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Innovativeness in the motor carrier industry†

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Drawing upon diffusion of innovation and institutional theory, we examine the effects of innovativeness on various aspects of motor carrier performance and reputation. Motor carriers operate in an extremely competitive environment, where there is little if any room for strategic mistakes. It is understandable that leadership within these organisations is cautious when it comes to the adoption of innovations, as little evidence exists in the literature to support whether or not adoption of common motor carrier innovations will lead to positive outcomes. The results of this study suggest that the degree of motor carrier innovativeness is positively related to on-time delivery, claims ratio, safety, and reputation. These findings provide support for diffusion of innovation and institutional theory while also providing evidence that motor carriers can make more informed decisions regarding innovation adoption.

Keywords: innovativeness; reputation; operational performance; motor carriers

1. Introduction

Unlike most other industries, the motor carrier industry is characterised as a derived demand that is highly competitive, with low profit margins, and few barriers to entry (Belzer 2002; Fowkes et al. 2004; Douglas 2010; Liu, Wu, and Xu 2010). As an evidence of those characteristics, the recent economic downturn resulted in many carriers being forced to downsize or go out of business (Burnson 2010). In hopes of offsetting these negative factors and enhancing efficiencies, motor carriers increasingly turn to technology. Indeed, among motor carriers, investing in innovation has ranked among the top 10 issues for four consecutive years (American Trucking Associations 2010). In light of the important investment decisions faced by motor carriers, the purpose of this study is to examine the performance and external legitimacy consequences of motor carrier innovativeness.

Relatively little attention is being directed towards the firm level of innovation performance (Carayannis and Provance 2008; Wu and Chuang 2009). This is especially true in research regarding the motor carrier industry, which has seldom examined post-adoption outcomes of technological innovation adoption. Technology adoption has been shown across industries to enhance many aspects of organisational performance (Brynjolfsson and Hitt 2000; Melville, Kraemer, and

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Gurbaxani 2004). We propose that more research regarding performance outcomes of innovation adoption in the motor carrier industry is needed to enhance understanding within both academia and practice.

Grounded in diffusion of innovation and institutional theory, this research adds to the transportation literature by investigating both performance and legitimacy implications of motor carrier innovativeness using five years of data gathered from multiple sources. This longitudinal study provides an informative and compelling picture regarding the outcomes of investment in motor carrier innovations. The remainder of the paper is organised as follows. We begin by discussing both theory and extant research to develop our hypotheses. Then, we discuss the methodology of our study and how it was implemented. Finally, we report our results and discuss the limitations of our study as well as implications for research and practice.

2. Literature review

This study is theoretically grounded in two areas. First, we focus on diffusion of innovation and discuss how this theory and past literature based on the theory describe how motor carrier innovativeness should enhance operational performance outcomes. Then, we turn our attention to institutional theory in order to describe how motor carrier innovativeness may enhance external legitimacy.

2.1. *Diffusion of innovation theory*

Diffusion of innovation theory is a well-known and widely used theory that involves how, when, and by whom an innovation is adopted (Lippert and Forman 2005). Diffusion is 'the process in which an innovation is communicated through certain channels over time among members of a social system' (Rogers 2003, 5), whereas an innovation is 'an idea, practice, or object that is perceived as new by an individual or other unit of adoption' (12). Logistics innovations are more narrowly defined by Flint et al. (2005), as a logistics service or tool of any level of complexity that is perceived as new and helpful to the unit of adoption.

Many scholars have addressed logistics innovation in recent years (Grawe 2009). However, a vast majority of this research investigates either diffusion of a single innovation throughout a particular industry (Patterson, Grimm, and Corsi 2004; Sheffi 2004b; Vijayaraman and Osyk 2006; Melville and Ramirez 2008) or antecedents to adoption of an innovation by individual firm (Patterson, Grimm, and Corsi 2003; Russell and Hoag 2004; Hofer et al. 2011). Little research has investigated post-adoption outcomes at the organisational level (Jasperson, Carter, and Zmud 2005; Mishra and Agarwal 2010). Furthermore, few studies examine outcomes of innovation adoption in the motor carrier industry, which serves as motivation for our study.

Innovativeness, the degree to which an organisation is earlier in the adoption of an innovation relative to its peers, has been referred to as the bottom-line behaviour in diffusion research (Rogers 2003). Typically, organisational innovativeness is a measure of the speed and quantity of which innovations are adopted by a firm, compared to its competitors (Hansen, Shook, and Knowles 2008). The earlier the firm can adopt and integrate a new technology, the greater the likelihood of achieving positive performance outcomes (Dos Santos and Peffers 1995). Thus, we find it important to investigate how motor carrier innovativeness may enhance certain performance measures and outcomes.

Rogers developed categories of adopters to describe the degree of diffusion of an innovation throughout a population as well as to identify the degree to which an organisation or individual may be considered innovative. These categories are: innovators (97.5 percentile), early adopters (84th percentile), early majority (50th percentile), late majority (16th percentile), and the remaining

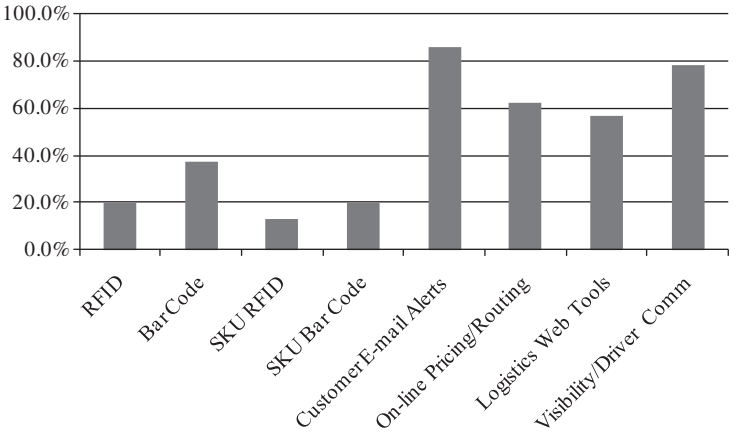

Figure 1. IT innovation adoption percentages.
Note: Reproduced by permission of O'Reilly (2010, 56).

adopters are termed laggards. The innovations being reviewed in this study are at various stages of diffusion (Figure 1). Of the motor carriers we consider in this study, only 13–36% have adopted radio frequency identification (RFID), bar codes, stock keeping unit (SKU) RFID, and SKU bar codes. It must be emphasised that a logistics innovation is simply a technology that is *perceived* as new and useful to the unit of adoption. Thus, although these technologies may not be considered 'new' by many, these technologies are still in the early stages of diffusion within the motor carrier industry (i.e. 13–36% adoption means that these innovations have been adopted by carriers considered to be early adopters or within the early majority). The remaining innovations, email alerts, online pricing/routing, logistics web tools, and visibility/driver communication, have been adopted by 56–86% of the motor carriers, which suggests that these innovations are in the later stages of diffusion.

Firm innovativeness is a well-accepted antecedent to measures of firm performance (Keskin 2006). Many studies have found support for a positive relationship between innovativeness and firm performance (Deshpandé, Farley, and Webster 1993; Han, Kim, and Srivastava 1998; Hult, Hurley, and Knight 2004). Within the area of logistics, a recent meta-analysis by Hazen and Byrd (2012) examined a number of performance outcomes that have been realised via adoption of logistics information technologies. Performance outcomes included reduced processing costs, improved equipment utilisation, and increased accuracy and timeliness of deliveries over a variety of logistics settings. Although these innovations have been shown to improve performance in many logistics settings, there lacks a large base of empirical research that specifically addresses how use of such innovations by motor carriers may impact various measures of performance.

Carrier performance is addressed using a variety of measures in the literature, which are often used to differentiate carriers and enhance shipper satisfaction (Premeaux 2002). Providing high service quality strengthens corporate brands and increases customer satisfaction (Xing et al. 2010). Such measures have included several aspects of service performance (Allen and Liu 1995). Although there are many aspects of motor carrier performance, three areas that are often considered in research and practice are on-time delivery, claims ratio, and safety. Indeed, many operational performance scales are based upon these measures (Sheffi 2004a; Pagell and Gobeli 2009; Scheraga 2010; Zelbst, Green Jr., and Sower 2010; Inman et al. 2011). In this study, we examine how innovativeness may affect such measures of performance.

Motor carriers provide time and place utility for their customers through the physical distribution of cargo. For this service to be of value, motor carriers must meet customer expectations regarding

on-time delivery. Research has provided evidence to support greater levels of on-time delivery and more accurate inventory tracking via use of logistics information technology (Smith and Morris 2005; McKinnon et al. 2009). Because research suggests that adoption of technological innovations generally increases many aspects of logistics performance, it follows that adoption of such technologies should also enhance on-time delivery for motor carriers. Therefore, we propose the following hypothesis.

Hypothesis 1: Motor carrier innovativeness is positively associated with on-time delivery.

Not only is it important for the cargo to arrive on-time, but it is also important that the cargo arrives without being damaged. Claims ratio (as a percentage of shipments) is the measure of the motor carrier's performance with regard to the error-free delivery of cargo. In addition to potentially losing business because of poor performance, paying damage claims by customers can be expensive. In their article on packaging requirements, Topper, Singh, and Singh (2010) reported that the six carriers in their study spent approximately $50 million a year settling damage claims with customers. Again, because research suggests that adoption of technological innovations generally increases many aspects of logistics performance, it follows that adoption of such technologies should improve the ability of motor carriers to provide error-free deliveries. Therefore, we propose the following hypothesis.

Hypothesis 2: Motor carrier innovativeness is negatively associated with claims ratio.

According to Britto, Corsi, and Grimm (2010), the total costs for truck crashes in the USA in 2008 that included injury or death exceeded $47 billion. Research conducted regarding the safety performance of motor carriers is varied (e.g. driver characteristics, regulations, and driver compliance); however, relatively little has been done to investigate the attitudinal and behavioural aspects (Douglas and Swartz 2009). In one such study, Zohar and Luria (2005) found evidence that organisational climate significantly influenced employee perceptions and safety behaviour. Therefore, a motor carrier that readily embraces new safety technology through an inclination towards innovation may imbue subunits (particularly drivers) with the same proclivity. Because of the liability and potential costs, safety performance can have a significant impact on the viability of a motor carrier. Since the adoption of technological innovations generally increases logistics performance, it follows that adoption of such technologies should improve the safety performance of motor carriers. Therefore, we propose the following hypothesis.

Hypothesis 3: Motor carrier innovativeness is positively associated with safety.

2.2. *Institutional theory*

In addition to being a production system, an organisation is also a social and cultural system that should espouse and adhere to the norms of its external environment (Meyer and Rowan 1977; DiMaggio and Powell 1983; Williams et al. 2009). Institutional theory focuses on the environmental forces that act upon and direct behaviour within an organisation. Through conformity to external or societal norms, organisations seek recognition and legitimacy.

Suchman (1995, 574) defined legitimacy as 'a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions.' External legitimacy is the degree of acceptance by external stakeholders for the propriety of the activities performed by a firm (Suchman 1995). By conforming to external pressures, organisations become legitimate and gain the perception of credibility, persistence, and meaningfulness, thereby increasing their chances of survival (Meyer and Rowan 1977; DiMaggio and Powell 1983; Williams et al. 2009; Savage 2011). It is common for industry rankings such as those published by *Fortune* or *Newsweek* to be used as proxies for external legitimacy (Kim 2007; Cho et al. 2012).

For the majority of firms, being seen as innovative can improve the corporation's reputation (Staw and Epstein 2000; Wang 2010). Further, a carrier's external legitimacy (i.e. reputation) has been shown to be an important selection criterion for shippers (Evans, Feldman, and Foster 1990). It follows that organisations would like to understand ways in which they can bolster their reputation. We suggest that enhancing innovativeness is one such way. Therefore, we propose the following hypothesis.

Hypothesis 4: Motor carrier innovativeness is positively associated with external legitimacy.

3. Data and methodology

The motor carrier innovativeness research framework illustrates all of the relationships proposed in this study, and is shown in Figure 2. To test this model via empirical means, data were gathered from archival material located in industry journals, commercial and governmental databases, and company websites. After we compiled the data, we built a comprehensive database and performed quantitative analysis. We describe these processes in a greater detail in this section.

3.1. *Sample*

A sample of motor carriers was taken from *Inbound Logistics'* Annual Trucking Issue 2007–2011, which reports the top 100 motor carriers every year. As reported by Randall, Defee, and Brady (2010), this publication's annual ranking provides a robust group of small, medium, and large trucking firms. The companies are not stratified, but rather they are listed alphabetically. The articles contained the company name, type of trucking service, operating area, and other descriptive data. Of primary interest within these annual articles is the self-reported adoption of eight innovations. The 68 companies listed in Table 1 are the companies that appeared in every issue from 2007 to 2011. Because granular details regarding the three separate FedEx carriers were not available, we consolidated FedEx into one entry and averaged the three scores to arrive at a single innovation score for FedEx, which reduced our sample size to 66.

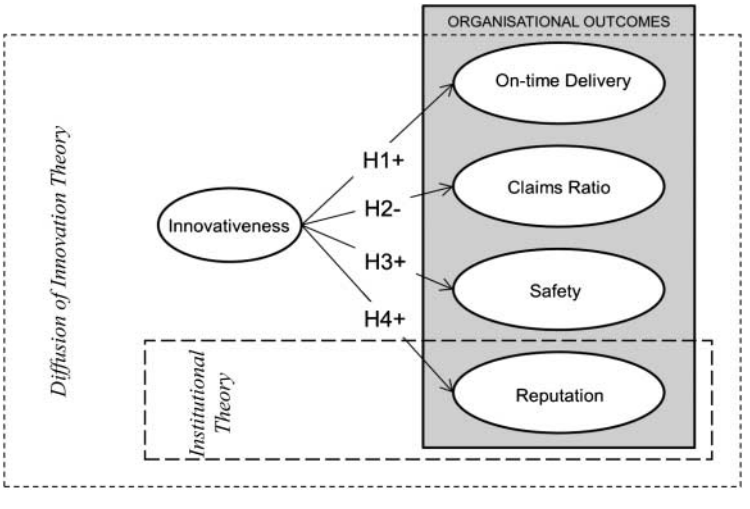

Figure 2. Research framework with constructs and hypotheses.

Table 1. Sample of motor carriers.

1	A. Duie Pyle	35	Lynden Transport
2	AAA Cooper	36	Marten Transport Services
3	ABF Freight System	37	May Trucking Co.
4	Averitt Express	38	Melton Truck Lines
5	Bison Transport	39	Mercer Transportation
6	Boyd Bros. Transportation	40	Miller Transporters
7	C.R. England	41	National Retail Systems
8	Cardinal Logistics Management	42	New Penn
9	Carlile Transportation Systems	43	NFI
10	Celadon Trucking Services	44	Oak Harbor Freight Lines
11	Central States Trucking	45	Old Dominion Freight Line
12	Challenger	46	Panther Expedited Services
13	Con-way Freight	47	Paschall Truck Lines
14	Covenant Transport Group	48	Penske Logistics
15	Crete Carrier Corporation	49	Pitt Ohio Express
16	CRST International	50	Prime Inc.
17	Daily Express	51	R & L Carriers
18	Dart Transit	52	Roehl Transport
19	Daylight Transport	53	Ruan
20	Dayton Freight Lines	54	Ryder Supply Chain Solutions
21	Evans Network of Companies	55	Saia
22	FedEx Custom Critical[a]	56	Schneider National
23	FedEx Freight[a]	57	Southeastern Freight Lines
24	FedEx Ground[a]	58	Standard Forwarding
25	FFE Transportation Services	59	Swift Transportation
26	FLS Transport	60	Transportation Corp. of America
27	Gordon Trucking	61	Trimac Transportation
28	Heartland Express	62	US Xpress Enterprises
29	Interstate Distributor Co.	63	Universal Truckload Services
30	J.B. Hunt Transport Services	64	UPS
31	KLLM Transport Services	65	Vitran Corporation
32	Knight Transportation	66	Ward Trucking & Logistics
33	Landstar System	67	Willis Shaw Logistics
34	Lily Transportation	68	Wilson Trucking Corporation

Notes: These motor carriers appeared in the *Inbound Logistics'* 'Top 100 Motor Carriers' listing in every year from 2007 to 2011.
[a]FedEx companies were combined for the analysis.

The *Commercial Carrier Journal* (*CCJ*), which is considered as one of the most respected practitioner journals within the motor carrier industry (Margiotta 2011), provides an ordinal ranking of the top 250 motor carriers every year. *CCJ* has ranked the top motor carriers for the last 50 years. The ranking is calculated based upon a variety of factors, such as revenue, fleet size, and employment base, thus serving as an adequate proxy for external legitimacy. The journal also provided demographic information including the number of drivers, number of trucks and tractors, and gross revenue.

We collected safety data from the Federal Motor Carrier Safety Administration's Safety Measurement System. For each carrier, we totalled the scores for the five Behaviour Analysis and Safety Improvement Categories (unsafe driving, fatigued driving, driver fitness, controlled substance, and vehicle maintenance). The scores are a 24-month average.

3.2. *Measures*

3.2.1. *Dependent variables*

The dependent variables for this study are on-time delivery, claims ratio, safety, and reputation. On-time delivery and claims ratio were reported by *Inbound Logistics*. On-time delivery is the

ratio of all on-time shipments to all total shipments made by the carrier. Claims ratio is measured using three ordinal bins (1 = claims ratio < 0.05%, 2 = claims ratio between 0.05 and 1%, and 3 = claims ratio above 1%), which represent the overall average for each firm. Motor carrier safety numbers were reported by the Federal Motor Carrier Safety Administration as a percentage of non-compliance in each of the five categories. The average of the five categories was subtracted from 1 to provide an overall measure of safety. *CCJ* presented an ordinal ranking of carriers from 1 to 250. Each rank was subtracted from 251 to reverse the direction, so that the analysis would logically reflect the direction of the relationship. This rank was used as our proxy for reputation.

3.2.2. *Independent variable*

The independent variable was the composite innovation score. In our analysis, each of the 8 motor carrier information technology innovations were equally weighted and loaded as a 1 to indicate adoption or a 0 to indicate non-adoption. While depicting innovation adoption as a dichotomous variable is not optimal, it is commonly used in logistics research (Hazen, Overstreet, and Cegielski 2012) and has been shown to be valid across many research efforts (Pennings and Harianto 2006; Rai and Bajwa 2007; Vilaseca-Requena et al. 2007). The sum of adopted innovations for a given year is the innovativeness score of that motor carrier. The mean innovativeness score was 3.83 (range 0–8) with a standard deviation of 1.98.

3.2.3. *Control variables*

Because past research suggests a positive association between firm size and innovation adoption (Narasimhan and Kim 2002; Rogers 2003; Teo, Wei, and Benbasat 2003), and the sample descriptives suggest large variations in motor carrier size within our sample (Carayannis and Provance 2008), we used a measure of firm size as a control. Firm size can be reported using measures such as revenue or the number of assets (Zhang, Chen, and Wang 2009). To address the collinearity of these two measures, we followed the example of Raff and Ryan (2008), who divided gross revenue by total assets. By deriving revenue per truck (in thousands), carriers can be directly compared, thus creating an effective control for firm size.

According to Schulz (2011), union carriers are generally less nimble and may require more time to change organisational processes. Additionally, Corsi et al. (2012) found significant performance differences between union (i.e. organised labour) and non-union motor carriers. Thus, we employed a dichotomous variable to control for unionisation, with a 0 indicating a non-union workforce and a 1 indicating a union workforce. Enis (2003) highlights the importance and opportunity of studying organisational behaviours, such as innovativeness in this unique industry that is dominated by privately held firms versus publically traded firms. Because of the many noted differences between public and private firms, we chose to control for ownership. The control variable for ownership is dichotomous, with a 0 indicating that the company is publicly traded and a 1 indicating that the company is privately held. In our sample, 80% of the motor carriers are non-union with the remaining 20% being union, and 72% are privately owned with the remaining 28% being publicly traded.

3.3. *Descriptives and correlations*

Table 2 presents the mean, standard deviation, and correlations among the variables included in our analysis. All correlations were below the recommended threshold of 0.7 indicating that multicollinearity is not a concern (Zhu and Kraemer 2002; Britto, Corsi, and Grimm 2010).

Table 2. Correlations among variables.

	1	2	3	4	5	6	7	8
Dependent variables								
1. On-time delivery	1							
2. Claims ratio	−.15*	1						
3. Safety	−.03	.18	1					
4. Reputation	.13*	.18*	−.21*	1				
Independent variable								
5. Innovation score	.13*	.15*	.27**	.01	1			
Control variables								
6. Firm size	−.28***	.01	.36***	−.05	.34***	1		
7. Ownership	.04	−.10	.14	−.28***	−.09	.01	1	
8. Unionisation	−.07	.04	.30***	−.16**	.22***	.31***	−.04	1
Mean	.98	–	70.72	–	3.83	$279 K	–	–
SD	.02	–	14.14	–	1.98	$196 K	–	–

Notes: Missing value technique: pairwise deletion. No mean or standard deviation given for claims ratio (ordinal), industry ranking (ordinal), ownership (dichotomous), or unionisation (dichotomous).
*Significant at the 0.05 level.
**Significant at the 0.01 level.
***Significant at the 0.001 level.

3.4. *Models*

The data for this study were collected from 66 motor carriers operating within the USA over a five-year period, 2006–2010. Our database contained multiple observations for each company (i.e. a line of data for each company for each year). To take full advantage of the data collected for our analyses, we did not test for lag effects. This would have resulted in the loss of one or more years of data by lagging the dependent variable.

Modelling with panel data can be problematic because the correlation between a firm's data over multiple years can bias the standard error estimates (Petersen 2009). We used the cluster option in Stata, which provided robust standard error estimates to account for the dependency of the observations over the five-year period (Baum 2006; Wang 2010). This method goes beyond describing a diagnostic statistic (i.e. the Durbin–Watson statistic) to actually adjusting the standard errors to account for dependencies.

To analyse this *panel* data, we performed two types of regression analysis. Ordinary least-squares regression was used to evaluate on-time delivery, safety, and reputation. Because claims ratio is an ordinal variable that could not be treated as continuous, we used ordered logistic regression. We assume that each model is a linear function of the variables and can be generically expressed as follows:

Organisational outcome $= \beta_1 \times$ firm size $+ \beta_2 \times$ ownership $+ \beta_3 \times$ unionisation $+ \beta_4 \times$ innovativeness $+ \varepsilon$.

We used a two-step approach to test the significance of each hypothesised relationship. We conducted four separate analyses. For each analysis, we first tested a baseline model using just the controls as predictors. We then add the hypothesised predictor variable and use the results for hypothesis testing.

4. Results

The results of the regression models are given in Table 3. For each variable within the model, the critical value and significance, if appropriate, are indicated. Below we discuss the results for each model tested.

Table 3. Results of regression analysis (unstandardised coefficients with test statistics in parenthesis).

	Dependent variables							
	On-time delivery		Claims ratio		Safety		Reputation	
	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b
Control variables								
Firm size	0.00**	0.00	−0.00	−0.00	0.11***	0.06*	0.27*	0.10
	(2.88)	(1.24)	(−.22)	(−1.19)	(3.77)	(2.57)	0.(2	(.94)
Ownership	0.61***	0.46***	−0.49	−0.35	39.77***	29.54***	80.92***	42.44*
	(6.42)	(7.41)	(−1.09)	(−.80)	(6.59)	(6.47)	(3.53)	(2.35)
Unionisation	0.01	0.02	0.33	0.23	12.96	5.44	−28.24	−45.03
	(0.09)	(0.20)	(0.61)	(0.43)	(1.36)	(0.69)	(−0.70)	(−1.27)
Independent variable								
Innovation score		0.11***		0.23**		6.57***		25.09***
		(5.90)		(2.64)		(5.36)		(4.91)
R^2	0.83	0.89	0.01	0.04	0.85	0.90	0.61	0.70
ΔR^2		0.06		0.03		0.05		0.09
Critical value	471.99***	305.22***	1.90	10.27*	219.94***	171.12***	43.56***	63.20***
Observations	222		164		123		311	
N (clusters)	63		62		64		65	

Notes: Missing value technique: pairwise deletion.
*Significant at the 0.05 level.
**Significant at the 0.01 level.
***Significant at the 0.001 level.

In our first model, we examine on-time delivery. Model 1a is the baseline model that evaluates the effect of the control variables on on-time delivery. Model 1a is significant ($F_{3,62} = 471.99$, $p < .01$, $R^2 = .83$). Model 1b includes innovation score and is also significant ($F_{4,62} = 305.22$, $p < .01, R^2 = .89$). In this model, we find that innovation score is a significant predictor of on-time delivery ($t_{63} = 5.90, p < .01$) when added to a model that already includes the control variables.

Model 2a is the baseline model that evaluates the effect of the control variables on claims ratio. Model 2a is not significant (Wald $\chi^2(3) = 1.90$, $p = .59$, $R^2 = .01$). Model 2b includes innovation score and is significant (Wald $\chi^2(4) = 10.27$, $p = .04$, $R^2 = .04$). In this model, we find that innovation score is a significant predictor of claims ratio ($z_{63} = 2.64$, $p < .01$) when added to a model that already includes the control variables. However, the relationship was not in the predicted direction.

Model 3a is the baseline model that evaluates the effect of the control variables on safety. Model 3a is significant ($F_{3,63} = 219.94, p < .01, R^2 = .85$). Model 3b includes innovation score and is also significant ($F_{4,63} = 171.12, p < .01, R^2 = .90$). In this model, we find that innovation score is a significant predictor of safety ($t_{63} = 5.36, p < .01$) when added to a model that already includes the control variables.

Model 4a is the baseline model that evaluates the effect of the control variables on reputation. Model 4a is significant ($F_{3,64} = 43.56, p < .01, R^2 = .61$). Model 4b includes innovation score and is also significant ($F_{4,64} = 63.20, p < .01, R^2 = .70$). In this model, we find that innovation score is a significant predictor of reputation ($t_{64} = 4.91, p < .01$) when added to a model that already includes the control variables.

5. Discussion

In hopes of enhancing efficiencies and increasing competitiveness, motor carriers have invested significant time and resources in technology. Indeed, among motor carriers, investing in innovation

Table 4. Hypotheses.

*H*1: Motor carrier innovativeness is positively associated with firm performance	Supported	$t = 5.90$	$p < .001$
*H*2: Motor carrier innovativeness is negatively associated with claims ratio	Not supported	$z = 2.64$	$p = .008$
*H*3: Motor carrier innovativeness is positively associated with safety	Supported	$t = 5.36$	$p < .001$
*H*4: Motor carrier innovativeness is positively associated with reputation	Supported	$t = 4.91$	$p < .001$

Note: Although *H*2 was statistically significant, it was not in the hypothesised direction.

has ranked among the top 10 issues for four consecutive years (American Trucking Associations 2010). However, little has been done to determine if those investments have been successful. The purpose of this study was to examine the performance and external legitimacy consequences of motor carrier innovativeness. To that end, we analysed five years of data for 66 motor carriers. The findings suggest that motor carrier innovativeness is significantly related to on-time delivery, claims ratio, safety, and reputation (see Table 4).

As hypothesised, on-time delivery performance was found to have a significant positive relationship with the degree of innovativeness of motor carriers. This positive association provides some evidence that more innovative companies are better able to meet delivery times. Next, it appears that organisations that are more innovative are also safer. It may be that these innovations aid in making organisational processes safer; or, it may be that firms that are more apt to be innovative are also more apt to stress safety as an important goal. Finally, we also found evidence to support that more innovative companies are more highly regarded externally. Firms that are quicker to adopt innovations may be seen as on the cutting edge of technology, which in turn enhances reputation.

Contrary to our hypothesised relationship, claims ratio was found to be higher for more innovative companies. Perhaps the innovations considered herein serve to advance efficiencies in such a way that care in handling is reduced. Or perhaps there is a learning curve associated with adoption of these innovations; it may be that, upon adoption, immediate gains are realised for on-time delivery performance, but claims increase as a function of more volume for a short period before the innovation becomes more routinised. Additionally, there may be a number of non-innovation-related issues that affect a motor carrier's claims ratio. One such issue could be high truck driver turnover rates (Suzuki, Crum, and Pautsch 2009).

The work presented in this paper offers several research implications. This study provides value by expanding innovation and institutional theory research within the motor carrier domain. Also, while the study answers some questions, it identifies areas that could benefit from more in-depth research. Although our study identifies significant relationships, more research should investigate why these relationships exist. For instance, is there a certain level of prestige gained by being innovative, which in turn enhances reputation? Does an innovative culture also suggest a culture of safety? Why does innovativeness enhance on-time delivery while negatively affecting claims ratio? Is there an additional moderating variable that affects these outcomes, such as the degree of routinisation of innovations? These questions may be used as the basis for future studies that will help to enhance our understanding of the outcomes of innovativeness in the motor carrier industry.

For the practitioner, this study provides evidence that innovativeness can have an impact on the performance of the company. The current economic environment coupled with the competitiveness of the motor carrier industry has made managers cautious about investing in technological innovations. Hopefully, these results can help alleviate some of their apprehension and provide managers with greater understanding that will help them to make a more informed decision regarding whether or not to adopt common motor carrier innovations.

While this research provides insight into outcomes of motor carrier innovativeness, the study is not without limitations. First, empirical studies that use financial data from many companies

over multiple years typically have missing values (Cho and Pucik 2005). Because the majority of the motor carriers in this study are privately owned, some financial data were not reported to the public and therefore were not available for analysis. A pairwise deletion technique was used to address missing data, which is the reason for different cluster sizes between some models. Another validity threat is that much of the data were self-reported; however, we believe that the ability of industry peers to observe and critique motor carrier claims regarding performance mitigates some of the bias normally associated with this type of data. In addition, any bias that such self-reporting may incur would likely manifest itself uniformly throughout the sample; because this study is concerned with relationships between variables in lieu of mean comparisons, such self-reporting may not significantly threaten the validity of our results. Finally, although the dichotomous view of adoption versus non-adoption of the innovations within our sample provides some indication of the motor carriers' innovativeness, it caters to the assumption that all adoption is equal and is the end-state of organisational diffusion process. As noted by Hazen, Overstreet, and Cegielski (2012), the act of adoption is just one stage of the diffusion process. Therefore, it would be beneficial for future research to supplement the innovativeness score with a measure of the firm's routinisation of the technology after adoption.

6. Conclusion

Motor carriers operate in an extremely competitive environment with little, if any, room for strategic mistakes. It is understandable that leadership within these organisations is cautious regarding the adoption of costly innovations. Adding to their caution is the almost incessant addition of new technology that is being adapted for use in the motor carrier industry. Our findings suggest that more innovative carriers have generally higher levels of organisational performance and are seen as more legitimate by external stakeholders, which may provide practitioners with a better understanding of the return on their investment in such innovations.

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