Supply Chain Design for e-Commerce Marketplace Same/Next Day delivery

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Abstract

Marketplace model inherits uncertainty due to dependency on external attributes like seller behaviour, seller inventory and many more. Apart from these, marketplace model inherits turbulence from within Supply Chain. As a result, the performance of the marketplace model when compared to conventional warehouse model in terms of speed, reliability, shrinkage is low in standards.
The insights from customer experience survey establish that one of the key drivers for higher customer satisfaction is speed. Better speed can be achieved by designing process to reduce risk contributed by external and internal factors. The Express Supply Chain provides same/next day delivery for marketplace model as compared to 4-5 days' delivery in usual marketplace model.

Keywords
Supply chain, Marketplace, Speed, Design

1. Introduction

Major focus for an ecommerce company is to capture more and more customer base. As a study suggests, while a customer is placing an order he looks at price, availability and speed or SLA (Service Level Agreement) of the product. Although the traditional warehouse model excels in all the above mentioned criteria, marketplace provides a platform for sellers to have competitive pricing and increases the selection base for customers, however a major drawback of this model as studied is greater SLA with respect to warehouse model. Due to additional dependencies in a marketplace model with respect to a warehouse model, there is an impact on quality and SLA to the customer, as a result the customer develops aversion towards ecommerce.

2. Methodology

Identify the current steps involved and suggesting the improvement areas, involve rigorous study. As depicted in Figure 1 below, a process can be broken down into three basic elements: the inputs to the process, the process under study and the outputs from the process. The concept of improvement is quite simple; to improve the outputs of a process, you simply improve the inputs and the process itself. To improve the output (also called the "Y" or the "Key Measure"), identify, measure and improve the inputs and process metrics (also known as the "X's"). Focusing on the results, the output Y measures instead of the X's is an after-the-fact, reactive, expensive and inefficient approach to improving results. The DMAIC steps are the true backbone of any process improvement initiative. The steps make sense, they are easy to understand and they are logical in their sequence. The steps allow a team to adequately scope the problem, measure the current performance, analyse the root causes of

problems and inefficiencies, test and verify improvement recommendations and then implement changes for sustainability over the long haul. Process improvement projects are the norm these days. Improving key measures is something every project manager is going to be faced with sooner or later; therefore, a project manager should be skilled in the art of applying the DMAIC steps to improve results.

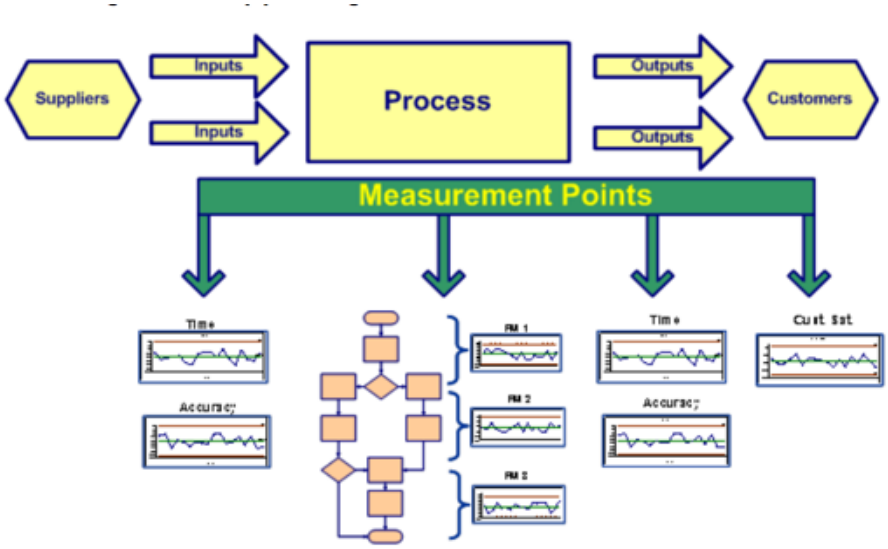

Figure 1. Process steps and study

3. DMAIC

DMAIC is a data-driven quality strategy used to improve processes. It is an integral part of a Six Sigma initiative, but in general can be implemented as a standalone quality improvement procedure or as part of other process improvement initiatives such as lean.

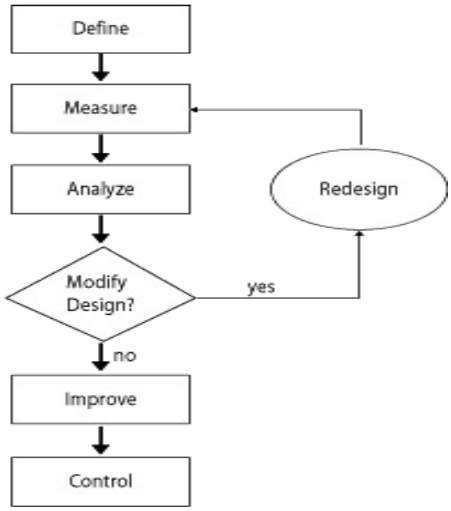

Figure 2. DMAIC Steps involved

DMAIC is an acronym for the five phases that make up the process:

- Define the problem, improvement activity, opportunity for improvement, the project goals, and customer (internal and external) requirements.
- Measure process performance.

- Analyse the process to determine root causes of variation, poor performance (defects).
- Improve process performance by addressing and eliminating the root causes.
- Control the improved process and future process performance.

3.1 Define

Efficient supply chain become uncompetitive as they don't respond to changes. Hence the idea is not to design a supply chain which adds constraints but at the same time, inherits change and utilize to its advantage. Goal is enabling same day and next day delivery for marketplace orders, for which we need to understand the industry's current performance and break it down to the lowest tracked element in processing the order with associated TAT(turn around time). The logical segmentation to target speed is based on distance from source to destination, hence we categorize the source destination combination 3 segments:

Lane segments	Travel time
Lane1	0-6 hours
Lane2	6-24 hours
Lane3	>24 hours

Table 1. Lane Segmentation based in travel time

This gives a clear view of our target set, which is Lane 1 and Lane 2, where we can achieve same day or next day delivery with certain process changes.

3.2 Measure

Documenting the current process, validating how it is measured, and assessing baseline performance is the next step. Develop a map for all handshake processes and build distribution associated with each leg. The first step towards measure is to identify the type of data we are dealing with, is it discrete or continuous, which in our case is continuous. The next step is to draw the frequency distribution curve to understand the behaviour of the data. The figure provides 3 types of curves, normal distribution, positive skew and negative skew. Based on the data skewness our areas of measurement will also vary. Where the data is negatively skewed, we measure median and 85th or 95th percentiles for performance measure instead of mean, to provide an idea about the distribution.

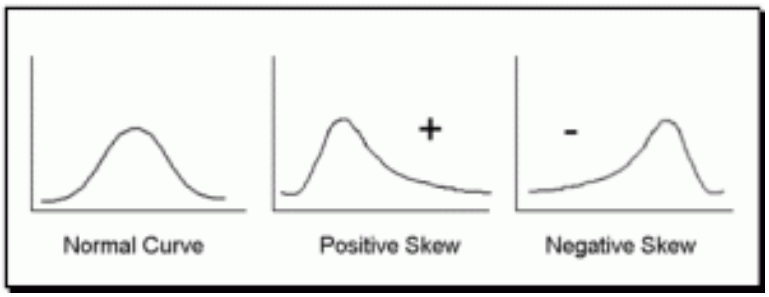

Figure 3. Distribution curves

In a normal distribution, the mean and the median are the same number. When a distribution is skewed it affects the mean and median. They become *different* numbers. Which way a distribution is skewed will affect the mean and the median in different ways. A left-skewed, negative distribution will have the mean to the left of the median. A right-skewed distribution will have the mean to the right of the median, which will be used in the next phase for evaluation.

The measure of process will give a view on the major areas to be acted upon to achieve the goal. We need to collect historical data in order to establish the baseline.

3.3 Analyse

This stage involves the comparison between the current performance of the existing process and its requirements. This comparison shows the actual deviation of the existing process from its expectation and the requirements. Once the deviation is measured the problem causing this deviation is identified. This is a stage where practical problems are converted into statistical problems and are dealt with utmost care. The following are the key factors of this stage:

- Identify the problem causing the deviation in the outputs.
- A statistical approach towards the problem shows the inputs that are creating the variation in the outputs.
- Study the changes in the inputs, which may affect the output.
- Draw a conclusion based on the measurements.

The most applicable tools of this stage are the 'Five Why's', 'Tests for normality (Descriptive Statistics, Histograms)', 'Correlation/Regression Analysis', 'Analysis of Variances (ANOVA)', 'Failure Mode and Effect Analysis (FMEA)', and the 'Hypothesis Testing Methods'.

3.4 Improve

This stage puts forward a solution to the problem being analysed in the last stage, After the analysis of the problem, the team finds the solution for the existing problems and refines the existing process. The following are the key factors of this stage:

- Identify the ways to eradicate the existing problem.
- Verify the inputs that are creating the problem and are causing the variation in the outputs.
- Control the inputs that are creating the problem.
- Measure the amount of DPMO decreased.
- Design the changes in the existing process to eradicate the existing problem and get the approval of the management section for its implementation.

The most applicable tools of this stage are the 'Process Mapping', 'Process Capability Analysis (CPK)', and 'Design of Experiment (DOE)'.

3.5 Control

This is the last method of the Six Sigma DMAIC methodology and apparently, is the most important also. It helps to ensure that the problems that are creating variations in the desired output are rectified. The new process is implemented under a controlled plan to achieve the desired results. The following are the main key factors of this stage:

- Verify the long-term capability of the implemented process.
- Implement the new process under a controlled plan to ensure that the problems do not occur again.
- Continually monitor the process to control the quality level of the product.
- Measure the performance of the new process under a controlled plan and define its effectiveness.
- At the close of this stage the information is passed to the process owner and the team responsible for the Six Sigma process. The team then decides the next stage.

4. Marketplace model evaluation

The study begins with understanding the current process of delivering a marketplace order. The first step involved is the checking serviceability, whether the area is serviceable by logistics. Reach of a logistics network becomes one of the key factors while order placement. Once the order is placed, the fulfilment engine will get all its corresponding details and assign a logistics partner, for our study we consider it to be an ecosystem of multiple logistics partner. The SLA (Service Level Agreement) for all the logistics partner are equal, however their actual

performance may vary based on the logistics partner's design and constraints. We will not go deep into the assignment process of a logistics partner. The seller gets an intimation about the order he has received, based on the seller's procurement SLA he'll dispatch the shipment from his warehouse and hand it over to the logistics partner. We'll call this leg order to dispatch. The supply chain is designed such that shipments are consolidated at local hubs from sellers and then sent to the major sortation facility called the mother hub, where these shipments will be sorted based on their destination. We'll call this leg pickup to shipped. Once the sortation happens, the consignments are created and sent for hubs at destination, where again the shipments are assigned to field executives to be delivered to customer. We'll call this leg shipped to Delivery. We'll delve into each leg and design for same day, next day delivery along with identifying the improvement areas and non-value add processes. We have considered an order cut-off of 12 pm.

4.1 Seller selection logic

We are trying to enhance the speed of our highest selling items. Using Pareto (80-20 rule) on the selling items, suggests 20% of items which contribute to 80% of our sales. Mapping these items to the sellers who have listed these items for sale, provides the pool of eligible sellers. We further apply selection criteria for sellers based on their past performance, also if the seller is selling a strategic item, becomes one of the parameters for selection.

Criteria for seller selection:

- Returns : Considering returns as defects in shipments provided by seller, we apply Defects Per Million Objects(DPMO) approach and say that for 6 sigma, the percentage of returns to be below 0.00034%.
- Seller processing SLA: Sellers provide SLA for packing and handing over the shipment, we identify sellers with SLA <=1day and giving the shipment over in 0days. Sellers who provide the shipment in 1day, were discussed the possibility from their end to hand over the shipment on the same day as order placement.
- Seller Breach: Seller breach is defined as orders which the seller did not hand over on time by the total numbers of orders received by the seller. The selection criteria is breach less than 0.00034%.

4.2 Order to Dispatch

Each hub has a defined capacity in supply chain in terms of processing area, manpower, vehicles etc., which become the constraints and defines a pickup priority, which in our study is a FIFO (First In First Out). At this point, we need to split the capacity into 2 priority queues, one which handles regular shipments, and the other which handles express shipments. Let the entire capacity of a hub be defined as C. Based on load prediction at seller level we assign Cr and Ce, regular capacity and express capacity respectively. Projected values are taken into consideration so we achieve minimal spillage on both the queues. However, any express shipment goes to the queue of some other day, will lead to failure of design for same day/next day delivery model.

Once a shipment enters the queue for the day, the seller will receive intimation about the order. Seller has a defined SLA by when he will dispatch and hand over the shipment to logistics partner. In case of express shipment, seller is given a minimum time window of 2 hours to pack, dispatch and hand over the shipment. Hence an order placed at 12PM should be handed over by 2PM by seller to logistics partner. Sellers are distributed over a time window of 2PM to 7PM, where the sequence in which a seller will be attempted is determined based on the route. Sellers which are attempted in later half of the day, get a greater time to process the shipment when compared to a seller who is attempted earlier in the day. This can be built as a business model for providing differentiated service to seller where both seller and the customer benefit in terms of speed.

Failure mode of this leg arrives when the capacity is incorrectly attributed to express and regular queue. In this case, spillage happens for express order, and leads to higher SLA than the designed SLA.

4.3 Dispatch to Ship

Once the seller marks the Order as Ready to Dispatch, it signals the executive to go and attempt the seller for the shipments he has marked as dispatched. The executive follows a defined route, with ETA for every seller he needs to attempt is available to with him, so that he plans his time accordingly. The sellers which have been on-boarded based the selection criteria for express have to be necessarily attempted post 2PM by design. It is not necessary

that all the shipments picked from a seller are part of express orders, however the executive doesn't treat express shipments any differently and at his end there is no change in process. Post collecting shipments from all sellers assigned to the executive he brings the shipments to a primary consolidation centre. Similarly, other executives will accumulate shipments from other sellers and bring to primary consolidation center. The primary consolidation center will then forward shipments to the secondary consolidation center. This secondary consolidation center will cumulate shipments from other primary consolidation centers and further process it for the destination.

There are various models for connecting shipments from seller to secondary consolidation center. When a vehicle is collecting shipments from all sellers on his route the destination could be connected to primary consolidation center or secondary consolidation center. Load becomes the differentiating factor for selecting the route plan.

- Milk route: When load is low and the vehicle is under-utilized, shipment picked from all sellers on route are brought to primary consolidation center. This enables low load from various other routes to be consolidated and sent to the secondary consolidation center, improving utilization of route from primary to secondary consolidation center.
- Direct connection: Case when the load is high, the operations which were to happen at primary consolidation center can now be carried out in the vehicle itself, directly connecting the shipment to secondary sortation facility.
- Implant with FTL: Sellers which provide high load, enough for the entire vehicle to be utilized, executive doesn't attempt any other seller on his route and directly connects to secondary sortation facility. This is a variation of Direct connection explained above, with only one seller to be catered in the entire route, based on the load.

While picking the shipments, first level of sortation takes place, where based on the transport connections, shipments are segregated, so that it becomes easy for the secondary sortation facility to prioritize based on connections. This leg ends when the shipments reach the secondary sortation facility. The TAT for inwarding of shipments in the secondary sortation facility is the day end of order placement.

The failure modes in this leg are:

- Executive not adhering to time slot of seller
- Seller not handing over the shipment despite marking it as dispatched. The model doesn't support attempting the seller multiple times in a day, hence if the shipment is not handed over, by default it will lead to 1-day addition in TAT due to reattempt to seller.

4.4 Ship to Deliver

Once the shipments are received in secondary sortation facility, they are processed based on cut-off and a sequence for processing is developed. Sortation process at the facility is design based. The facility sorts for destination and hands over shipments to transporter.

Failure mode in this leg are:

- Shipment to be processed at priority, getting mixed with low priority (or shipment type with a later processing cut-off) shipments from source and hence leading to delayed processing by secondary sortation facility

Once the sortation is done for destination, it is handed over to transportation partner. Each lanes has an estimated SLA associated with it, the target for local lane is less than 6 hours of transport. Ideally, this leads to shipments reaching last mile the next day of order placement. Last mile will then assign an executive for delivering the shipment to customer.

Failure modes in this leg are:

- Customer not available on the day of scheduled delivery.

5. Model for Same Day Delivery

Same Day Delivery has delivery time <24 hours. To design a supply chain for 24-hour delivery, there are multiple factors involved in terms of cost, availability, reach etc.

- Local Consolidation Center : Orders which are to be delivered on same day, they get connected to a local consolidation center instead of the the primary sortation or secondary sortation facility. The orders are consolidated and sorted for destination. Let us have n number of pickup points i.e. the seller location and m be the number of customers who chose same day delivery option. From n points the orders are consolidated and sorted for d points, where d is the number of delivery facilities. Each point in d is assigned one or more points in m. This gives a better speed but complicates the sortation logic, as the first level of sortation happens during pickup, where orders are sorted based on service.
- On the go sortation: While picking up from seller, we not only differentiate based on service, we also sort for the destination facility and aggregate the sorted load at a facility, from where each destination facility can collect the consolidated load. The other way we can use the on the go sortation is by building dynamic routes based on the demand and directly handover the orders to the delivery facility and picking any shipment to be delivered by the facility itself. This would require understanding of the fleet of vehicle, route optimization for better speed and cost.

6. Conclusion

The literature research and the study has shown improvement in speed for marketplace supply chain tends to impact other areas in e-commerce sector. NPS (Net Promoter Score) is directly proportional to the speed, better the speed higher is the NPS, and it is one of the most important factor which we have seen improve with this design implementation in industry. Order cancellation percentage reduced, with orders reaching the customer faster, there was less time with the customer to consider cancelling, moreover one of the major reasons for order cancellation, as we observed through customer feedback, was higher SLA. Same day and next day promise to customer also helped in improving order conversion for those products, hence the sellers providing those orders had a higher satisfaction index and considered the platform a success.

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Biography

Megha Bhardwaj is currently working as an Assistant Manager in Flipkart India as part of Design team. She did her graduation in Electrical and Electronics from BITS Pilani in 2014. She join Flipkart in 2014 under Supply Chain Analytics and had worked on various assets in Supply Chain. Her areas of interest include big data analytics, data sciences and machine learning. Currently as a member of First Mile Design team, she helps validate hypothesis with data and develops design approach which is highly data driven.

Sarvartha Kanchan is currently working as a Director of Supply Chain Design for Flipkart India Pvt. Ltd. He earned B.Tech. in Electronics and Communication Engineering from Technical University of Uttar Pradesh, India and Masters in Operations Management from ICFAI University, India. Sarvartha has worked in supply chain environment of highly regulated / process driven manufacturing companies like GE Healthcare, Britannia Industries Limited and complex logistics and warehousing domain with Flipkart. He has worked across different supply chain functions namely, Strategic Sourcing, Vendor Development, Process Engineering & Quality, Materials Management and Order Fulfilment. He was responsible for driving efficiency improvement projects in supply chain at a corporate level and was looking at end to end value chain for driving LEAN Six Sigma improvements. Currently he looking at transforming supply chain design to improve speed, reliability and cost for the logistics function of Flipkart. His interests include vendor development, manufacturing, simulation, optimization, design for six sigma and lean. He is member of ASQ, APICS, WERC.