

**2nd phase of Cross-ministerial Strategic
Innovation Promotion Program (SIP)
/Automated Driving for Universal Services /
Fundamental Research for Automated Buses
Friendly to Mobility-Constrained People**

**FY2020 Annual Report
Summary**

NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, Inc.

April 2021

Agenda

1. Project outline

1. Background
2. Project overview
3. Premises
4. Schedule
5. Investigative committee

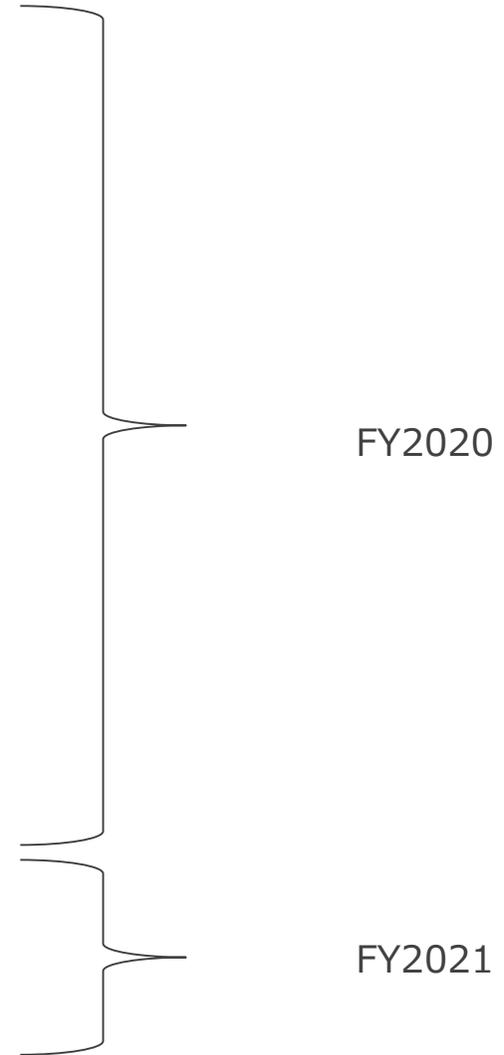
2. Organizing issues and discussing ideas

1. Organizing mobility-constrained people (MCP) types
2. Behavioral observation
3. Interviews with MCP
4. Value and issue analysis
5. Idea hearing and workshop for ideas
6. Selecting ideas
7. Research of relevant laws and standards

3. Evaluating ideas

4. Improving ideas

5. Conclusion



1. Project outline

1. Project outline

1. Background and objective

The 2nd phase of SIP includes research on transportation services with automated buses that can be used independently and safely by mobility-constrained people (MCP). The purpose of this research is to propose draft guidelines including a bus interior layout design, which can be used safely by MCP.

Background

- In the 1st phase of the SIP, automatic bus arrival and departure control and acceleration/ deceleration smoothing control were developed.
- In the 2nd phase of SIP, we will conduct surveys and verification experiments to clarify the requirements for the application and social implementation of automated bus transportation services that can be used independently and safely by MCP, such as wheelchair users, people with visual or hearing disabilities, and those who use baby carriages.

Objective

- In this research, we will:
 - conduct research and analysis of the needs of MCP and domestic and international trends
 - propose design guidelines, including interior layout design for buses that can be used safely by MCP

1. Project outline

2. Project overview

We will organize the values and issues that MCP perceive in buses and examine ideas. We evaluate ideas with mock-ups and virtual reality (VR), improve ideas and draft a guideline.

#	Title	Summary	What we do	Schedule
1	Value and issue analysis	Organize values and issues of using buses perceived by multiple MCP	<ul style="list-style-type: none">• Workshop for opinions• Behavioral observation and interviews with MCP• Organize values and issues• Survey on laws, regulations and standards• Layout case study	FY2020
2	Discussing ideas	Consider ideas for improving the issues while maintaining the values perceived by MCP	<ul style="list-style-type: none">• Expert interviews• Workshop for ideas	
3	Evaluating ideas	Formulate derived ideas and get feedback from MCP	<ul style="list-style-type: none">• Evaluation with mock-up• Evaluation with VR• Evaluation with illustration	FY2021
4	Improving ideas	Organize the idea improvement policy based on the feedbacks and obtain feedbacks from MCP again	<ul style="list-style-type: none">• Organize the idea improvement policy• Interviews with MCP	
5	Drafting guideline	Draft guideline based on ideas and feedbacks	<ul style="list-style-type: none">• Draft guideline	

1. Project outline

3. Premises

In this survey, we assume that MCP who are still using the bus are the users. The automatic driving level is Lv3, and the bus is a fixed-route buses. The guidelines include a bus design layout plan and a service plan for passengers at the bus company.

User image	<ul style="list-style-type: none">• MCP who still use buses (people with disabilities, elderly, baby carriage users) Especially,• Those who are currently able to carry out their daily activities and short-distance transportation by themselves or with the help of escorts, but have concerns about using buses• Those who are able to use buses with escorts, but are not able to do so because of anxiety about using buses.• Healthy elderly people will increase in the future (those who can move around but cannot drive, etc.)
Assumed automated driving level	<ul style="list-style-type: none">• Lv3<ul style="list-style-type: none">➤ System does most of the accelerating, braking, steering, etc.➤ Drivers need to stay in the driver's seat in case of emergency, but it will be possible to operate the navigation system, etc. while driving.
Assumed buses	<ul style="list-style-type: none">• Fixed route-buses (Not the small ones currently used in demonstration experiments, but the large ones that we see on our routes every day.)

1. Project outline

4. Schedule

We will proceed this study according to the following schedule.

	FY2020									FY2021					
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Investigative committee															
Gather opinion, discuss MCP type															
Workshop															
MCP behavioral observation, interview															
Behavioral observation, interview															
Value and issue analysis															
Analyze results of observation and interview															
Value and issue analysis															
Deriving questions															
Share, evaluate and modify results															
Interview for ideas															
Interview for ideas															
Workshop for ideas															
Workshop for ideas															
Decide way of prototyping															
Decide way of prototyping															
Make mock-up, VR, illustration															
Mock-up															
Electric ramp															
Wheelchair fixture															
flip-up seat															
VR															
Illustration															
Evaluate mock-up															
Design and schedule evaluation															
Evaluation															
Improve ideas															
Define requirements of improvement															
Gather opinions															
Guideline, report															
The first half															
Design guideline															
Reflect evaluation results															
Finalize guideline and report															
Confirmation by committee															
Modification															

1. Project outline

5. Investigative committee

In this study, an investigative committee is established to give opinions and advice from expert viewpoints.

- Member of investigative committee

Name	Organization
Tadashi Aisaka	Japan Federation of the Visually Impaired
Hirofumi Asaka	National Federation of Organization for the Disabled Persons
Kasuhiro Ariyama	Japanese Federation of the Deaf
Shungo Okano	Japan Automobile Manufacturers Association, Inc.
© Masayuki Kawamoto	i-mobility platform, inc.
Kiyokuni Goshima	The Association for Technical Aids (ATA)
Hiroshi Tanaka	Nihon Bus Association
Shinichi Watanabe	Yokohama rehabilitation center

2. Organizing issues and discussing ideas

2. Organizing issues and discussing ideas

1. Organizing mobility-constrained people (MCP) types

Through a workshop attended with MCP, 9 types of MCP were determined. 3 more types were added based on the opinions of experts, making a total of 12 types for the survey.

Workshop

Determined MCP type

photos



Questions and opinions (excerpt)

- **How will automated buses change your mobility? How do you think it will change the lives of MCP?**
 - The less brakes you have, the safer you can sit.
 - Hearing-impaired people currently have to endure the communication. ex) when they want to know the destination of a bus they are not used to riding.
 - The use of buses will increase if the ride quality (shaking) and steps in buses are improved.
 - When they don't know where the bus is going or how to pay the fare, the driver help them.
- **In your experience, what are the different types of disabilities that cause different problems?**
 - visual impairment : full(white cane, guide dog, etc.), partly(narrow-vision, Difficulty in adapting to light and dark, etc.)
 - Hearing : deaf, blind-and-deaf, etc.
 - Physical disability : upper/lower limbs, wheelchair, with/without caregiver, etc.

#	MCP type	Disability type	Reason
1	Full-blind, white cane	Visual	WS
2	Full-blind, guide dog		WS
3	Low-vision		WS
4	Deaf	Hearing	WS
5	Hard-of-hearing		WS
6	Power wheelchair user	Physical	WS
7	Cane and brace user		WS
8	Physically handicapped (upper limb)*		added 3 types
9	Mental disability	Mental	Expert
10	Intellectual and developmental disability	Intellectual developmental	Expert
11	Stroller user	—	WS
12	Elderly	—	Expert

*With regard to upper limb disabilities, no clear issues regarding bus use were obtained from the interviewees. However, since challenges can be expected depending on the disability status, we have organized them based on our findings.

2. Organizing issues and discussing ideas

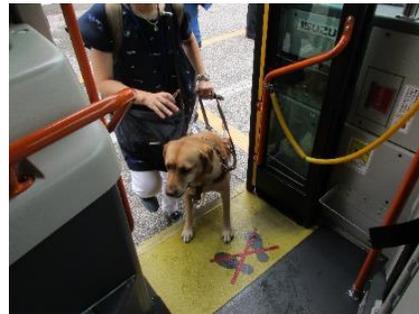
2. Behavioral observation

In the behavioral observation, we used an actual bus to recreate the situation of bus use. We were able to obtain opinions on the problems people have when using the bus and the physical and psychological reasons for them.

Contents of behavioral observation

What we did

- Used actual buses to recreate normal usage conditions
- Observed the driver when the driver needs assistance
- Organized the results of the survey by phase of use (getting to the bus stop, getting on the bus, getting a ticket, etc.) and by flow line in the car.



Photos

What we found(example)

- Unaware of the existence of support facilities or that they are inadequate
- The priority seats were equipped with belts to secure strollers, but **stroller user was unaware of their existence.**
- The guide dog was trying to get into the space under the seat, **but it couldn't fit and was sticking out into the aisle. Owner didn't even notice it.**
- Guide dog owner hit his/her face on the handrails and change rails.
- Imagine a bus layout based on their own experience.
 - **Front/back riding varied** depending on the subject.
 - White cane user **was aware that priority seating is sideways**, and were surprised that the bus they used was forward-facing.
- Choose a location that is easy to get off
 - Most subjects **choose to be near the drop-off door.**
 - Deaf people who have no problem with steps in the aisle should choose the front-most seat in the back, where they can easily see the stop sign at the front of the bus.
 - Low vision people who do not know which seats are available should stand in an open space near the door for getting off the train.

2. Organizing issues and discussing ideas

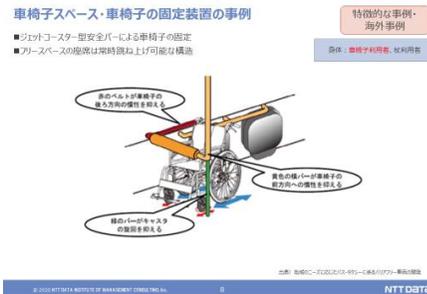
3. Interviews with MCP

In the interviews with MCP, we asked them to bring their own tools and applications that they normally use. We also asked them to refer to case studies in Japan and abroad. By doing so, we were able to get their opinions on actual usage scenarios and advanced layouts that they do not normally use.

Contents of interview

What we did

- We asked MCP to bring their personal belongings and apps that they normally use, and devised a way to get a detailed understanding of the context of bus use and issues.
- MCP reviewed materials on bus layout examples from Japan and overseas, and gave their opinions on layouts and ideas that are not normally used.



Photos

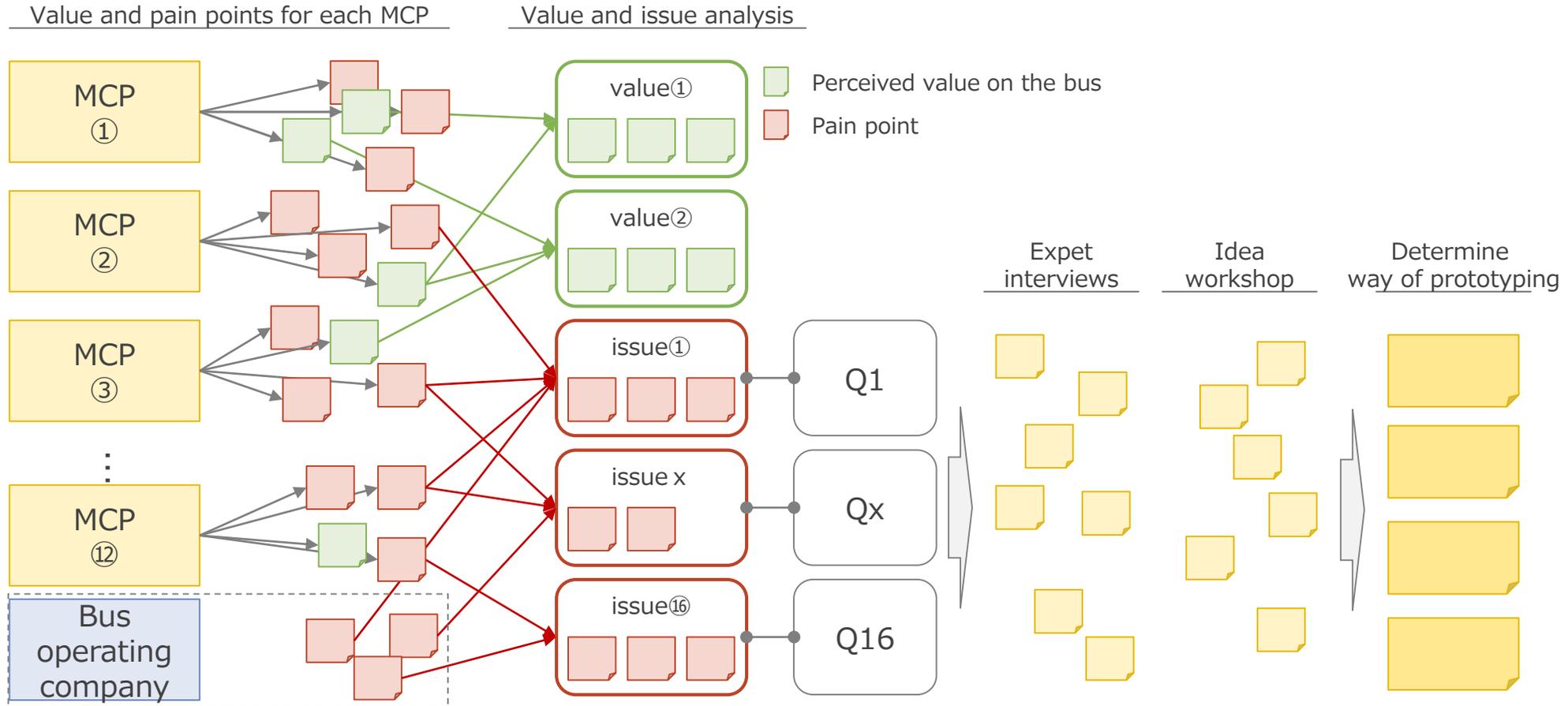
What we found(example)

- Resistance to priority seating due to mixed feelings
- White cane user and cane/brace user **feel that there are people who need priority seating more than they do.**
- Deaf people and people with mental disabilities **find it difficult to use priority seating because their disabilities are difficult to see from the outside.**
- Expectations and concerns about service automation
- People with mental disabilities will **feel safer as services are automated and variability is eliminated.**
- Many subjects **want a flexible response by the driver in case of emergency.**
- High acceptance of new technologies (e.g., smartphones)
- low vision and hearing impaired people **utilized apps that provide functions appropriate for different disabilities.**
- Among the hearing impaired, those who cannot hear are more familiar with the app.

2. Organizing issues and discussing ideas

4. Value and issue analysis - Analysis method

We identified the values and pain points of each MCP, grouped similar contents, and derived 2 values and 16 issues. Questions on how to solve the issues were formulated and used as input for idea consideration.



2. Organizing issues and discussing ideas

4. Value and issue analysis - Organize values and pains for each MCP and overall values and issues

The values and pain points of MCP were identified after organizing the values and pain points in bus use for each MCP as follows.

Value and pain points for MCP

Values and issues

2.交通制約者の行動観察およびヒアリング調査結果
6.価値・ペインポイント分析 (1.全盲白杖利用者)

交通制約者タイプ毎に価値、課題を整理した。

交通制約の要因	<ul style="list-style-type: none"> 目の前で手が動くのが見える程度の視力が無い 白杖歩行 	バス利用目的の頻度	<ul style="list-style-type: none"> 買い物・通勤・読書 (音訳) 遠1回程度
バスに感じる価値	<ul style="list-style-type: none"> バスは鉄道でいけないところまで移動しやすい点で欠かせない交通手段 バスの広告アナウンスも街が知れてよい 		
バス利用上のペイン	<ul style="list-style-type: none"> 乗車前 <ul style="list-style-type: none"> 点字ブロックが無い場合、バス停を見つけるのが大変 原を譲られることに非難感。お年寄り優先し、自分も他の席に誘導してほしい 乗車時 <ul style="list-style-type: none"> 運転士が行き先アナウンスが終わらないうちに扉を閉める。また音割れしていることもある 乗車準備時 <ul style="list-style-type: none"> 降車ボタンの位置がまちまちで混乱 降車時に他の乗客を待たせてしまう非難感 乗車時 <ul style="list-style-type: none"> 後部座席は、降りる際に段差を気にするが画面でわからない 降車時 <ul style="list-style-type: none"> 降車ボタンが車道の時もあるため、常に確認が必要 降りる場所が車道の時もあるため、常に確認が必要 乗車中 <ul style="list-style-type: none"> 今どこにいるかを知るの、音声アナウンス頼り。音声アナウンスがズレると混乱 緊急時 <ul style="list-style-type: none"> 緊急時は適切に誘導してほしい 		
期待すること	<ul style="list-style-type: none"> 降車ボタンの位置等の標準化 正確な情報の音声でのリアルタイム提供 (次のバスはいつ?と行き?次の停留所、到着した停留所、空いている座、降りた後の障害物) 専用カード等で、障がい者割引、同乗者の処理等を適切に 		

© 2020 NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, INC. 18 NTT DATA

2.交通制約者の行動観察およびヒアリング調査結果
6.価値・ペインポイント分析 (3.ロービジョン)

交通制約者タイプ毎に価値、課題を整理した。

交通制約の要因	<ul style="list-style-type: none"> 視野の中央が見えず、周囲はぼやけて見える 	バス利用目的の頻度	<ul style="list-style-type: none"> 通勤、役所、銀行、多荷物 天気が悪い日、慣れている場所
バスに感じる価値	<ul style="list-style-type: none"> 慣れている場所ではバスを利用する (慣れない場所ではタクシーを使用することが多い) 		
バス利用上のペイン	<ul style="list-style-type: none"> 乗車前 <ul style="list-style-type: none"> バス停で時刻表が見えない 大きなターミナルでは目的のバスを見つけるのが大変 並んでいる人の最後尾が分からない 乗車時 <ul style="list-style-type: none"> 音声表示が見えない。放送がしっかり聞こえないと、目的地に到着するバスが分からない 後部座席は、降りる際に段差を気にするが画面でわからない 空いている座が分からない 優先席が前向きか側向きかわからない 乗車中 <ul style="list-style-type: none"> 白杖を持っていると、気を使わせて悪いなあと思う。高齢者の方に譲られると申し訳ない 降車準備時 <ul style="list-style-type: none"> 降車ボタンの位置は違うことがある ボタンの色と手すりの色が同系色であるため押しにくい 		
期待すること	<ul style="list-style-type: none"> 人がいないと出来ない声掛けがある。自動運転化されると機械化されると、助けを求められる人がいないのは不安。(緊急事態の際や、上手にSUICAが返らない時等)これをしっかり担保してほしい 		

© 2020 NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, INC. 20 NTT DATA

2.交通制約者の行動観察およびヒアリング調査結果
6.価値・ペインポイント分析 (2.全盲盲導犬利用者)

交通制約者タイプ毎に価値、課題を整理した。

交通制約の要因	<ul style="list-style-type: none"> 生後2か月で目の病気が発覚。光を見ることが無い 21年盲導犬と一緒に生活。介助者はいない 	バス利用目的の頻度	<ul style="list-style-type: none"> 区役所への用事、買い物 月2~3回程度
バスに感じる価値	<ul style="list-style-type: none"> ほっとする時間、そらいう気持ちと結びついている 利用したい時間、行きたいところにバスがあれば利用する 		
バス利用上のペイン	<ul style="list-style-type: none"> 乗車前 <ul style="list-style-type: none"> 並ぶ際の最後尾が分からない(犬は人の間に入ります) 乗車時 <ul style="list-style-type: none"> 行き先のアナウンスが聞こえづらい 乗りたいのに、運転士に乗りなさいと強引にされ出発してしまう 乗車時にバスとの距離感が分からない (踏み外したり顔をぶつけたこともある) 乗車中 <ul style="list-style-type: none"> 混んでいると、椅子を探しづらい 座を譲ってもらうのは申し訳ない 緊急時 <ul style="list-style-type: none"> 詳しい状況が分からないと困るため、ちゃんと説明してほしい 		
期待すること	<ul style="list-style-type: none"> 自動運転になった場合、情報をどのように仕入れるか心配であるため、ハンディキャップボタンの様なものを押下することで情報を入手できるようにしてほしい。(タッチ式ではなく、ボタン式が良い) 		

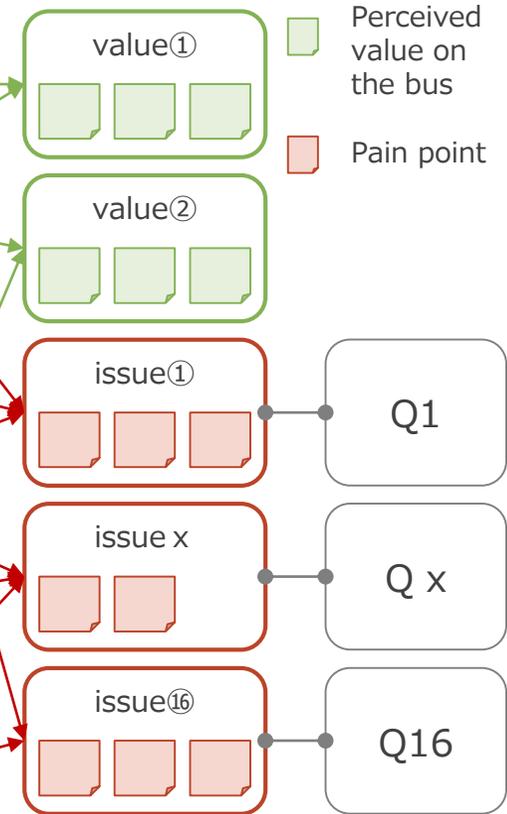
© 2020 NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, INC. 19 NTT DATA

2.交通制約者の行動観察およびヒアリング調査結果
6.価値・ペインポイント分析 (4.ろう者)

交通制約者タイプ毎に価値、課題を整理した。

交通制約の要因	<ul style="list-style-type: none"> 先天性感音性難聴 	バス利用目的の頻度	<ul style="list-style-type: none"> 最寄り駅までの移動 ほぼ毎日
バスに感じる価値	<ul style="list-style-type: none"> 普段の生活の中でもとても重要。乗るバス停にはいるとバスが来るので便利 身近な感じがある。慣れているので、慣れている場所であればバスの方が安心 		
バス利用上のペイン	<ul style="list-style-type: none"> 乗車前 <ul style="list-style-type: none"> 初めての路線では情報が入りにくいことが不安 (運転士とうまくコミュニケーションをとれない場合もあるため) 乗車時 <ul style="list-style-type: none"> 言われていることが分からないとき、他の乗客が後ろに並んでいると焦る 運転士が誰に話しているのがわからない(自分なのか他の乗客なのか) 乗車中 <ul style="list-style-type: none"> 次の停留所空の時間が示されず、降車準備ができない 後ろの方に座ると表示が見えにくい 乗車準備時 <ul style="list-style-type: none"> 車道ホートのマークの位置がわからず不安 降車準備時 <ul style="list-style-type: none"> 降車ボタンがどこに止まったのかわからない(バス停or横断歩道) 降車時 <ul style="list-style-type: none"> ICカードで支払の際、タッチが有効であったかどうか分からない 緊急時 <ul style="list-style-type: none"> アナウンスが理解できず、緊急の内容がわからない 		
期待すること	<ul style="list-style-type: none"> 何が聞きたいこと、急病者などの緊急時には対応できる人がほしい 		

© 2020 NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, INC. 21 NTT DATA



2. Organizing issues and discussing ideas

4. Value and issue analysis - Summary of value

By grouping the values of bus use organized by each MCP type, two values were derived: "a valuable link in daily life" and "a door to the world that expands the range of activities".

#	MCP type	Perceived value on the bus
1	Full-blind, white cane	<ul style="list-style-type: none"> Buses are an indispensable means of transportation because they can easily take you to places that cannot be reached by train. Advertising announcements on buses are also a good way to get to know the city.
2	Full-blind, guide dog	<ul style="list-style-type: none"> Time of relief, and it's connected to those feelings. Use the bus if it is available at the time you want to use it and where you want to go.
3	Low-vision	<ul style="list-style-type: none"> Use buses in places you are familiar with (often use cabs in unfamiliar places)
4	Deaf	<ul style="list-style-type: none"> Very important in daily life. It's convenient that various buses come to the bus stop you get on. It feels familiar. I'm used to it, so I feel safer on the bus if I'm in a familiar place.
5	Hard-of-hearing	<ul style="list-style-type: none"> (N/A)
6	Power wheelchair	<ul style="list-style-type: none"> Easy to travel with The distance between stops is close, making it suitable for short-distance travel.
7	Cane and brace user	<ul style="list-style-type: none"> The bus stop is close to my house, so I just use it for convenience.
8	Physically handicapped (upper limb)	<ul style="list-style-type: none"> It's hard for me to walk and I can't drive, so it's an important means of transportation for me when I'm alone (plus my kids).
9	Mental disability	<ul style="list-style-type: none"> To use as a means of access to the train station because my house is far from the station. Also, depending on your destination, it may be more convenient to take the bus.
10	Intellectual & developmental disability	<ul style="list-style-type: none"> The means of transportation you usually use. Based on this training, you will be able to use other means of transportation and expand your range of activities.
11	Stroller user	<ul style="list-style-type: none"> It's convenient to get from the front of my house to my destination with hardly any walking. Strollers can't use the escalator and sometimes have to take a long way, so the bus is convenient.
12	Elderly	<ul style="list-style-type: none"> Transportation necessary for daily activities such as visiting family members in the facility or going to the hospital

value①

a valuable link in daily life

value②

a door to the world that expands the range of activities

2. Organizing issues and discussing ideas

4. Value and issue analysis - Derivation of issues and questions

A total of 16 issues were derived from the grouping of pain points organized by MCP.

#	Task Title	問
1	I can't get to the bus I want to take.	What kind of information should be provided to people with transportation constraints so that they can easily reach the bus they want to take? How to ride without getting lost which to ride front or back ?
2	Fee payment method unknown	How can we streamline the process of paying fees and checking disability certificates?
3	Difficulty in grasping space	How can we tell traffic constrained people where the buses are and where the seats are?
4	Fixing the wheelchair requires time and psychological burden.	What is the best way to secure a wheelchair that is not time-consuming and stressful for the person and other passengers?
5	Burden on the body when getting on and off	How can I get on and off the bus without straining my body?
6	Rear bumps are inconvenient.	How can we make it easier for traffic constrained people to use the back seat? How can we make it easier for transportation constrained people to use the back seat, and make it easier for them not to have to?
7	Anxiety about horizontal shaking	How can we get rid of our fear of lateral movement?
8	Communication with the driver	How can we better communicate with the driver? Or, can we get the information we need without communicating with the driver?
9	I don't know where I am or what I'm doing.	How can we find out where the bus is?
10	Difficulty in hearing announcements inside and outside the vehicle	How can we best convey the information conveyed in the announcement?
11	Stroller space	What would an obvious stroller space look like without undue concern for other passengers?
12	Guilt, reticence, and relationships with other passengers	How can we remove our guilt and reservation about other passengers? Will other passengers notice?
13	Difficulty in pressing the get-off button	What would a get off button look like that was easy for anyone to understand and press?
14	Impatience to get off the train	How can traffic constrained people get off the bus without feeling rushed?
15	Anxiety about drop-off location	How can we ensure safety and security when getting off the train?
16	Anxiety about health problems	How can I get rid of my anxiety about my health condition?

2. Organizing issues and discussing ideas

5. Idea Hearing

In the idea hearing, we received ideas for situations such as ramps, wheelchair fixation, folding chairs, and fare collection.

Location	Idea title/type	Idea Details
slope	Automatic Slope	Automatic stairs and ramps to connect bus stops and buses
Wheelchair fixation	Automation of wheelchair fixation	The seat automatically lifts up and the wheelchair fixture comes out of the floor
folding (collapsible) chair	Folding chair like a movie theater	Considering the needs of the elderly for seating, free space is difficult. Chairs that snap together like in a movie theater are better.
receipt of freight	Improve efficiency of fare collection	It would be nice to be able to pay the fare away from the driver's seat
	Simplify the fare box	The fare box makes it impossible for wheelchair users to ride from the front. Why don't we eliminate the seats immediately in front of the front door? This would eliminate the need to change direction
	Improved convenience of payment	It would be nice to be able to get off at the door you get on. This won't happen until the fare collection issue is resolved.
IC card	Use of IC cards	IC cards can be set up to offer a discount if the passenger rides within a certain period of time after getting off the card.
glass window	In-car display using window glass	Information such as the current location and destination is displayed on the glass window, and information can be obtained in the car no matter where you sit.
Light to teach space	A light that shows where the traffic constrained person is getting on and off the bus.	Lights (LED) that show the position of disabled passengers, priority spaces, and seat positions. Lights that can flexibly change their space and position according to the passenger's behavioral style.
Handrail outside bus	Handrails that only come out when getting in and out	The elderly sometimes get off the bus backwards while holding on to the handrails inside the bus. It would be better if there were handrails that smoothly connect the bus stop to the bus.
Tacit knowledge practice system for drivers	Driver Support System	A system that can replace the work and tacit knowledge that drivers used to have to respond flexibly by judging the surrounding situation, such as where traffic constrained people get off.
App	Navigation apps	We experimented with an app for traffic constrained people in another SIP project last year. (https://www.sip-adus.go.jp/file/showcase2019/SIP_zone2-6_s.pdf)
	An app to keep track of bus stop locations	A system that shows the location of bus stops for the visually impaired
	Matching Apps	An app that matches people who need help with people who can help them.
	Notification to the driver	The driver should be able to recognize that you are sick when you press the get off button.
	Automatic Slope Reservation App	An app that allows you to reserve an automatic ramp in advance before boarding the bus
	An app that allows you to experience the layout of a car	Since information that can be prepared in advance is important for people with traffic constraints, it would be good to have something (such as an app) that can simulate the layout of the vehicle.

2. Organizing issues and discussing ideas

5. Idea Workshop (1/2)

The idea workshop identified ideas that could be realized by changing only the bus, ideas that could be realized with the bus and external ICT, ideas that could be realized with external ICT, etc. **Achieved by changing only the bus**

Changes	layout improvement	Provision of information	Institutional and cultural modifications
Entire bus	Full flat (EV)	The reason for stopping is indicated by the color of the light inside the vehicle.	Automatic driving and driver assistance technologies (anti-rolling)
entrance and exit	Increase the number of entrances and exits (front, middle, and rear)		
slope	Automatic Slope		Even able-bodied people basically use the ramp
	Handrails on both sides		
	Roof at the top of the ramp		
Fare box and IC reader	Elimination of belt conveyor type fare boxes Minimize the number of fare boxes by separating the money changer, etc.	SUICA payment completion is indicated by light	
space	Backrest for standing passengers	Automatically detects vacant spaces and indicates them by illuminating them (stroller spaces, spaces for the elderly, etc.)	thoughtful seat
	small piece of furniture upon which one can sit and relax		
Chair	folding (collapsible) chair	A system that detects when a traffic constrained person leaves his seat before getting off and alerts the driver.	
	Ample space between seats		
	Chairs that are easy for wheelchair users to transfer		
	Seating zoning (priority)		
Wheelchair fixture	One-touch fixing of wheelchair wheels		
handrail	Cushioned handrails		
	Handrail to hold a stroller		
	Add handrails for standing passengers		
Get off button	touch sensitive button	Display the next station (name, symbol, etc.) on the get off button.	
	Buttons that are easy to see in the dark		
windowpane		Display using a glass window	
Panels and boards		Touch Panel FAQ	
		Panel board to inform passengers of available seats when they board the train	
Sound and announcements		Automated announcements	
		Use of chimes (sound, pitch, melody, frequency, texture)	
		Provide information on the environment around the bus stop through announcements	
		Announcement of available seats when boarding the train	
Outside the car said		Lower the outside display of the bus	

2. Organizing issues and discussing ideas

5. Idea Workshop (2/2)

The idea workshop identified ideas that could be realized by changing only the bus, ideas that could be realized with the bus and external ICT, ideas that could be realized with external ICT, etc.

Bus x external ICT (applications, etc.)

Changes	layout improvement	Provision of information	Institutional and cultural modifications
IoT for Buses		Operation information, bus location, destination, front/back boarding, payment method, current location, arrival time	
		In-train information, in-train seat availability, internal layout	
		Intention display function, intention to get off the vehicle (application, external switch), seated, request for assistance	

外部ICT(アプリ等)のみで実現

変更箇所	layout improvement	Provision of information	Institutional and cultural modifications
Building the app		Learning information, learning videos of traffic constrained people, simulated internal layout	
		Bus stop information and environment around the bus stop (availability of space to rest, etc.)	

2. Organizing issues and discussing ideas

6. Selecting ideas

Of the ideas we identified, we selected ideas to be evaluated using actual vehicle mock-ups, VR, and illustrations

Mock-up of actual vehicle	VR	illustration
<ul style="list-style-type: none">Automatic Slopefolding (collapsible) chairOne-touch fixing of wheelchair wheelstouch sensitive buttonButtons that are easy to see in the darkDisplay the next station (name, symbol, etc.) on the get off buttonTouch Panel FAQAutomated announcementsAnnouncement of available seats when boarding the train.Use of chimes (sound, pitch, melody, frequency, texture)	<ul style="list-style-type: none">The reason for stopping is indicated by the color of the light inside the vehicleHandrails on both sidesRoof at the top of the rampAmple space between seatsLower the outside display of the bus.Display using a glass windowAdd handrails for standing passengers.SUICA payment completion is indicated by lightAutomatically detects vacant spaces and indicates them by illuminating them (stroller spaces, spaces for the elderly, etc.)	<ul style="list-style-type: none">Intention display function, intention to get off the vehicle (application, external switch), seated, request for assistance

2. Organizing issues and discussing ideas

7. Research of relevant laws and standards

As a basic research for the formulation of the draft guideline, existing laws, regulations and standards related to the use of buses by people with transportation constraints were surveyed. Based on the laws and regulations (ministerial ordinances), certification guidelines, guidelines and UN, and national projects and reports, the information was organized into essential requirements, certification requirements, target requirements, issues, policies and goals, and discussions.

Objective

Research existing relevant laws, regulations, and standards to understand the assumptions that should be considered when developing draft guidelines.

Current requirements for bus layout and services to be organized in this project, etc.

Laws and Regulations (Provincial Orders)

H30 Standards for Facilitating Mobility, etc. (Revised) → Necessary

Recognition gist

H27 Non-step Bus Certification Guidelines (Revised) → Recognized elements

Guidelines·UN

H30 Guidelines for Public Transport Operators

H31 Barrier-free Maintenance Guidelines (Vehicles)

H31 Barrier-free Maintenance Guidelines (Passenger Facilities)

H30 UN Regulation No.107 → Objective Elements

National projects and reports

SIP

H26~**H30** SIP Ph.1 Next-generation urban transportation system Positive arrival control related

H26~**H27** SIP Ph.1 Reduce boarding and alighting time for public transportation

H30 SIP Ph.1 Data collection and storage (bus field)

H30 SIP Ph.1 Demonstration experiment in Okinawa Prefecture

H30 SIP Ph.2 Automated Driving in Rural Areas

Other

H23 Study group on the development of barrier-free vehicles for buses and cabs to meet local needs

→ Topics

→ Policy and Goals

→ consideration

2. Organizing issues and discussing ideas

8. Research of relevant laws and standards

Relevant regulations and standards were organized by bus part.

■ items to be sorted

- | | |
|---|-----------------------------|
| • entrance and exit | • handrail |
| • Priority Seats | • Communication Equipment |
| • Slope board | • Get-off button difference |
| • Rear section | • Aisle and floor surfaces |
| • Interior color | • Seats |
| • place where one puts the money required to ride public transportation | • Positive arrival control |
| • Wheelchair space | • Internal monitor |
| • Outside the car said | • Congestion monitoring |
| • Inside the car said | |
| • Outbound Release | |
| • in-car announcement | |

■ An example of an arrangement result

要件の整理 (スロープ板)

スロープ板

必須:720mm以上
認定:800mm以上

必須:14度以下
認定:7度以下

120mm
1050mm以下
1040mm以下

- 法規 (必須要件)
 - 乗降口のうち**1以上**には、車椅子使用者等の乗降を円滑にするための**スロープ板等**を設置
 - スロープ板の幅は**720mm**以上
 - スロープ板の一端を地上高150mmのバスベ이에乗せた状態における、スロープ板の角度は**14度以下**とし、長さは**1050mm以下**とする。
- ノンステップバス認定要領
 - スロープ板の幅は**800mm**以上とする。
 - 地上高150mmのバスベ이에車椅子使用者等を乗降させる際のスロープ板角度は**7度 (約12%勾配) 以下**とし、長さは**1050mm以下**とする。
 - スロープ板の表面は滑りにくい材質若しくは仕上げ
 - スロープ板は、容易に取り出せる場所に格納する。
- ガイドライン (目標要件)

(標準的な要件)

 - スロープ板の幅は**800mm**以上とする。
 - 地上高150mmのバスベ이에車椅子使用者等を乗降させる際のスロープ板の角度は**7度 (約12%勾配、約1/8) 以下**とし、スロープ板の長さは**1,050mm以下**とする。
 - 耐荷重については、**300kg**程度。(電動車椅子本体 (90~100kg)、車椅子使用者本人、介助者の重量を勘案)
 - スロープ板は、使用時には**フック等で車体に固定**できる構造
 - 車椅子の脱輪を防止するよう**左右に立ち上げ**を設ける。
 - スロープ板の表面は滑りにくい材質又は仕上げとする。
 - 乗務員の混乱防止、スロープ板の出し入れの迅速化のため、**反転式スロープ板**等の取り扱いが簡易なスロープ板を採用する。

(望ましい要件)

 - スロープ板の角度は**5度 (約9%勾配、約1/12) 以下**とする。
 - また、**自動スロープ板**、バス停側の改良等により、さらに乗降しやすい方法を採用することが望ましい。*

© 2020 NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, INC. 8 NTT DATA

要件の整理 (車いすスペース) 2/6

車いすスペース

UN標準車いす

- 長さ (l) :1200mm
- 幅 (b) :700mm
- 高さ (h) :1090mm

- 認定要件: ノンステップバス認定要領 (プリースペース)
 - 車いすの固定、解除、入ベルトの着脱は、乗務員の適切な接遇介助によって行う
 - ベビーカーを折りたたまず乗車できるプリースペースを設け、車いすスペースと共用することができる
 - プリースペースに備える座席は、**席時兼ね上げ可能な座席**とする
 - プリースペースには**ベビーカーを固定するベルト**を用意する
 - プリースペースにはベビーカーを折りたたまず使用できることを示すピクトグラムを貼付し、ストラップの使用法、車いす乗車の優先を記載する
- 目標要件: ガイドライン・UN

【ガイドライン】

(望ましい)

 - 車いすそのものの固定を省くことや手すりなどでの**固定の簡素化**が望ましい
 - ノンステップバスの普及に合わせ、車いすスペースの数の**再検討**が望まれる
 - 腰ベルトを使用する場合は、腰ベルトに正しく装着される**ことが望ましい**
 - 乗務員の混乱を避けるため、**仕様の統一**が望ましい
 - 安全ベルトに代わり得る手すり (安全バー等) の開発が望ましい
 - 車いすスペースの有無、車いす使用者からの乗車希望は運転席に表示される**ことが望ましい**
 - 車いすスペースに座席を設置する場合には、その座席は席時兼ね上げ可能な構造と**することが望ましい**

【UN】

 - 少なくとも幅750mm、長さ1300mm、高さ1400mm**の車いすスペースを設ける
 - 車いすスペースの床面には滑り止めが施されているものとし、**前後方向の傾斜は5%を超えないものとし、横方向の傾斜は3%を超えないものとする**
 - 車いす使用者が通過できる出入口が**少なくとも1つ**あるものとする
 - 車いす用ドアは、UN規定に適合した乗降装置 (リフトまたはスロープ) を備えるものとする
 - 荷重アライメントは**車いす用ドアは、最小高さ1400mm**を有しているものとする
 - 車いす用のドアの最小幅は900mm**であるものとし、手すりの位置では800mm以上とする

© 2020 NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, INC. 13 NTT DATA

Future Schedule

We will now proceed according to the following schedule.

	4		5			6			7			8			9			
	11-	21-	1-	11-	21-	1-	11-	21-	1-	11-	21-	1-	11-	21-	1-	11-	21-	
Milestone																		
Plan	←→																	
Mock-up production	←→ Electric Slope Wheelchair fixation			←→ Folding Chair														
Mock-up production (NTT) VR-illustration	←→ VR Production				←→ illustration Mock-up production (NTT)													
Evaluation	←→ Prepare to request to Evaluator			←→ Request to Evaluator			←→ Schedule fix		←→ evaluation									
Improve ideas										←→ Create requirements for improvement		←→ opinion poll						
Guidelines and Report	←→ First half of the chapter			←→ Designing Guidelines						←→ Evaluation results Reflection of evaluation results			←→ Finalization		←→ inspe ction		←→ corr ecti on	

NTT DATA
Trusted Global Innovator