MODELING THE OPERATIONAL PERFORMANCE OF 3PLs

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ABSTRACT

This research examines theoretical links between factors thought to influence capability development and their effects on performance using data from a third party logistics (3PL) environment. The research extends previous work that has demonstrated links between integration capabilities and performance, and between learning processes and performance, by providing an overarching theoretical framework. Structural equation modeling was used to test direct and indirect 3PL relationships between learning processes, the absorptive capacity of employees, integration capabilities and performance. The results of the research are discussed within the theoretical framework. Brief suggestions of the practical implications of the research are also presented.

INTRODUCTION

Research focusing on capabilities of relevance to deliver market winners is emerging slowly within the supply chain domain, but so far has been perceived to be a particular weakness within the 3PL sector (e.g., [37]). Cost and service delivery are identified as drivers of outsourcing by researchers who have reviewed extant literature relating to the 3PL sector [31] [32] [37]. This paper will develop the basic theoretical framework presented by Zollo and Winter [46] to examine whether inter-firm capability development is a source of market winners for 3PL firms.

LITERATURE REVIEW AND HYPOTHESES

The influence of integration capabilities on 3PL performance

A substantive area of capability research is focused on relational capabilities required to support alliances and extended organizational networks, such as supply chains. The underlying theory posits that competitive advantage is embedded in inter-firm resources and routines rather than the capabilities of a single firm [17]. This theory and its associated streams of research (e.g., [14] [15] [16]) are particularly relevant to outsourcing within supply chain contexts since they provide the theoretical bases for the development of competitive advantage in inter-organizational settings.

Research in recent decades has highlighted the need for integration with buyers, and suppliers, as well as within organizations [20] [30]. Logistics integration is held to be critical within this context [5] [6]. One might expect the 3PLs to make material contributions to performance of logistics integration in supply chains that have deployed outsourcing options. In this environment, capabilities that enable and facilitate integration logically become important strategically for 3PLs. Hypothesis 1 is therefore stated as follows.

Hypothesis 1: 3PL integration capabilities positively influence 3PL performance.

The influence of organizational learning on 3PL integration capability improvement

Researchers have sought to map the relationships between learning mechanisms, organizational capabilities and performance (e.g., [4] [27]). Hult, Ketchen and Slater [26], Hult, Ketchen, and Arrfelt [25], and Fugate et al [21] showed that learning processes have significant effects on logistics performance. Cheung et al's [8] study demonstrated the relationship value of a joint learning process among buyers and suppliers. Further, Panayides [33] demonstrated that learning processes affect 3PL performance, and have a role in a relational context. However, studies of the direct effects of learning processes on integration capabilities of 3PLs and organizational performance are yet to emerge. These cross-effects can be examined in the following hypotheses.

Hypothesis 2: 3PL learning processes positively influence 3PL integration capabilities.

Hypothesis 3: 3PL learning processes positively influence 3PL performance.

The influence of 3PL employee absorptive capacity

Cohen and Levinthal [9] used the concept of absorptive capacity to explain why organizations learn more quickly when they build upon prior learning and experiences. Zahra and George [45] argued that assimilation and exploitation of knowledge, the core elements of absorptive capacity, reflect dynamic capabilities used to drive change within organizational resource bases. Zacharia et al [44] attempted to demonstrate that absorptive capacities enable collaborative process capabilities in collaborative inter-firm environments. These arguments and results suggest absorptive capacities may act as links between the learning process and the evolution of operational capabilities in the manner of Zollo and Winter's [46] theoretical model.

Tu et al [40] recognized the multi-dimensional nature of absorptive capacity and separated the capacity to assimilate knowledge from the organizational mechanisms that transmit and enable exploitation of that knowledge. However, extant research remains silent on the importance to organizations of initially "… recognizing the value …" [39, p777] of new knowledge in the relationship between learning processes, operational capabilities and organizational performance. The following hypotheses are therefore offered for examination.

Hypothesis 4: Absorptive capacities of 3PL employees mediate the positive influences of 3PL learning processes on 3PL integration capabilities.

Hypothesis 5: Absorptive capacities of 3PL employees positively influence 3PL integration capabilities.

Hypothesis 6: Absorptive capacities of 3PL employees positively influence 3PL performance.

Proposed model for operational performance of 3PLs

The proposed research model is shown in Figure 1 below. It is based on the capability development framework of Zollo and Winter [46], and provides theoretical grounding to explain why a key capability evolves to positively affect 3PL performance. This theoretical grounding answers the calls of Maloni and Carter [31, p33] to use "… theory-based hypotheses …" within 3PL research, and of Marasco [32, p142] to increase the theoretical base of 3PL research. The model also directly addresses the proposition of Selviarides and Spring [37, p140] to use the 3PL environment to extend and refine existing generic theories by linking the capability development model to organizational performance.

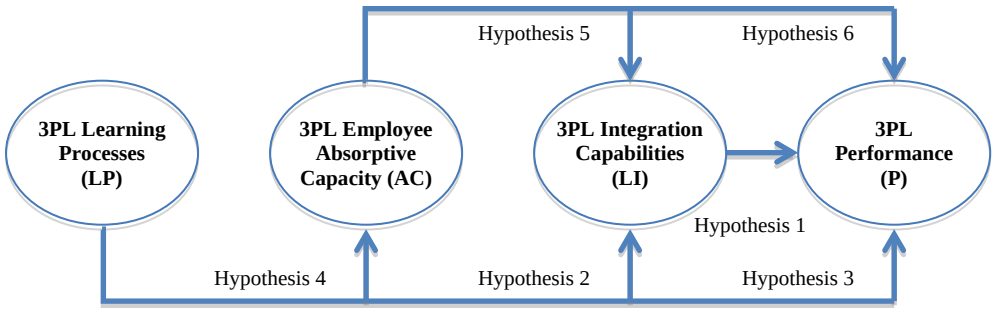

FIGURE 1
Hypothesized direct relationships between Learning Processes, Employee Absorptive Capacity, Integration Capabilities and Performance in 3PL organizations

METHODOLOGY USED

The model and the specific hypotheses were tested via the use of structural equation modeling (SEM). SEM is a technique that enables multiple relationships, including mediated relationships, to be tested within a single model.

Sample profile

The sample frame used in this study responds to the call by Ray et al [35] to test theories based on the resource-based view by using data at business unit levels rather than at aggregated organizational levels. Participants chosen in this study were managers and operational supervisors of a large third-party logistics service provider and its clients in Australia. The web-based data collection procedures were based on the recommendations of Cook et al [10]. A total of 241 usable responses were received from a sample of 494 prospective participants; 28 of these were removed from the final model due to issues relating to model fit.

Data analysis and model development

The basic data review and examination process deployed the missing data procedure recommended by Schafer and Graham [36]. Missing values were imputed using the regression imputation algorithm for pre-defined Confirmatory Factor Analysis (CFA) variables in the statistical programme Amos 18 [1] [18] [36]. The "jigsaw" approach recommended by Bollen [3] was employed to analyze CFAs and SEMs using SPSS 18 and Amos 18. CFA models were specified using indicators selected from extant

literature and the SEMs were extensions of the CFAs that tested the hypothesized relationships among the latent variables. The indicators selected for testing are not shown here in order to conserve space but are available by contacting the authors.

There is some dispute with regard to the selection of appropriate statistics for analysis of normality [2] [19] [24] [38] and critical values for selection of outliers [12] [22] [34] [42] [43]. The recommendations of DeCarlo [13], Lei and Lomax [29] and Gao et al [22] were therefore selected as a compromise and used in a progressive manner as recommended by De Maesschalck et al [12] to identify the data sets with the least number of cases removed.

The CFA and SEM models were analysed using maximum likelihood estimation and the Bollen-Stine bootstrap procedure using 2000 samples in Amos 18 for multivariate non-normal data. The Bollen-Stine bootstrap procedure followed that of Cunningham [11, p5-23].

Data were accepted as fitting specified models if Chi-squared scores were not significant at p=.05, or the Bollen-Stine bootstrap p > .05 for multivariate non-normal data, chi-square/degrees of freedom < 2, the root mean square error of approximation (RMSEA) <.05 with the lower and upper bounds of the 90% confidence interval below .05 and .1 respectively with a p value that does not exceed .05 (Pclose), the comparative fit index (CFI) > .95, the Tucker-Lewis coefficient (TLI) > .95, the standardized root mean square residual (SRMS) < .05, and there were no standardized residual covariances above 2 [11] [28].

The process recommended by Cheung and Lau [7] was used to analyze mediation, with Amos 18 used to generate 2000 bootstrap samples to estimate 90% confidence intervals.

RESULTS

The fit of the model was acceptable with Chi-square = 263.739, DF = 201, p = .002, Chi-square / DF = 1.312, TLI = .970, CFI = .974, RMSEA = .038 (.024 - .051, Pclose = .941), and SRMR = .0449. The Bollen-Stine bootstrap registered at p = .650 with Mardia's coefficient equal to 143.826 and its critical ratio at 32.297. Peak kurtosis was 4.049 and peak skew was – 1.568. Though not shown here to conserve space, all unstandardized regression weights of all measured variables that were free to vary were significant. The standardized regression weights were also significant for all measured variables in the model.

The unstandardized and standardized regression weights of the hypothesized relationships in the model are shown in Table 1. The results support Hypothesis 1. The results suggest 3PL integration capabilities could directly influence 3PL performance. The model also supports the hypotheses associated with the Learning Process. The results suggest the model effectively explains the mediation of 3PL Learning Processes (LP) > 3PL Performance (P) via 3PL Employee Absorptive Capacity (AC) and 3PL Integration Capabilities (LI), supporting hypothesis 4, and supporting hypotheses 2 and 3 via the mediated relationships but *not* via the direct relationships. The hypothesized influence of absorptive capacity on logistics integration and 3PL performance within the model was supported. The results suggest the model effectively explains mediation of AC > P via LI supporting hypothesis 5, and partially supporting hypothesis 6 through the mediated relationship.

The squared multiple correlations for the model variables show that the model explains 49.1% (p = .002) of the variance of AC, 48.7% (p = .004) of the variance of LI and 45.8% (p = .010) of the variance of P. These results suggest that the model explains significant proportions of the overall variance for these latent variables.

TABLE 1

Unstandardized and standardized regression weights for hypothesized relationships

Hypothesis	Hypothesized Relationship	Unstandardized Regression Weight*	Standardized Regression Weight*
1	LI > P	.926 (.615 – 1.258, p = .002)	.726 (.514 - .888, p = .003)
2	LP > LI (Direct)	.196 (-.088 - .451, p = .202)	.189 (-.087 - .427, p = .216)
	LP > LI (Indirect)	.403 (.216 - .742, p = .002)	.387 (.215 - .626, p = .003)
3	LP > P (Direct)	.063 (-.377 - .506, p = .816)	.047 (-.304 - .356, p = .819)
	LP > P (Indirect)	.446 (.150 - .807, p = .031)	.336 (.110 - .599, p = .033)
4	LP > AC	.755 (.557 - .945, p = .002)	.701 (.563 - .813, p = .002)
5	AC > LI	.534 (.275 - .840, p = .004)	.552 (.296 - .790, p = .005)
6	AC > P (Direct)	-.144 (-.594 - .237, p = .539)	-.117 (-.450 - .216, p = .561)
	AC > P (Indirect)	.494 (.245 - .845, p = .003)	.401 (.206 - .678, p = .003)

*90% confidence intervals and significance levels shown in brackets

Note: LI: 3PL Integration Capabilities; P: 3PL Performance, LP: 3PL Learning Processes, AC: 3PL Employee Absorptive Capacity .

DISCUSSION

The research presented in this paper seeks to operationalize a theoretical model of capability development and link it to performance within a third party logistics environment. The overall model explains almost half the variance of absorptive capacity of 3PL workers, logistics integration and 3PL performance, suggesting that the theoretical ideas that underpin the model contribute meaningfully to our understanding of both capability development and its influence on performance in 3PL environments.

The results suggest that learning processes directly influence the absorptive capacities of employees. The results also suggest that it is the absorptive capacities of the employees that directly influences logistics integration, and that the learning processes influence the operational capability through the absorptive capacities of the employees. Similarly, the results suggest it is the operational capability that directly influences operational performance, and that both learning processes and the absorptive capacities of the employees influence performance indirectly through the operational capability in 3PL environments.

The research adds to our knowledge at theoretical levels and at more practical management levels within 3PL environments. The results support the theoretical ideas that dynamic capabilities influence operational capabilities, and that in turn, the operational capabilities influence performance (see [23] for discussions in relation to these arguments). The results also highlight the important role learning processes play in support of both dynamic and operational capabilities (see [41] for extended ideas in this area). However, the results do not support the direct link between learning processes and operational capabilities hypothesized by Zollo and Winter [46].

The practical implications of the research reported here include highlighting the applicability of theoretical models to the 3PL environment, as mentioned earlier. More specifically, the present research highlights the importance of ensuring there is sufficient emphasis on integration capabilities when 3PL relationships are established. The research also highlights the critical role of employee knowledge and robust learning processes in 3PL relationships.

There are many limitations associated with the present research. While use of indicators from the extant literature was deliberate, there is no doubt room to build more 3PL centric measures of each of the key latent variables. Qualitative research that explores each construct within the model in more depth in a 3PL environment would also help our understanding. Finally, the research could benefit from replication across a broader range of 3PLs both within Australia and within other markets.

References available upon request from Chris Hemstrom, chrishemstrom@optusnet.com.au