



# Revenue Enhancement by Planning & Scheduling – BEST Undertaking



# Background - Planning & Scheduling

## BEST at a glance –

|                           |            |
|---------------------------|------------|
| No. of depots             | 27         |
| Fleet                     | 3770 buses |
| Routes operated           | 510        |
| Daily Avg. effective kms. | 5.84 Lakhs |

## Planning & Scheduling of buses and staff

### ➤ Need –

- To ensure timely arrival and departure of buses.
- Maximum utilisation of resources.
- Intermodal integration.
- Maintenance requirements

### ➤ Based on –

- Passenger Demand.
- Operational requirement.
- Topographical needs.
- Provisions of various Acts and Regulations.

### ➤ Duration –

- Thrice in a year i.e. 1<sup>st</sup> March, 1<sup>st</sup> July and 1<sup>st</sup> November.

# Previous Method

- Centrally and Manually done by a skilled team with in depth mathematical and statistical knowledge using various permutations and combinations.

## Basic Parameters

| Running Schedules  | Duty Schedules   |
|--|--|
| Number of buses  | Combine maximum in one route   |
| Running time (peak/non-peak, Congested/Highway/Interior road, etc) | Combine with feeder with long route & vice versa ( if 2 trips not possible in one long route). |
| Interval   | Rest period (Feeder & long route).   |
| First bus / Last bus   | Optimisation through experience.   |
| Relief Point for staff   | Relief point Capacity.   |
| Origin / destination control points                                | Time consuming depends on the volume of buses.   |
| Capacity of terminus   |  |

## Limitations

- Limited capacity of a Human IQ to get the optimized combination.
- Optimization becomes difficult as it varies from person to person.
- Time consuming.
- Not possible for an individual to work/ explore all the available data at one go to get the optimized result.

# Need and Market research for Computerisation of Crew & Bus Scheduling

## Need

- Creating Multiple plans manually is time consuming – (what if, scenarios).
- Analysis of each of the multiple plans for maximum efficiency and utilisation of bus and crew – choosing the best plan of these multiple plans – cannot be easily done.
- Updation of changes made to any schedules of bus and crew and publishing the data is tedious and prone to errors.

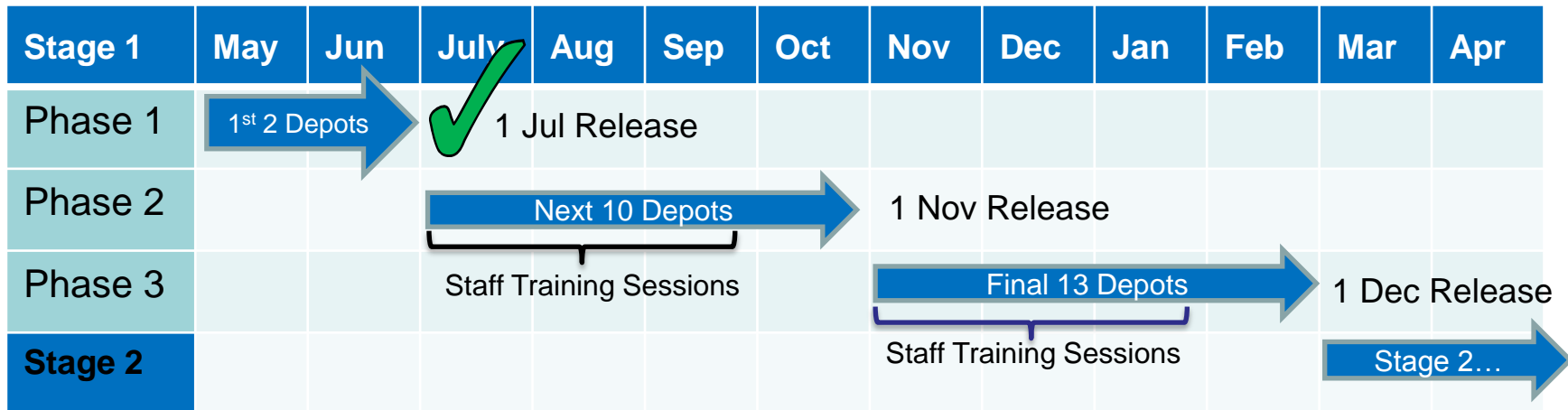
## Market Research

- Very few companies provide planning and scheduling solutions for large transport fleet. Also BEST planning and schedule requirements are unique.
- BEST enquired with various solution providers.
- Trapeze responded to execute a Pilot Study for Wadala depot based on parameters provided by BEST.

# Implementation Plan

## Staged Approach

- Optimising duties within existing business rules
  - Early “wins” targeting real savings of 4-5% in operational costs
  - Build up staff skills in use of the systems
- Optimise schedules and fleet utilisation more broadly
  - Run “What-if” scenarios to understand better ways of operating
  - Use this to engage stakeholders in continuous improvement
  - Expect a further round of savings of additional 4-5%
- Shift focus to Day of Operations
  - Having optimised the Planning, then focus on Daily Operations
  - Deliver further rounds of savings in operational costs



# Computerisation of Schedules – Phase 1

- Pilot – 2 depots w.e.f. 1<sup>st</sup> July 2013 (Wadala & Oshiwara Depots)
- Existing Running Schedules (Manual) + Computerised Duty Schedules.

## Parameters Set for duty schedules software optimisation

### 1<sup>st</sup> Plan

Combination of 2 long routes.

Rest less 35 to 40 minutes.

Duties combined with routes / buses of other depot at a common relief point.

Different type route combination.

Maximum duties spread over more than 10.30 hrs.

SAVINGS in DUTIES – more than 8 %

### 2<sup>nd</sup> Plan

Rest Period at least 50-60 minutes.

Preferred same route combination.

Feeder + Long Route combination.

Spread over less than 10.30 hrs.

Same depot route combination.

Combination of same type route ( AC with AC).

SAVINGS in DUTIES – 4.3 %

|          | Manual<br>(25 Depots) |          |        |         | Combined<br>(Manual -23 + Computerised 2 depots) |          |        |         | Saving by Computerised schedules |          |        |         |
|----------|-----------------------|----------|--------|---------|--|----------|--------|---------|----------------------------------|----------|--------|---------|
|          | Monday to Friday      | Saturday | Sunday | Holiday | Monday to Friday                                 | Saturday | Sunday | Holiday | Monday to Friday                 | Saturday | Sunday | Holiday |
| Overall  | 9811                  | 9564     | 7464   | 8266    | 9775   | 9524     | 7427   | 8225    | -36                              | -40      | -37    | -41     |
| Wadala   | 421                   | 419      | 353    | 378     | 401  | 397      | 331    | 353     | -20                              | -22      | -22    | -25     |
| Oshiwara | 419                   | 415      | 302    | 340     | 403  | 397      | 287    | 324     | -16                              | -18      | -15    | -16     |

\* No. of duties

# Computerisation of Schedules – Phase 2

- 10 depots + 2 depots of Phase 1 w.e.f. 1<sup>st</sup> Nov. 2013
- Existing Running Schedules (Manual) + Computerised Duty Schedules.

## Savings at 12 depots

| Depots       | Manual      |             |             | Computerised |             |             | Savings     |             |             |
|--------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|
|              | Mon to Fri  | Saturday    | Sunday      | Mon to Fri   | Saturday    | Sunday      | Mon to Fri  | Saturday    | Sunday      |
| Wadala       | 399         | 398         | 316         | 361          | 359         | 290         | -38         | -39         | -26         |
| Oshiwara     | 428         | 425         | 314         | 408          | 403         | 290         | -20         | -22         | -24         |
| Colaba       | 241         | 216         | 113         | 236          | 209         | 107         | -5          | -7          | -6          |
| Backbay      | 309         | 282         | 174         | 295          | 267         | 162         | -14         | -15         | -12         |
| Anik         | 451         | 449         | 408         | 435          | 432         | 397         | -16         | -17         | -11         |
| Deonar       | 356         | 352         | 273         | 338          | 333         | 274         | -18         | -19         | 1           |
| Ghatkopar    | 412         | 394         | 303         | 403          | 384         | 302         | -9          | -10         | -1          |
| Vikhroli     | 362         | 354         | 215         | 345          | 336         | 224         | -17         | -18         | 9           |
| Magthane     | 376         | 376         | 342         | 353          | 352         | 313         | -23         | -24         | -29         |
| Goregaon     | 397         | 396         | 307         | 384          | 381         | 288         | -13         | -15         | -19         |
| Poisar       | 292         | 277         | 226         | 275          | 259         | 212         | -17         | -18         | -14         |
| Gorai        | 431         | 425         | 354         | 430          | 422         | 349         | -1          | -3          | -5          |
| <b>Total</b> | <b>4454</b> | <b>4344</b> | <b>3345</b> | <b>4263</b>  | <b>4137</b> | <b>3208</b> | <b>-191</b> | <b>-207</b> | <b>-137</b> |
|              |             |             |             |              |             |             | -4.3%       | -4.8%       | -4.1%       |

# Resentment by unions

- Final phase scheduled 1<sup>st</sup> March 2014
- Union agitation against longer spread over, Combination of different routes & Increase in rest period
- Proposed duty implementation of 1<sup>st</sup> March 2014 postponed by one month
- Strike by Union on 1<sup>st</sup> & 2<sup>nd</sup> April 2014
- Discussion with all Unions by BEST & MoU signed with Union
- Chief Secretary intervened and ordered to withdraw strike and discuss issues with Unions
- H'ble High Court passed order to withdraw strike and follow MoU



# Computerisation of Schedules – Phase 3 & 4

## Phase 3

- 2 depots with new depot at Malad w.e.f. 12<sup>th</sup> April 2014
- Existing Running Schedules (Manual) + Computerised Duty Schedules.

## Phase 4

- Balance 12 depots implemented w.e.f. 2<sup>nd</sup> June 2014
- As on 2<sup>nd</sup> June 2014 Crew schedules at all 26 depots implemented
- Existing Running Schedules (Manual) + Computerised Duty Schedules

# Features of software

| FEATURES                         | MANUAL PROCESS   | SOFTWARE  |
|----------------------------------|--|---|
| Relief Point                     | Provided only at parent depot.   | Crew can take relief at any Authorized point/s  |
| Combination of duty within Depot | The crew work within the same route number and its parent depot.               | The crew can work on 2 route numbers of the same depot.   |
| Combination of duty within BEST  | Crew can only be scheduled to operate within one Depot.                        | Crew can be scheduled to operate on any route number and any bus of any depot of BEST.  |
| Circular Route                   | The Circular Route can only be operated by the same bus.                       | Can be operated with 2 or more buses.   |
| Multiple duty options            | Easy to schedule crew only between serial numbers.                             | Many combinations can be created and Multiple schedules created.  |
| Use of GIS map                   | Crew have to visualize a route without any ready reference to map of the area. | Planning staff have a overlay of the Map in front of them and can easily visualize every route and path along with the stops. |
| Incorporating changes            | Changes to schedule are manually applied , time consuming and error prone.     | Staff can make adjustments dynamically and all other details and data get re-adjusted automatically.                          |

# Features of software

- Intelligent algorithms with permutations and combination to fit any demographic for bus route and scheduling optimization.
- Faster processing of schedules and rostering of conductors and driver at any time required.
- Optimization of routes and schedules every quarter based on current permutation and the on ground reality and not year on year legacy information.
- Features like last minute or mid quarter changes to the route and schedules to address any unexpected changes to operational requirements.

# Process of use of software

- Create Origin / Destination
- Create Stops
- Create paths on the map
- Create Depots
- Create Z-paths (to track dead run)
- Create Timetables
- Vehicle linking to timetable
- Create Crew scheduling
- Running reports and statistics

# Objectives & Benefits

## Objectives & Benefits

- Achieving Optimum Duty of 8 hours.
- Subsequently containing the Spreadover of duty within 11 hours.
- Future Infrastructure Planning & Upgradation.
- Better Staff Facilities - Canteen & Rest.
- Savings in staff cost to the tune of Rs.85 Crores as against payment of Rs.15 Crore approx. **Net Savings – Rs.70 Crores**

## Further Usage of software tools

1. Reporting of Staff at Bus Stations – implemented at 5 Bus Stations
2. Bus Schedules
3. Reporting of staff at other depots
4. Performing duty on routes of 2 depots
5. Operation of one depot route by crew of 2 depots

**Thank You**