An empirical model relating Supply Chain Sourcing performance, Making performance and Delivery performance to Company Performance

*Satish M **Dr Vivek.N

ABSTRACT

In today's complex Business scenario, success to an organization is not easy. Every company works hard to better their products and make their supply chain more efficient and effective. R&D is about creativity and being innovative, to bring unique value propositions and solutions to the customers. There is very little that can be done to control it. Whereas, the area of Supply chain is one that can be tweaked to deliver performance, starting from providing the best in class service to customers to be able to push the profits up.

This research paper is an initiative to establish a relationship between the components of Supply chain, namely Plan, Source, Make, Deliver and the overall Company Performance. A random set of 54 firms from Chennai have been studied with an objective to find a relationship between the components of Supply chain and the company performance. These firms were administered a structured questionnaire containing pre validated scales to measure the Supply chain components and relative performance of these organizations.

After the data was collected, the scales were purified using Loading values and Composite reliability. The resultant purified scales were then tested for convergent validity using PLS path modeling software (Visual PLS). Once the constructs were both reliable and valid, the impact of supply chain components on company performance was tested using bootstrapping method. The result shows that there is a significant correlation between the Sourcing, Delivery functions of the Supply chain and the company performance. The making function does not seem to have a significant impact on the company performance.

Introduction

Supply Chain Management

In the competitive world, Success in a marketplace requires that companies, regardless of size, offer products or services that customers' value(Fawcett, Allred, Magnan, & Ogden, 2009). This means that one has to work with limited resources to achieve the organizational objectives. These resources are slowly drifting from just assets like Investments to their value creation processes says (III & McCormack, 2004). He further goes on to say that processes are becoming the organizations assets. Supply chain is defined as the process of adding value to a product and ensuring that the same reaches the destined user in the most efficient way(Janvier-James, 2011). Taking the same a step forward is the process of ensuring that the components of supply chain namely Plan, Source, Make and Deliver are well manages is summarized as Supply chain management.

* Technical Marketing Manager, National Instruments, India. Email : satchat@gmail.com

** Associate Professor, PSG Institute of Management, Coimbatore, India, Email : vishwadatta@gmail.com

Supply chain management from a frustrating set of processes is now looked at as a way to engage with Customers and suppliers. As an organization evolves and climbs the Supply Chain Maturity levels, they build an ecosystem around themselves that help them deliver better products and services to the customer and also engage with their suppliers in a mutually beneficial way. The Supply Chain integration has generated the approach of extended corporate and the supply chain is nowadays manifested as the cooperative supply chain across inter-corporate borders to increase the value across of the whole supply chain(Janvier-James, 2011).

A maturity model measures the readiness and completeness of a system, an organization, an operation or a process. A Supply Chain Maturity Reference Model (SCMRM) can be used to assess the readiness of a supply chain for the adoption of proven supply chain models (e.g. Supply-Chain Council's SCOR). Supply Chain Maturity is defined in four stages based on the status of the existing operations within a company. In SCMRM, four stages of maturity have been defined: initial, managed, integrated and collaborative. A company's supply chain operation may fall into any one of, or between, these stages. Initial Stage refers to the very early stage of supply chain operation where everything is relatively unorganized and not well-structured. The focus of the operation is expediency. Managed Stage refers to the stage of operation where the business owner starts to collect data on operational performance and apply some control over business operation. Integrated Stage refers to the stage of operation where management makes an effort to align and integrate resources to reduce wastage which occurs due to duplicated operations such as redundant data entry or duplication in the preparation of functional reports. Collaborative Stage refers to the stage of operation where management further optimizes the operation by extending its management scope to involve upstream suppliers and downstream customers and then initiating collaborative programs with these trading partners(GS1, 2008).

Company's Competitive performance

A company's competitive performance can be defined in broad terms as the ability to differentiate themselves from competition and the same is achieved through process improvements strategies(McCormack, Ladeira, & Oliveira, 2008). This enables us to now discuss more in detail on the relationship between the Supply chain processes and the actual performance improvement.

With the Supply chain Management evolving, there are proven ways that have been proposed by (Netland, Alfnes, & Fauske, 2007). There is a lot of interest that is getting gathered in the area of the effectiveness of Supply chain in impacting the organizational performance. There have been different attempts to establish relationships between, Quality Management and Organizational Performance(Lin, Chow, Madu, Kuei, & Peiyu, 2005), Supplier performance and Organizational Performance(Vivek.N & Ravindran.Sudharani, 2009),(Tan, Vijay, & Robert, 1998),(Barney, 2012) Strategy-flexibility and performance(Fantazy, Kumar, & Kumar, 2009)

Supply Chain Planning Performance

Plan is the first and foremost component of the SCM process. Planning enables one to have a look at historical trends and anticipated market conditions and make an actionable set of items that can be executed. At different levels of maturity of the SCM processes, at the first level, the firm focuses on its functional processes, in the second level attention is given to the logistical gains, at the third level, planning involves tuning of inter-organizational processes, at the fourth level plans are based on collaborative initiatives, at the fifth or final level, Planning involves all the agents involved in the Supply chain process.(Oliveira, Ladeira, & McCormack, 2011). A well made plan is no good unless executed well, this leads us into the execution part of the SCM process that consists of Source, Make and Deliver.

Supply Chain Sourcing Performance

Sourcing, generally known as 'procurement' or 'purchasing', is about the acquisition of products from suppliers, which involves purchase order processing, logistics arrangement, goods receipt and warehouse put away(GS1, 2008). Sourcing plays a vital role in the success of the organization as the same involves Scheduling deliveries from Vendors, build custom engineering products, assess business and supplier performance, manage inventory and assets.(Phelps, 2006). Hence Sourcing by all means is a strong contender for the top factors driving the Organizational Performance. Purchasing and supplier management is important to managerial accounting and supply chain efficiency because purchasing selects suppliers and establishes mutually beneficial relationships with them(Joyce, 2006). An interesting observation by(Vivek.N & D, 2009) is that the supplier performance is directly correlated with the organizational performance.

Supply Chain Making Performance

The Making process involves the Scheduling of production activities, issuing of products, production and testing, packaging and release of product to deliver. Also finalize the engineering for engineer-to-order products, Managing rules, performance, data, in-process products (WIP), equipment and facilities, transportation, production network, and regulatory compliance for production.(Phelps, 2006)

Supply Chain Delivery Performance

Delivery includes, all order management steps from processing customer inquiries and quotes to routing shipments and selecting carriers. Warehouse Management including but not limited to receiving and picking product to load and ship product. Receiving and verifying product at customer site and installing, if necessary. Invoicing customer, Managing performance, information, finished product inventories, capital assets, transportation, product life cycle, and import/export compliance(Phelps, 2006). Delivery of finished goods and services fulfill the demand(Vanany, Suwignjo, & Yulianto, 2005). Delivery performance is one of the important metrics that have been incorporated in measuring the maturity of the SCM processes based on the SCOR model.(Wong & Wong, 2008). There have been exploratory studies done on the complexity of Supply chain and the delivery performance.(Vachon & Klassen, 2002).

Theoretical Framework and Hypothesis

The Supply chain process has gained popularity as it helps organizations perform better. Within the framework of the SCM, the different functions such as Plan, Source, Make and Deliver have different impacts on the Competitive performance of the company, the objective is to understand the same in detail.

H1: Supply Chain sourcing performance increases the Company's performance also increases

H2: Supply Chain Delivery performance increases the Company's performance also increases

H3: Supply Chain Make performance has no impact on the Company's performance also increases.

Data collection methodology and instrument administered

The instrument consisted of four constructs Source, Make, Deliver and Company's competitive performance. These constructs were measured using a questionnaire based on an already validated instrument developed by Kevin McCormack(McCormack et al., 2008). A random list of firms in Chennai was targeted and a sample of 54 firms was requested to fill in the questionnaire.

Analysis Methodology

After the data is collected the scales are analyzed to achieve the following objectives- Purification of scales, reliability of scales, unidimentionality of scales and validity of the scales. Purification is done using Loading values and Composite reliability(Nunnally, 1978). Validity and unidimentionality are tested using PLS Path modeling.

Before any type of factor analysis is done (EFA or CFA), it is essential to purify the measuring instruments of variables that do not correlate to the constructs. Purification is carried out by inspecting the Loading values and composite reliability of each variable with respect to the construct to which it belongs. Loading values indicates whether the variable actually belongs to the construct or not. Variables showing scores lower than 0.5 are deleted, unless there is a compelling reason to keep them in the construct(Gilbert A Churchill, 1986).

Reliability of constructs refers to the accuracy with which the constructs repeatedly measure the same phenomenon without much variation. The reliability of each construct in question was examined using Composite reliability values. An reliability score larger than 0.7 is generally acceptable as sufficient accuracy for a construct(Nunnally, 1978). After purifying the constructs one by one, we arrive at purified scales for the constructs, each of which displays sufficient reliability.

Unidimentionality is a common trait exhibited by all the indicator variables of any given construct(McDonald, 1981). Unidimentionality is best measured by Confirmatory Factor Analysis (CFA). A combination of CFA and path analysis is Structural Equation Modeling. This is the best method of measuring the unidimentionality of any construct. In this research we will use structural equation modeling to test the unidimentionality of the constructs. There are two approaches to structural equation modeling-Covariance methods and PLS path modeling. Covariance methods make rigid assumptions about the distribution of variables (multivariate normality) and the sample size (at least 200). Another criterion is the degrees of freedom, which means that each construct should have at least three indicators for it to be identified. This makes them unsuitable to use in this research. PLS methods on the other hand are non parametric in nature. They do not make any assumptions about the distribution of the data and the sample size needed is much smaller for model validation and testing (five to ten times the largest number of indicators/construct in the model). The convergent validity of each construct is checked by examining the "Average variance extracted (AVE)" values. Constructs which have AVE values greater than 0.5 are said to have convergent validity or unidimentionality. In some cases values up to 0.4 are also considered if they are central to the model(Chin, Degross, & Marcolin, 1996)

The following section will present the large scale validation results on each of the constructs Source, Make, Deliver and Company's competitive performance. For each construct the instrument assessment methodology described above has been applied.

Measurement results

Supply Chain Sourcing Performance

The Supply chain Sourcing Performance construct was initially represented by 15 variable indicators. The analysis began with purification using Loading values. The loading values corresponding to each variable are shown in table 1. At the end of the purification process 14 variables are left. All except one variable had loading values less than 0.5 and had to be removed. The resulting reliability of the dimension is 0.978211. The unidimentionality of the construct is tested in VisualPLS by considering the AVE value. The AVE value of 0.764303 shows a good convergent validity and hence unidimentionality for the construct.

Table 1: Loading Values – Supply Chain Sourcing Performance

Source	Loading	
Variables	Iteration1	Iteration2
Q2.01	0.7874	0.7874
Q2.02	0.9155	0.9155
Q2.03	0.9439	0.9439
Q2.04	0.954	0.954
Q2.05	0.9052	0.9052
Q2.06	0.7811	0.7811
Q2.07	0.7925	0.7925
Q2.08	0.6204	0.6204
Q2.09	0	—
Q2.1	0.875	0.875
Q2.11	0.9613	0.9613
Q2.12	0.9679	0.9679
Q2.13	0.9148	0.9148
Q2.14	0.8801	0.8801
Q2.15	0.872	0.872
Reliability	0.971793	**0.978211**
AVE	0.713348	**0.764303**

Supply Chain Making Performance

The Supply chain Making Performance construct was initially represented by 14 variable indicators. The analysis began with purification using Loading values. The loading values corresponding to each variable are shown in table 2. The data was clean and none of the variables had to be removed. The resulting reliability of the dimension is 0.970592. The unidimentionality of the construct is tested in VisualPLS by considering the AVE value. The AVE value of 0.675241 shows a good convergent validity and hence unidimentionality for the construct.

Supply Chain Deliver Performance

The Supply chain Deliver Performance construct was initially represented by 31 variable indicators. The analysis began with purification using Loading values. The loading values corresponding to each variable are shown in table 3. At the end of the purification process 26 variables are left. All except five variables had loading values less than 0.5 and had to be removed. The resulting reliability of the dimension is 0.968844. The unidimentionality of the construct is tested in VisualPLS by considering the AVE value. The AVE value of 0.548781 shows a good convergent validity and hence unidimentionality for the construct.

Table 2: Loading Values -
Supply Chain Making Performance

Make Variable	Loading Iteration
Q3.01	0.9139
Q3.02	0.9139
Q3.03	0.9139
Q3.04	0.9029
Q3.05	0.6576
Q3.06	0.8408
Q3.07	0.8095
Q3.08	0.8215
Q3.09	0.8434
Q3.1	0.8025
Q3.11	0.7765
Q3.12	0.7336
Q3.13	0.7543
Q3.14	0.7542
Reliability	**0.970592**
AVE	**0.675241**

Table 3: Loading Values – Supply Chain Deliver Performance

Deliver Variable	Loading				
	Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5
Q4.01	0.7249	0.7245	0.7279	0.7281	0.7321
Q4.02	0.8136	0.8134	0.8114	0.8078	0.8053
Q4.03	0.7731	0.7721	0.7688	0.773	0.7658
Q4.04	0.3952	0.3958	—	—	—
Q4.05	0.5319	0.5327	0.534	0.5376	0.5383
Q4.06	0.1014	0	—	—	—
Q4.07	0.7039	0.703	0.6979	0.7031	0.6941
Q4.08	0.6966	0.6944	0.6974	0.6978	0.6972
Q4.09	0.5148	0.514	0.4938	0.4901	—
Q4.1	0.6943	0.6958	0.6959	0.685	0.6885
Q4.11	0.4567	0.457	0.4505	—	—
Q4.12	0	0	—	—	—
Q4.13	0.8175	0.819	0.8194	0.8133	0.8172
Q4.14	0.8015	0.8003	0.8046	0.8095	0.8126
Q4.15	0.8023	0.802	0.8047	0.8072	0.8076
Q4.16	0.7669	0.7662	0.76	0.7567	0.7478
Q4.17	0.7042	0.7026	0.7043	0.7069	0.7059
Q4.18	0.7624	0.762	0.7661	0.7709	0.7756
Q4.19	0.6781	0.6794	0.6766	0.67	0.6716
Q4.2	0.7151	0.7161	0.7207	0.7256	0.7333
Q4.21	0.789	0.7867	0.7926	0.796	0.7983
Q4.22	0.6944	0.6932	0.6938	0.6896	0.6884
Q4.23	0.6429	0.6429	0.6435	0.6488	0.6485
Q4.24	0.6415	0.6438	0.641	0.6337	0.6351
Q4.25	0.673	0.672	0.6734	0.6709	0.6701
Q4.26	0.5102	0.5098	0.5154	0.5218	0.5207
Q4.27	0.6539	0.6552	0.6593	0.6662	0.6711
Q4.28	0.7629	0.7645	0.7685	0.7709	0.7747
Q4.29	0.923	0.9241	0.925	0.9255	0.926
Q4.3	0.8707	0.8719	0.873	0.8758	0.8758
Q4.31	0.905	0.9055	0.9039	0.9	0.8986
Reliabilility	0.96305	0.96714	0.967862	0.968419	**0.968844**
AVE	0.478813	0.511502	0.524527	0.536876	**0.548781**

Company's competitive Performance

The company's competitive Performance construct was initially represented by 9 variable indicators. The analysis began with purification using Loading values. The loading values corresponding to each variable are shown in table 4. At the end of the purification process 8 variables are left. All except one variable had loading values less than 0.5 and had to be removed. The resulting reliability of the dimension is 0.929602. The unidimentionality of the construct is tested in VisualPLS by considering the AVE value. The AVE value of 0.626606 shows a good convergent validity and hence unidimentionality for the construct.

Table 4: Loading Values – Company's Competitive Performance

Company Competitive performance Variables	Loading	
	Iteration 1	Iteration 2
Q6.01	0.7354	0.7141
Q6.02	0.6627	0.6729
Q6.03	0.9331	0.9403
Q6.04	0.6788	0.69
Q6.05	0.8694	0.8783
Q6.06	0.3025	—
Q6.07	0.7213	0.7107
Q6.08	0.7701	0.7604
Q6.09	0.9028	0.9139
Reliability	0.917018	**0.929602**
AVE	0.565211	**0.626606**

Causal Model and Hypothesis Test

A causal effect of environmental uncertainty on the supply chain integration of the firms is tested using Visual PLS path modeling software. A rigorous test of the significance of various proposed relations can be tested using the bootstrap function in Visual PLS. PLS path modeling is a non parametric method, and as such cannot be used for performing a t-test. But it is possible to use resampling methods (bootstrap and jack knife) to obtain the significance of the various paths in the model. Bootstrap is more reliable in estimating the significance of paths(Chin et al., 1996). So this research has considered and used bootstrap for the purpose of determining causal relations proposed in the model. In boot strap used in this research, random samples sized 54 (the respondent number) were taken, and 500 such samples were taken (to get best estimates a resample number of 500 is recommended although in theory an infinite resample is needed for the purpose). The Results were examined for significance. At 5% level of significance the cutoff t-statistic is 1.96. In general we assume that if the t-statistic is more than 2, the path is significant.

H1: Supply Chain sourcing performance increases the Company's competitive performance also increases

This Hypothesis is validated and is highly significant with beta = 0.532, t = 3.040 as shown in Fig 1

H2: Supply Chain Delivery performance increases the Company's competitive performance also increases

This Hypothesis is validated and is highly significant with beta = 0.364, t = 3.183 as shown in Fig 1

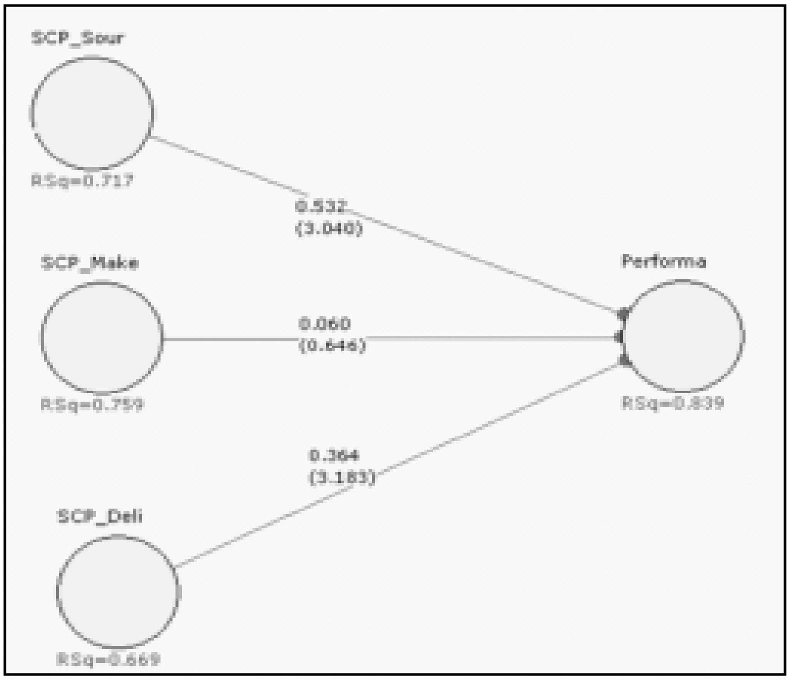

Figure 1: Model

H3: Supply Chain Make performance has no impact on the Company's competitive performance also increases

This Hypothesis is validated and is not highly significant with beta = 0.060, t = 0.646 as shown in Fig1

Implications and Summary

The competitive performance of the organization is directly dependant on the Supply chain Sourcing and Delivery performance. The Making function helps internal improvisation but directly does not impact the Company's performance. This data can help Companies focus on these functions of supplychain and better the performance in these areas. During the tough times in the market, the study results will enable decision-makers to take an informed decision on the areas to focus.

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