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DRT, Future of Public Transportation

: Test Run of Demand Responsive Transport in Kwa-Chon City in Korea

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KOTI KOREA TRANSPORT INSTITUTE

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Private car-oriented transportation system

- Despite the great efforts made by governments in each country, the social costs of excessive use of private cars continue to increase
- Public transportation pax in many cities use public transportation because inconvenient to use cars
- However, when congestion is eased or their incomes rise, they move back to a personal vehicle

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- In rural and suburban areas, public transportation deteriorates due to population decline
- Forced to use a car
- **The world is changing into a personal car-oriented transportation system**

Why is public transportation inconvenient compared to private cars?

- The reason why public transportation is inconvenient compared to buses is ;

  1) Station, 2) Schedule, and 3) Line are all fixed

- Passengers must move to station by walk and wait until the schedule of vehicle arrival
  Also, Fixed Line is mostly detour from the shortest route, and have to stop at many passenger-less stops
- BRT has greatly helped improve the service level of the bus, but it has not completely eliminated the inconvenience of bus itself compared to the door-to-door provided by the private car
- **Personal mobility(PM) such as electric kickboards has emerged to solve this First-Last Mile problem**

Can shared mobility be a solution?

- **Car sharing services seemed to solve all the problems, but now it's questionable**
- People don't own cars just for the sake of transportation (For some people, a car means more than a vehicle)
- If individuals do not significantly reduce vehicle ownership or the number of shared cars increases, parking lots and roads are needed more with the growth of car sharing business.
- In the worst case, car sharing only increases the sales of vehicles
- Car sharing companies only focus on the urban area, regardless of the rural mobility insufficiency problems
- As a results, car sharing causes congestion in cities and do nothing to help rural areas.

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DRT is a solution

- DRT can solve the transportation service of low population rural areas at a low cost
- In private car overused cities,

DRT with the public sector is the effective way to change personal vehicle-love drivers into public transportation pax

DRT in world

chariot

shotl

100won taxi

Call bus DRT

Phase of DRT development

DRT 1.0

Public taxi, On-demand taxi ('15~)

Community taxi
Service supported by local governments

Telephone call-based reservation system

Unavailable real-time vehicle reservation and allocation

DRT 2.0

Hyundai Motor's Shucle, Incheon City I-MOD ('19~)

Based on existing stops

Real-time App-based systems

Frequent failures of vehicle allocation and Increased time required during peak demand times

DRT 3.0 Features

01 **PLANNING**

Design the optimal DRT operation

02 **OPERATION**

Maximize operational efficiency with rapid upgrades

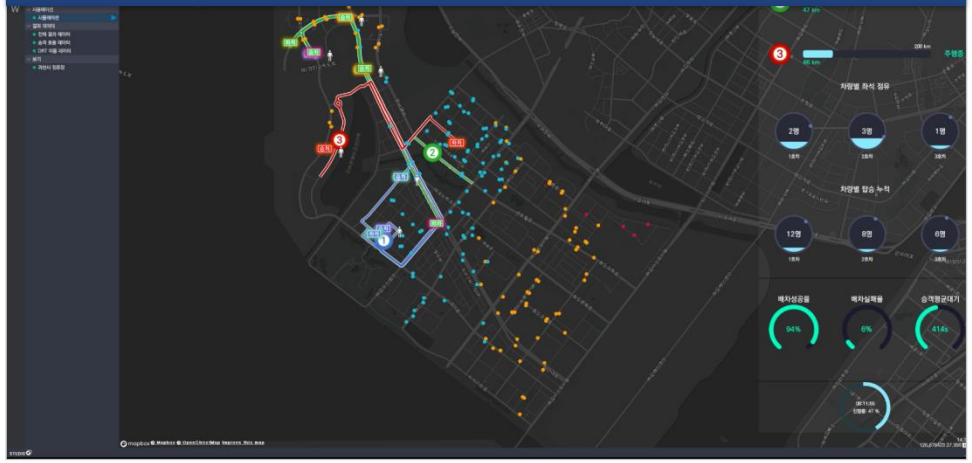
03 **MONITORING**

Service Optimization through Usage Pattern Analysis

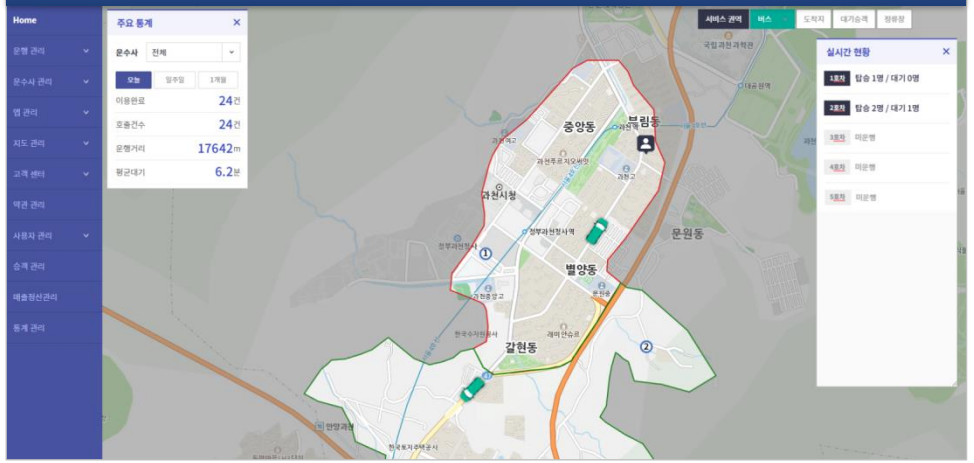
What makes Studio Galilei's DRT different?

- **Accurate pre-planned service is possible by TAMOS P-O-M solution**
- Co-work tool when collaboration with bus companies because it can simulate the scenario simulation quickly
- Possible to create a Conflict-Zero ecosystem in terms of the joint dispatch service with taxi companies
- **Platforms that leverage Super Fleet Operation(SFO) technology for maximum efficiency of DRT**

TAMOS-P Simulation



Optimal waiting position ADMIN



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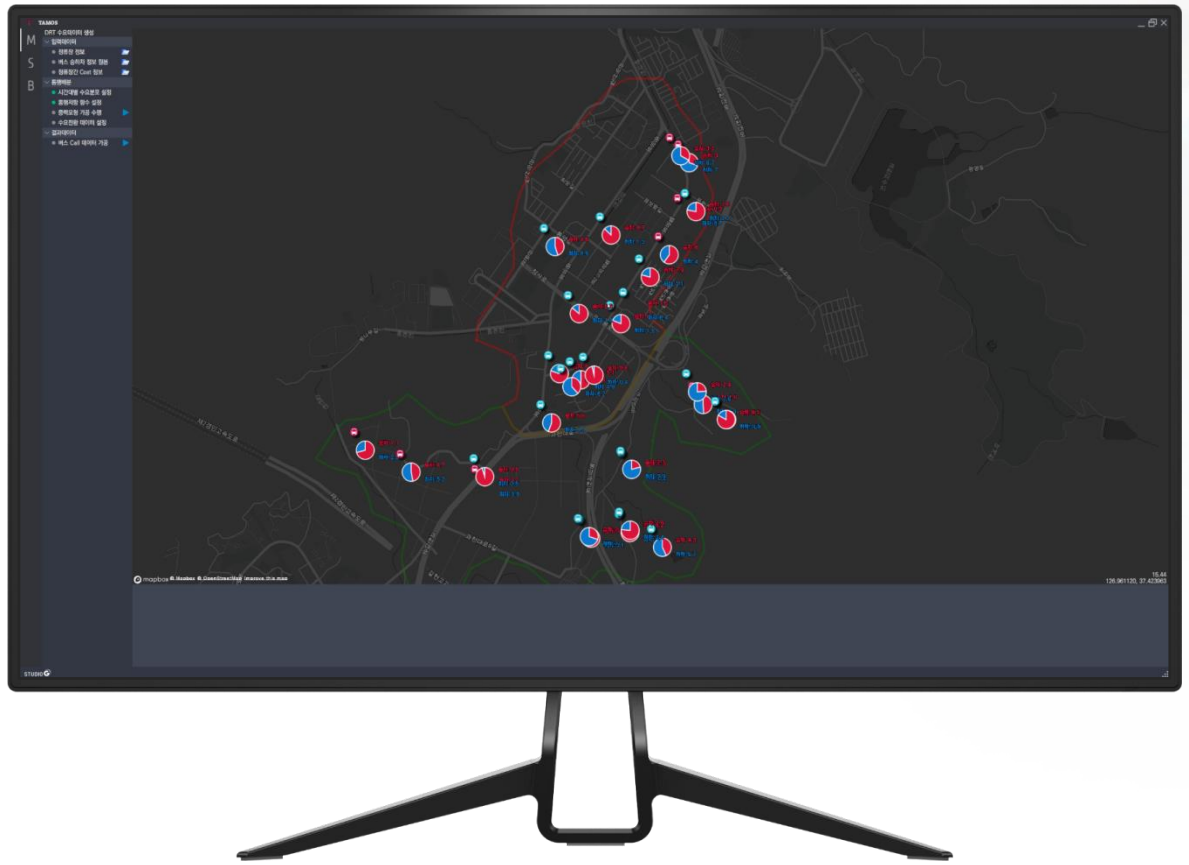
TAMOS-P



TAMOS Technology Solution

DRT Call Demand Data Generation

Based on 1) DRT Operation Data, 2) Public Transportation Smart Card Data, 3) Cellular phone Data, 4) Traditional data for travel demand forecasting (Socio-economic data), Advanced 4 step-model is available in TAMOS-P

Trip Generation Model

Utilizing a categorical analysis method that uses static DB and the unit loading factor method

Trip Distribution Model

Equipped with a traffic distribution module that uses a gravity model and the Fratar method; verification and correction using DRT operation data

Modal Choice Model

Is a new mode selection model based on conjoint-logit analysis

DRT Call Demand Generation

Equipped with mobile stochastic DRT call demand generation function
Based on travel survey data, traffic card data, and DRT operation data

TAMOS-P

TAMOS Technology Solution

DRT Simulation

Service index calculation from the simulations that are based on the DRT initial location information and the DRT synthetic call demand loaded

Simulations conducted as if actual DRT is being operated in response to DRT call demand synthesized by the scenarios of time and location of boarding and alighting

A variety of evaluation indices calculated through simulation results, such as the total mileage of DRT, user waiting times, total boarding frequency per DRT, success/failure rates of dispatchments, operation costs, etc.

Optimization of local governments' DRT introduction proposals and management through index calculations per call scenario

Simulations equipped with the economic and policy impact analysis function that can measure the amount of fine dust and greenhouse gases after the DRT introduction

TAMOS-P

TAMOS Technology Solution

Fleet Operation Optimization Function

Searches for the best route after setting the origin, destination, and stops in between

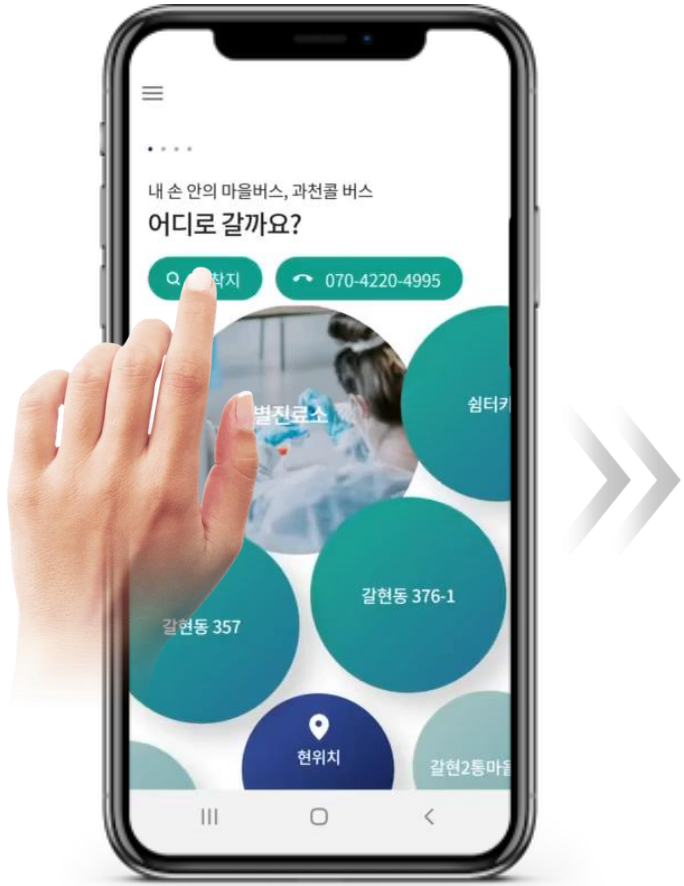
Fleet operation optimization technology that minimizes the chances of dispatchment failures and user waiting times

Route generation technology that manages all detour distances of users so that they don't exceed the permissible standards of the shortest route available

Route generation technology that provides accurate expected arrival times to users

Passenger Departure Merging technology that temporally and spatially merges passengers with origin-destination pairs, which allows the passengers to share the same vehicle

TAMOS-O



APP for Passengers on Gwacheon Call Bus (VARO DRT)

Video clip of actual operation and getting on and off at virtual stop

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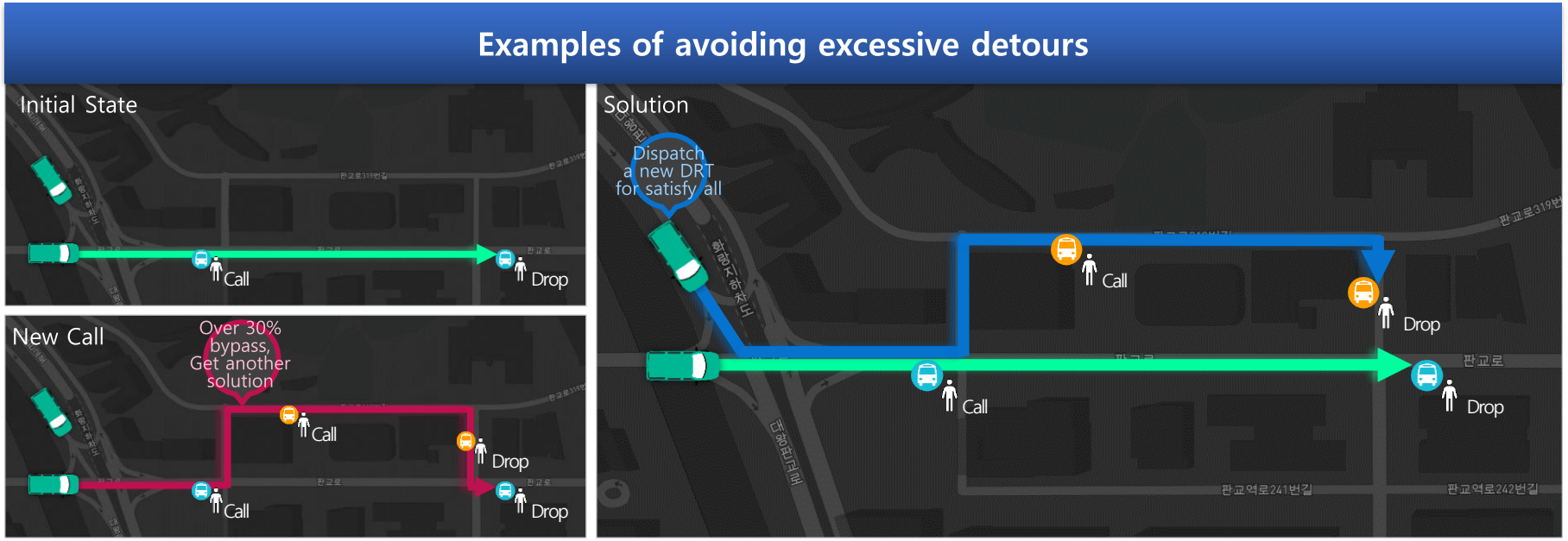
TAMOS-O

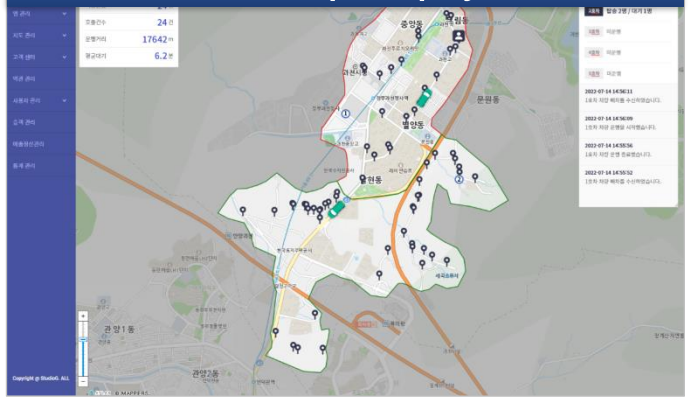
- TAMOS-O operates with various powerful algorithms to ensure the efficient operation of the vehicle and the quality of passenger-oriented service
- **All passengers on board are serviced by new called passengers on routes that do not cause more than 30% detour**
- **Due to the limitation of detour length, the travel time is highly reliable**



TAMOS-M

- **Local governments and transportation companies can check real-time operation information and various histories and statistics**
- No need to build a high-budget digital center by providing it as a subscription service (Platform as a Service Model)
- Also possible to upgrade the bus information system based on the DRT platform
- **In developing countries, it is desirable to use a web-based cloud platform in which a bus information system is also integrated**

Administrator screen with virtual stops displayed



Statistical Dashboard

Pilot Project : Gwacheon City, Korea

Gwacheon City Overview

Gwacheon is a city in Gyeonggi Province, South Korea.

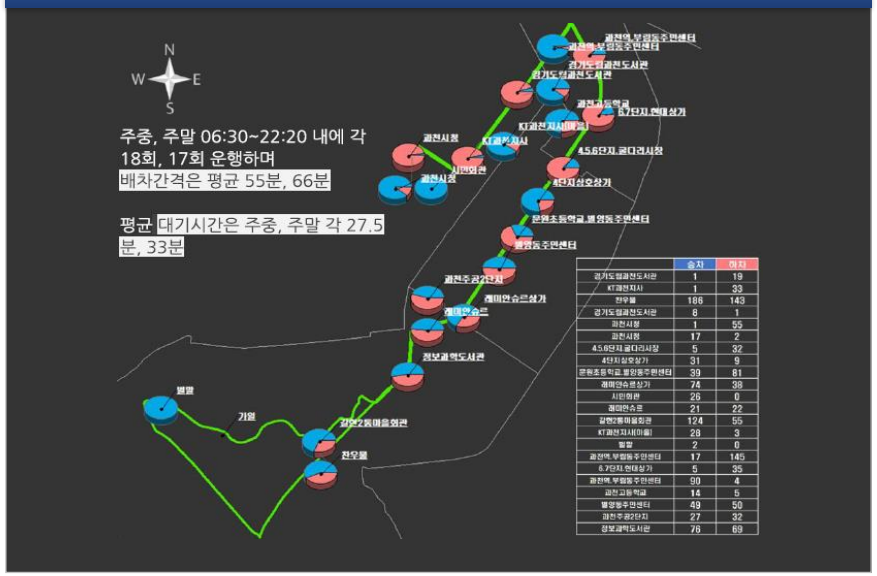
It lies close to Seoul in the heart of the Seoul National Capital Area.

- **Population** : 73,345 people (as of 2021, Statistics Korea)
- **Total area** : 35.87㎢, accounting for 0.04% of Korea's land area
- **Administrative districts** : 6 Administrative Dong
- **Current status of public transportation (Bus, Subway)**
  - 4 general bus routes : 6, 7, 8 and 8-1
  - 4 community bus routes: 1, 2, 3 and 5
  - Seoul subway line 4 passes through the city (5 stops)

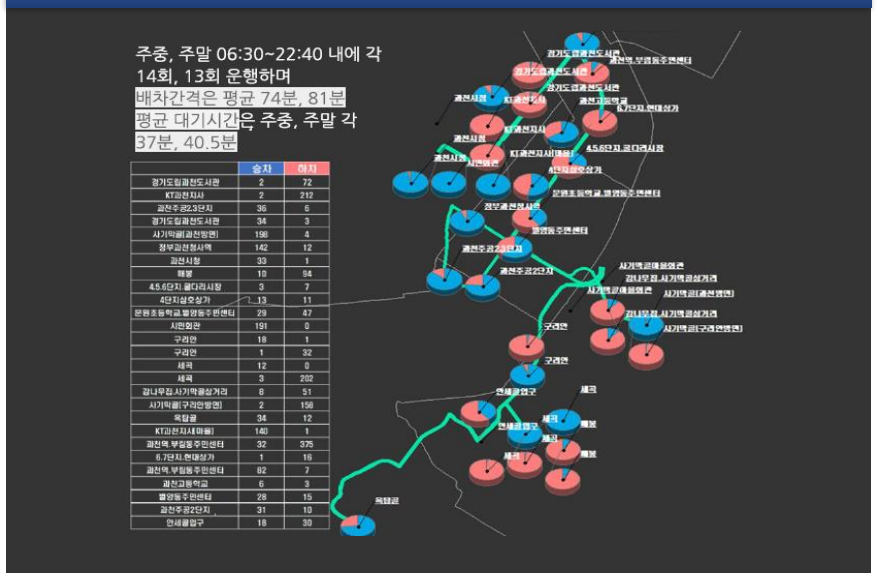
Pilot Project : Gwacheon City, Korea

- The annual operating budget of Gwacheon City Public Transportation Bus No. 3 and 5 is 3.1 billion KRW
- **In August 2020, the total number of passengers was 2,434, the cost per pax is 10,613 KRW**
- **The average travel distance was 2,313 meters, so the transportation cost per unit distance per pax is 4,594 KRW/person*km.**
- **Much higher than taxi fare; The city government wastes huge budget**

Bus No.3 get on and off information



Bus No.5 get on and off information



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Pilot Project : Gwacheon City, Korea

Suggestion for Gwacheon City and Korea Government

MONEY TODAY 22.04.06

Gwacheon City's
Demand Responsive Transport
'Gwacheon Call Bus' Test Operation

A DRT platform enterprise, Studio Galilei Inc. requested the MSICT's regulator sandbox and was designated as the Regulatory Exceptions for a Demonstration and is now set to perform a trial run in parts of Gwacheon City (Moonwon-dong, Galhyeon-dong) from the coming 7th to June 30th.

70% reduction in waiting time
The previous 30 minutes → Less than 9 minutes for DRT

34% reduction in bus mileage
The previous 416 km → 274km for DRT

13% reduction in transportation costs
The previous 630,000 KRW → 548,000 KRW for DRT

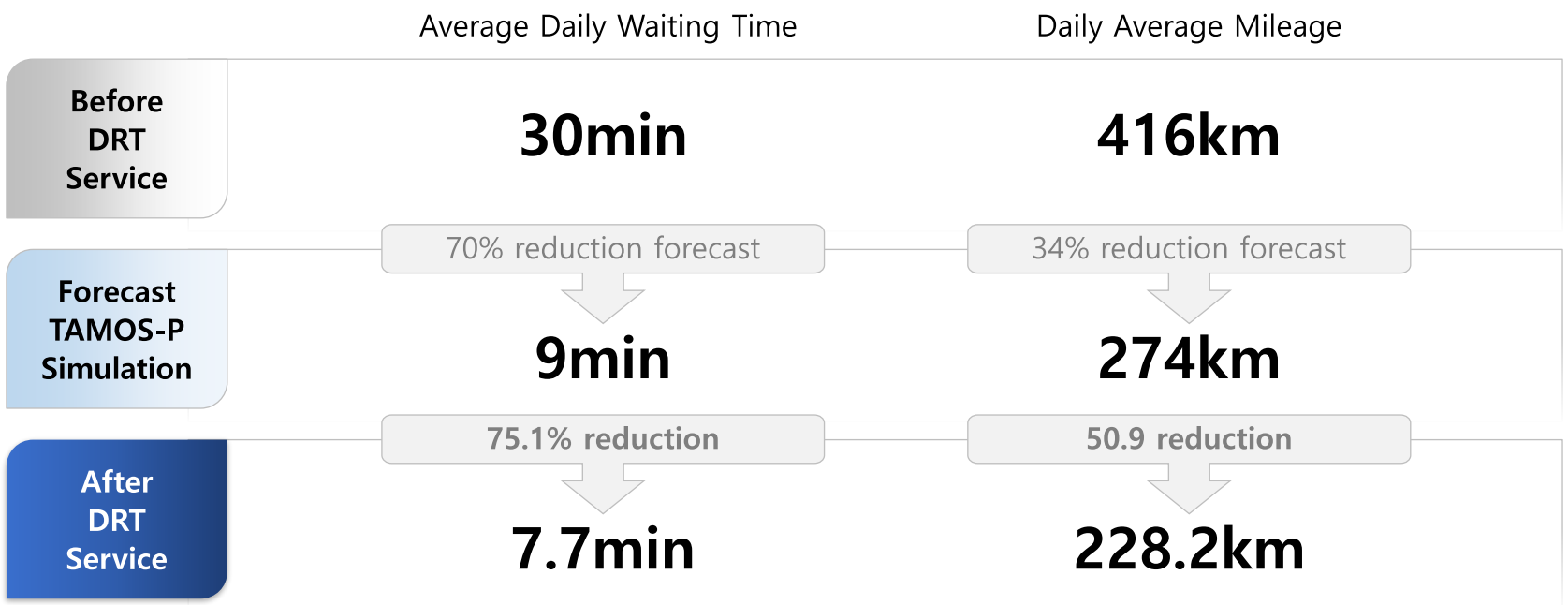
Equal to increase the number of existing route-type buses by 4

Savings of approximately 1.1 billion KRW based on annual cost conversion

Pilot Project : Gwacheon City, Korea

Validation actual operational data against expected effects

Actual operational data results of DRT in Gwacheon City (Weekdays from April 7th to May 31st)



Validate high accuracy and reliability of pre-analysis data

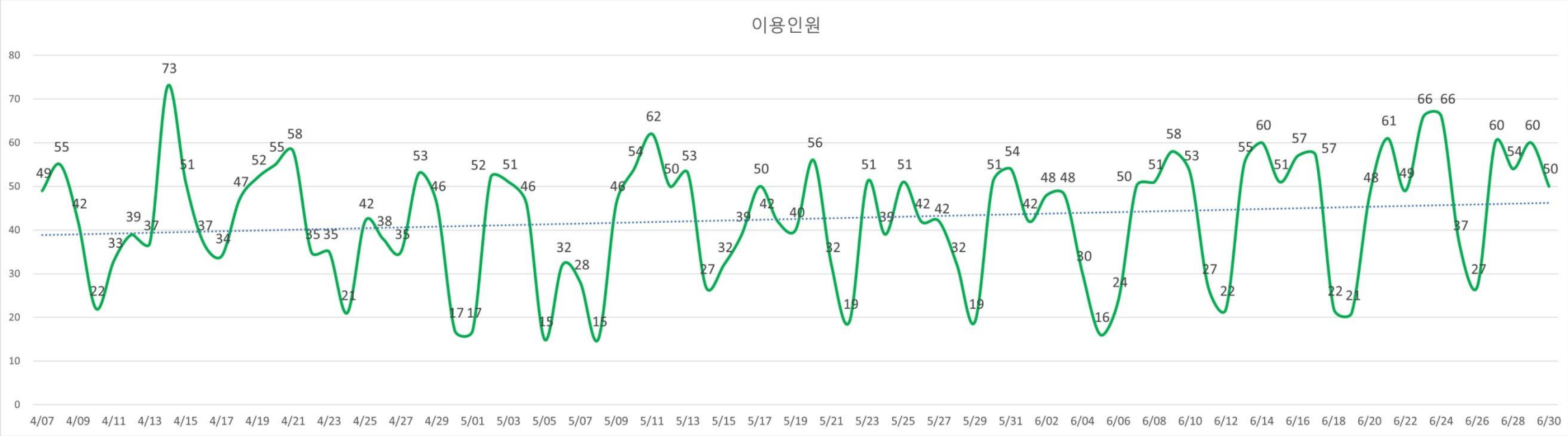
[TAMOS-P Simulations]

Pilot Project : Gwacheon City, Korea

- The average number of passengers on board is 43 per day, continued to increase during the pilot period
- Contrary, the number of call cancellations continued to decrease to 4 in total
- The current DRT operation is a Hybrid On-Demand (HOD) method, where passengers call the DRT and cancel the call when the existing route bus arrives quickly
- **Compared to conventional route buses, DRTs are 1) comfortable, 2) have fewer intermediate detours or stops, so even if the DRT comes a little late, the number of people on board the DRT is steadily increasing**
- **The decrease of call cancellation proves passengers' satisfaction**

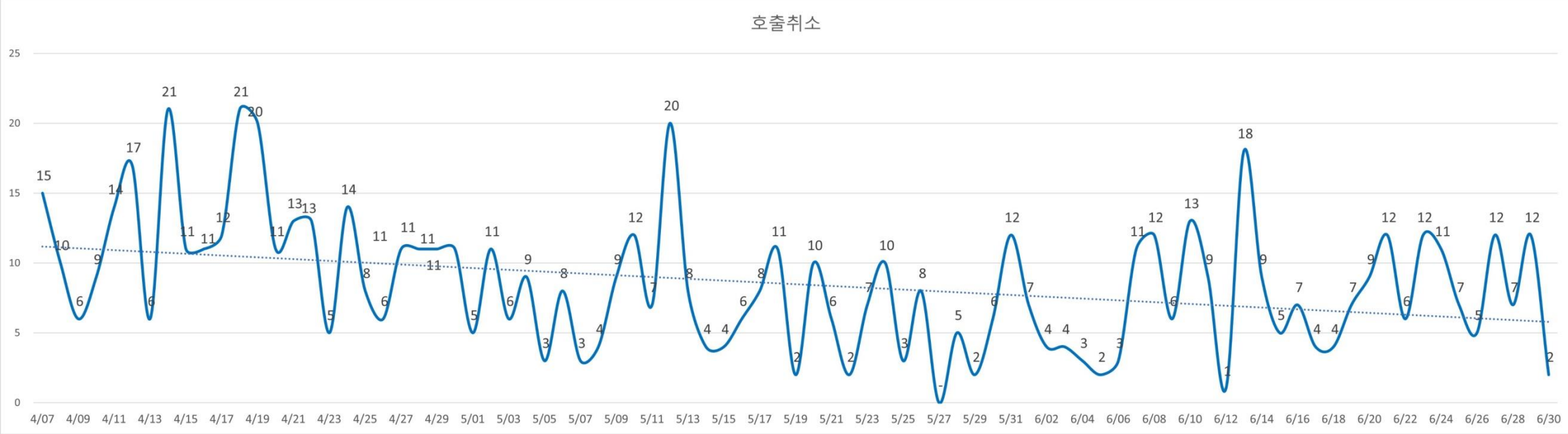
Pilot Project : Gwacheon City, Korea

The number of passengers on board



Pilot Project : Gwacheon City, Korea

Call cancellation daily trend



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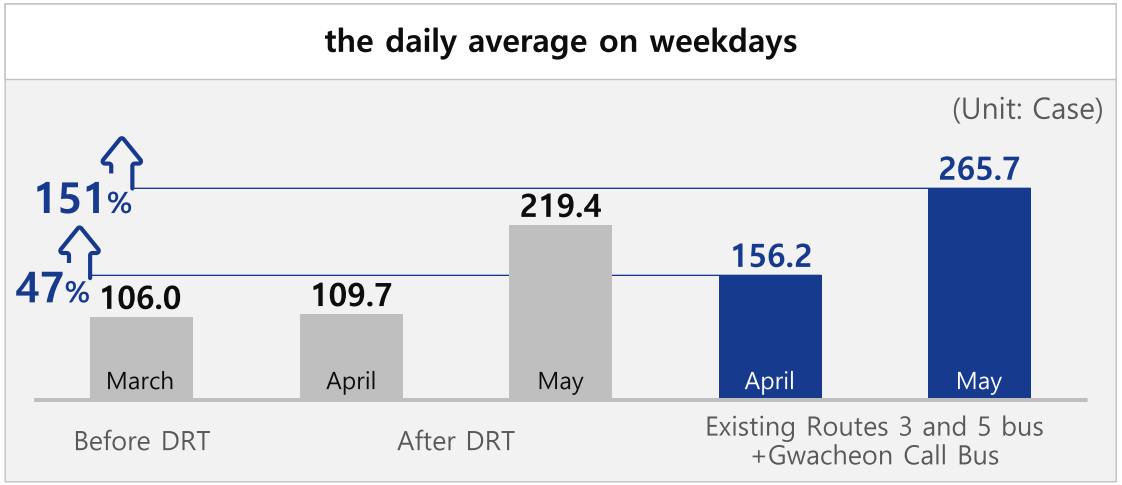
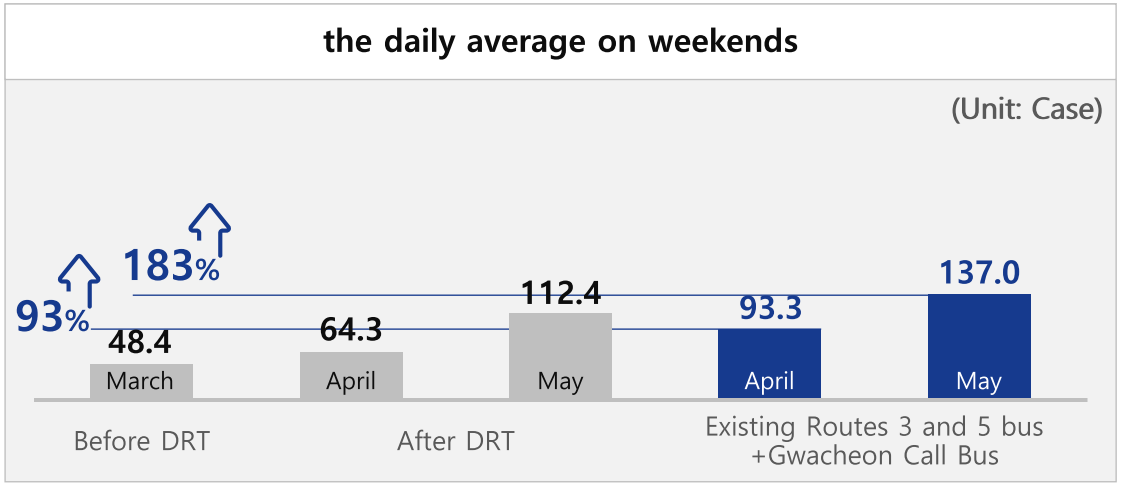
Pilot Project : Gwacheon City, Korea

- Increasing trend of DRT passengers during the week/weekend
- **Bus+DRT passengers increase significantly**

Analysis of Public Transportation Demand Before and After Introduction of 'Gwacheon Call Bus' in Gwacheon City

(Data aggregation from March 01 to May 31, 2022)



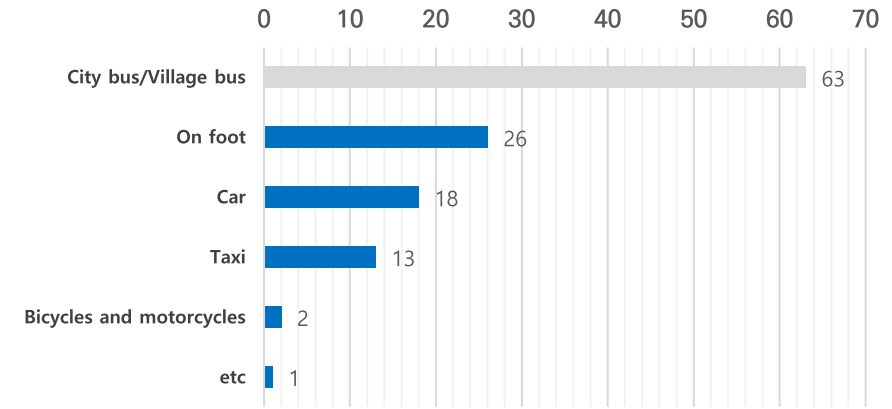


The introduction of DRT services increases the utilization rate of public transportation (existing route bus + DRT)

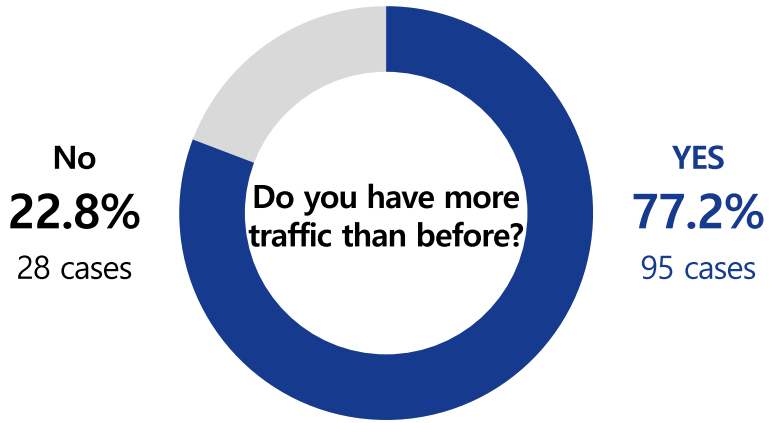
Pilot Project : Gwacheon City, Korea

- **Two main reasons for the increase in passengers after the HOD transition:**
  1) Demand conversion from private cars to DRT (Modal Shift)
  2) Frequency increase of travel due to improved convenience
- 77.2% of the respondents said the number of traffic increased, and the main reason was that it arrived quickly at the time of call and the travel time decreased.
- According to the results of this pilot operation, DRT can be called "DReam Transit"

Modal shift rate survey results



Increased traffic frequency



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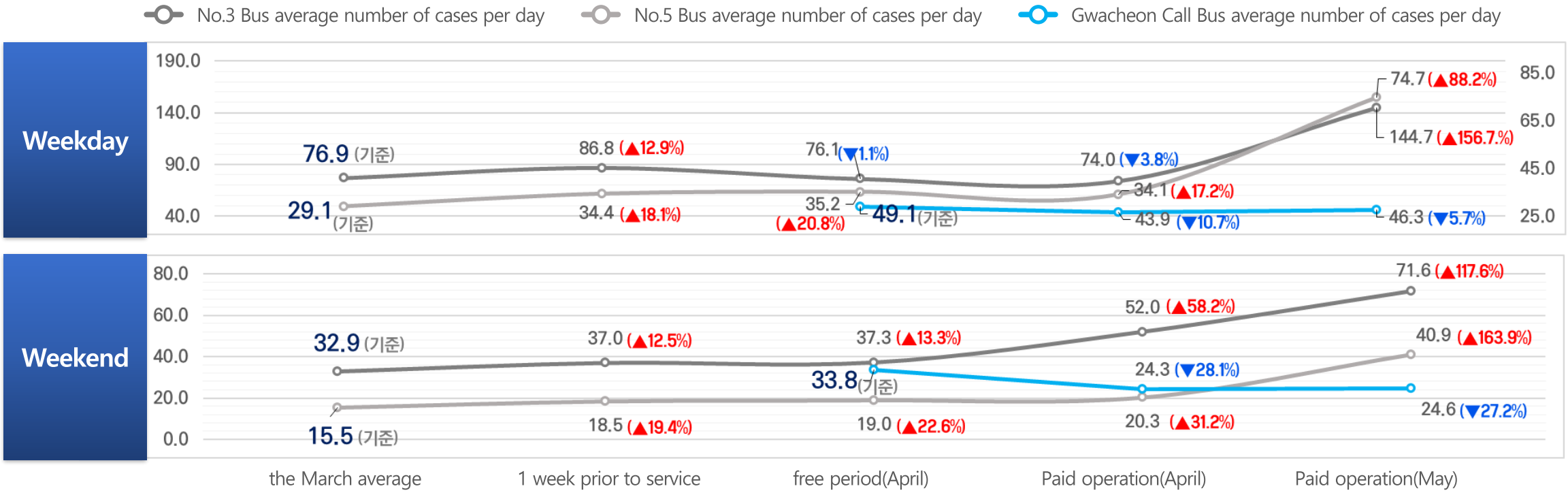
Hybrid On-Demand : Mobility solution without confliction

Development of new HOD(hybrid on-demand) models can eliminate friction with transportation companies

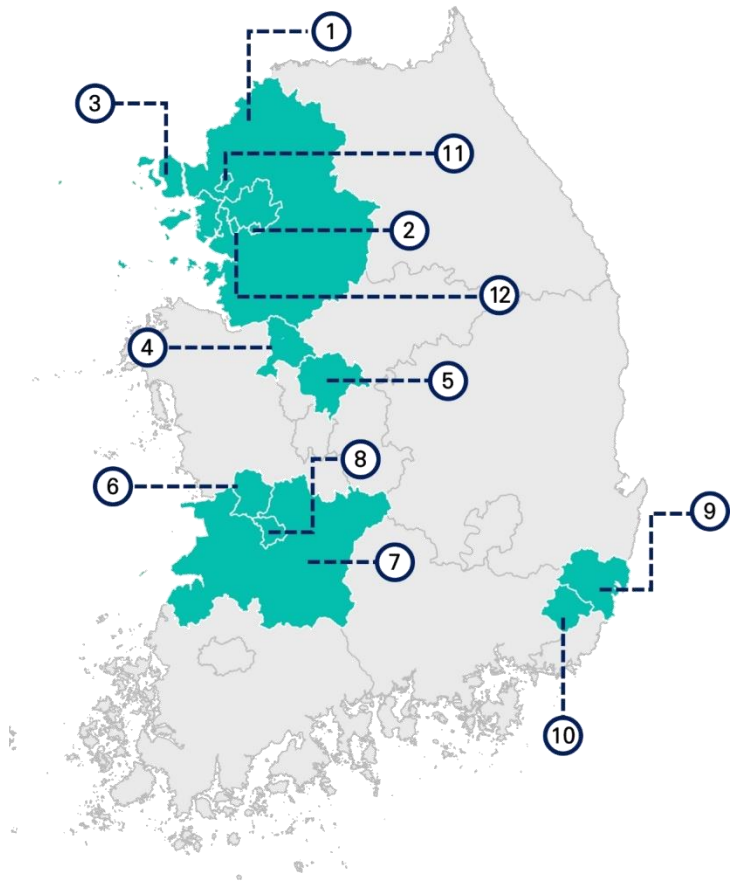
Developing a new DRT operation model based on changes in demand for village buses



A structure that can coexist with local governments, transportation companies, and platform operators

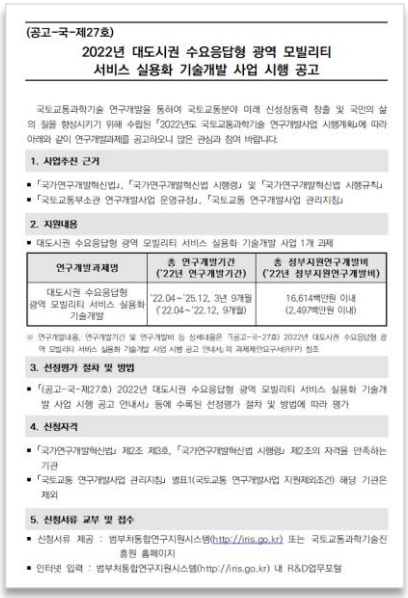
Business in progress : Domestic

Current status of introduction in local governments in Korea



1. Wide area DRT
2. Gwacheon City
3. Incheon Metropolitan City
4. Cheonan City
5. Cheongju City
6. Iksan City
7. Jeollabuk-do
8. Jeonju City
9. Ulsan Metropolitan City
10. Yangsan City
11. Gyeonggi Province
12. Goyang-si

Metropolitan (between local governments) DRT R&D project with Kakao Mobility



(공고-국-제27호)

2022년 대도시권 수요응답형 광역 모빌리티 서비스 실용화 기술개발 사업 시행 공고

국토교통과학기술 연구개발을 통하여 국토교통분야 미래 신성장동력 창출 및 국민의 삶의 질을 향상시키기 위해 수립된 「2022년도 국토교통과학기술 연구개발사업 시행계획」에 따라 아래와 같이 연구개발과제를 공고하오니 많은 관심과 참여 바랍니다.

1. 사업추진 근거

- 「국가연구개발혁신법」, 「국가연구개발혁신법 시행령」 및 「국가연구개발혁신법 시행규칙」
- 「국토교통부소관 연구개발사업 운영규정」, 「국토교통 연구개발사업 관리지침」

2. 지원내용

- 대도시권 수요응답형 광역 모빌리티 서비스 실용화 기술개발 사업 1개 과제

연구개발과제명	총 연구개발기간 ('22년 연구개발기간)	총 정부지원연구개발비 ('22년 정부지원연구개발비)
대도시권 수요응답형 광역 모빌리티 서비스 실용화 기술개발	22.04~'25.12, 3년 9개월 ('22.04~'22.12, 9개월)	16,614백만원 이내 (2,497백만원 이내)

※ 연구개발내용, 연구개발기간 및 연구개발비 등 상세내용은 「(공고-국-27호) 2022년 대도시권 수요응답형 광역 모빌리티 서비스 실용화 기술개발 사업 시행 공고 안내서」의 과제제안요구서(RFP) 참조

3. 선정평가 절차 및 방법

- 「(공고-국-제27호) 2022년 대도시권 수요응답형 광역 모빌리티 서비스 실용화 기술개발 사업 시행 공고 안내서」 등에 수록된 선정평가 절차 및 방법에 따라 평가

4. 신청자격

- 「국가연구개발혁신법」 제2조 제3호, 「국가연구개발혁신법 시행령」 제2조의 자격을 만족하는 기관
- 「국토교통 연구개발사업 관리지침」 별표1(국토교통 연구개발사업 지원제외조건) 해당 기관은 제외

5. 신청서류 교부 및 접수

- 신청서류 제공 : 범부처통합연구지원시스템(http://iris.go.kr) 또는 국토교통과학기술진흥원 홈페이지
- 인터넷 입력 : 범부처통합연구지원시스템(http://iris.go.kr) 내 R&D업무포털

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Business in progress : Outside the country

Based on the TAMOS-based DRT business model that is being promoted in Korea,

Go overseas markets by developing smart city consulting and transportation/DRT services suitable for each overseas city

Public transportation management consulting	Consulting + DRT Platform + Vehicle	DRT Platform + MaaS
 kotra Business in progress	 kotra Business in progress	  
2021/22 EIPP Kenya Konza Smart City Establishment of transportation network and basic plan for smart mobility	2021/22 Mexico City Public Transport Network Improvement and Integrated Transportation System Linkage Measures KSP	
KRW 143,117,773 / 9 months	**KRW 91,272,727 / 7 months**	

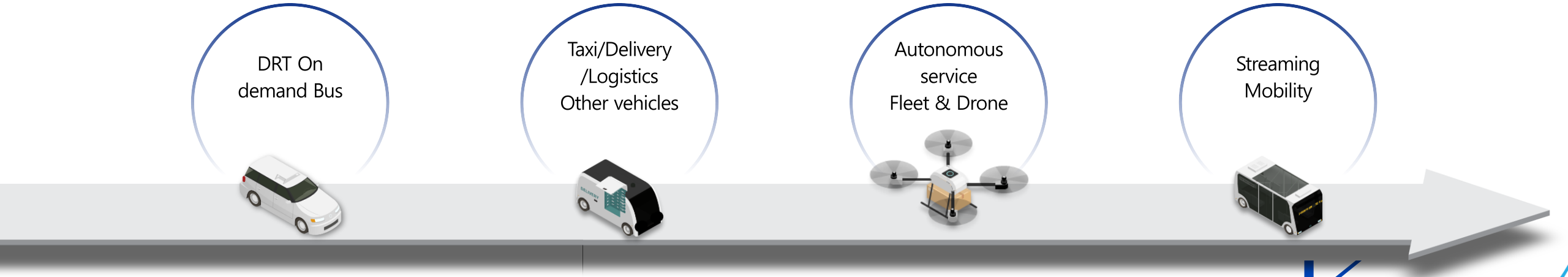
Our Vision

Everything moves with us

We will start with DRT and expand to all means of mobility

Start from DRT service to demonstrate Super Fleet Operation technology

- Expand the scope of collaboration with mobility companies including taxis, delivery, courier-logistics, police cars, recycling trucks, etc.
- Expanded to all land autonomous fleets, after upgrading the optimal operation technology of unmanned fleets through the development of drone operation management technology
- Evolution to Streaming Mobility Operations Platform for all mobility means and activities within Fleet



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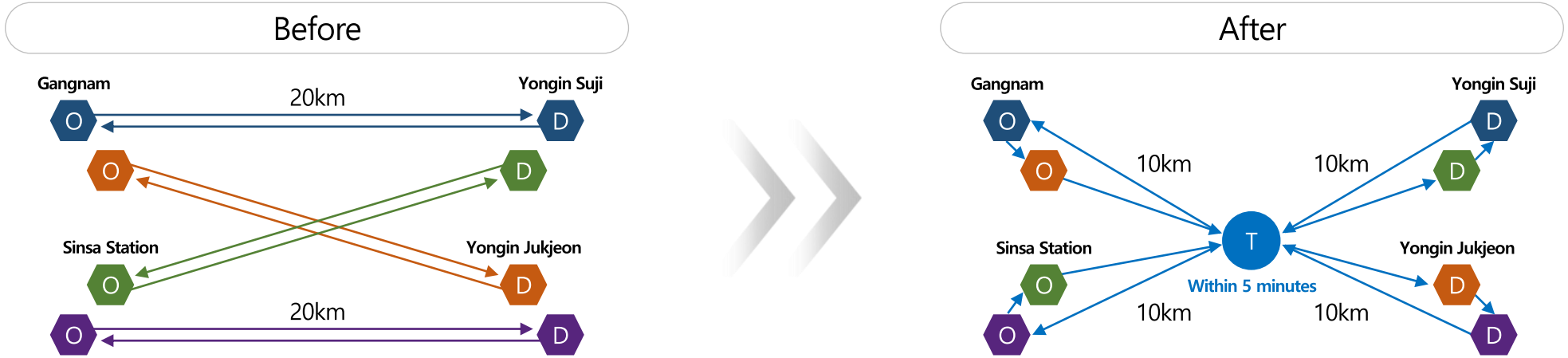
Our Vision : Super Fleet Operation

- **What can Super Fleet Operation do?**

  Through minimum vehicle and maximum transportation technology, delivery and taxi services can be innovatively changed

- **How will it be realized?**

  The key is the technology that enables accurate interconnection between vehicles, and advanced development is under way based on TAMOS



Concept of Optimization Technology with Reduced Distance and Number of Vehicles to Drive

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DRT

Future of Public Transportation DReam Transit