Framework for measuring the Procurement performance in Dairy Supply Chain

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Abstract

The dairy industry has a significant role for the Indian economy as well as for the rural development. For business operations in the dairy industry, the quick & safe procurement of milk from the farmer is of crucial importance. The current study is aimed to develop a framework for evaluating the performance of procurement practices in the dairy industry. An optimum competitive procurement model has been developed through factor analysis and exploratory structural equation modelling techniques. The model is developed on the basis of responses collected from dairy industries from northern India. The results of hypothesis testing suggest that all the four factors (derived through factor analysis) influence the procurement performance positively. The outcome of this study reveals that the milk processing industry needs substantial development in procurement practices to meet the best product quality, supply chain sustainability and food safety norms of the global market. This study is useful for the dairy industry to handle the traceability issues, execution of effective information systems, the overall quality of procured milk, build supplier trust, and hence, to achieve higher procurement performance.

Keywords: Procurement practices, factor analysis, structural equation modelling (SEM), dairy industry, supply chain, performance analysis.

1. Introduction

India, being a leading milk producer globally, has perceived 4% improvement (approx.) in the production of milk per annum for the last three decades, which surpasses the typical global improvement of approx. 1%. The primary goal of the Indian dairy industry is to boosting milk production as well as upgrading the milk processing sector. In India, the milk is being treated and sold by 170 milk producer cooperative (coop.) unions consisting of 22 state coop. federations. Milk unions save the milk producers from unfair trade practices of *middlemen, dudhiyas* (milkmen in the unorganized sector) and *milk contractors* thereby improving their economic condition tremendously. However, the organized sector handles only 20% (approx.) of the milk,

whereas the rest is controlled by the unorganized sector of the industry. Milk unions were formed to provide a ready market to the milk producers for sale of milk in the villages through cooperatives and to provide wholesome hygienic good quality processed milk to the urban consumers at a remunerative price. Dairy supply chains start with procuring the milk from the farmers, transportation to the plant, milk processing, packaging and distribution to the retailers and finally to the consumer. The technological innovation, supply chain integration & collaboration, eradication of uncertainties help to achieve sustainability in the agri-food supply chain. Further, it needs to set up priority for R&D, investment, governance and trade policies (Mor *et al.,* 2015; 2017; 2018e). Decentralized supply chains are the indications of distortion in food quality (Chen *et al.,* 2014; Bhardwaj *et al.,* 2016; Mor *et al.,* 2018a; 2018b; 2018c). In Indian dairy market, there are some major players namely; Nestle, Amul, Mother Dairy, Verka, Britannia, Vita, Lakshaya, Nandini etc.

The structural equation modelling is a useful multivariate method and its usage have been growing since its development in the 1980s. It is used to calculate the reliability and validity of the constructs of agile manufacturing predominant in the automotive industries (Robertsa *et al.* 2010). SEM is favored by the academicians as it estimates the interrelated dependence in a distinct analysis. It is a group of statistical methods for the analysis of associations between multiple predictor and response variables (Bagozzi and Yi 1988). A linear structural method can be used to confirm the enablers of sustainable practices developed through interpretive structural modelling (Thirupathi and Vinodh, 2016). The SEM methodology based on Malcolm Baldrige principles can be used to estimate the environmental performance of SMEs (Hussey and Eagan, 2007). The SEM methodology includes two sorts of variables, viz., endogenous and exogenous (Vinodh and Joy, 2012)a. The latent variables having abstract nature are difficult to recognize directly, whereas, the observed variables are easier to explore (Xiong *et al.,* 2015; Tenenhaus *et al.,* 2005). Vinodh *et al.,* (2012)b focused on turbulent market changes through an agile model using the SEM. Sitek and Wikarek (2015) demonstrated a hybrid structure through the mathematical programming to improve the sustainable supply chain resolutions. The statistical modelling indicators are certainly the beginning of all-inclusive methodologies for the techniques like SEM and multilevel (regression) modelling (Goldstein 1986).

The rest of this chapter is designed in the following way. Section 2 is the comprehensive literature review, whereas, section 3 consists of the problem formulation detailing the emergence of theme and objective of the study. Section 4 covers the methodology adopted; and, section 5 comprises of the analysis, results & discussion part. The final production model is developed in

section 6 along with the hypothesis testing & significance of the results obtained. Finally, section 7 involves the conclusion and the scope for future work in continuation of this research work.

2. Literature Review

A comprehensive assessment of literature for dairy supply chain and the structural equation modelling is presented in this section, as follows.

2.1. Dairy Supply Chain

Mangla *et al.* (2016) suggested to focus on the critical success factors to improve the organizational performance and for achieving sustainability in the food supply chain. Okano *et al.* (2014) focused on consolidating the domains of the dairy supply chain through performance indicators to benchmark the supply chain practices and become sustainable. Lemma *et al.* (2014) offered the modelling approach for short lifecycle food supply chain by focusing at product's perishability and the waste & loss assessment. Ayodele *et al.* (2014) recognized the research issues in the approaches for unpacking and knowledge optimization in the food supply chain. García *et al.* (2014) emphasized the strategic inferences in the context of packaging design for achieving a competitive advantage in sustainable supply chain operations. Ghosh *et al.* (2014) analyzed the enablers of risk management for the dairy industry using the interpretive structural modelling (ISM). Kumar (2014) aimed to evaluate the effectiveness of a theoretical model of the dairy supply chain and proposed an integrated model for performance measurement of the dairy industry. Prakash *et al.* (2013) presented the case of Indian milk processing sector and demonstrated how balanced scorecard methodology can help to assess the supply chain performance. Singh *et al.* (2011) found that a loss of 72% of perishable food products due to no use of information technology by the retailers of perishable food products in the unorganized sector. Kumar *et al.* (2011) concluded that the modern milk supply chain, and found that the traceability & food safety helps in strengthening the modern milk supply chain. Punjabi (2009) considered different factors influencing the effectiveness of the dairy sector through performance analysis. Gupta *et al.* (2012) untaken an assessment of the profits gained from vertical coordination through regression analysis and field survey. Glover *et al.* (2014) concluded that a broader systemic way is desired to encourage the sustainable practices in dairy supply chains for the energy reduction.

2.2. Structural Equation Modelling

Thirupathi and Vinodh, (2016) explored the usage of ISM methodology with the SEM to establish a structural relationship among the enablers of sustainable supply chain practices. Hussey and

Eagan (2007) established a model to evaluate the performance of green aspects in small & medium enterprises through SEM methodology and found the model as valid. Vinodh and Joy (2012)c developed a theoretical model comprising of the enablers as criteria and attributes for the manufacturing industry. Hou *et al.* (2014) discovered the relationship between sustainable operations and the issues responsible for behavior changes in the manufacturing industry. Vinodh and Joy (2012a) studied the usage of SEM procedures to evaluate the lean supply chain practices through empirically collected data from manufacturing industries in Tamil Nadu. The conventional SEM models have been generalized to accommodate different responses. Eid (2009) discovered the interactions among variables and explained the requisite to empirically check the factors affecting world-class manufacturing. Mor *et al.* (2018a; 2018b; 2016; 2018c; 2018d) worked on the supply chain practices of food processing industry through ISM & SEM tools and found that the usage of these tools helps to establish a contextual relationship among the factors affecting the performance of supply chain practices.

2.3. Research Gaps

After a comprehensive literature review, it is revealed that no study yet relate the assessment of the performance of procurement practices in Indian dairy industry. Further, the SEM techniques have vast applications, but its use to study the procurement practices in the context of the dairy industry has not been tried. Thus, this is a unique study in itself which explore the procurement performance in the context of dairy industry and all these causes encouraged the authors to discover the procurement concerns in this study.

3. Problem Formulation

The increasing competition and global quality standards have stirred the industries towards managing their supply chain activities effectively. On the other hand, the pricing, order-fill-rate and delivery requirements of food sector are the key concerns pooled by every stakeholder in the supply chain. Thus, it has been realized from the literature review that maximum researches in dairy sector are focused on dairy science, raw milk quality & technology development, and does not consider the procurement practices, especially in Indian context. Moreover, the existing studies put forward the high-tech support to the farmers for networking them up with markets. Further, the literature review reveals that only a few dairy industries or regions have been covered in India and many states like northern India, being the focal point of the white revolution in the 1970s, are still not explored. Hence, this research study attempts to address various procurement issues in dairy supply chains. An optimum competitive procurement model has been proposed by

applying the structural equation modelling methodology to the responses obtained from a questionnaire survey of respondents in dairy industries from the northern region of India.

3.1. Objectives of Study

- To bring out various issues related to procurement practices in the dairy supply chain.
- To develop an optimum competitive supply chain model for the procurement practices in Indian dairy industry using SEM techniques.

4. Methods

Both the primary and secondary type of data is used in the present study. The primary data composed of a well-structured questionnaire including key supply chain issues and other organizational information. The secondary information has been collected from various published as well as unpublished research articles, websites, press notes, media clippings and official reports of NDDB as well as the internationally acclaimed organizations. SEM has been used to study the structural relationship and an interaction between measured variables and latent constructs of supply chain practices of the dairy industry in the current study. A scale was developed to quantify the supply chain performance. A number of measures were used in developing the scale. The survey questionnaire was prepared as per the comprehensive literature review of the supply chain operations and dairy industry. The questionnaire was improved in consultation with managers and academicians. Morgan (1993) mentions such modification when the target population is new as was in this study. The first section of the questionnaire involves the statements related to procurement, processing and distribution practices, and outcome variables measuring overall performance. The 2nd section is dedicated to accumulating the demographic data of the industry. In advance of distribution, the questionnaire was authenticated via a pilot study as proposed by Robson (2002). The pilot study enabled to diagnosing the inconsistency or lack of understanding. The suggestions of the experts were incorporated and the questionnaire was revised accordingly. Figure- 1 represents the research methodology flowchart for the current study.

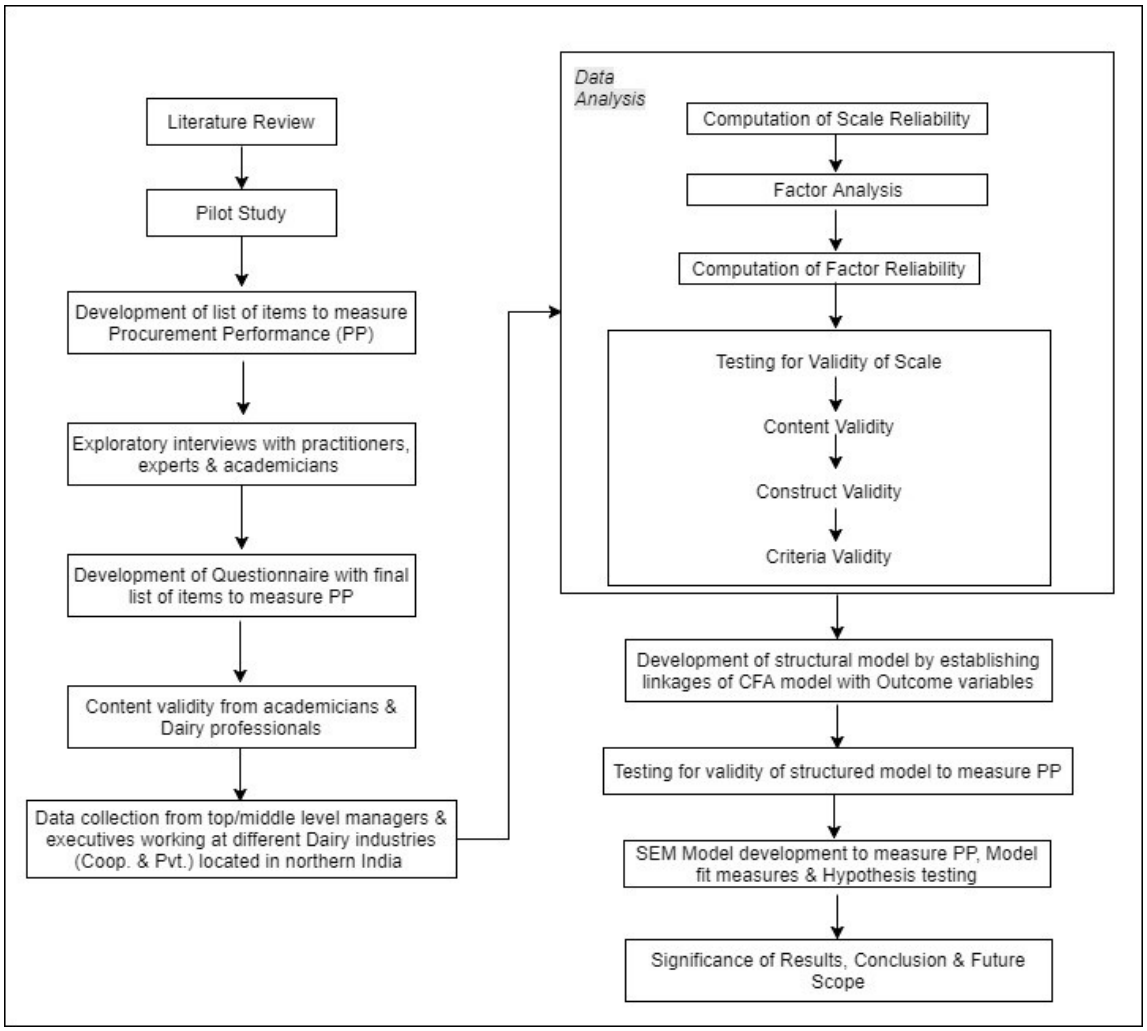

Figure- 1. Research Methodology Flowchart

In order to evaluate the procurement performance of the dairy industry, both cooperative & private industries of northern India were nominated. The questionnaire was distributed to 504 persons with an appeal to submit their visions about the issues highlighted in the questionnaire. The questionnaire was prepared online, through Google Forms, also. The answers were collected over both methods i.e. by personal visits to the dairy industries as well as via online (Google Forms). The snowball sampling method was employed to enable the direct contact with respondents (Nargundkar, 2004). The respondents were requested to enter their perceptions of procurement issues in the dairy supply chain on a 5-point Likert scale. Initially, the introductory e-mails & letters to grant permission for the exploratory study were sent to the general manager or plant head of each selected industry. The unit-heads referred the researcher to key respondents for filling out the questionnaire. The responses were collected through both personal visits to industries and online via Google Forms after verifying their identity. First of all, the respondents were briefed about the issues and the Likert scale to obtain more reliable responses. The

respondent's individual privacy was retained surreptitious in order to achieve the unbiased answers (Robson, 2002; Saunders *et al*., 2009). Most of the persons filled & returned the questionnaire on-spot, while others returned it in continual calls for getting the high response rate as well as the quality of the collected figures. This method of data collection was validated by other researchers like Flynn *et al.* (1990); Forza (2002); and Kang and Bradley (2002). The replies were received from almost all levels i.e. MDs, senior managers, plant heads, GMs, senior engineers, HODs, etc. Out of the expected responses, only 265 valid retorts were chosen for the next level of exploration.

5. Analysis, Results, and Discussion

5.1. Pilot Study

A pilot study was conducted to assess the validity & practicality of the questionnaire as well as to enrich the quality of questionnaire (Forza, 2002). Accordingly, a pilot study was performed by distributing the questionnaire to ten industry experts and two from an academic organization to get a view on questionnaire design. The views of experts were incorporated in order to make minor changes. The questionnaire was thus made ready-for-distribution after modifications.

5.2. Reliability Analysis

The reliability of the issues related to procurement practices was assessed using 'Cronbach alpha coefficient'. Cronbach alpha describes the reliability through internal consistency method which redirects the 'homogeneity and inter-correlation' of procurement issues. The Cronbach alpha coefficient was carried out by IBM SPSS v22 software and it comes out to be 0.837 which indicate the highly reliable data with reference to Lee *et al*., (2000); and Cronin & Taylor (1992). The reliability parameters of all constructs have been verified (Cronbach, 1951).

5.3. Factor Analysis

The exploratory factor analysis has been performed in various steps. All the 20 procurement issues, taken as variables, were taken for EFA. Initially, 'Bartlett test of Sphericity' was performed to check the importance of factors and it was judged by the correlation matrix of the data (Hair *et al*., 2005). At the same time, the suitability of sampling (N= 265, in this study) was referred by KMO (Kaiser-Meyer-Olkin) value. The KMO varies from zero to one and it comes out to be 0.831 in this case which reflects the significance of factor analysis. The respective scores of 'Bartlett test of Sphericity' and 'KMO' are as follows: Chi-Square: 5324.516; df: 378; Sig.: 0.000. The results of factor analysis are indicating the suitability of factor analysis (Hair *et al*., 2005). EFA was directed by means of principal component analysis (PCA) method with Varimax

rotation and Kaiser Normalization (Eigenvalue >1) in the SPSS software. Initially, 38 questions were selected in the questionnaire to conduct EFA which later on reduced to 20 due to various reasons like low factor score, commonality below 0.5, cross-loading etc. Four factors were obtained explaining approx. 69.79 percent of the total variance. The individual factor explained 20.969, 17.977, 17.810, and 13.037 percentages of variance correspondingly. All the factor loading values were reliable with the proposed factor structure (Table- 1).

Table- 1. Exploratory Factor Analysis

Factor No.	Statements (Name & Label)	Commonality	Factors				Mean	Standard Deviation	Overall Score of Factor	
			F1	F2	F3	F4	Measurement on 5-point Likert Scale		Mean	Standard Deviation
F1	**Inventory Management (F1)** (Rate followings as how do you manage the surplus or shortage of milk):									
	PRC34 Convert the value-added products into milk	0.73	0.80				3.89	1.31	3.81	1.37
	PRC28 Convert milk into other value-added products	0.79	0.85				3.80	1.36		
	PRC36 Buy milk from other units	0.87	0.86				3.94	1.35		
	PRC33 Suppliers make-up for the shortage by increasing supply of milk	0.62	0.78				3.78	1.39		
	PRC35 Convert the stored powder into milk	0.55	0.65				4.06	1.30		
	PRC32 Stores the milk	0.50	0.69				3.38	1.53		
F2	**Quality Management (F2)** (Rate followings as how do you perceive the wastages of milk due to):									
	PRC20new Improper milk handling at source/site	0.79		0.87			3.40	1.25	3.51	1.34
	PRC21new Unhygienic practices at source/site	0.82		0.87			3.71	1.39		
	PRC23new Improper quality checks	0.70		0.82			3.95	1.34		
	PRC19new Deterioration in milk quality due to temperature variation	0.68		0.70			3.18	1.44		
	PRC18new Delayed shipping due to poor road conditions/poor infrastructure	0.50		0.69			3.32	1.30		
F3	**Supplier Management (F3)**									
	PRC9 You are satisfied with the exchange of information and level of cooperation with suppliers	0.56			0.69		4.27	0.86	4.19	0.95
	PRC1 You have installed the automatic milk quality testing machines at each society	0.80			0.88		4.16	0.99		
	PRC2 You have implemented the traceability system for identification of poor-quality milk suppliers	0.75			0.86		4.23	0.91		

	PRC4 You are satisfied with the consistency of milk quality supplied by suppliers	0.67			0.79		4.12	0.98		
	PRC7 You include the key suppliers in your planning and goal-setting activities	0.66			0.77		4.16	0.99		
F4	**Technological Innovations (F4)**									
	PRC12 You have installed the vehicle tracking system like GPS/GIS/others for procurement	0.82				0.89	3.04	1.50	2.90	1.52
	PRC13 You have installed the Lid Opening Sensors in procurement vehicles	0.75				0.84	2.62	1.53		
	PRC14 You have installed the independent BMCs (Bulk Milk Chillers) at each society	0.79				0.89	2.91	1.48		
	PRC17 You have installed the ERP system for dealing with suppliers	0.61				0.64	3.02	1.55		
Reliability (Cronbach Alpha# value) of identified factors			0.886	0.881	0.877	0.861				

Factor Extraction Mode: Principal Component Analysis.

Rotation Mode: Varimax with Kaiser Normalization.

a. Rotation congregated in 5 iterations.

*Cutoff point for loadings is 99% substantial and is measured using 2.58/√n (Pitt *et al.*, 1995),

where n (=20) is the no. of statements, F1 to F5 signifies the factors.

α values ≥ 0.70 are adequate (Nunnally, 1978).

Now, the factors extracted through EFA were entitled as 'Inventory management, Quality Management, Supplier Management and Technological Innovations' based on the subjective opinion of the investigator and experts. The communalities state the amount of variance derived through the four factors. All the statements have substantial communalities i.e. ≥0.50 (Hair *et al.*, 2005) (Table- 1). Individual factor values signify the associations between the item and the respective factor. Each item represents the factor loading of >0.5 and is acceptable (Pitt *et al.*, 1995). The internal reliability of factors is perceived through the Cronbach constants which comes out to be 88.6%, 88.1%, 87.7%, and 86.1% (Table- 1) and hence, is acceptable (Bagozzi & Yi, 1988; Nunnally, 1978).

5.4. Confirmatory Factor Analysis (CFA)

CFA method is used to authenticate the developed measure for evaluating the performance of procurement practices. As CFA analyzes the model fit, the CFA model is developed by means of SPSS AMOS v21 software for all the four factors with their respective items. The model fit has been studied for each factor with reference to the procedure recommended by Sureshchandar *et al*. (2002) and Beinstock *et al*. (1997), Table- 2.

Table- 2. Key Fit Indices for CFA model of Procurement practices

Factors	**(χ2)/df = Cmin/df**	**RMR**	**GFI**	**NFI**	**CFI**	**RMSEA**
F1: Inventory Management	1.921	.046	.980	.985	.993	.059
F2: Quality Management	1.196	.029	.993	.994	.999	.027
F3: Supplier Management	2.742	.035	.979	.936	.957	.081
F4: Technological Innovations	1.403	.041	.995	.990	.999	.039

As shown above, all the GFI values are above the threshold value, i.e. 0.9, which indicates the confirmation of the individual factor (Hair *et al*., 1995). The final CFA model comprising of the four factors and 20 sub-factors, or items, is represented in Figure- 2.

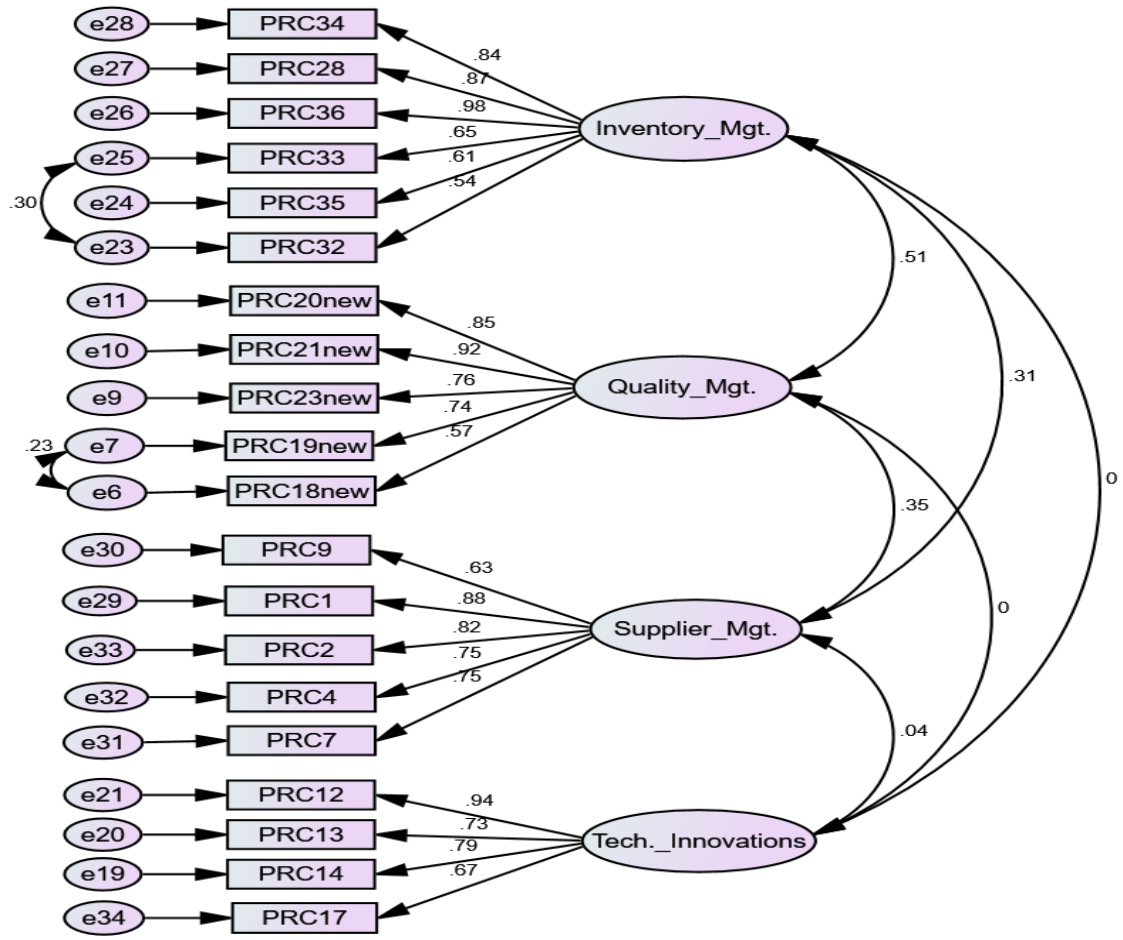

Figure- 2. CFA Model Development for Procurement practices

5.4.1. Model Fit Measures

The goodness-of-fit index (GFI) is measured by running the developed CFA model through AMOS v21 software. The Normed Chi-square value comes out to be 2.481, which implies a decent model fit. The standard value of Normed Chi-square value, as suggested by Bollen, 1993; Tanaka, 1987, ranges from 3 or even 5. Further, the GFI, CFI (comparative fit index) and NFI (normed fit index) value come out to be 0.879, 0.927 and 0.884 respectively. The RMSEA value of the model, i.e. 0.07, displays a rational model fit. Based on the CFI, NFI, GFI score, it is concluded that the developed model signifies an adequate fit for the problem undertaken.

5.4.2. Explanation of Factor Structure

The total variance offered by four factors was 69.793 percent. These outcomes indicate that these factors can illuminate the procurement issues considerably. The average score and standard deviation were calculated using IBM SPSS v22 software (Table- 1). The extracted factors are labeled as follows.

The 1st factor labeled as 'Inventory management' explains 20.969% variance. Six statements supporting this factor have the loadings in the range of 0.54 to 0.98 (Table- 1). Based on the first factor, the following hypothesis has been established to measure its impact on the final outcome of the SEM model:

H1: 'Inventory management' has a positive impact on procurement performance of the dairy supply chain

The 2nd factor labeled as 'Quality management' explains 17.810% variance. Five statements supporting this factor have the loadings in the range of 0.57 to 0.92 (Table- 1). Based on the second factor, the following hypothesis has been established to measure its impact on the final outcome of the SEM model:

H2: 'Quality management' has a positive impact on procurement performance of the dairy supply chain

The 3rd factor labeled as 'Supplier management' explains 17.977% variance. Five statements supporting this factor have the loadings in the range of 0.63 to 0.88 (Table- 1). Based on the third factor, the following hypothesis has been established to measure its impact on the final outcome of the SEM model:

H3: 'Supplier management' has a positive impact on procurement performance of the dairy supply chain

The 4th factor labeled as 'Technological Innovations' explains 13.037% variance. Four statements supporting this factor have the loadings in the range of 0.67 to 0.94 (Table- 1). Based on the fourth factor drawn, the following hypothesis has been established to measure its impact on the final outcome of the SEM model:

H4: 'Technological innovations' have a positive impact on procurement performance of the dairy supply chain

5.5. Validity of Construct

5.5.1. Face Validity

The face validity of the model is a subjective technique and it is measured by considering the model 'on-its-face'. The model illustrates a good image of the procurement issues (Trochim, 2007).

5.5.2. Content Validity

The content validity is reasonably measured through many discussions with the researchers & academicians in this area, the perceptions resulting from previous studies and the scholar's individual understanding (Trochim, 2007). Consequent modification in the scale has been confirmed via group conversation with the dairy professionals. The instrument thus has strong content validity for processing practices.

5.5.3. Construct Validity

Construct validity is calculated in three phases, as follows.

i. Uni-dimensionality

The value of CFI relates the developed structure with a null model supposing that there exist no associations among the measures. The developed CFA model represents the CFI value of 0.927, which entails a strong uni-dimensionality (Bollen and Ting, 1993; Byrne, 1994).

ii. Convergent Validity

The convergent validity determines the degree to which dissimilar methodologies of developing a theory offers the similar output (Ahire *et al*., 1996). As recommended by Chin *et al*. (1996), a value of ≤0.5 exhibits a robust convergent validity. In this case, all the factor loading ranges from 0.54 to 0.94, and thus, the items have a strong convergent validity.

iii. Discriminant Validity

The discriminant validity demonstrates the amount to which a model and its statements vary from a different (Bagozzi *et al*., 1991). Fornell and Larcker (1981) proposed that the square root of the mean ought to be superior to the total value of homogenous correlation with any other construct in the study. Table- 3 denotes the square root of AVE for respective factor as diagonal cell and correlation number as non-diagonal. The discriminant validity has been calculated by the 'StatToolPackage' proposed by Prof. James Gaskin. With respect to the current analysis, the square root of AVE is more than the correlation number of the specific factor compared to other factors. Thus, the AVE values reinforced the discriminant validity in this study.

Table- 3. Results of Discriminant Validity for CFA model of Procurement practices

Inventory Management	**0.829**			
Quality Management	-0.287	**0.765**		
Supplier Management	0.046	0.312	**0.771**	
Technological Innovations	-0.256	0.505	0.348	**0.776**

√AVE is represented as diagonal cells and correlation in other cells

iv. Predictive Validity

The predictive validity is recognized if a measure exterior to the scale is associated with factor configuration (Nunnally, 1978). It was evaluated by recognizing the interrelationship of each factor with the average score of items using the Pearson correlation value. All the correlation values were found substantial (Table- 4) in the present study.

Table- 4. Results of correlation between dimensions and Procurement practices

Dimension	**Correlation with Procurement practices**
Inventory Management	0.776*
Quality Management	0.744*
Supplier Management	0.912*
Technological Innovations	0.832*

*0.05 level (2-tailed).

6. Procurement Model

After confirming the reliability and validity measures, a final model has been developed in order to evaluate the procurement practices of the dairy industry by linking the CFA model with the three outcome variable. The outcome variables were considered with the consultation of experts from academics and dairy industry sector. Relevant information was collected from 265 participants, as a part of the questionnaire itself, for the outcome variables. The selected outcome variables for measuring the procurement performance are as follows:

- PRC_out1: Traceability in milk quality issues for procured milk
- PRC_out2: Overall quality level for procured milk (Reduction in total milk adulteration, wastages during transportation and rejections due to various procurement issues)
- PRC_out3: Supplier trust in the organization

The final procurement model consisting of the four factors (with 20 statements) and the three outcome variables defines the procurement performance in the dairy supply chain (Figure- 3).

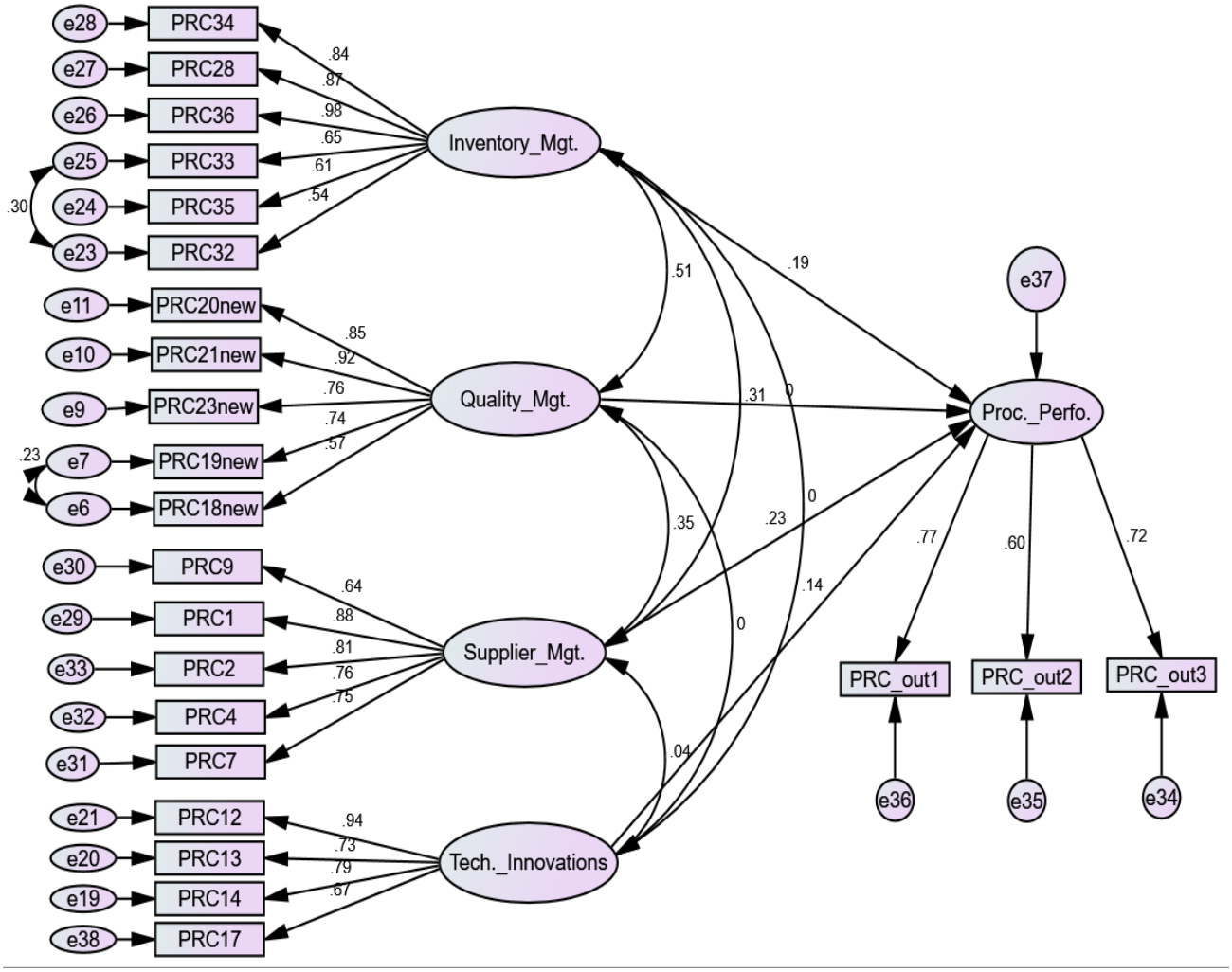

Figure- 3. SEM Model for measuring Procurement performance

6.1 Validity of Model

The validity of the model is assessed as follows.

6.1.1. Discriminant Validity of Model

The discriminant validity has been calculated by the 'StatToolPackage' and the 'AMOS Plugin' proposed by Prof. James Gaskin. All the respective values of MSV are lower than AVE, all the AVE values are greater than 0.5, and the CR is greater than AVE. The square root of AVE for all factors comes out to be higher than the correlation constant of an individual factor with others. Thus, these values verified the discriminant validity of the model (Table- 5). Reference to the thresholds proposed by Hu *et al.* (1999), all the values are within limits. Hence, no validity concerns here in the proposed procurement model.

Table- 5. Results of Discriminant Validity for measuring PP

	CR	AVE	MSV	MaxR(H)	Tech._Innovations	Inventory_Mgt.	Supplier_Mgt.	Quality_Mgt.
Tech._Innovations	0.812	0.503	0.081	0.917	**0.709**			
Inventory_Mgt.	0.864	0.507	0.255	0.978	-0.285	**0.712**		
Supplier_Mgt.	0.847	0.504	0.122	0.982	0.043	0.313	**0.710**	
Quality_Mgt.	0.829	0.503	0.255	0.985	-0.256	0.505	0.349	**0.709**

Ref.: Hu *et al.* (1999); Gaskin *et al.* (2016).

6.2 Model Fit Measures

The model fit measure has been carried out as follows.

The model fit measures were calculated by the 'StatToolPackage' proposed by Prof. James Gaskin. All the respective values comes out to be as: CMIN/DF: 2.234, CFI: 0.923, SRMR: 0.073, RMSEA: 0.068, and PClose: 0.06. Reference to the thresholds given by Hu *et al.* (1999), all the respective values are within the specified limits (Table- 6).

Table- 6. Results of Model Fit Measure for measuring PP

Measure	Estimate	Threshold	Interpretation
CMIN	486.915	--	--
DF	218	--	--
CMIN/DF	2.234	Between 1 and 3	Excellent
CFI	0.923	>0.95	Acceptable
SRMR	0.073	<0.08	Excellent
RMSEA	0.068	<0.06	Acceptable
PClose	0.06	>0.05	Acceptable

Ref.: Hu *et al.* (1999); Gaskin *et al.* (2016).

Hence, the developed SEM model is acceptable for measuring the performance of procurement practices in the dairy industry.

6.3 Hypothesis Testing

The prime aim of SEM is to check the validity of the hypothetical model by identifying, estimating & assessing the linear interactions among observed & unobserved variables (Panuwatwanich *et al.,* 2008). The hypotheses tested in SEM are often more positive in nature and considered as much more definitive than other correlational analyses methods (Collis and Rosenblood, 1985; Crosbie, 1986; Cudeck and O'Dell, 1994; Larzelere and Mulaik, 1977). Here, predictors are the four factors drawn during EFA (Table- 1) and the outcome indicates the outcome variable for the SEM model, and S.E. is the standard error. From the values of C.R. (critical ratio) and p values given in Table- 7, all the critical ratios are above 1.96 (95%

confidence) and p values are <0.05 indicating a significance. Thus, all the four factors have a positive impact on procurement performance of dairy supply chain and the hypothesis designed for this study are accepted.

Table- 7. SEM Model for measuring Procurement performance

Sr. No.	Outcome	Predictor	Estimate	S.E.	C.R.	p Value	Status	Order of importance
1	Procurement Performance	Inventory Management	0.138	0.065	2.133	***	Significant	2
2		Quality Management	0.123	0.072	3.321	***	Significant	1
3		Supplier Management	0.188	0.068	2.760	***	Significant	3
4		Technological Innovations	0.172	0.040	3.074	***	Significant	4

Note: Significance *** $p < 0.05$

Further, to bring out the order of importance of four factors comprising various statements for measuring the procurement performance, the regression analysis was performed by considering the ratings of procurement practices as the dependent variable and the mean scores on the four factors as independent variables. The standardized coefficient beta (β) of the individual dimension represented their importance (Parasauraman *et al*., 1985; 1988) as presented in Table- 7. The results clearly show the significance of the overall regression model ($p < 0.05$), with 69.79% of the variance in procurement practices explained by the independent variables. The significant factors that remained in the equation in the procurement practices and are shown in order of their importance based on a standard estimate or β coefficient. Higher the standardized β coefficient, the more the factor contributes to explaining the dependent variable (Lee *et al*., 2000). The factor 'quality management' emerges to be the most important dimension, followed by the others as inventory management, supplier management, and the technological innovations.

6.4 Significance of Results

This study has shown how the model for procurement practices was built and expressed its usefulness for managers in the dairy industry sector. Once developed, the SEM model for managing the procurement practices could be used by the researchers and dairy professionals/managers in several ways as:

1. This study can assist the scientists and dairy professionals in getting the issues related to procurement practices of the dairy industry.
2. The model offers four dimensions to measure the procurement performance in dairy industry viz. inventory, quality, supplier, and the technology.

3. The scores on individual statements illustrate the proposals for improving the procurement practices.

4. The results of hypothesis testing suggest that all the four factors influence the procurement performance positively. The developed model may be used to benchmark the supply chain practices through various milk unions.

7. Conclusions

This study is intended to fill the research gap for measuring the performance of procurement practices in Indian dairy industry. Secondly, the study proposes a framework for measuring the procurement performance of the dairy industry through SEM techniques. So, the study examines the procurement practices not only from an academic viewpoint but also from practical validation by developing a structural model in a real-time industrial scenario. The information, in the form of a pre-tested questionnaire, was collected from various dairy industries located in northern India. 20 issues, called as statements, related with procurement practices were selected for the factor analysis. Factor analysis condensed the 20 issues into four factors viz. inventory management; quality management; supplier management; and technological innovations. The relative importance of the factors has also been carried out. Out of these four factors, 'quality management' seems to be the most significant, followed by 'inventory management, supplier management, and technological innovations'. The CFA model has been developed by interlinking the statements. A final procurement model has been developed after verifying the reliability & validity of the CFA model. The results of hypothesis testing suggest that all the four factors influence the procurement performance positively for the dairy industry. Finally, the SEM model has been developed by linking the CFA model with three outcome variables. The SEM model was checked for discriminant validity & model fit indices, and authors found it acceptable for measuring the procurement performance of Indian dairy industry.

The outcome of this study depicts that the procurement performance of dairy supply chain can be evaluated by means of the proposed factors & sub-factors. The procurement practices in the dairy supply chain are highly affected by the abnormal wastage and poor handling at source & site. More wastages occur because of multiple points of handling and unhygienic practices. These challenges further compel dairy industries for significant development in their procurement system. The complexity of Indian coop. the dairy sector with the milk unions at farmer's level also requires advanced methods for effective procurement management. Moreover, the technological innovations, automatic milk quality testing technology, effective BMC at milk collection centers, traceability in poor quality issues, and the execution of effective information systems can help the dairy sector to accomplish its long-term corporate goals. Thus, the proposed

framework will support the dairy professionals to plan their procurement practices in a competent manner to fulfill the product quality, supply chain sustainability, and food safety & security standards of the global marketplace.

7.1. Limitations and Future Scope

The interpretations of current study rely on the cooperation of academicians and managers from the dairy industry. The proposed model can be applied to another milk procuring & processing firms across different states or country. Some cause & effect relationships can also be conducted. Further, this procedure may be executed to other perishable food processing industries like meat, bakery, poultry, fishery, etc.

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