply Chain Orientation on External Integration
- The effect of Internal Integration on External Integration
  - Consistent with the stages of supply chain integration proposed by Steven (1989)

Discussion and Conclusion

- RQ1: What is reverse logistics and how can reverse logistics contribute to the competitive advantage of a firm?
  - The definition is based on Rogers and Tibben-Lembke (2001)
  - Contribute to the competitive advantage by creating customer value and achieving cost and differentiation advantages
- RQ2: What are the factors that influence the performance of reverse logistics processes?
  - Supply Chain Orientation, Information System Support, Resource Commitment, External Integration, and Internal Integration
- RQ3: How does information system support directly and indirectly influence the reverse logistic performance?
  - Direct impact is not statistically significant
  - The impact was created through external integration and internal integration

Discussion and Conclusion

- RQ4: How does resource commitment directly and indirectly influence the reverse logistic performance?
  - Direct impact is not statistically significant
  - The impact was created through external integration and internal integration
- RQ5: How do external integration and internal integration influence the reverse logistic performance?
  - Both external integration and internal integration would help enhance the performance of reverse logistics process
- RQ6: Is supply chain orientation an antecedent of external integration?
  - Supply Chain Orientation was found to be a crucial antecedent of external integration

Theoretical Contribution

- The first study to investigate the effect of supply chain integration on reverse logistics performance
- Identification of a structural relationship between supply chain orientation, information system support, resource commitment, external integration, internal integration, and reverse logistics performance
- The role of supply chain integration on reverse logistics performance
- Empirical test of the stages of supply chain integration concept proposed by Stevens (1989)
- Confirm the arcs of integration concept proposed by Frohlich and Westbrook (2001) in the context of reverse logistics

Managerial Implication

- The importance of external integration and internal integration on reverse logistics performance
  - Internal integration or external integration alone is not adequate
- External integration shall be done on both customers and supplier sides
- In order to have external integration, supply chain orientation must be in place first
- Information system support and resource commitment are crucial for the successful implementation of external integration and internal integration

Limitations and Suggestions for Future Research

Limitation	Recommendation & Suggestion for the Future Research
Focus on certain types of product returns	Future research may be done in other industries with different product return characteristics
Single industry research	Replications of this study are necessary to determine the applicability of this study and the magnitude of parameter estimates outside the automotive industry and to other countries
Focus only on a direct supply chain	Future researches may attempt to measure supply chain integration and reverse logistics performance of an extended supply chain or a whole supply chain.
Reverse logistics processes are done only between firms	Future researches can be done on the supply side of the automotive industry that deals with product returns made by end customer, or in other industries which product return from customer is considered strategically important.


Questions and Answers