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AN EMPIRICAL INVESTIGATION OF SUPPLY CHAIN ENGINEERING ON LEAN THINKING PARADIGMS OF IN-HOUSE GOLDSMITHS

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Abstract: *Supply Chain Engineering is an emerging field based on analysis and comprehension of the essential principles of production and distribution systems. Lean Manufacturing is a phenomenon, where the production is restricted strictly only to the actual components (or) materials involved in the production (i.e.) Zero wastage. The task of this research paper is to examine whether there is any influence of Supply Chain Engineering practices over the Lean Thinking Paradigms of In-House goldsmiths. The target population belongs to micro unorganized sector. For this purpose a sample of 201 In-House goldsmiths were taken and in-depth personal interviews were conducted using a structured questionnaire cum schedule. The proposed model was based on the theory constraints with respect to the constructs of Supply Chain Engineering and Lean Thinking. The fitted model showed the positive and negative influences of the items stating the level of desirability of individual constructs. EndNote X7, SPSS 20 and AMOS 20 were the softwares deployed for this research paper.*

Keywords: *Supply Chain Engineering (SCE), Lean Thinking (LT), In–House Goldsmith.*

1. INTRODUCTION

This problem encompasses micro unorganized sectors. The target population involves goldsmiths who produce ornaments in small scale without mechanical production units (*i.e.*) in-house gold smiths. The data was collected from 201 goldsmiths, using a structured questionnaire-cum-schedule by conducting personal interviews. Unorganized sectors are not familiar with the concept of Micro, Small and Medium-rated enterprises in India. The globally available literature for this niche area in terms of supply chain management was studied for this purpose. Major people in the developing world rely upon self-employment and microenterprise set-ups as their primary and solitary foundation of earnings. Hence the study of the existing literatures might bring new insights to the future entrepreneurs. As

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a study of exploratory nature extensive reviews are not available. Hence the research design was framed appropriately.

The purpose of this research paper is to know the Supply Chain Engineering practices on Lean Thinking paradigms of in-house goldsmiths, to find the relationship between them and also to give numeric proofs for validating them.

SCE is relevant to Supply Chain Management (SCM), but it carefully does some more activities than SCM. Designing is the quorum of SCE which is executed in all the nodes of the network like Distribution Centres, Warehouses, Micro Distribution Centres, Retailers etc. It also helps in maintaining the integrity of the Supply Chain without any interruptions by giving proper justifications (Ravindran and Warsing Jr 2012).

SCE focuses on understanding the different processes across the end to end supply chain and results in optimizing the resources in order to design the supply chain network and improve the effectiveness of demand and supply chains.

2. REVIEW OF LITERATURE

For the purpose of improving quality, diminishing inventory cost and providing low cost customer services integration is useful in supply chain management. It helps in such a way right from the ordering till the delivery of the product. (Ohdar and Ray 2012).

Though supply chain management techniques have concentrated on more number of retailers and huge manufacturers, the hierarchy of the organization and the reduced size of medium and small enterprises delay the implementation of SCM techniques (Higginson and Alam 1997).

SCM not only helps in improving quality, reducing costs, providing satisfactory customer service, leveraging of business and reduced risks in getting benefits for small and medium businesses but also, reduces the firm's private differentiation advantages and reveals it to greater management and control hazards (Arend and Wisner 2005).

The supply activities of component manufacturers and the purchase activities of vehicle assemblers resulted in the scrutiny of supply systems which developed lean production (Lamming 1996). When manufacturing performance and product quality improvement are considered, SCM plays a vital part in improvisation (Narasimhan and Jayaram 1998).

In SMEs, SCM is considered as a one way process because, it appears to be the power exertion by customers alone. This implies that there is a lack of literatures in and around SMEs and SCM practices (Quayle 2003). In any Indian organization,

the business environment is limited to process efficiency, formal security strategy, centralized control structures and lack of expertise business practices (Ranganathan and Kannabiran 2004).

3. RESEARCH METHODOLOGY

This paper contains the output of data gathered from in-house goldsmiths through structured questionnaire cum schedule. Also the study is the result of complete primary data. A sample of goldsmiths was identified from gold, diamond and silver merchants association. Personal interviews were conducted and the data was collected extensively after repeated appointments with the target population. The respondents were asked to fill the data using a five-point Likert Scale for both Supply Chain Engineering (SCE) and Lean Thinking (LT) which are given as Annexure (i) and Annexure (ii) respectively. The research design of this paper is said to be exploratory and analytical.

Supply Chain Engineering is treated as independent variable, which has the following four constructs:

(a) Designing Engineering Budget (DEB);

(b) In-House Facility (IHF);

(c) Dynamism (DYM);

(d) Performance (PER).

Meanwhile, Lean Thinking is treated as dependent variable subject to the following three constructs:

(e) Manufacturing/Production Flow (PRF);

(f) Process Control (PRC);

(g) Metrics (MET).

The hypotheses proposed are as follows:

H1: There is a positive relationship between DEB and PRF

Designing the engineering budget takes business cost and labour availability for the work to be accomplished. Production flow is concerned with organizing and giving the manufacturing or production process a proper hierarchy in which the job is to be done. Hence both of them are having a positive relationship.

H2: There is a positive relationship between DEB and PRC

Process control is concerned right from requirement analysis till proper monitoring of the work. Hence for the appropriate engineering budget, the process control phenomenon should be structured properly. Both of them are directly proportional resulting in a positive connection.

H3: There is a positive relationship between DEB and MET

Metrics correspond to the set of etiquettes followed by firms in order to maintain the integrity and thereby influencing the positive growth of the organization. Hence it is positively related with the business cost and labour availability.

H4: There is a positive relationship between IHF and PRF

In–House facility of firm determines the ability of it to satisfy the customer's needs. When production flow is considered, only availability of tool and machine in a proper manner could result in a consistent flow. Hence they are positively correlated.

H5: There is a positive relationship between IHF and PRC

The relationship in this case also is positive and only a properly managed facility could give a better process control. This makes them fall in a positive relationship.

H6: There is a positive relationship between IHF and MET

Metrics of a firm is dependent to the facilities available within it. Hence higher the facility results in in the goodwill of the firm's promise. Both the constructs are positively related.

H7: There is a positive relationship between DYM and PRF

If the firm is dynamic and responds to the trend settings and event creations appropriately, then there is more control for the changes and the process flow is uninterrupted. Hence they have a positive correlation.

H8: There is a positive relationship between DYM and PRC

Process control in terms of dynamism should bring more business because, contemporary process control mechanisms would be the direct reflection of the customers' aspiration. Greater the advancements gives better results in output. The relationship is positive between them.

H9: There is a positive relationship between DYM and MET

When the firm fails in adapting itself to modernization, then there is no room for any improvements in the process scenario and metrics of the firm falls drastically. Both of them influence each other resulting in a positive association.

H10: There is a positive relationship between PER and PRF

For a greater performance, production flow of the firm should be high. This means both of them are positively correlated.

H11: There is a positive relationship between PER and PRC

Only when process is controlled, monitored and analysed properly, performance improves by giving out high business profits. Hence they are associated positively.

H12: There is a positive relationship between PER and MET

Only when the performance of an organization makes a good show to its customers, their metrics become more trustworthy. Hence the metrics of a firm is directly associated with its performance. Construct validity details are shown in Table 1.

Table 1
Construct validity

Trial No.	*Construct*	*No of items*	*Alpha*	*Source*
1.	DEB	9	.769	(Amoako-Gyampah and Boye 2001)
2.	IHF	5	.756	Developed*
3.	DYM	4	.679#	(Amoako-Gyampah and Boye 2001)
4.	PER	8	.653#	(Dean and Snell 1991)
5.	PRF	3	.643#	(Feld 2000)
6.	PRC	6	.681#	(Ahmad and Schroeder 2001), (Ahmad and Schroeder 2002)
7.	MET	5	.751	(Feld 2000)

* Developed using expert opinion.
# More items are to be added to improve the marginal variations that occur in this operational domain.

4. RESULTS AND DISCUSSION

This portion represents the descriptive and inferential statistical analysis of SCE and LT using ANOVA, Chi-Square (using SPSS 20) and SEM (using AMOS 20). AMOS was chosen over SMART PLS and LISREL because this paper corresponds to model development and theory building. The latter is usually preferred for testing the existing theory or model. ANOVA was performed with respect to the business demographic variables over these constructs. For this purpose, Types of Business Ownership (Sole Proprietorship (SLP), Partnership (PSP), and Hindu Undivided Family (HUF)) and Types of Goods Produced (B2C, B2B and Both)) were taken into account. The impact of each and every individual business demographic variable over the constructs were identified as follows:

The alternative hypothesis states that there is a significant difference amongst the means of business demographic variables as discussed below.

Table 2
Business Ownership (*vs.*) Designing Engineering Budget

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
Sole Proprietor	168	3.4623	.57758	.04456	4.616(.011)
Partnership	9	4.0247	.48361	.16120	
HUF	24	3.6111	.54826	.11191	
Total	201	3.5053	.58096	.04098	

From Table 2 we can infer that difference exists amongst the opinion of SLP, PSP and HUF firms respectively as indicated by their mean differences. This implies that partnership firms concentrate more on DEB. Next comes HUF and SLP falls last which bother the least about DEB.

Table 3
Goods Produced (*vs.*) Designing Engineering Budget

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
B2C	10	3.6222	.62460	.19752	2.513(.084)
B2B	9	3.9012	.46296	.15432	
Both	182	3.4792	.57866	.04289	
Total	201	3.5053	.58096	.04098	

From Table 3 we can infer that the ratio between the mean responses B2C, B2B and both combined together is not very vivid. Also they are approximately equal. Hence all kinds of goods manufactured deal with the same notion while designing the engineering budget.

Table 4

Business Ownership (*vs.*) In-House Facility

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F* Ratio(Sig)
Sole Proprietor	168	3.7917	.49687	.03833	3.094(.048)
Partnership	9	4.1333	.51962	.17321	
HUF	24	3.9750	.55736	.11377	
Total	201	3.8289	.51045	.03600	

From Table 4 we can infer that a PSP firm keenly ponders on the IHF of the firm more than HUF and SLP. Hence a difference exists between them in maintaining the In–House facilities. SLPs should concentrate more in maintaining the IHFs in order to compete with the facilities of other firms.

Table 5
Goods Produced (*vs.*) In-House Facility

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
B2C	10	3.6600	.49933	.15790	.826(.439)
B2B	9	3.9556	.56372	.18791	
Both	182	3.8319	.50901	.03773	
Total	201	3.8289	.51045	.03600	

From Table 5 we can infer that firms producing B2C, B2B and both view the facilities equally with respect to IHF and maintain the same level of set-up with

the tools which they use in manufacturing process. All of them should come out of the primitive set-up and adapt new engineering processes of the Strategic Business Units.

Table 6
Business Ownership (*vs.*) Dynamism

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
Sole Proprietor	168	3.6563	.64202	.04953	9.344(.000)
Partnership	9	4.4444	.30046	.10015	
HUF	24	4.0313	.71594	.14614	
Total	201	3.7363	.66718	.04706	

From Table 6 we can infer that dynamism is a key to success. This is one of the important constraints in maintaining the business. More the organization is updated and eager in dynamism, more is its business and profits. PSP firms focuses more than HUF and SLP. Hence business owners treat dynamism differently amongst them.

Table 7
Goods Produced (*vs.*) Dynamism

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
B2C	10	3.4250	.63519	.20087	1.217(.298)
B2B	9	3.8333	.77055	.25685	
Both	182	3.7486	.66300	.04914	
Total	201	3.7363	.66718	.04706	

From Table 7 we can infer that types of goods produced have nothing to do with dynamism, when this operational problem is considered. It is clear that firms which tend to improvise its operations shows greater interest in dynamism.

Table 8
Business Ownership (*vs.*) Performance

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
Sole Proprietor	168	3.9792	.44108	.03403	1.554(.214)
Partnership	9	4.2500	.46771	.15590	
HUF	24	4.0052	.50605	.10330	
Total	201	3.9944	.45144	.03184	

From Table 8 we can infer that without improving dynamism, selling patterns and sales promotion activities, In-House goldsmiths face a tough competition with the performance. Also the measure of performance is unaware to this particular crew, which is vital for their continuity. No mean differences are identifies in this respect of business ownership.

Table 9
Goods Produced (*vs.*) Performance

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
B2C	10	3.8000	.57795	.18276	1.000(.370)
B2B	9	3.9722	.31732	.10577	
Both	182	4.0062	.44931	.03330	
Total	201	3.9944	.45144	.03184	

From Table 9 we can infer that performance shows no difference when the type of goods produced is susceptible to change (*i.e.*) adaption to environment is mandatory with this aspect in order to improve their growth. Performance and related items fails to show any difference over the types of goods produced.

Table 10
Business Ownership (*vs.*) Production Flow

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
Sole Proprietor	168	3.0536	.54514	.04206	.262(.770)
Partnership	9	3.1111	.57735	.19245	
HUF	24	3.1389	.74157	.15137	
Total	201	3.0663	.57059	.04025	

From Table 10 we can infer that this particular community of population had not yet modernized when compared with major game players in Jewellery manufacturing sector. Hence PRF fails, causing a major issue in business ownership. None of the types of business owners had shown interest in PRF mechanisms.

Table 11
Goods Produced (*vs.*) Production Flow

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
B2C	10	3.4667	.39126	.12373	6.137(.003)
B2B	9	3.5185	.60349	.20116	
Both	182	3.0220	.56129	.04161	
Total	201	3.0663	.57059	.04025	

From Table 11 we can infer that when the manufacturers tend to do B2B, they exercise caution showing a high mean difference as the component or product is given to another business entity. This implies that the procurers from In – House goldsmiths sell more product of higher quality (due to restrictions in business agreements) than the goldsmiths themselves.

Table 12
Business Ownership (*vs.*) Process Control

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
Sole Proprietor	168	1.9613	.31800	.02453	13.196(.000)
Partnership	9	2.5185	.58597	.19532	
HUF	24	2.2083	.58411	.11923	
Total	201	2.0158	.39462	.02783	

From Table 12 we can infer that, when PRC is considered, PSP and HUF firms use high monitoring and control measures than SLPs. In this particular problem, a PSP and HUF firm has high business profits and turnovers. Hence the mean difference is significant with respect to the groups of business owners, which shows that they take more care in accomplishing PRC operations to gain more business profits and customer strength.

Table 13
Goods Produced (*vs.*) Process Control

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
B2C	10	2.0500	.35180	.11125	.443(.643)
B2B	9	2.1296	.21695	.07232	
Both	182	2.0082	.40382	.02993	
Total	201	2.0158	.39462	.02783	

From Table 13 we can infer that different goods producers don't show any difference in their judgment towards PRC. They think that PRC is not a viable factor to improve their business opportunities. But when PRC is considered, better the adaption to SPCs and foolproof designs in the manufacturing process makes them to adapt lean manufacturing. Not because that gold is a precious metal, but due to their mechanisms which are governed by six sigma principles. These are adapted by the major SBUs in Jewellery business. They have brought down the wastages and gave the benefit of them directly to customers.

Table 14
Business Ownership (*vs.*) Metrics

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
Sole Proprietor	168	3.9964	.58216	.04491	5.793(.004)
Partnership	9	3.3333	.81240	.27080	
HUF	24	4.0667	.51975	.10609	
Total	201	3.9751	.60032	.04234	

From Table 14 we can infer that when the metrics of LT is considered, it states that differences exist with respect to the type of business ownerships. HUF shows greater interest to fulfill customers' needs and it is followed by SLP and PSP firms stand last in the queue.

Table 15
Goods Produced (*vs.*) Metrics

	N	*Mean*	*Std. Deviation*	*Std. Error*	*F Ratio(Sig)*
B2C	10	4.0200	.63561	.20100	.144(.866)
B2B	9	4.0667	.43589	.14530	
Both	182	3.9681	.60757	.04504	
Total	201	3.9751	.60032	.04234	

From Table 15 we can infer that manufacturers show no great opinion changes over metrics. The difference is not significant. B2B tends to give more importance for integrity and related measures of metrics than others. Other manufactures should also keenly follow the metrics of LT in order to reduce the wastages and improve the manufacturing process.

Business Demographic variables were dealt DEB and LT and their mean differences were considered as a vital part of this research. In this modern era, product life cycle is shrunk, which shows that consumers have little interest in durability and more interest in trend settings. The quality of gold is governed by BIS, HALLMARK and KDM, for all the jewelers across the country. Yet In- House Goldsmiths are failing to adapt the changes which proportionately decrease their livelihood.

4.1 Operationalizing the Proposed Model using Structural Equation Modeling (SEM)

SEM is used for simplifying complex modeling which is based on the general linear model. SEM includes the purpose and goals of statistical analysis as well as the fit indices which proves to be the numerical proof for validating the model (Ullman and Bentler 2003). The proposed model based on the hypotheses is given in Figure 1. Model Fit Indices are shown in Table 16.

From Table 17 we can infer that the influence of the constructs of SCE had proven the extent of relationship with LT. Some of the constructs show positive correlation whereas some others give negative correlation. The values are as shown in Table 18.

From Table 18 we can infer that PRF is positively influenced by DEB (*i.e.*) when DEB increases it shows an improvement in PRF. Both of them are directly proportional. Meanwhile PRF is negatively influence by IHF (*i.e.*) they are inversely

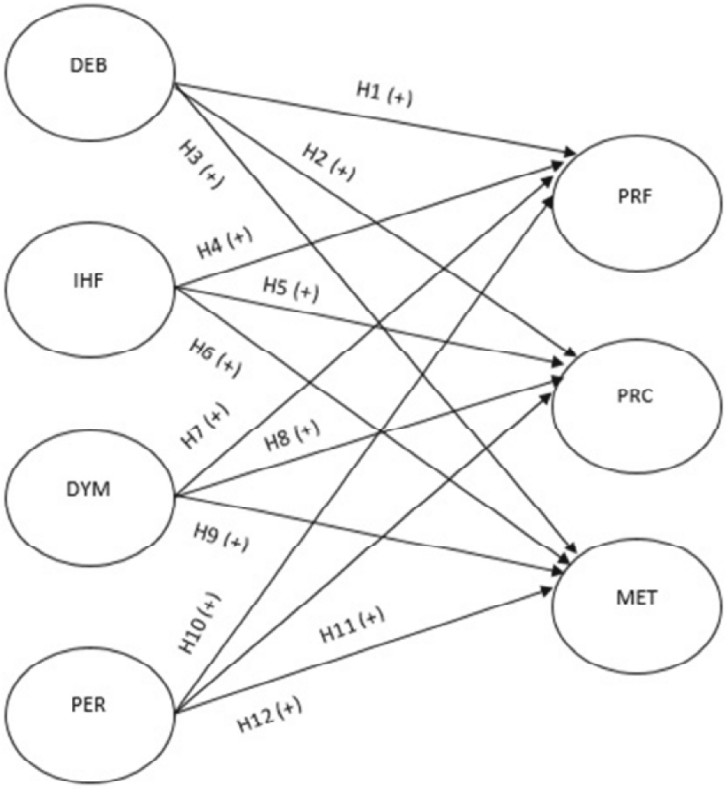

Figure 1: Proposed Model: Influence of Supply Chain Engineering (SCE) on Lean Thinking (LT)

Table 16
Model Fit Indices

Trial No.	*Model Fit Parameters*	*Values*
1.	Chi-Square	1081.818
2.	Degrees of Freedom (DF)	534
3.	Chi-Square/DF Ratio	2.026
4.	Goodness of Fit Index (GFI)	0.757*
5.	Adjusted Goodness of Fit Index (AGFI)	0.713*
6.	Root Mean Square Error of Approximation (RMSEA)	0.072

*Chi-Square is sensitive to sample size and departures from normality. Out of the two any constraint might affect the Chi-Square/DF Ratio. Many suggest the ratio to be between 2 to 5, for a good fit but it can be out of the path and misguiding in some cases. To compensate this GFI and AGFI were developed. The distribution of GFI and AGFI is unknown. Hence it is concluded that there is no fixed standard to make a comparison(Volkan 1987). Here the items are significant in most of the cases. Hence the marginal variation is adjusted with respect to Chi-Square/DF Ratio. Measures of the model fit indices are giving the appropriate values for supposition as follows:

Table 17
Measurement of Model Fit Indices

Constructs		*Measure*	
Independent Variables	*Corresponding Items*	*Beta(t-Value)*	*Standardized Beta*
Designing Engineering Budget (DEB)	DEB 1	1.000 –	0.62
	DEB 3	1.480 8.649	0.735
	DEB 4	1.537 9.242	0.807
	DEB 5	1.090 7.301	0.605
	DEB 6	1.678 7.965	0.686
	DEB 8	0.990 6.620	0.324
	DEB 9	1.000 –	0.327
In – House Facility (IHF)	IHF 2	1.000 –	0.454
	IHF 3	0.701 4.343	0.458
	IHF 4	1.395 5.100	0.804
	IHF 5	0.754 4.282	0.447
Dynamism (DYM)	DYM 1	3.109 2.728	0.446
	DYM 2	2.976 2.889	0.641
	DYM 3	5.930 2.875	0.870
	DYM 4	1.000 –	0.254
Performance (PER)	PER 1	0.312 3.646	0.311
	PER 2	1.000 –	0.664
	PER 3	0.848 6.146	0.577
	PER 4	1.171 6.590	0.647
	PER 5	0.367 3.482	0.296
	PER 6	0.880 5.468	0.494

Table 18
Dependent (*vs.*) Independent Variable Model Fit Indices

Dependent Variable	*Independent Variable*	*Beta(t value)*	*Hypothesis*
Production Flow (PRF)	DEB	0.570 3.590***	H1 is accepted
	IHF	–0.350 –2.482**	H4 is rejected
	DYM	–0.265 –1.628#	H7 is rejected
	PER	0.015 0.129#	H10 is accepted but not significant
Process Control (PRC)	DEB	0.278 2.114**	H2 is accepted
	IHF	–0.178 –1.502#	H5 is rejected
	DYM	0.505 2.148**	H8 is accepted
	PER	–0.210 –1.839*	H11 is rejected
Metrics (MET)	DEB	0.436 3.161***	H3 is accepted
	IHF	–0.155 –1.318#	H6 is rejected
	DYM	–0.440 –2.186**	H9 is rejected
	PER	0.237 2.076**	H12 is accepted

*** Significant at 99% confidence level, ** Significant at 95% confidence level, * Significant at 90% confidence level, # Not Significant

proportional. Any improvement in In-House Facilities would bring a degradation to the Production Flow. Hence there is no need to improve IHF to develop the Production Flow of In-House Goldsmiths.

For the case of PER to PRF, the hypothesis is accepted but not significant, which means that in this case of argumentation there exists an influence and that is positive. But it could not be the same across all samples. Hence there is no guarantee to other authors that they could get similar results in their work.

From Figure 2 we can infer that positive correlation gives a direct impact over the Dependent variable, while negative one gives adverse effects. Items which have high negative correlation means that their influence is not needed if the corresponding dependent variable is to be improved. If the correlation coefficient is very high in this case, it drastically reduces the importance of the dependent variable.

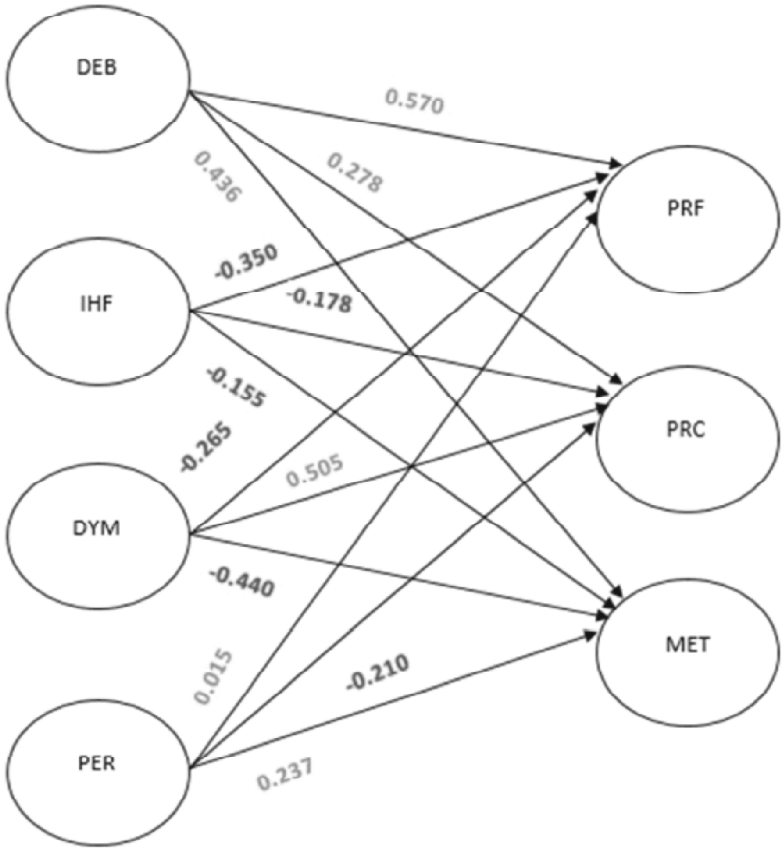

Figure 2: Fitted Model Influence of Supply Chain Engineering (SCE) on Lean Thinking LT) (With Fit Indices)

In case of PRF, for every improvement in IHF and DYM the production flow comes down. In-House Facilities and Dynamism need not be improved for improving PRF. In case of PRC, IHF and PER are not necessary for improved process control. For improved metrics, IHF and DYM should be minimal. Operational model of the influence of supply chain engineering over lean thinking paradigms of In-House goldsmiths in SEM is shown in Figure 3

5. CONCLUSIONS

Forces of Supply Chain Engineering over Lean Thinking causes influencing and diminishing effects. Appropriate ideologies for improvements should be made. In-House faclity is a vital factor in diminishing the Lean Thinking paradigms. Goldsmiths should adapt modernization of equipments and follow improved Statistical Process Control techniques in order to minimize wastages and achieve a proportionate gain in business. Performance factor in SCE and Metrics in LT can

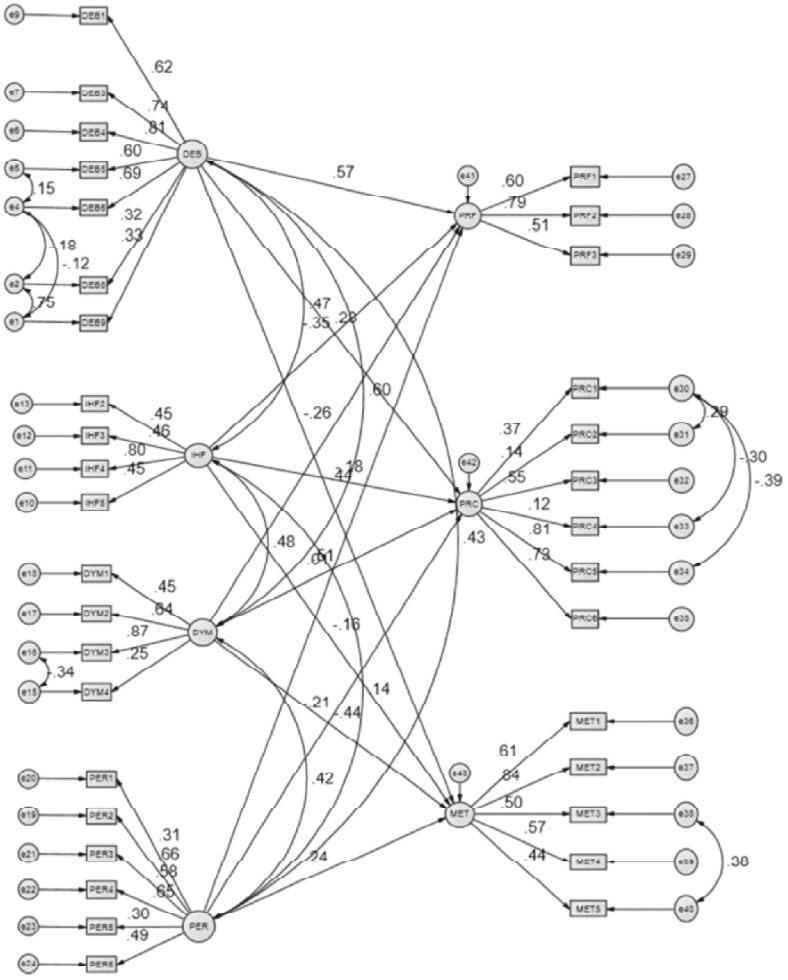

Figure 3: Path Diagram of the Fitted Model

be significantly improved if there is room for automation in the production process. Understanding these issues makes the goldsmiths ready to compete with the contemporary world by achieving appropriate benefits through Lean Thinking in turn could also give a tough competetion to the retail-chain of jewelry outlets in future.

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ANNEXURE 1

Supply Chain Engineering

Kindly rate the importance assigned to the following issues related to the characteristics of Supply Chain Engineering by your enterprise in Likert's five point scale (1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High)

Trial No.	*Statement*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
	Designing Engineering Budget (Business Cost and Labour Availability)					
1.	Rising Labour Cost					
2.	Rising Material Cost					
3.	Rising Transport Cost					
4.	Rising Telecommunication Cost					
5.	Rising Utilities Cost					

Cont. Annexure 1

Trial No.	*Statement*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
6.	Rising Rental Cost					
7.	Rising Healthcare Cost					
8.	Shortage of Artisans					
9.	Shortage of Clerical and Related Workers					
In-House Facility						
1.	Availability of Tools					
2.	Availability of Sophisticated and Automated Instruments					
3.	Timeliness of Raw Material Suppliers					
4.	Suitability of the Location					
5.	Availability of Tools to Process Finished Goods					
Dynamism						
1.	Rate at Which Products and Services Become Outdated					
2.	Rate of Innovation of New Products and Services					
3.	Rate of Innovation of New Operation Processes					
4.	Rate of Change in Taste and Preferences of Customers in Your Industry					
Performance						
1.	Product Quality					
2.	Employee Morale					
3.	On-Time Delivery					
4.	Inventory Management					
5.	Employee Productivity					
6.	Equipment Utilization					
7.	Product Lead Time					
8.	Scrap Minimization					

ANNEXURE 2

Lean Thinking

Kindly rate the importance assigned to the following issues related to the characteristics of Lean Thinking by your enterprise in Likert's five point scale (1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High)

Trial No.	*Statement*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
Manufacturing/Production Flow						
1.	Assessment of Ornament Group					
2.	Layout Design					
3.	Process Mapping					

Cont. Annexure 2

Trial No.	*Statement*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
Process Control						
1.	Customer Requirements are Thoroughly Analyzed in the New Product Design Process					
2.	Process in our Plant are Designed to be Foolproof					
3.	A large Percentage of the Equipment or Processes on the Shop Floor are Currently Under SPC					
4.	We Make Extensive Use of Statistical Techniques to Reduce Variance in Processes					
5.	We Use Charts to Determine Whether Our Manufacturing Processes are in Control					
6.	We Monitor Our Processes Using SPC					
Metrics						
1.	On-Time Delivery					
2.	Process Lead-Time					
3.	Quality Yield					
4.	Travel Distance					
5.	Productivity					