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DEVELOPING OPERATIONAL COMPETENCE IN PURCHASING

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Abstract

This paper contributes to the emerging theory of purchasing competence. First, it replicates and cross-validates the construct with the five underlying supply-side competence dimensions of Narasimhan, Jayaram and Carter (2001), using telephone survey data from 200 high-turnover European companies. The addition of an IT Competence dimension to the construct is proposed and empirically validated. In response to the growing importance of services, equivalence of the competence construct across manufacturing and financial services contexts was shown using the structural equation technique of invariance analysis. Using set correlation analysis, competence dimensions were found to be significant drivers of multiple operational performance measures. All competence dimensions had significant positive impact on at least one performance measure. IT Competence had the most significant positive impact, driving Quality, Purchase-Order Cycle Time and Professionalism. Certain dimensions had significant negative effects on performance, providing evidence for the possible existence of the *"competency trap"* phenomenon. Potential areas of further research and implications for academics and managers are discussed.

Keywords: Operational Competence, Purchasing, Empirical Methods.

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DEVELOPING OPERATIONAL COMPETENCE IN PURCHASING

1. Introduction

In recent years, the area of purchasing has been elevated to a strategic level and has become established as an important area of study (González-Benito, 2007; Cox, 1996; Carter and Narasimhan, 1996). A strong reason for this rise has been the recognition that functional level competences can dramatically affect firm performance (Vickery, Droge, and Markland, 1993; Jayaram, Droge, and Vickery, 1999). The emerging theory of purchasing competence has been led by Narasimhan et al. (2001), who defined supply chain competence in terms of functional competences in purchasing, manufacturing and marketing/sales. In particular, they highlighted the importance of purchasing competence, defining and validating the construct in terms of five underlying practice-related dimensions: Empowerment, Employee Competence, Tactical Interaction Effectiveness, New Product Development Interaction Effectiveness, and Buyer-Seller Relationship Management. Practitioners have sought to hone these dimensions of purchasing competence in the drive to reduce costs and improve performance. The practice dimensions of Narasimhan et al. (2001) are consistent with the capabilities of González-Benito (2007).

In recent years, information technology (IT) has become an enabler of supply chain activities and has impacted on the way purchasing is performed (e.g., Guimaraes, Cook, and Natarajan, 2002; Frohlich, 2002a; Sanders and Premus, 2002). With increasingly sophisticated IT, new competences have been developed in practices such as e-auctions, real-time knowledge sharing, spend/order tracking, streamlined invoice payment systems and the purchasing of ever more complex commodities. While Stratman and Roth (2002) validated an IT Competence dimension for enterprise resource planning (ERP), apparently no such dimension has been studied within the purchasing context. To address this we build on the purchasing competence construct of Narasimhan et al. (2001). We first replicate their work and then extend their construct to include IT competence as a sixth underlying dimension of purchasing competence.

Purchasing has usually been studied solely from the point of view of manufacturing, but services also have a similar reliance on the supply of physical goods (Chartered Institute of Purchasing and Supply, 2003), and are increasingly motivated to develop purchasing competence that results in delivery and cost improvements (Handfield, 1993). The emerging field of services science (Bitner and Brown, 2006) also emphasizes the importance of extending theory in operations to services. We thus argue that any theory of purchasing competence

should embrace both services and manufacturing. We therefore choose to cross-validate and extend Narasimhan et al. (2001) purchasing competence construct using data from both manufacturing and service companies. We thus also seek to test whether this construct is stable across both services and manufacturing. In this study we use financial services as one example for service operations.

A number of important purchasing performance measures have been identified (Chao et al., 1993), yet we know little about the connections between these measures and the competence dimensions that are understood to drive them. A final objective of this paper is thus to empirically explore the links between the dimensions of purchasing competence and performance.

2. Purchasing Competence: Issues Emerging from the Literature

2.1. Underlying Dimensions of Purchasing Competence and the Role of IT

Narasimhan et al. (2001) developed and validated a purchasing competence construct consisting of five underlying dimensions which, in turn, were defined in terms of 15 purchasing practices.

These five dimensions: empowerment, employee competence, interaction effectiveness – tactical, interaction effectiveness – new product development, and buyer-seller relationship management, were strongly grounded in the literature. As there is no *a priori* reason why these dimensions should not still be relevant, or be different in a multi-country context, we put forward the following proposition:

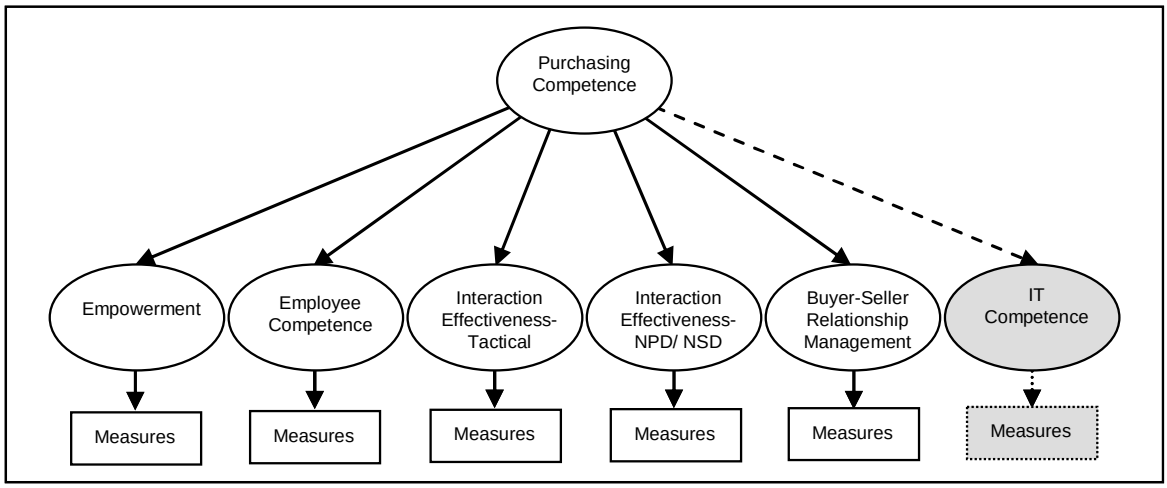
> *Proposition 1: Narasimhan et al. (2001) purchasing competence construct, as defined by five underlying dimensions and 15 associated purchasing practices, is applicable across national settings, manufacturing and service contexts.*

The broader supply chain management literature abounds with examples of the importance of IT, and the extended enterprise model identifies IT as a key component (Bowersox and Daugherty, 1995; Edwards et al., 2001). Guimaraes et al. (2002) found a positive link between effective use of IT and supplier network performance. Sanders and Premus (2002) stated that IT is significantly changing the way in which supply chain partners do business. Frohlich (2002a) identified the lack of internet-related IT skills as a significant barrier to supply-side activities. Sarkis and Talluri (2002) contend that increased investment in IT has played a significant role in enabling the purchasing function to meet its critical objectives. We propose that this increased role of IT has required the development of corresponding organizational and employee IT skill-based competence. There are a number of now common purchasing practices where such IT competence is needed: i) ensuring company-wide spend and order tracking visibility; ii) obtaining best prices through e-auctions; iii) facilitating the buying of complex commodities; iv) streamlining the invoice to payment process, and v) enabling real-time buyer-supplier knowledge transfer. Therefore we propose the addition of an IT competence dimension to Narasimhan et al. (2001) original purchasing competence construct. The modified construct is shown in Figure 1. We further propose that this dimension can be defined in terms of these five practices:

> *Proposition 2: Purchasing competence can be defined in terms of six underlying dimensions, comprising the five original dimensions, plus an IT competence dimension.*
>
> *Proposition 3: IT competence in purchasing can be defined in terms of 5 purchasing practices.*

Figure 1

Conceptual model: Dimensions of purchasing competence



2.2. Purchasing Competence in Manufacturing and Service Contexts

The literature consistently contends that supply-side competence leads to operational benefits in manufacturing companies (Akinc, 1993; Lawrence and Hottenstein, 1995; Agrawal and Nahmias, 1997), yet there is little research that explicitly addresses these issues within service organizations. Service companies are gaining importance in the role of economic growth (World Bank, 1983; Voss et al., 1997) and are increasingly adopting hitherto largely manufacturing-focused practices in purchasing and supply (Bowen and Youngdahl, 1998). There is thus a growing need both to consider purchasing issues in service companies and to compare with manufacturing.

In the broader supply chain context it is useful to separate upstream from downstream when considering services. Downstream, the differences between manufacturing and service customer-facing operations (Zeithaml and Binter, 1996) complicate the task of drawing comparisons. However on the upstream-purchasing side, there are considerable operational similarities. Like manufacturing, service companies also rely on the provision of physical goods from suppliers. In fact, the motivations for developing effective purchasing competence appear to be the same for manufacturing and service contexts: reduced costs and lead times (Ansari and Modaress, 1990); improved supplier reliability (Carr and Pearson, 1999); and improved communications (Freeland, 1991). Krause et al. (1998) also point out that manufacturing and service companies seek benefits from supply-side practices. Clearly, practices such as frequent small deliveries, selecting suppliers on quality and delivery, establishing supplier contracts, and reducing inventories and paperwork, could benefit service as well as manufacturing organizations (Handfield, 1993). Furthermore, membership lists of professional institutes (e.g., Chartered Institute of Purchasing and Supply, 2003) suggest that universal purchasing practices are promoted in both manufacturing and service firms. Generic or synonymous operational terminology is certainly used across the two contexts (e.g., Froehle et al., 2000). One specific, strict context that has been identified as appropriate for studying purchasing issues is the financial services sector. Thus with the same motivations, sources of advice and terminology for developing purchasing competence, we put forward the following hypothesis:

> *H1: The purchasing competence construct is stable across manufacturing and financial service contexts.*

2.3. Impact of Purchasing Competence Dimensions on Purchasing Performance

It has been argued that increased purchasing competence development results in improved performance (Burt, 1984; Burton, 1988). Narasimhan et al. (2001) found significant positive correlation between the purchasing competence construct and performance measures for TQM and customer satisfaction. They also found the dimensions of empowerment and buyer-seller relationship management to be positively related to these performance measures. The dimensions of purchasing integration and supplier capability have been found to benefit manufacturing performance (Das and Narasimhan, 2000); positive correlations have been found between out-sourcing practices and manufacturing flexibility (Suarez et al., 1996), and between supplier relationship management and manufacturing flexibility (Narasimhan and Das, 1999).

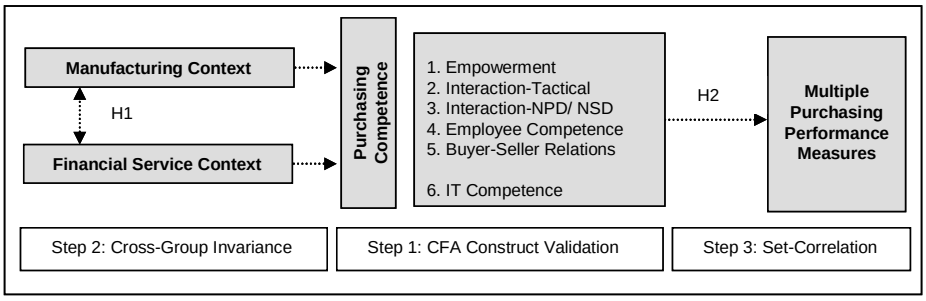
Purchasing performance can be seen as consisting of: Quality, On-time Delivery, Accuracy, Purchase Order (PO) Cycle Time, Commodity Knowledge, Professionalism and Negotiating Ability (Chao et al., 1993). We therefore hypothesize that there are links between the underlying dimensions of purchasing competence and specific purchasing performance measures.

> *H2: Underlying dimensions of purchasing competence significantly impact purchasing performance measures.*

We bring together these propositions and hypotheses in the research framework in Figure 2.

Figure 2

Research framework



3. Research Methods

3.1. Sampling Procedure and Measurement Issues

Data were collected through a survey targeted at heads of purchasing in European companies with revenues over $400 million. Two hundred full telephone interviews were conducted with a random sample, split equally between manufacturing and financial services companies. All interviews were completed over a period of two weeks in 2004 and comprised 50 each from the United Kingdom, France and Germany, and 25 each from Italy and Benelux. The survey was translated and administrated in the appropriate language of each country.

The survey methodology was executed following existing guidelines (Malhotra and Grover, 1998; Frohlich, 2002b; Rungtusanatham et al., 2003). An extensive up-to-date source database was used, compiled and refreshed by telephone interview over a number of years and representing close to the entire population. N^{th} number random sampling from this database and screening questions minimized sampling and coverage error. Analysis of the random sample indicated that the spread of sub-sectors, company sizes and locations did not differ markedly from the population. Measurement error was considerably reduced through the survey not being self-completed. Trained interviewers

administered a structured questionnaire with Likert scale items which had been pre-tested on a group of professionals. The first 20 interviews were piloted and the only amendment made was a minor simplification of wording in one item. One in 10 interviews was validated by a project leader, effectively re-interviewing the respondent. Each interview questionnaire was checked individually for 'branching errors' or omissions and the respondent was called again if there were any problems. The overall response rate was 23%.

There were no significant differences in response rates between manufacturing and financial services. Also, statistical tests did not reveal significant differences between respondent and non-respondent groups in the subsector, location and job title variables. Responses to certain objective questions had strong relationships with those from a previous year's survey using different respondents, indicating that non-response of previously surveyed groups was not a problem. While the survey was conducted confidentially, almost all respondents agreed to be re-interviewed in the event of unclear answers and requested a copy of the survey findings. This indicated an interest in providing accurate answers, and high overall interest in the survey. A summary report was given to respondents.

3.2. Measurement of Dependent Variables: Purchasing Performance

This study included the seven measures of purchasing performance deemed most important by Chao et al. (1993). These included objective measures for Quality (% items obtained/orders made that meet quality requirements), On-time Delivery (% purchase orders that arrive at the scheduled time), Accuracy (% purchase orders emitted that contain errors in specifications) and Purchase-Order Cycle Time (Days). Five-point Likert scales (1-"Very Poor" to 5-"Very well") were used to rate the subjective aspects of Commodity Knowledge (knowing items, suppliers, prices), Professionalism (upholding standards of conduct, ethics, conventions, courtesy), and Negotiating Ability (negotiating prices, terms of sales, delivery dates). Certain items were reverse coded to prevent/identify spurious responses. The means and standard deviations of the responses were as follows: Quality 79.3% (9.5), On-time delivery 82.6% (9.9), Accuracy 96.6% (2.6), PO Cycle Time 1.74 days (0.9), Commodity Knowledge 4.1 (0.7), Professionalism 4.4 (0.6) and Negotiating Ability 3.9 (0.7).

3.3. Measurement of Independent Variables: Purchasing Competence

The survey instrument measured the 20 practices listed in Table 1. Fifteen of the items (1-15) replicated those used by Narasimhan et al. (2001) to create the five multi-item competence scales: Empowerment, Employee Competence, Tactical Interaction Effectiveness, New Product/Service Development Interaction Effectiveness, and Buyer-Seller Relationship Management. The construct (face) validity of these fifteen survey items and corresponding competence dimension scales was re-confirmed for this study by a group of purchasing professionals and academics. Some minor wording changes were made to adapt these items to a telephone survey. Also, appropriate, synonymous terminology was included to ensure clarity of items to respective manufacturing and financial service respondents. The group of purchasing professionals and academics considered the final item wording to be true to the aims of replicating Narasimhan et al. (2001). Similarly, to ensure the content validity of a new multi-item IT Competence scale, an extensive literature search was carried out to identify potential item measures. Measurement options were discussed and five items chosen to reflect the concept being studied (Table 1, variables 16 to 20).

Table 1

Descriptive statistics and correlations

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Involvement-Job related	3.51	1.07	1.00																		
2. Involvement-Operational	3.27	1.14	**.52**	1.00																	
3. Job autonomy	3.63	1.07	**.31**	**.29**	1.00																
4. Job security	3.49	1.26	**.28**	**.22**	**.23**	1.00															
5. Training-purchasing	3.51	1.07	**.27**	**.26**	**.26**	**.21**	1.00														
6. Training-suppliers	3.13	1.14	**.17**	.12	.08	.05	**.34**	1.00													
7. Performance Evaluation	3.68	1.11	**.35**	**.28**	**.18**	**.20**	**.18**	**.31**	1.00												
8. Interaction-Operations	3.70	1.13	**.27**	**.23**	**.27**	.10	**.20**	.13	**.26**	1.00											
9. Interaction-QC/ QA	3.61	1.26	**.20**	**.21**	**.16**	.11	.08	.09	**.30**	**.46**	1.00										
10. Interaction design function	3.29	1.32	**.16**	**.20**	**.146**	.125	.09	.08	**.15**	**.36**	**.37**	1.00									
11. Interaction-R&D/ research	3.07	1.38	**.18**	**.28**	**.19**	**.17**	.08	.08	.08	**.33**	**.36**	**.73**	1.00								
12. Risk sharing	2.62	1.39	.06	.13	.00	-.09	**.14**	.14	.13	**.14**	**.20**	.04	.05	1.00							
13. Tech. Assist./Info. Sharing	3.27	1.30	.11	.08	-.01	.07	.06	.06	**.19**	**.23**	**.26**	**.34**	**.29**	**.29**	1.00						
14. Joint production planning	2.72	1.38	**.18**	**.22**	.05	.11	.08	**.21**	**.24**	**.27**	**.32**	**.30**	**.36**	**.36**	**.46**	1.00					
15. Share cost savings	3.04	1.36	**.15**	**.16**	**.19**	-.03	.10	**.21**	**.20**	**.31**	**.25**	**.24**	**.25**	**.42**	**.37**	**.50**	1.00				
16. Spend/Order tracking	3.39	1.39	.13	**.16**	**.22**	.066	.02	.06	**.19**	.03	**.20**	.11	.09	.08	.08	.07	.08	1.00			
17. Prices e-auctions	2.07	1.40	.01	.11	.06	.01	**.19**	**.15**	.13	.09	**.19**	.05	.07	**.17**	**.15**	**.20**	**.16**	**.31**	1.00		
18. Complex commodities	2.56	1.38	-.02	.02	.13	-.02	-.01	.02	.12	.13	**.16**	**.15**	.08	.02	**.17**	.10	.13	**.27**	**.34**	1.00	
19. Streamline invoice-payment	3.31	1.44	.09	.12	**.20**	.09	.09	.13	**.19**	.10	.10	.10	.09	.03	**.18**	**.17**	**.17**	**.46**	**.32**	**.29**	1.00
20. Real-time know sharing	2.70	1.56	.05	.12	.10	-.08	.04	.13	.13	.11	.13	.09	.01	.15*	.12	.12	.07	**.35**	**.46**	**.31**	**.32**

Correlations in bold are significant at 0.05 level. Sample size = 200.

The same question format was used for survey items corresponding to all independent variables. Respondents indicated on a five-point scale (e.g. 1-"Strongly Disagree" to 5-"Strongly Agree") the level of interaction frequency, extent of use or degree of agreement with statements such as: "Purchasing personnel are involved in key decisions affecting their jobs." The respondent could reply 1, 2, 3, 4, 5 or 6 (for "don't know"), or have the question explained and repeated if necessary. Some items were reverse coded. Descriptive statistics and correlations of the independent variable items are presented in Table 1.

4. Analysis and Results

4.1. Reconfirming Narasimhan et al. (2001) Scales

A preliminary analysis was conducted in line with that of Narasimhan et al. (2001) to reconfirm the original and new IT competence scales. Factors were found to be representative, unidimensional and practically significant. Substantial significant correlations were identified; KMO sampling adequacy of 0.80 is "meritorious"; and Bartlett's test of sphericity was significant (.001). Cronbach alpha values exceeded the lower acceptance level of 0.60 (Nunnally, 1979; Robinson et al., 1991). Only the Employee Competence value fell marginally short of this threshold (0.55). These high alpha values correspond well to those achieved by Narasimhan et al. (2001). The sample size of 200 and high factor loadings indicated statistical significance at the .05 level and a power of over 80%. Thus, the factors proposed by Narasimhan et al. (2001) are valid and reliable for our sample, along with the proposed IT Competence factor.

4.2. Cross-validation of Narasimhan et al. (2001) purchasing competence construct and Validity of IT competence dimension

To cross-validate Narasimhan et al. (2001) 5-factor purchasing competence model for our sample, and to confirm the validity of adding the IT Competence dimension, two second-order factor models were tested using the maximum likelihood method of estimation (Joreskog and Sorbom, 1989). This method is appropriate for our survey data (Bentler and Chou, 1987; Green et al., 1997). The total sample (200) exceeded the threshold of 100 needed to provide stable estimates (Boomsma, 1985; Hayduk, 1987), and was in line with the rule of thumb of approximately five observations per parameter estimate (MacCallum et al., 1992). Narasimhan et al. (2001) original model estimated 35 parameters, and 46 parameters were estimated with the addition of IT Competence. The validities of both models were assessed for the full sample data and the results are summarized in Tables 2 and 3. Both models demonstrated a very high degree of convergent validity as all first- and second-order factor loadings were found to be positive and highly significant ($p<.001$). In addition, adequate squared multiple correlation (SMC) values were observed for first- and second-order levels (Anderson and Gerbing, 1988). High levels of discriminant validity were demonstrated by all modification indices (MI) having values less than 10.

Validity of the two models and cross-validation between them was assessed against the multiple fit criteria in Table 2 (Bollen, 1989; Hoyle, 1995; Marcoulides and Schumacker, 1996). Critical N values estimate the minimum sample size needed for adequate model specification, and show that the sample of 200 is sufficient for both models (Hu and Bentler, 1995).

Cross-validation of Narasimhan et al. (2001) 5-factor purchasing competence model

Model 1 in Table 2 specifically addresses the first aim of the analysis. Chi-square, Goodness of Fit (GFI), Parsimony Goodness of Fit (PGFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA) statistics indicate that Narasimhan et al. (2001) 5-factor model fitted our data well. The relatively low Normed Fit Index (NFI) did not give cause for concern since Bentler (1990) states that NFI tends to underestimate fit and recommends placing more emphasis on CFI. Thus, cross-validity of Narasimhan et al. (2001) 5-factor purchasing competence model with the data was confirmed and Proposition 1 is supported.

Confirming the validity of adding the IT competence dimension

Model 2 in Table 2 addresses the second aim of validating the addition of the IT Competence dimension to the purchasing competence construct. Values for chi-square, GFI, PGFI, CFI, IFI, TLI, and RMSEA indicate a good fit to the sample data and thus validity of the 6-factor model is confirmed. Closer inspection of the fit criteria in Table 2 indicates that Model 2 fits the data better than Model 1. Thus, adding the IT Competence endogenous variable results in improved model specification and explanatory power without adversely affecting parsimony. Furthermore, adding IT Competence improves model fit without detracting from the importance of the other dimensions. In sum, the IT Competence dimension is a substantively appropriate and valid extension to Narasimhan et al. (2001) original 5-factor purchasing competence model, and Propositions 2 and 3 are supported.

Table 2

Second-Order factor analysis: Summary statistics

2nd Order Model	**SMC range** 1st Order	2nd Order	**Max MI**	**X^2**	**df**	**P**	**X^2/ df**	**GFI** ~.90	**PGFI** >.50	**NFI** ~.90	**CFI** >.90	**IFI** >.90	**TLI** ~.95	**RMSEA** <.05	**Critical N.** ~200 .05	.01
1. 5-Factor Model (Narasimhan et al., 2001)	.13-.73	.35-.80	6.83	130.1	85	.001	1.531	.924	.655	.833	.933	.935	.917	.052	165	181
2. 6-Factor Model (Including IT Competence)	.19-.74	.15-.78	6.76	215.6	164	.004	1.315	.906	.708	.794	.940	.941	.930	.040	180	193

[a] All loadings were significant at the p<.001 level. Criteria for Good Fit indicated for appropriate statistics.

Table 3

Second-Order factor analysis results

Indicator/ Construct	Construct	5- Factor Model			6- Factor Model		
		Standardized Factor Loading	Unstandardized Factor Loading	t-Value	Standardized Factor Loading	Unstandardized Factor Loading	t-Value
Second-Order Results							
Buyer-Seller Relationship	Purchasing Competence	0.657	0.461	5.201***	0.671	0.471	5.296***
Interact Effectiveness- NPD/ NSD	Purchasing Competence	0.627	0.703	6.729***	0.609	0.688	6.641***
Interaction Effectiveness-Tactical	Purchasing Competence	0.893	0.686	7.533***	0.880	0.665	7.405***
Employee Competence	Purchasing Competence	0.633	0.302	4.002***	0.663	0.309	4.062***
Empowerment	Purchasing Competence	0.593	0.464	5.754***	0.596	0.464	5.794***
IT Competence	Purchasing Competence	-	-	-	0.386	0.318	3.723***
First-Order Results							
Involvement-Job related	Empowerment	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Involvement-Operational	Empowerment	0.695	1.011	6.598***	0.698	1.021	6.618***
Job autonomy	Empowerment	0.449	0.613	5.079***	0.452	0.622	5.113***
Job security	Empowerment	0.366	0.588	4.244***	0.364	0.589	4.226***
Training-purchasing	Employee Competence	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Training-suppliers	Employee Competence	0.527	1.250	3.799***	0.517	1.259	3.786***
Performance Evaluation	Employee Competence	0.584	1.350	3.871***	0.598	1.417	3.899***
Interaction-production/ operations	Interaction Effectiveness-Tactical	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Interaction-QC/ QA	Interaction Effectiveness-Tactical	0.666	1.089	6.384***	0.678	1.126	6.405***
Interaction-engineering/ design	Interaction Effectiveness-NPD/ NSD	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Interaction-R&D/ research	Interaction Effectiveness-NPD/ NSD	0.853	1.045	8.393***	0.847	1.031	8.234***
Risk sharing	Buyer-Seller Relationship	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Technical assistance/Info. Sharing	Buyer-Seller Relationship	0.582	1.075	5.445***	0.584	1.076	5.466***
Joint production planning	Buyer-Seller Relationship	0.753	1.481	6.048***	0.753	1.478	6.071***
Share cost savings	Buyer-Seller Relationship	0.686	1.322	5.886***	0.685	1.318	5.902***
Spend/Order tracking	IT Competence	-	-	-	n.a.	n.a.	n.a.
Prices e-auctions	IT Competence	-	-	-	0.620	1.052	6.003***
Complex commodities	IT Competence	-	-	-	0.501	0.839	5.235***
Streamline invoice-payment	IT Competence	-	-	-	0.595	1.034	5.867***
Real-time knowledge sharing	IT Competence	-	-	-	0.623	1.171	6.019***

*** p<0.001. 2) To define the measurement scales for the constructs, one of the links has to = 1. Thus these factor loadings & t-values have been marked as "not applicable" (n.a.).

Table 4

Group invariance analysis for manufacturing and financial services

Model Description	Comparative Model	X^2	df	ΔX^2	Δdf	p	CFI	TLI	PGFI	IFI	RMSEA
5-Factor Baseline- No constraints	-	215.608	170	-	-	-	0.923	0.905	0.621	0.928	0.037
Constrained Measurement Model	5-Factor Baseline	227.959	180	12.351	10	**0.262**	0.919	0.906	0.652	0.923	0.037
Constrained Factorial Structure	5-Factor Baseline	239.647	185	24.039	15	**0.064**	0.908	0.896	0.666	0.912	0.039
6-Factor Baseline- No constraints	-	415.421	328	-	-	-	0.891	0.874	0.653	0.898	0.037
Constrained Measurement Model	6-Factor Baseline	427.073	341	11.652	13	**0.556**	0.893	0.880	0.674	0.898	0.036
Constrained Factorial Structure	6-Factor Baseline	445.438	347	30.017	19	**0.052**	0.877	0.866	0.682	0.882	0.038

4.3. Purchasing Competence Construct Across Manufacturing and Financial Services

Establishing validity of purchasing competence models on the full sample (200) does not guarantee the equivalence of measures and structures across manufacturing and financial services groups; hence this was explicitly tested via group invariance analysis (Marsh, 1987; Marsh, 1994; Byrne, 2001). We followed the procedure used by Doll et al. (1998) derived from the seminal work of Joreskog (1971). "Totally non-invariant" baseline models were simultaneously estimated for each group and subjective fit criteria (CFI, TLI, PGFI, IFI and RMSEA) showed these baseline models to adequately fit separate group data, thus qualifying for invariance testing (Bollen, 1989). Invariance analysis results are shown in Table 4.

Equivalence between baseline and group parameter constrained nested models was tested by differences in chi-square values, degrees of freedom and the corresponding p-value (Bentler, 1990). Non-significant p-values ($p>.05$) for constrained factorial structure and measurement models failed to reject the hypotheses of equal factor loadings and error terms, and provided strong support that observed differences between group parameters are due to chance (Bentler and Bonnet, 1980; Marsh, 1987). Therefore both 5- and 6-factor purchasing competence models are fully equivalent across manufacturing and financial services groups. Thus, the hypothesis (H1) that the purchasing competence construct is the same across manufacturing and services groups is statistically supported for both Narasimhan et al. (2001) 5-factor model and the 6-factor model (including IT Competence).

4.4. Performance impact of purchasing competences

To test the hypothesis (H2) relating to the impact of purchasing competence dimensions on multiple purchasing performance measures, we chose not to perform multiple regressions of each single dependent measure onto independent variables, opting instead for the more sophisticated technique of set correlation (SC) analysis (Cohen et al., 2003; Vastag and Montabon, 2001). SC analysis is a generalization of multiple regression/correlation analyses, such that a set of dependent variables can be related to a set of independent variables. Since SC analysis considers multiple dependent variables simultaneously, it is a truly multivariate method that addresses the shortcomings of more common methods by providing a single measure of association between data sets and a single framework for variable association, parameter estimation, hypothesis testing, and statistical power analysis. The results are shown in Table 5.

Table 5

Set correlation analysis: Purchasing competence dimensions and purchasing performance measures

A. Correlations among basic variables

	Set Y_B							Set X_B				
	Y1	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**Y7**	**X1**	**X2**	**X3**	**X4**	**X5**
Y1: Quality	1.000											
Y2: On-Time Delivery	0.246	1.000										
Y3: Accuracy	-0.233	-0.085	1.000									
Y4: PO Cycle Time	-0.004	-0.173	0.092	1.000								
Y5: Commodity Knowledge	0.028	0.098	-0.157	0.083	1.000							
Y6: Professionalism	0.103	0.014	0.006	0.052	0.310	1.000						
Y7: Negotiating Ability	0.146	0.106	-0.049	-0.049	0.387	0.301	1.000					
X1: Empowerment	0.171	0.072	0.020	-0.026	0.278	0.156	0.281	1.000				
X2: Employee Competence	0.135	0.141	0.004	-0.078	0.202	0.148	0.228	0.402	1.000			
X3: Int. Effectiveness-Tactical	0.150	0.097	0.015	-0.071	0.225	0.110	0.134	0.332	0.276	1.000		
X4: Int. Effectiveness-NPD/ NSD	0.221	0.113	-0.014	-0.067	0.108	0.146	0.158	0.282	0.136	0.446	1.000	
X5: Buyer-Supplier Relations	-0.005	-0.063	0.121	0.072	0.122	0.026	0.090	0.182	0.275	0.395	0.342	1.000
X6: IT Competence	0.192	0.046	-0.063	0.126	0.125	0.142	0.136	0.163	0.210	0.212	0.127	0.235

B. Set Correlation Analysis findings for simultaneous multiple dependent variables

Model $R^2_{Y,X}$ = .334 ; $\tilde{R}^2_{Y,X}$ = .171; Rao F = 1.898; (*df:* u = 42.0, v = 880.6); p < .001

Variable	r^2 (Set X toY)	Empowerment	Employee Competence.	Int. Effectiveness-Tactical	Int. Effectiveness-NPD/ NSD	Buyer-Seller Relations	IT Competence
Y1: Quality	0.108***	0.07	0.077	0.043	0.207**	-0.166**	0.168**
Y2: On-Time Delivery	0.054*	-0.021	0.156**	0.07	0.124*	-0.178**	0.028
Y3: Accuracy	0.028	0.035	-0.026	-0.009	-0.062	0.169**	-0.093
Y4: PO Cycle Time	0.048*	0.028	-0.119*	-0.095	-0.079	0.13*	0.146**
Y5: Commodity Knowledge	0.106***	0.202**	0.075	0.137*	-0.03	0.009	0.05
Y6: Professionalism	0.059*	0.075	0.098	0.016	0.12*	-0.088	0.111*
Y7: Negotiating Ability	0.106***	0.2**	0.131*	-0.014	0.09	-0.025	0.073

*** p< .001. ** p< .05. * p< .1. Number of Cases = 200.

The $R^2_{Y,X}$ value of 33.4 % indicates a high degree of multivariate association between performance measures and purchasing competence factor scores. The $\tilde{R}^2_{Y,X}$ value indicates "shrinkage" to be acceptable (Rozeboom, 1965; Van den Burg and Lewis, 1988). Rao's F value of 1.90 rejects the null hypothesis of no association between sets at the p<.001 level (Rao, 1975). A statistical power estimate of 95% (p = .05) was obtained from Cohen et al. (2003) and we followed their suggestions for guarding against Type I errors. Therefore the good overall SC association between competence dimensions and performance measures is highly significant. Supplementary analysis of Table 5 B showed that three regression (Set X to Y) r^2 values were significant at p<0.001 level, and a further three at the p<0.1 level. This further supports the predictive validity of the purchasing competence dimensions.

5. Discussion of Results

Further refined assessment revealed specific impacts of individual competence dimensions on the multiple performance measures. Nine of the SC partial regression coefficients were significant at the p<0.05 level, and a further seven at the p<0.1 level. Thus hypothesis H2 is strongly supported: purchasing competence dimensions do have significant impact on specific purchasing performance measures. Thirteen of these significant relationships were found to be positive, with each purchasing competence dimension relating significantly positively to at least one purchasing performance measure. Empowerment is positively correlated with both Commodity Knowledge (p<0.05) and Negotiating Ability (p<0.05). Employee Competence is positively related to On-time Delivery (p<0.05) and Negotiating Ability (p<0.1). Tactical Interaction Effectiveness is positively associated with Commodity Knowledge (p<0.1). New Product/Service Development is positively related to Quality (p<0.05), On-time Delivery (p<0.1), and Professionalism (p<0.1). Buyer-Seller Relationship Management is positively correlated with PO Cycle Time (p<0.1), and with Accuracy (p<0.05). Each of these positive significant correlations makes substantive sense- supporting practical significance and relevance of the findings. In addition, IT Competence was found to be significantly positively correlated with Quality (p<0.05), PO Cycle Time (p<0.05), and Professionalism (p<0.1). This represents the most significant positive impact on performance measures by any single competence dimension.

Interestingly, when considered in isolation, not all individual competence-performance relationships were found to be positive. Three significant negative effects were identified. Employee Competence was found to be significantly negatively related to PO Cycle Time (p<0.1). Also, Buyer-Seller Relationship Management was identified as being significantly negatively correlated with Quality (p<0.05) and On-time Delivery (p<0.05). These significant negative impacts add empirical support to existing operations management literature indicating that not all individual competence dimensions positively influence all performance measures, and that some might have a negative impact. For example, Upton (1995) found that workforce experience had a significant negative effect on manufacturing flexibility. Also, Corbett and Van Wassenhove (1993) identified trade-offs between dimensions of manufacturing competence and competitiveness. Although such negative correlations have not been extensively researched in the operations management literature, the strategic management literature has identified negative effects of competence dimensions on performance, and proposed mechanisms to explain them. Work on learning curves in organizations (Epple et al., 1991) indicate possible diminishing returns as individual competences depreciate over time, potentially becoming a performance-limiting phenomenon (Brown and Duguid, 1991). Ingram and Baum (1997) demonstrated that a firm can develop specific competences that are beneficial in the short-term,

but that in the long-term become performance reducing "competency traps." Levinthal and March (1993) explain this phenomenon in terms of exploitation of existing competencies, technologies and paradigms versus the exploration of new alternatives. The exploitation of existing competencies leads to more predictable short-term results, compared to the uncertainties of exploring and developing new work methods. Organizations might thus be tempted to allocate scarce resources to the refinement and extension of known competencies rather than the experimentation and development of better ways of doing things. As a result, organizations can find themselves trapped in a "suboptimal stable equilibrium" that is self-destructive in the long run. Effectively, the over-development of certain specific competence dimensions might result in a myopic and rigid organization, corporate inertia, and adversely affected performance (Miller and Chen, 1994).

In this respect, the negative impacts found in this study make substantive sense in terms of potential adverse long-term association with certain purchasing performance measures. Firstly, in line with the findings of Upton (1995), employee competence can reach levels of diminishing returns and could become a competency trap. As training and evaluation systems become embedded, corporate inertia and organizational myopia can result in over-qualified and over-experienced employees undertaking relatively mundane tasks. In the longer term, these employees might become bored, un-stimulated and de-motivated in certain run-of-the-mill tasks, such as purchase-order administration, leading to increased levels of procrastination and corresponding detrimental impact on performance in these tasks. Conversely, an employee with a lower, more appropriate level of training and experience is liable to complete mundane administration quicker and more efficiently with a corresponding improved Purchase Order (PO) Cycle Time.

Secondly, for similar reasons, high and sustained levels of risk sharing, technical information sharing and joint planning and shared cost savings could lead to overly 'cosy' buyer-seller relationships, resulting in the competence-performance trade-offs identified by Corbett and Van Wassenhove (1993). While in the short-term there are clear benefits to developing strong buyer-seller relationships, the value of such competence could depreciate if corporate inertia and organizational myopia were to confine long-term purchasing options to suppliers who are no longer motivated by the commercial need to compete for and maintain a demanding customer. In this case, buyer-seller relationships could become a competency trap as buyers and sellers become over-comfortable, over-confident, and blasé in terms of Quality and On-time Delivery performance. The negative associations found between buyer-seller relationships and some performance measures merit further investigation. Given the emphasis that firms place on buyer-seller relationships, a better understanding of these results could lead to better resource deployment.

Despite certain significant negative impacts found at individual competence dimension level, it is important to note that, at an aggregate level, the set of competence dimensions had an overwhelmingly positive impact on performance measures. All of the significant regression (r^2) values in Table 5B indicate a positive association between the combined set of competence dimensions and performance measure. In other words, while the over-development of individual competences in isolation, and to the exclusion of other important competence dimensions, might have a negative impact, the combined development of the set of competence dimensions together has a positive outcome on performance measures. The aggregate results thus support the notion underlying the purchasing competence construct: that competence dimensions are best developed in combination rather than on their own.

6. Conclusions

6.1. Impact on Academic Studies

The empirical results of this study indicate that three broad conclusions can be drawn that support existing theory. First, this study has replicated the empirical work of Narasimhan et al. (2001) in different geographical and business environments, and considered alternative conceptualizations. The cross-validation of Narasimhan et al. (2001) Purchasing Competence construct with up-to-date international manufacturing and service data might serve to justify continued recognition of this operational framework. The replication results indicate that academics and managers across broad geographical and business contexts could potentially benefit from knowledge of the underlying dimensions of competence in purchasing. Furthermore, a reliable IT Competence dimension is shown to be a potentially appropriate extension to the Purchasing Competence construct, resulting in possible increased scope and explanatory power. The inclusion of IT Competence does not detract from the original dimensions of purchasing competence, but rather supports and builds on recent literature, indicating the importance of IT to modern purchasing and supply operations.

Second, results of this study indicate that the Purchasing Competence construct applies equally across manufacturing and service contexts. In our study, financial services are used as one example of service operations. This lends empirical support to literature and institutions promoting uniform purchasing practices. To our knowledge, this is the first study to empirically indicate equivalence of an OM framework across manufacturing and service organizations, and could serve to motivate further comparative research. It would appear that service organizations are developing the same purchasing competencies that had hitherto been considered the domain of manufacturing organizations.

Third, the results indicate that underlying dimensions of purchasing competence have a significant impact on multiple purchasing performance measures, and account for a high degree of performance variance. Positive impacts of specific competence dimensions on particular performance measures support the general OM literature notion of beneficial competence-performance relationships. The results indicate that each competence has significant positive impact on at least one performance measure. Specific positive associations were found between the following: Empowerment and Commodity Knowledge/Negotiating Ability; Employee Competence and On-time Delivery/Negotiating Ability; Tactical Interaction Effectiveness and Commodity Knowledge; New Product/Service Development Interaction Effectiveness and Quality/On-time Delivery/Professionalism; and Buyer-Seller Relationship Management and PO Cycle Time/Accuracy. Of particular note was that IT Competence was found to have the most significant positive impact, driving Quality, PO Cycle Time and Professionalism.

While the majority of individual impacts observed were positive, the results also indicate the possibility of negative impacts if certain purchasing competence dimensions are over-developed in isolation of the other dimensions. One possible explanation of this is the phenomenon of competency traps. The results indicate specific negative impacts associated with Buyer-Seller Relationship and Employee Competence dimensions. Nevertheless, the results from this study do indicate that perhaps the OM literature should shed the overall presumption of competence development being universally good in favor of more careful contingency-driven analysis of appropriate competences for specific business scenarios.

6.2. Impact on Managerial Decision Making

Finally, the results indicate several potential managerial implications regarding the strategic importance of the purchasing function. It would appear from the results of this study that professionals in both manufacturing and service organizations could consider competence in purchasing to consist of six underlying dimensions for audit and diagnostic purposes. Of particular interest to managers in such organizations is the potential impact of competence dimensions on operational performance. The results suggest that managers perhaps should not run operations by relying on a single performance measure, but, instead, might tailor contingent "competence configurations" to achieve those particular performance requirements that constitute organizational competitive performance priorities. Similarly, the results suggest that, for any given organization, competitive priorities should determine where competence-developing efforts might best be focused within each of the underlying dimensions.

7. Study Limitations and Further Research

Given the limitations of the survey-based methods used, and the particular contexts of the population studied (Financial services and European countries), care should be exercised in the generalization of this study's findings without further research. Future studies could consider other service sectors and also could be extended to other geographical areas beyond the United States and EU. Further research could confirm or refute such specific negative "competency trap" findings. In addition, care should be taken not to over-emphasize isolated negative impacts, since the aggregate results indicate positive associations between purchasing performance and the *combined* development of purchasing competence dimensions. The identification of such multiple competence-performance relationships constitutes a potential refinement of existing literature and, to this end, it is suggested that researchers continue to study the impacts of competence factors on multiple performance measures.

This study has cross-validated an existing Purchasing Competence construct and extended it by adding an IT competence dimension. Such an extension of the Purchasing Competence concept is in line with a broader view of Purchasing and Supply Management (PSM). Further studies could investigate additional extensions of the construct in this paper in order to validate a fuller PSM competence construct. Also, this study focuses on purchasing practices in contrast with approaches that consider purchasing capabilities (González-Benito, 2007). This proposal considers practices because capabilities for our understanding are not so directly applicable to managers. Managers need frameworks in terms of practices; in our opinion, this approach helps managers with "what do I do?" questions. We also found González-Benito's (2007) proposal, to compare both approaches to indicate lines of knowledge in Purchasing Competence, interesting.

The findings of this study have potential implications for theory, practice and future research. The purchasing competence construct has been found to be relevant across geographical and contextual boundaries, and thus possibly deserves further attention from researchers. Also, the results of this study indicate that it is no longer appropriate to ignore IT in purchasing or supply operations. Furthermore, given the indicated cross-sector functional equivalencies, it might now be inappropriate for the OM literature to regard manufacturing and services as discrete areas of research. This study also raises the prospect that the impact of competence on performance might not always be beneficial, and, finally, that a one-size-fits-all theory could be inappropriate.

Further theory development should perhaps concentrate on establishing the contingent reasons why certain competences might positively drive a specific performance measure, while others potentially have no effect (or perhaps even a detrimental one). While the findings from this study indicate complications in the competence-performance research landscape, they also open new avenues for exploration, and it is hoped that these avenues will attract other researchers.

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