

Research paper:

Supply Chain ToolCube

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Supply chain integrates a firm in holistic way that it can work with skeletons of a business and works towards sustainable cost reductions and increased profit.

Supply chain can be seen as a group of organizations, or a complex process carried out by the cooperating companies (Gelei, 2010). Sometimes these two interpretations are blended within one definition. The first group of supply chain definitions is interpreted as a **group of organisations** which are built up from the joint value creating activities of different organisations. Supply chain is a set of companies among which the product and service flows during the production process. “Normally several independent firms are involved in manufacturing a product and placing it in the hands of the end user in a supply chain” – raw material and component producers, product assemblers, wholesalers, retailers and transportation companies, are all members of a supply chain (LaloNde and Masters, 1994). Those players can be regarded as part of a supply chain that cooperates in the processes of purchasing, product and service production and delivery to the end user (Harland, 1996). Supply chain can be defined as a group of companies, which cooperate in delivering products or services to the market (LaMbert et al., 1998). The supply chain can be interpreted as a parent company surrounded by its subsidiaries sharing different tasks of materials flow. This kind of supply chain will be regarded as an *internal supply chain* in the following (Gelei, 2009).

The second interpretation of a supply chain is the process-based view (Gelei, 2009). In this approach, it is still correct that supply chains consist of more members, but the focus of the interpretation is on the process and its optimisation. This concept emphasises the role of the value creating process along which companies join to serve the end user as much as possible. Consequently, a supply chain may involve all players who add value, such as suppliers of raw materials or components, manufacturers, final product assemblers, packaging, transportation, warehousing and logistics service providers (DawaNde et al., 2006). Supply chains are usually organised around a *focal company* which is the initiator of supply chain thinking and coordinated operation (Gelei, 2003a).

SCM can be regarded as a management philosophy which helps to coordinate supply channels from suppliers to end consumers (Cooper et al., 1997). The goal of supply chain management is to harmonise customer expectations, and suppliers’ materials flow to help find equilibrium between those substantially controversial aims like high level of customer service and low level of inventory and unit cost (SteveNs, 1989).

“Supply chain management is a conscious management of a supply chain in order to enhance the competitiveness of cooperating partners” (Gelei, 2003a. p. 5).

According to Zheng and co-authors (2000), supply chain management is a process of optimising a company's internal practices and improving the interaction with its suppliers and buyers. Zheng's interpretation represents a minority within the literature while focusing on the integration of company's internal processes. Authors – like Mentzer et al. (2001) – who interpret supply chain management as *management philosophy* regards it as an integrated whole not as a set of different activities.

Thus supply chain involves such a lot of core activities of a business decisions that SCM people basically runs the business. Supply chain professionals therefore can be called as knights of a business. According to, Cambridge dictionary, a man given a rank of honour by a British king or queen because of his special achievements,: According to Collins dictionary, a man invested by a sovereign with a nonhereditary rank and dignity usually in recognition of personal services, achievements. Now, we can say knights are the core strategist and leading front line fighter of a kingdom. So as supply chain professionals. Their action defines sustainable business goal achievement in terms of reduced cost and coordination of whole business. They are the key business decision making personnel as knights of a kingdom Also, they are real life business action figure works in the field in line of product, has direct interaction with internal external stakeholders. Therefore, we can name supply chain professionals as **‘Supply chain knights’**. Like all knights, Supply chain knights also has to work with tools. There are lot of tools practiced in SCM arena. But not all are useful. In this study we tend to identify the effective tools. Before going into that. Let's discuss about tools first...

Use of Tools

In today's fast changing economic situation, every company is trying to assess its performances regularly. In order to survive companies are taking steps to expand by accessing new markets; making product and price more attractive; satisfying customers; developing new strategies. Thus, managers and executives of the companies looking for a suitable tools and techniques in order to investigate the internal and external cost of the products/service, get market information, product costs, analyse customer needs and wishes, predict and assess organizational performance, as well to ensure

Some of the studies have argued that utilization of management tools and techniques influences organizational performance (Iseri Say et. al, 2008; Al-Khadash & Feridun, 2006; Indiaty et. al, 2014). While other studies concluded that there were no clear relationship between management tools and techniques and organizational performance (Rigby, 1994, Friedl & Biloslavo, 2009; Efendioglu & Karabulut, 2010). Thus, in the literature there is very little empirical support to justify this relationship. For example, Rigby (1994) reflected the effect of management tools on performance by considering five performance categories (financial results, organizational integrity, performance capability, customer equity and competitive advantage). Al-Khadash and Feridun (2006) discovered a significant relationship between the level of utilization strategic tools (such as ABC, JIT, and TQM) and financial performance of 56 industrial companies in Jordan (measured by return on assets).

A study by Iseri-Say et al. (2008) is focused on the issue how the adoption of management tools (the study considered the group of 25 tools) influences organizational performance. Their findings show a significant positive relationship between competitive positioning, organizational integrity, performance capabilities, customer equity, financial results and adoption of management tools and techniques. There are also other empirical findings which examine the effect of tools utilization on performance. For example, Friedl and Biloslavo (2009) concluded that there is no strong connection between sixteen and financial performance (net profit, return on equity, the financial independence,

equity-to-debt ratio and the added value per employee among). However, they found that only two of sixteen management tools were connected with performance. Another performance related issue is presented by Efendioglu and Karabulut (2010). They looked into the effect of most commonly used management tools on the financial performance (average sales growth per year, average profit per year, and average export growth rate per year). The effects of this relationship have been found "somewhat unanswered". Indiaty et al (2014) investigated how the application of Porter's five forces influences organizational performance in Kenyan banking industry. They found a strong positive relationship. It should be noted that the utilization of different techniques helps managers to improve various organizational outcomes, such as market share, revenue growth, and overall revenues. For example, Abdul Hussien and Hamza (2012) noted that strategic management accounting techniques (such as activity-based costing, value chain analysis, benchmarking, balance scorecard etc.) are "reducing costs, improving product quality, and performance evaluation". Several researches concluded that higher customer satisfaction and loyalty lead to better revenue, profitability and cash-flows (Heskett et al., 1994, Ittner & Larcker, 1998; Williams & Naumann, 2011).

Tools and techniques used in management assist managers and executives in decision-making process. Another tools used in marketing management process are responsible for identifying and satisfying customer needs. Tools and techniques involved in operations management aim to ensure competitive advantage in production, distribution and project management activities. The financial management area involves tools which provide the basis for decision-making for finance and predicting the performance of the company. Therefore, management tools and techniques are powerful lever which can help managers to define and develop proposed solution to the existing problems inside the organization.

Manager, specially supply chain managers who realizes functions of management needs proper tools. Literature often presents such terms as managers' skills, roles, predispositions and functions (Antoszkiewicz J. D, Pawlak Z ,2000). The managerial tool sometimes is treated as a technique. Therefore this is perceived, on one hand, as a research tool, a physical or mathematic model, and on the other hand as a way of using the instrument (Mikołajczyk, 1998) However, from the lexical point of view it seems all the terms above do not include a material aspect of things necessary to manage the organisation. To fill this gap it is necessary to define a term of a management tool that will mean a simple or compound instrument enabling working by managers (Szymczak M, 1979). We assume that the instrument can be in a real form (a.e. a paper sheet, work cards, tables) or in virtual one (a.e. a software, data bases saved on the computer). Using a management tool the manager can use some technique, so we can call the management tool an aimed, rational and based on the theory a way of doing the managers' work (Penc, 1997):. Therefore a management tool is detached from a manager, his/her predispositions and skills of using techniques and methods of management. A management tool is an algorithmic and efficient way of accomplishing management functions, possible to use by any manager.

The management tools used in the research have such features:

- they split a process of management into small parts (according to the idea of an „unit of behaviour” (Curtis B, Kellner M, Over J, 1992):, a result of using management tools is an object that is an effect of a management process (Flak, 2013):, is useful for management process documentation (as a resource according to the fact theory (Flak, 2013):.
- a possibility of registering organisational resources as results of processes conducted within the organisation (Glykas, 2011),
- a possibility of analysing information on processes and resources together, recorded in a management tool (Curtis B, Kellner M, Over J, 1992):.

The system of organizational terms was a basis of two management tools used in the research: a goaler (for setting goals) and a tasker (for describing tasks), which were used in the experiment. In the same time these tools were used in the experiment as research tools which recorded

the participants' actions. The concept of the tools was described in the previous publications of the authors, but their short characteristic was presented below.

The tools consists of similar forms which are aimed on collecting data about planned actions. There is a strong division between both tools. The goaler is to put down goals of actions. A goal is meant as a solid state of a part of the world which is aimed to be achieved (Skalik, 2009):. The tasker was projected to record real processes which are to be started to achieve goals. A process is described as a sequence of intended events which leads to the defined state of the world (Grajewski, 2007):.

Tools used in Supply chain

In the last decades several famous supply chain management techniques have evolved for managing distribution processes such as Efficient Customer Response in FMCG sector (Bhutta et al., 2002; Harris and Swatman, 1997), Quick Response in fashion industry (Al-Zubaidi and Tyler, 2003; Birtwistle et al., 2003; Fernie and azuma, 2004) and CPFR in various industries (skjøtt-larsen et al., 2003; Fliedner, 2003). Judit Nagy (2010), studied different and mentioned different tools specially on Logistics focused tools. Cox A., Lonsdale C., Sanderson J., Watson G. (2005) worked and identifis on different production and operations tools. Christian et all. (2009) identified different tools for Procurement and Purchasing management.

Based on Literature review, we have identified 16 areas and below mentioned tools used in different areas of supply chain

Supply Chain Planning: Make or Buy analysis, MRP, CPFR (skjøtt-larsen et al., 2003; Fliedner, 2003). Production management: Productivity analysis, Pereto, Cause and effect, Control chart (Cox et all. ,2005) Operations management: TQM, JIT, Kaizen, Lean, (Cox et all. ,2005) Procurement management: Bid and Spend *Tools*, *Core cost analysis*, *Tender process* Christian et all. (2009) ,Purchasing management: Supplier market intelligence, Vendor Evaluation Christian et all. (2009) Commercial management: Letter of credit, Knowledge of Regulations (Butta et al., 2002; Harris and swatman, 1997), Shipping management: Freight scheduling, Freight costing, (Cox et all. ,2005) Logistics Management: Order Processing Tools, Facility Layout knowledge, (Cox et all. ,2005), Transportation: Vehicle routing planning, Scheduling (Vörösmarty, 2000, Gordon, 2005) Materials Management: Capacity Planning, Risk Management, Value chain reconfiguration, Virtual inventory management, Vendor Managed Inventory(Cox et all. ,2005) Warehouse/Inventory management: 5S, FIFO, LIFO, EOQ (Cox et all. ,2005), Distribution Management: Gravity Method, Location analysis, Political analysis (al-Zubaidi and tyler, 2003; birtwistle et al., 2003; FerNie and aZuMa, 2004) Demand Management: S&OP, Demand Forecasting (beNsaou, 1999), (Nagy, 2010). Lee (2000), Cigolini et al. (2004) Coordination & Information Management: Direct contact, ERP Lamming et al., 2001). (Gelei, 2008), Varma et al. (2006) Project Management: CPM, PERT, Earned value analysis, Cost Analysis, (MisHra and ragHuNatHaN, 2004). (tHayer, 1991). Gelei (2003), Gümüs and Bookbinder, 2004; Schaffer, 2000) Supply Chain Leadership: Contingency, Situational leadership, Autocratic leadership ((Harris and swatMaN, 1997; Vörösmarty (2000), Gordon (2005)

Demographic Information of the Respondents

This study conducted study on 103 Supply chain Professionals in Bangladesh specially BISCMBangladesh Institute of Supply chain Management members. Among the respondents, 86.80% of the respondents were male and 13.20% were female.

Research Format with the respondents:

Given along with the tools as an example in each area, respondents were asked whether those tools are useful or important or not. Also they were asked for any additional tools they think are currently practiced and effective or not.

After survey we found more tools in each area are useful in the industry. Even One person's suggested tool was found in another person's suggestion. Those suggested tools were included in the survey questionnaire for responded on those tools and to be included in statistical analysis

We found below mentioned additional tools from the survey:

In Supply Chain Planning we found S&OP, Value chain reconfiguration as suggested tool . In Operations management- Material reconciliation, MPS, Machine utilization. In Procurement management- TCO, Comparative study, In Purchasing management- Comparative study, Supplier visit, Supplier Personnel meeting, In Commercial management- Trade payments, Incoterms, UCPDC-600, VAT regulations, HS code, Currency knowledge. In Shipping management- Freight costing, Cross Docking. In Logistics Management- Logistics equipment knowledge, Postponent, In Transportation Shortest Path method, Transport, Asset handling. In Materials Management: Material & Receiving report. In Warehouse/Inventory management: Kaizen, Record Management, Inventory Counting, Distribution Management: Geographical knowledge, Cross Docking, DRP, Network Management tool Demand Management: Supply Chain Analytics, Reports. Coordination & Information Management: In ERP, Programming Supply chain, Interpersonal communication, Negotiation. In Project Management: Scheduling, In Supply Chain Leadership: Participative leadership, KPI tools as suggested tool

As such, this study intends to reveal the issues related to the industrial goods procuring decision making process. This covers factors influencing supplier selection, the influencing factors within and outside the organization. In other words, This research intends to achieve the following research objectives:

1. To examine the Areas influencing the Supply chain management area
2. To understand the effective tools of different supply chain areas
3. To determine the tools supply chain professionals could focus more to achieve efficiency.

Hypothesis Development

H1: "Supply Chain Planning, Production management, Operations management, Procurement management, Purchasing management, Commercial management, Shipping management, Logistics Management, Transportation, Materials Management, Warehouse/Inventory management:, Distribution Management, Demand Management, Coordination & Information Management, Project Management Supply Chain Leadership" decisions tools has significant effect on Supply chain Management as a whole H2: "Make or Buy analysis, MRP, CPFR, S&OP" has significant relation for Supply Chain Planning: decision. H3: "Productivity analysis, Pereto, Cause and effect, Control chart" has significant relation with Production management decision. H4: "TQM, JIT, Kaizen, Lean, Material reconciliation, MPS, Machine utilizationTQM, JIT, Kaizen, Lean, Material reconciliation, MPS, Machine utilization " has significant relation for **Operations management:**. H5: TCO, Comparative study, Bid and Spend *Tools, Core cost analysis, Tender process, Bid and Spend Tools, Material Price Variance* has significant relation for **Procurement management:** H6: Comparative study, Supplier market intelligence, Supplier visit, Vendor Evaluation, Supplier Personnel meeting has significant relation for **Purchasing management:** H7: Letter of credit, Knowledge of Regulations, Trade payments, Incoterms, UCPDC-600, VAT regulations, HS code, Currency knowledge has significant relation for **Commercial management:** H8: Shipping Status **Tools**, Freight scheduling, IT tools, Freight costing, Cross Docking has significant relation for **Shipping management:** H9: Order Processing Tools, Facility Layout knowledge, Logistics equipment knowledge, IT tools, Postponent has significant relation for **Logistics Management:** H10: Shortest Path method, Vehicle routing planning, Transport Law, Scheduling, Asset handling has significant relation for **Transportation** H11: Capacity Planning, Risk Management, Value chain reconfiguration, Virtual inventory management,

Material & Receiving report, Vendor Managed Inventory has significant relation for **Materials Management** H12: For example 5S, FIFO, LIFO, EOQ, Kaizen, Record Management, Inventory Counting, has significant relation for **Warehouse/Inventory management** H13: Gravity Method, Location analysis, Political analysis, IT tools, Geographical knowledge, Cross Docking,DRP, Network Management tool has significant relation for **Distribution Management** H14: S&OP, Demand Forecasting, Supply Chain Analytics and Reports has significant relation for **Demand Management:** H15: Direct contact, online communication, spreadsheet Excel, ERP, Programming Supply chain, Interpersonal communication, Negotiation has significant relation for **Coordination & Information Management:** H16: CPM, PERT, Earned value analysis, Scheduling, Cost Analysis has significant relation for **Project Management:** H17: Contingency, Situational leadership, Autocratic leadership, Participative leadership, KPI tools has significant relation for **Supply Chain Leadership:**

Demographic Information of the Respondents

This study conducted study on 204 Supply chain/Procurement employees in Bangladesh. Among the respondents, 82.80% of the respondents were male and 17.20% were female (Table 1)

Descriptive Statistics							
	N	Sum	Mean	Std. Deviation	Variance	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Gender	101	121	1.20	.400	.160	.374	.476
Experience	102	340	3.33	1.137	1.294	-.759	.474
Valid N (listwise)	101						

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.961	.960	111

Questionnaire Design

The structured questionnaire was used in this research to collect information from different organizations in Bangladesh. Responses to all the statements in the questionnaire were measured on a five-point scale ranging from 1 to 5 with 1 indicating strongly disagree and 5 indicating "Every time" choice, eventually 4="Most of

the time", 3= "Average times", 2= "Sometimes", 1 indicating "Never" choice in terms certain procurement scenario. One of the relative advantages of using this scale is its suitability for the applications of multifarious statistical tools used in marketing and social research study (Malhotra, 1999). The collected data were statistically processed subsequently to get useful information. The reliability statistics show that the internal consistency of the questionnaire is under the acceptable limit. The reliability statistics are at the acceptable level.

Data Collection & Analysis

Data were collected from both primary and secondary sources. Primary data were used for the purpose of analyzing the effect of work stress on the performance of readymade garment workers in Bangladesh. The survey was conducted among the 104 supply chain/procurement professional from 140 organizations of Bangladesh. The survey was conducted in 2019. The interviewers were properly trained on the items included in the questionnaire for data collection before commencing the interview. Along with descriptive statistics, inferential statistical techniques such as, Factor Analysis and Multiple Regression Analysis were used to analyze the data.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.694
Approx. Chi-Square		1114.565
Bartlett's Test of Sphericity	df	190
	Sig.	.000

A Principal Component Analysis (PCA) with an Orthogonal Rotation (Varimax) using the SPSS (Statistical Package for Social Sciences) was performed on the survey data. Multiple Regression Analysis such as, Multiple Regression was conducted by using SPSS to identify the relationships between the dependent and independent variables and the significant factors. The execution of this study took a lot of time and effort to prepare this research paper. Specially, the survey section was very difficult to execute. Procurement employees are very busy people and with close deadlines and massive workloads. It was also difficult to manage them to participate and respond to the survey.

Results and Discussions

This section of the study includes the analysis of the results of factor analysis and multiple regression analysis.

Results of Factor Analysis

Factor analysis show that all the communalities of the variables are very high indicating that the variables constitutes the stress factors that increases turnover intention among the supply chain employs are related to each other.(Appendix 1)

This study worked with 97 tools of Supply chain. Factors analysis 41 factors within 100 limit. Other factors were also given significant value. But as the study worked with lot of factors and it's a mathematical process, we can be taken into account almost all the tools are significant from 16 areas of supply chain.

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	23.934	21.563	21.563	23.934	21.563	21.563
2	14.618	13.170	34.732	14.618	13.170	34.732
3	7.680	6.919	41.652	7.680	6.919	41.652
4	5.396	4.861	46.513	5.396	4.861	46.513
5	5.015	4.518	51.031	5.015	4.518	51.031
6	4.502	4.056	55.087	4.502	4.056	55.087
7	4.166	3.753	58.840	4.166	3.753	58.840
8	3.764	3.391	62.231	3.764	3.391	62.231
9	3.527	3.178	65.408	3.527	3.178	65.408
10	3.386	3.050	68.459	3.386	3.050	68.459
11	2.932	2.641	71.100	2.932	2.641	71.100
12	2.816	2.537	73.637	2.816	2.537	73.637
13	2.549	2.296	75.933	2.549	2.296	75.933
14	2.310	2.081	78.014	2.310	2.081	78.014
15	2.207	1.988	80.003	2.207	1.988	80.003
16	2.103	1.894	81.897	2.103	1.894	81.897
17	1.915	1.726	83.622	1.915	1.726	83.622
18	1.856	1.672	85.295	1.856	1.672	85.295
19	1.749	1.576	86.870	1.749	1.576	86.870
20	1.670	1.504	88.375	1.670	1.504	88.375
21	1.523	1.372	89.747	1.523	1.372	89.747
22	1.432	1.290	91.037	1.432	1.290	91.037
23	1.316	1.186	92.223	1.316	1.186	92.223
24	1.139	1.026	93.249	1.139	1.026	93.249
25	1.044	.940	94.189	1.044	.940	94.189
26	.848	.764	94.953			

27	.828	.746	95.699		
28	.738	.665	96.364		
29	.645	.581	96.945		
30	.583	.525	97.470		
31	.497	.448	97.918		
32	.494	.445	98.363		
33	.442	.399	98.762		
34	.417	.376	99.138		
35	.291	.262	99.400		
36	.232	.209	99.609		
37	.153	.137	99.747		
38	.138	.125	99.871		
39	.083	.074	99.946		
40	.043	.038	99.984		
41	.018	.016	100.000		

Extraction Method: Principal Component Analysis.

The rotated factors analysis results show that the factors constituted with the variables have higher level of correlations among them. The results show expected factors are matched with each other.

Rotated Factor Matrix

	Factor					
	1	2	3	4	5	6
Supply chain planning	-.014	.727	-.052	.058	-.104	-.092
Supply Chain Planning [Make or Buy analysis]	-.114	-.070	.142	.102	-.010	.947
Supply Chain Planning [MRP]	.105	.124	-.034	.932	.068	.041
Supply Chain Planning [CPFR]	.364	.019	.399	.593	.020	.318
Supply Chain Planning [SnOP/SIOP]	.058	.156	.190	.616	.303	-.004
Supply Chain Planning [Value chain reconfiguration/ Optimization]	.250	-.022	.465	.180	-.062	.287
Procurement	-.046	.990	.024	.121	-.004	-.006
Procurement management [TCO]	.322	.009	.594	-.011	.055	.326
Procurement management [Comparative study]	.440	.027	.152	.361	.162	-.007
Procurement management [Core cost Analysis/Cost Breakdown]	.709	-.031	.180	.142	-.118	-.080
Procurement management [Tender process]	.443	-.064	.290	-.058	.226	.277
Procurement management [Bid and Spend Tools,]	.431	-.207	.292	.115	.377	.160
Procurement management [Material Price Variance]	.309	.044	.503	.041	-.003	-.076
Purchasing	-.062	.930	.066	.071	.074	.030
Purchasing management [Supplier Market Itelligence]	-.043	.015	.597	.423	.237	.103
Purchasing management [Comparative study]	.378	.093	.207	.127	.718	.126
Purchasing management [Core cost Anlysis]	.801	-.027	.001	.035	.186	.013
Purchasing management [Supplier Visit]	.051	-.001	.712	.063	.247	.020
Purchasing management [Supplier Personnel meeting]	.052	-.072	.058	.188	.705	-.080
Purchasing management [Vendor Evaluation]	.571	-.068	.271	.089	.326	-.085

	Factor				
	1	2	3	4	5
Production	.067	-.054	.789	-.091	-.002
Production management [Productivity analysis]	.094	.839	.025	-.003	.063
Production management [Pereto]	.209	.171	-.010	.120	.901
Production management [cause and effect diagram]	.179	.379	-.046	.729	-.061
Production management [Control chart]	-.023	.551	-.133	.211	.145
Oprations	.038	-.029	.889	-.032	-.018

Operations management [TQM]	.566	.365	.266	.149	-.189
Operations management [KAIZEN]	.587	-.032	.132	.037	.140
Operations management [Lean]	.102	.384	-.033	.577	.220
Operations management [JIT]	.549	-.042	-.066	.441	.032
Operations management [Machine Utilization]	.331	.315	-.005	.186	-.028
Operations management [Material Reconciliation]	.725	.134	-.103	.272	.288
Operations management [MPS]	.157	-.031	-.046	.451	-.057
Commercial	-.001	.038	.099	.820	-.045
Commercial management [Letter of credit]	.648	.146	.337	-.104	.028
Commercial management [Knowledge of Regulations]	.510	.315	.318	.212	-.020
Commercial management [Trade payments]	.500	.188	.512	-.103	-.027
Commercial management [Incoterms]	.776	.050	-.050	.041	.291
Commercial management [UCPDC-600]	.275	.406	.471	-.012	.283
Commercial management [VAT regulations]	.690	.138	.107	-.005	-.037
Commercial management [HS Code]	.555	.391	.216	.045	.295
Commercial management [Currency knowledge]	.106	.079	-.026	-.073	.675
Logistics	.002	.056	.012	.799	-.015
Logistics Management [Order Processing Tools: FCFS, STP,EDD]	.045	.167	.443	.086	.311
Logistics Management [Facility Layout knowledge]	.164	.724	.476	.084	.108
Logistics Management [Logistics equipment knowledge]	.287	.705	.253	-.007	-.115
Logistics Management [IT tools]	.125	.822	-.141	.086	.239
Logistics Management [Postponent]	.226	-.001	.844	.147	-.238

	Factor					
	1	2	3	4	5	6
Transportation	-.030	.895	.107	-.019	-.001	.139
Transportation Management [Shortest Path method]	.077	.109	.764	.209	.183	.168
Transportation Management [Vehicle routing planning]	.718	.077	.176	.143	.120	.029
Transportation Management [Transport Law]	.222	-.066	.301	-.056	.096	.107
Transportation Management [Scheduling]	.235	.082	.570	.387	-.005	-.410
Transportation Management [Asset handling]	.012	.091	.142	-.183	-.061	.590
Materials	.016	.894	.013	.000	-.079	.065
Materials Management [Capacity Planning]	.243	.232	.547	.177	.074	.270
Materials Management [Risk Management]	.636	-.054	.396	.030	-.166	-.013
Materials Management [Value chain reconfiguration]	.402	-.073	.259	-.023	.782	-.080
Materials Management [Vendor Managed Inventory]	.397	-.041	.314	.446	-.110	.173
Materials Management [Virtual inventory management]	.304	.038	.098	.329	.331	.156
Materials Management [Material & Receiving report]	.029	-.040	.200	.527	-.093	-.016
Warehouse	-.121	.698	.102	-.025	.035	.013
Warehouse/Inventory management [5S]	.282	.202	.593	.281	.066	.106
Warehouse/Inventory management [FIFO/ LOFO]	.609	.044	.120	.260	.247	.222
Warehouse/Inventory management [EOQ]	.625	-.093	.080	.116	.192	.082
Warehouse/Inventory management [Inventory Counting]	.146	-.018	.062	.874	.227	-.192
Warehouse/Inventory management [Record Management]	.204	.164	.188	.235	.107	.442
Warehouse/Inventory management [Kaizen]	.771	-.125	.117	.010	.127	-.080
Shipping	.128	-.033	.751	.008	.099	.088
Shipping management [Shipping Status Tools]	.343	.248	.093	.576	.078	.126
Shipping management [Freight scheduling]	.263	.595	-.017	.478	.148	.070
Shipping management [Vehicle knowlege]	.197	.671	-.020	.112	.104	.217
Shipping management [IT tools]	-.193	.178	.143	.117	.717	.135
Shipping management [Freight costing]	.186	.323	.026	.759	.233	.050
Shipping management [Cross Docking]	-.095	.566	-.080	.368	.136	.236
Distribution	.047	.033	.977	.069	.025	.045
Distribution Management [Gravity Method]	-.032	.744	.033	.085	.138	.211
Distribution Management [Location analysis]	.468	.513	.036	.180	.003	-.070
Distribution Management [IT tools]	.204	.102	.015	.082	.735	-.021
Distribution Management [Political analysis]	.029	.066	.035	.105	-.031	.643
Distribution Management [Geographical knowledge]	.491	.440	-.061	.018	-.078	.310
Distribution Management [Cross Docking]	.159	.709	.084	.163	.052	-.133
Distribution Management [DRP]	.328	.244	.099	.407	-.169	.086
Distribution Management [Network Management tool]	.528	.278	.030	.097	-.092	-.126

Demand	.000	.042	.878	.031	.011	-.073
Demand Management [S&OP]	.733	.114	.061	.106	.070	.121
	Factor					
	1	2	3	4	5	6
Demand Management [Demand Forecasting]	.764	.070	.125	.142	.14	.032
Demand Management [Supply Chain Analytics]	.787	-.131	.033	.295	.38	.135
Demand Management [Supply Chain Reports]	.559	.053	.007	.142	.18	.224
Demand Management [Geographical knowledge]	.262	.217	.026	.031	.72	.726
Demand Management [Network Management tool]	.764	.172	.011	-.109	.4	-.045
					.16	

Rotated Factor Matrix

	Factor			
	1	2	3	4
Coordination Information	-.036	.973	.103	-.092
Coordination & Information Management [Direct contact]	.217	.206	.720	-.058
Coordination & Information Management [online communication]	.784	-.006	.212	-.130
Coordination & Information Management [spreadsheet Excel]	.486	-.092	.311	-.307
Coordination & Information Management [ERP]	.692	.061	.124	.117
Coordination & Information Management [Programming Supply chain]	.480	.126	.372	.099
Coordination & Information Management [Interpersonal communication]	.645	-.017	.316	-.265
Coordination & Information Management [Negotiation]	.619	.004	.394	-.073
SupplyChainLeader	-.048	.978	.091	-.034
Supply Chain Leadership [Contingency leadership]	.308	.008	.644	.145
Supply Chain Leadership [Situational leadership]	.718	-.071	.026	.293
Supply Chain Leadership [Participative leadership]	.561	-.102	.167	.115
Supply Chain Leadership [Autocratic leadership]	-.062	-.141	-.086	.565
Supply Chain Leadership [KPI tools]	.182	.053	.222	.524
Project	.012	.978	.002	-.049
Project Management [CPM]	.558	.131	-.037	.543
Project Management [PERT]	.153	-.121	.323	.408
Project Management [Earned value analysis]	.063	-.049	.132	.479
Project Management [Sceduling]	.287	-.123	.062	.589
Project Management [Cost Analysis]	.019	.042	.278	.545
Coordination Information	.048	.967	.026	-.104
Coordination & Information Management [Direct contact]	.586	.274	.107	.192
Coordination & Information Management [online communication]	.550	-.033	.597	.235
Coordination & Information Management [spreadsheet Excel]	.688	-.118	.184	.091

Coordination & Information Management [ERP]	.217	.000	.763	.214
Coordination & Information Management [Programming Supply chain]	.283	.118	.515	.260
Coordination & Information Management [Interpersonal communication]	.684	-.048	.371	.036
Coordination & Information Management [Negotiation]	.547	.053	.337	.280

Results of Regression Analysis

Multiple regression analysis was calculated to test Procurement decision based on, Delivery performance, Ease of business Transaction, Reliability of service. A significant regression equation was found (most of the data are 0.4 to 1.94) , $p < .001$ with and R^2 of 0.3 -0.60 . It was found that Costing of Product with Most of the factors are positive and significant value ($p < .001$.) where some factors came negative, therefore we can assume those tools are not significant to related area. Apart from the statistical results, there may be some important tools came negative as respondents may not be familiar or never used the tool before.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.188a	.035	-.015	.59991
2	.195a	.038	-.003	.59799
3	.398a	.159	.090	.47280
4	.263a	.069	.010	.48850
5	.257a	.066	.006	.50809
6	.305a	.093	.013	.50619
7	.265a	.070	.010	.50231
8	.176a	.031	-.019	.59923
9	.301a	.091	.043	.49486
10	.356a	.127	.068	.54097
11	.334a	.112	.053	.58038
12	.190a	.036	-.052	.57881
13	.186a	.035	-.028	.60060
14	.309a	.096	.028	.58508
15	.245a	.060	.009	.59110
16	.223a	.050	-.001	.59273

ANOVA shows that all the tools are significantly related to application by supply chain professionals.

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.256	5	.251	.698	.626b
	Residual	34.190	95	.360		
	Total	35.446	100			
2	Regression	1.338	4	.335	.936	.447b
	Residual	33.972	95	.358		
	Total	35.310	99			
3	Regression	3.627	7	.518	2.318	.033b
	Residual	19.224	86	.224		
	Total	22.851	93			
4	Regression	1.683	6	.281	1.175	.326b
	Residual	22.670	95	.239		
	Total	24.353	101			

5	Regression	1.702	6	.284	1.099	.369b
	Residual	24.008	93	.258		
	Total	25.710	99			
6	Regression	2.393	8	.299	1.167	.327b
	Residual	23.317	91	.256		
	Total	25.710	99			
7	Regression	1.775	6	.296	1.172	.328b
	Residual	23.465	93	.252		
	Total	25.240	99			
8	Regression	1.107	5	.221	.617	.687b
	Residual	34.471	96	.359		
	Total	35.578	101			
9	Regression	2.344	5	.469	1.914	.099b
	Residual	23.509	96	.245		
	Total	25.853	101			
10	Regression	3.788	6	.631	2.157	.055b
	Residual	26.045	89	.293		
	Total	29.833	95			
11	Regression	3.848	6	.641	1.904	.089b
	Residual	30.652	91	.337		
	Total	34.500	97			
12	Regression	1.093	8	.137	.408	.913b
	Residual	29.147	87	.335		
	Total	30.240	95			
13	Regression	1.203	6	.200	.556	.764b
	Residual	33.547	93	.361		
	Total	34.750	99			
14	Regression	3.401	7	.486	1.419	.207b
	Residual	32.178	94	.342		
	Total	35.578	101			
15	Regression	2.059	5	.412	1.179	.326b
	Residual	32.145	92	.349		
	Total	34.204	97			
16	Regression	1.725	5	.345	.982	.433b
	Residual	33.025	94	.351		
	Total	34.750	99			

1. Predictors: (Constant), Supply Chain Planning [Value chain reconfiguration], Supply Chain Planning [S&OP], Supply Chain Planning [Make or Buy analysis], Supply Chain Planning [CPFR], Supply Chain Planning [MRP]
- 2 a. Predictors: (Constant), b. Predictors: Production management [Control chart], Production management [Pereto], Production management [Productivity analysis], Production management [cause and effect diagram]
- 3 a. Predictors: (Constant), b. Predictors: Operations management [MPS], Operations management [Machine Utilization], Operations management [KAIZEN], Operations management [Lean], Operations management [TQM], Operations management [JIT], Operations management [Material Reconciliation]
4. a. Predictors: (Constant), b. Predictors: Procurement management [Material Price Variance], Procurement management [Bid and Spend Tools,], Procurement management [Core cost Anlysis], Procurement management [TCO,], Procurement management [Tender process], Procurement management [Comparative study]
5. a. Predictors: (Constant), b. Predictors:Purchasing management [Vendor Evaluation], Purchasing management [Supplier Market Iteligence], Purchasing management [Supplier Personnel meeting], Purchasing management [Core cost Anlysis], Purchasing management [Supplier Visit], Purchasing management [Comparative study]
- 6 a. Predictors: (Constant), b. Predictors:Commercial management [Currency knowledge], Commercial management [Knowledge of Regulations], Commercial management [VAT regulations], Commercial management [UCPDC-600], Commercial management [Incoterms], Commercial management [Trade payments], Commercial management [HS Code], Commercial management [Letter of credit]
- 7 a. Predictors: (Constant), b. Predictors:Shipping management [Cross Docking], Shipping management [Vehicle knowlege], Shipping management [IT tools], Shipping management [Shipping Status Tools], Shipping management [Freight scheduling], Shipping management [Freight costing]
- 8 a. Predictors: (Constant), b. Predictors:Logistics Management [Postponent], Logistics Management [IT tools], Logistics Management [Order Processing Tools: FCFS, STP,EDD], Logistics Management [Logistics equipment knowledge], Logistics Management [Facility Layout knowledge]
- 9 a. Predictors: (Constant), b. Predictors:Transportation Management [Asset handling], Transportation Management [Vehicle routing planning], Transportation Management [Transport Law], Transportation Management [Shortest Path method], Transportation Management [Scheduling]

- 10 a. Predictors: (Constant), b. Predictors: Materials Management [Material & Receiving report], Materials Management [Value chain reconfiguration], Materials Management [Risk Management], Materials Management [Virtual inventory management], Materials Management [Capacity Planning], Materials Management [Vendor Managed Inventory]
11. a. Predictors: (Constant), b. Predictors: Warehouse/Inventory management [Kaizen], Warehouse/Inventory management [Inventory Counting], Warehouse/Inventory management [Record Management], Warehouse/Inventory management [5S], Warehouse/Inventory management [EOQ], Warehouse/Inventory management [FIFO/ LOFO]
12. a. Predictors: (Constant), Distribution Management [Network Management tool], Distribution Management [IT tools], Distribution Management [Political analysis], Distribution Management [Gravity Method], Distribution Management [DRP], Distribution Management [Geographical knowledge], Distribution Management [Cross Docking], Distribution Management [Location analysis]
13. a. Predictors: (Constant), Demand Management [Network Management tool], Demand Management [Geographical knowledge], Demand Management [Demand Forecasting], Demand Management [Supply Chain Reports], Demand Management [Supply Chain Analytics], Demand Management [S&OP]
- 14 a. Dependent Variable: Coordination Information
b. Predictors: (Constant), Coordination & Information Management [Negotiation], Coordination & Information Management [Programming Supply chain], Coordination & Information Management [Direct contact], Coordination & Information Management [ERP], Coordination & Information Management [spreadsheet Excel], Coordination & Information Management [Interpersonal communication], Coordination & Information Management [online communication]
- 15 a. Dependent Variable: Project
b. Predictors: (Constant), Project Management [Cost Analysis], Project Management [PERT], Project Management [Earned value analysis], Project Management [CPM], Project Management [Scheduling]
- 16 a. Dependent Variable: SupplyChainLeader
b. Predictors: (Constant), Supply Chain Leadership [KPI tools], Supply Chain Leadership [Participative leadership], Supply Chain Leadership [Autocratic leadership], Supply Chain Leadership [Contingency leadership], Supply Chain Leadership [Situational leadership]

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1	(Constant)	4.746	.394	12.048	.000
	Supply Chain Planning [Make or Buy analysis]	-.095	.074	-.146	.201
	Supply Chain Planning [MRP]	.046	.093	.073	.624
	Supply Chain Planning [CPFR]	-.010	.066	-.022	.874
	Supply Chain Planning [SnOP/SIOP]	.048	.091	.073	.601
	Supply Chain Planning [Value Chain, Optimization]	-.022	.081	-.033	.784
2	(Constant)	4.856	.394	12.334	.000
	Production management [Productivity analysis/Time/Method study]	.080	.079	.114	.316
	Production management [Pereto]	.002	.074	.002	.984
	Production management [cause and effect diagram]	-.047	.071	-.076	.508
	Production management [Control chart]	-.107	.077	-.167	.168
3	(Constant)	4.327	.408	10.614	.000
	Operations management [TQM]	.217	.068	.366	.002
	Operations management [KAIZEN]	.125	.077	.193	.107
	Operations management [Lean]	-.017	.063	-.030	.790
	Operations management [JIT]	-.068	.056	-.143	.230
	Operations management [Machine Utilization]	.002	.058	.004	.972
	Operations management [Material Reconciliation]	-.136	.079	-.232	.091
	Operations management [MPS]	-.033	.062	-.058	.594
4	(Constant)	4.866	.320	15.217	.000
	Procurement management [TCO,	.070	.061	.136	.257
	Procurement management [Comparative study]	.083	.066	.151	.216
	Procurement management [Core cost Anlysis]	.016	.059	.030	.781

	Procurement management [Tender process]	-.022	.059	-.045	-.372	.711
	Procurement management [Bid and Spend Tools,]	-.133	.057	-.303	-2.323	.022
	Procurement management [Material Price Variance]	-.048	.066	-.086	-.725	.470
5	(Constant)	4.445	.395		11.255	.000
	Purchasing management [Supplier Market Itelligence]	.053	.089	.074	.592	.555
	Purchasing management [Comparative study]	.186	.095	.278	1.949	.054
	Purchasing management [Core cost Anlysis]	-.035	.068	-.064	-.522	.603
	Purchasing management [Supplier Visit]	.025	.081	.039	.307	.760
	Purchasing management [Supplier Personnel meeting]	-.070	.069	-.127	-1.010	.315
	Purchasing management [Vendor Evaluation]	-.095	.067	-.186	-1.429	.156
6	(Constant)	4.543	.347		13.084	.000
	Commercial management [Letter of credit]	-.056	.079	-.109	-.704	.483
	Commercial management [Knowledge of Regulations]	.204	.076	.360	2.684	.009
	Commercial management [Trade payments]	-.047	.071	-.099	-.668	.506
	Commercial management [Incoterms]	-.018	.112	-.026	-.163	.871
	Commercial management [UCPDC-600]	.004	.062	.009	.070	.944
	Commercial management [VAT regulations]	-.012	.070	-.024	-.175	.862
	Commercial management [HS Code]	-.006	.071	-.012	-.085	.933
	Commercial management [Currency knowledge]	-.024	.061	-.046	-.396	.693
7	(Constant)	4.423	.303		14.579	.000
	Shipping management [Shipping Status Tools]	.129	.078	.243	1.655	.101
	Shipping management [Freight scheduling]	.023	.084	.046	.278	.782
	Shipping management [Vehicle knowlege]	-.023	.058	-.043	-.396	.693
	Shipping management [IT tools]	.083	.050	.187	1.673	.098
	Shipping management [Freight costing]	-.055	.101	-.093	-.544	.588
	Shipping management [Cross Docking]	-.088	.066	-.181	-1.329	.187
8	(Constant)	4.216	.320		13.178	.000
	Logistics Management [Order Processing Tools: FCFS, STP,EDD]	-.001	.066	-.001	-.013	.989
	Logistics Management [Facility Layout knowledge]	.017	.107	.028	.157	.876
	Logistics Management [Logistics equipment knowledge]	-.036	.077	-.065	-.467	.642
	Logistics Management [IT tools]	.064	.075	.130	.850	.397
	Logistics Management [Postponent]	.078	.071	.151	1.099	.275
9	(Constant)	4.027	.404		9.960	.000

	Transportation Management [Shortest Path method]	.103	.073	.173	1.406	.163
	Transportation Management [Vehicle routing planning]	.022	.073	.033	.305	.761
	Transportation Management [Transport Law]	-.058	.051	-.117	-1.140	.257
	Transportation Management [Scheduling]	.007	.095	.009	.069	.945
	Transportation Management [Asset handling]	.110	.058	.208	1.900	.060
10	(Constant)	4.741	.436		10.886	.000
	Materials Management [Capacity Planning]	.184	.068	.312	2.687	.009
	Materials Management [Risk Management]	-.054	.089	-.075	-.605	.547
	Materials Management [Value chain reconfiguration]	-.131	.066	-.215	-1.992	.049
	Materials Management [Vendor Managed Inventory]	.021	.080	.036	.269	.788
	Materials Management [Virtual inventory management]	.066	.065	.119	1.010	.315
	Materials Management [Material & Receiving report]	-.097	.077	-.137	-1.264	.210
11	(Constant)	4.434	.407		10.898	.000
	Warehouse/Inventory management [5S]	.199	.082	.290	2.438	.017
	Warehouse/Inventory management [FIFO/ LOFO]	.044	.096	.061	.462	.645
	Warehouse/Inventory management [EOQ]	-.033	.084	-.050	-.395	.693
	Warehouse/Inventory management [Inventory Counting]	-.040	.068	-.063	-.590	.556
	Warehouse/Inventory management [Record Management]	.042	.084	.057	.497	.620
	Warehouse/Inventory management [Kaizen]	-.179	.081	-.282	-2.201	.030
12	(Constant)	4.044	.518		7.809	.000
	Distribution Management [Gravity Method]	.009	.070	.017	.131	.896
	Distribution Management [Location analysis]	.003	.105	.005	.031	.975
	Distribution Management [IT tools]	.032	.067	.053	.484	.630
	Distribution Management [Political analysis]	.049	.090	.064	.541	.590
	Distribution Management [Geographical knowledge]	-.044	.074	-.077	-.591	.556
	Distribution Management [Cross Docking]	.069	.105	.087	.662	.510
	Distribution Management [DRP]	.081	.079	.134	1.021	.310
13	Distribution Management [Network Management tool]	-.019	.075	-.033	-.255	.799
	(Constant)	4.343	.317		13.686	.000
	Demand Management [S&OP]	.020	.094	.035	.212	.832
	Demand Management [Demand Forecasting]	.126	.082	.230	1.541	.127

	Demand Management [Supply Chain Analytics]	-.023	.075	-.045	-.302	.763
	Demand Management [Supply Chain Reports]	-.017	.077	-.030	-.226	.821
	Demand Management [Geographical knowledge]	.005	.083	.007	.060	.952
	Demand Management [Network Management tool]	-.041	.075	-.078	-.542	.589
14	(Constant)	4.281	.373		11.473	.000
	Coordination & Information Management [Direct contact]	.219	.081	.319	2.710	.008
	Coordination & Information Management [online communication]	-.054	.093	-.090	-.582	.562
	Coordination & Information Management [spreadsheet Excel]	-.104	.090	-.150	-1.164	.247
	Coordination & Information Management [ERP]	.008	.081	.012	.094	.925
	Coordination & Information Management [Programming Supply chain]	.024	.084	.037	.287	.775
	Coordination & Information Management [Interpersonal communication]	-.034	.097	-.048	-.351	.727
	Coordination & Information Management [Negotiation]	.014	.068	.027	.203	.839
15	(Constant)	4.827	.411		11.758	.000
	Project Management [CPM]	.153	.084	.217	1.825	.071
	Project Management [PERT]	-.084	.065	-.146	-1.289	.201
	Project Management [Earned value analysis]	.035	.077	.052	.457	.649
	Project Management [Scheduling]	-.149	.096	-.191	-1.555	.123
	Project Management [Cost Analysis]	-.010	.067	-.017	-.155	.877
16	(Constant)	4.992	.444		11.246	.000
	Supply Chain Leadership [Contingency leadership]	.032	.073	.050	.443	.659
	Supply Chain Leadership [Situational leadership]	-.053	.085	-.072	-.618	.538
	Supply Chain Leadership [Participative leadership]	-.063	.075	-.096	-.843	.401
	Supply Chain Leadership [Autocratic leadership]	-.105	.068	-.167	-1.556	.123
	Supply Chain Leadership [KPI tools]	.084	.085	.110	.985	.327

Effective Tools found from Research: Supply Chain ToolCube

Based on the research conducted above, from hypothesis 97 tools tested and 9 tools suggested from respondents and tested again in total 108 tools from survey. These 108 tools then tested statistically above and found 84 tools found statistically viable. These 84 tools are found from 16 supply chain areas which were tested in above calculations.

To represent these 84 tools we can choose Rubik's cube. In $4 \times 4 = 16$ blocks of Rubik's cube we can represent 16 areas of supply chain. In 4×4 cube, there are 96 blocks. We can place our 84 tools of supply chain in the 4×4 Cube, we can call it Supply chain 'toolCube'. As discussed earlier Supply chain

One face of a Cube. More than 1 tool can be chosen from 1 area. For example DRP and Cross docking both can be used from Distribution area.

Conclusion:

Summing up the results, supply chains differ in different companies from each other, in real company practice the model does not appear so clearly, as supply chain tools used in organizations has wide variety in nature and very often organizations practice tailored tools suited to product and customers need. I was not able to complete the model for differences in the demand chain management tools applied based on the different operational focuses and practice limitations. There are more tools in supply chain are used and should be used can be identified and listed in future research.

But the attempt to combine all effective and useful tools, combining and categorizing to a “Supply Chain ToolCube Model” will definitely help supply chain participants to identify and categorize needed tool to use in specific business scenario. Proper use of the model will enhance use of SCM tools more and thrive to business efficiency.

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