# India Monsoon Project Summary – Regional Monsoon Section

## Introduction

There are significant consumption uptrends in many commodities during the Indian Monsoon Period, i.e. from June to October. The India Monsoon Project aims to provide an analytics solution to cope with the uptrends in India National Distribution Center (DC), and corresponding regional service warehouses (FSL).

There are two major components in the project:

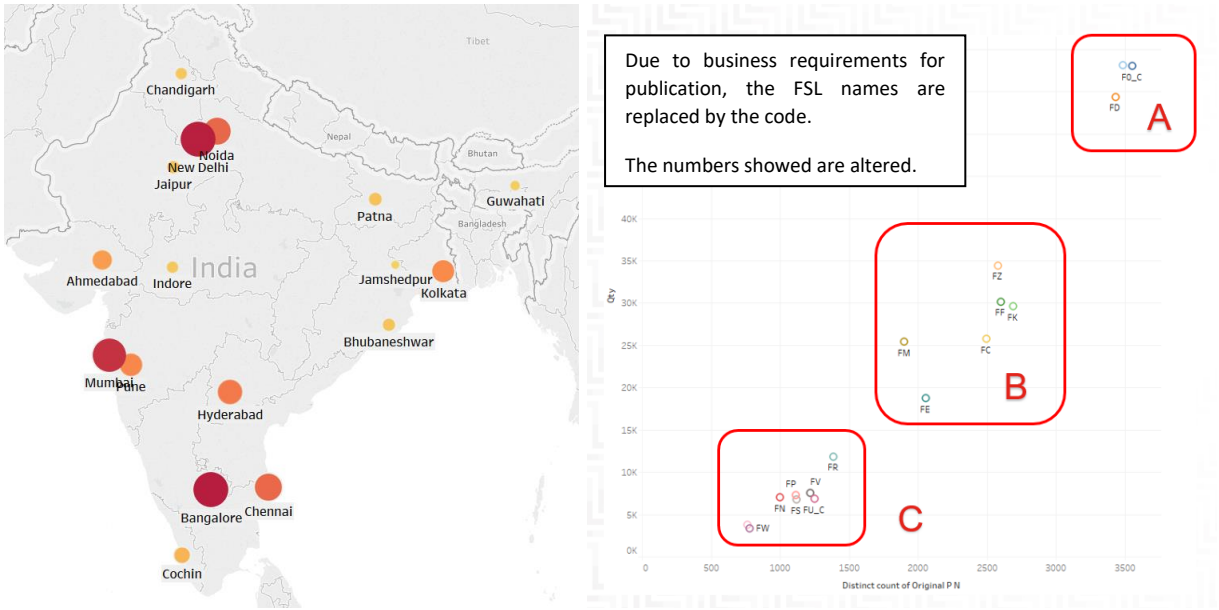
1. Demand forecast for the DC
2. Replenishment strategy improvement for FSLs

In this report, the impacts in each FSL brought by the Indian Monsoon will be analyzed, and a proposed a solution will be discussed. The reports will partially cover the second components, i.e. the Indian Monsoon impacts on each FSLs.

## Background

1. FSL overall status

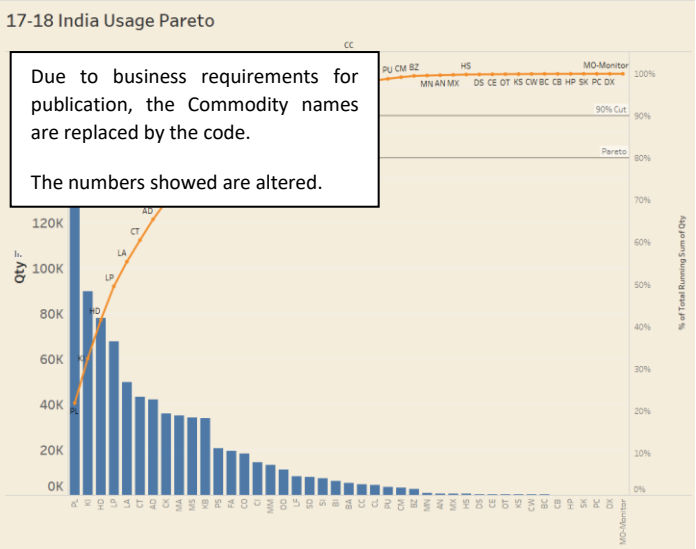
The locations and consumptions of current FSLs can be illustrated in the following charts.



According to the overall consumption, FSLs can be clustered by three. And the Group C is the consists of 20% of overall consumptions.

2. Commodity overall status

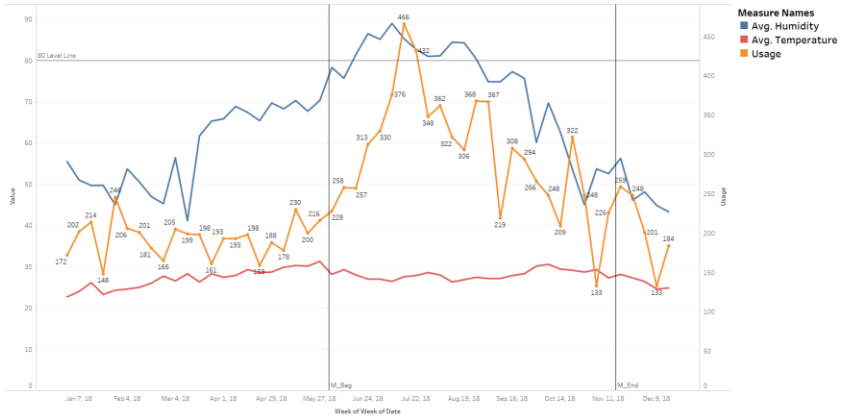
The total consumptions in India by commodity can be illustrated in the following chart.




The distribution pattern of commodities is similar to distribution of the overall global consumption.

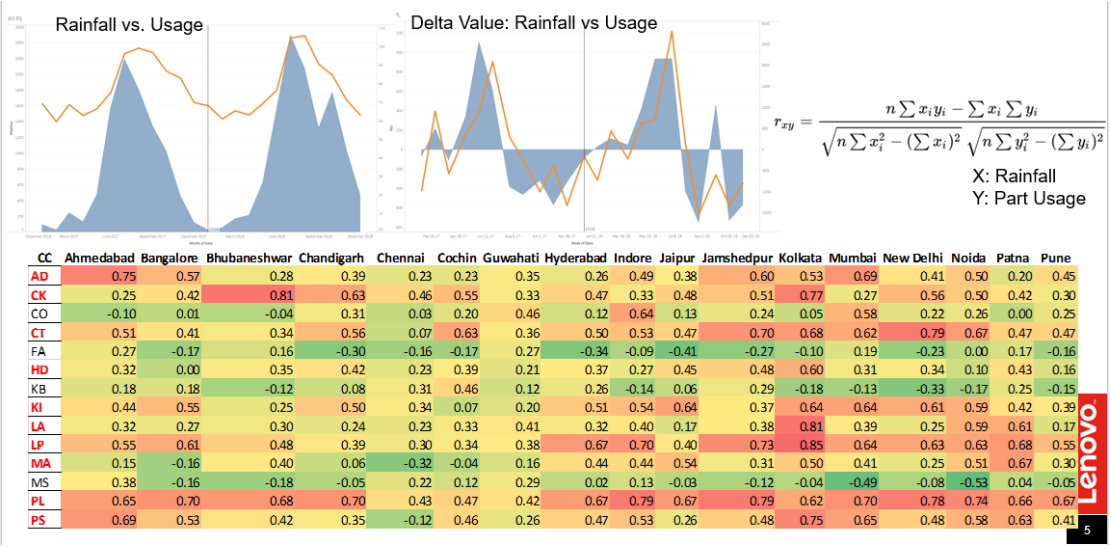
**Analytics**

The initial study showed that there is little correlation between consumption and humidity, as the humidity in coastal area remains high regardless of the Monsoon. And the local temperature has no correlation with the consumption uptrend.




After a thorough correlation study, the parts consumption has a strong correlation with the local rainfall. And each commodity shows different level of correlation with the rainfall data. And the Monsoon shows

little impact on the FSLs in the east costal area. The rainfall, also, can serve as a leading indication of the trend of consumption.




| CC | Ahmedabad | Bangalore | Bhubaneshwar | Chandigarh | Chennai | Cochin | Guwahati | Hyderabad | Indore | Jaipur | Jamshedpur | Kolkata | Mumbai | New Delhi | Noida | Patna | Pune |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AD | 0.75 | 0.57 | 0.28 | 0.39 | 0.23 | 0.23 | 0.35 | 0.26 | 0.49 | 0.38 | 0.60 | 0.53 | 0.69 | 0.41 | 0.50 | 0.20 | 0.45 |
| CK | 0.25 | 0.42 | 0.81 | 0.63 | 0.46 | 0.55 | 0.33 | 0.47 | 0.33 | 0.48 | 0.51 | 0.77 | 0.27 | 0.56 | 0.50 | 0.42 | 0.30 |
| CO | -0.10 | 0.01 | -0.04 | 0.31 | 0.03 | 0.20 | 0.46 | 0.12 | 0.64 | 0.13 | 0.24 | 0.05 | 0.58 | 0.22 | 0.26 | 0.00 | 0.25 |
| CT | 0.51 | 0.41 | 0.34 | 0.56 | 0.07 | 0.63 | 0.36 | 0.50 | 0.53 | 0.47 | 0.70 | 0.68 | 0.62 | 0.79 | 0.67 | 0.47 | 0.47 |
| FA | 0.27 | -0.17 | 0.16 | -0.30 | -0.16 | -0.17 | 0.27 | -0.34 | -0.09 | -0.41 | -0.27 | -0.10 | 0.19 | -0.23 | 0.00 | 0.17 | -0.16 |
| HD | 0.32 | 0.00 | 0.35 | 0.42 | 0.23 | 0.39 | 0.21 | 0.37 | 0.27 | 0.45 | 0.48 | 0.60 | 0.31 | 0.34 | 0.10 | 0.43 | 0.16 |
| KB | 0.18 | 0.18 | -0.12 | 0.08 | 0.31 | 0.46 | 0.12 | 0.26 | -0.14 | 0.06 | 0.29 | -0.18 | -0.13 | -0.33 | -0.17 | 0.25 | -0.15 |
| KI | 0.44 | 0.55 | 0.25 | 0.50 | 0.34 | 0.07 | 0.20 | 0.51 | 0.54 | 0.64 | 0.37 | 0.64 | 0.64 | 0.61 | 0.59 | 0.42 | 0.39 |
| LA | 0.32 | 0.27 | 0.30 | 0.24 | 0.23 | 0.33 | 0.41 | 0.32 | 0.40 | 0.17 | 0.38 | 0.81 | 0.39 | 0.25 | 0.59 | 0.61 | 0.17 |
| LP | 0.55 | 0.61 | 0.48 | 0.39 | 0.30 | 0.34 | 0.38 | 0.67 | 0.70 | 0.40 | 0.73 | 0.85 | 0.64 | 0.63 | 0.63 | 0.68 | 0.55 |
| MA | 0.15 | -0.16 | 0.40 | 0.06 | -0.32 | -0.04 | 0.16 | 0.44 | 0.44 | 0.54 | 0.31 | 0.50 | 0.41 | 0.25 | 0.51 | 0.67 | 0.30 |
| MS | 0.38 | -0.16 | -0.18 | -0.05 | 0.22 | 0.12 | 0.29 | 0.02 | 0.13 | -0.03 | -0.12 | -0.04 | -0.49 | -0.08 | -0.53 | 0.04 | -0.05 |
| PL | 0.65 | 0.70 | 0.68 | 0.70 | 0.43 | 0.47 | 0.42 | 0.67 | 0.79 | 0.67 | 0.79 | 0.62 | 0.70 | 0.78 | 0.74 | 0.66 | 0.67 |
| PS | 0.69 | 0.53 | 0.42 | 0.35 | -0.12 | 0.46 | 0.26 | 0.47 | 0.53 | 0.26 | 0.48 | 0.75 | 0.65 | 0.48 | 0.58 | 0.63 | 0.41 |



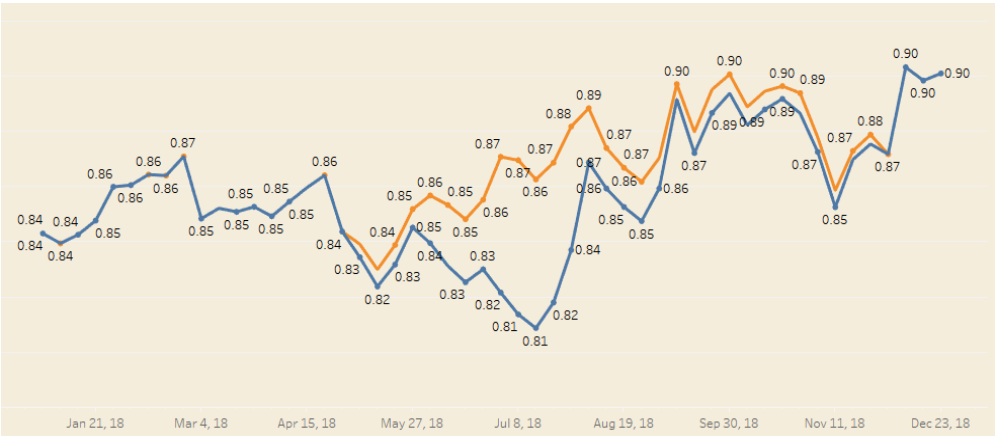
Proposed solutions

The solution consists of two elements:

1. Replenishment strategies that specialized in dealing with the uptrend caused by the Indian Monsoon. The new strategies utilize the rainfall data to predict the trend.
2. Replenishment strategies that specialized in dealing with the marginal situation when the Month of Inventory (MOI) in the entire India system is equals to/below the lead time from the Central DC to the Indian DC

** Details Omitted **

The simulated result using the data in 2018 is shown below.



**Summary**

The rainfall plays an important role in determining the demand during the Indian Monsoon. However, the east costal area of India is free from the impact. The new strategy consists of traditional methods in which parts are ranked according to the average consumption, MOI and price, integer programming to cope with the marginal situation, and the demand forecast technics that utilize seasonal ARIMA and the rainfall data. The simulated result shows a improvement of 6% increase of the performance during Monsoon.

Further efforts will be put on generalizing the research method and expand a generalized replenishment strategy to other countries.