IT Revolutionizing the Supply chain Transformation: A Case Study of Unilever Pakistan Ltd.

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Abstract

Supply chain Management is a combination of three words supply, chain and management. Supply is all about meeting the needs, wants and demands of customers where as the chain actually represents connectivity. Further management is all about planning the supplies transit to meet demand , organizing the processes sequence for it , controlling and ensuring the process quality through check points and gate control systems, leading by defining process ownership and staffing by right sizing at each and every step. Thus aforementioned three words combined together to form supply chain management. Supply chain management is also to provide the best possible services to the customer with maximum cost effectiveness. Another recent development in the field of supply chain management is the evolution of supply chain operation reference model also known as SCOR model. This model was first introduced by the supply chain council (SCC), a globally known corporation due to excellence in supply chain practices and systems formulation. This SCOR model is actually a reference model standardized terminology and processes [42] which actually emphasizes on benchmarking. This benchmarking is actually related to an operational measurement in order to craft a portfolio for improvement which is directly linked and tied with balance sheet of the company for improved performance along with bottom line increment. Information technology (IT) applications in the field of supply chain management (SCM) has achieved a significance by virtue of its capability and ability to lessen the costs and enhanced responsiveness in the supply chain functions [41], [15] , [19], [36], [45], [43].

Keywords: Supply chain management, Information technology, SCOR model.

1.1 Background of the study

With global increasing competition and evolution of SCOR model in supply chain which is actually connecting both tiers of supply chain that is suppliers and customers is actually compelling the organizations globally to become more and more creative in terms of their strategic attempts for serving the customer with cost effectiveness as well.Many organizations in almost all sectors are seeking for using IT as a competitive advantage which is actually an enabler of SCOR and supply chain management. FMCG sector is also using IT and realizing its significance for getting more and more competitive advantage and making their supply chain more agile, cost efficient and productive.

1.2 Problem statement

Globally, integrated supply chain management is an emerging area for revolutionizing the supply chain performance. Information technology is considered as a key for this type of integration. Since, the competition is getting tougher so companies have entered into a fierce competition and focusing on transforming their supply chain into efficient and effective supply chain management by integration. Therefore it is imperative to find the level of effectiveness in supply chain drivers (plan, source, make, deliver and return) by virtue of information technology with special reference to Unilever Pakistan Ltd as Unilever is the leading FMCG of the Pakistan.

1.3 Objectives

- To measure contribution of IT in performance improvement of supply chain planning
- To measure contribution of IT in performance improvement supply chain Sourcing
- To measure contribution of IT in performance improvement supply chain manufacturing

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- To measure contribution of IT in performance improvement supply chain delivery.
- To measure contribution of IT in performance improvement supply chain return

1.4 Significance

Past research has addressed impacts of IT on supply chain on a global context and most of the researches were conducted on automobile and manufacturing concern organizations. Also with a fierce growth ambition by FMCG sector in growing market of Pakistan and equipping them with more and more advanced ERP systems there is a need for establishing a relationship between IT systems and supply chain systems. Very few studies has been conducted comprehensively in Pakistan on role of IT as effective supply chain enabler especially in FMCG sector.

1.5 Limitations

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- Data confidentiality policy at Unilever Pakistan Ltd would be a limitation in some cases while gathering data.

- Data accessibility would rely on secondary sources where Unilever Pakistan would be reluctant to share their numerical figures.

- Due to geographical constraints and resources limitation questionnaire will be shared on email with the sites of Unilever across Pakistan.

- Due to broadness of this research area and time constraint the research is restricted to Unilever Pakistan Ltd.

1.6 Scope of the study

The scope of this research is restricted to application of IT on supply chain drivers and evaluating its impact and effectiveness on these drivers. Unilever Pakistan is selected for this study as Unilever is the largest FMCG of Pakistan with a turnover of more than PKR 55 Bn and its findings are applicable to whole FMCG sector of Pakistan.

2. RESEARCH METHODOLOGY AND PROCEDURES

The basis of this study is to explore the contribution of IT in impacting over all supply chain performance Unilever Pakistan Ltd. Since, it is a quantitative study therefore it comprises of extensive primary and secondary sources.

2.1 Research Design

Research is design in a way to get as much as information possible within limited time. Since, it is a quantitative study therefore it comprises of extensive primary and secondary sources. Five hypotheses are formed for studying five drivers of supply chain to evaluate the impact of information technology in supply chain transformation. For primary data collection questionnaire encompass the five drivers of supply chain for establishing the relationship between information technology and supply chain improvement. Data have also been gathered through observation and interviews because of quantitative studies have to be undertaken. The data of have tested through different statistical tools like regression and ANOVA etc.. Secondary data pertaining to performance of each driver has been collected from 1990 to 2011 for evaluating them with or without IT so that actual impact of IT implementation on these drivers could be investigated.

2.2 Research methodology selected

Since research is quantitative so an extensive regression and ANOVA analysis will be done which will derive the contribution of IT in supply chain performance improvement in terms of effectiveness in its drivers (plan, source, make, deliver and return). On the other hand 100 questionnaires (See Annexure 2) will be distributed 20 in number at each site of organization. Data pertaining to performance of each driver is also collected from 1990 to 2011 to perform a comparative analysis of supply chain driver's performance with and without IT. Garch (1, 1) model have also been applied for predicting forecasted error of upcoming years which will also decide the performance of other drivers.

2.3 Samples and sampling technique

Sampling units of this research are employees of largest FMCG Company of Pakistan i.e. Unilever Pakistan Ltd. Sampling technique used is stratified random sampling with proportionate sampling. Sample taken from these companies for filling the questionnaire is classified as below:

- Senior Managers - 5 from each Site
- Managers – 5 from each Site
- Assistant Managers – 10 from Each Site

2.4 Research instruments

Research instrument for primary research consists of a questionnaire (Annexure 2) which is crafted on the basis of Likert scale. Data collected from the respondents undergoes statistical analysis like regression and ANOVA

in which each variable have been studied separately for determining the impact of each variable. For secondary data collection Professional journals and magazines, articles, internet, books, reports provided by government and research conducted by researching agencies have been used for comparative analysis of supply chain driver's performance with and without IT systems. Garch (1, 1) model have also been applied for predicting forecasted error of upcoming years which also decided the performance of other drivers.

3.0 Literature review

In this section of research, a categorization scheme has been devised to review the literature and information available on the relationship between Information technology (IT) and supply chain management (SCM). This categorization is done with the aim to discover the relevant factors that would support the professionals in their work and effort for effectively managing SCM which is enabled by IT.

This literature review is aimed to discover the key success factors (KSF) which are enabling SCM through IT, This include defining the concepts of supply chain management in different researches, supply chain operation reference model (SCOR) and its drivers i.e role of IT in supply chain delivery, sourcing, planning, manufacturing performance and return.

According to the study conducted by [24] (2008) described supply chain management as a system based approach for enhancing the performance level in addition to that also leverages the opportunities evolved due to downstream and upstream linkages with customers and vendors (suppliers).Another study conducted by [32] et al (1998) in one of the well renowned forum, global supply chain forum described that supply chain management is actually the amalgamation of core and key processes of the business from end user through original suppliers for the sake of value addition and better services to stakeholders and customers too.Another definition stated by [29] (1999) that supply chain management involves the integration of a set of tasks and activities through continuously improved Supply chain relationship for the sake of achieving sustainable benefit.

Many researchers have documented IT in Supply Chain as a new dimension to it by using the terms like materials resource planning (MRP), bill of material (BOM) and master production scheduling (MPS).apart from aforementioned IT technologies a large number of IT programs has been designed, launched and implemented for meeting the different requirements of the supply chain activities.

Another recent development in the field of supply chain is the progression in this field known as supply chain operation reference model or SCOR model. This model was first introduced by the supply chain council (SCC), a globally known corporation due to excellence in supply chain practices and systems formulation. This SCOR model is actually a reference model standardized terminology and processes ([42] et al. 2002) which actually emphasizes on benchmarking. This benchmarking is actually related to an operational measurement in order to craft a portfolio for improvement which is directly linked and tied with balance sheet of the company for improved performance along with bottom line increment.

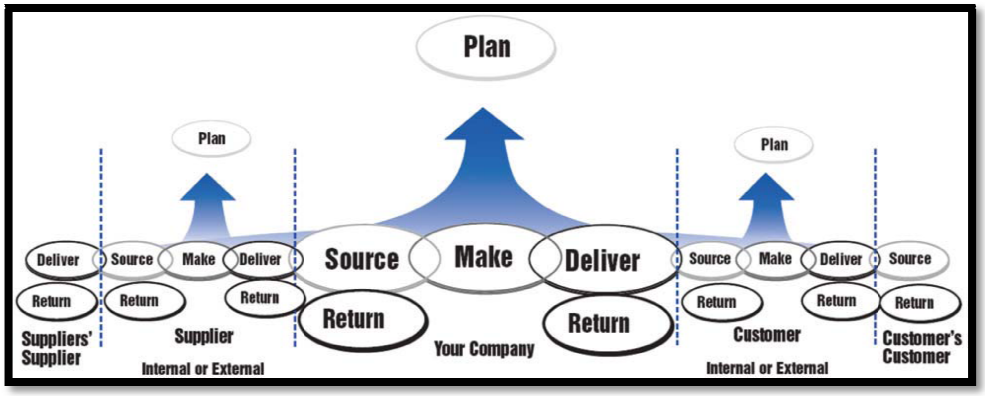
Figure-1: SCOR Model

Source: SCC, 2009.

As depicted in Figure 1, the SCOR model of supply chain consists of five drivers or components which are as Plan , source, make ,deliver and return.

IT revolutionizing the supply chain and SCOR is described by [29] (1999) by explaining the chief drivers of integration as the information revolution , more and more demanding customer along with a demand driven market by increasing competition at a global level , the evolutions of innovative synergy and relationship among supply chain functions. They described the core fundamentals for developing an IT enabled supply chain. These include information systems, inventory management and supply chain relationships. With reference to the aforementioned model the foundation and basis of integration are characterized by trust, technological cooperation, partnering, business collaboration and sharing of information managed in synergic way ([1] et al., 1999). According [7] et al.(2000) synergy through IT is involved at every stage of product life cycle..

According to [12] (1998) some outbound activities like recycling ,after sales services, waste management including reverse logistics could also be managed in more efficient way through IT integration with supply chain functions. As described by [17] and Austrian (2000) integration and supply chain are mandatory for effectively managing companies operations outside its boundaries. As highlighted by [55] (1996) the relationship between information systems and SCOR model is a mandate for better utilization of resources, managing after sales services and reverse logistics improvement



Another prospective highlighted is regarding the enhancement and improvement of competitiveness along with integration of the supply chain. [59] (1997) highlighted that supply chain is a major cost centre in an archetypal company's cost and just by improving supply chain performance and bringing in cost effectiveness in it would result in improvement of yield in terms of pretax profits by 40 to 50 percent.

Another study conducted by [18] (1997) on integration highlighted that integration has evolved in supply chain as a permanent entity for maximum effectiveness. It is just like the SCOR model described by SCC (2008).It consists of a virtual enterprise without any traditional approach like company boundaries etc. It can be steered directly by consumer and customers via IT and electronic support. His belief was on implementation of these transformations at the company in the initial phase for focusing on procurement, manufacturing, planning and delivery drivers of SCOR model and then extending it to suppliers and customers so it may also capture the Return driver of SCOR model. The main benefit comes out to be reduction in both cost and the cycle time of the processes.

[59] (1997) & [21] (1995) also emphasized on significance of integration across the functions described in SCOR model by enhancing cooperation and collaboration for an improved supply chain performance. [35] & [44] (1997) also highlighted the integrated supply chain functions as an enabler of improved performance.

Another study highlighted that integration of supply chain actually happens when there is a strong relationship and partnership exists between clientele and supplier which results in reduced days on hand, shorter delivery and lead-time and customer services excellence. ([46], 1998)

Reduction in complexity is one of the main objective of IT enabled SCOR and SCM. [47] (1990) highlighted two core types in terms of complexity. This includes dynamic type and detail type. According to [47] (1990) if there is a separation exists between cause and effect and it is complicated and difficult to associate and link both in terms of space and time. However detail complexity involves so many variables needed to be controlled and managed simultaneously.

[22] (1958 & 1961) further highlighted that traditional methodology of planning and forecasting results in "bull whip effect" which is an example of dynamic complexity. In bull whip effect artificial demand is created due to misleading information regarding product actual demand in the market. According to [13] et al. (2000) bull whip effect can be controlled by IT backed SCOR model in a company. According to [37] et al. (1997) drawbacks of bullwhip comes out to be decline in service level, in accurate and untimely planning of capacities, hit on company bottom line, high level of inventories, lost Sales, poor production scheduling and increasing logistics cost. He also explained that administration of information is vital for reducing aforementioned issues. He explained that bullwhip effect can be controlled and supply chain performance can be improved easily by better coordination, information sharing and planning among the supply chain drivers. [10] (1998) highlighted that the concept of IT enabled SCM is not a new one but actually companies realized the speed, time, accuracy and quality of it at an affordable price now. Also highlighted in Australian yellow pages regarding emails usage by over 40 percent small sized and 80 percent medium sized firms for doing their businesses with their suppliers and customers. (Yellow Pages Survey, 1999, cited in [35], 1997). As described by and Calantone (1998) there are a wide number of other software applications which are in use for integration of SCOR drivers for better information

flow across supply chain and with customers and suppliers. Some of these applications are enterprise resource planning (ERP) systems, automatic order management and fulfillment system, Forecast and demand planning systems, warehouse management systems, fleet management systems, customer relationship management systems etc.

Information systems flow outside the organization with vendors and customers is also a very significant area to consider from supply Chain perspective as stated below:

[11] (1997) narrates the incident regarding dissatisfaction of customer despite of very good packaging by vendor and thus highlighted the significance of connectivity with customer to determine what they actually expects from the company.

Handfield (1999) also highlighted the significance of interaction for maximizing supply chain effectiveness by explaining that integration across the supply chain is the foundation stone of well connected supply chain. According to and Nichols (1999) any attempt to manage the information or material flow seems to be unfruitful without connectivity among drivers of supply chain.

[53] (1998) also highlighted that firms where supplier relationships are on priority are enjoying better fiscal performance and higher rate of customer satisfactions. In case companies are not recognizing the significance of information flow and integration with suppliers and customers then this “silo” type operating philosophy may impact and threaten the entire SCOR drivers. ([34], 1998a:[8], 1999; b; [56], 2001; [27] et al., 2000). [32] (2000) also highlighted the level of management and integration as the key drivers required strategically from focal company for creating an integrated relationship with vendors [2] (1997) highlighted SCOR model as a broad framework for gauging Supply Chain effectiveness and for discovering further avenues for improvement.

[48] (1998) highlighted the significance of SCOR model for Supply chain transformation and narrated that in first level, a firm describes its intentions and aims for performance and compiles the data required to construct its own supply chain model. “Supply-chain configuration” comprises of product mix and volume mix which you are offering, technological essentials and assets pertaining to accounts which would be focused in level 2. In level 3 company actually focused on estimating and forecasting its anticipated performance through aforementioned variables and can focus on further fine tuning of it..

[39] (1997) defined SCOR model as a strategic and benchmarking tool for transformation of Supply Chain and a key in developing more IT softwares for SCM support in a rapid fashion. [5] (1998) described SCOR as a common platform for integration, creating a harmony and better understanding among the drivers of supply Chain. [2] (1997) defined SCOR model as a leveraging point for more fine tuned allocation of resources among the drivers.

With the evolution of new technology in IT and increasing thrust on E commerce a large number of forms like EDI, Internet, Intranet are enabling supply chain for interacting with suppliers and inter- organizational sharing of information. As an enabler of SCM IT is playing a pivotal role ([38], 1996). By virtue of internet managing supply chain becomes convenient as it highlights the types of products which are in demand, types of products available at Warehouse, What is manufacturing and what lies at facilities and customer sites ([33] et al. , 2000)

In Souring and purchasing driver of supply chain IT is creating operational excellence by incorporating cost savings, reduction in lead times, reduced paper works, suppliers- company partnering and business to business networks.

[40] et al. (2000) proposed his views that IT revolutionizes the supply chain sourcing by improving Business processes, buyer- supplier relationship, business expansion and electronic intermediation.

[58] (2000) suggested that e commerce is not only about enabling supply chain and doing online business but also about redesigning the organization.

[30] (2001) emphasized on the role of IT in make driver of supply chain and highlighted the current usage of IT in manufacturing processes and define the industry practices in this regard. They also pointed out a web based model for collaborative supply chain manufacturing.

[16] (1998) presented the concept pertaining to the logistics driver of the supply chain and proposed the idea of virtual logistics which is actually treatment of physical and information aspects of logistics in an independent manner from each other. In such mechanism internet is controlling the resources in terms of monitoring and ownership instead of any physical control.

[20] (2001) put forward a new model famous by as service –controlled agile logistics which emphasized on logistics system driven by IT and usage of the state of the art IT tools for logistics excellence and effectiveness.

[14] (1995) provided an integrated distribution network system for improvement of firms logistics and distribution systems.

Another study conducted by [3] and Quinn (1986) highlighted the significance of logistics information

systems and explained that by virtue of these types of systems inventory management and flow, transportation, warehousing and customer services can better be managed. They also pointed out the reduction and optimization of logistics cost by using logistics information systems.

[26] (2004) explained that IT budgets in all companies are at a rising trend and will continue in future due to visible gains in supply chain effectiveness by virtue of IT. Another study conducted by [9] (2007) pointed out the fact that e- purchasing software are experiencing a growth rate at an enormous pace and growing in double digits.

[25] and Westbrook (2001) explained supply chain has now become flow of information in a rapid fashion for ensuring flawless material flow.

Another study conducted by [49] et al. (2002) described IT as an enabler of supply chain coordination and integration. They pointed out that tangible benefits could be gained in supply chain forecasting, innovation, new product development, production planning, production scheduling, supply management, vendor management, inventory tracking and inventory reduction by integrating them through IT as an enabler.

[57] and Gupta (1999) identified IT integration has become a popular operational paradigm in supply chain performance improvement. Internet and mobile communication has enhanced the richness of communication and interaction among organizations and consumers. [4] and Hagel (1996) illustrated the online business communities an evolution of supply chain integration.

IT as a tool for collaborative relationship development has enhanced the information sharing capability between firms and suppliers and thus created greater relationship with reduced uncertainty. ([51]

, 200). Another study conducted by [6] and Brynjyoolfsoon (1993) indicates that IT has created cooperative governance structure which brings in the reduction in transactions cost and more synergy in supplier- buyer correspondence. [28] (1999) highlighted that most of the study devised till now comprises of strategies, people, technology and system with a low focus on integration as an enabler of SCM. [50] and Hanna (2000) also highlighted the unavailability and scarcity of empirical evidences on supply chain performance by virtue of integration. As evident from the literature review the integration of SCM through IT is quite significant for effective performance that's why now FMCGs are also focusing on revolutionizing the supply chain management with the help of IT. The core objective is to take out the maximum out of their business performance.

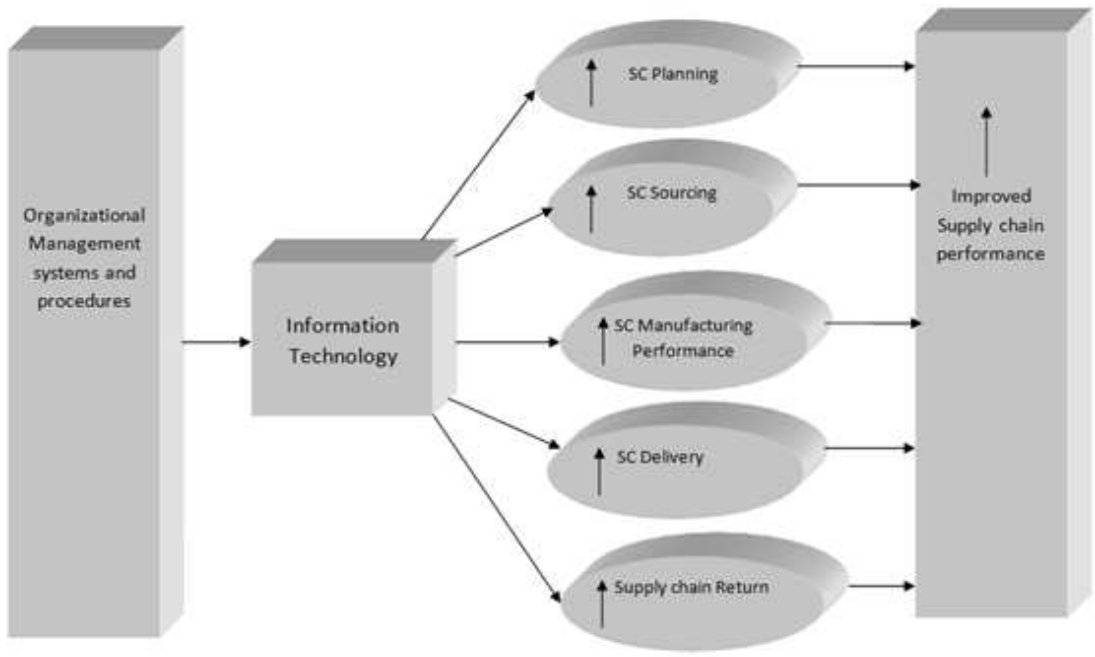
3.1 Conceptual Framework

3.2 Hypothesis

Based on aforementioned researches, studies and concepts, following Hypothesis are formed for investigating and exploring the Impact of IT on Supply chain: A case study of Unilever Pakistan Ltd (The leading FMCG company of Pakistan).

Hypothesis 1

H1: IT is an effective enabler of supply chain planning performance improvement.



Hypothesis 2

H2: IT is an effective enabler of supply chain sourcing performance improvement.

Hypothesis 3

H3: IT is an effective enabler of supply chain manufacturing performance improvement.

Hypothesis 4

H4: IT is an effective enabler of supply chain delivery performance improvement.

Hypothesis 5

H5: IT is an effective enabler of supply chain return performance improvement.

4.0 Data Analysis and presentation

This research is an investigative study to determine the impact of IT as enabler on the performance iThe chart mentioned below is the descriptive analysis of the primary data collected through questionnaire from Unilever Pakistan Ltd. Below chart is the descriptive analysis of the primary data collected through questionnaire. The result indicating that IT has a clear positive effect on supply chain drivers as mean of the supply chain variable is more or less greater than 3.5.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
BP	100	2.00	5.00	4.2600	.71943
ISCM	100	3.00	5.00	4.3200	.60101
Plan	100	3.00	5.00	4.0962	.41910
Source	100	2.00	5.00	3.9405	.55347
Make	164	2.00	5.00	4.0144	.56312
Deliver	100	2.67	5.00	3.6867	.60611
Return	100	1.67	5.00	4.0233	.61303
Valid N (listwise)	100				

Table: 1 (Descriptive statistics)

4.1 Data Reliability:

The reliability statistics also known as coefficient of reliability (alpha) comes out be 0.763 which is quite high as alpha values greater than 0.7 or higher is considered as acceptable. This value of cronbach's alpha narrates that internal consistency of the variables is quite high.

Reliability Statistics

Cronbach's Alpha	N of Items
.763	7

Table: 2 Reliability statistics

4.2 Testing of Hypotheses

As discussed earlier, three hypotheses were derived for determining the relationship of IT on SCOR model or drivers of supply chain in terms of their performance improvement. These drivers include Plan, source, make, deliver and return. IT variable comprises of two main areas which are distinguished as foundation stone of IT in organizations like IT as an embedded part of their business practices and IT initiatives for integration of functions. These are termed as BP and ISCM respectively.

H1: IT is an effective enabler of supply chain planning performance improvement

Statistical Model application for hypothesis (H1) testing

In this hypothesis a model is developed among supply chain planning and BP and ISCM. In this model supply chain planning is dependent variable which is relying and dependent on IT pillars in organizations mentioned as BP and ISCM. Major areas of supply chain planning like demand supply reconciliation, vendor managed inventory (VMI), forecasting and production scheduling was tested that what increase it will bring in over all supply chain planning aforementioned factors by BP and ISCM. Mathematically model is depicted as below:

$$\text{Supply Chain Planning} = \alpha + \beta_1 \text{ BP} + \beta_2 \text{ ISCM}$$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.326[a]	.106	.088	.45174

a. Predictors: (Constant), ISCM, BP

Table: 3 Model Summaries

Here value of R square come out be 0.106 which means that Supply chain planning performance is 10.6 % explained through BP and ISCM which is significant. Adjusted R square value which is the refined and purified value of R square also comes out to be 0.088 which is 8.8% and considered as significant.

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.618	.409		6.408	.000
	BP	.159	.063	.242	2.509	.014
	ISCM	.157	.076	.199	2.069	.041

a. Dependent Variable: Plan

Table: 4 Coefficients

$$\text{Supply Chain Planning} = 2.618 + .159 \text{ BP} + .157 \text{ ISCM}$$

On the basis of the results derived above we can conclude the following regarding H1.

- By keeping other variables constant 1 % increase in BP will increase the supply chain planning performance by 0.159 (15.9%) which is a significant relationship and it means that organization's business practices regarding IT usage is supply chain planning are strongly interlinked with performance improvement of plan driver. Also by keeping other variables constant 1 % increase in ISCM will increase the supply chain planning performance by 0.157 (15.7%) which is again quite significant and it means that integrated supply chain management across all the drivers through IT also contributes in plan driver performance in a strong manner.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.358	2	1.179	5.777	.004[a]
	Residual	19.794	97	.204		
	Total	22.152	99			

a. Predictors: (Constant), ISCM, BP

b. Dependent Variable: Plan

Table: 5 ANOVA

On the basis of ANNOVA analysis which is indicating that overall model is significant (the p-value of F-Test is less than .05) but the model has low correlation and adjusted R-square. Supply chain planning performance improvement is 8.8 % explained through BP and ISCM. The results are representing that IT enabling programs has positive, direct and significant effect on supply chain planning performance improvement. So we might not reject our hypothesis and hence can conclude that IT is an effective enabler of supply chain planning performance improvement.

H2: IT is an effective enabler of supply chain sourcing performance improvement.

Statistical Model application for hypothesis (H2) testing

In this hypothesis a model is developed among supply chain sourcing and BP and ISCM. In this model supply chain sourcing is dependent variable which is relying and dependent on IT pillars in organizations mentioned as BP and ISCM. Major areas of supply chain sourcing like strategic procurement, supply management extension and real time connectivity with supplier was tested that what increase it will bring in overall supply chain sourcing aforementioned factors by BP and ISCM. Mathematically model is depicted as below:

$$\text{Supply Chain Sourcing} = \alpha + \beta_1 \text{ BP} + \beta_2 \text{ ISCM}$$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.372[a]	.139	.121	.51898

a. Predictors: (Constant), ISCM, BP

Here value of R square come out be 0.139 which means that Supply chain sourcing performance is 13.9 % explained through BP and ISCM which is significant. Adjusted R square value which is the refined and purified value of R square also comes out to be 0.121 which is 12.1% and considered as significant.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.181	.469		4.646	.000
	BP	.232	.073	.301	3.186	.002
	ISCM	.179	.087	.194	2.052	.043

a. Dependent Variable: Source

$$\text{Supply Chain Sourcing} = 2.181 + .232 \text{ BP} + .179 \text{ ISCM}$$

- By keeping other variables constant 1 % increase in BP will increase the supply chain sourcing performance by 0.232 (23.2%) which is a significant relationship and it means that organization's business practices regarding IT usage is supply chain sourcing are strongly interlinked with performance improvement of source driver. Also by keeping other variables constant 1 % increase in ISCM will increase the supply chain sourcing performance by 0.179 (17.9%) which is again quite significant and it means that integrated supply chain management across all the drivers through IT also contributes in source driver performance in a strong manner.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.201	2	2.101	7.799	.001[a]
	Residual	26.126	97	.269		
	Total	30.327	99			

a. Predictors: (Constant), ISCM, BP

b. Dependent Variable: Source

On the basis of ANNOVA analysis which is indicating that overall model is significant (the p-value of F-Test is less than .05) but the model has low correlation and adjusted R-square. Supply chain sourcing performance

improvement is 12.01 % explained through BP and ISCM. The results are representing that IT enabling programs has positive, direct and significant effect on supply chain sourcing performance improvement. So we might not reject our hypothesis and hence can conclude that IT is an effective enabler of supply chain sourcing performance improvement.

H3: IT is an effective enabler of supply chain manufacturing performance improvement.

Statistical Model application for hypothesis (H3) testing

In this hypothesis a model is developed among supply chain manufacturing and BP and ISCM. In this model supply chain manufacturing is dependent variable which is relying and dependent on IT pillars in organizations mentioned as BP and ISCM. Major areas of supply chain manufacturing like effective capacity utilization , manufacturing flexibility and cost was tested that what increase it will bring in over all supply chain manufacturing aforementioned factors by BP and ISCM. Mathematically model is depicted as below:

$$\text{Supply Chain Make} = \alpha + \beta_1 \text{ BP} + \beta_2 \text{ ISCM}$$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.318[a]	.1011	.89	.4641

a. Predictors: (Constant), ISCM, BP

Here value of R square come out be 0.101 which means that Supply chain sourcing performance is 10.1 % explained through BP and ISCM which is significant. Adjusted R square value which is the refined and purified value of R square also comes out to be 0.89 which is considered as significant.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.035	.547		7.006	.000
	BP	.064	.085	.076	3.751	.004
	ISCM	.107	.102	.106	2.049	.017

a. Dependent Variable: Make

$$\text{Supply Chain Make} = 3.035 + .064 \text{ BP} + .107 \text{ ISCM}$$

By keeping other variables constant 1 % increase in BP will increase the supply chain manufacturing performance by 0.064 (6.4%) which is a significant relationship and it means that organization's business practices regarding IT usage is supply chain manufacturing are strongly interlinked with performance improvement of make driver. Also by keeping other variables constant 1 % increase in ISCM will increase the supply chain manufacturing performance by 0.107 (10.7%) which is again quite significant and it means that integrated supply chain management across all the drivers through IT also contributes in make driver performance in a strong manner.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.564	2	1.782	5.16	.001
	Residual	33.530	97	.345		
	Total	36.094	99			

a. Predictors: (Constant), ISCM, BP

b. Dependent Variable: Make

On the basis of ANNOVA analysis which is indicating that overall model is significant (the p-value of F-Test is less than .05) but the model has low correlation and adjusted R-square. Supply chain manufacturing performance improvement is 8.9 % explained through BP and ISCM. The results are representing that IT enabling programs has positive, direct and significant effect on supply chain manufacturing performance improvement. So we might not reject our hypothesis and hence can conclude that IT is an effective enabler of supply chain manufacturing performance improvement.

H4: IT is an effective enabler of supply chain delivery performance improvement.

Statistical Model application for hypothesis (H4) testing

In this hypothesis a model is developed among supply chain delivery and BP and ISCM. In this model supply chain delivery is dependent variable which is relying and dependent on IT pillars in organizations mentioned as BP and ISCM. Major areas of supply chain delivery like speed to market, logistics management and logistics cost was tested that what increase it will bring in over all supply chain delivery aforementioned factors by BP and ISCM. Mathematically model is depicted as below:

$$\text{Supply Chain Delivery} = \alpha + \beta_1 \text{ BP} + \beta_2 \text{ ISCM}$$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.384[a]	.147	.112	.48715

a. Predictors: (Constant), BP, ISCM

Here value of R square come out be 0.147 which means that Supply chain sourcing performance is 14.7 % explained through BP and ISCM which is significant. Adjusted R square value which is the refined and purified value of R square also comes out to be 0.112 which is 11.2% and considered as significant.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.189	.531		4.121	.000
	BP	.095	.082	.113	1.156	.251
	ISCM	.253	.099	.251	2.567	.012

a. Dependent Variable: Deliver

Supply Chain Delivery = 2.189 + .095 BP + .253 ISCM

By keeping other variables constant 1 % increase in BP will increase the supply chain delivery performance by 0.095 (9.5%) which is a significant relationship and it means that organization's business practices regarding IT usage is supply chain delivery are strongly interlinked with performance improvement of deliver driver. Also by keeping other variables constant 1 % increase in ISCM will increase the supply chain delivery performance by 0.253 (25.3%) which is again quite significant and it means that integrated supply chain management across all the drivers through IT also contributes in deliver driver performance in a strong manner.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.929	2	1.464	4.248	.017[a]
	Residual	33.441	97	.345		
	Total	36.370	99			

a. Predictors: (Constant), ISCM, BP

b. Dependent Variable: Deliver

On the basis of ANNOVA analysis which is indicating that overall model is significant (the p-value of F-Test is less than .05) but the model has low correlation and adjusted R-square. Supply chain delivery performance improvement is 11.2 % explained through BP and ISCM. The results are representing that IT enabling programs has positive, direct and significant effect on supply chain delivery performance improvement. So we might not reject our hypothesis and hence can conclude that IT is an effective enabler of supply chain delivery performance improvement

H5: IT is an effective enabler of supply chain return performance improvement.

Statistical Model application for hypothesis (H5) testing

In this hypothesis a model is developed among supply chain return and BP and ISCM. In this model supply chain return is dependent variable which is relying and dependent on IT pillars in organizations mentioned as BP and ISCM. Major areas of supply chain delivery like Customer feedback, electronic data interchange link with modern trade and customer complaints traceability was tested that what increase it will bring in over all supply chain return aforementioned factors by BP and ISCM. Mathematically model is depicted as below:

$$\text{Supply Chain Return} = \alpha + \beta_1 \text{ BP} + \beta_2 \text{ ISCM}$$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.414[a]	.171	.142	.39601

a. Predictors: (Constant), ISCM, BP

Here value of R square come out be 0.171 which means that Supply chain sourcing performance is 17.1 % explained through BP and ISCM which is significant. Adjusted R square value which is the refined and purified value of R square also comes out to be 0.142 which is 14.2% and considered as significant.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.777	.559		6.753	.000
	BP	.146	.087	.174	2.532	.006
	ISCM	.212	.104	.311	3.112	.001

a. Dependent Variable: Return

Supply Chain Return = 3.77 + .146 BP + .212 ISCM.

- By keeping other variables constant 1 % increase in BP will increase the supply chain return performance by 0.146 (14.6%) which is a significant relationship and it means that organization's business practices regarding IT usage is supply chain return are strongly interlinked with performance improvement of return driver.
- Also by keeping other variables constant 1 % increase in ISCM will increase the supply chain

return performance by 0.212 (21.2%) which is again quite significant and it means that integrated supply chain management across all the drivers through IT also contributes in return driver performance in a strong manner..

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.118	2	1.559	4.441	.003
	Residual	34.086	97	.351		
	Total	37.204	99			

a. Predictors: (Constant), ISCM, BP

b. Dependent Variable: Return

On the basis of ANNOVA analysis which is indicating that overall model is significant (the p-value of F-Test is less than .05) but the model has low correlation and adjusted R-square. Supply chain return performance improvement is 14.2 % explained through BP and ISCM. The results are representing that IT enabling programs has positive, direct and significant effect on supply chain return performance improvement. So we might not reject our hypothesis and hence can conclude that IT is an effective enabler of supply chain return performance improvement.

4.3 Comparative analysis of secondary data with and without IT

A comparative analysis of secondary data was conducted for determining the performance of supply chain drivers with and without information technology systems and is there any significant difference or impact realized after the implementation of IT systems on supply chain drivers. Following are the areas which were captured for analyzing the performance of the drivers of supply chain with respect to IT.

4.3.1 Forecasting error

In year 1990 forecasting error was standing at 11.34% per annum which was lessen to 9.41% in year 2001 with very little or no involvement of IT systems in supply chain planning. Aforementioned figures are showing a reduction of 13.5% in forecasting error of the company over a decade. However upon analyzing the forecasting error reduction after implementation of IT systems in supply chain planning and forecasting it is showing a drastic reduction of 84.7% in forecasting error which is only due to integration, more data capturing and real time information availability by virtue of IT.

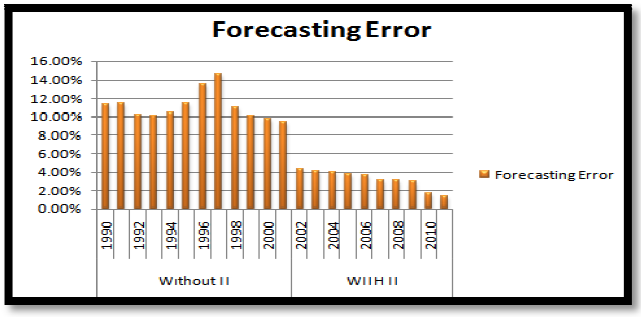


Figure 2: Forecasting error

4.3.2 Effective capacity utilization

In below data effective capacity utilization is an analyzed from 1990 to 2011 with and without IT usage. Data without IT is captured from 1990 to 2001 where as data after implementation of IT is taken from 2002 to 2011 for making a comparison. In year 1990 effective capacity utlization was standing at 63.24% per annum which was increased to 71.04% in year 2001 with very little or no involvement of IT systems in supply chain manufacturing processes. Aforementioned figures are showing an improvement of 12.3% in effective capacity utilization of machines of the company over a decade. However upon analyzing the capacity utilization improvement after implementation of IT systems in supply chain manufacturing processes it is showing a drastic improvement of 26.6% in effective capacity utilization of machine which is only due to integration, real time information availability , less changeovers , production plan accuracy by virtue of IT.

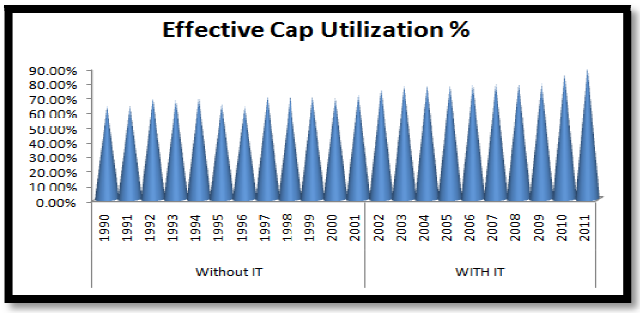


Figure 3: Effective capacity utilization

4.3.3 Plant wastages

In below data plant wastage figures are analyzed from 1990 to 2011 with and without IT usage. Data without IT is captured from 1990 to 2001 where as data after implementation of IT is taken from 2002 to 2011 for making a comparison. In year 1990 plant wastages ware standing at 15% per annum which were reduced to 7.80% in year 2001 with very little or no involvement of IT systems in supply chain manufacturing processes. Aforementioned figures are showing a reduction of 48% in plant wastages of the company over a decade. However upon analyzing the plant wastages reduction after implementation of IT systems in supply chain manufacturing processes it is showing a drastic

improvement of 87.2 % which is only due to integration, real time information availability , less changeovers by virtue of IT.

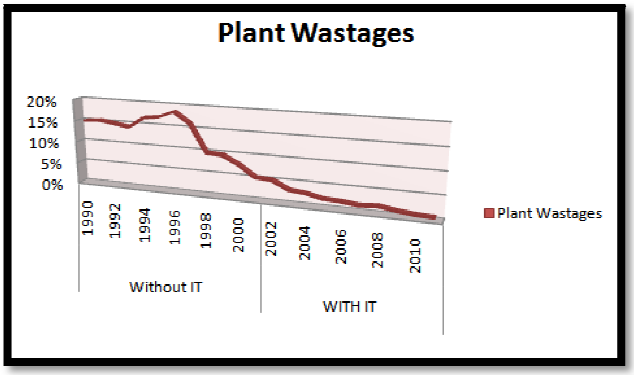


Figure 4: Plant wastages

4.3.4 Customer complaints trend

.In below data customer complaints trends were analyzed from 1990 to 2011 with and without IT usage. Data without IT is captured from 1990 to 2001 where as data after implementation of IT is taken from 2002 to 2011 for making a comparison. In year 1990 customer complaints were standing at a number of 134 per annum which were increased 150 in year 2001 with very little or no involvement of IT systems in supply chain return driver. Aforementioned figures are showing an increase of 11.9 % in customer complaints over a decade. However upon analyzing the customer complaints trend after implementation of IT systems in supply chain return processes it is showing a drastic enhancement of 94.6 % which is only due to integration, awareness among the consumer, availability of portals for interaction with company, online feedback facilities and mobile feedback facilities.

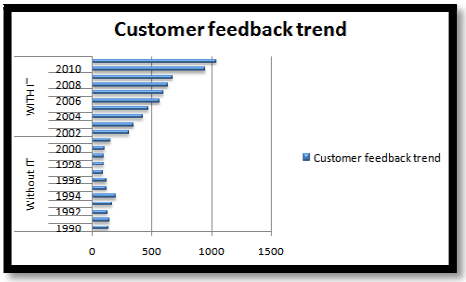


Figure 5: Customer feedback trend

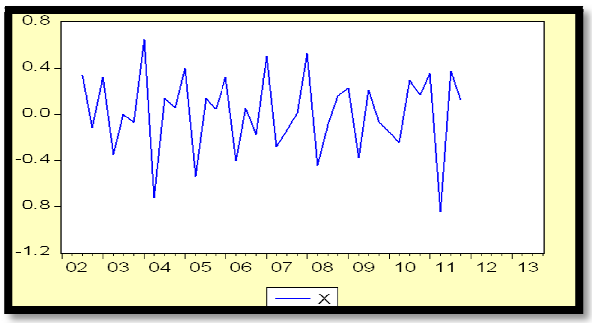
4.4 Forecasting error estimation

Univariate time series data from 2002 to 2011 has been taken from Unilever Pakistan's forecasting error and then Garch (1, 1) model is applied for forecasting the forecasting error of upcoming years. E-views is being used for complete analysis and forecasting of data.

1st Log Difference

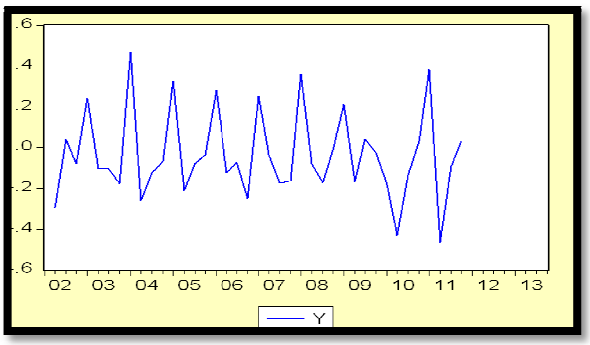
1st log difference of forecasting error of Unilever is weak stationary rather than it is a pure stationary. The series have not the zero mean but variance is more or less constant. So now we take 2nd log difference to check the series for stationary.

Figure 6: 1st log difference



2nd Log Difference

Now the pattern of the series is indicating that the series has constant mean and variance with the passage of time and not changing overall. Therefore the series is stationary and we can further proceed for analysis with this series.



Unit Root Test

Before estimation of Garch models the series must be stationary or unit root. Now we apply **"unit root test"** as a statistical inference to examine series **X (2nd log difference)** as a stationary or not.

Null Hypothesis: X has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.60140	0.0000
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.

Table: 6 Unit root test

4.5 Estimation of GARCH (1, 1) Model

Garch (1, 1) model is applied for forecasting the forecasting error of upcoming years. E-views is being used for complete analysis and forecasting of data. Two very important criteria are used for the selection of ARMA models the Akaike Info Criterion **(AIC)** and Schwarz Criterion **(SIC).** The best fit models have the lowest AIC and SIC.

Estimated GARCH Model: Garch (1, 1)

$$\sigma_t^2 = \omega + \alpha\epsilon_{t-1}^2 + \beta\sigma_{t-1}^2$$

After Substituting Coefficients:

$$\sigma_t^2 = 0.000397 - 0.137580\epsilon_{t-1}^2 - 1.406652\,\sigma_{t-1}^2$$

Model Statistics

Adjusted R-Square: 74.36% , AIC & SIC: Most Negative, P-Value (F-Statistics): .0000

For Complete Model Statistics see Annexure 4.

Graphical results

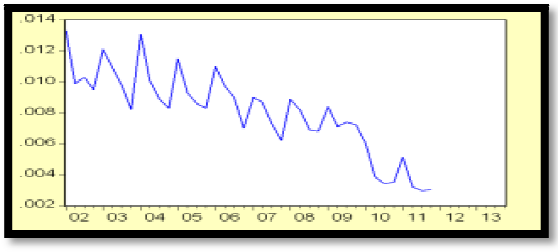


Figure 8: Forecast error

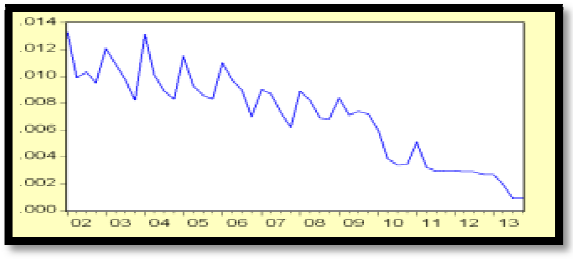


Figure 9: Forecast error predicted

Analysis and Interpretation

On the basis of the results extreacted by application of Garch (1,1) model it is eveident that foreacsting error will further reduce in next two years and will recah to a point near to zero but never gets zero so on the basis of forecasted error for 2013 and 2014 other supply chain funtions can be aligned accordingly. Further what steps needs to be taken in terms of IT infrastrcuture for getting the forecast to this level can also be estimated proactively.

5.0 Results and Discussion

Since IT is revolutionizing the supply chain transformation has been tested both empirically and statistically and it is established that at IT is contributing majorly in performance improvement of supply chain drivers like plan, source, make, deliver and return of FMCG organizations and can also be generalized to other sectors after doing some further research.. All the hypotheses H1, H2, H3 , H4 and H5 pertaining to supply chain planning performance , sourcing performance, manufacturing performance, delivery performance and return performance are statistically tested and proven and IT an effective enabler of supply chain transformation.In aforementioned hypotheses (H1, H2 and H3) Organization's business practices pertaining to IT and new initiatives of IT in supply chain functions are tested against demand supply reconciliation, forecasting error, strategic procurement, supply management extension, plant wastages, effective capacity utilization, logistics management, speed to market and customer feedback and it shows a significant relationship in all of them It is also depicted in the statistical results that forecasting accuracy is a key attributes of supply chain which plays a great deal in supply chain transformation. ANOVA has also proved the significant relationship among IT and supply chain transformation. Comparative analysis of secondary data like forecast accuracy, plant wastages, effective capacity utilization and customer complaints trends also highlighted the transformation in supply chain by comparing the aforementioned factors over a decade with and without IT systems usage. Application of application of Garch (1,1) model it is eveident that foreacsting error will further reduce in next two years and will recah to a point near to zero but never gets zero so on the basis of forecasted error for 2013 and 2014 other supply chain funtions can be aligned accordingly. Further what steps needs to be taken in terms of IT infrastrcuture for getting the forecast to this level can also be estimated proactively.

Forec

6.0 Conclusion

Despite the limitations mentioned in the beginning of the research, this study on Unilever Pakistan Ltd provides several important contributions to the literature. Notably, it clarifies the relationship between the IT and supply chain transformation and determines the complementary variables whose synergistic effect enhances this relationship. The study findings conclude the significance of IT in supply chain drivers is increasing on daily basis and information technology, integrated business processes, real time information availability , interconnectivity with customers and cumulative forecasting planning and replenishment with integrated supply chain management is the need of upcoming days for getting an edge in supply chain transformation and management. SCOR model drivers can better be handled in terms of cost and effectiveness by integrating them through information technology systems. QM practices. Significant evidences are also available now for considering information technology as an important area for firm's supply chain improvement. Thus study findings provide relatively robust support for the aggressive adoption of IT systems in FMCG sector for continued focus on supply chain transformation. Further forecasting is a key parameter to control as its accuracy will result in improvement of overall supply chain management and is a key factor in supply chain transformation management. Hence IT backed organizations are improved in terms of effective supply chain management by having proper strategic fit between IT and the other complementing variables like SCOR model drivers which is the essence of this study and proved empirically too.

7.0 Recommendations

- ✓ Clear vision regarding information technology usage in company with top management commitment should be defined since the beginning for more focus on business performance improvement especially in supply chain.
- ✓ Organizations should focus on IT systems usage enhancement in supply chain processes for better forecast accuracy and overall supply chain performance improvement.
- ✓ Organizations should embedded information systems in manufacturing processes for reduction in plant wastages and effective capacity utilization.
- ✓ Organizations must evaluate the need of IT systems for better interconnectivity with consumers.
- ✓ Better usage of information technology systems can bring supply chain transformation and cost efficiency in organizations.

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Annexure 2

Dependent Variable: D(DLOG(ERROR))
Method: Least Squares
Date: 04/14/12 Time: 00:29
Sample (adjusted): 2002Q4 2011Q4
Included observations: 37 after adjustments
Convergence achieved after 104 iterations
Backcast: OFF (Roots of MA process too large)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000397	0.008295	0.047841	0.9621
AR(1)	-0.137580	0.111506	-1.233839	0.2257
MA(1)	-1.406652	0.299504	-4.696612	0.0000

R-squared	0.757880	Mean dependent var	-0.000253
Adjusted R-squared	0.743638	S.D. dependent var	0.344833
S.E. of regression	0.174597	Akaike info criterion	-0.575072
Sum squared resid	1.036455	Schwarz criterion	-0.444457
Log likelihood	13.63884	F-statistic	53.21313
Durbin-Watson stat	2.452419	Prob(F-statistic)	0.000000

Inverted AR Roots	-.14
Inverted MA Roots	1.41
	Estimated MA process is noninvertible