



**A Model for Scheduled Bus Service  
Optimization Using IT and Marketing  
Augmented by Increased Tourism**

Jan.28 2015

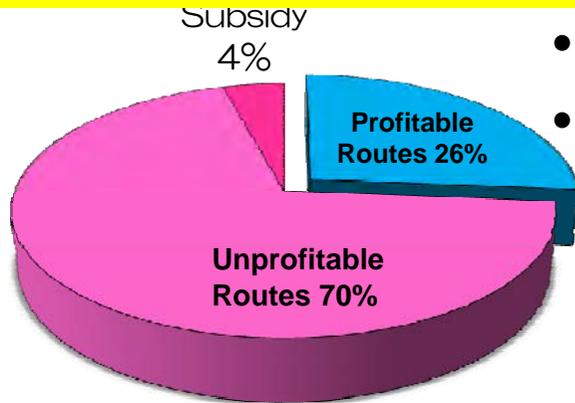
EAGLE BUS CO., Ltd  
CEO Masaru Yajima, MBA, PhD



©EAGLE BUS CO., LTD

# Present Situation of Japanese Scheduled Bus Service

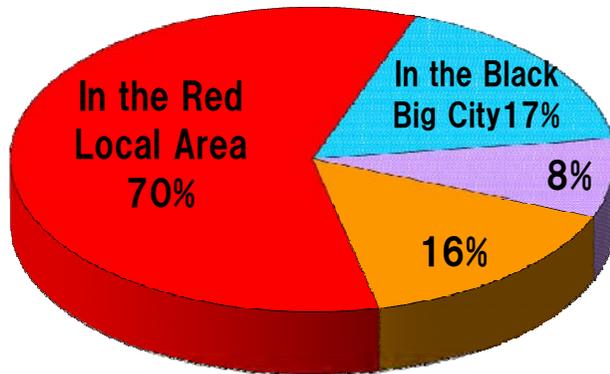
## Profitable/Unprofitable Routes



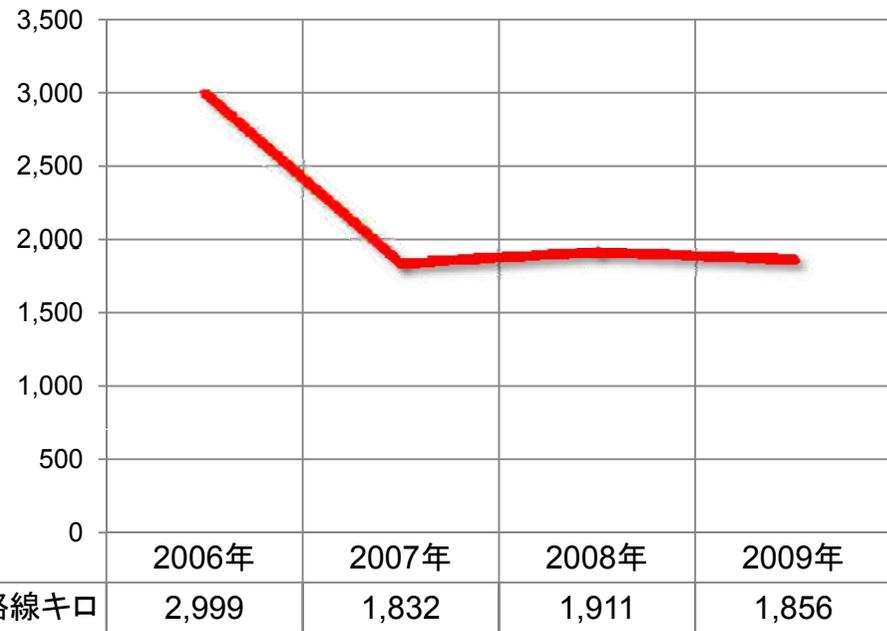
75% of Operators are in the Red

- 75% of routes are unprofitable
- As a result, 2,000 Km of service are lost each year

Bus Operator Profit and Loss Ratio



Km Discontinued Bus Routes/ Km



# What are the difficulties in optimizing the Scheduled Bus business?

## “Hidden Obstacles”

**Jammed or Vacant?**



**On-time Schedule?**



**Convenient for Riders?**



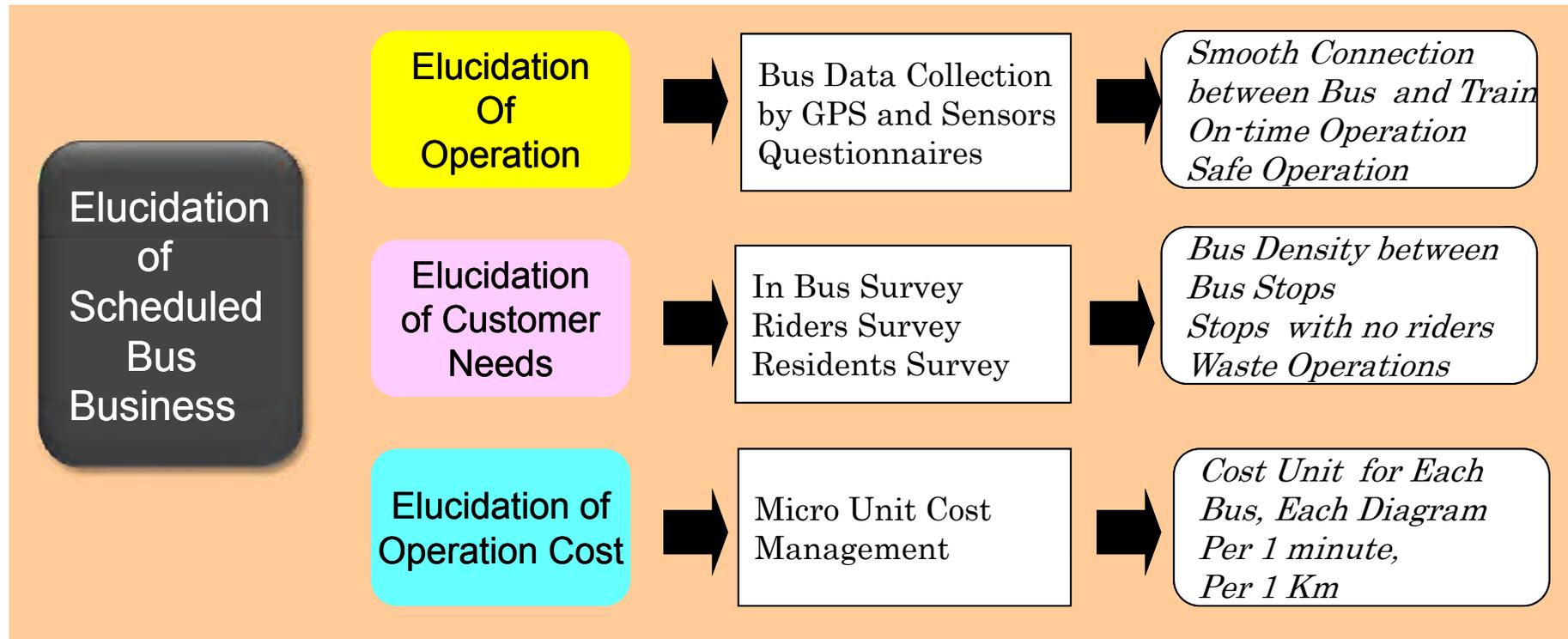
Once a Bus leaves the Garage, no one is able to manage it's operation.

**Efficient Operation?**



Fundamental Problems

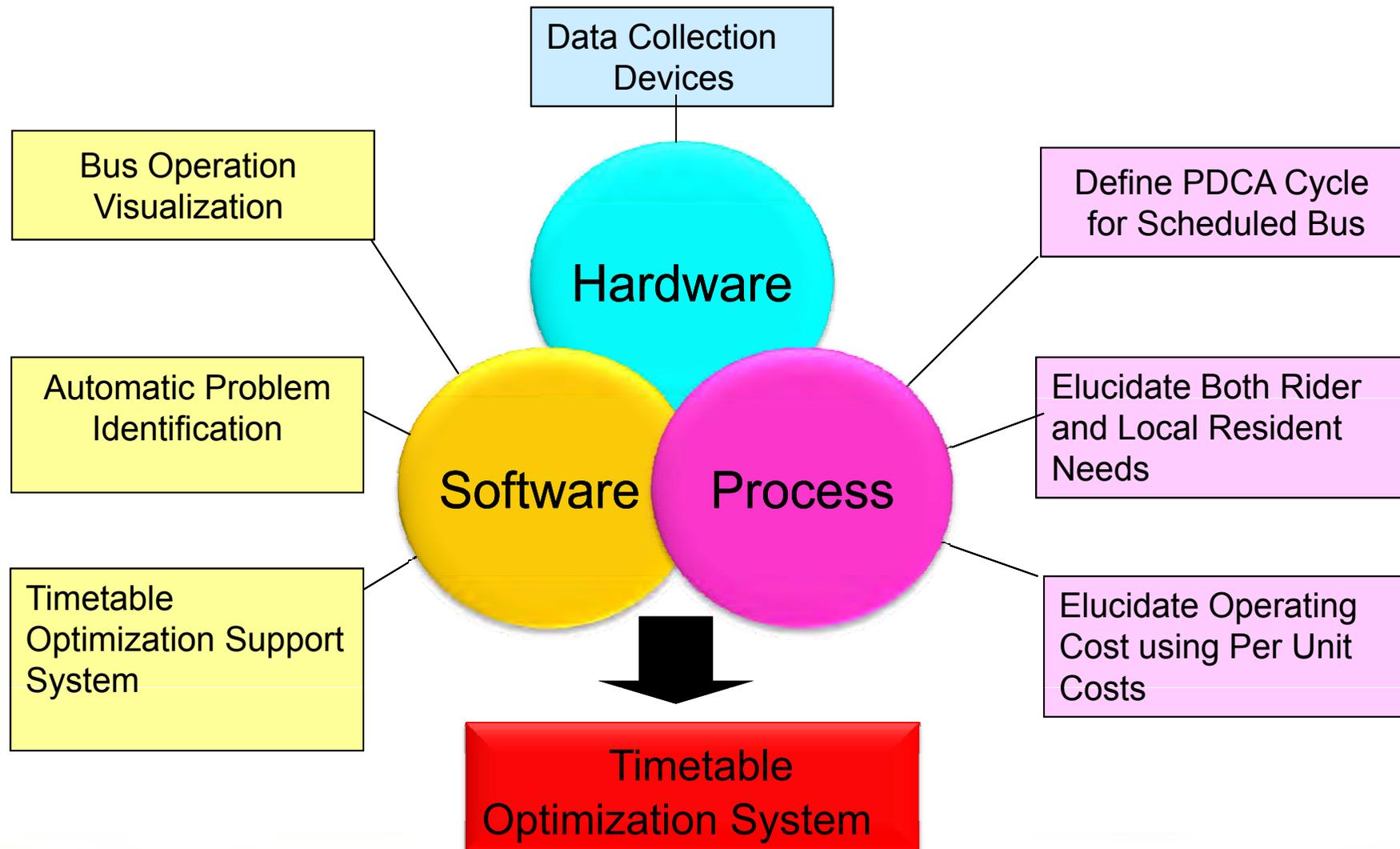
# Elucidation of Scheduled Bus Business



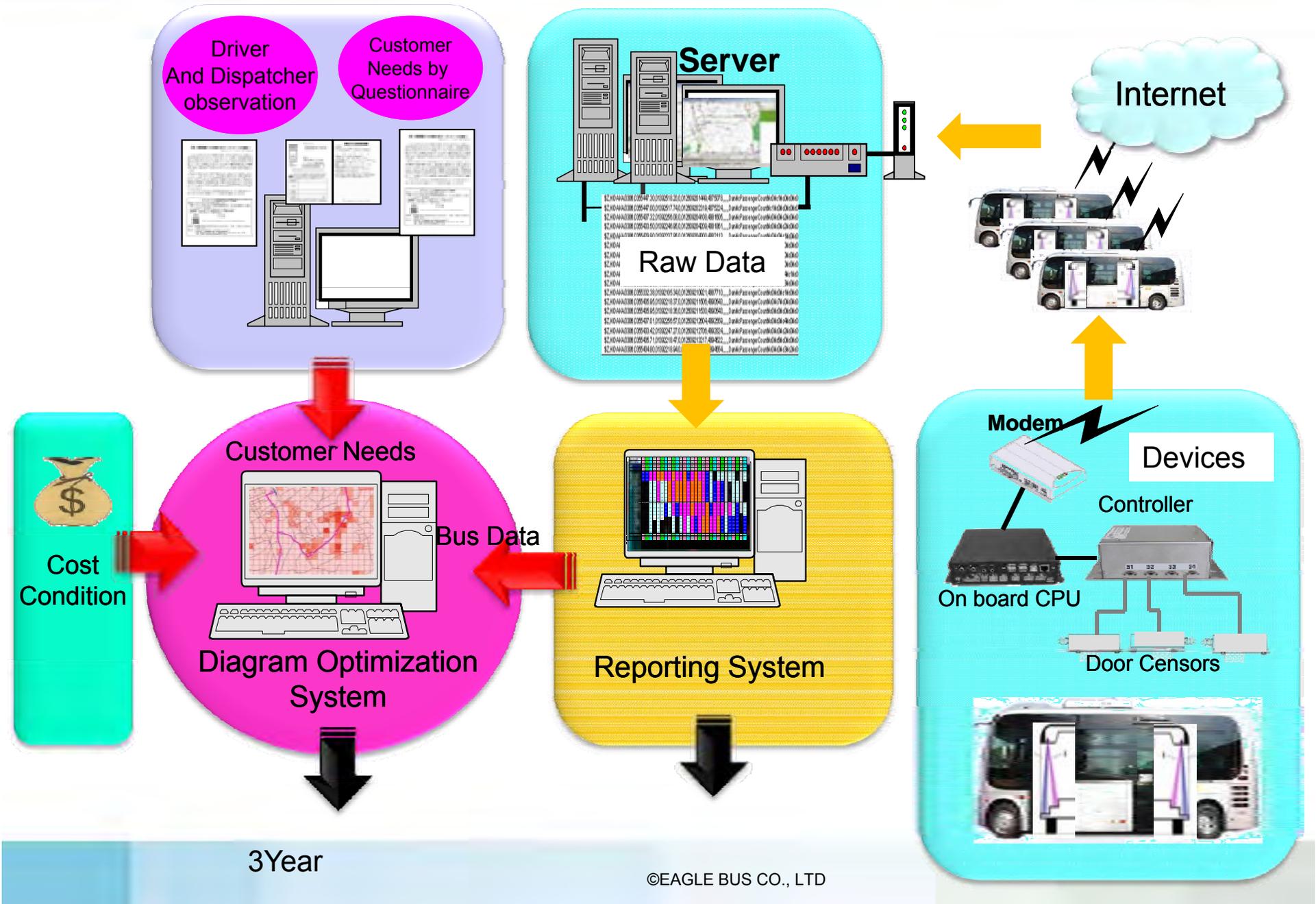
**Elucidation of Improvement**



# Timetable Optimization Trinity



# Bus Diagram Optimization System



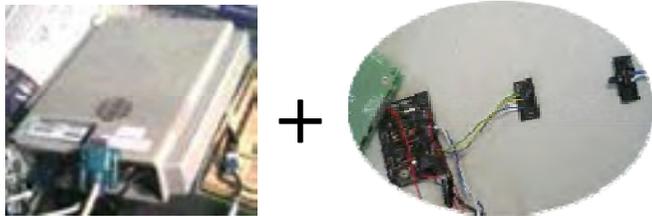
Hardware

Software Process

# Data Collection Device Evolution

## 第1世代乗降カウントシステム

USBによるデータ転送



車載CPU

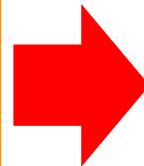
GPSアンテナ

センサー



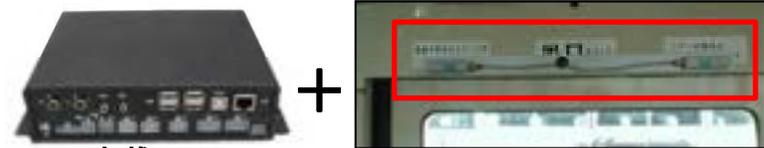
乗降センサー

乗降センサー



## 第2世代乗降カウントシステム

パケット通信によるリアルタイム転送



車載CPU

センサー

+



パケット  
モデム

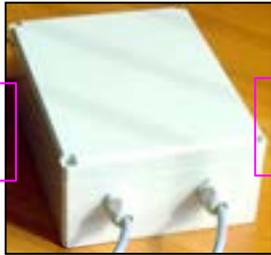


## 第3世代乗降カウントシステム

WiFiによるデータ転送



+



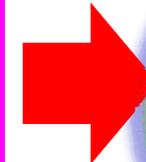
+



WIHI  
アンテナ

車載CPU

センサー



## 第4世代乗降 カウントシステム



実証中

©EAGLE BUS CO., LTD

# Analytic and Reporting Software



# Software Evolution

Elucidation  
+  
Diagram Optimization



Data Acquisition by  
Sensor and GPS

Data Collation

Reporting

Analytics

Simulation

Optimization

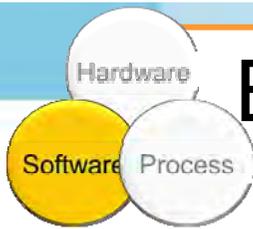
Visualization

Comparative  
Analysis

Problem  
Identification

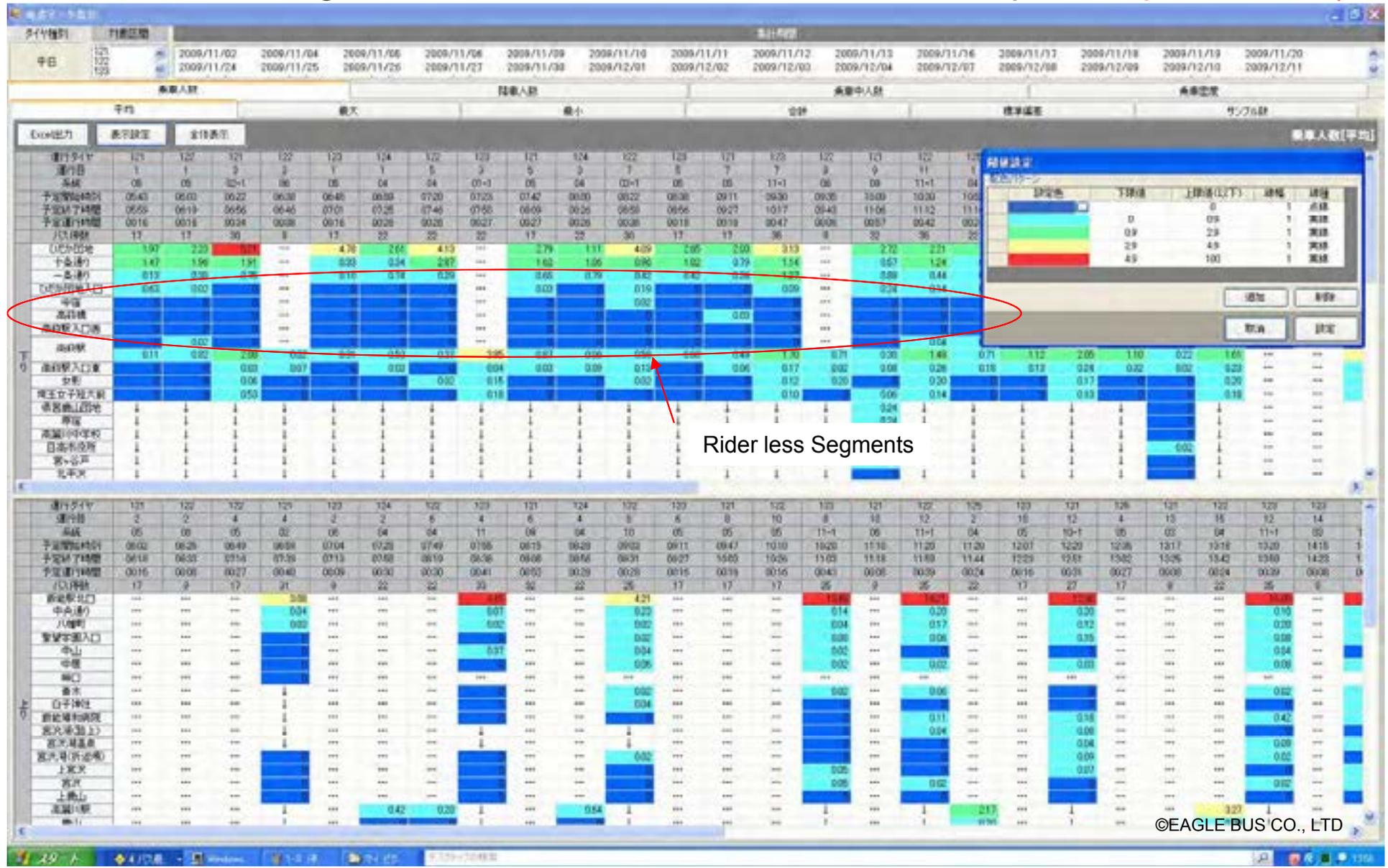
Rank Analysis

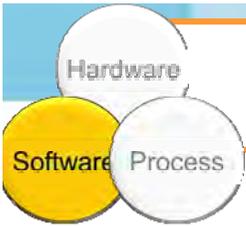
Balancing  
Quality & Cost



# Elucidation of Operation (Data Visualize System)

## Average Number of Bus Riders at each Bus Stop (Simplified View)





# Elucidation of Operation (Data Visualize System)

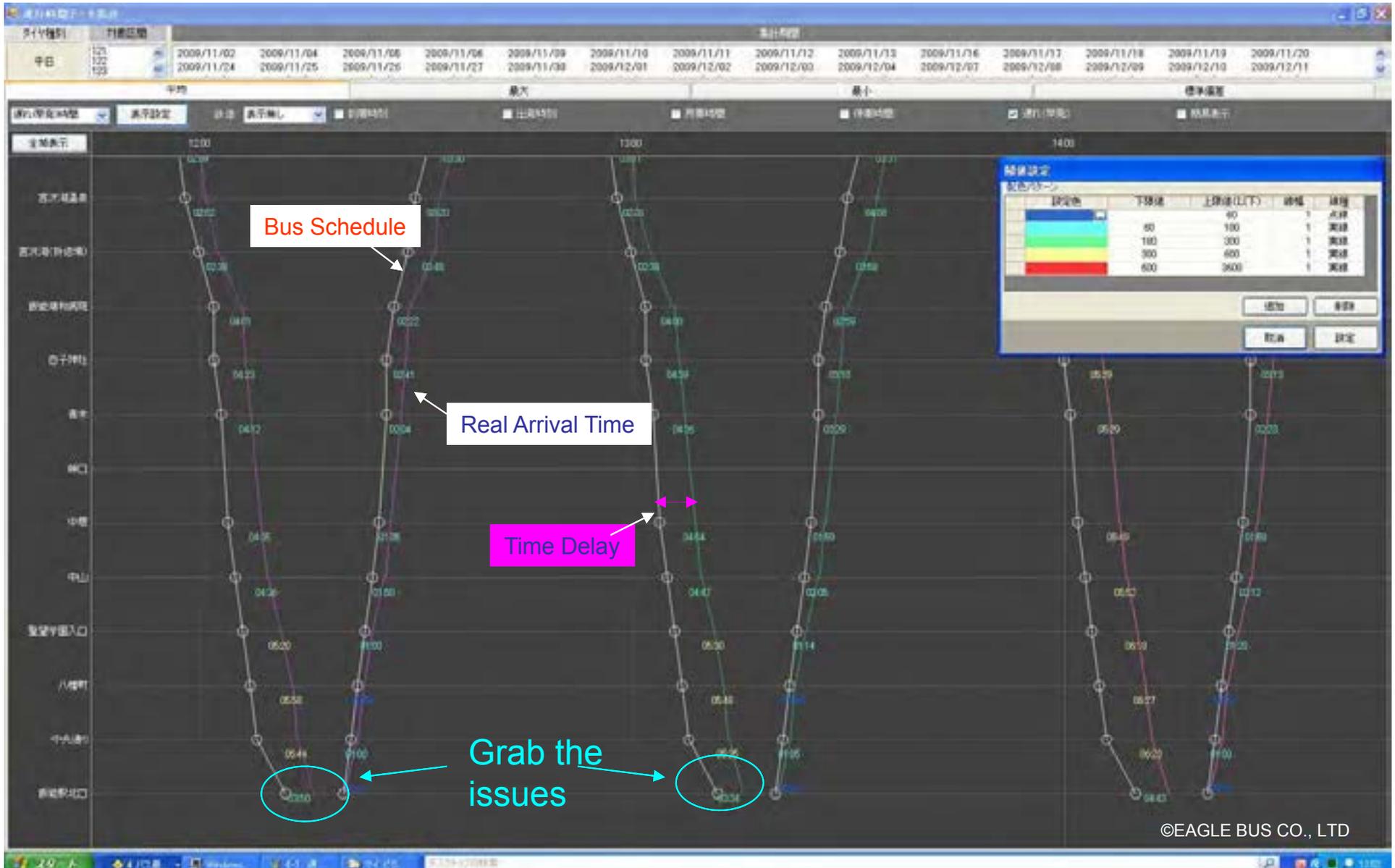
## Bus Rider Density between Each Bus Stop (Simplified view)





# Elucidation of Operation (Data Visualize System)

Bus Delay time (Delay time between schedule and real arrival time)



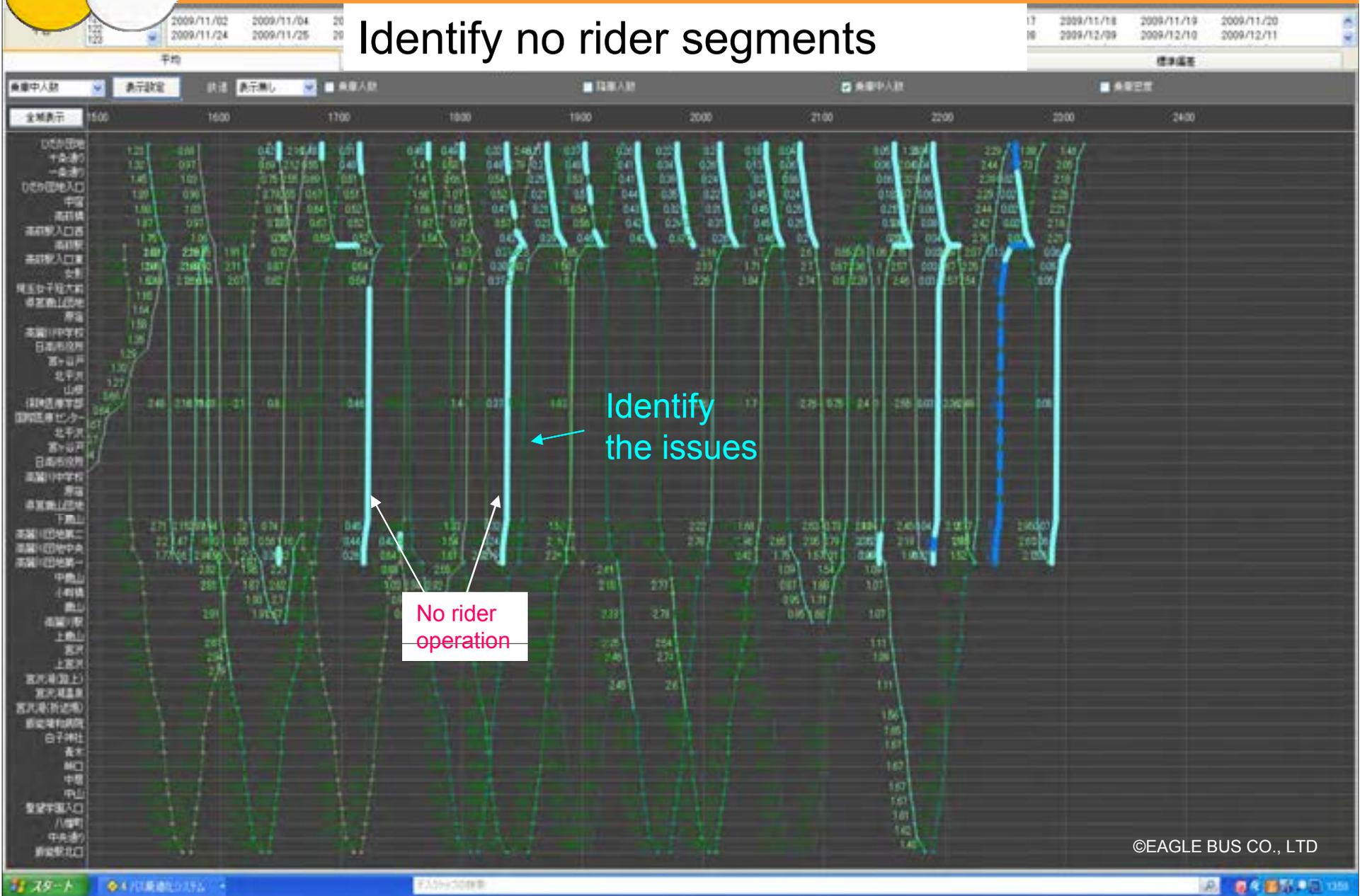
Hardware

Software

Process

# Elucidation of Operation (Data Visualize System)

Identify no rider segments



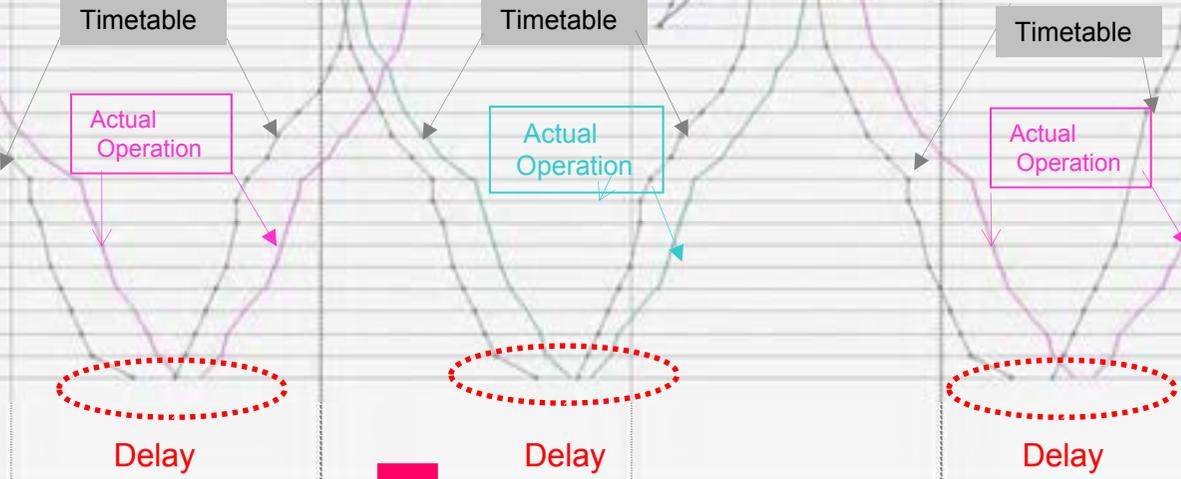
Hardware

Software Process

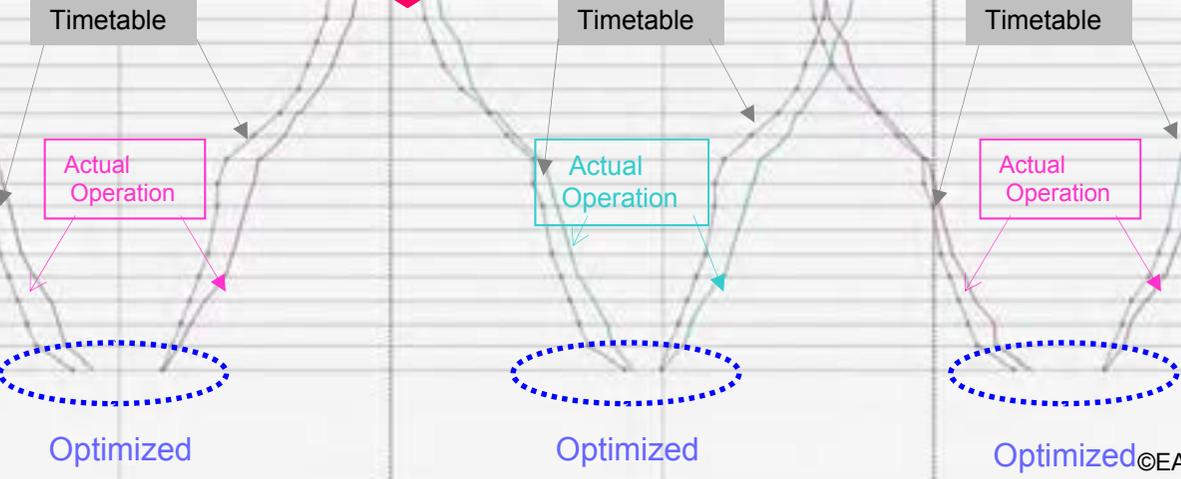
# Evaluation of Diagram Optimization

## Actual Arrival Time vs. Scheduled Time

Prior to Optimization  
~2010.04.18

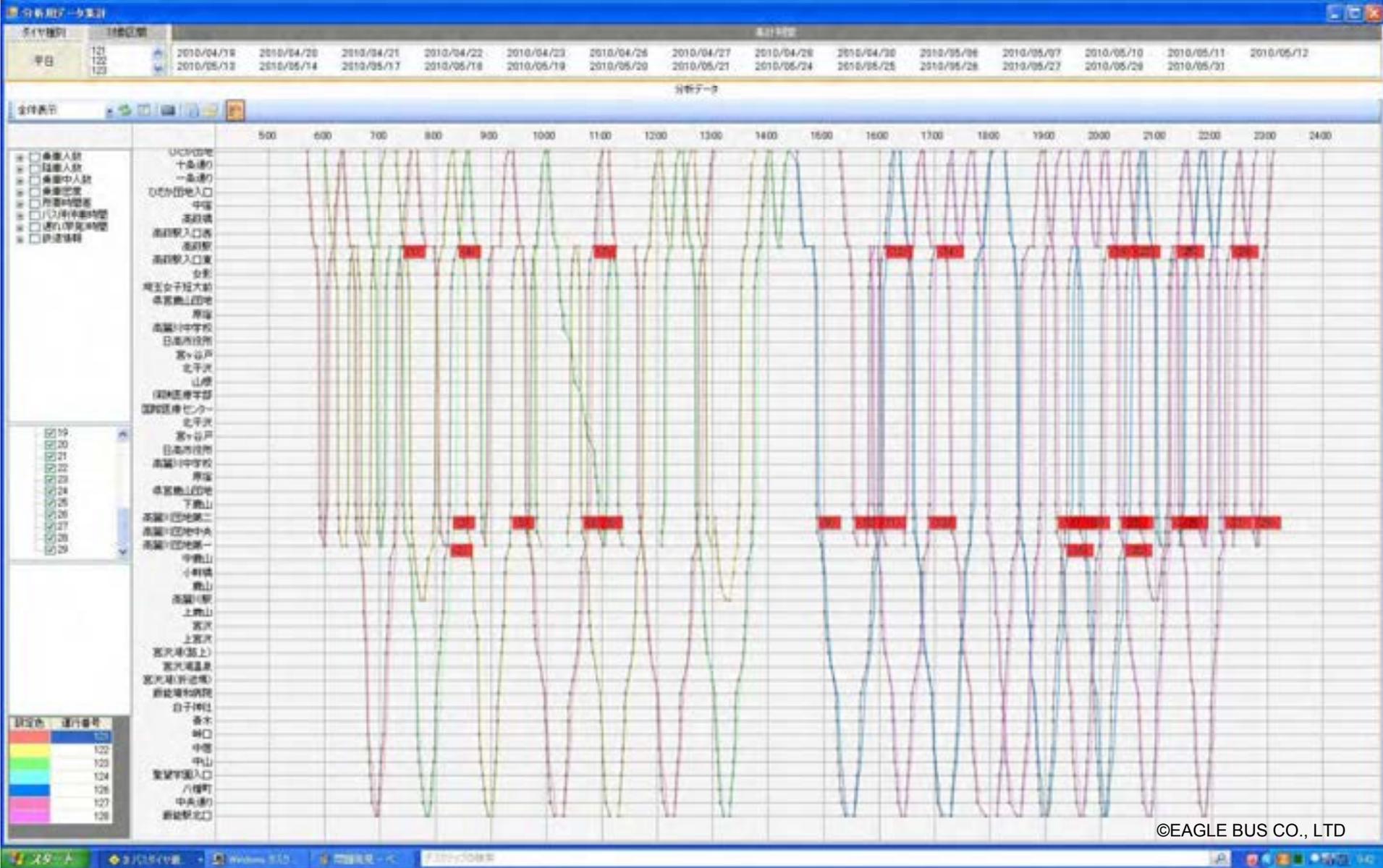


After Optimization  
2010.04.19~



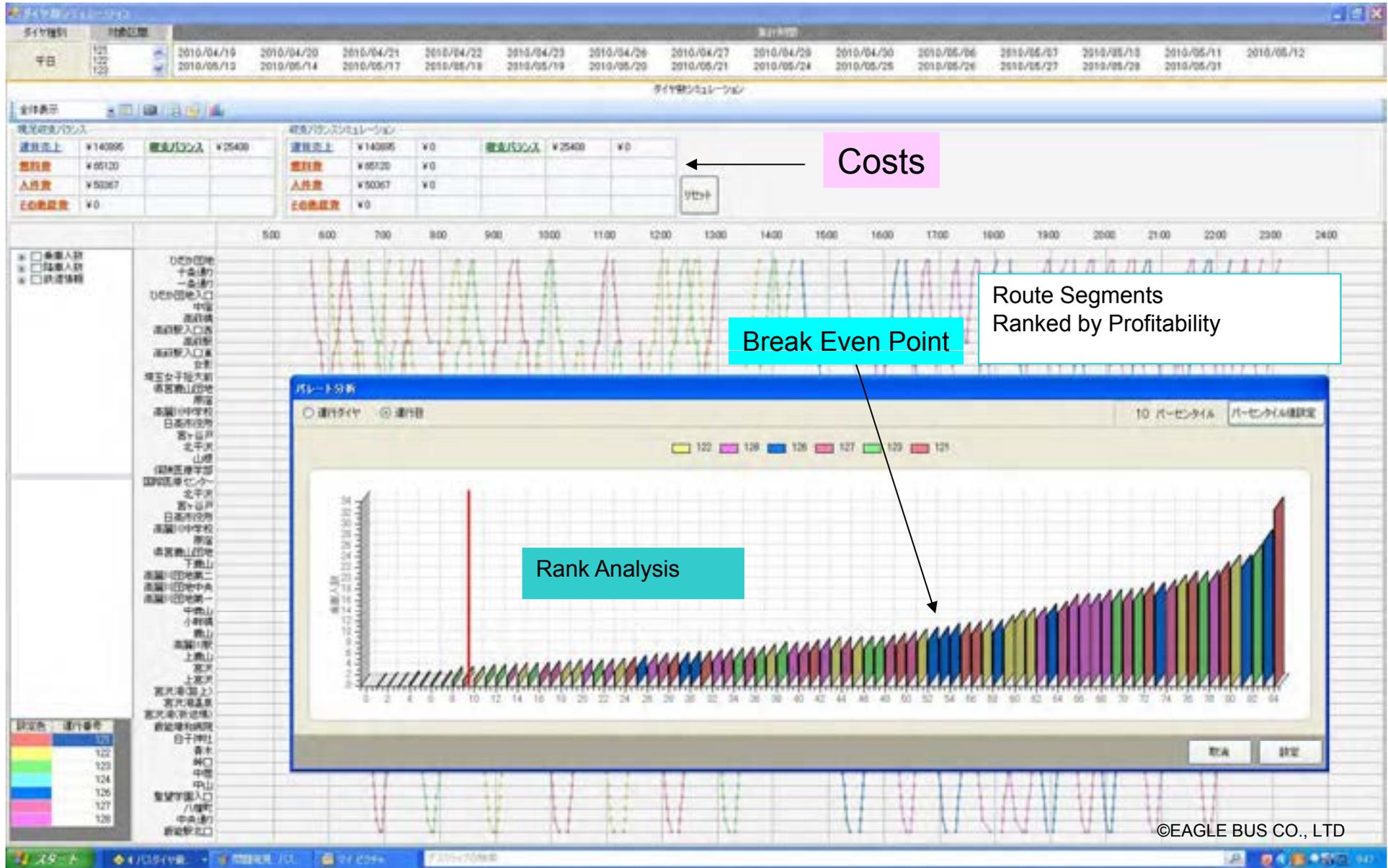
# Fine-tuned Reporting System

Automatically Identifies Predetermined Problem Areas



# Profit Loss Analysis Reporting System

## Identify Profitable and Non Profitable Route Segments



# Elucidation of Customer Needs (Surveys)

In-Bus Survey Card

Every Day

乗車券が書  
3508790  
425  
お客様満足推進室  
ご住所  
お電話  
フリガナ  
お名前

Printed on prepaid postcard

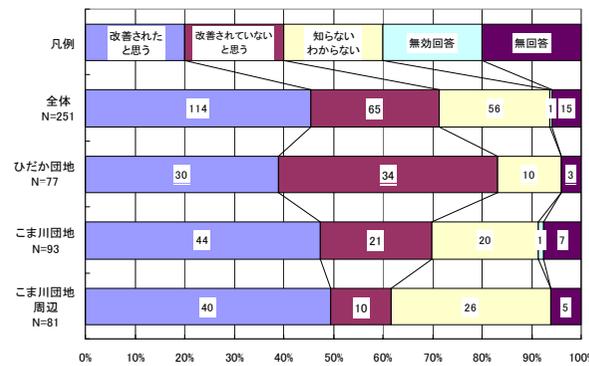


Complaints, Riders Needs

Yearly rider questionnaire

Every Year

New diagram Evaluation

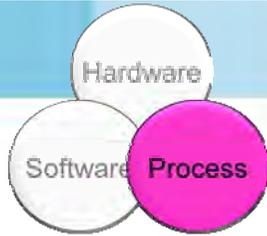


Resident Survey

Every Three Years



Life Style



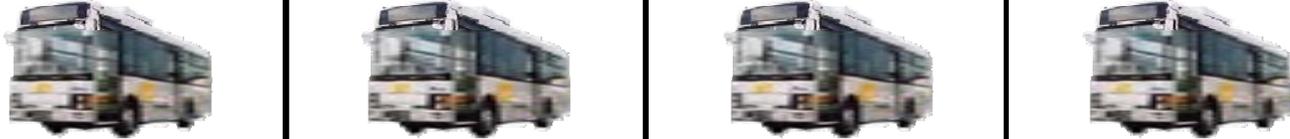
# Elucidation of Operation Costs

## (Micro Unit Cost Management)

Micro Components	Before Revision 2007	After Revision 2008	Improving	
Total Km	356,506km	309,783km	-46,724km	
Out of Service Ratio	12.0%	12.6%	+0.6%	
Runs per day	Weekday 129 Weekend 99	Weekday 115 Weekend 98	Weekday -13 Weekend -1	
Total Driver Shifts	2,676	2,433	-243	
Total Operation Hours	15,172H	15,076H	-96H	
Labor Cost	¥24,084,000.	¥21,897,000	¥-2,187,000	<b>Cost Reduction 10%</b> <b>¥-3,589,000</b>
Fuel Cost	¥10,695,000.	¥9,293,000.	¥-1,401,000	

# Micro Unit Costs

Hidaka Case Study: 4 Buses 8 Drivers 7 operations/Driver  
 Cutting 1 minute and 1 Km = Savings of 1,343,000円 (US\$13,000)

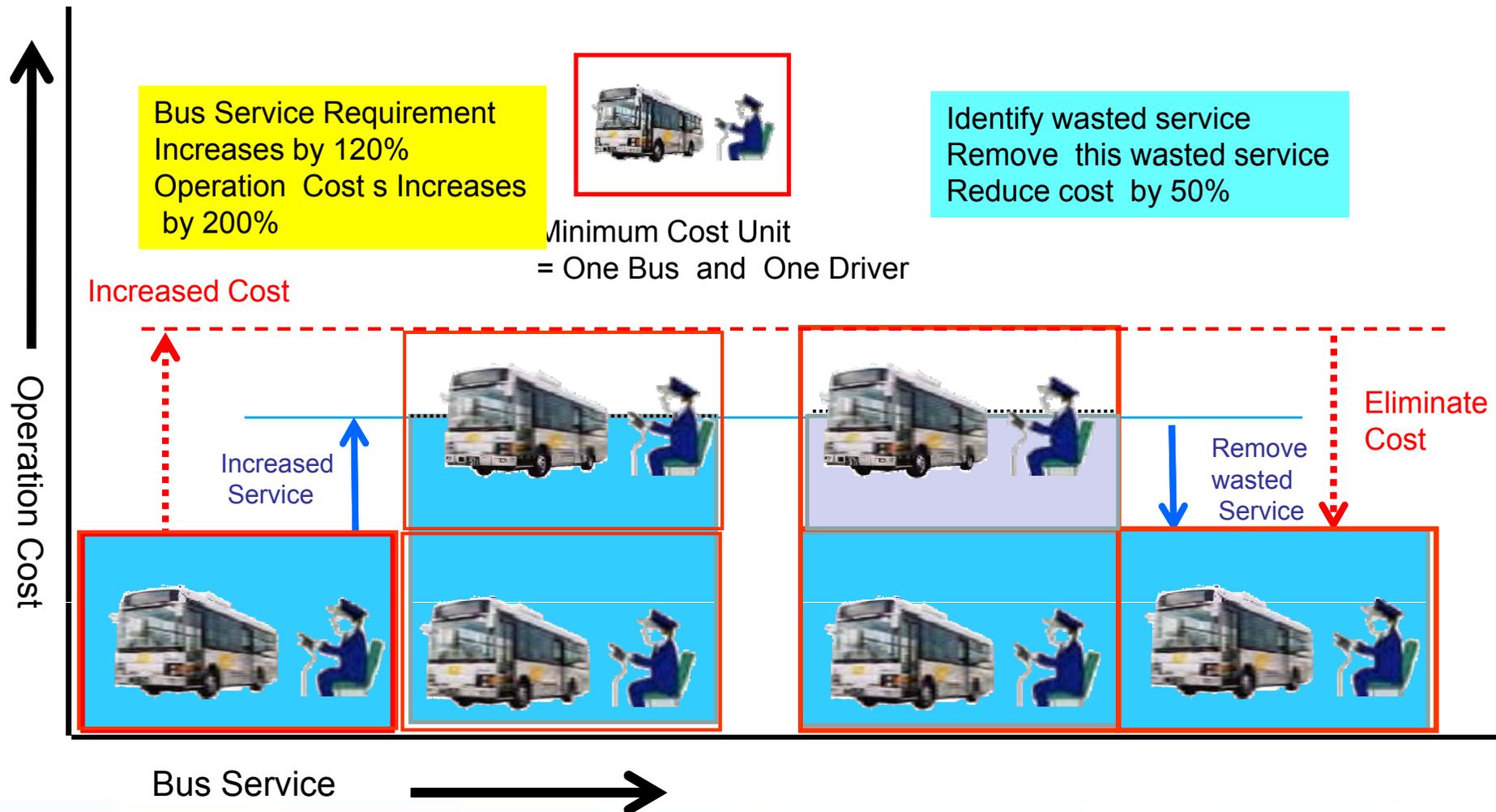
4 Buses					Per Day	
8 Drivers					8 Drivers	
Operation	7	7	7	7	56	
CUT	Minutes	7分	7分	7分	7分	56 minutes
	Km	7 Km	7 Km	7 Km	7 Km	56 Km
Reduced Yearly Labor Cost	Eliminate 56m/Day × 365 days = 20,440(m) (340H) 340 H ÷ 8 H = 42.5 days = 約60万円				1便運行あたり1分短縮できれば 年間で60万円の コストが削減可能	
Reduced Yearly Fuel Cost	Eliminate 56Km/Day × 365 Days = 20,440Km Fuel Consumption 1ℓ 3.3Km 走行 軽油: 1ℓ 120円 として 20,440Km ÷ 3.3Km/ℓ × 120円 = 743,000円				1便運行あたり1 Km短縮できれば 年間で74万円の コストが削減可能	

1分+1 Km  
同時に削減出来れば年間134万円の  
コスト削減が可能となる。

Conversely, Every minute or Km added increases costs greatly

# Scheduled Bus Cost Structure

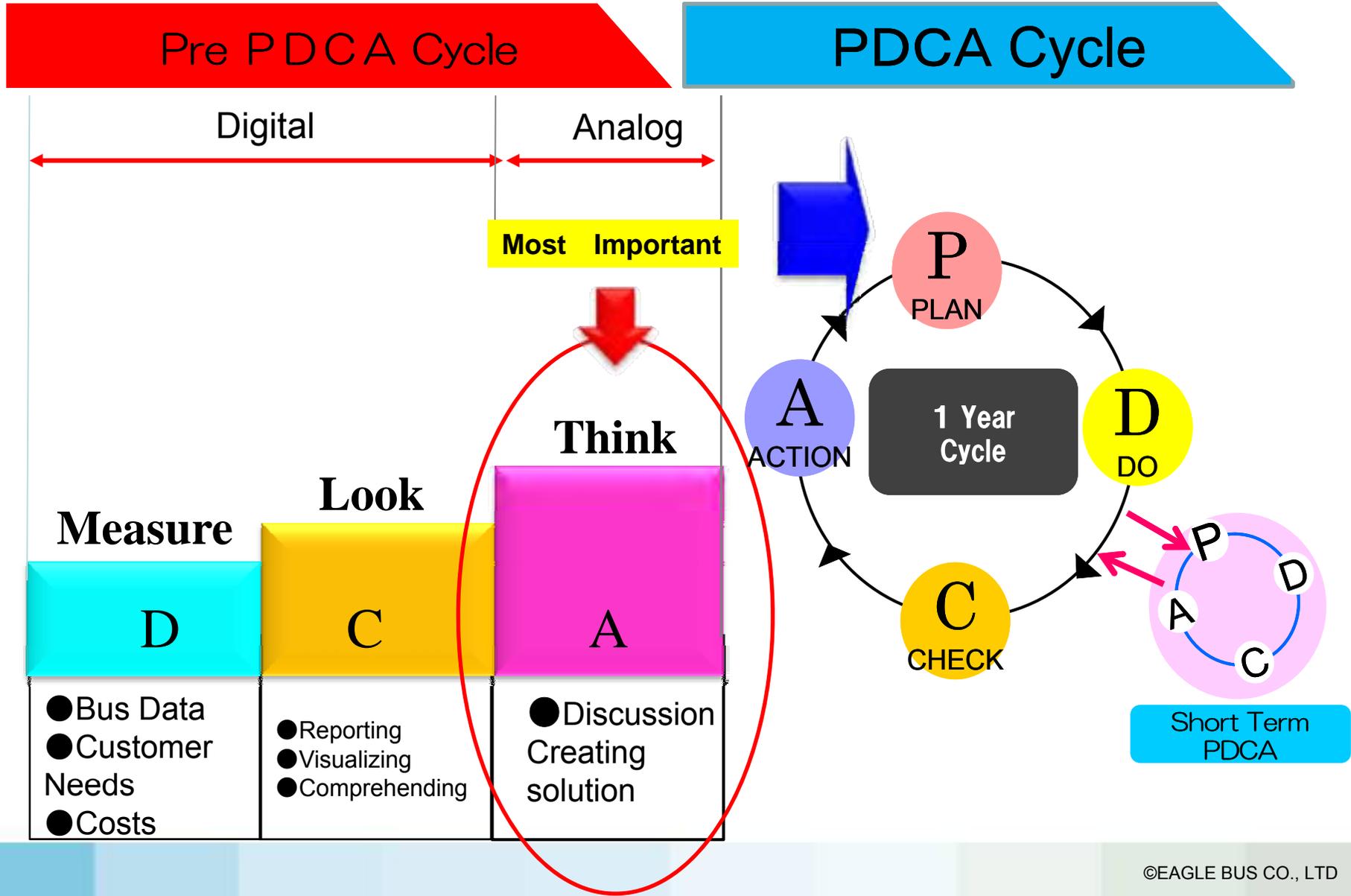
## Scheduled Bus Cost Increases and Declines Stepwise



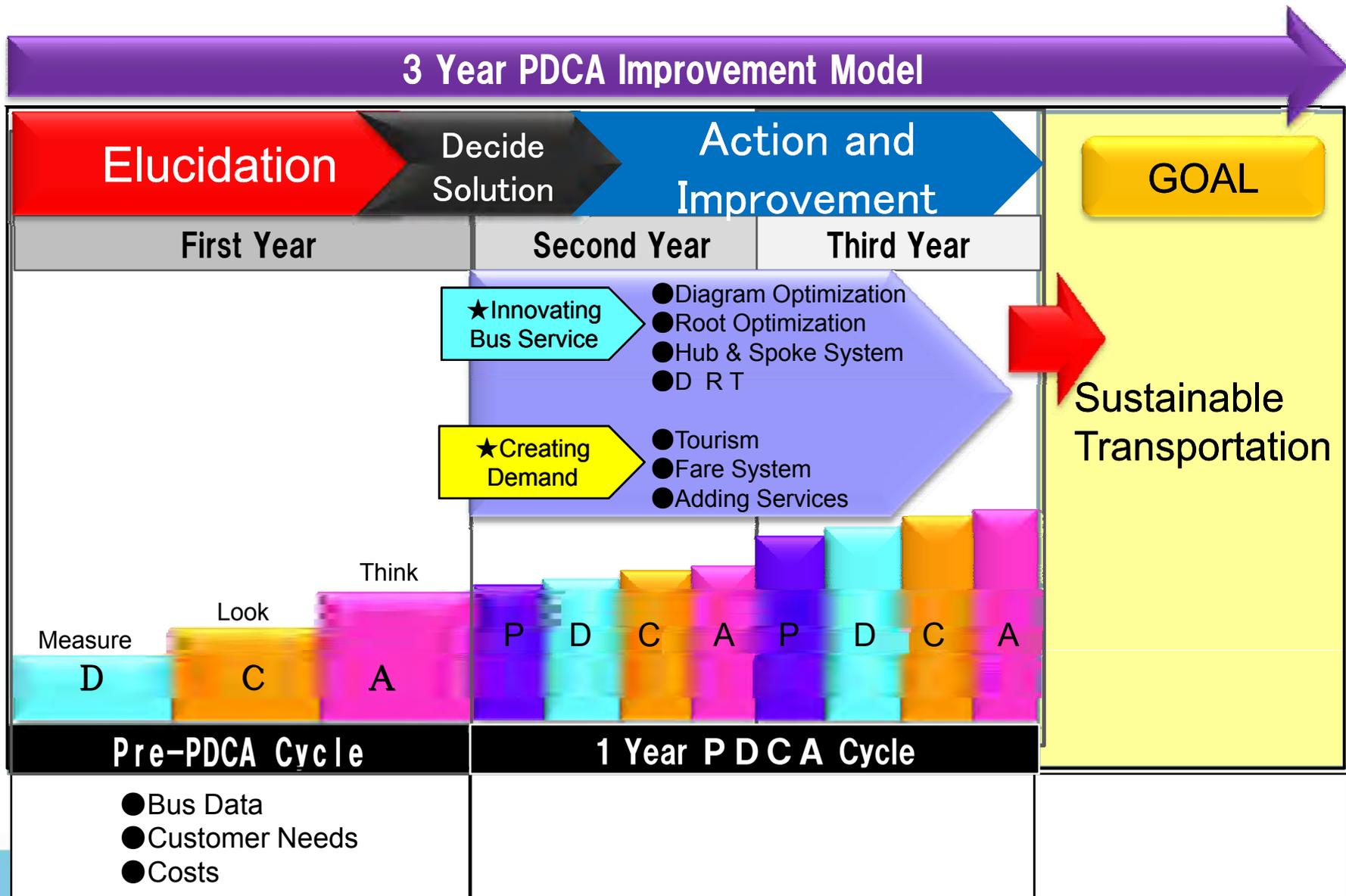


## 2. Elucidating Improvement using a 3 Year PDCA Cycle

# Pre PDCA Cycle is Definitely Needed



# 3 Year PDCA Improvement Model





★ Creating Demand

# Augmenting Scheduled Bus Ridership With Tourists

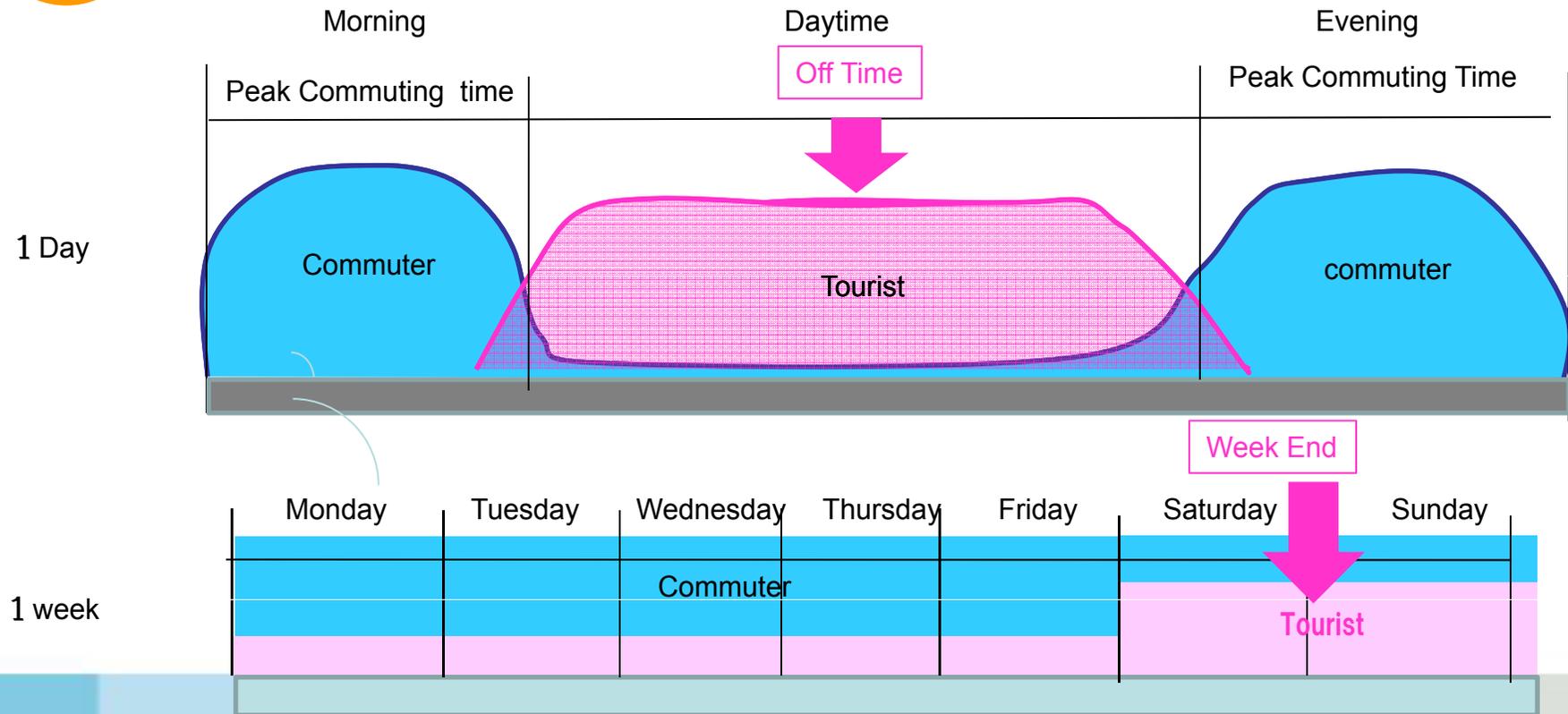
Negative Aspect

Ridership is declining every year by increasing retired people



Positive Aspect

Retired people go to trip and use buses at the tourist site.



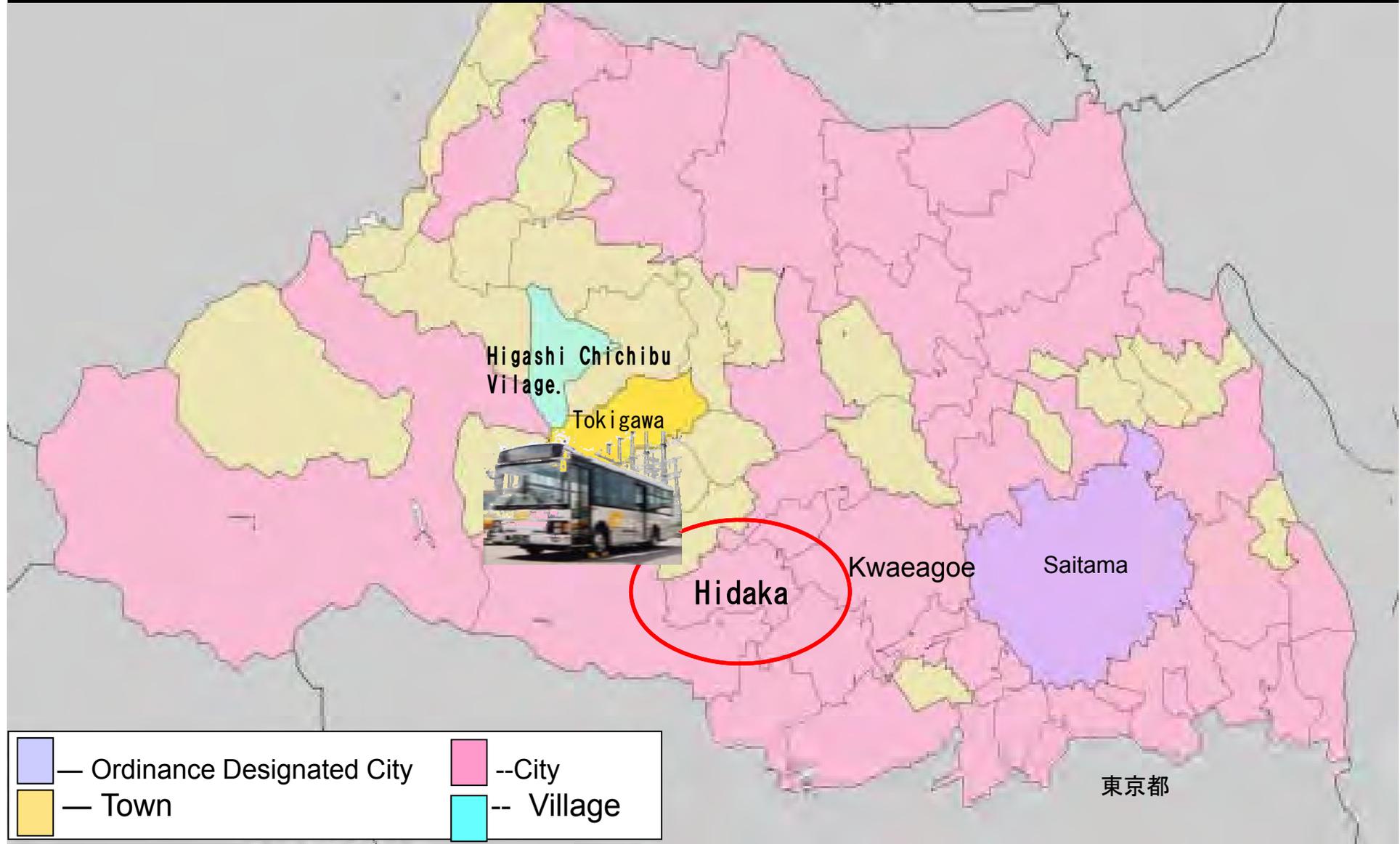


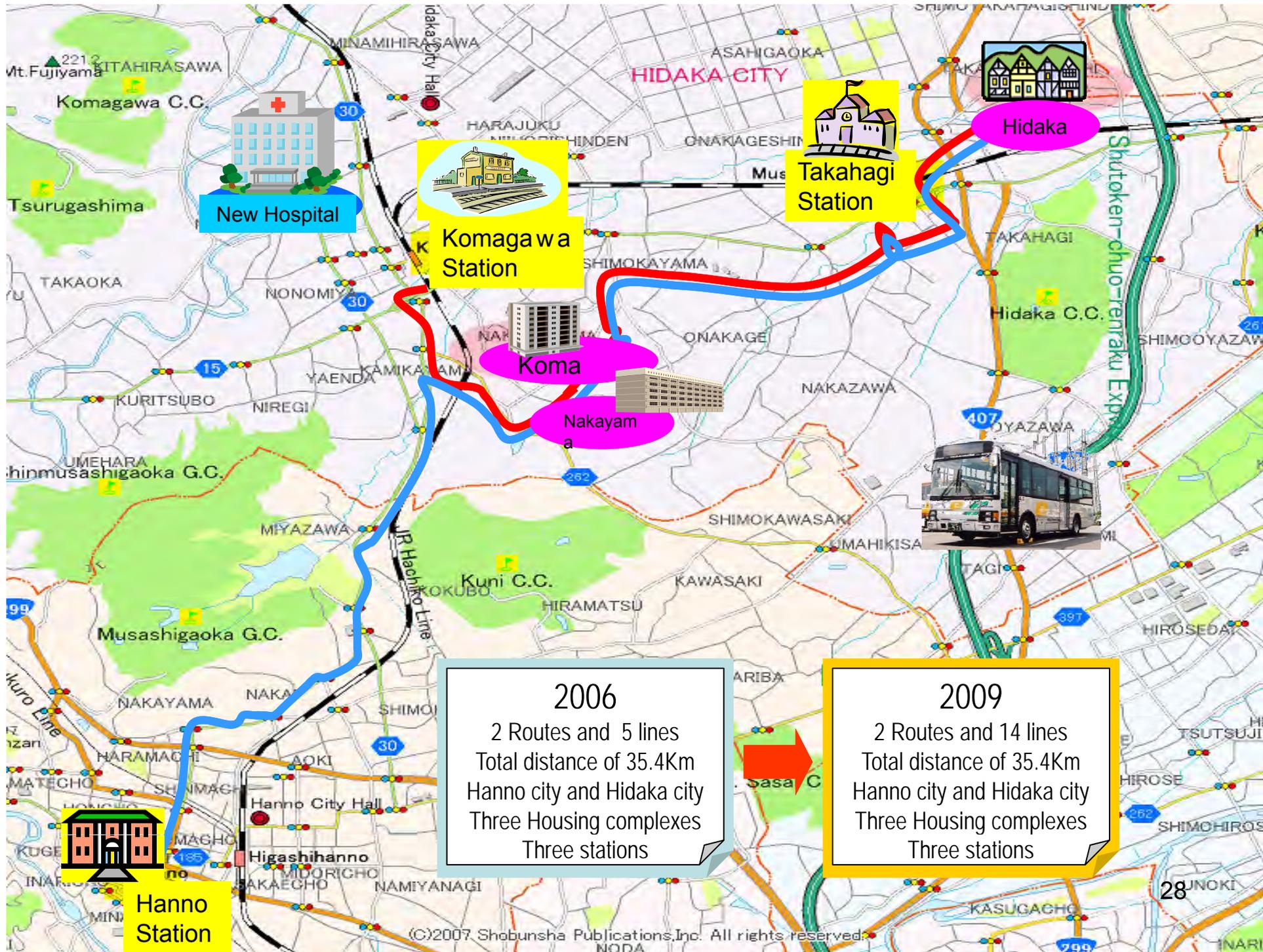
# Hidaka-Hannou Case Study

## A Real World Challenge

# Optimization of Hidaka Scheduled Bus

Scheduled Bus Optimization through Elucidation and Marketing





**2006**  
 2 Routes and 5 lines  
 Total distance of 35.4Km  
 Hanno city and Hidaka city  
 Three Housing complexes  
 Three stations

**2009**  
 2 Routes and 14 lines  
 Total distance of 35.4Km  
 Hanno city and Hidaka city  
 Three Housing complexes  
 Three stations

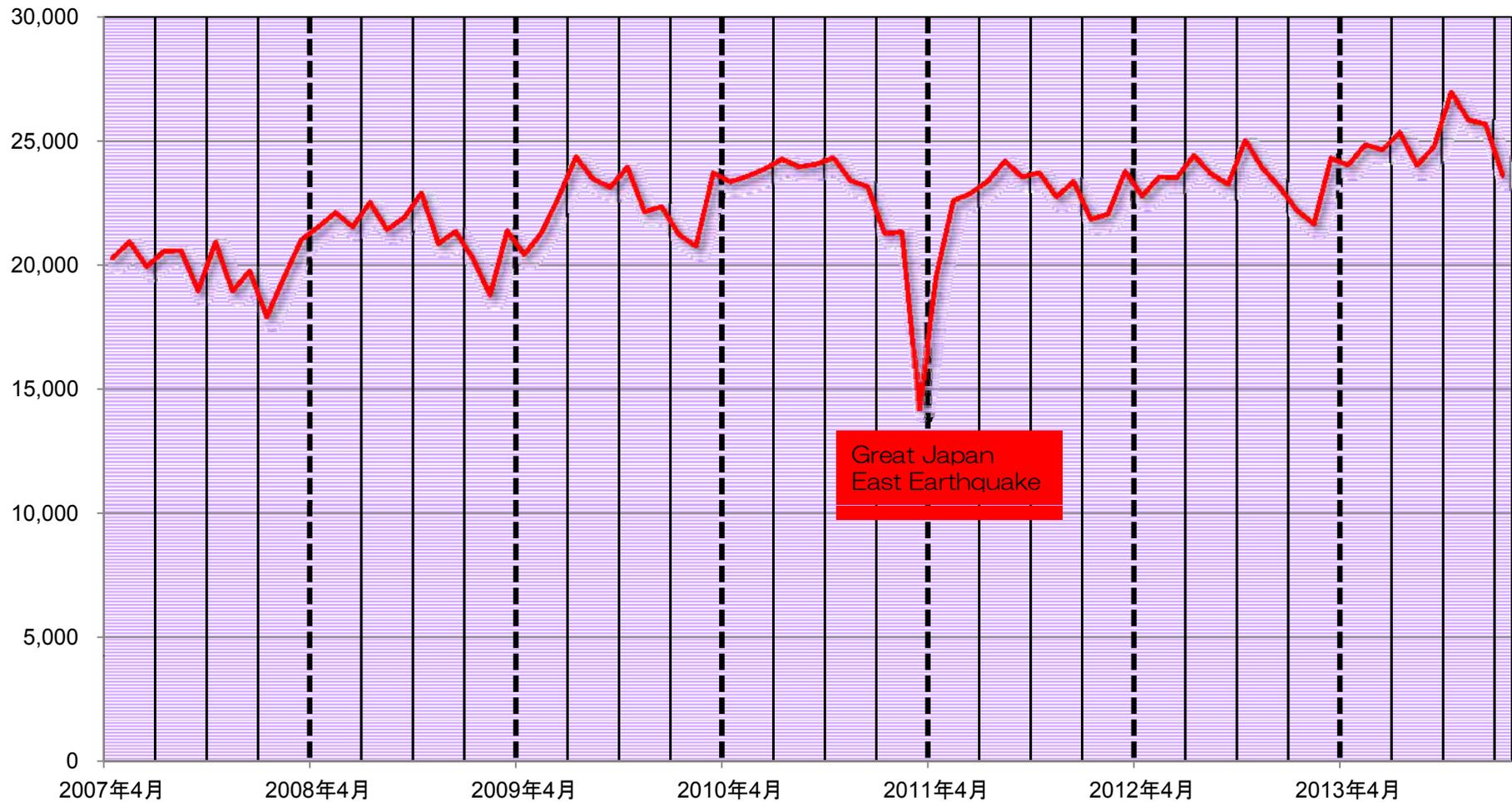
# HIDAKA –HANNOU Optimization

Exploratory Period → 3 Year PDCA → Continuing PDCA

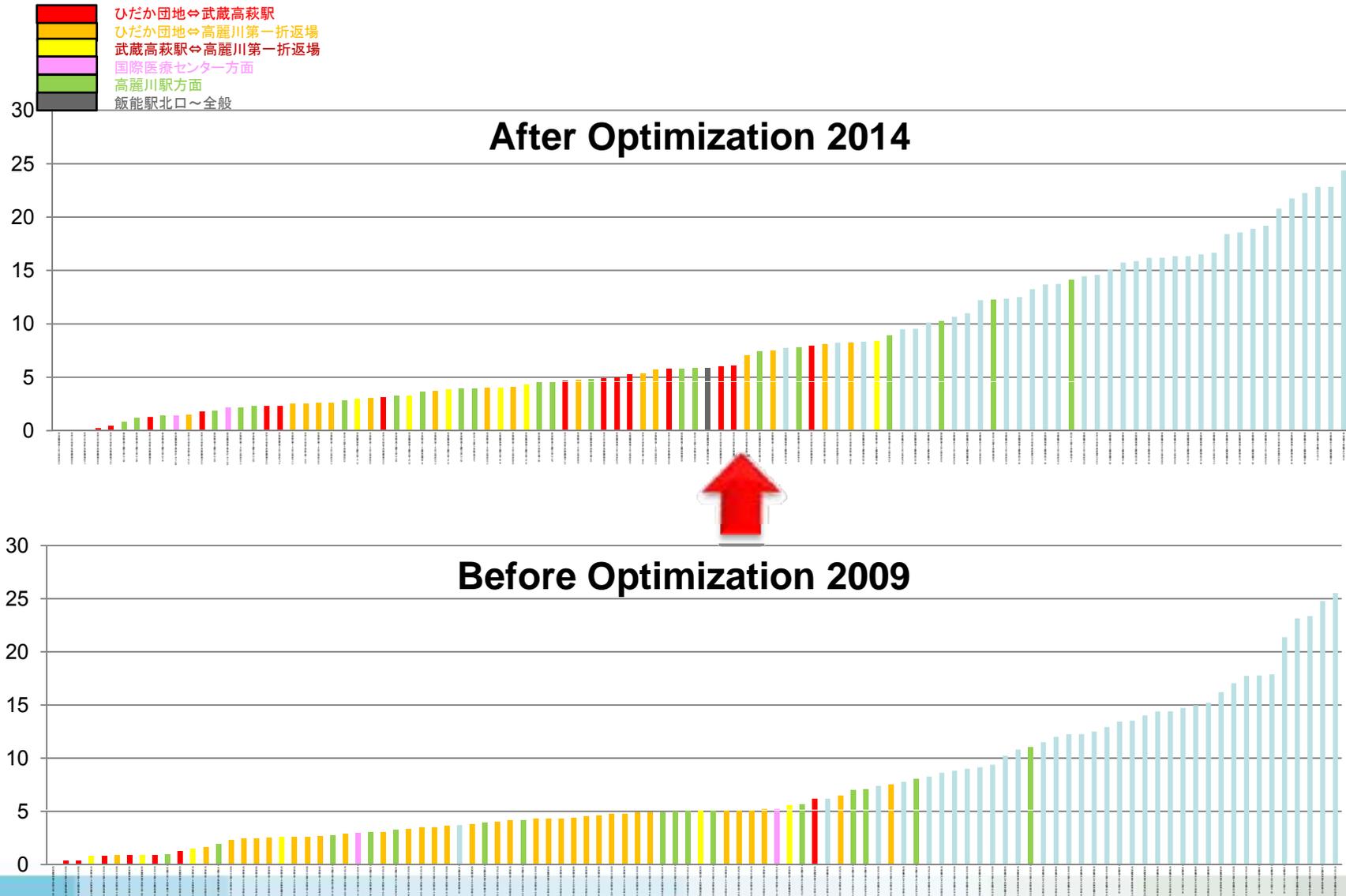
	2006	2007	2008	2009	2010	2011	2012
<b>Diagram change</b>	Apl. Took Over Bus route from Former Company	April. The First Timetable Optimization	April. The Second Timetable Optimization	April. The Third Timetable Optimization	April. The Fourth Timetable Optimization	April. The Fifth Timetable Optimization	April. The Sixth Timetable Optimization
<b>Questioners</b>	July: The first Questionnaire to all residents	Dec. : The First Questionnaire To Bus riders	July. : The Second Questionnaire To Bus riders	July. : The Third Questionnaire To Bus riders	July. : The Fourth Questionnaire To Bus riders	July. : The Fifth Questionnaire To Bus riders	Jan. The Second Questionnaire to all residents
			Improvement of Train Connection	Set a new Bus Stop at Onsen	Move a Bus Stop by data	Find a improving process	
<b>Results Of Optimization</b>		×Failure	△Even	○Improved	○Improved	○Improved	○Improved
		Decline Passengers	Recovered	Increased Passengers	Increased Passengers	Down and recovered	Increased Passengers
		cost Up	Cost down	Improving	Improving	Improving	Improving
<b>PDCA</b>	Define P D C A Cycle   Pre-PDCA   Short-term PDCA   3Year ODCA						 3 Year Model
<b>Measure</b>	APC V.1 Developing		APC V.2 Developing		APC V3 Developing		
<b>Look</b>	Questionnaire Design improving						
<b>Think</b>	Elucidation		Find problems		Evaluation   Simulation		
	Hub & Spoke   On demand bus						

# Upward Trending Ridership

— Ridership



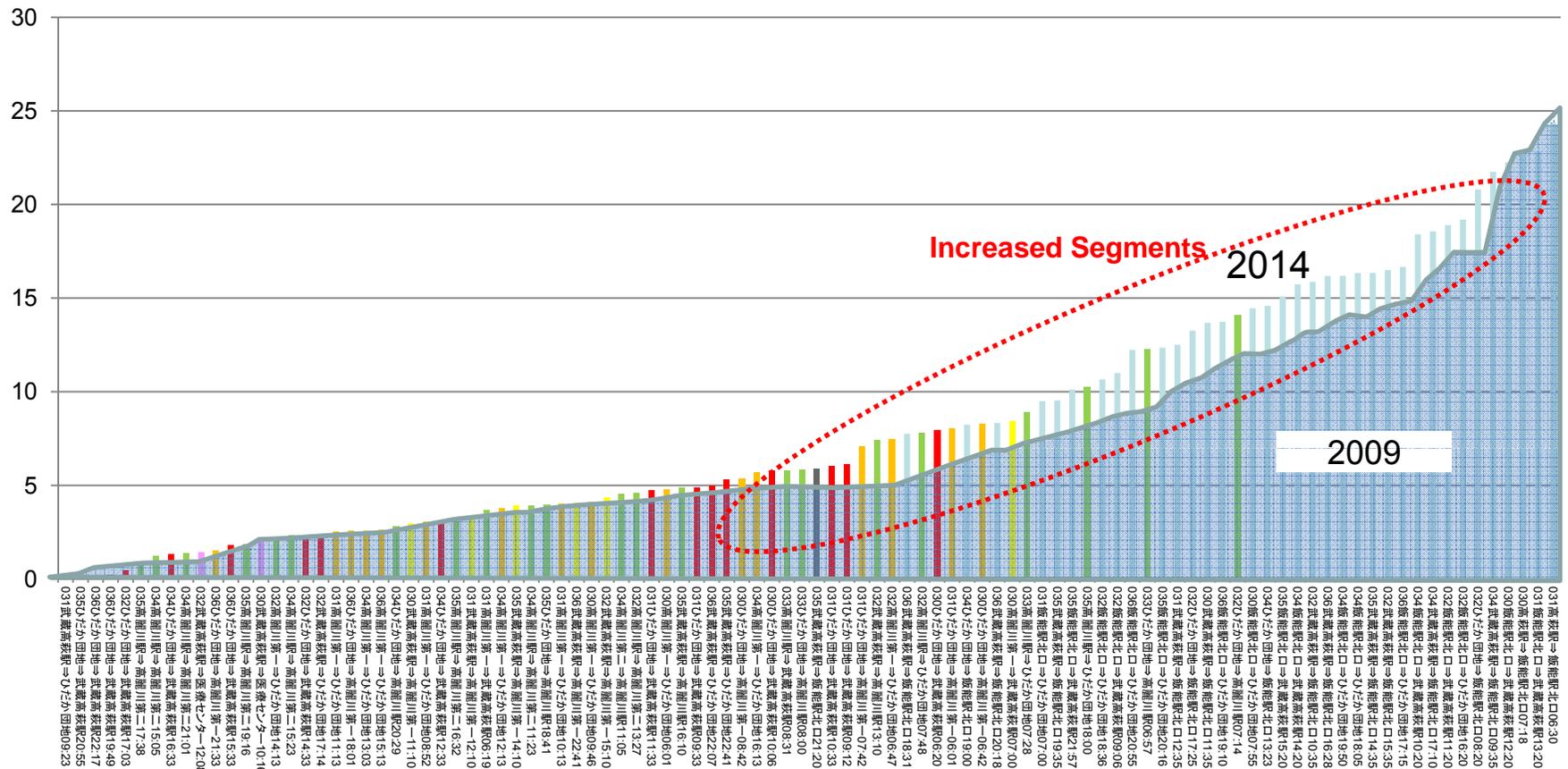
# Riders per route per operation Before and After Optimization



# Riders per route per operation increase following Optimization

- ひだか団地⇄武蔵高萩駅
- ひだか団地⇄高麗川第一折返場
- 武蔵高萩駅⇄高麗川第一折返場
- 国際医療センター方面
- 高麗川駅方面
- 飯能駅北口～全般

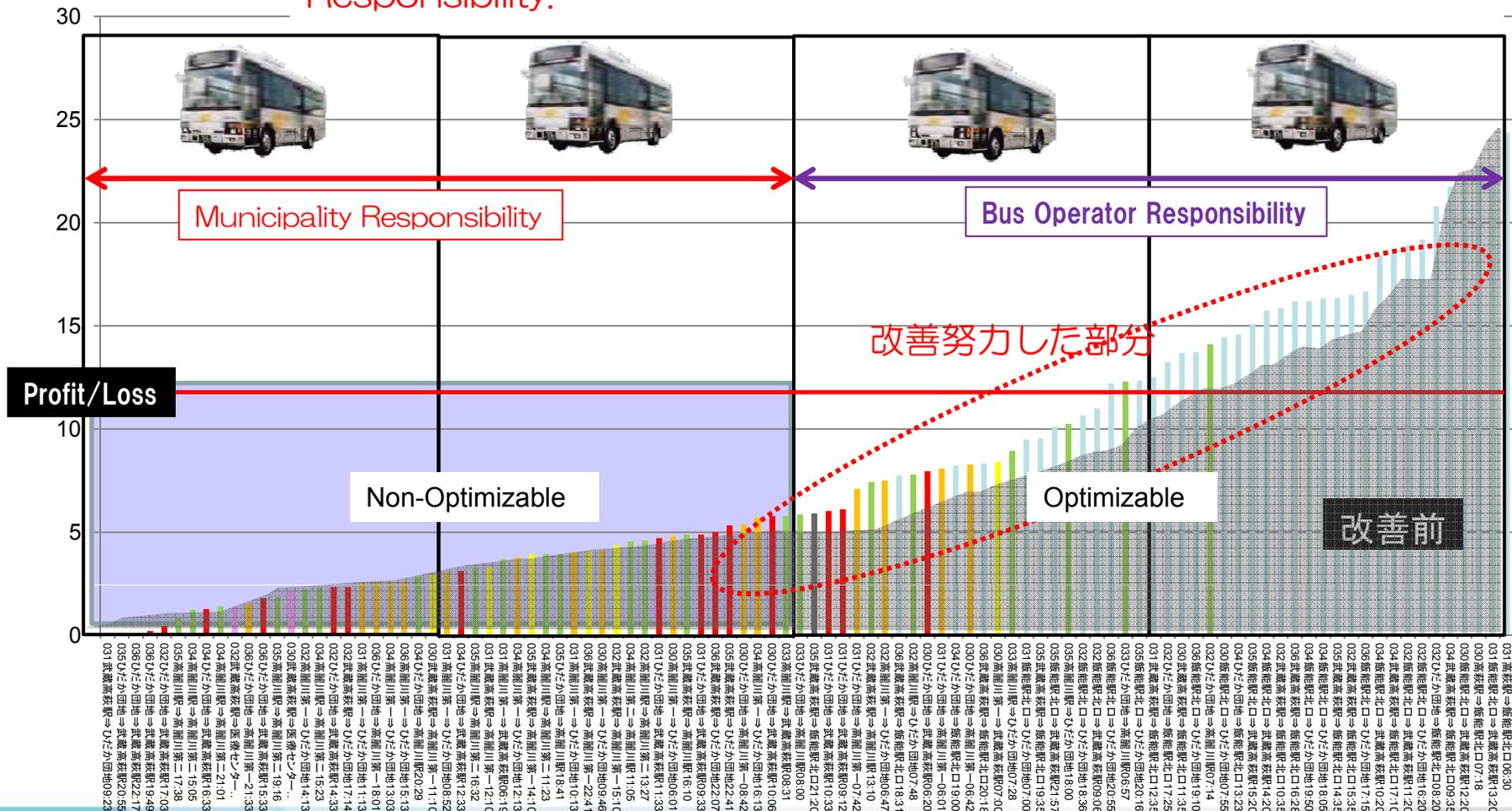
## Number of Riders 2009 vs. 2014



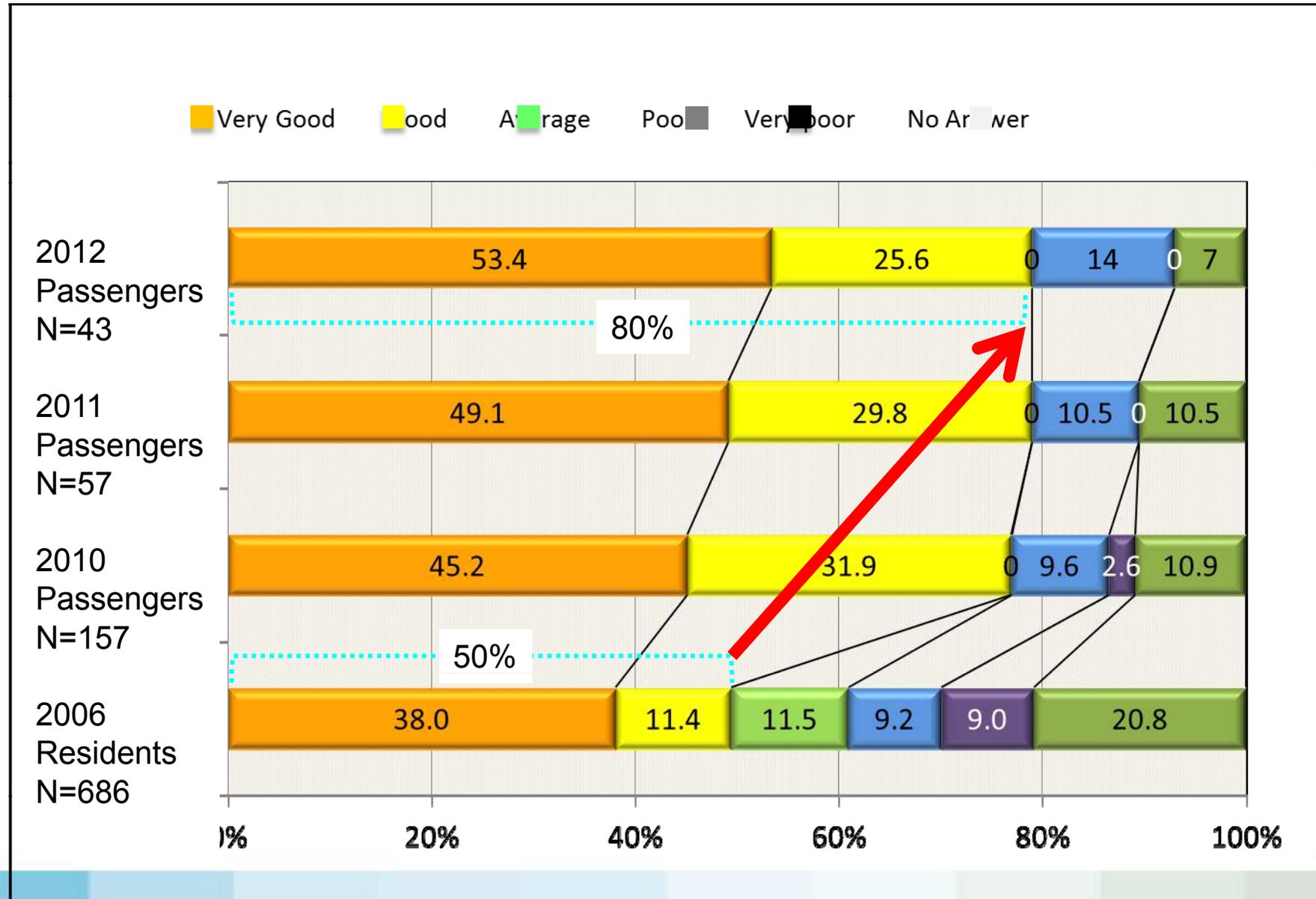
# Elucidating the financial Responsibility of The Municipality and Bus Operators

- ひだか団地⇄武蔵高萩駅
- ひだか団地⇄高麗川第一折返場
- 武蔵高萩駅⇄高麗川第一折返場
- 国際医療センター方面
- 高麗川駅方面
- 飯能駅北口～全般

Our Elucidation and Optimaization Process allows us to clearly know the Profit/Loss condition of each operation segment. Thereby demarcating the municipality and bus operator financial Responsibility.



# Hidaka-Hannou Service Evaluation





Tokigawa Case Study  
Reorganization introducing Hub & Spoke

# Tourist Attractions



Tokigawa River



Hot Spa

Tokigawa Town

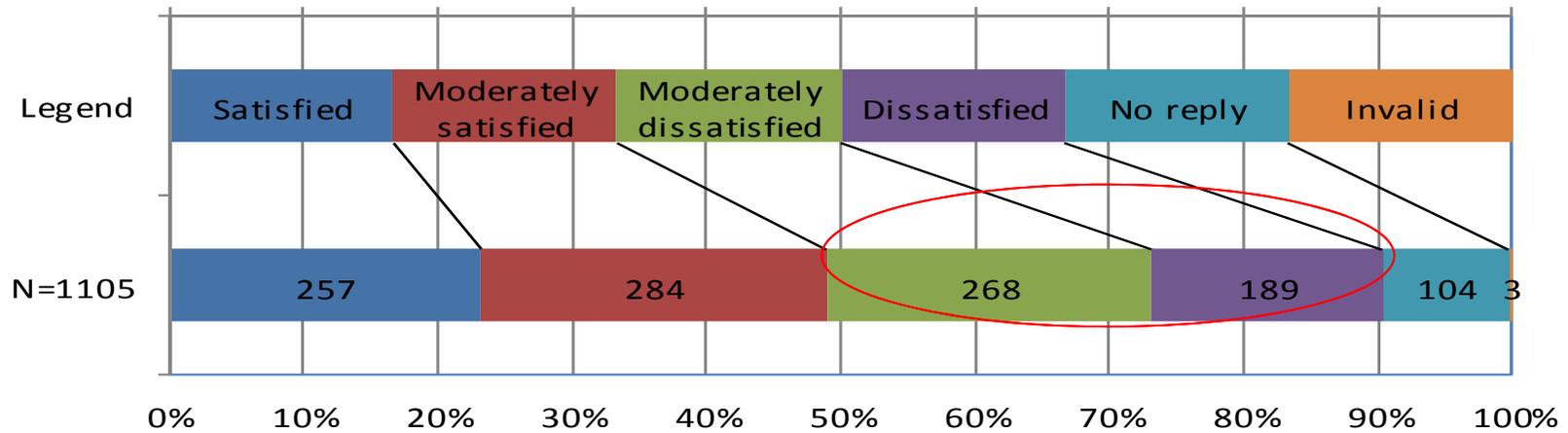


Town Restaurant

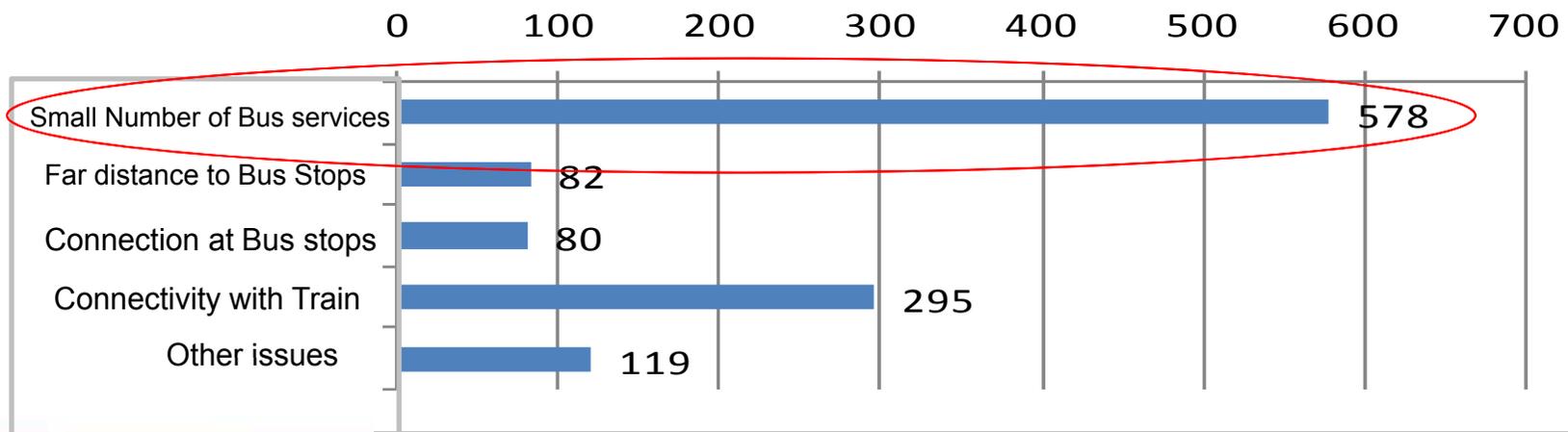


Town Restaurant Inside

## Satisfaction levels for Tokigawa town municipal bus (pre-reorganization)

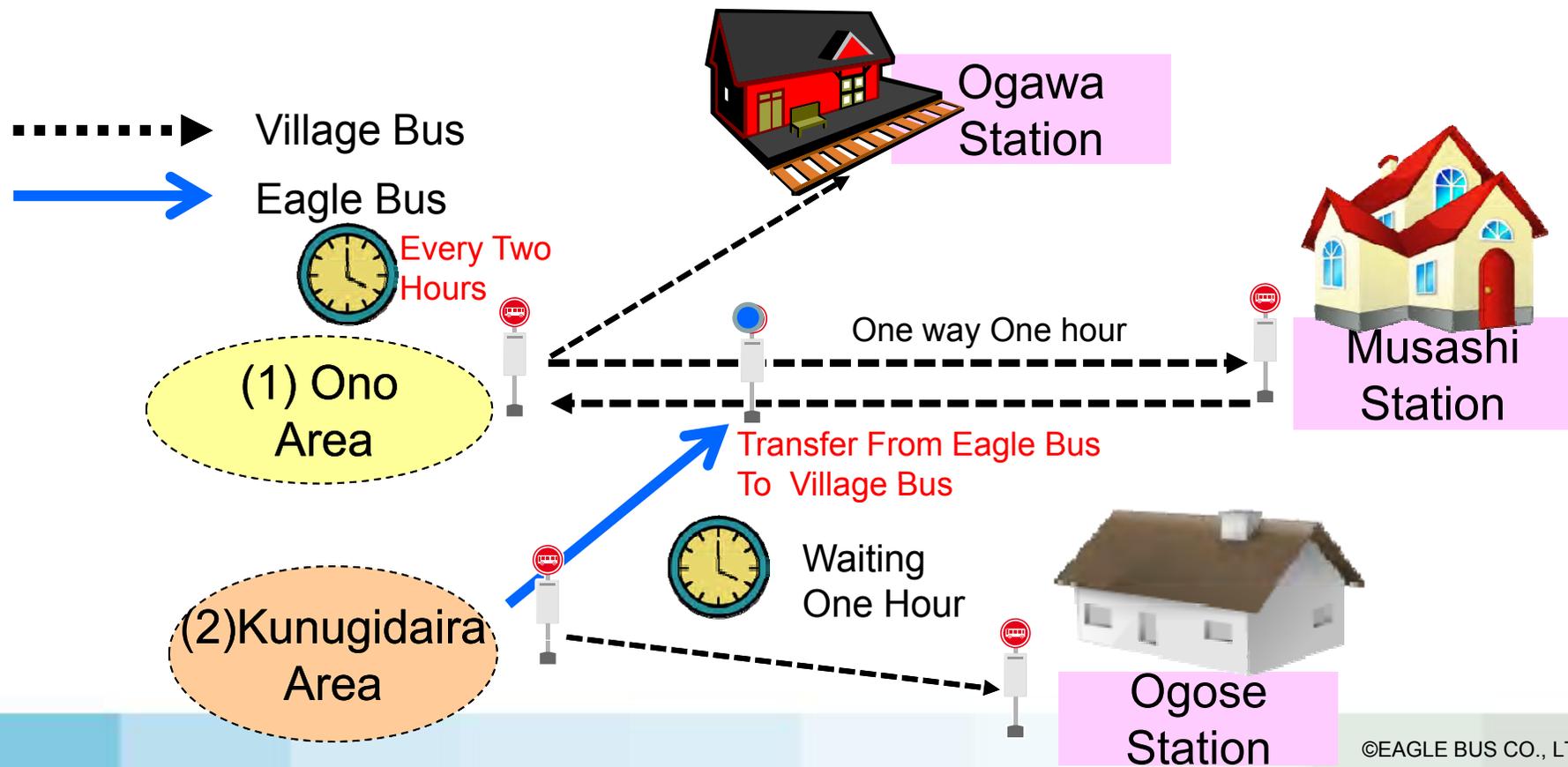


## Reason for dissatisfaction



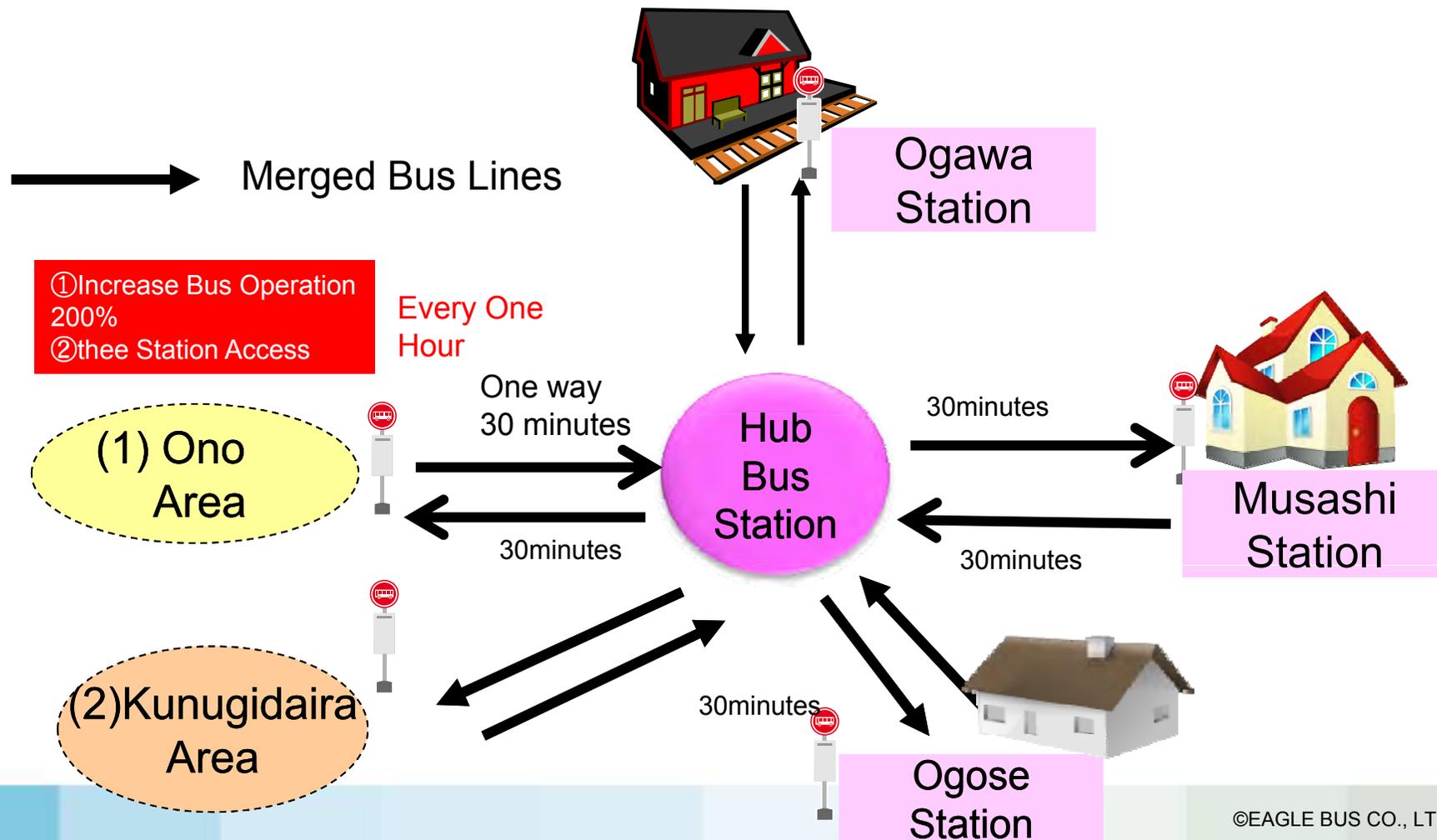
# Insufficient bus interval prior reorganization

The One issue of Scheduled Bus service in Rural areas is less bus operation.  
Main reason of inefficent operation is long operation



# Introducing Hub and Spoke System

One good solution is Hub & Spoke System . Putting a Hub Station center of town and connect all bus lines to this Hub station. We could increase bus operation without add buses and three station access is available changing buses at the Hub station.



# Hub Bus Station at Tokigawa Town



## 2. DRT- Demand Responsive Transport Introducing New Transport system for Elderly people

山間地域は高齢率が高く、バス停留所も離れているので実質的な交通空白地域となっている。この地域に朝の通勤・通学帯は今までのバスによる定時運行とし、10時以降は、バスからミニバンに変えて、定時バス路線から更に奥まったところに設定したサブバス停留所～ハブ停留所間運行を行う。

### Special Features

1. Simple Design dispatch system  
Easy and Low Cost.
2. Point to multi point operation  
Hub to designated pick up poin.
- 3 Duo-mode DRT/Scheduled Bus  
Operation.

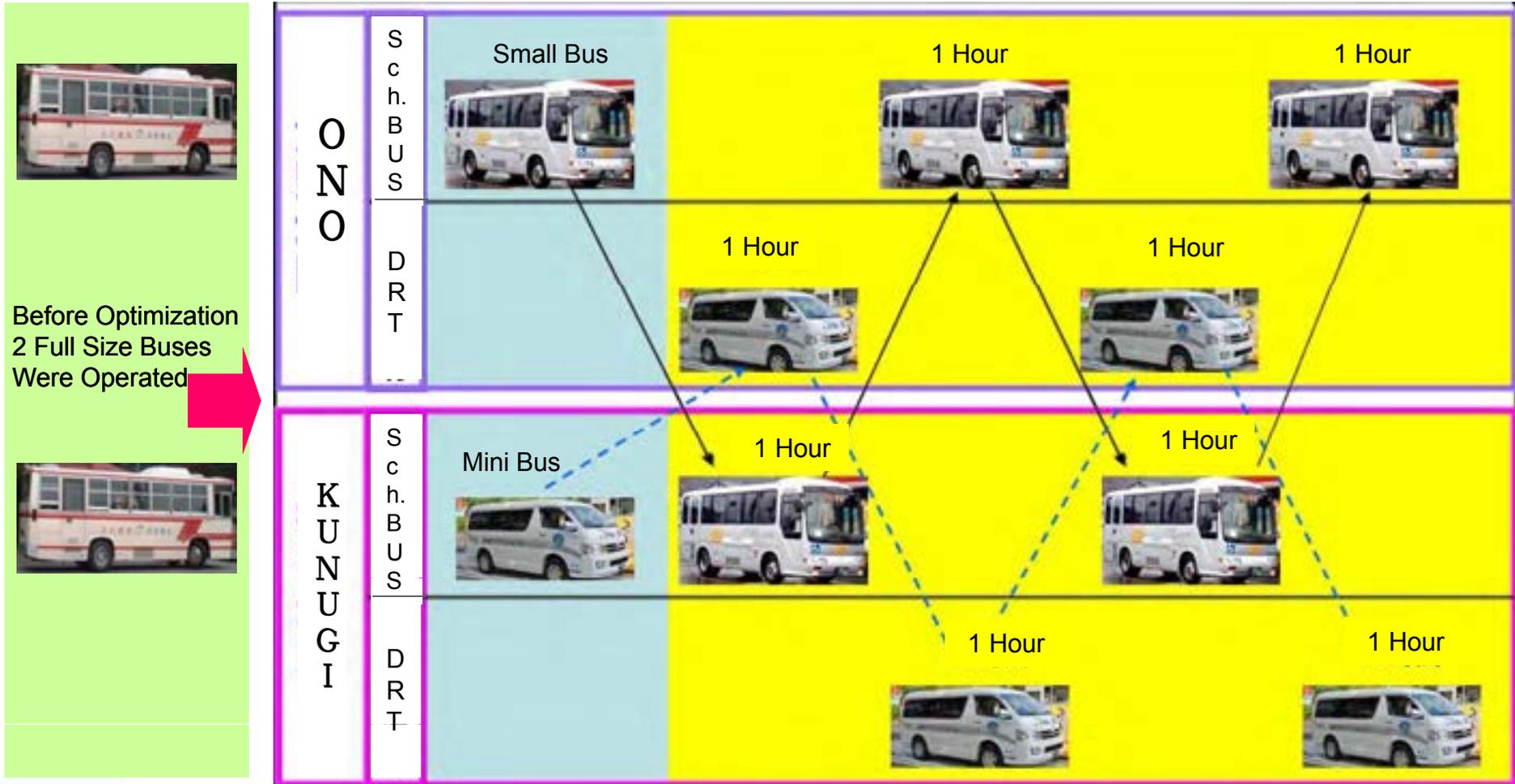


# Tokigawa DRT Unique Operation

Before reorganization two full size buses were operated throughout the day. After reorganization, these buses were replaced with one small bus and one minibus DRT service. During peak commute time, this bus operated as a scheduled bus, but at off peak times the Minivan DRT service took over.

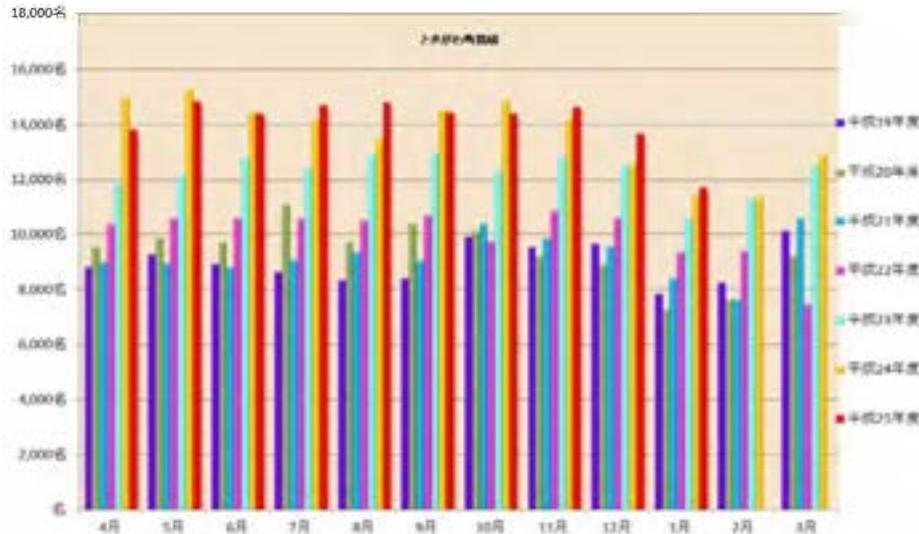
Commuting Time

After 09:00 Scheduled Bus and DRT Operate Alternately



Before Optimization  
2 Full Size Buses  
Were Operated

### Increased Passengers Numbers by 25%



## Tokigawa Optimization 2010

### Introducing Hub & Spoke and DRT (Demand Responsive Transportation)

- Service increased by 150% to 300%
- Passengers Increased by 25%
- Operation Distance reduced by 5% (22,802Km)

added equipment one mini van

### Increased bus service after re-organization

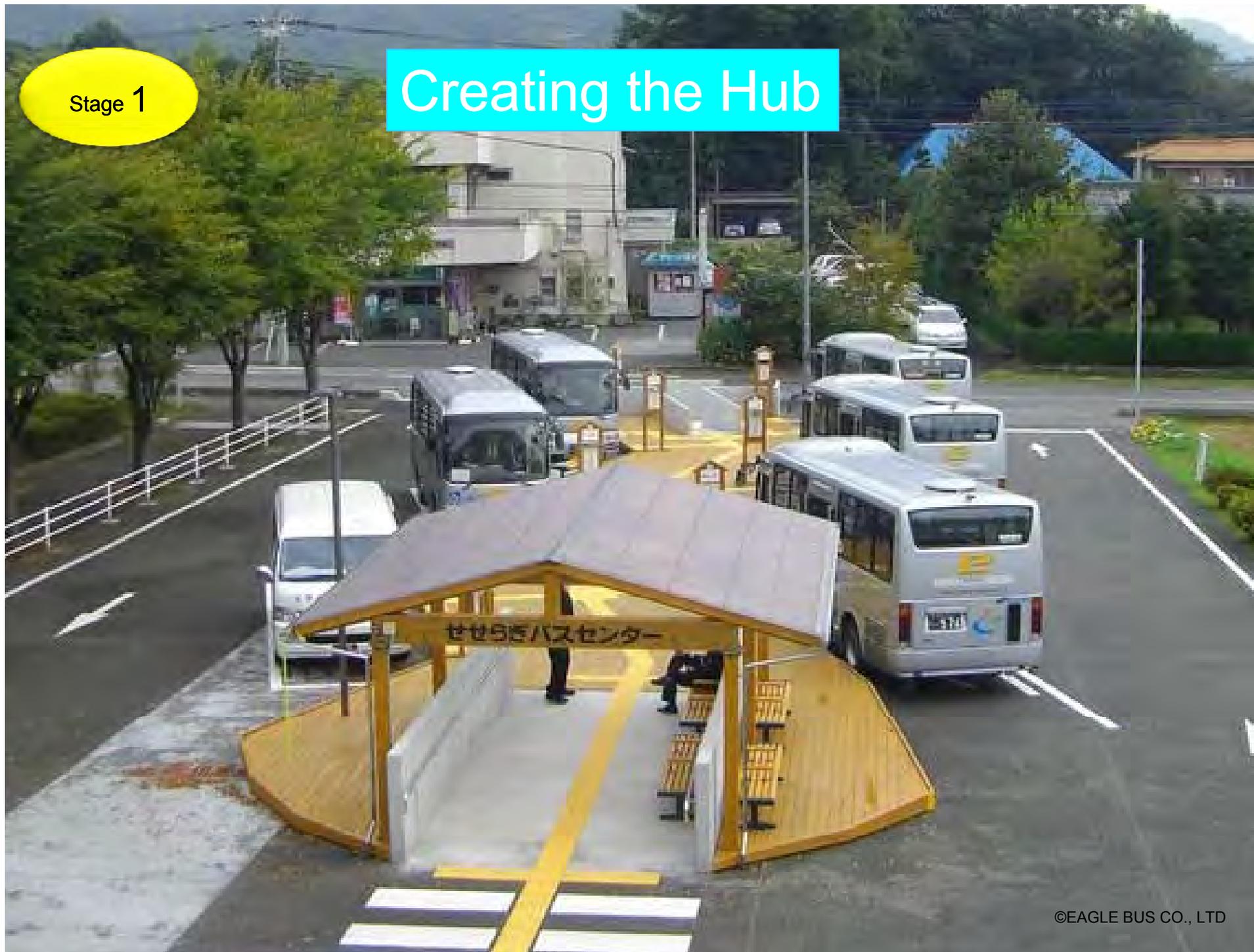
地区	行先	小川駅				武蔵嵐山駅				越生駅			
		改正前	改正後	増減便数	増加率	改正前	改正後	差	増加率	改正前	改正後	差	増加率
杵の森	11月	6	9	3	50%	6	12	7	21%	11	14	3	27%
	3月	6	11	5	83%	3	14	11	467%	11	12	2	18%
日向坂	11月	6	9	3	50%	6	12	7	21%	11	14	3	27%
	3月	6	11	5	83%	2	14	12	700%	11	12	2	18%
日影	11月	7	11	4	57%	6	12	6	200%	9	12	3	33%
	3月	7	11	4	57%	6	11	5	183%	7	9	2	29%
十王堂前	11月	7	8	1	14%	6	8	2	33%	9	7	▲2	22%
	3月	7	4	▲3	-43%	6	4	▲2	-33%	7	6	▲1	-14%
原	11月	7	8	▲1	-14%	6	11	5	167%	6	9	3	50%
	3月	7	3	▲4	-57%	4	4	0	0%	7	8	1	14%
新所	11月	0	0	0	0%	0	10	10	100%	0	16	16	100%
	3月	0	3	3	100%	0	9	9	100%	0	16	16	100%
瀬戸	11月	7	8	1	14%	3	12	9	300%	17	17	0	0%
	3月	8	10	2	25%	2	12	10	500%	17	17	0	0%
合計	11月	40	59	19	48%	39	60	21	54%	63	80	17	27%
	3月	41	60	19	46%	26	60	34	131%	60	78	18	30%

### Operation Efficiency Reduced Total operation Km

種目	科目	2011年度								2010年度			
		上かがわ路線全線				上かがわ路線全線-PO1-PO2-PO3				2010年度			
		10月	11月	12月	合計	10月	11月	12月	合計	10月	11月	12月	合計
片側	10月	947	21,483	20,800	42,230	1,199	28,286	26,820	55,115	-221	-16,803	-16,020	-33,624
	11月	244	59,420	58,763	118,187	290	74,611	74,611	149,512	146	14,990	14,990	30,126
	12月	819	14,824	14,824	29,648	0	0	0	0	81	14,824	14,824	29,729
片側計	10月	794	38,796	38,428	77,220	1,199	59,824	53,640	114,663	-395	-20,027	-20,110	-40,137
	11月	244	59,420	58,763	118,187	290	74,611	74,611	149,512	146	14,990	14,990	30,126
	12月	819	14,824	14,824	29,648	0	0	0	0	81	14,824	14,824	29,729
片側計	10月	794	32,220	38,223	70,443	719	32,796	32,640	65,436	-1	-6	14,667	14,660
	11月	244	14,001	14,001	28,002	0	0	0	0	206	14,001	14,001	28,002
	12月	819	0	0	819	0	0	0	0	81	14,001	14,001	28,002
片側計	10月	-	33,421	52,224	85,645	-	32,796	32,640	65,436	-	-15,015	14,667	-1,348
	11月	362	14,000	14,000	28,002	0	0	0	0	206	14,001	14,001	28,002
	12月	819	0	0	819	0	0	0	0	81	14,001	14,001	28,002
片側計	10月	-	33,421	52,224	85,645	-	32,796	32,640	65,436	-	-15,015	14,667	-1,348
	11月	362	14,000	14,000	28,002	0	0	0	0	206	14,001	14,001	28,002
	12月	819	0	0	819	0	0	0	0	81	14,001	14,001	28,002

Stage 1

# Creating the Hub



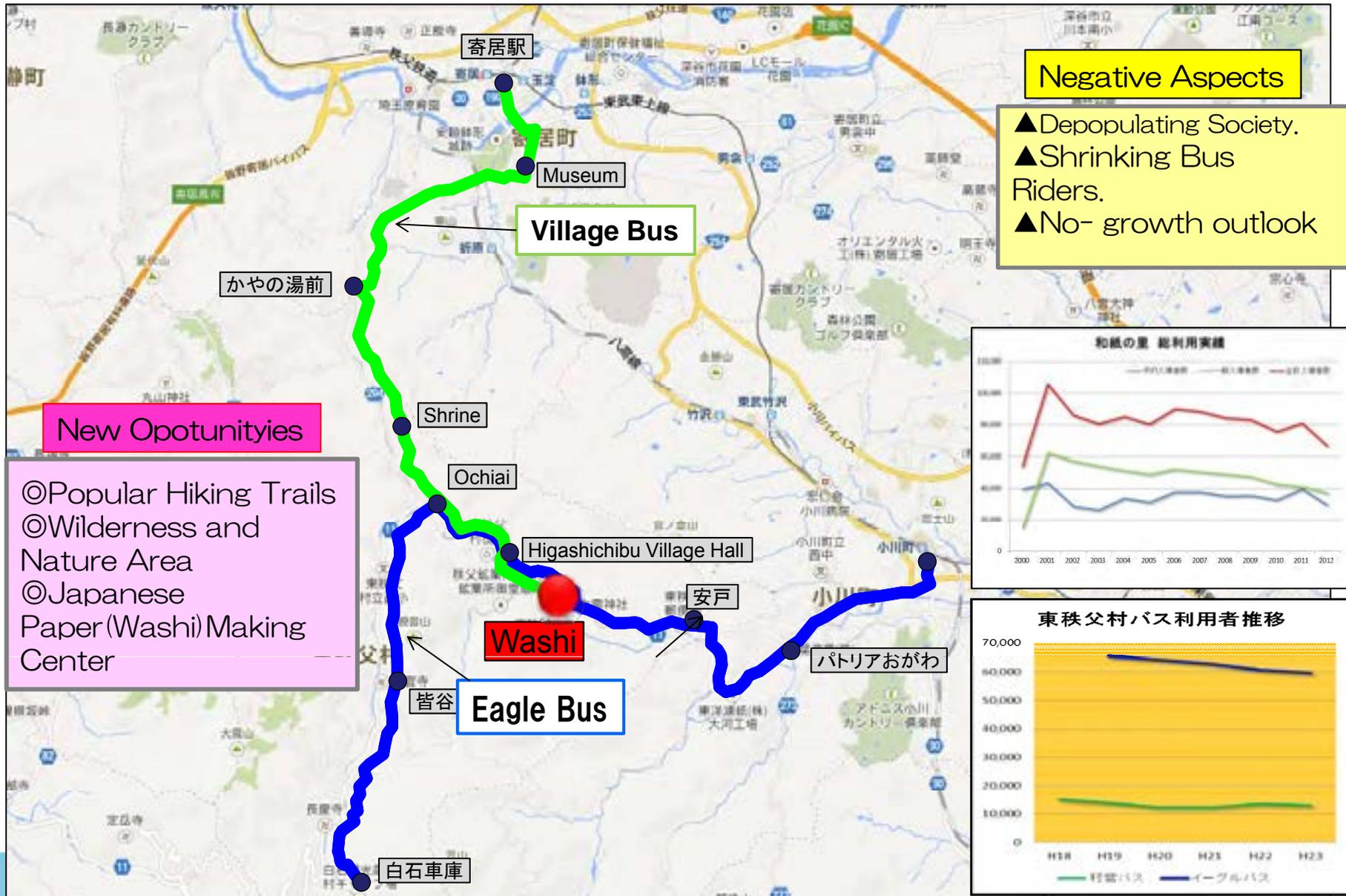
Stage 2

# Adding Value and Services to the Hub

In sparsely populated areas, there are few shops and public service nearby home. we introduce facilities such as convenience shop, drug store etc. to meet residents needs. Now the hub is more than just a transportation tool, It also attracts new Riders with its services.



# Higashi-Chichibu Bus Line (2015. Jan.)



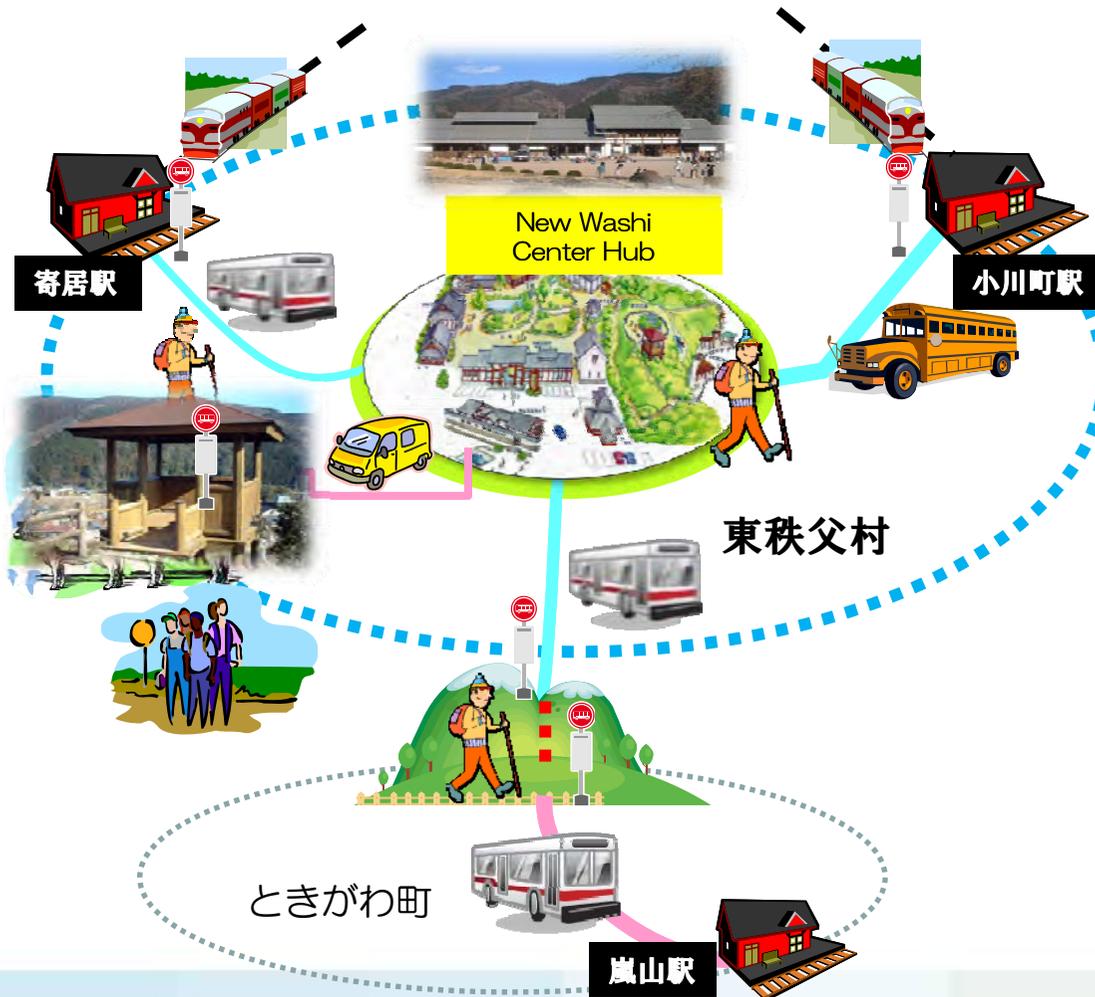
# Higashi-Chichibu Hub & Spoke Model



## Local Industry

The new Washi Center Hub will bring many new customers to buy HigashiChichibu local produce and crafts.. Including Japanese paper, Konnyaku, water, vegetables and create an opportunity for new businesses such as cheese making to develop.

Revitalization through residential and tourist infrastructure improvement: Four Pillars.



## Public Transport

Village Bus and Eagle Bus Operation will be Merged. The new Washi Center Hub will make the Bus transfer easy, convenient and provide riders with Value added services.



## Retail Services

New retail services will be added such as:  
 ATM  
 Bill Payments  
 Ticket Sales  
 Package Delivery  
 Post Office  
 to attract local residents and provide them with convenient Retail shopping center.

## Tourism

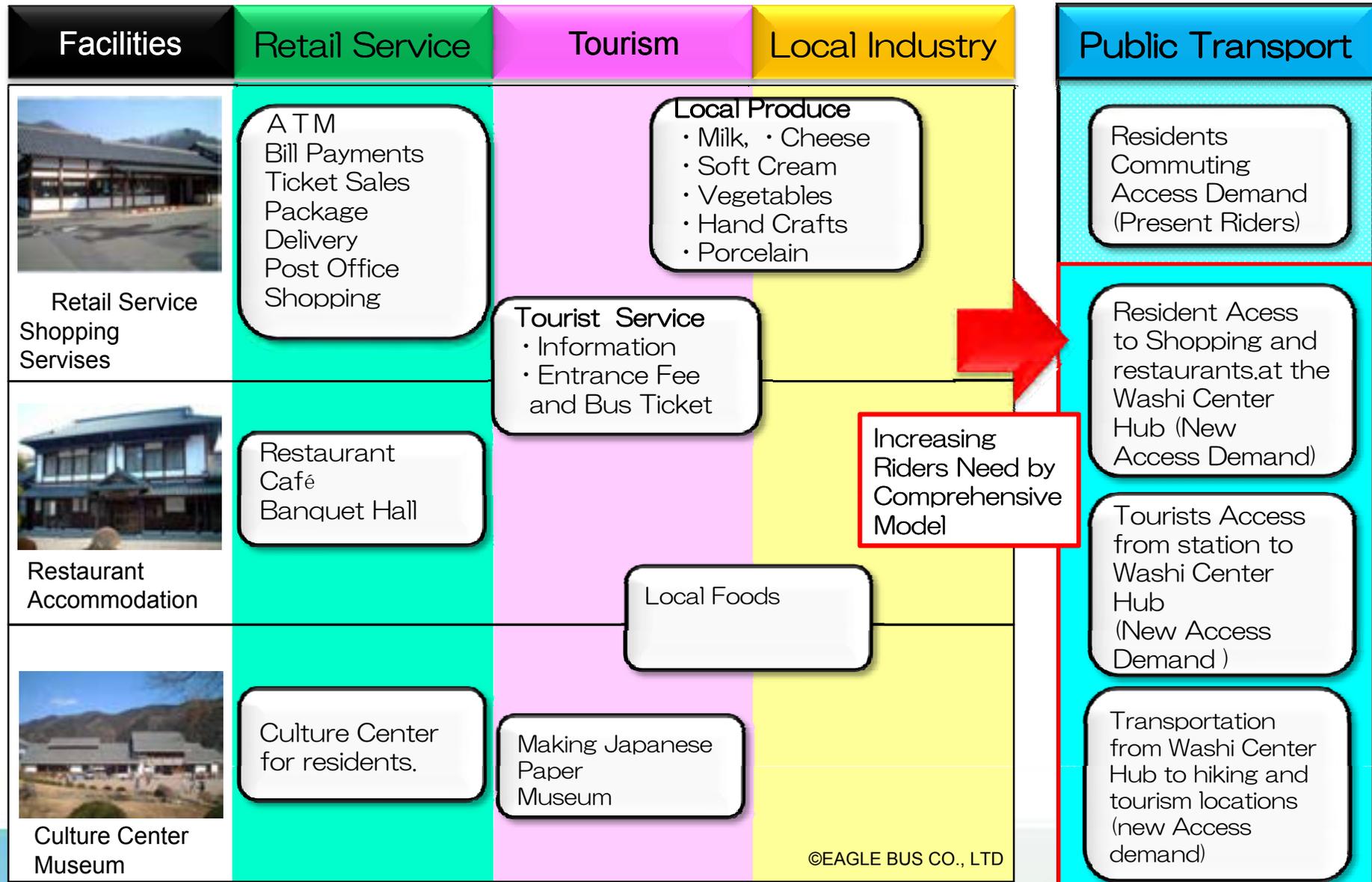
Each year many Hikers visit Higashichichibu With April alone seeing more than 7,000 hikers. The New Washi Center Hub will provide new, easy access to the popular Hiking trails. These hikers will raise the number of Bus riders improving profitability.

# Hub & Spoke: A Comprehensive Model for Adding Value



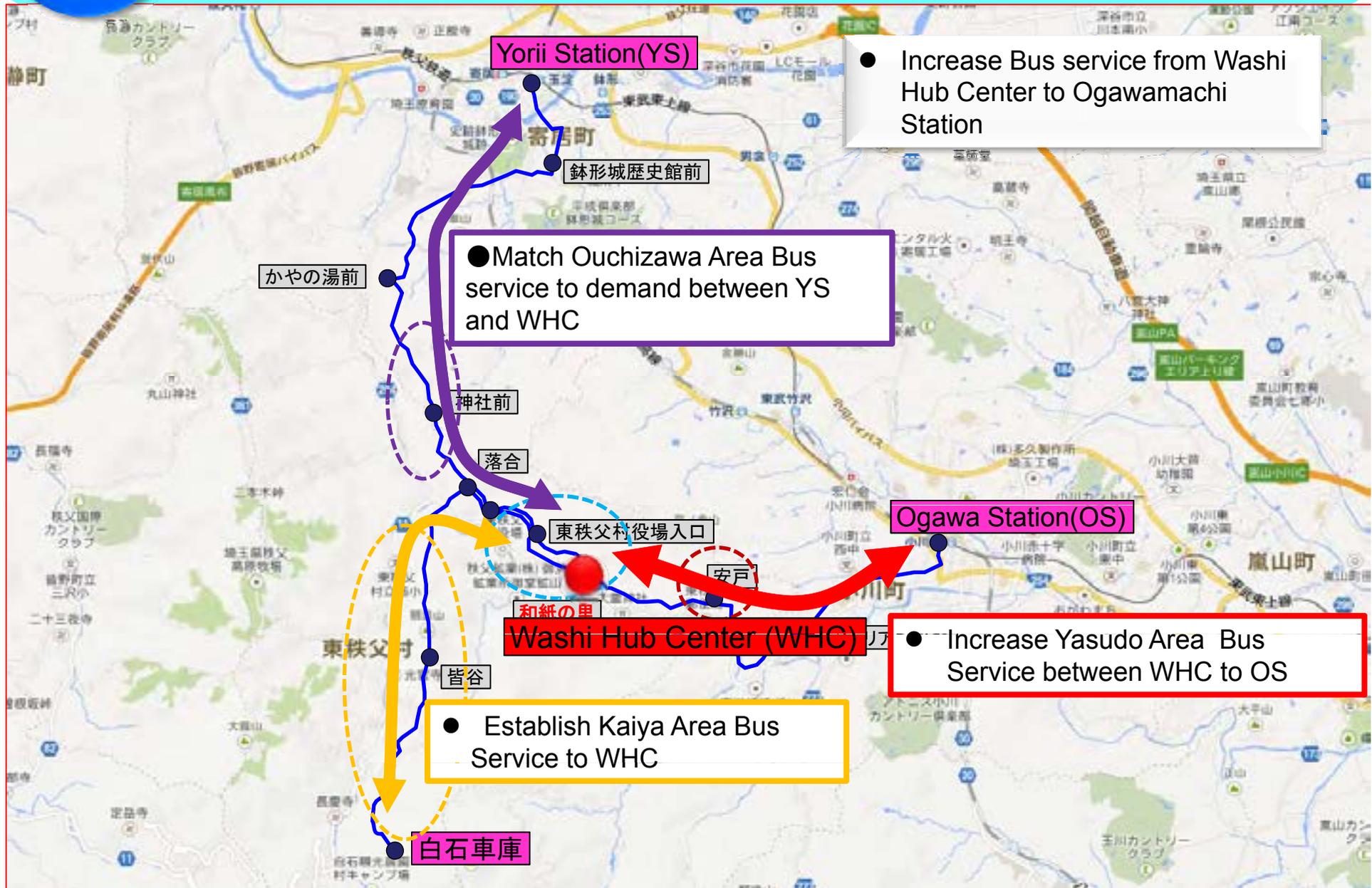
# Comprehensive Model for Sustainable Public Transportation

Increase Bus riders by Adding Value to the Washi Center Hub



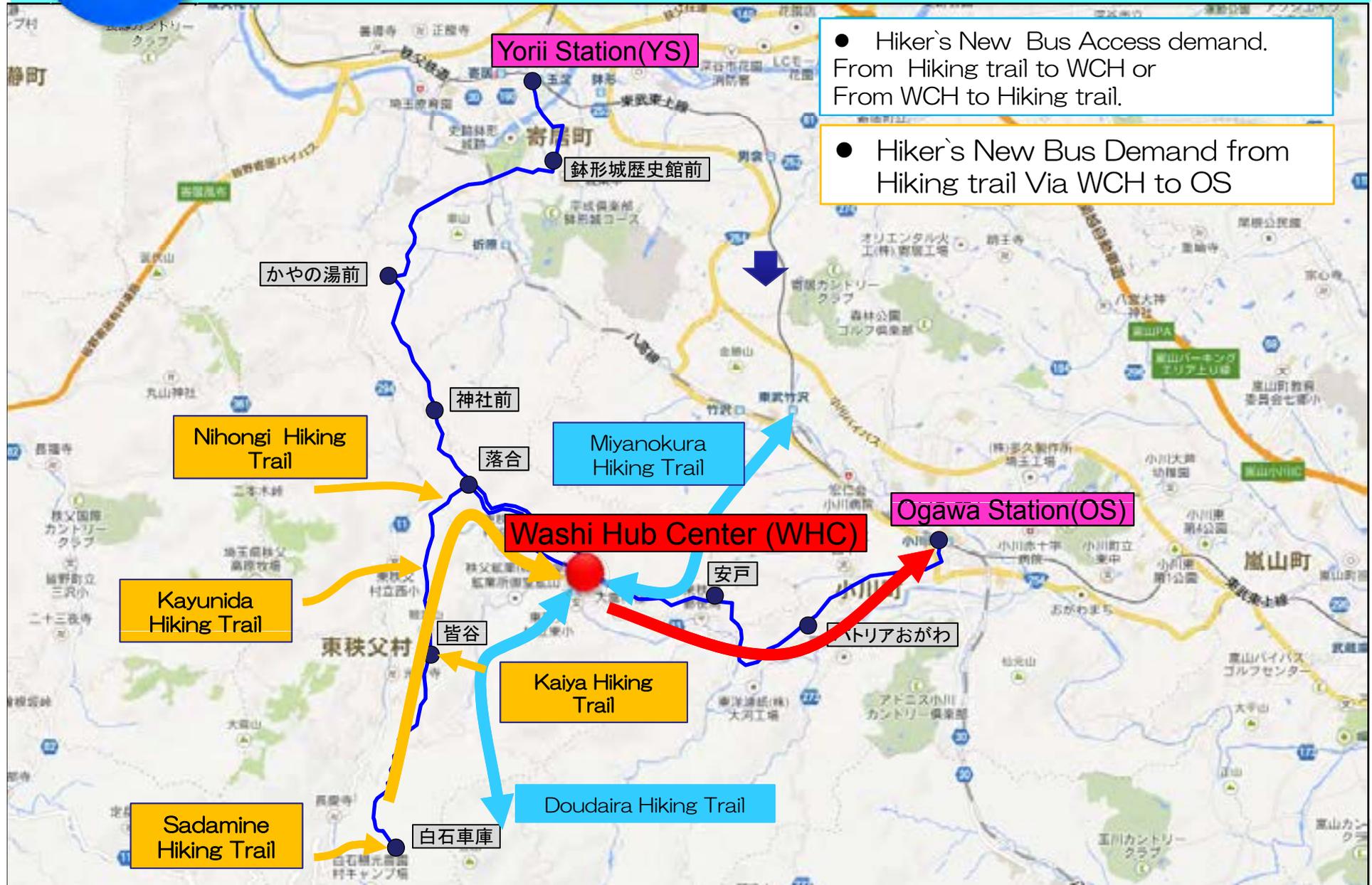
Increasing Riders Need by Comprehensive Model

# Increased Service and Rider Convenience through Hub & Spoke Reorganization



Public  
Transport

# Increasing Tourist Bus Riders By connecting The Washi Center Hub and Hiking Trails



Tourism

# Seasonal Tourist Destinations Via Hub Bus Center

Prior to our DRT introduction Tourist arrived by car and Foot. Now they arrive by train, Take the bus to Hub and transfer To DRT to reach the seasonal Natural attractions. This reduces Automobile traffic and increases Accessibility.



Retail  
Service

# Adding Value to the Hub Creates a Bustling Gathering Point

There are no convenient shops in the village, therefore Residents must go shopping outside. Providing New retail services to the Hub station such as: A T M, Bill Payments, Ticket Sales, Package Delivery, Post Office, and Shopping attracts village residents and Creates a community gathering point.

## Retail Services Shops

A T M  
Bill Payments  
Ticket Sales  
Package Delivery  
Post Office

## Tourist Service

- Information
- Entrance Fee  
and Bus Ticket

## Local Produce

- Milk, • Cheese
  - Soft Cream
  - Vegetables
- Hand Crafts  
Porcelain





# New Local Business Attractions for Tourists

Local Traditional Japanese taste

**Japanese Taste**

Japanese Paper Production Place



Local Sweet



Soba Noodle



Konnyaku



Vegetables



Fresh Milk



Game Meet

Adding New Attractions

**French Taste**

Sister city Ambert City of France



Garrete



cheese



French Cuisine



Game Cuisine

Local taste  
And  
New Taste  
For

+

=

地産材料で二つのテイスト

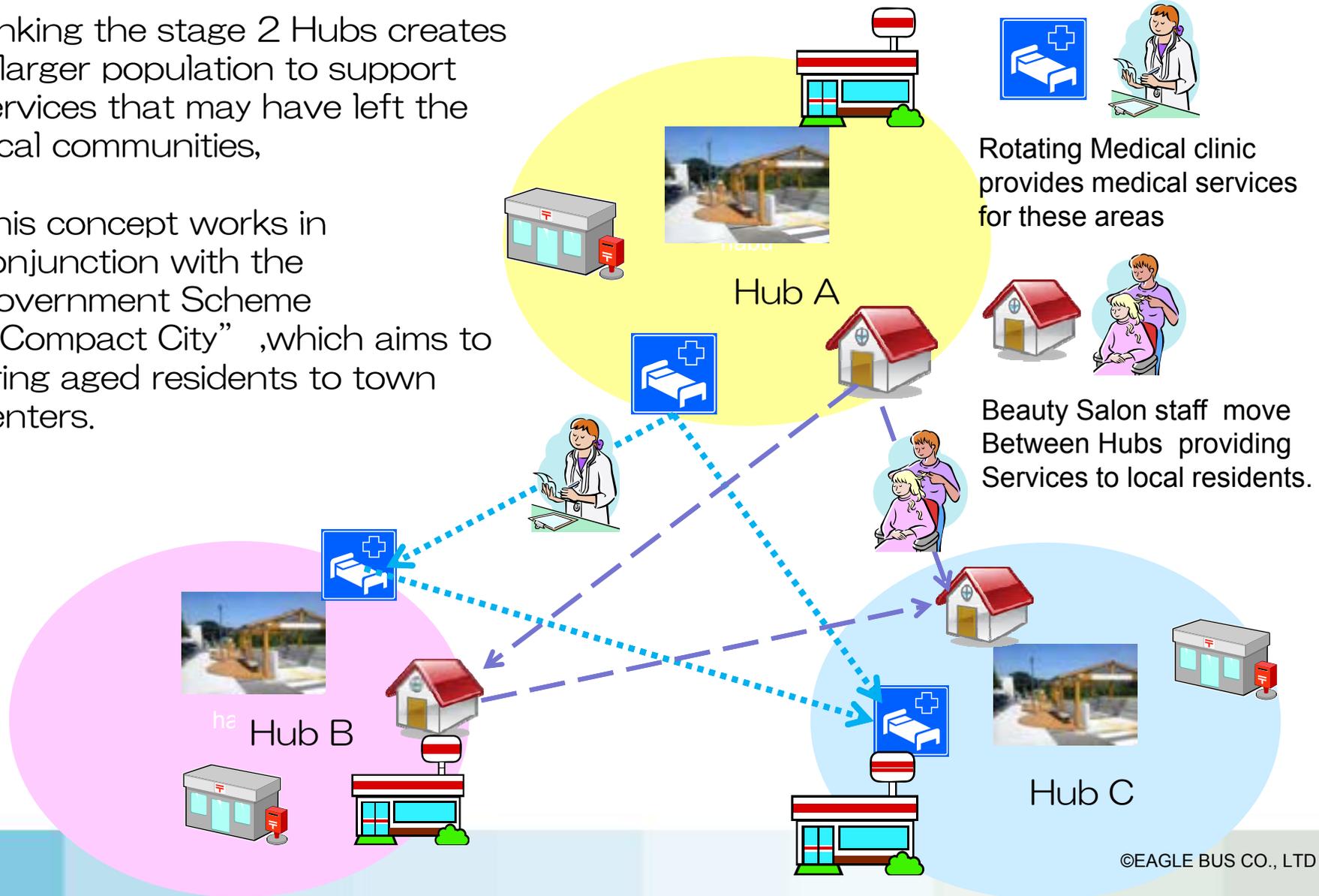
広がる観光  
顧客層と  
地域在住  
女性の取り  
込み

### Stage 3

# Wide Area service enhancement By Linking Stage 2 Hubs

Linking the stage 2 Hubs creates a larger population to support services that may have left the local communities,

This concept works in conjunction with the Government Scheme “Compact City” ,which aims to bring aged residents to town centers.



Thank you for your attention

