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Industrial Engineering

Basic Metal Industry

Cement Manufacturing Process

Highlights

Rework in Food Industry

Forecasting of Cement Industry

Discovering Thoughts, Inventing Future

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Simulation of Cement Manufacturing Process and Demand Forecasting of Cement Industry

By Md. Irfan Uzzaman, Mohammad Shakilur Rahman, Md. Shafiul Alam
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Abstract- Demand forecasts form the basis of all supply chain planning. This research is focused on the simulation of cement manufacturing process to find out the production loss of machines that will affect the production quantity, and analyzing different methods of forecasting to compare their errors so that appropriate forecasting method is identified to predict correct demand. Depending on the forecasting, the simulation process applied can aid to estimate amount of raw materials require producing particular amount of cement to fulfil the demand including the losses in various steps of manufacturing process. Moreover, seasonality of demand is considered where the same demand will repeat at a particular period. The longer horizon forecasts, using Holt-Winters method, are usually less precise than the shorter horizon forecast; that is, long horizon forecasts have larger standard deviations. This investigation on overall demand could facilitate the comparison between the futures forecasted demand and the overall customer demand.

Index Terms: simulation, supply chain, demand, forecasting, cement industry, efficiency.

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Simulation of Cement Manufacturing Process and Demand Forecasting of Cement Industry

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Abstract- Demand forecasts form the basis of all supply chain planning. This research is focused on the simulation of cement manufacturing process to find out the production loss of machines that will affect the production quantity, and analyzing different methods of forecasting to compare their errors so that appropriate forecasting method is identified to predict correct demand. Depending on the forecasting, the simulation process applied can aid to estimate amount of raw materials require producing particular amount of cement to fulfil the demand including the losses in various steps of manufacturing process. Moreover, seasonality of demand is considered where the same demand will repeat at a particular period. The longer horizon forecasts, using Holt-Winters method, are usually less precise than the shorter horizon forecast; that is, long horizon forecasts have larger standard deviations. This investigation on overall demand could facilitate the comparison between the futures forecasted demand and the overall customer demand.

Index Terms: simulation, supply chain, demand, forecasting, cement industry, efficiency.

I. INTRODUCTION

Simulation is the imitation of the operation of a real-world process or system over time. The act of simulating something first requires that a model be developed; this model represents the key characteristics or behaviors/functions of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time. Simulation is used in many contexts, such as simulation of technology for performance optimization, safety engineering, testing, training, education, and video games. Often, computer experiments are used to study simulation models. Simulation is also used with scientific modelling of natural systems or human systems to gain insight into their functioning. Simulation can be used to show the eventual real effects of alter-native conditions and courses of action. Simulation is also used when the real system cannot be engaged, because it may not be accessible, or it may be dangerous or unacceptable to engage, or it is being designed but not yet built, or it may simply not exist. Key issues in simulation include acquisition of valid source information about the relevant se-lection of key characteristics and behaviors, the use of simplifying approximations and assumptions within

the simulation, and fidelity and validity of the simulation outcomes. Process simulation is used for the design, development, analysis, and optimization of technical processes such as: chemical plants, chemical processes, environmental systems, power stations, complex manufacturing operations, biological processes, and similar technical functions [12]. Process simulation software describes processes in flow diagrams where unit operations are positioned and connected by product or edict streams. The software has to solve the mass and energy balance to find a stable operating point. The goal of a process simulation is to find optimal conditions for an examined process. This is essentially an optimization problem which has to be solved in an iterative process. Process simulation always use models which intro-duce approximations and assumptions but allow the description of a property over a wide range of temperatures and pressures which might not be covered by real data. Models also allow interpolation and extrapolation within certain limits and enable the search for conditions outside the range of known properties. The development of models for a better representation of real processes is the core of the further development of the simulation software. Model development is done on the chemical engineering side but also in control engineering and for the improvement of mathematical simulation techniques. Process simulation is there-fore one of the few fields where scientists from chemistry, physics, computer science, mathematics, and several engineering fields work together.

Forecasting plays a crucial role in the development of plans for the future. It is essential for the organizations to know for what level of activities one is planning before investment in inputs. Forecasting is an estimate of future event achieved by systematically combining and casting forward in a predetermined way data about the past. To know the future demand of cement industry forecasting is an essential part.

II. LITERATURE REVIEW

In literature, different aspects of demand forecasting problems with unknown demand distributions and information updates have been studied. For seasonal demand forecasting, starting from the 1990s, a Quick Response (QR) policy was adopted by many researchers. This policy is intended to reduce manufacturers' production time to respond to retailers

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order in a quicker way so that forecast can be improved by collecting more information about the future demand. Hammond (1990) and Fisher et. al. (1994) [5] studied the QR policy with ski apparel (ski suits, ski pants, parkas, etc), and showed that forecast accuracy can be substantially improved by adopting QR policy. Fisher and Raman (1996) [6] developed a forecasting model based on the sale trend using the early stage market sales data to reduce the uncertainty of the future demand under QR ordering system. Iyer and Ber-gen (1997) [7] studied demand forecast by collecting the demand information of a preseason product to forecast the actual demand of a seasonal product using Bayesian approaches. They proposed that the demand process of the fashion apparel follows normal distribution and presented the improvement of demand forecast due to Bayesian information update in forecasting process. Agrawal and Smith (1996) [1] used negative binomial distribution (NBD) for the demand model and suggested that NBD model provides a better fit than the normal or Poisson distributed data. They developed a parameter estimation method for the demand model in which sales are truncated at a fixed point. Time series forecasting models are increasingly applied to forecast demand and short-life product demand. Under an auto-regressive moving average (ARMA) assumption, Kurawarwala and Matsuo (1998) [8] estimated the seasonal variation of PC products

demand using demand history of pre-season products and validated the models by checking the forecast performance with respect to actual demand. Miller and Williams (2003) [11] incorporated seasonal factors in their model to improve forecasting accuracy while seasonal factors are estimated from multiplicative model.

Hyndman (2004) extended Miller and Williams' (2003) work by applying various relationships between trend and seasonality under seasonal autoregressive integrated moving average (ARIMA) procedure. In several articles, Liao and Lau (1997) [10], Eppen and Iyer (1997) [4], Choi et al. (2003, 2006) [3], inventory models were studied to determine the order quantity for a lead time and inventory cost of the seasonal demand. Liao and Shyu (1991) [9] first introduced the concept of crushing cost to variable lead time for a fixed order quantity, where crushing cost is the cost that increases if the procurement lead time is reduced. Ben-Daya and Raouf (1994) [2] extended Liao and Shyu's (1991) work by treating both order quantity and lead time as the decision variables.

III. EXPERIMENTAL PROCEDURE

Simulate the simplified cement manufacturing process adding different input for each of the following stage

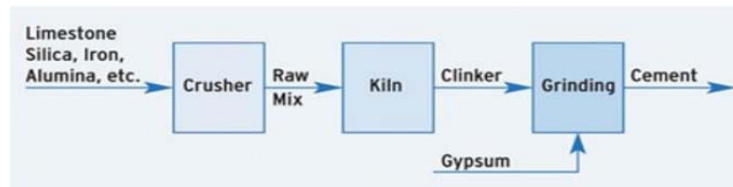


Fig. 1 : Simplified Cement Manufacturing Process

Analyzed one year sales data of a cement company and found forecasted demand as well as error by following 5 methods of forecasting which is:

- Regression Analysis
- Exponential Smoothing
- Moving Average
- Holt Method
- Holt-Winters' Model

The below table shows the variation of output, loss and efficiency for the particular input of raw material. Here input raw material 50 tons are taken for every batch production.

IV. RESULTS & DISCUSSION

a) Process Simulation

Simplified process of manufacturing of cement, simulation process is done to find out the efficiency of overall process and final output of cement and the loss. For different loss of machine those parameters are calculated. Here the loss, output and efficiency is different for different batch production because for every batch machine variation of machine loss is not same.

Table 1 : Process Simulation

Batch No.	Output	Loss	Efficiency (%)	Batch No.	Output	Loss	Efficiency (%)
1	44.72	5.28	89.4	11	47.59	2.41	95.2
2	45.19	4.71	90.4	12	45.68	4.32	91.4
3	45.2	4.80	90.4	13	44.74	5.26	89.5
4	44.72	5.28	89.4	14	44.74	5.26	89.5
5	43.81	6.19	87.6	15	45.68	4.32	91.4
6	45.66	4.34	91.0	16	47.58	2.42	95.2
7	43.81	6.19	87.6	17	45.19	4.81	90.4
8	44.72	5.28	89.4	18	46.62	3.38	93.2
9	44.28	5.72	88.6	19	46.62	3.38	93.2
10	46.61	3.39	93.2	20	47.10	2.90	90.4



Fig. 2 : Graphical Representation of Process Simulation

Cement manufacturing process is simulated through Matlab in this research. For simulation, Fig 1. Simplifies cement manufacturing process is followed. At the initial stage, 50 ton/hr limestone is given into crusher machine as input and this input value is fixed for all 50 batch. In respect to the input of limestone, final output of cement per batch/hr is calculated as well as the loss per batch. From the Table 1, at the first batch output of final cement 44.72 and respective loss is 5.27. In Table 1, cement output varies from 43 to 48 ton/hr. Before coming out cement as output, loss occurs in all 3 machining stage. Some loss occurs due to attaching material with the machine surface, some amount of material are blown away and some amount of material came out as wastage

b) Forecasting

For the current amount of demands for 12 months that is 316, 326, 373, 377, 315, 368, 318, 315, 319, 315, 320, 392 (all are in thousands) in this paper different forecasting is done to find out which method is most appropriate to use for forecasting future demand by comparing their errors as shown in below table.

Table 2 : Error Comparison

	Mean Absolute Deviation	Mean Squared Error
Regression Analysis	7	64
Moving Average	For 3 months	906
	For 5 months	769
Exponential Smoothing	For $\alpha = 0.1$	904
	For $\alpha = 0.1$	1039
Holt Method	29	1342
Holt-Winter's Method	25	1048

Less Mean Squared Error (MSE) value gives better forecast. Therefore, in the error comparison table, Regression Analysis gives lowest MSE (value of 64) among. Holt Method and Holt-Winters Method can be compared also as future years demand can be forecasted by this two. Analyzing error comparison table, Holt and Holt-Winters MSE are 1342 and 1048 respectively. To conclude, Holt-Winters method is more appropriate than Holt method.

V. SCOPE OF FUTURE RESEARCH

Case studies in multiple cement manufacturing companies on sales data's to make accurate forecast Survey on several geographic areas for cement utilization based on random sampling. Application of hybrid Artificial Neural Network and Fuzzy Logic method in demand forecasting and process simulations [12]

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Study Supply Chain Integration to basic Metal Industry

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Abstract- Objective: The objective of this research is to investigate the, effect, system and role of supply chain integration on basic manufacturing industries and Identify the main constraints /gap SCI on developing nation metal to develop further investigations.

The purpose of this paper is to know what extent supply chain integration affect firm performance and identify gap for pervious work.

Design/methodology/approach: To achieve the objectives a Systematic literature reviews is carried out to the previous research work in the SCI research area, evaluate their role and contributions, identify the main concept and summaries knowledge, thereby identifying their gap, implications and potential directions of further research.

Keywords: *supply chain: basic metal industry: supply chain integration: global supply chain: supply chain leadership: logistics.*

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Study Supply Chain Integration to basic Metal Industry

Alie Wube Dametew ^α, Birhanu Beshah Abebe ^σ & Frank Ebinger ^ρ

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Results: Our study investigates, key factors of supply chain integration are Technology, information shearing and information technology, Collaboration, cooperation and integration, way and level of supply chain integration and belief affect the overall capacity and performance of the supply chain integration. Also, effective and efficient resource utilization, information shearing, supply chain coordination and cooperation, highly bonded supply chain integration, adopting appropriate technology, fully supply chain system (Internal, customer & supplier), are improve quality, trust, market shear and the overall performance of the Supply chain Industries.

In addition to the above supply chain integration involves, Innovation and technology transfer, Social and Environmental responsibility, Supply chain leadership (Leader), on industrial safety and Occupational health, Environmental sustainable performance, political issue will into consideration and need further researches.

Keywords: supply chain: basic metal industry: supply chain integration: global supply chain: supply chain leadership: logistics.

I. INTRODUCTION

Industrial growth is starts and begin by the growth and development of metal Industries. Metal industry is a backbone of most other Manufacturing industries for economic growth and development for the country. The Industrial Revolution created a demand for metal parts used in machinery. This led to the development of several machine tools for cutting metal parts. To built and the, installing, building and construction of new manufacturing industry (lather, textile, metal, Agro

processing industry) use metal product machinery and equipment. Metal industries considered as Key Enabling Technologies (KETs) provide the basis for industrial growth and innovation in a range of products across all industrial sectors and also drive the development of entirely new industries. The developed and developing nations, rapidly growing in deferent sectors like electric power generation, Agro processing industry, railway developments and booming housing and condominium constructions requires huge tons of steel production. additionally the expansion and newly emerging industries like motor vehicle assembly, spare parts supplier, agricultural equipment and the expansion of requires huge amount of iron ore and other basic minerals. However, in the sector the rising costs of manufacturing, the shrinking metal resources of manufacturing bases, shortened product life cycles, the leveling of the playing field within manufacturing, and the globalization of market economies, with the growth of the world economy, the expenditure of steel has been growing dramatically Xiong & Hello (2008), Addis Ababa chamber of Commerce and Sectoral Association (AACCSA), (2015). In today's markets is led by advances in industrial technology, increased globalization of demand and supply sources, tremendous improvements in information availability, plentiful venture capital, and creative business designs (Mentzer, 2006). Presently with the developments of information and communication technology (ICT) and Era of globalization, supply chain is now accepted as the normal way of doing business Johnso (2006), Devaraj.et.al (2007). However Competition is no longer among firms, but among supply chains (Hult,2007).The enhancement of competitive performance of closely integrating the internal cross-functions within a company and effectively linking them with the external operations of suppliers and customers to be successful for Supply chain firms Silva *et.al* (2102), Otchere *et.al* (2013). According to Boon-itt (2011), elaborates that effective and efficient supply chain management requires integrated business processes that go beyond purchasing and logistics activities. The previous research work on supply chain integrations shows the significance role for manufacturing industries to improve their efficiency and firm performance for highly integrated Supply chains for quality and Competitive advantage Fabbe-Costes.*et.al* (2008), Wang (2010), Alfalla-Luque.*et.al* (2013). Otchere.*et.al*(2013). Formerly,

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Manufacturing industries (like Agro processing, lather and Textile industries) in developing countries are trying to access the different markets segment of the world starting from their local market to the complex and dynamic international market through limited supply chain Georgise, (2011).

The strategic supply chain integrating with suppliers to customer implies to improved operations and overall performances of the firms Kim (2009), Flynn.*et.al*(2009). Meanwhile, the basic metal industries of developing countries doesn't get enough attention and are not studied well and seems to be isolated from global literature Georgise,(2014).Nevertheless, Sutton & Kellow (2010), Thoben & Georgise, (2012), Msimangira, (2014) also indicate that there are many global supply chain problems, from the overseas suppliers to the local companies of developing nation industries in the domestic market. These problems are related to the use of outdated technology in the domestic market, lack of trust, documentation problems, specification requirements problems for products, procurement, product quantity, standardization, price set up, information systems, delivery lead time to compete in the global market. Even though developing country Basic metal industry have fragmental implement supply chain systems, without integrated supply chain, the success and survival of industries are less. hence we are intended to implement supply chain integrations on this basic metal industries on developing countries. However, In this paper to summarize the previous work about supply chain integration and identify the role of supply chain integration for developing nation Basic metal industries to contribute and develop the new way for integrating basic metal industries into supply chain as further investigation of the research .we are expect to show the effect, role of supply chain integration on Basic metal industry and what extant industries integrate into supply chain for comparative advantage.

a) *Objective*

The objective of this research is to investigate the, effect, system and role of supply chain integration on basic manufacturing industries and Identify the main constraints /gap SCI on developing nation metal to develop further investigations.

b) *Why supply chain (SC)?*

The establishment of supply chain was begins 1980s to improve the business efficiency and effectiveness for competitive manner from end user to suppliers. Supply Chain is a system of organizations, people, activities, information, and resources involved in moving a product or service from supplier to customer Georgise (2011). Supply chain also describes as to the flow of materials, information, payments, and services from raw materials suppliers, through factories and warehouses, to the end customers. According to, Bhattacharya et al (2014) states that network of

organizations involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services to customer satisfactions through supply chain. The performance of the supply chain is measured by how companies are able to match supply to demand whilst driving down costs and simultaneously improving customer satisfaction and it is a critical tool to improve the various aspects organizations/firms.

Supply chain Scholars shows the importance of Supply Chain practice to firms' their competitive strategies and advantage as well as can improve organization performance Lambert and Cooper (2000), Birhanu (2014), Pathak (2015) Rao(2015). This idea supports the other scholars like Beamon (1998, Georgise (2011). Flynn.*et.al*(2009)also elaborates the direct effect of internal integration on business and operation performance, Customer integration operation performance and the collaborative effect of Supplier and customer integration on operational performance of the manufacturers. This implies that supply chain integration affect the performance of the organizations(Supply chain Firms). Companies began to reengineer ,old technology using information technology to improve the competitiveness of the sector. This led to emerge Supply chain integration. A supply chain consists of all stages involved, either directly or indirectly, in fulfilling a customer request. A supply chain includes manufacturer, supplier, transporters, warehouses, retailer, third-party logistics provider, and customer Awad & Nassar (2010). According to Georgise (2011) study, one of the most significant paradigm shifts of modern business management is that individual businesses no longer compete as solely autonomous entities, but rather as supply chains. Getting the right product, at the right price, at the right time to the consumer is not only the key success factor competitive success but also the key to survival. in the same fashion, many researchers and practitioners have studied Ethiopian SC issues related to Agro processing, lather and Textile industries Georgise & Thoben (2013), Pathak (2015). But the previous studies in metal industry sector mainly focused on, infrastructure and master planning, improving efficiency and Effectiveness of Individual industries. However, little attention has been paid by researchers to study SC issues in the metal industry sector. However Ethiopian Basic Metal Industries (EBMI) have fragmental Supply chain systems. According to Sutton and Kellow (2010) shows that, Ethiopian Flat steel product manufacturers import their input, cold-rolled sheet in coil (except for one firm which imports hot-rolled sheet, i.e. one step back). The long product manufacturers typically source their input from billets and scrap. Billets are imported from the international market through local agents and competitive bidding procedures. Scrap is mainly sourced from government organizations such as the

Ministry of Defense. Other sources include scrap collectors who gather from individual collectors (known as *kuraleows*). Formerly (Addis Ababa chamber of Commerce and Sectoral Association (AACCSA), 2015) indicate Metal and engineering industries is expected to raise the export earnings performance of the country in the near future. most production outputs from this subsector are primarily supplied to the domestic market, Despite its current export performance is inadequate, in the subsector the existing ones are not adequate and effective supply chains. Scholars Georgise.*et.al* (2011) shows that the problems are occurs due to Lack of advices technology and problems well organize information system regarding creating a business network among producer and consumers in and outside the country. But Scholars Melkas (2010), Aggarwal (2014), Amue (2014), Argue that, Information technology allows a prerequisite for the effective control of today's complex supply chains, so as to coordinate production with demand, slash inventory and cycle times, better manage logistics, improve customer satisfaction, and reduce overall costs. Dong (2009) describes, success of supply chain integration is largely conditioned by the extent of use of information technology and, enhance quality supply chain between organizations. Through the supply chain by ordering and responding of their needs, manufacturing industries improve the quality and timing of information flow to enhanced business environments Devaraj. *et. Al* (2007), Alfalla-Luqu.*et.al* (2013). Even though, basic metal industries have inadequate supply chains, it lacks this benefit, Hence we are intended to study supply chain integration of developing nation Basic metal industry, so as to integrate in global supply chains.

c) Why Supply chain integration (SCI)?

It is a close alignment and coordination within a supply chain. Supply chain integration means the co-operation between various functions in the supply chain. The degree to which an organization strategically collaborates with its partners and manages intra- and inter-organizational processes in order to achieve efficient and effective flows of products, services, information, money and decisions Halme(2010).An effective and efficient supply chain integration achieves the well defined flows of products and services, information, money and decisions, to provide maximum value to the customer at low cost and high speed Flynn.*et.al*(2009).Integration can be characterized by cooperation, collaboration, information sharing, trust, partnerships, shared technology, and a fundamental shift away from managing individual functional processes, to managing integrated chains of processes Power (2005, Krishnapriya (2014). Supply chain member organizations integrate in to three dimensions customer, supplier and internal integration. This dimensions are considered as independent variables of supply chain

integrations on manufacturing industries Flynn.*et.al*(2009), Otchere.*et.al*(2013). Furthermore, Study describes as, Successful coordination and integration of supply chains for all the activities associated with moving goods from the raw materials stage through to the end user for sustainable competitive advantage Lambert and Cooper (2000).World-class organizations now realize that non-integrated manufacturing processes, non-integrated distribution processes and poor relationships with suppliers and customers are inadequate for their success. the success coordination, integration management of key business across the member of supply chain will determine the ultimate success of the single industry Vorst (2000). Researchers like Alfalla-Luqu *et.al* (2013) literature review analyses shows how supply chain integration affects the overall supply chain (SC) performance in terms of efficiency and responsiveness. In most modern systems, the wisdom is it's better to do what you do best and own a very limited asset. Nearly everything is outsourced but the brand and distribution process integration with supply chain partners Ray (2013). However, in the developing Country manufacturing industry, supply integration still infant. According to Getahun (2012) Investigates that, lack of supply integration and customer integration within the garment industry, Have the potential to affect the quality and competitive advantage of the sector.

Negussie (2014) supply chain Evaluation study shows that leather are suffering from the shortage of raw material (hides and skins) as well as its quality problem. Companies in developing countries need to integrate their operations, especially the sourcing processes into the global supply chain Georgise (2014),Msimangira (2014) and some sectors are Fragmental and infant integration(like basic metal) industries Xiong & Helo (2008). Hence it is an important issue, to implement supply chain strategy. while, supply chain integration focuses on two key issues--alignment and linkage--both *inside* an organization and *across* organizations. However, we intended to implement integrated supply chains systems for Basic Metal industries, order to bring the improvement within basic metal industry, the problems associated with resource, information, skill man power, market place will be address. although creating better integration and communication through the supply chain will implement. Integrating supply chain, helps between this integrated metal industries, Aligned to accomplish common vision, goals, purpose and objectives across organizations, functions and processes in the supply chain. they ensures that there is consistency in the direction and objectives as these plans and decisions are made Maqsood(2002, Malik Khalfan(2004). Scholars argue that, currently metal resource reduce time to time, this reduce the performance and capacity of metal industries, main while to overcame the problems, BMI should link trough

supply chain. Linkage provides Communication and sharing of information needed for planning and decision-making, and the interaction of people involved in planning and decision-making, Sharing problems and working together to find solutions Malik Khalfan (2004). Linkage ensures that the information necessary for decision-making is available, and that different functions and entities in the supply chain are working with the same data as decisions are made. Hence we select as a Key, How, when and what Extent to link and Align, this Basic metal industry through Supply Chain as way of to improve the effectiveness and performance of an organization.

II. DESIGN/METHODOLOGY/APPROACH

To achieve the objectives a Systematic literature reviews is carried out to the previous research work in the SCI research area, discusses, evaluate their role and contributions, identify the main concept and summaries knowledge, thereby identifying their gap, implications and potential directions of further research.

Selection of the Journals

In order to achieve the objective, we use online databases and library services such as Taylor & Francis (www.tandfonline.com), Emerald (www.emeraldinsight.com), ELSEVIER (www.elsevier.com), www.sciencedirect.com and other related international journals allied to our work. The selection of the data base and journals for the study is follow and guided by data base and journal rankings and citation index, Date of Publication, Name of Author(affiliation), for Google scholar browse we also Title of Journal(Is this a scholarly or a popular journal). A search of articles published between 2000 and 2016 identify with the words Supply chain: integration: Global Supply chain: Basic metal: Supply chain leadership and logistics in the title, keywords, we used. From total of 58 articles 21 articles are selected and use for the analysis.

a) *Literature review*

In this section go through **21 selected** articles which are related to Supply chain and Supply chain integrations are presented in the table, then discuss the main concepts of the article and identify the gap and future work is proposed.

Author	Title	Objectives	Research type	Research Method and Materials	Findings	Journal
1. Alfalla-Luqu. et.a/(2013)	Supply chain integration framework kusing literature review	-Identify dimension and variable of Supply chain integration	literature review	critical review of the literature	- illustrated SCI is analyzed in terms of as multi-dimensional framework (information integration, Coordination resource sharing and organizational relationship linkage) into consideration and these are analyzed from both the inter- and intra-organizational perspectives. In addition found out variables of SCI is not only considered a process and technique, it also has important human and organizational behavior components. SCI needs to be included in the organizational Culture because SCI supported by human interactions. Also shows pints, before external integration firms should be integrated internally and then develop external integrations. -show performance improved by implementing supply chain integrations between Firms.	Taylor & Francis /journal of Production Planning & Control
2. Xiong & Helo(2008)	Challenges to the supply chain in the steel industry	paper investigates the key factors within the supply chain that supports steel production	Research	Survey	-Relationship; Engineering and information technology is identified as the factors that influence steel SC. The result shows the benefit of relocation and consolidation of SC b/n steel industries. They indicated as complex steel industry SC improve trough business relationship; engineering and Visible information sharing, so as to the success of steel industry cooperation: distribution: shearing and exchange b/n(supplier ,distributor and end-user) and develop win-win -situations	International Journal of Logistics Economics and Globalization 2008
3. Msimangi & Tessa(2014)	Global Supply Chain Practices and Problems Facing Developing Countries: A Study in Tanzania	To explore global supply chain problems and risk facing on developing nation.	Case study	qualitative data collection method used -Apply cross-case analysis to analyze the data	-Key problems for SC investigated from the study are the use of outdated technology in the domestic market, lack of trust, documentation problems, quality assurance, procurement of counterfeit products, quantity demanded, price set up, information system, ,problems skill managers, lack of cooperation b/n SC firms. The result also shows that the problems are occurred due to overseas suppliers to the local public transport companies (buyers or customers) has not been working effectively and efficiently (in the local part of the global supply chain) to meet the requirements of the customers,	Operations And Supply Chain Management (2014)
4. Otch	Assessing the Challenges	Examined the major challenges	Survey	Study adopted an additive	-identify, three stages of SCI , Functional, internal and external integrations, also found in three levels ; low integration, medium (partial) integration, and full	International Journal

ere.et. a/(201 3	es and Implemen tation of Supply Chain Integratio n in the Cocoa Industry	within the industry, which inhibits effective implementatio n and use of supply chain integration		(inductive and deductive) approach, the focus leaned more towards deductive and Interview administere d questionnai re and self- administere d questionnai re were used to collect quantitative data.	(complete) integration are observed, the power of integration to leads to improved performance and competitive advantage on SC firms. They proposed that implementing complete integration both upstream (Supplier Integration), operations (Internal Integration), and downstream (Customer Integration) is better than concentrating on only one aspect. - Also find out the factors faced in the industries were include problems database and information inefficient resources ,Problems in JIT , these leads /challenges performance, and product.	of Busines s and Social Science, 2013
5.Flyn n.et.a/(2009)	The impact of supply chain integratio n on performa nce: A contingen cy and configurat ion approach	study and determined the impact of individual SCI dimensions (customer, supplier and internal integration) and their interactions on performance.	applying the contingen cy approach	Survey	-Found that internal integration SCI was direct effect on both business and operational performance and that customer integration was directly related to operational performance. Although supplier integration was not directly related to either type of performance, but the interaction of supplier and customer integration was related to operational performance. They summarize that, while internal integration was positively related to business performance, supplier and customer integration were not directly related to business performance. This may be because customer and supplier integration are related to business performance through operational performance. internal integration forms the foundation upon which customer and supplier integration build.	Journal of Operatio ns Manage ment
6.Zha o.et.a/(2008)	The impact of power and relatio nship commitm ent on the integratio n between manufact urers and customer s in a supply chain	Investigate the relationship between power, relationship commitment and the integration of manufacturers with their customers,	Survey	They use power- relationship commitmen t theory	-Results show that appropriate use of power can significantly enhance relationship commitment. Improvement in relationship commitment, especially normative relationship commitment, while reducing transaction costs and opportunistic behaviors. They also found that reward power had a positive impact on both normative(culture) and instrumental relationship commitment in China.	Journal of Operatio ns Manage ment

7. Mos hkdani an& Molah ossein i(2013)	Impact of supply chain integration on the performance of Bahman group(Automotive Industry)	Examine the relationships of long-term relationships, information integration, logistic integration and find out impact on operational performance.	survey	Survey	-They dig out the as information sharing and information technology are a key argument in success of logistic integration of automotive industries to improve their performance. Further, show that long-term relationships with suppliers will improve performance but Long-term relationships indirectly and through information technology and information sharing, and then logistics integration are effective for operational performance.	Interdisciplinary Journal of Contemporary Research In Business
8Agus (2011)	The Structural Influence of Supply Chain Management on Product Quality and Business Performance	The study determine critical variables of SCM and assess the importance of each SCM dimension on performance. significant influence on product quality.	Research	The instrument used in this study was a structured survey questionnaire, and analyzed using SPSS.	-Find that Product conformance, product reliability and. -The findings suggested that to enhance product quality, a manufacturing company should invest its resources in incorporating lean production and technology and innovation in SCM to ensure that production runs effectively and efficiently resulting in high quality products. The result shows, ultimately overall business performance improved trough manufacturing company investment in new technology and innovation in SCM and adoption of lean production would be able to improve 'return on sales', 'return on assets', market share. Study suggest that SCM enhances product quality and has a positive effect on business performance.	International Journal of Trade, Economics and Finance
9 Boon-itt(2011)	Achieving Product Quality Performance: The Roles of Supply Chain Integration and Information Technology	To discover whether or not product quality requires different types of information technology in implementing supply chain integration.	Research paper	Survey	-They found that internal integration highly a significant effect on product quality performance. Further, product quality performance is not influenced by the interaction effect between supply chain integration and information technology in terms of communication/information flow. Rather, interaction effect of collaboration/decision support information technology to enhance the effectiveness of supply and customer integration.	International Journal of Innovation Management and Technology
10. Lotfi et al/(2013)	A Product Quality - Supply Chain Integration Framework	Investigated the relationship between dimensions of product quality and supply chain integration.	Research	Adopted both a qualitative and a quantitative approach	-Effective supply chain integration and collaborative activities between manufacturer, supplier and customer which enables firms to work together and improve product quality. Three dimensions for supply chain integration are customer integration, supplier integration, and internal integration, whereas design quality and conformance quality as quality dimensions.	Integration Framework Journal of Applied Sciences,
11. Lotfi et al/(2013)	The Relationships between Supply Chain Integration and Product Quality	examine the effect of seamless supply chain on the product quality	Research	literature review	From the study indicated that internal integration has effects on supplier integration as well as customer integration. On the other hand design quality has effects on conformance quality and also each dimension of supply chain integration affects each dimension of product quality. -Theoretical and literature review evidences that internal and external integration have impacts on design quality and conformance quality leading to improvements of competitive capabilities in firms. they	International Conference on Electrical Engineering and Informatics

					advise that ,firms pay more attention to supplier integration and customer integration then to predict that their product quality capability to enhanced.	
12. Maleki & Cruz-Machado(2010)	An Empirical Review On Supply Chain Integration	The result was review discussed and criticizes the current state of literature on SCI.	literature review	literature review	The result directed, SCI driving forces of industry sectors; positioning in the chain; lack of reports in fail stories; focuses of SCI literature on vertical integration and performance measures and missing other aspects.	Management and Production Engineering Review
13. Ozdemir and Aslan(2011)	Supply Chain Integration, Competition Capability and Business Performance	The effect of supply chain integration on the companies' competitive capabilities and performance was examined.	Case study in Turkey.	surveys	The result found that the supply chain integration affects the companies competitive capabilities and performance positively. Also supply chain integration and subtitles of the competitive capabilities (cost leadership, customer service, flexibility and product indicators) are found to be significant. mean time found that competitive capabilities affect market performance and financial performance in a positive way, no significant effect on customer satisfaction is found. Supply chain integration has very little effect on business performance; affects only market performance positively.	Asian Journal of Business Management.
14. Zolait. et.al(2010)	Supply Chain integration	Examines the relationship between supply chain process integration and firm performance	Survey	Quantitative method, sampling and self-administered survey questionnaires were use.	Found the impact of dimensions of supply chain process integration were significant to firm performance. The study highlighted the achievement of supply chain strategy through upstream and downstream integration as part of the manufacturing strategy. In addition, several significant contributions in terms of managerial implications are also purported. First, managers in manufacturing firms whom are not to totally involved in the initiative of supply chain process integration should start aggressively managing supply chain process integration. Second, manufacturers who are already following this approach but at a slow pace of execution should move rapidly to enhance information flow integration followed by physical flow and financial flow integration across supply chain. Moreover, information flow integration shows a greater influence than physical and financial flow integration, and considered as the most dominant factor to influence the firm performance.	Journal of Systems and Information Technology
15. Georise. et.al(2014)	Integrating Developing Country Manufacturing Industries into Global Supply Chain	examined the level of inter organizational and intra-organizational supply chain integration practices in developing country, Ethiopia.	survey	questionnaire survey is used to collect the current practices of Descriptive statistics is primarily used for the analysis	-Results show a low level of supply chain relationship both in intra and inter organizational supply chain integration have inefficient supply chain integration. Their result indicates ,companies seem to be oriented towards integration inside the organization but their result shows, degree of integration is low. There is also problems on information shearing, instead of using integrated information systems(internet), still use old communication systems(mainly telephone, mobile, letters, telex, and faxes) were applied.	Journal of Industrial Engineering and Management.

16Georgise.e t.a/(2014)	Supply Chain Integration in the Manufacturing Firms in Developing Country	Analyzed supply chain integration practices and the challenges faced in the manufacturing firms in developing countries.	Case Study	Literature survey and primary data semi structured interviews they used	-Identified supply chain integration is fragmental and limited on functional base boundaries within the firm. Also show, the problem of supply chain members(Firms) and allocation of functions among the members. the company has faced higher challenges in their raw material, lack of integration between (companies, departments, functions), information exchange and planning activities to fulfill the appropriate delivery lead time, problems in quality and standardization in operational processes were investigated.	Hindawi Publishing Corporation, Journal of Industrial Engineering
17 Jozi & Moradi(2014)	The Impact of Supply Chain Integration on Customers' Satisfaction and Financial Performance	Investigated effects of supply chain integration on customers' satisfaction and financial performance	Case study	They used quantitative, descriptive and correlative methodology, and instrument study a questionnaire were apply.	-Study showed, a positive relationship among internal integration with suppliers integration and customers integration is, customers' integration has positive influence on customer satisfaction, and customers' satisfaction has a positive influence on the financial Performance. -They elaborate that, coordinates activities in a way that customers would be able to obtain the products with high quality and at a minimum cost.	International Journal of Review in Life Sciences
18. Agan(2011)	Impact of Operations, Marketing, and Information Technology Capabilities on Supply Chain Integration	Identify Impact of Operations, Marketing, and Information Technology Capabilities on Supply Chain Integration.	Research	Used... Survey method and is Multi- scale measurements is employed.	-In the study they find out the following results, partner selection and collaboration are positively impacting integration, while learning is not significant and operations human resources can be conceived to be negatively correlated with supply chain integration. Information technology infrastructure is significantly impacting integration as well as performance directly. Market orientation also have both direct effects on financial performance and indirect effects through supply chain integration.	Journal of Economic and Social Research
19.SofyaliođluOztürk(2012)	Meta Analysis of the Relationship between Supply Chain Integration Dimensions and Firm Performance	Investigated Supply Chain Integration Dimensions and Firm Performance Relationship.	Research	Meta Analysis	-SCI is handled under the four dimensions in our study; internal integration, supplier integration, customer integration and information integration respectively. Study found that most of the SCI sub-dimensions does not directly relates to operational and business performance, it reveals two exceptional situations. They are also found the relationships between customer integration and operational performance, and between internal integration and business performance. Further investigated customer integration positively influences operational performance and internal integration positively influences business performance.	European Journal of Economics, Finance and Administrative Sciences

	nce					
20Baharanci(2011)	Investigating Relationship between Product Features and Supply Chain Integration	-Examined the relationships between supply chain integrations(internal, upstream (supply)and downstream (demand)) and with product features(innovative and quality)	Research	survey method	-This result provides that highly collaborative practices with suppliers and customers are likely to have an excellence performance in product quality and innovation due to the improvement of information visibility in supply chain. Firms targeting in high product quality performance require a greater need for supply integration than customer integration. -Also obtained that, firms that focus on product innovation need more focus on customer integration than supply integration.	International Journal of Mechanical Aerospace, Industrial, mechatronics, and Manufacturing Engineering.
21. Deshpande(2012)	Supply Chain Management Dimensions, Supply Chain Performance and Organizational Performance	To Analyzed the SCM performance measures and how SCM dimension related to organizational performance .	Research	Comprehensive literature review, a theoretical framework and propositions were derive.	-Result show that increased interaction between important constituents of supply chain management, enhance the organization's ability to meet desired goals. Improved organizational performance, measurements like Cost savings, increased revenues, and the reduction of defects in products were obtained by the implementation of supply chain managements. -The result also indicated that, the integrated framework provides managers with a overarching framework for linkages between SCM dimensions, SCM performance, and organization performance.	

III. DISCUSSION

Wide range of research work was conducted to related with supply chain and supply chain integrations. We apply Systematic review analysis to summarized the concepts in the table above and it give lights on to different aspects of supply chain integrations of manufacturing industries. The analysis of the paper are trussed and researchers conducted about the level and dimension of supply chain integration, the extent of firm integration, affect comparative advantages was truss. Other papers give direction for the effect of supply chain integration on product quality, firm performance, market shear, efficiency, capability and competitiveness of the company. furthermore they also show the effect of information shearing, resource, knowledge, culture on supply chain integrations. Therefore from the analysis we find the following points.

a) The key factors influence on supply chain integration

There are numerous factor influence the implementation of supply chain integration, this factor have appositive or negative impact on firm performance, market shearing and competitiveness. Vaar & Donk (2008), Otchere *et.al* (2013), Msimangira & Tesha (2014) Technology, skill, information shearing, collaboration, decision making, Trust, the extent of integration or level

of integration, are the common problems indentified from the study. according to Moshkdanian & Molahosseini (2013) Information sharing between Manufacturer and its suppliers has a positive relationship with its logistics integration. integration of material flow needs to be information shearing and integration between supply chain companies for competitive performance. Furthermore market share and in particular business performance on manufacturing company improved trough investing in new technology and adopting of innovative supply chain integrations Agus (2011). this result shows that instead of using outdate technology it is better to use new technology and systems to improve the overall performance of Supply chain integrations on integrated and member organizations. weak and improper supply chain integration also major factor on supply chain integrations.

Flynn *et.al* (2009), Agus (2011, Lotfi *et.al* (2013) argue, that Supply chain partners cooperation and collaboration improve manufacturing companies in terms of quality, performance and market shearing. Effective supply chain integration and collaborative activities between manufacturer, supplier and costumer which enables firms to work together and improve product quality. They believe that the integration is found as customer integration, supplier integration, and

internal integration. The study indicated that internal integration has effects on supplier integration as well as customer integration. we argue that the interaction, collaboration and level of supply chain integration affects the companies competitive capabilities and their performance. However, Adopting proper information shearing, Manufacturing industries should implement highly integrated supply systems in three levels that is, customer, supplier and internal integrations so as to improve product conformance, manufacturing capacity, product quality, market shearing and their performances as well.

b) The Role of Information on Supply Chain Integration

In this study we find out the role of information shearing and information technology for the collaboration, communication and coordination of Supply chain industry, enhance the effectiveness of supply and customer integration. Boon-itt (2011), Moshkdanian & Molahosseini (2013) bring to light that, information sharing and information technology are a key argument in success integration of automotive industries to improve their performance. Researchers also argue that, information technology infrastructure is significantly impacting supply chain integration as well as firm performance directly Agan (2011). According to Alfalla-Luqu.*et.al* (2013) Supply chain integration was analyze in terms of as multi-dimensional framework on information integration, Coordination resource sharing and organizational relationship linkage from both the inter- and intra-organizational perspectives.

c) The effect of supply chain integration on Quality

Supply chain integration and quality are the two success factor of an organizations. An integrated supply chain improve quality and customer satisfaction. From the previous study we observed that Lotfi.*et.al*(2013), the higher integration of internal and external supply chain have impacts on design quality and conformance quality. these quality affects the overall performance of the organizations. They also Argue, collaborative activities between manufacturer, supplier and costumer which enables firms to work together and improve product quality. The interaction effect of collaboration/decision support information technology to enhance the effectiveness of supply and prevent quality problems Boon-itt(2011).This implies that within integrated information shearing and collaboration, integrated supply chain have critical role for enhancing quality and comparative advantages. other study provides that, highly collaborative practices with suppliers and customers are likely to have an excellence performance in product quality and innovation due to the improvement of information visibility in supply chain Baharanchi (2011). Hence high supply chain integration results, excellence performance in product quality.

d) The effect of supply chain integration on performance

The performance of manufacturing industry highly interrelated with the way and the extent of supply chain integrated. This Supply chain integration is considered as a critical effect in improving firm performance. Ozdemir and Aslan (2011) found that the supply chain integration affects the companies competitive capabilities and performance of firms. He elaborates, supply chain integration and subtitles of the competitive capabilities (cost leadership, customer service, flexibility and product indicators), affect market and financial performance of supply chains. study on Agan (2011) show that, Supply chain integration likely improve performance by eliminating inefficiencies and inconsistencies, streamlining processes, providing customers what they want, when they want it, reducing excess inventories, and proactively managing demand. However valuable integration of suppliers into supply chain will be a key factor for some manufacturers in achieving competitive advantage and performance. These also supported by Vickery.*et.al* (2003), Agus (2011), Moshkdanian & Molahosseini (2013) findings of Product conformance, product reliability and product durability had high correlations with all SCM dimensions especially with 'lean production', and 'new technology and innovation. The analysis also supported Vaart& Donk(2007), Krishnapriya & Baral (2014). The result shows, ultimately overall business performance improved trough manufacturing company investment in new technology and innovation in supply chain integration and adoption of lean production Systems in Manufacturing companies. These shows implies that developing an integrated supply chain system ultimately improve the performance of manufacturing industries.

From the analysis and finding, we summarize, most of the selected articles are discussed about how variables, key factors of supply chain integration like Technology, information shearing and information technology, Collaboration, cooperation and integration, way and level of supply chain integration and belief affect the overall capacity and performance of the supply chain integration. On the other hand, effective and efficient resource utilization, information shearing, supply chain coordination and cooperation, highly bonded supply chain integration, adopting appropriate technology, fully supply chain system(Internal, customer & supplier), are improve quality, trust, market shear and the overall performance of the Supply chain Industries Zolait *et al*(2010), Agan (2011), Baharanchi (2011), Deshpande (2012), Jozi & Moradi(2014).

Most of the research is concerned on supply chain performance, supply chain cooperation and information shearing, type of integration(internal, external), the effect of supply chain integration on firm

performance and quality Xiong & Helo (2008), Otchere.*et.al*(2013, Msimangira & Tesha(2014). In Basic metal industry Supply chain integration found and it should be a complex and compressive issue between the supply chain organizations. These implies that supply chain integration involves, Innovation and technology transfer, Social and Environmental responsibility, Supply chain leadership (Leader), on industrial safety and Occupational health, Environmental sustainable performance, political issue will into consideration and need further researches. Few researches Flynn. *et. Al* (2009) also conducted to effects of supply chain integration on performance and quality seen from manufacturers point of view but missing for supply chain integration effect on firm performance from customer and supplier concepts. Because supply chain integration is interaction and effect of multi-dimensional joints(Manufacturer, Supplier, Customer) systems and hence justify the exact performance, needs for further investigations.

IV. CONCLUSION

In this study, supply chain integration of basic metal industry is addressed. During of globalization and advancement of information technology basic metal industries work together, to improve their performance and competitiveness on global markets. Meanwhile, in this work the key factors of supply chain integration and the effects of supply chain integration on basic metal industries are clearly discussed. In main time further research areas also proposed. The limitation of this work is, most information's gather from secondary data not considered primary data (questioners are not distributed to the industries.

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Minimization of Rework in Food Industry by Applying Pareto Chart and Cause Effect Diagram

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Abstract- As food manufacturing sector is an emerging sector in Bangladesh, quality improvement can play an indispensable role in improving productivity and economic development for our country as well. The fast changing economic conditions such as global competition, declining profit margin, customer for high quality product and reduced lead-time etc. The demand for higher quality product is increasing and to survive in the competitive market food manufacturers need to improve their operations through producing the product right first time. This paper illustrates a very detailed investigation on rework reduction as well as quality improvement of a food factory by applying Pareto Analysis and Cause-Effect Diagram. The aim of this study is to minimize rework generation that will improve productivity and profitability. One month data has been collected from the management, then Pareto Analysis and Cause-Effect Diagram are performed on them. The application of this paper improves the process performance of the critical operational process, leading to better utilization of resources, decreases variations and maintains consistent quality of the process output. The outcome of this observation demonstrates that a manufacturing industry can gain higher productivity and profitability. It also minimizes cost and reduces the production time.

Keywords: reworks, pareto analysis, root cause analysis, cost reduction, profitability.

GJRE-G Classification: FOR Code: 090805



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I. INTRODUCTION

The food industry has played an immense role in the development of industrial sector of Bangladesh. Although it started lately, it soon established its reputation in the competitive Bangladeshi market. In many food manufacturing processes, some of the products can be defective due to an unstable production environment, non-perfect technology or human mistakes. Instead of being disposed of, defective items are more and more put into recovery processes in order to reassemble material and value added. These reuse activities are also supported by a growing environmental consciousness. Recovery actions belong to the broad field of Reverse Logistics which deals with all kinds of reuse processes in supply chains. As a major activity in this context we face rework which aims at recovering defective products in such a way that they definitely meet the quality level of a good

item. Integrating rework and manufacturing processes successfully leads to challenging planning and control problems, especially if both processes are using the quite same equipment. Rework is the unnecessary effort of re-doing a process or an activity that was incorrectly implemented or produced at the first time. It is an endemic feature of food manufacturing and is a fundamental factor that contributes to time, effort and cost overruns in manufacturing processes.

Rework occurrences adversely impact the performance aspects of food manufacturing process e.g. with respect to costs, time, quality as well. The impacts of rework on food manufacturing management control include (a) additional time to rework, (b) additional costs for covering rework occurrences, (c) additional materials for rework and subsequent wastage handling, (d) additional labor for rework and related extensions of supervision manpower.

Although changes may be considered as inseparable in some perspectives, uncontrolled occurrences of rework and wastages should be effectively controlled to improve various targeted objectives of food manufacturing process e.g. with respect to timeliness, costs targets and product quality as well. The study has been conducted in food industry that chiefly aims at (a) identifying significant rework items and their root causes in the manufacturing process and (b) developing structured frameworks for effective rework control and management.

Minimization of reworks is a must in quality and productivity improvement. Reworks are the nonproductive activities focusing on any activity that customer are not willing for. Nonproductive activities describe that the customer does not consider as adding value to his product. By reacting quicker in minimization of reworks to make a product as per customer demand with expected quality, the company can invest less money and more costs savings. Therefore, the study has been carried out in food manufacturing industry named Nestle Bangladesh Limited. In the organization, we worked in a particular section (i.e. manufacturing section) for a particular product (i.e. noodles) to identify reworks so as to eliminate them for saving time, cost and improved product quality. A general overview over the development is given in this paper that suggests

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how to handle these issues and bring down the rework to minimum conclusively.

II. METHODOLOGY

In this study, we have maintain some basic steps. We apply some fundamental Quality Control (QC) tool for our analysis purpose. The method we followed is described by some steps in below:

a) *Industry & Factory Selection*

Industry and Factory selection is most important with respect to our study. As we planned to minimize the rework generation in a Food industry, we have gather information and communicate with some of the declining industry in the market for helping them to develop its production.

b) *Conducting Case study*

In this step, we have studied the whole process of production and review of the existing quality system. We also go through some research work related with our field.

c) *Accumulation of Information*

Collecting the relevant information we used the Check sheet for everyday rework generating at different place. This data collection process lasts for 12days.

d) *Problem Identification*

We analysis the raw data and we interpret this data in the Pareto Chart and identify the vital few and most critical zone of rework generation.

e) *Analysis & Calculation*

After processing the Pareto chart we have analysis the most critical Zone with Cause-effect diagram and find the actual problem that lies behind the loss of productivity. A cost calculation of the total rework is also calculated for getting the total monitory loss in every month.

III. REWORK

Broken cakes, chips generated from cakes are usually called Rework. Certainly, the dry rework is a safe product and can be consumed, but the QA release is required for it. But the concern is, it is not at the desired shape. So, it needs further processing with new batch. Chips are generated at different transformation zone, from one conveyor to another conveyor at wrapping section. If any problem occurs at wrapping machine, cakes are temporarily stored at different buffering boxes from slat conveyor. While buffering, cakes may get broken and chips are also generated as well. Thus rework generates. But, generation of rework is undesired and the general practice is to minimize the rework generation as less as possible.

a) *Types of Rework*

Steam Rework: Rework collected from Roller section to Pre-Dryer section is called steamed Rework. Shelf life of this Rework is 2:30 hours. It must be mixed with dough mixture within that time after having prescribed treatment.

Dry Rework: Rework collected at wrapping section is called Dry Rework. Expired time of this Rework is 90 days. It needs Soaking operation for oil removal and then gets mixed with dough mixture.

IV. PROCESS FLOW IN NOODLE LINE

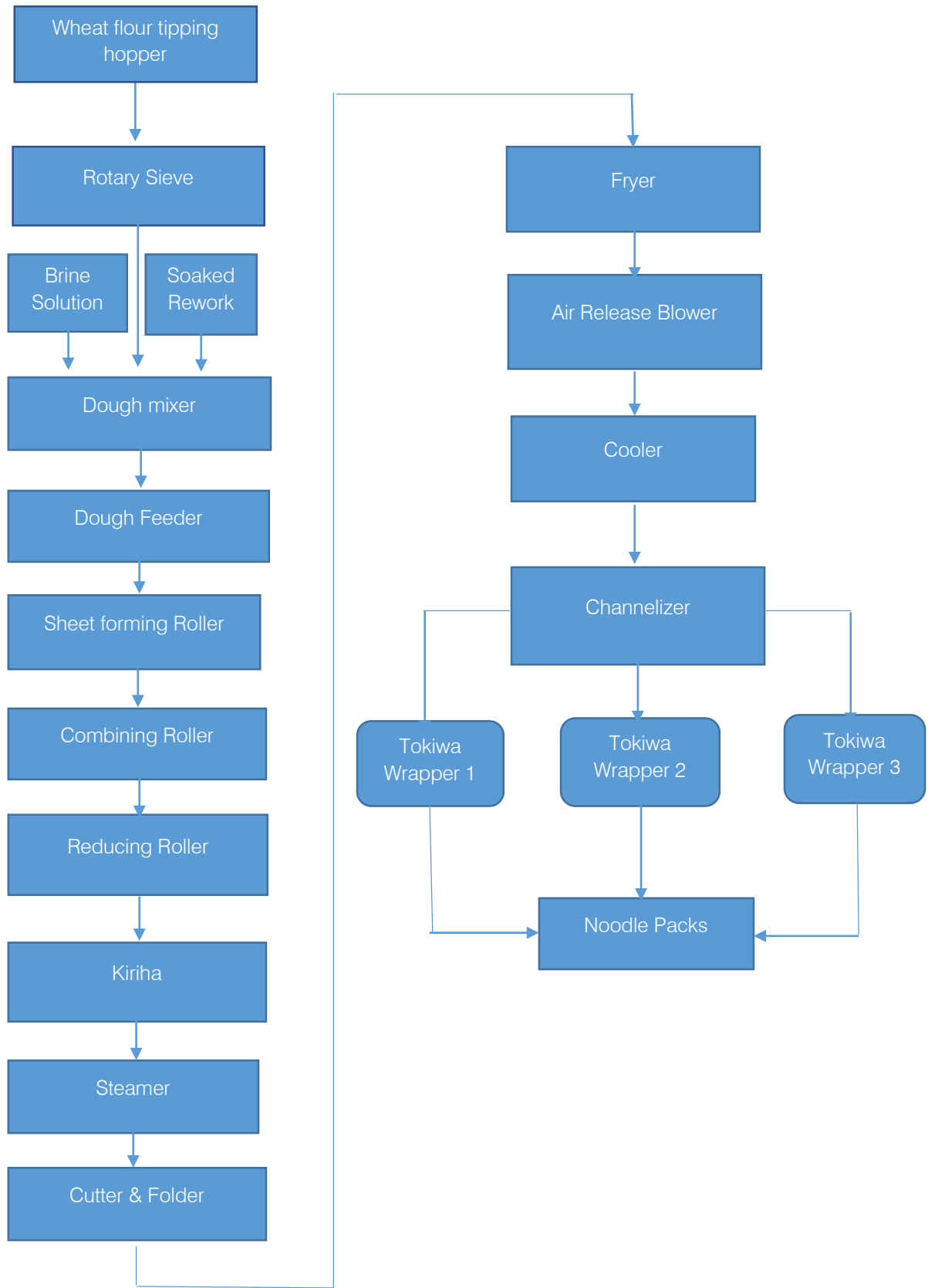


Fig.1 : Process flow Diagram of Noodle Line

V. EXPERIMENTAL DATA

Week	Day	Buffering Box	Channelizer	Feed Conveyor	Sachet Dispenser	Metal Detector	Auto Feeder	Pull Conveyor	Slat Conveyor	Overhead Conveyor	Total
1	1	270	8	4	3.5	2.5	9	1.5	.5	.5	299.5
	2	265	6	5	2	2	8	2	.5	1	291.5
	3	280	5	3	4	1.5	7.5	2	1	.5	304.5
	4	285.5	10	4.5	5.5	1	9.5	2	.5	.5	319
	5	265.5	6.5	3	4.5	2	7.5	1.5	.5	1	292
	6	277	7	2.5	3	2.5	7	2	.5	.5	302
2	1	265	6	3	2	2	5	1.5	.5	.5	285.5
	2	285	5.5	2	2.5	1	4.5	1.5	.5	1	303.5
	3	277	4	5	3.5	2	6	2	1	1	301.5
	4	282	3.5	4.5	3	2.5	4.5	1.5	1	1	303.5
	5	284	3	4	2.5	3	7	1.5	.5	.5	306
	6	268	3	5	4.5	2.5	4	2.5	.5	.5	290
Total		3304	67.5	45.5	40.5	24.5	79.5	21.5	7.5	8.5	3678.5
3	1	52	3.5	4	2	3	3	2	.5	.5	29.5
	2	61	5	3	1.5	1.5	2.5	1	.5	1	38
	3	53	4	3	2	2	3.5	1.5	1	1	29
	4	50	5	6	2	1.5	2	.5	.5	.5	38
	5	46	5.5	4	3	2.5	3	1	2	1	45.5
	6	49	6	5	4	2	2	1.5	1	1	42.2
4	1	54	3	6	2.5	1.5	2.5	2.5	1	1	39.5
	2	51	3.5	4	3.5	2	1.5	1	1	1	40
	3	60	3.5	3	4.5	1.5	2.5	2	.5	.5	40
	4	65	3.5	2.5	3.5	1	2	1.5	1	.5	35.5
	5	46	4	2.5	3	2.5	3	1	2	.5	39.5
	6	54	4	3	3.5	2	2	2	.5	.5	41
Total		641	50.5	46	35	23	29.5	17.5	11.5	9	417

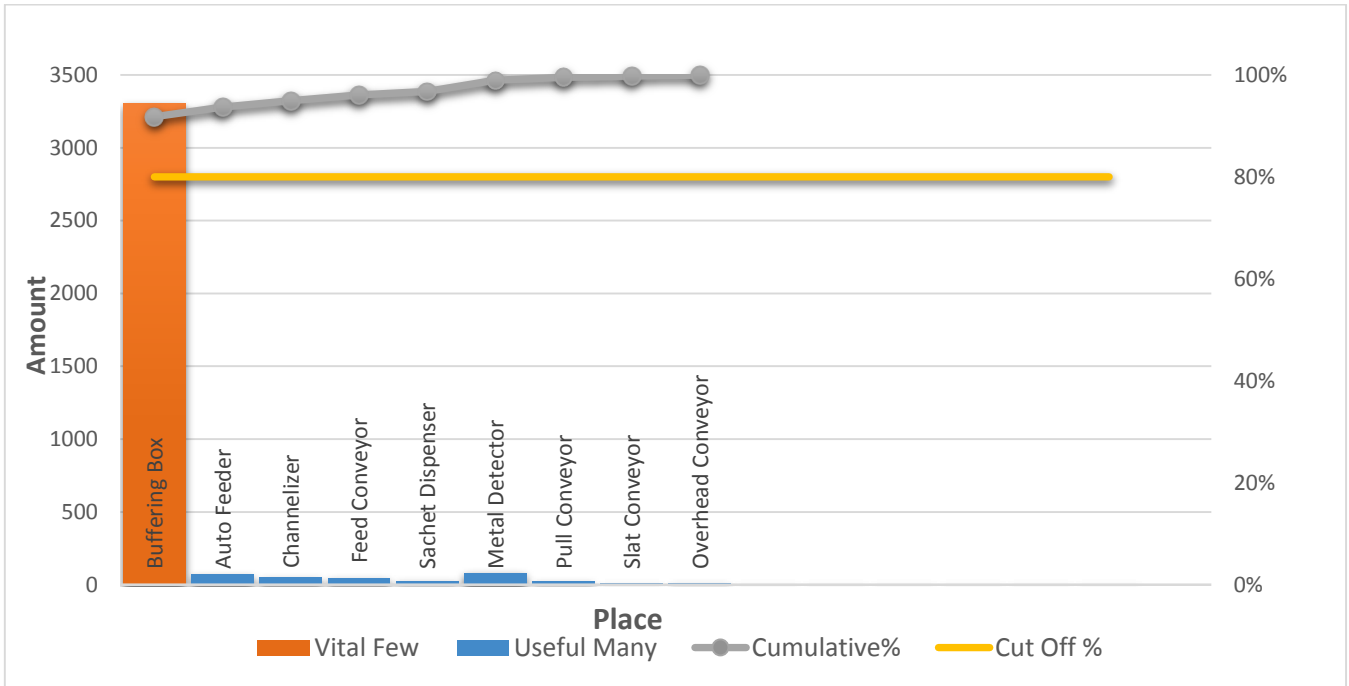


Chart 1: Pareto chart of Rework generation before implementation

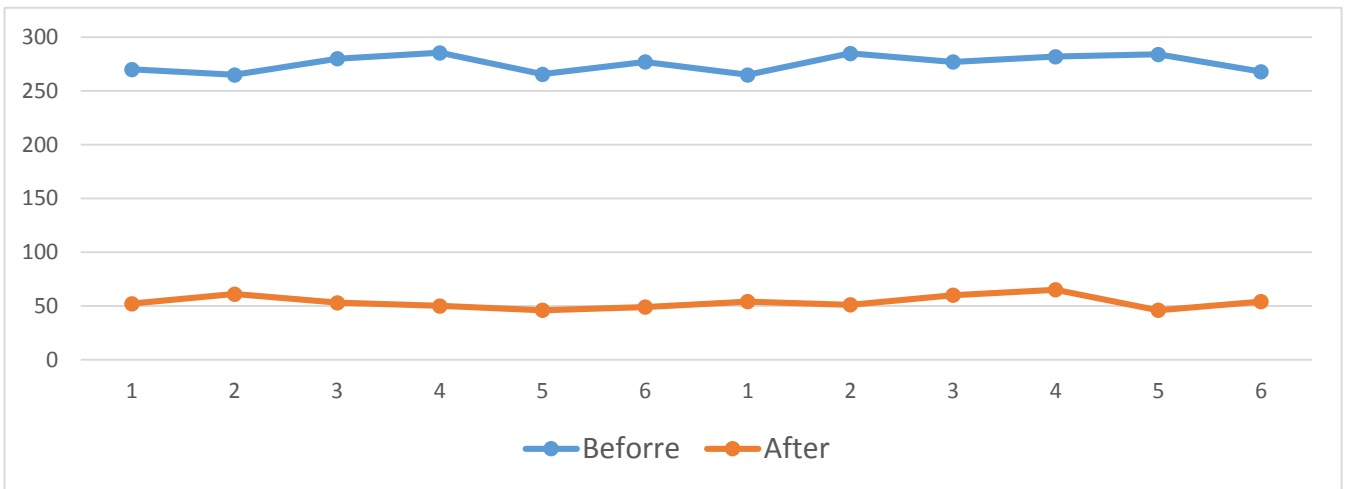


Chart 2 : Daily rework generation at Buffering Box

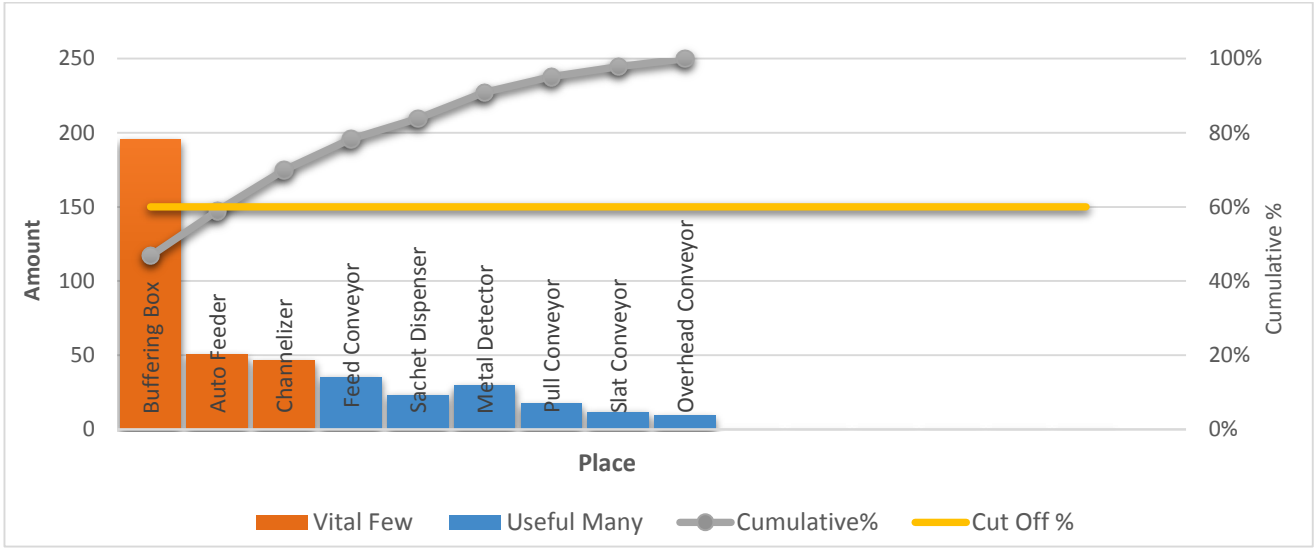


Chart 3 : Pareto chart of Rework generation after implementation

VI. CAUSE-EFFECT DIAGRAM

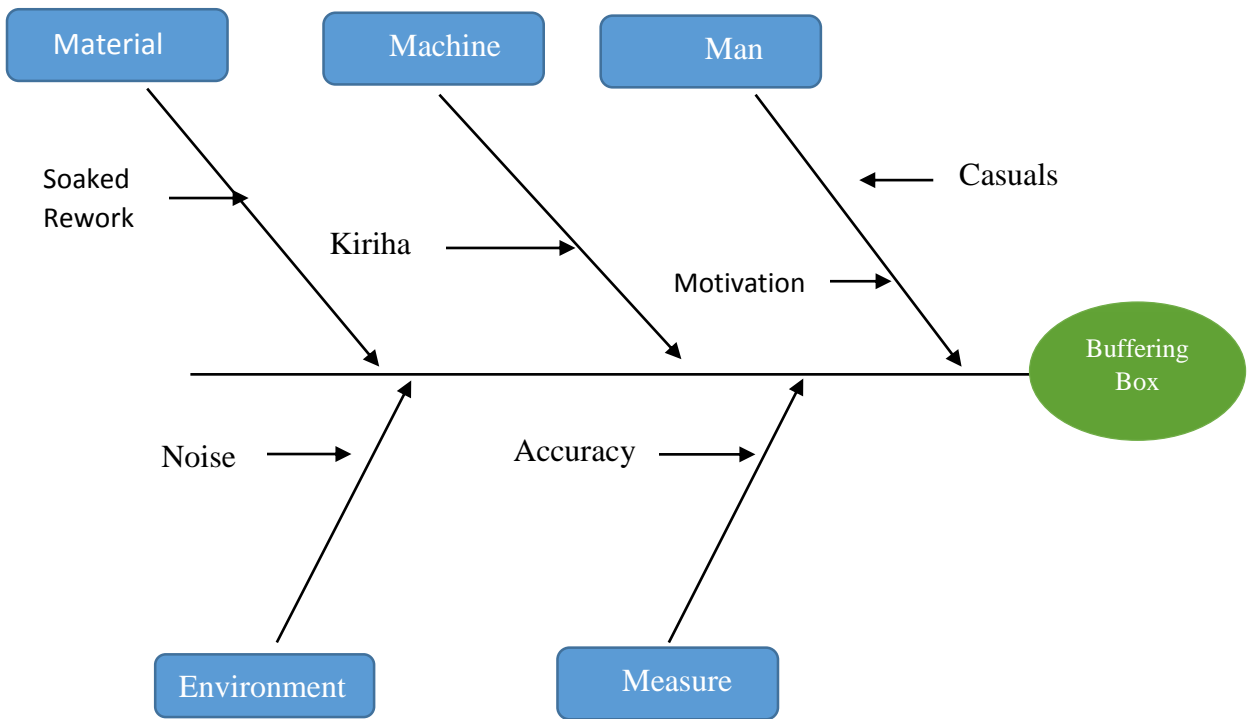


Diagram 1 : Cause effect diagram for Buffering Box

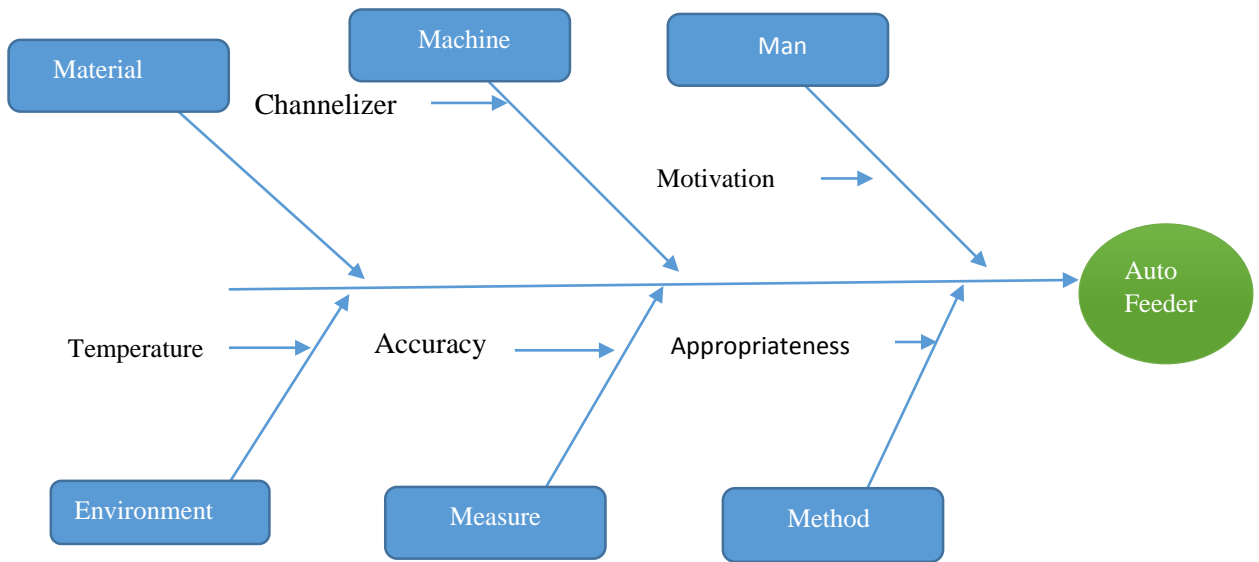


Diagram 2 : Cause effect diagram for Auto Feeder

VII. COST ANALYSIS

Table 1 : Cake Falling on Side Wall

Sample No	Weight of Cake		Rework generation	Average quantity of Rework generation (gm)
	Before (gm)	After (gm)		
1	65	63	2	2.33
2	62	61	1	
3	64	61	3	
4	65	62	3	
5	63	60	3	
6	61	59	2	

Table 2 : Cake Falling on Bottom Portion Buffering Box

Sample No	Weight of Cake		Rework generation	Average quantity of Rework generation (gm)
	Before (gm)	After (gm)		
1	62	58	4	3.16
2	64	61	3	
3	65	62	3	
4	63	59	4	
5	64	62	2	
6	66	63	3	

Storage capacity of one Buffering box = 1120 pcs of cakes

General cut speed = 55 pcs/min

Total no. of cakes cut per minute = Cut Speed × No. of lanes = 55 × 9 = 495 pcs/min

No. of cakes passes through every Slat Conveyor per

$$\text{minute} = \frac{\text{No. of cakes}}{\text{No. of slat Conveyor}}$$

Rework contribution from one buffering box = 6 Kg (measured manually)

In case of 100 Kg Rework generation from one buffering box,

Idle time of wrapping machine =

$$\frac{\text{Total rework generation at buffering box}}{\text{Per minute rework generation at three slat conveyor}} = \frac{100}{0.88} = 113 \text{ min}$$

$$= \frac{495}{3} = 165 \text{ pcs}$$

Time needed to fill the buffering with cakes

$$= \frac{\text{Storage capacity of one buffering box (pcs)}}{\text{No. of cakes at slat conveyor}}$$

$$= \frac{1120}{165} = \cong 6.8 \text{ min}$$

Per minute Rework generation from one Slat

$$\text{Conveyor} = \frac{6.8}{6} = .88 \text{ Kg/min}$$

Cost before applying our proposed process

Material	Amount	No. of line	Total Amount	*Loss	Loss in BDT
	3304 kg	3	9912Kg	0.3×9912=2973.6Kg(estimate direct loss 30% of total rework)	654192
Labor	113 min	3	339 min	339min (100% loss of labor) 339×33.04=11200.56min	19444
Total Daily loss					673636

Material	Amount	No. of line	Total Amount	*Loss	Loss in BDT
	641kg	3	1923kg	576Kg	126720
Labor	113min	3	339min	339*6.41=2173 min	3772
Total Daily loss					130492

VIII. DISCUSSION

We found 3304kg rework generated in every month by buffering box. That`s why we add some features in it to control and minimize the huge loss of

raw material. Our proposed buffering box minimize about 80% of its local rework produced in the buffering box. After applying our proposed recommendation almost BDT 543144 saved per month.

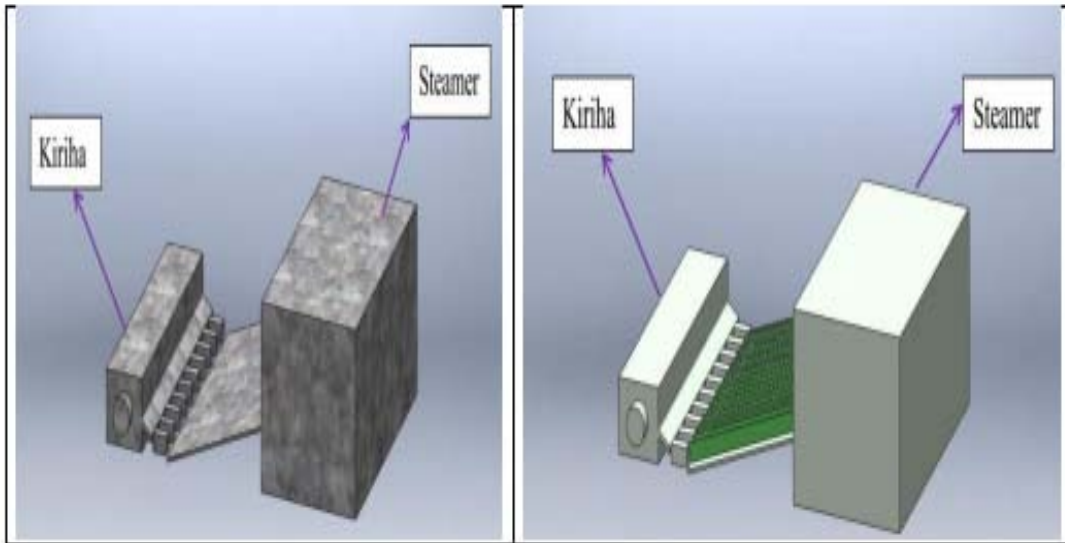


Figure 1 : Existing

Figure 2 : Proposed

IX. CONCLUSION

Bangladesh, an emerging food manufacturing country faces a huge trouble with its conventional food processing method. The country now experienced a lack of quality control hence most of the factory are semi- automated or partially automated, that`s why a huge portion of rework is generating every day. Rework minimization is very necessary for increasing productivity. Our primary objective was to find out the main rework generating area and then find out its solution. We have performed Pareto-chart analysis to measure the higher concentration area. After all, we

conducted a complete cause-effect analysis to find out the principal cause of the problem. About 89% rework generated in Buffering Box area and the second most in Auto feeder. We finally gave some suggestions and a little bit change of design in the buffing box. After implementing this steps we further took the data and found about 80% of rework can be minimized in the buffering box area.

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Study on Supply Chain Management of Industries in FMCG Sector in Bangladesh

By Sobuj Kumar Ray, Avizit Basak, Kanij Fatema
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Abstract- Now a days, supply chain management plays an important role in business industry. Supply chain management involves optimizing industrial operations to increase both speed and efficiency. Both speed and efficiency are vital to increase service quality and ensure product delivery at earliest time. Efficiency also increase the power of industry to handle their partners in a structured manner. The FMCG Industry is on a high growth in our country. Proper supply chain management practice is important for FMCG industries of our country because customers will choose the company that meets their needs fastest. It is also important to get competitive advantages in global market. Industries of our country increasingly find that they must rely on effective supply chains, or networks, to compete in the global .Industries are now realizing that customer driven supply chain configuration helps them to participate in achieving growth.

Keywords: KPI, SWOT, lean concept.

GJRE-G Classification: FOR Code: 150309, 290502p



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Study on Supply Chain Management of Industries in FMCG Sector in Bangladesh

Sobuj Kumar Ray ^α, Avizit Basak ^σ, Kanij Fatema ^ρ & M. M. Israfil Shahin Seddiqe ^ω

Abstract- Now a days, supply chain management plays an important role in business industry. Supply chain management involves optimizing industrial operations to increase both speed and efficiency. Both speed and efficiency are vital to increase service quality and ensure product delivery at earliest time. Efficiency also increase the power of industry to handle their partners in a structured manner. The FMCG Industry is on a high growth in our country. Proper supply chain management practice is important for FMCG industries of our country because customers will choose the company that meets their needs fastest. It is also important to get competitive advantages in global market. Industries of our country increasingly find that they must rely on effective supply chains, or networks, to compete in the global .Industries are now realizing that customer driven supply chain configuration helps them to participate in achieving growth. This requires appropriate thinking on the ways in which an industry would structure itself in terms of its key supply chain tools. Supply chain management is also important for industrial success. Industries with geographically more extensive supply chains connecting diverse trading groups tend to become more effective, innovative, and productive and customer focused.

Keywords: KPI, SWOT, lean concept.

I. INTRODUCTION

Fast Moving Consumer Goods (FMCG) goods are commonly named as consumer packaged goods. Items in this category include all consumables (other than groceries/pulses) people buy at regular periods. The most common in the list are toilet soaps, detergents, shampoos, toothpaste, shaving products, shoe polish, packaged foodstuff, and household accessories and extends to certain electronic goods. These items are meant for daily of frequent consumption and have a high return.

The FMCG Industry is on a high growth curve with the overall demand expected to multiply over the next decade. This high growth is most likely to be

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accompanied by significant structural shifts such as changing customer preferences, emergence of modern retail dimensions, growing rural spend tendency.

II. SUPPLY CHAIN MANAGEMENT

Supply chain management, then, is the active management of supply chain activities to maximize customer value and achieve a sustainable competitive advantage. It represents a conscious effort by the supply chain firms to develop and run supply chains in the most effective & efficient ways possible. Supply chain activities cover everything from product development, sourcing, production, and logistics, as well as the information systems needed to coordinate these activities. A customer-focused definition is given by Hines (2004:p76): "Supply chain strategies require a total systems view of the links in the chain that work together efficiently to create customer satisfaction at the end point of delivery to the consumer. As a consequence, costs must be lowered throughout the chain by driving out unnecessary expenses, movements, and handling. The main focus is turned to efficiency and added value, or the end-user's perception of value. Efficiency must be increased, and bottlenecks removed. The measurement of performance focuses on total system efficiency and the equitable monetary reward distribution to those within the supply chain. The supply chain system must be responsive to customer requirements."

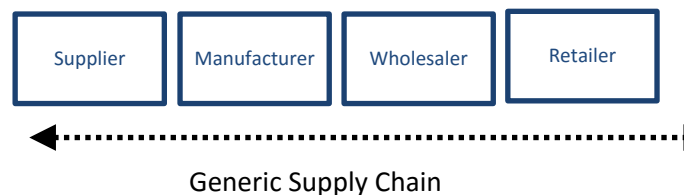


Fig. 1: Basic Supply Chain Management Diagram

III. VALUE-CHAIN CONCEPT

The value chain framework quickly made its way to the forefront of management thought as a powerful analysis tool for strategic planning. The value-chain concept has been extended beyond individual firms. It can apply to whole supply chains and distribution networks. The delivery of a mix of products and services to the end customer will mobilize different economic factors, each managing its own value chain. The

industry wide synchronized interactions of those local value chains create an extended value chain, sometimes global in extent. Value chain analysis has also been successfully used in large organizations to show how work selection, work planning, work scheduling and final work execution.

IV. SWOT ANALYSIS

a) Strength

Most of the FMCG companies of Bangladesh are producing fresh drinking water, Atta, Maida, Suji, Soyabean Oil and so on. ISO 9001:2000, certificate earned by many industries for their facilities for quality product and management. Some company achieved Quality Summit Award for outstanding performance in quality commitment and industrialization.

b) Weakness

There are some limitations to run operations of industries in Bangladesh. Most of the employee and worker of factories are not used to with ERP system. So in this case to collect information sometimes need to use manual system, which causes information gap. In FMCG sector should use pull marketing strategy, but in many industries are mostly dependent on push strategy.

c) Threats

Inflation and political instability causes so many problems, like inflation raise the price of raw materials

and instable political situation causes hamper in delivery process, planning process etc.

d) Opportunities

There is a huge opportunity for many Industries. Some company has huge capital and resources to become multinational company. But in this case it is necessary to change their position gradually and need to proper utilization of their resources.

V. PUSH PULL CONCEPT

Push based supply chain strategy, usually suggested for products with small demand uncertainty, as the forecast will provide a good direction on what to produce and keep in inventory, and also for products with high importance of economies of scale in reducing costs. Moreover, Pull based supply chain strategy, usually suggested for products with high demand uncertainty and with low importance of economies of scales, which means, aggregation does not reduce cost, and hence, the firm would be willing to manage the supply chain based on realized demand. Again, Hybrid Push-Pull strategy, usually suggested for products which uncertainty in demand is high, while economies of scale are important in reducing production and/or delivery costs

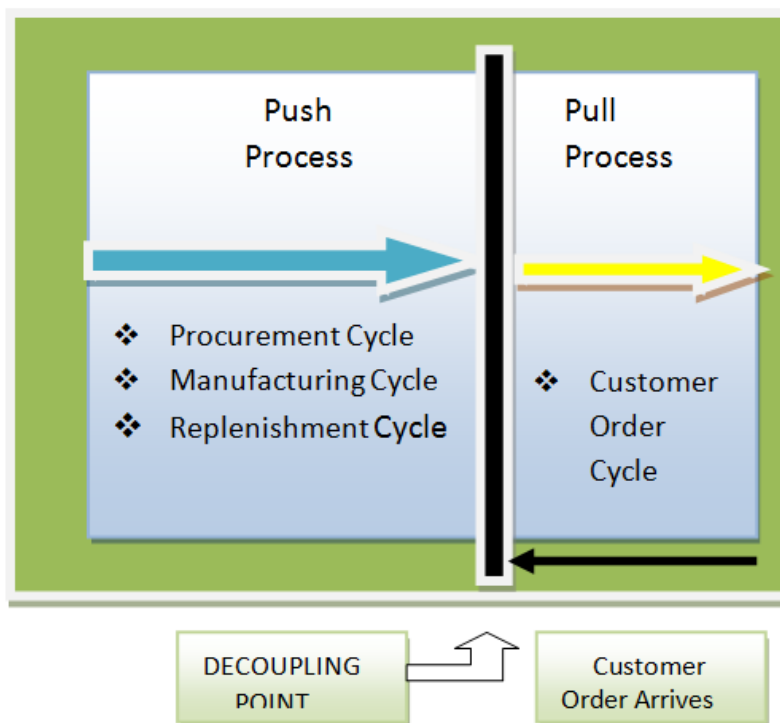


Fig. 2: Push pulls Strategy of supply chain management

VI. IMPORTANCE OF SUPPLY CHAIN MANAGEMENT IN INDUSTRIES OF BANGLADESH

To overcome new challenges that need to be addressed for an efficient and effective supply chain are

1. Managing generation of different varieties
2. Aligning to the out start of new channels
3. Competitive pressures
4. The need to improve operations
5. Increasing levels of outsourcing
6. Managing the challenges of reach and so on

Agility in supply chain: Agility practices enable the supply chain to change how processes operate.

Agility allows supply chain partners to work together to produce the amount of product that is needed daily, not based on quarterly, monthly, or yearly forecasts. Essentially, agile solutions are a means of taking the lean supply chain and improving it to respond and foster supplier-to-customer-to-manufacturer relationships. Supply chain entities who have implemented agile supply chain solutions understand that real-time data means the sudden change in demand could occur without warning, which could undermine the relationship between suppliers. Therefore, these entities have sought to find ways to still arrive at the same finished product, but at a customized result for each order.

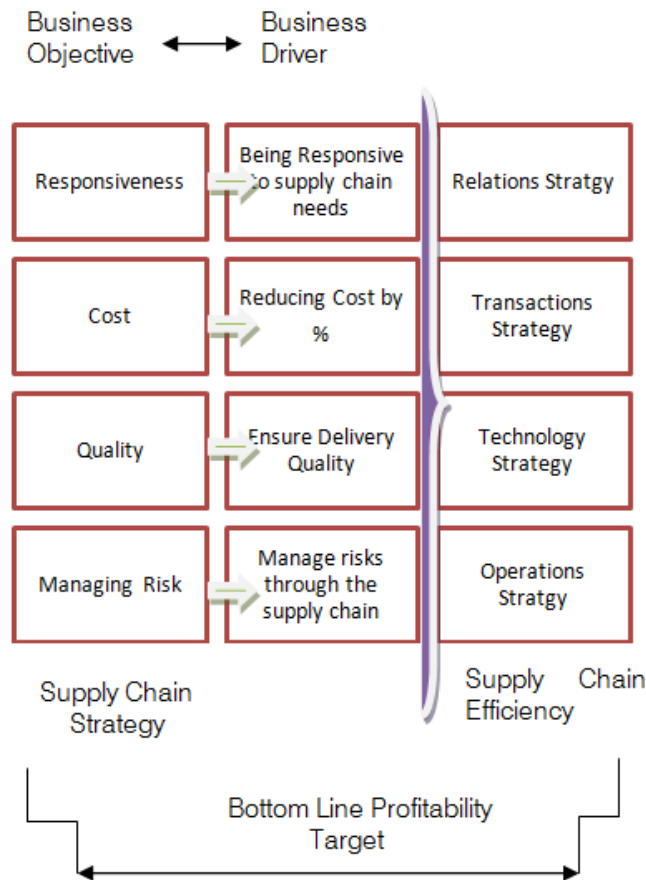


Figure 3: Agile supply chain strategy

VII. LEAN CONCEPT

The concept of Lean which is essentially a team-based approach to continuous improvement focused on eliminating non-value added activities or “waste” from the viewpoint of the customer, has been around in one form or another for many years, at least in manufacturing. It is only recently that it has been applied to the supply chain & logistics management area.

Importance of transportation system: A transportation management system is a subset of

supply chain management concerning transportation operations and may be part of an enterprise resource planning system. A TMS usually sits between an ERP or legacy order processing and warehouse/distribution module. Transportation system plays a vital role to get competitive advantages. Proper transportation system save time and money and ensure quick delivery of the product to the customer. Transportation management systems manage key processes of transportation management such as

Planning and optimizing of transport rounds
 Inbound and outbound transportation mode and transportation provider selection
 Management of motor carrier, rail, air and maritime transport
 Real time transportation tracking
 Service quality control in the form of KPIs
 Vehicle Load and Route optimization
 Transport costs and scheme simulation
 Shipment batching of orders
 Cost control and so on.

VIII. KEY SUPPLY CHAIN ACTIVITIES OF SCM DEPARTMENT OF SOME INDUSTRIES

a) *Procurement*

Raw materials and packaging materials inventory purpose continuously coordinate with local and foreign trade department. According to product requirements based on market demand, analysis is made to find out proper quantity within the right time of raw materials and packaging materials. This is approved by the top management.

b) *Inventory*

Accomplished real time visibility into demand, supply, costs and fulfillment measures and trends. Create an inventory costs, turn rates and inventory profitability

c) *Production*

It is an important part which is done by based o forecast production plan provides by the factory and meet demand from the regular stock.

d) *Planning*

Strategy for managing all resources that goes toward meeting customer demand for their product & services. Ensure resources utilization to achieve exact efficiency through inventory and production planning. Distribution planning is necessary to improve utilization levels of transportation. Optimization is essential to collaboration with suppliers, customers and partners.

e) *Order Processing & Distribution*

Co-ordinate with receipt order from customer, take immediate steps for approval & make DO for fast delivery. Proper transport system is essential to distribute. For abnormal situation, use rail and cargo trailer to ensure smooth delivery process. Transport optimization analysis done by analyzing of data.

f) *Depot Management*

Small amount sales order taken from depot and distributed from there to minimize the transport cost and leading time.

IX. IMPORTANCE OF KPI

Using KPIs for performance measurement ensures that industries are always evaluating business activity against a static benchmark. This shows that fluctuations are immediately visible and if performance moves in the wrong direction, action can quickly be taken to address the situation. When a KPI shows that performance is consistently meeting or exceeding the required level, industries can decide to raise the bar and set a higher standard to aspire to. For this reason, KPIs are essential for any business improvement strategy.

a) *Competitive Advantages*

Greater and more intense competition and global value chains are leading to substantial shifts in what is expected of the supply chain function. It is no longer enough to simply connect supply and demand at optimal cost and service levels. Today's business industries are demanding more from their supply chains, including competitive advantage. Operations and Supply Chain both play important parts in any organization. Focuses on how Firms can use Operations Management and Supply Chain Management to gain competitive advantage. The ways in which competitive advantage in operations management can be achieved are explained with special focus on game-changing trends in operations and supply chain management Integrated Strategies supply chain experience comprises a powerful combination of industry research and consulting support. Our track record includes advancing methodologies and business contributions in the following areas: Sourcing/Purchasing, Commodity/Supply Base Management, Logistics, Materials Management and Planning, Distribution, Inventory Management, Warehousing, Customer Focus and Distinction, and Transportation.

b) *KPI Analysis of SCM*

If we consider a product, such as tea; then an industry will try to achieve next following objectives to improve their business in every month or every year. For this purpose, an industry can consider these areas such as to increase inventory turnover, perfect order rate, inventory to sales ratio, rate of returns and so on.

Process to achieve exact order rate with error reducing-

Formula= (Cancel D.O)/ (Total Customer Order)

Indicator	July 2016	August 2016
Quantity	(Value is assumed) 460/123455 = .0032	390/132455 = .00294
Value	108100/31859965 = .0033	245873/86422391 = .0029

Maintain proper rate of return-

Indicator	July 2016	August 2016
Quantity	(Value is assumed) 3/22391 = .00013	(Value is assumed) 5/21211 = .00023

To increase turnover-

Formula= Sales/ ((Opening stock+Closing stock)/2)

Indicator	July 2016	August 2016
Quantity	(Value is assumed) 45887/((2235+5663)/2) = 11.61	(Value is assumed) 39588/(3321+5773)/2 = 8.7
Value	2274521/(54772+68892)/2 = 36.78	2044931/(68342+67744)/2 = 30.05

Stable inventory to sales ratio-

Formula= (Total inventory value)/ (Total sales value)

Indicator	July 2016	August 2016
Value	(Value is assumed) 1543219/4577821 = .33	(Value is assumed) 1444733/3887331 = .37

X. CONCLUSION

Supply chain management of industries in Bangladesh is getting strong day by day to achieve business objectives. However, some necessary actions are essential to get the exact benefit of supply chain management for our industries. Supply chain management in these Industries of Bangladesh should be approached in a more systematic manner based on integrated and documented processes. The various supply chain components like suppliers, manufacturers, warehouses and stores should be integrated in a single system, which makes supply chain management more effective. The team involved in the operational side on handling the supply chain should be highly trained in supply chain management function. The visibility needs to be improved if supply cannot be directly controlled. The collaboration with local partners, across the industry and with universities is crucial to successfully managing social responsibility in supply chains. This sector should keep in a situation of political stability and a congenial business environment. Political turmoil and the disturbance are bad for this kind of industries. So, Proper steps should be taken by the government to keep this sector free from any kinds of disturbance. It is also necessary to improve the overall customer relationship and organizational environment though it is providing good organization environment.

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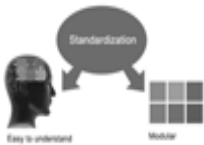
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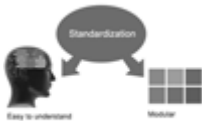
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28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.



Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

- Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

- Use standard writing style including articles ("a", "the," etc.)
- Keep on paying attention on the research topic of the paper
- Use paragraphs to split each significant point (excluding for the abstract)
- Align the primary line of each section
- Present your points in sound order
- Use present tense to report well accepted
- Use past tense to describe specific results
- Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives
- Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.



Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript-- must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for brevity. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

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The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
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- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.



- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
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This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently. You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.



Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
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- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.



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<i>Introduction</i>	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
<i>Methods and Procedures</i>	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
<i>Result</i>	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
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<i>References</i>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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