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"Research Method Decisions in a Supply Chain."

Kelly O. Weeks, Ph.D., CSSBB
Corresponding author: *Assistant Professor of Logistics, Texas A&M University at Galveston*
CLB, #225, 200 Seawolf Parkway, Galveston, TX 77553
E-mail: *weeksk@tamug.edu*

ABSTRACT

Profitability is a prime concern in all organizations. Operations management uses various tools and strategies to try and improve if not maximize profitability. Operations management, which encompasses supply chain management and logistics, deals with how well some function is performed. This research analyzes the specific strategy of production mix efficiency and what mediating effect it has on the relationship between operations management and financial profitability. Confirmatory factor analysis and structural equation modeling was utilized to analyze the relationship between the three constructs. This research found that operations management alone does not have a positive impact on profitability. However, the strategy of production mix efficiency has a positive mediating effect on profit, which provides a potential answer to firms trying to increase profits through operations.

Keywords: *Logistics, Manufacturing, Production, Supply Chain Management*

1. INTRODUCTION

This research studies and analyzes a strategy of operations management for the purposes of increasing profitability. The strategy of production mix efficiency looks at factors involved in the process of producing goods. Some variables here are the number of items each firm makes and the time and costs involved in each. This study is logistical aspects of business. The purpose of this paper is to provide operation managers and firms with an in-depth understanding of what factors have a more direct impact on profitability.

This study analyzes scrap steel companies and sent survey questionnaires to 1600. All of these firms are physically located within the United States. Literature asks more questions about how the supply chain affects profitability than it gives answers. This study attempts to provide some answer to the dilemma.

2. OPERATIONS MANAGEMENT LITERATURE

Operations management is concerned with all areas that affect the company on a daily basis. According to Jaggi (1992), one of the goals of operations management is to achieve profit maximization. In order to achieve this, there are various factors that can be utilised. A few of these strategies are production mix efficiency, product route efficiency, and resource commitment. This research analyses production mix efficiency.

Giuntini (1996) describes a situation in which a management process that is not optimised will result in less than optimal results. Such results lead to solid and hazardous waste, as well as increasing operational costs.

This forward supply chain issue creates a desire and need for a well-organised and robust reverse logistics system. Supply chain disruptions pose an increasingly significant risk to supply chains (Speier, C et. al, 2011).Synergy demands these forward and reverse systems be linked for effective communication and scheduling purposes. Typically, supply chains will consist of an independent system for the reverse chain; however, it will work hand in hand with the forward chain. Without such integration, Stock (1992) notes that several problems may arise because:

1. Firms do not understand they can positively affect the environment through reduction and recycling of waste.
2. Industries are in the habit of utilizing virgin materials rather than recycled ones.
3. There exists a perception that recycled materials are inferior to virgin ones.

Items 1 and 3 are problems of perception and belief. Management is in a prime position to alter people's beliefs through the information exchange that will occur within an integrated system of logistics. No research shows recycled materials to be inferior to new, virgin material made goods. This knowledge should not only be passed on but also reinforced by managers. Item 2 is a little more complicated but not without solutions.
Incentives are one method that can be offered to entice companies to use more recycled goods.

Operations management is traditionally a broad topic. This study focuses on 2 particular aspects of operations management: Production Commitment (OM1-4) and Production Efficiency (OM 5-8).

This research does not analyze the two aspects in different constructs for several reasons. The most important being, as this is new, empirically tested research it needs to be determined if any intercorrelation is present between the two dimensions. Also, this research needs to be not too restricting, at least initially to maximize potential usefulness among a broad array base of operation management firms.

3. PRODUCTION MIX EFFICIENCY

Slack (1984) tells that production mix efficiency is the flexibility to produce a wide range of products, accommodate modifications to existing products, and assimilate new products all with minimal degradation of performance. These scheduling "mixes" are based upon factors such as current demand, material availability, equipment, and profit margins. Also, firms may be limited in the amount they can produce and may not be able to match demand, whether it is scheduled or forecasted.

There are two types of location problems, uncapacitated and capacitated. Uncapacitated assumes each facility can produce and ship unlimited quantities under consideration, while capacitated places a limit on supply or demand. Some studies have focused on uncapacitated location problems (Salhi and Gamal, 2003; Lozano, Guerrero, Onieva, and Larraneta, 1998) while others have concentrated on capacitated problems (Sherali, Al-loughani, and Subranmanian, 2002; Eben-Chaime, Mehrez, and Markovich, 2002).

In the case of the scrap steel industry, these firms are capacitated since there is a limit to how much they can produce from a limited supply of inputs such as recyclable materials. The appropriate lot sizing scheduling decision enables the production system to produce more with existing resources and therefore increase its profits significantly (Himola, 2005).

Letmathe and Balakrishnan's (2005) study shows a relationship between optimal production mix efficiency and different environmental factors such as waste. This provides evidence that one factor may affect another and that the environmental factor must be taken into consideration when dealing with the production mix efficiency, which this study has done.

It is important with regard to profitability to make the most of the materials a firm has. This is achieved by using the materials the firm has to produce the optimal mix of products to achieve maximum profitability. There are several factors that need to be considered. For instance, turnover time is important. What if the most profitable item sits on a shelf for six months compared to a less profitable item that will ship immediately? In this situation, it would be more efficient to produce the item which will sell now then wait to produce the more profitable item closer to the date it is expected to be needed. Of course, there is always the problem of uncertainty (which is hard to account for) in regards to current and future product demands, as well as supplier deliveries. Wahab (2005) says that to combat this uncertainty the manufacturing system should be flexible under dynamically changing environments rather than static ones. Below, Figure 1 is good graphical representation of how materials can have an increase or decrease in value depending upon movement.

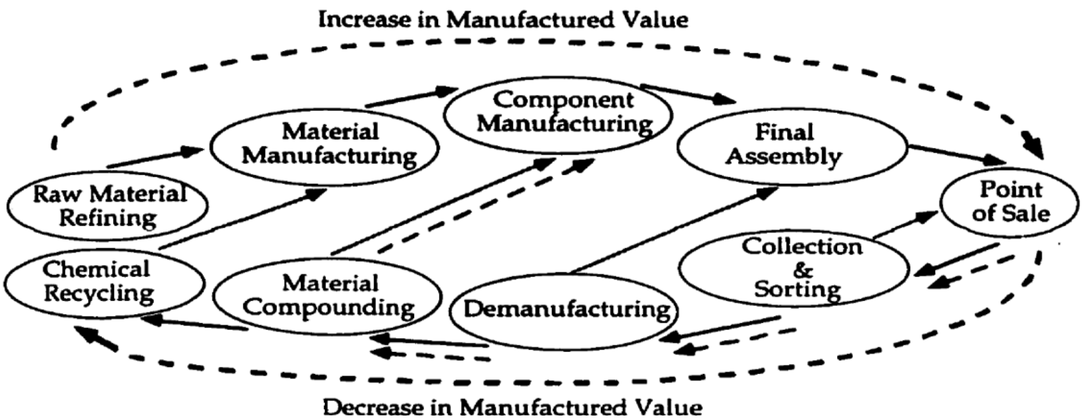

Figure 1: Material Flows in Forward and Reverse Production Systems (Realff, 1992).

4. PROFITABILITY

As Rothschild (2006) notes, "The ultimate goal of firms is profit maximization, regardless of what service or product they offer." Rothschild (2006) goes on to say that the ultimate definition of profitability is a firm's return on equity (ROE). He notes that other methods that are also sometimes used include return on assets (ROA) and net income. Jaggi and Freedman (1992) also support the use of these ratios to analyse a firm's profitability, while including net income.

If the efficient return and refurbishment of products is ignored, many companies miss out on a potential return on investment. Logisticians who treat reverse logistics as a way to maximize the value of returned assets make a significant contribution to their companies' bottom lines (Andel, 1997).

5. LITERATURE GAP

Prior literature has not studied operations management's impact on profitability in the aspect of the business strategy of production mix efficiency from a comprehensive analysis of variables according to literature. Furthermore, no study analyzes the relationships this research does from a comprehensive reverse logistics aspect. In addition, this study is the first to separate the OM construct into 2 dimension of production commitment and production efficiency,

6. DATA SOURCE

Data was collected via the developed survey instrument. This was then mailed via postal service. Usable response totaled 298 for the overall data set. This provided an effective response rate of 18.625%, since a total of 1600 surveys were mailed. As previously stated, scrap steel firms were surveyed and only firms within the United States were questioned.

7. METHODOLOGY

This section presents the development of each construct used in this research. The two-step approach is used. This approach which was presented by Anderson and Gerbing (1988) and Joreskog and Sorbom (1984), is one in which a measurement model is developed and is followed by the formulation of a structural model.

Each construct is developed through a rigorous process including the formulation of a measurement model for each latent construct operationalized. The purpose of a measurement model is to describe how well the observed manifest variables serve as a measurement instrument for the latent variable being modeled (Joreskog and Sorbom, 1993). The first step in this process involves running an exploratory factor analysis (EFA) on the data set to determine the authenticity of the data and cleanse the data. The second step here involves performing a confirmatory factor analysis (CFA) on each construct and its manifest variables. The last step involves building a measurement model for all the constructs in the model.

This study used Statistical Package for Social Sciences (SPSS) software to perform the reliability analysis and factor analysis for the exploratory analysis. The result of the EFA for all constructs is detailed in Tables 2, 3, and 4. EFA procedures include reliability analysis (Cronbach's Alpha), Kaiser-Meyer-Olkin measure of sampling adequacy, Bartlett's, test of sphericity, and a factor analysis on all the manifest variables and the constructs in which they are correlated.

The focus of this research was to examine the relationship between operations management (OM), Production Mix Efficiency, and Profitability. These characteristics inherently have an effect, as the literature states, but to what degree had yet to be tested.

This research first performs Confirmatory factor analysis which will allow for removal of any indicator items. This study uses LISREL 8.54 (Joreskog and Sorbom, 1993) to perform structural Equation Modeling. Structural equation modeling is a multivariate statistical technique that defines and estimates the relationships among endogenous and exogenous variables simultaneously (Bollen, 1989; Hair et al., 1998; Rakov and Marcoulides, 2000; Gillon, 2006).

The overall fit of the hypothesized model is generally accessed by the chi-square statistic. The significance of the chi-square value is directly related to the sample size, meaning the chi-square is sensitive to the number of observations in the research.

Since the overall sample size is less than 300 this study the χ^2 statistics will be relied upon for indicative fit of the model in this analysis. However, due to the proximity of this threshold, other measures will also be taken into account for overall model fit. Byrne (2001) said the assessment of the model adequacy must be based on a number of criteria that includes practical and theoretical considerations as well as statistical. Some of these criteria are listed below.

The goodness-of-fit index (GFI) measured the variance and covariance amount in the sample data that can be explained by the model. This is an absolute index since it compares a hypothesized model to no model (Byrne, 2001). The GFI provides information about how closely the models fitted compare to perfect fit (Maruyama, 1998; Gillon, 2006). The ranges in GFI are from zero to one, with values .90 or above indicative of a good fit. The normed fit index (NFI) is included here as advised by (Bentler & Bonnet, 1980). At situations where the samples are small, NFI has been known to underestimate fit; therefore, comparative fit index (CFI) will also be used to consider overall model fit. As with GFI, CFI and NFI also range from zero to one, with .90 or more being a very good fit. The root mean square error of approximation (RMSEA) takes the error of approximation into account and is expressed per degree of freedom (Gillon, 2006). The RMSEA has 3 levels of fit: lower than .50 indicates an excellent model fit; a range from .05 to .08 indicates a good fit; a range between .08 and .10 indicates a mediocre fit; and a value over 1.0 indicates a poor fit of the model. The following equation represents the CFA model of measurement used in the evaluation of the latent constructs in this research:

$$X_i = \Lambda_i \xi_i + \delta_i \quad (1)$$

where:

X_i = a vector of observed exogenous indicators
Λ_i = a matrix of structural coefficients (factor loadings)
ξ_i = a vector of exogenous concepts
δ_i = a vector of errors in the measurement model

The indicator items presented in the survey instrument represent the ξ_i construct. The structural coefficients (Λ_i) represented the path coefficients from the construct to the indicator items. Measurement errors present in the CFA measurement model are represented by the δ_i terms. In the path diagrams, manifest variables are presented by a rectangle. Structural coefficients for each manifest variable are printed along the path from the latent construct to the item. The error terms are printed on the inside of the circles to the left of the manifest variables. The X_i terms represent the exogenous (independent) variables. Endogenous (dependent) variables included in a CFA measurement model are represented with a Y term and not an X term.

In a standard CFA model each indicator is specified to load only on one factor, measurement error terms are specified to be uncorrelated with each other, and all factors are allowed to correlate with each other (Hair, et.al. 1998). One-factor standard models are identified if the factor has three or more indicators. Multi-factor standard models are identified if each factor has two or more indicators.

The first research question asks whether operations management has an impact on the profitability of these scrap steel companies. Jaggi (1992) gives a good overview of profitability in firms and describes the common techniques which are used to measure this factor. The literature showed many different ways to measure profitability. However, according to Jaggi (1992), the four most important and necessary are return on assets (ROA), return on equity (ROE), net income, and return on sales. All four of these measures will be used in this study.

Many researchers have studied operations management (OM). Anderson (2001) gives an excellent guide for measures used to analyze this item of OM. She says that the most crucial constructs to be studied are product quality, production efficiency, and productivity indexes, each of which is composed of several variables. This study incorporates Anderson’s recommendations. Hypothesis one addresses the first research question.

Hypothesis 1: Increased levels of operation management (OM) factors cause an increase in Profitability.

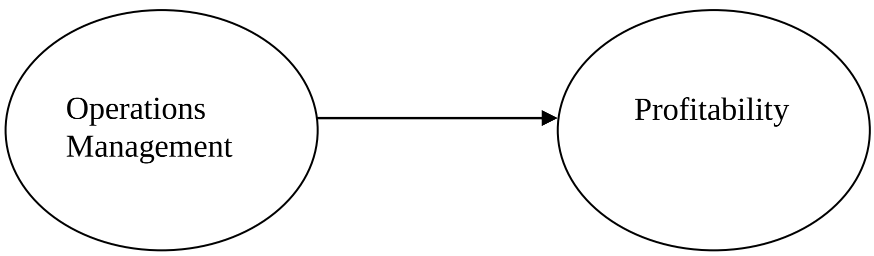

Figure 2: Conceptual Model of the Relationship between Operations Management and Profitability.

The second research question addresses the relationship between operations management and the strategy of production mix efficiency. Several different items must be taken into consideration to account for production mix efficiency. Wahab (2005) said that machine flexibility and production mix efficiency response time are two key elements of product mix, while Anderson (2001) included machine downtime and defect intolerance, and Mohammed & Reinstein (2005) added the factors of costs and time.

For this study, production mix efficiency is defined as the combination of goods a firm produces to meet demand while trying to maximize profitability. Of course the producing firm may have to take several factors into consideration to find the optimal output to produce. The few studies (Wahab, 2005; Anderson, 2001; and Mohammed & Reinstein, 2005) done on production mix efficiency as it relates to profitability used only a few elements of the production mix. This study incorporated all the factors mentioned in the studies to give a more, well-rounded and overall accurate analysis of optimizing the production mix efficiency. Hypothesis two addresses the second research question.

Hypothesis 2: The production mix efficiency will yield a positive effect on the relationship between OM and profitability.

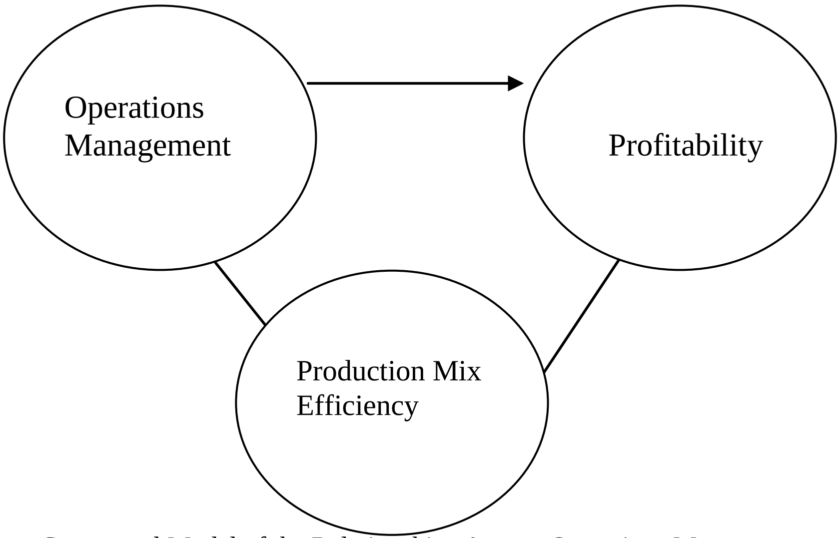

Figure 3: Conceptual Model of the Relationships Among Operations Management, profitability and Production Mix Efficiency.

8. FINDINGS

Table 1 presents the correlation matrix for the latent variables in this research. The relationship between Product Mix Efficiency and Profit showed a value of .057, which is significant at the .01 level. The relationship between OM and Profit is significant at the .05 level. The relationship between OM and Product Mix Efficiency, showed a value of .3 which does not fall within the .05 level of significance which is the normal, minimal acceptance limitation.

Table 1
Correlation Matrix of the Research Constructs
Data Set, N=298

	1	2	3
Operations Management	1		
Product mix efficiency	0.268	1	
Profit	0.116*	.057**	1

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

The reliability analysis measures the degree of consistency between the manifest variables measuring the construct in question. Determining Cronbach's Alpha coefficient and testing the corrected item total correlations perform this assessment. The KMO statistic measures the amount of intercorrelations among the variables being tested. This statistic also measure the appropriateness of factor analysis. This scale which was devised by Kaiser (1974) is as follows: a score greater than .90 is marvelous, greater than .80 is meritorious, greater than .70 is middling, greater than .60 is mediocre, greater than .50 is miserable and anything less than .50 is unacceptable.

Table 2 presents the results of the EFA for the Operations Management construct. The KMO measure is .763, which is fair. The Bartlett's test resulted in a χ^2 value of 10854.286. All items show low CITC scores. The two lowest are eliminated from the study due to the fact they are below .30 on the CITC scale. They are as follows: OM1, and OM7. However, the other items are not eliminated due to an acceptable Alpha and KMO score. The reliability coefficient is .7426, while the KMO value is .763 both of which fall into acceptable parameters.

Table 3 shows the findings of the EFA for the construct Product Mix Efficiency. The KMO measure is .775, which is good. The Cronbach's Alpha is .9174, which is excellent. The Bartlett's test resulted in a χ^2 value of 15952.95. A total of 1 item was eliminated from this construct. Item OM 2 showed a poor CITC score and also the alpha if this item was eliminated proved significant. All of the remaining item scores are acceptable and therefore not eliminated or rejected.

Table 4 shows the findings of the EFA for the construct Profitability. The KMO measure is .813, which is very good. The Alpha value is found to be .9183, which is excellent. The Bartlett's test resulted in a χ^2 value of 1264.380. All of the CITC values show very good scores. Elimination of any manifest variables would only serve to decrease the overall Alpha, hence none are removed.

Table 2
Reliability and Exploratory Factor Analysis Results
Operations Management (OM), N=298.

Operations Management (OM)							
Kaiser-Meyer-Olkin Measure of sampling Adequacy = .763							
Items	Descriptions	CITC	Alpha if item deleted	Factor Loading			
				1	2	3	4
OM1	Education level of Employees	0.2897	0.7018	-0.8248	-0.4781		0.632
OM2	% goods meet expectations	0.480	0.6829	0.6662		-0.523	0.446
OM3	Expected output	0.396	0.7232	-0.657			0.583
OM4	Amount spent on wages	0.423	0.6812		0.7965		
OM5	Scrap used in tons	0.373	0.7002		0.776		
OM6	Amount scrapped in tons	0.3861	0.6975	0.484		0.769	
OM7	Tenure of employees	0.2789	0.7559	0.5236		0.562	
OM8	Energy used	0.3825	0.7627	0.542		0.585	
		Eigenvalues		4.877	4.046	3.487	3.04
Bartlett's Test - 10854.286, 122 df		% of Variance Explained		30.691	24.973	22.74	19.765
Cronbach alpha - .7426		Cumulative % of Variance Explained		30.691	55.664	78.404	98.169

Table 3
Reliability and Exploratory Factor Analysis Results
Production Mix Efficiency (PM), N=298.

Production Mix Efficiency (PM)						
Kaiser-Meyer-Olkin Measure of sampling Adequacy = .775						
Items	Descriptions	CITC	Alpha if item deleted	Factor Loading		
				1	2	
PM1	Products each machine can produce	0.7318	0.9098	0.93032		
PM2	Time to switch machines	0.3398	0.9346	0.72475		
PM3	Cost to switch machines	0.728	0.91	0.91727		
PM4	Average amount of products each machine can produce in 2006	0.7213	0.9108	0.89918		
PM5	Cost to operate	0.7798	0.9086		0.97932	
PM6	Sum of depreciation	0.7912	0.9078	0.52163	0.8144	
Bartlett's Test - 15952.95, 190 df		Eigenvalues		9.298	4.783	
		% of Variance Explained		49.4887	46.9169	
Cronbach's Alpha - .9174		Cumulative % of Variance Explained		46.4887	95.4056	

Table 4
Reliability and Exploratory Factor Analysis Results
Profitability (PF), N=298.

Profitability (PF)					
Kaiser-Meyer-Olkin Measure of sampling Adequacy = .813					
Items	Descriptions	CITC	Alpha if item deleted	Factor Loading	
				1	
PF1	Average 3 year Net Income	0.8246	0.821	0.832	
PF2	Average 3 year Return on Assets	0.9247	0.911	0.923	
PF3	Average 3 year Return on Equity	0.7985	0.823	0.845	
PF4	Average 3 year Return on Net Sales	0.8412	0.849	0.869	
Bartlett's Test - 1264.380, 7 df		Eigenvalues		3.678	
		% of Variance Explained		88.4263	
Cronbach's alpha - .9183		Cumulative % of Variance Explained		81.631	

Tables 5, 6, and 7 presents the standardized regression coefficients, critical ratios, reliability terms, model fit indices, and the squared multiple correlations (SMC's). The SMC's represent the amount of variance explained by each item. Equation 1 demonstrates the path diagram measurement model for each of the constructs that will be presented.

Table 5
Coefficients, Parameters, and model Fit indices
Operations Management Measurement Model, N=298

Item	Structural Coefficients	Critical Ratio	SMC
OM2	0.48	11.783	0.518
OM3	0.54	11.754	0.581
OM4	0.74	11.753	0.721
OM5	0.76	11.761	0.503
OM6	0.57	11.818	0.321
OM8	0.63	11.825	0.546

Cronbach's Alpha = .7426

Average Variance Extracted =.6218

Composite Reliability =.787

Model Fit Indices

Chi-Square w/ 56 df = 136.31

Goodness of Fit (GFI) = .914

Root mean square error of approximation (RMSEA) = .067

Normed fit index (NFI) = .634

Comparative fit index (CFI)= .694

p-value = .00110

A review of the fit indices for the OM construct in Table 5 show the proposed model is a good fit with the data. All the structural coefficients are significant, which indicates construct validity. The AVE score of .6218 is above the .5000 threshold, which indicates the concept is measured accurately. The composite reliability is also above the threshold with a value of .787 further indicating reliability. The Cronbach's Alpha is measured at .7426, which is above the .7000 base, which also indicates internal consistency of the construct.

A review of the fit indices for the OM construct in Table 6 show the proposed model is a good fit with the data. All the structural coefficients are significant, which indicates construct validity. The AVE score of .6157 is above the .5000 threshold, which indicates the concept is measured accurately. Furthermore, the composite reliability is also above the threshold showing a value of .91 further indicating reliability. The Cronbach's Alpha is measured at .9147, which is above the .7000 base, which also indicates internal consistency of the construct.

Table 6
Coefficients, Parameters, and Model Fit Indices
Production Mix Efficiency Model, N=298

Item	Structural Coefficients	Critical Ratio	SMC
PM1	0.02	11.747	0.001
PM3	0.04	11.747	0.001
PM4	0.27	11.744	0.034
PM5	1.18	11.884	0.047
PM6	0.16	11.745	0.020

Cronbach's Alpha = .9174

Average Variance Extracted =.6157

Composite Reliability = .91

Model Fit Indices

Chi-Square w/ 35 df = 88.25

Goodness of Fit (GFI) = .940

Root mean square error of approximation (RMSEA) = .0742

Normed fit index (NFI) = .924

Comparative fit index (CFI) = .950

RMR = .0477

AGFI = .906

p-value= .00000

As Table 7 shows the Chi-square value is 4.12 with 3 degrees of freedom and a p-value of .01. The GFI is .981, while the NFI is .992. The RMSEA is .036, which falls within very good parameters. Cronbach's Alpha, Composite reliability, and average variance extracted are all within parameters, which validates the construct.

Table 7
Coefficients, Parameters, and Model Fit Indices
Product Route Efficiency Model, N=298

Item	Structural Coefficients	Critical Ratio	SMC
PF1	0.68	9.928	0.759
PF2	0.89	11.726	0.413
PF3	0.55	8.924	0.611
PF4	0.74	11.096	0.708

Cronbach's Alpha = .9183

Average Variance Extracted = .62275

Composite Reliability = .92

Model Fit Indices

Chi-Square w/ 3 df = 4.12

Goodness of Fit (GFI) = .981

Root mean square error of approximation (RMSEA) = .036

Normed fit index (NFI) = .992

Comparative fit index (CFI) = .979

p-value= .01

Figures 2 and 3 show the hypothesized model and relationships between the constructs within the model. Each of the constructs, $\xi 1$, $\eta 1$, $\eta 2$, and $\eta 3$, are properly and accurately measured with manifest variables in the final measurement model. Figure 4 reports the final structural model.

Path estimates and other statistics for the structural model are presented in Table 8. The path estimates presented in Table 8 are standardized. The relationship between each parameter is marked by the direction of the arrow in the path diagram. In Table 8, the small arrow between two parameter indicates the direction of the causal relationship.

The parameter results of the structural model are presented in Table 9 indicate a mixed fit. The Chi-Square value was 718.42 with 128 degrees of freedom. As previously, stated due to sample size, other model fit indices are evaluated. The GFI score was a good fit at .842. The RMSEA was .0713 which falls within acceptable parameters. The NFI value was .913, while the CFI score was .873. Both of these are fair to good fits.

Since the measurement model is now established, relationships among the latent variable can be analyzed through the path coefficients of the model. Table 8 shows the model parameters. Hypothesis 1 stated that increased levels of operation management (OM) factors cause an increase in profitability (PF). The path between OM and PF ($\gamma 13$) was not found to be significant for this study (p=.365). Therefore, the data does not provide strong evidence to support Hypothesis 1.

Hypothesis 2 states that the product route efficiency will yield a positive effect on the relationship between OM and Profitability. The path between OM and PF (γ12, β32) was found to be significant for the research (p-.000). Therefore the data provides strong evidence to support Hypothesis 2.

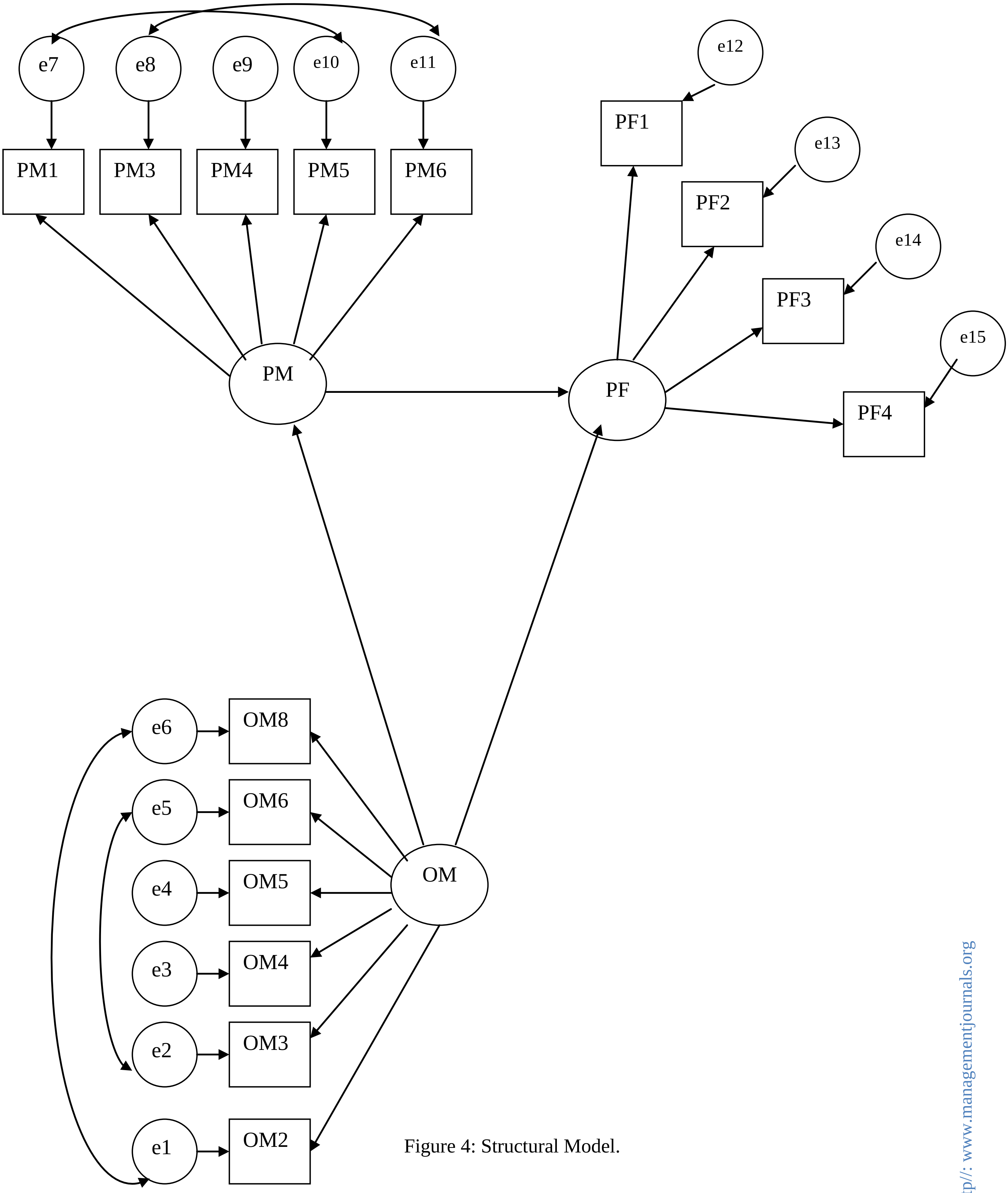

Figure 4: Structural Model.

Table 8
Structural Model Standardized Regression Weights

Parameter			Estimate	Standard Error	Critical Ratio	P-value
OM	→	PM	0.80	0.07	12.12	0.000
PM	→	PF	0.75	0.09	10.63	0.000
OM	→	PF	0.29	0.08	0.84	0.365
OM	→	OM2	0.48	0.08	11.873	0.000
OM	→	OM3	0.54	0.07	11.754	0.000
OM	→	OM4	0.74	0.14	11.753	0.000
OM	→	OM5	0.76	0.13	11.761	0.000
OM	→	OM6	0.57	0.13	11.818	0.000
OM	→	OM8	0.63	0.12	11.825	0.000
PM	→	PM1	0.02	0.07	11.747	0.000
PM	→	PM3	0.04	0.10	11.747	0.000
PM	→	PM4	0.27	0.09	11.744	0.000
PM	→	PM5	1.18	0.08	11.884	0.000
PM	→	PM6	0.16	0.11	11.745	0.000
PF	→	PF1	0.68	0.14	9.928	0.000
PF	→	PF2	0.89	0.07	11.726	0.040
PF	→	PF3	0.55	0.07	8.924	0.000
PF	→	PF4	0.74	0.09	11.096	0.000
Covariance						
E1	←→	E6	0.13	0.05	4.25	0.003
E2	←→	E5	0.15	0.04	6.38	0.000
E7	←→	E10	-0.12	0.03	-0.03	0.363
E8	←→	E11	0.19	0.07	3.19	0.000

Table 9
Statistical Model

LISREL Parameter	Path Coefficient	Critical Ratio	Standardized regression weights	P-value
OM>PM (γ11)	0.07	12.12	0.80	0.000
PM>PF (β31)	0.09	10.63	0.75	0.000
OM>PF (γ13)	0.08	0.84	0.29	0.365

<u>Model Fit Indices:</u>
Chi-square w/128 df = 718.42
Goodness-of-fit (GFI) =.842
Root Mean Square Error of Approximation (RMSEA) = .0713
Normed Fit Index (NFI)= .913
Comparative Fit Index (CFI) = .873

9. LIMITATIONS

All research, especially when it is exploratory as is this research, has limitations and this study is no exception. Some firms may not be able to utilize the strategy talked about in this research. For example, some firms may focus on one particular, unique product type. Therefore, they can't employ a strategy of producing different types of goods in differing lot sizes according to things such as demand, warehousing costs, and production times.

10. FUTURE RESEARCH

Future research needs to scour new sources of literature and add new variables to each construct to potentially adjust or re-analyze this study's findings or compare differentiations. This could potentially verify results shown here or show a variance in findings which in itself could be researched as to why. Also, future research should add different strategies and analyze them. There are other strategies in addition to the one provided here of product mix efficiency, and there are a number of possible combinations.

11. SUMMARY

The research questions posed in led to the development of the tested hypotheses. Each path in the conceptual model led to one of the two hypotheses. The application of the hypotheses was dependent upon the data being used to perform the statistical analysis to reject or fail to reject.

Data analysis included structural equation modeling (SEM), confirmatory factor analysis (CFA), and xploratory factor analysis (EFA). SPSS version 11.0.1 was used to perform the EFA and CFA. Other statistical analysis, such as SEM, used LISREL version 8.54. Testing of each hypothesis was tested using SEM in LISREL Regression results from SEM were used to consider the strength of the constructs in each model and how in combination they add to the overall variance explained by the construct.

As the findings show, this study contributes to existing literature in a several ways. First, this research focuses primarily on logistical aspects of operations. Second, this study took a comprehensive approach to literature and added manifest variables for each construct according to author's recommendations. Finally, rigorous statistical analyses were performed to verify or reject the hypotheses formulated. This research provides managers with a tool statistically proven to increase profitability by proper scheduling allocation. This can be done simply by allocating time and resources to each individual indicator item as managers see fit, using the findings within this study as a guide.

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