

[CNI세미나2018-084]

이동권 확보를 위한 지속가능한 교통

한일 공동 심포지움

일시 : 2018년 9월 11일(화) 15:30

장소 : 한밭대학교 국제회의실(S3동 108호)

주최 : 충남연구원

후원 : 대한교통학회 대전·충청지회



사단
법인

대한교통학회
Korean society of transportation

Schedule

Time	Contents	
15:30~15:40	Opening Speech	<ul style="list-style-type: none"> • Young Hyun Kwon (Acting President of Chungnam Institute)
	Congratulatory Message	<ul style="list-style-type: none"> • Jae Hyun Park (President of Branch of Daejeon, Chungcheong Province, Korean Society of Transportation)
15:40~16:30	Efforts for Elderly Mobility	<ul style="list-style-type: none"> • Understanding DRT and Its Efficiency for Elderly (Dr. Wonchul Kim, Korea) • Utilization of Private Cars to Secure Transportation in Japanese Local Cities (Dr. Jae Yeol Kim, Japan)
16:30~17:20	Eco-friendly and Advanced Transport for Mobility	<ul style="list-style-type: none"> • Utility and Disutility of Time Spent Traveling in the Era of Self-driving (Prof. Akimasa Fujiwara, Japan) • Development of a GPS-enabled Smartphone App for Improving Driving Safety (Prof. Junyi Zhang, Japan)
17:20~18:00	Discussion	<ul style="list-style-type: none"> • Chairperson : Prof. Namgung Moon (President of Wonkwang Digital University) <ul style="list-style-type: none"> - Prof. Myoung Soo Kim (Hanbat National University) - Dr. Back Jin Lee (Korea Research Institute for Human Settlements) - Dr. Sang Jin Oh (Chungbuk Research Institute) - Dr. Beom Kyu Lee (Deajeon Sejong Research Institute) - Dr. Joon Hong Lim (Chungnam Institute) - Dr. Hyoung Chul Kim (Chungnam Institute)
18:00	Closing	

Understanding DRT and Its Efficiency for Elderly

2018. 09. 11

Wonchul KIM, Ph.D
(iwonchul@cni.re.kr)

Chungnam Institute

Understanding DRT service for Elderly

Importance of Mobility Right of Elderly

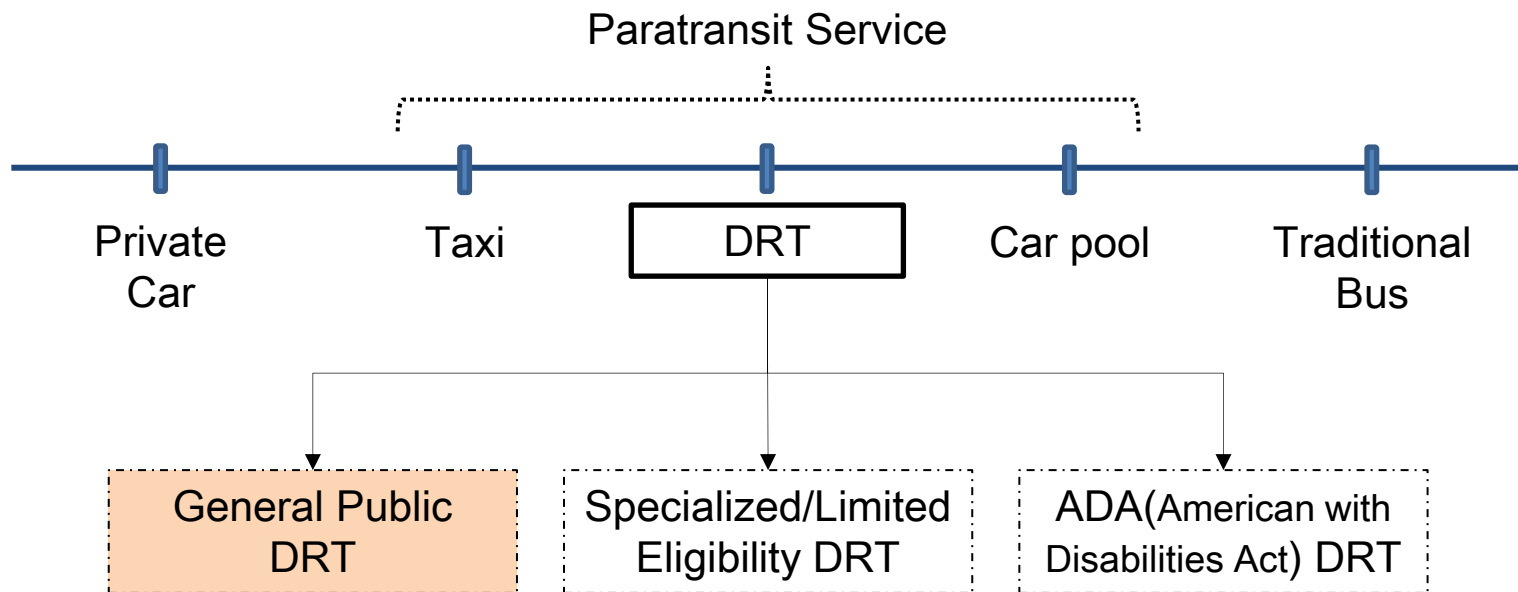
Laws & Regulations for Mobility Right of Elderly

Cases for Mobility Right of Elderly

Suggestions

Understanding DRT Service

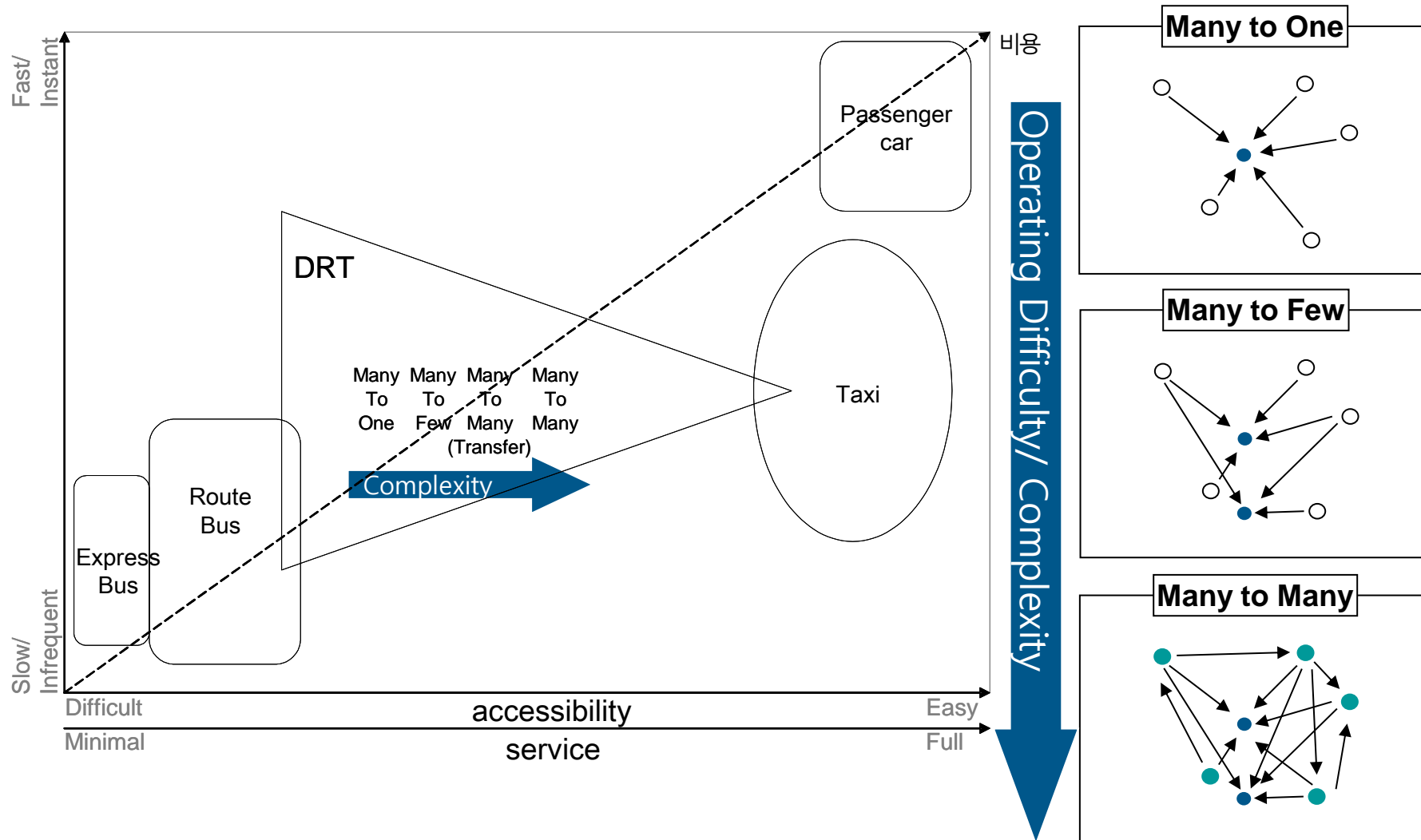
- **FLEXIBLE ROUTE & TIME**, Share the ride, Advance reservation
 - DRT Service is provided in response to calls from users



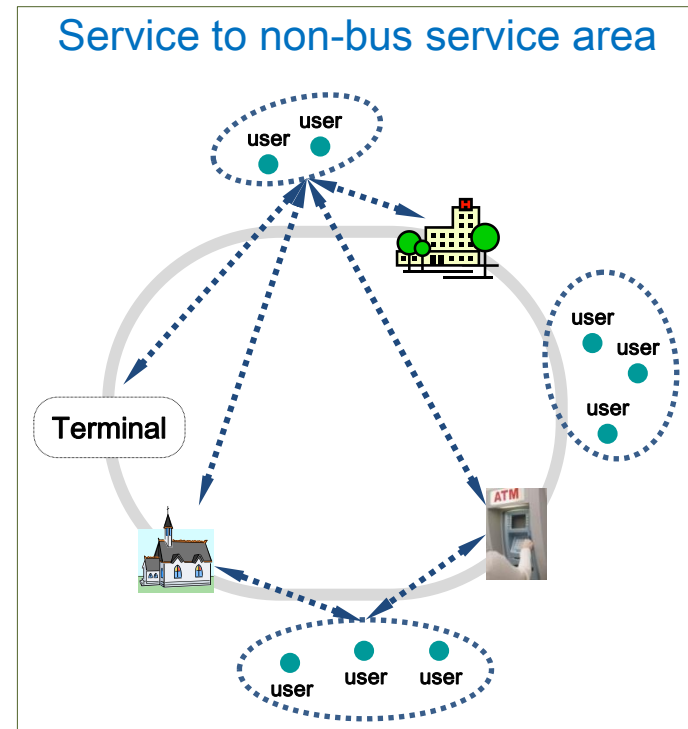
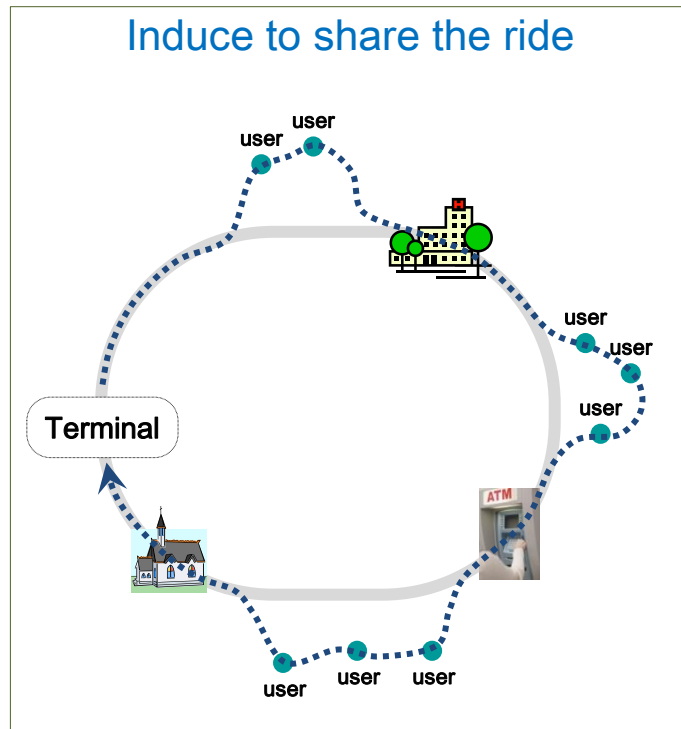
Reference) TRB, "Guidebook for Measuring, Assessing, and Improving Performance of Demand Response Transportation", TCRP report 124, 2008

● PARATRANSIT between BUS(Share the ride) and TAXI(Door-to-Door)

- Requires higher rates than the traditional BUS fare



- Demand Responsive Transport (DRT) according to users' call
 - Route & Time : Conventional → Flexible
 - DRT size : Large bus ~ small bus ~ sedan (taxi)
- Depending on road network, travel behavior of users, regional features

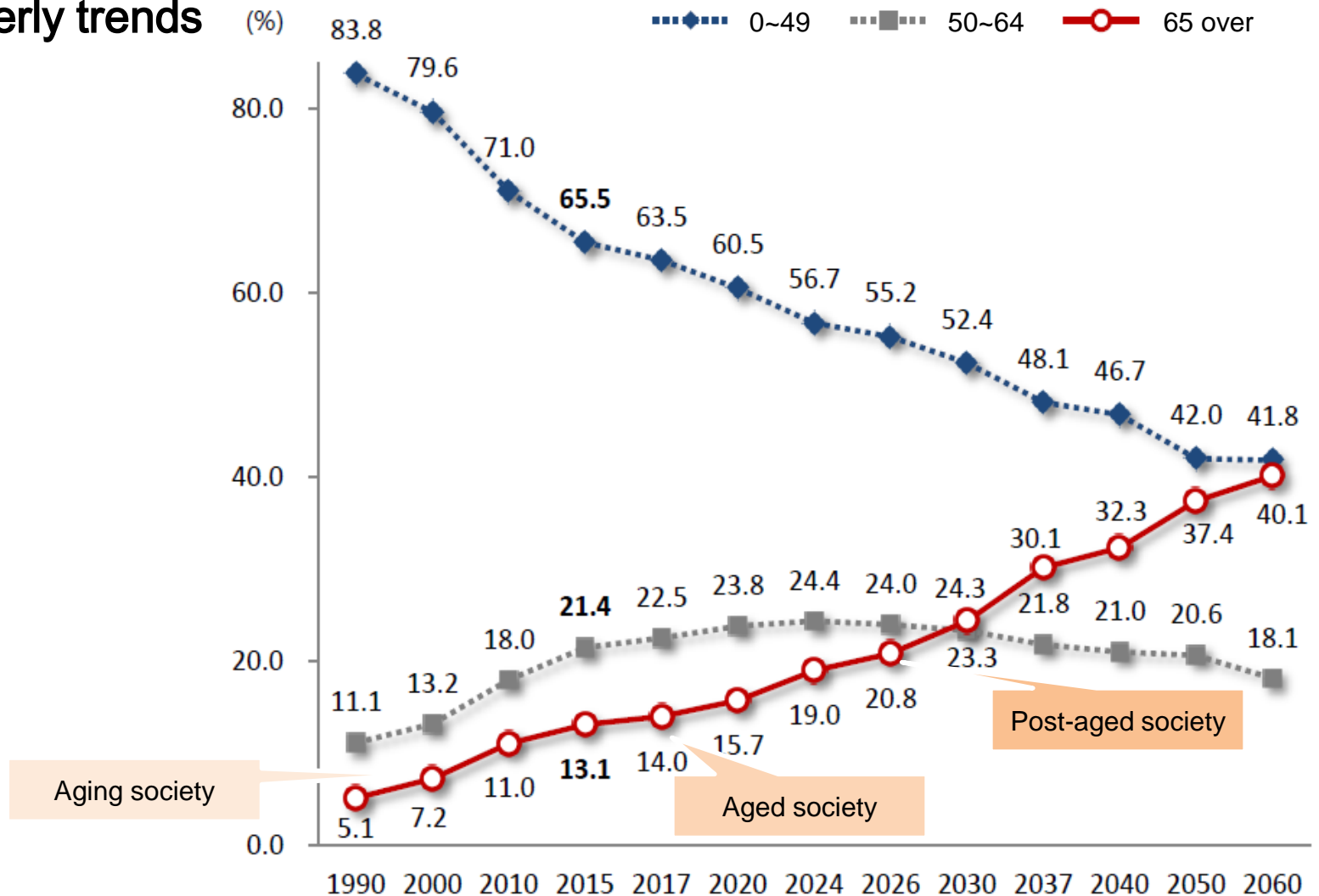


Importance of Mobility Right of Elderly

Our Reality (Korea)

- Elderly (People who are 65 years old or over)

- Elderly trends

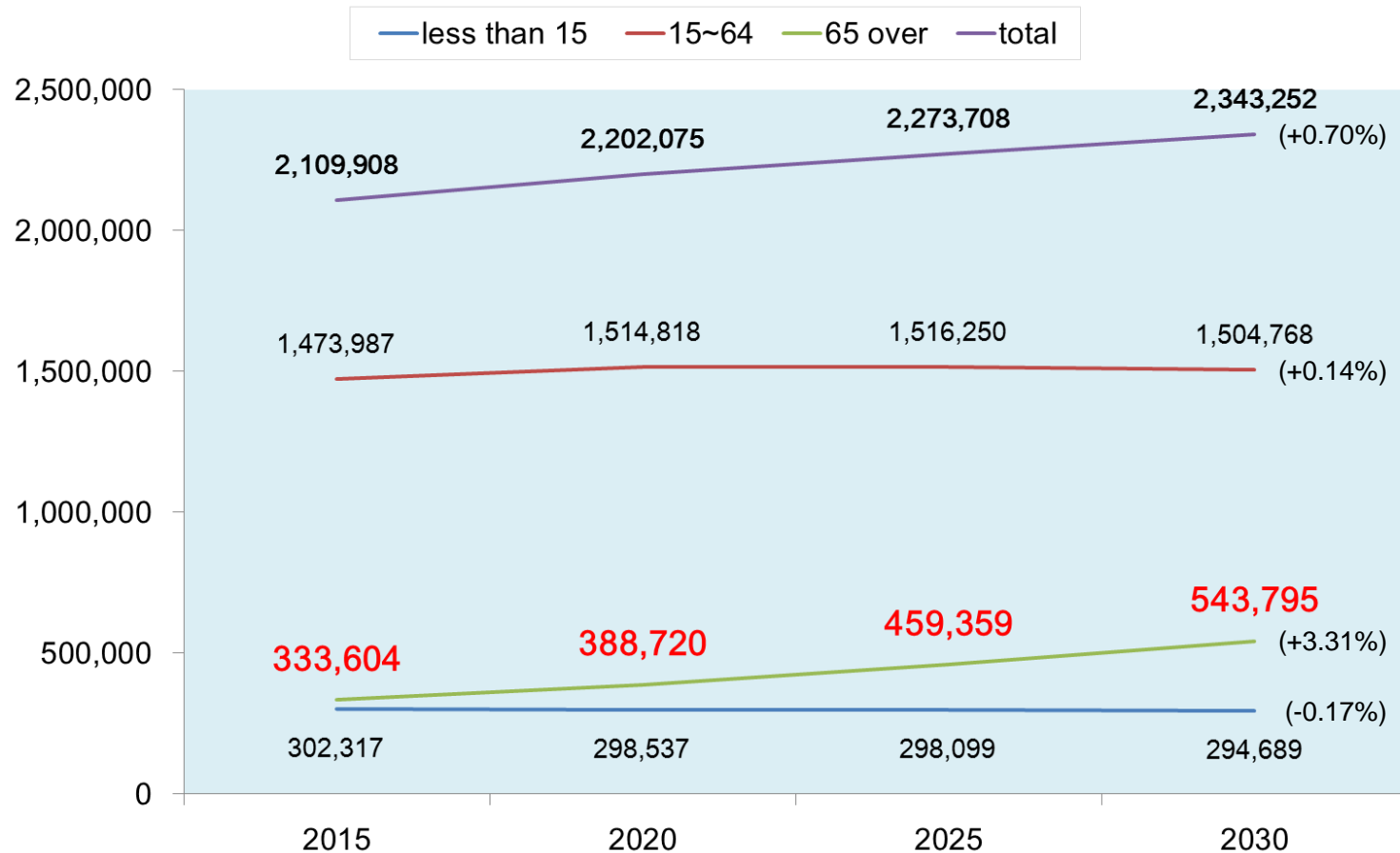


Reference : Statistics Korea, "2015 Elderly statistics", 2015.9

Our Reality (Chungcheongnam-do)

- Total population increases

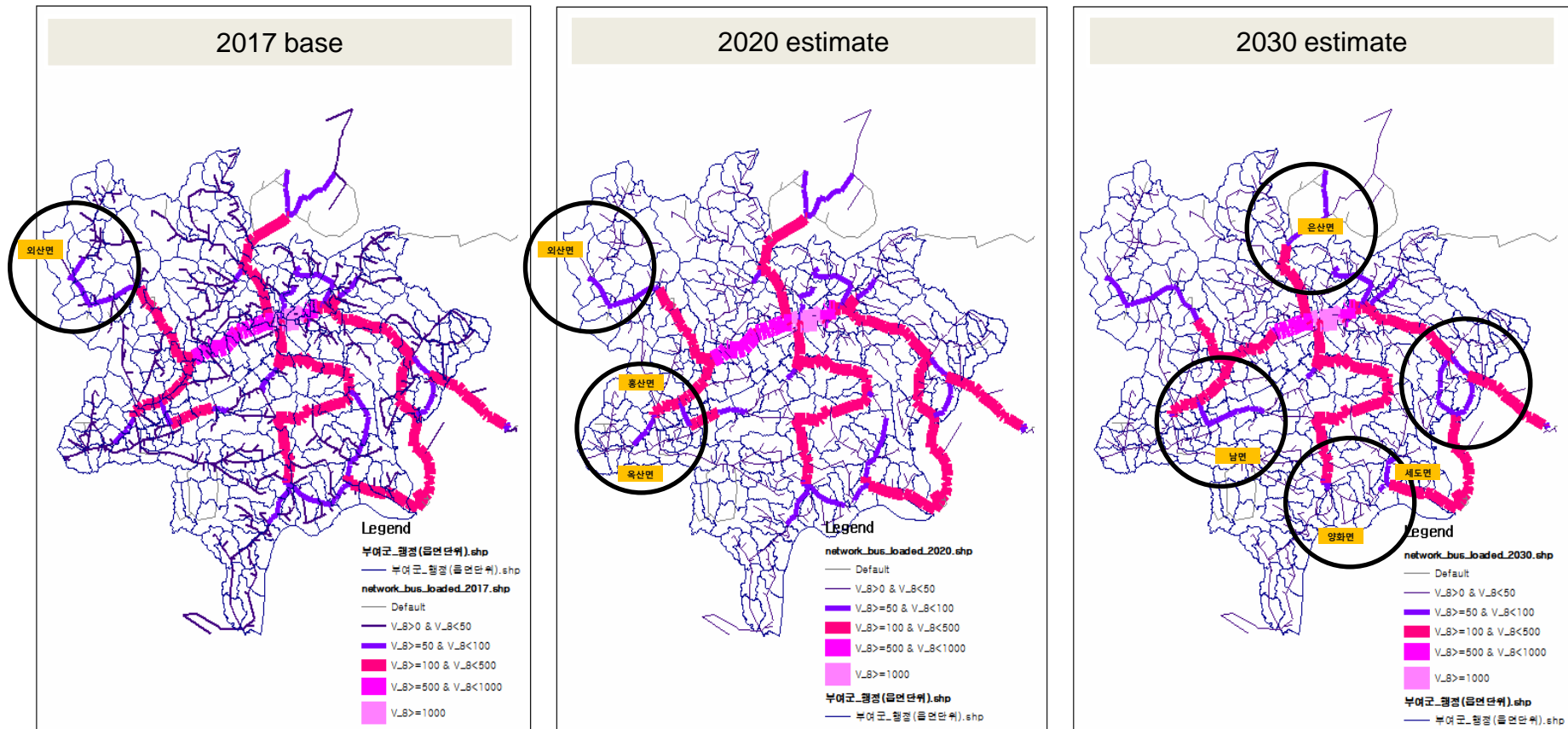
- Elderly dramatically increases but others continuously decrease



Reference : Chungnam Institute, A 2040 population estimation of Chungcheongnam-do province, 2016.3

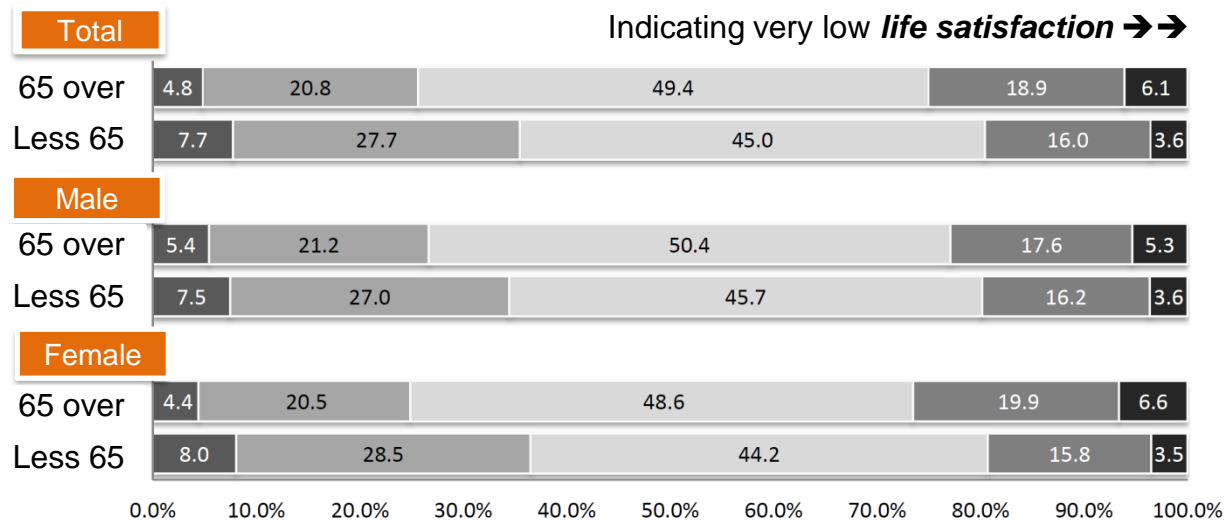
Our Reality (Buyeo-gun)

- Forecasting ridership of bus routes (Buyeo-gun, Chungcheongnam-do)
 - Ridership will continuously reduce in the outskirts from 2020 to 2030



Reference : A study on the cost analysis of bus operation and the strategies of efficient bus operation in Buyeo-gun, 2017.9

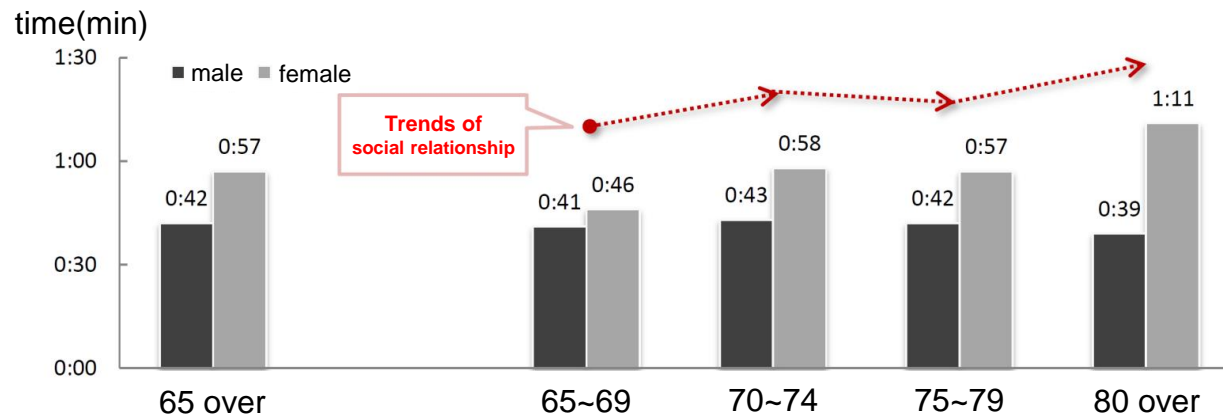
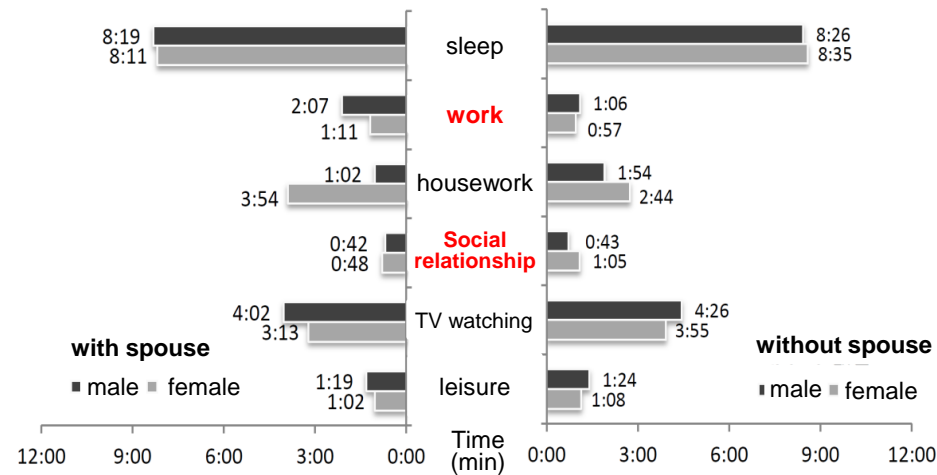
- Problems related to Elderly → “Limiting their mobility”
 - *Physical weakness* → reduction of visual acuity, hearing ability, perception-response ability → driving disabilities → driving cessation → *less movement*
 - *Retirement (income reduction)* → suburban living (social exclusion, isolation) → restricted mode choice (not use taxi) → *Intermittent movement*
 - *Poor public transportation service* (2~3 times per day in rural area) → *Intermittent movement*



Reference : Statistics Korea, “2015 Elderly statistics”, 2015.9

- Happiness conditions (A. Adler, Psychologist)

- Work, Love, Social relationship → **Mobility Right must be secured**



Reference : Statistics Korea, "2015 Elderly statistics", 2015.9

Laws & Regulations for Mobility Right of Elderly

- Act on the support and promotion of utilization of mass transit system
 - Provides matters necessary to systematically cultivate public transportation
→ convenience of transportation & the efficiency of transportation systems
 - Master plan (local public transportation plan) → every five years
 - Basic directions for and objectives of public transportation policies
 - Current state and target of rate of public transportation volume share

2009	2016		2030	
(2008 baseline)	Prediction	target	prediction	Target
40.9%	41.3%	47%	41.8%	52%

Reference : MOLIT, the 2nd master plan for public transportation, 2011.3

- Matters concerning the improvement and expansion of public transportation facilities and means of public transportation
- Matters concerning public transportation information, the encouragement of car owners to use public transportation, the improvement of connectivity between the use of bicycles and the use of public transportation
- Matters concerning the enhancement of convenience of public transportation use for residents in agricultural and fishing villages and secluded areas

- Act on promotion of the transportation convenience of mobility disadvantaged persons

- Expanding convenient mobility equipment
- Improving the pedestrian environment

Promotion of social participation
of mobility disadvantaged persons
and of their welfare

- Master plan (local public transportation plan) → every five years
 - Basic **direction, objectives, policies**
 - **Actual state** of installation and management of convenient mobility equipment, and pedestrian environment
 - Matters concerning the improvement and expansion of convenient mobility equipment, the introduction of **low-floor buses**, the improvement of the pedestrian environment, the introduction of **special means** of transportation, the expansion of **the right** to transportation of mobility disadvantaged persons
- Pedestrian priority zones
 - Mayor(gun) may designate a specific section of road as a pedestrian priority zone
→ safe and convenient pedestrian environments
 - The State may **wholly or partially subsidize** the expenses

● Passenger transport service act

- Establishing order in passenger transport services
- Striving for the smooth transport of passengers
- Overall development of passenger transport services
- Types of passenger transport business & License
 - (Bus) Route passenger transport business, (Taxi) Area-passenger transport → Minister of MOLIT → “registration license”
 - (DRT) **On-demand passenger transport business** (Business that transports passengers by using, **as the first or last stop, an agricultural or fishing village** and by operating lines, time and frequencies of transport flexibly upon request of passengers) → “Mayor/Do governor” → **“restricted license** (restrictions on the scope or period of the passenger transport business)”
- Financial support (**may** subsidize **some**)
 - Operation of unprofitable routes → “The state”
 - On-demand passenger transport business → “Mayor/Do governor”

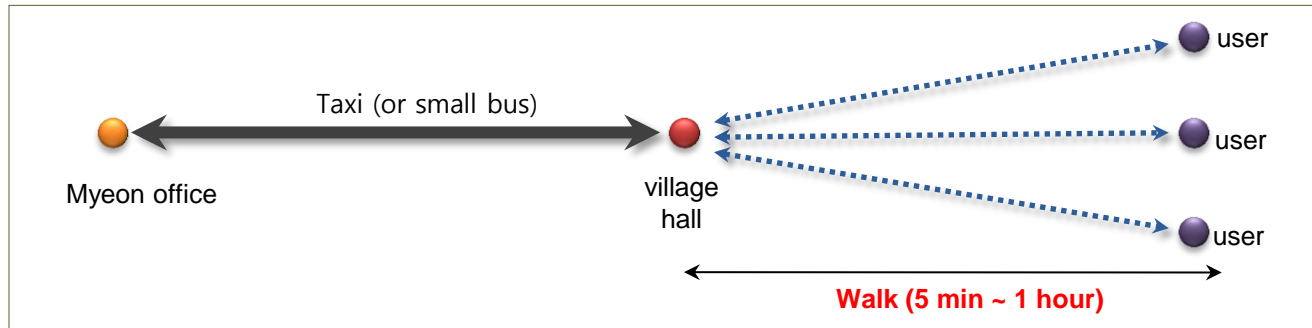
Promotion of public welfare

Cases for Mobility Right of Elderly

Case1 : Rural Transport Models

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- MAFRA (Ministry of Agriculture, Food and Rural Affairs)
 - Improving the mobility of rural areas with poor transport service



Type	Local government	Starting date	Schedule	Operating vehicle	Service frequency	Fare (won/person)	Service scope	
							Myeon(ri)	Village
Bus (van)	Hongchun-gun	15.12.01	Fixed	1	6 times/week	1,200	17	-
	Cheongju-si	15.07.01	Fixed	1	10 times/day	500	5	5
	Changnyeong-gun	15.08.01	Fixed	1	13 times/day	500	31	-
Taxi	Gochang-gun	15.04.01	Fixed	-	12 time/month	1,000	12	30
	Haenam-gun	15.03.01	Call	55	4 times/month/person	100	11	31
	Bonghwa-gun	15.01.01	Fixed	65	16 times/month/village	1,200	10	80
	Uiryeong-gun	15.05.01	Fixed	67	24 times/month/village	1,200	7	22
	Hapcheon-gun	15.01.20	Call	94	24 times/month/village	1,000	12	27

Case1 : Rural Transport Models

Classification		Before	After	note
Number of users (persons)		-	5,041.9	-
Satisfaction of public transportation service (point)		39.6	86.7	47.2 point increase
Number of passengers (persons/vehicle)	Taxi model	-	2.03	-
	Bus model	-	2.77	-
Number of visitors (persons/month) → Activation of regional economy	-	3.0	4.5	50.0% increase
Trip number of users (number/person·month) → Promotion of social relationship → Activation of regional economy	-	5.3	9.3	75.5% increase
Travel convenience for shopping (point) → Promotion of mobile welfare	-	40.1	83.5	108.2% increase

Reference : MAFRA, "Monitoring the 2nd rural transport model", final report, 2015.12, reconstitution

Case2 : DRT (Haenaru happy bus)

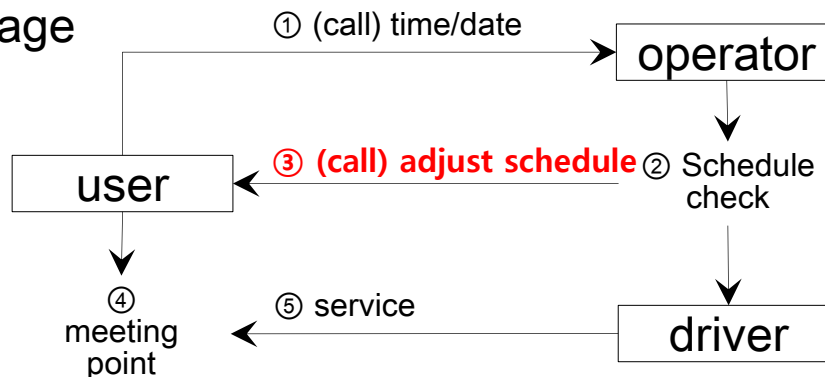
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● DRT pilot project (Chungcheongnam-do)

- Purposes : improvement of mobility and replacement of the existing bus
- Study area : Daehoji-myeon (5 ri)
- Operation scope : 5 ri ↔ myeon office
- Operation period : Mon. ~ Sat.(08:00~19:00)
- Fare : 1,300 won (same as the existing bus)
 - Coupon : 1,200 won (100 won discount)
 - Free transfer at myeon office

■ Vehicle(van with 12 seats)

■ Usage



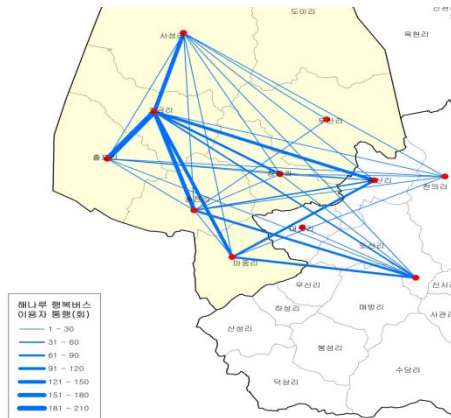
Case2 : DRT (Haenaru happy bus)

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● Improvement of mobility

Various trip patterns

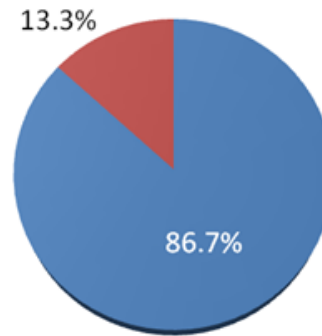
→ Promotion of communication between villages



Trip number of users

→ Promotion of social relationship
 → Activation of regional economy

■ increase ■ monotonic

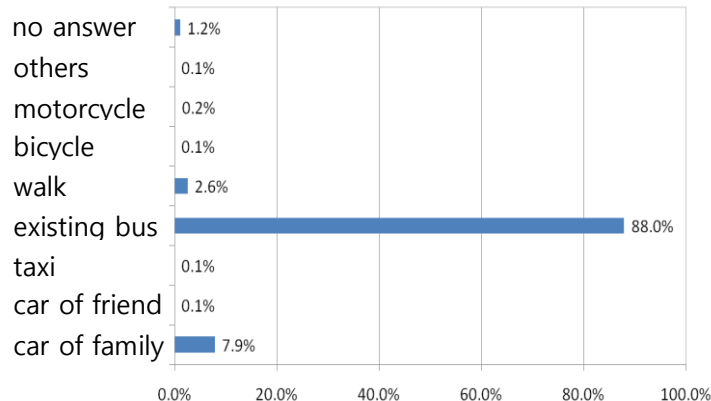


Desired fare

→ Possible to profitable operation

Desired fare	ratio
1,300 won	52.5%
1,350 won	0.6%
1,400 won	12.2%
1,500 won	31.5%
1,600 won	0.6%
2,000 won	2.2%
2,500 won	0.6%

● Possibility of replacement of the existing bus



Period of observation	Passengers in the route bus service time (person)								Total (person)
	06:55	07:15	08:05	09:25	13:25	15:25	15:55	19:25	
Feb. 2.07~2.13	59	16	154	140	70	15	29	1	484
Mar. 3.14~3.20	79	10	144	87	44	16	28	1	409
Apr. 4.18~4.24	88	11	157	112	62	18	40	6	494
May. 5.23~5.29	51	7	153	83	60	10	31	8	403
Jun. 6.20~6.26	60	14	125	85	47	15	21	3	370
Rate of change (%)	0.00	-0.03	-0.05	-0.12	-0.09	0.00	-0.08	0.32	-0.06

Suggestions

- **Limitations**

- Fewer users (financial support from local government)
- Lower revenue (100won/trip)
- Inconvenient reservation system (by call)

- **Sustainability**

- Private sector → Public sector
- Realistic Fare (at least similar to BUS fare)
- Smart reservation system (APP)

Thank you for your attention!



日本地方都市における 移動手段確保のための 自家用車活用について

2018年9月11日
金載烈



CONTENTS

- 01 ︳ はじめに
- 02 ︳ シェアリングエコノミー（ライドシェア）の動向
- 03 ︳ 日本政府の政策動向
- 04 ︳ 自家用車を活用したライドシェア事例
- 05 ︳ まとめ



01 はじめに

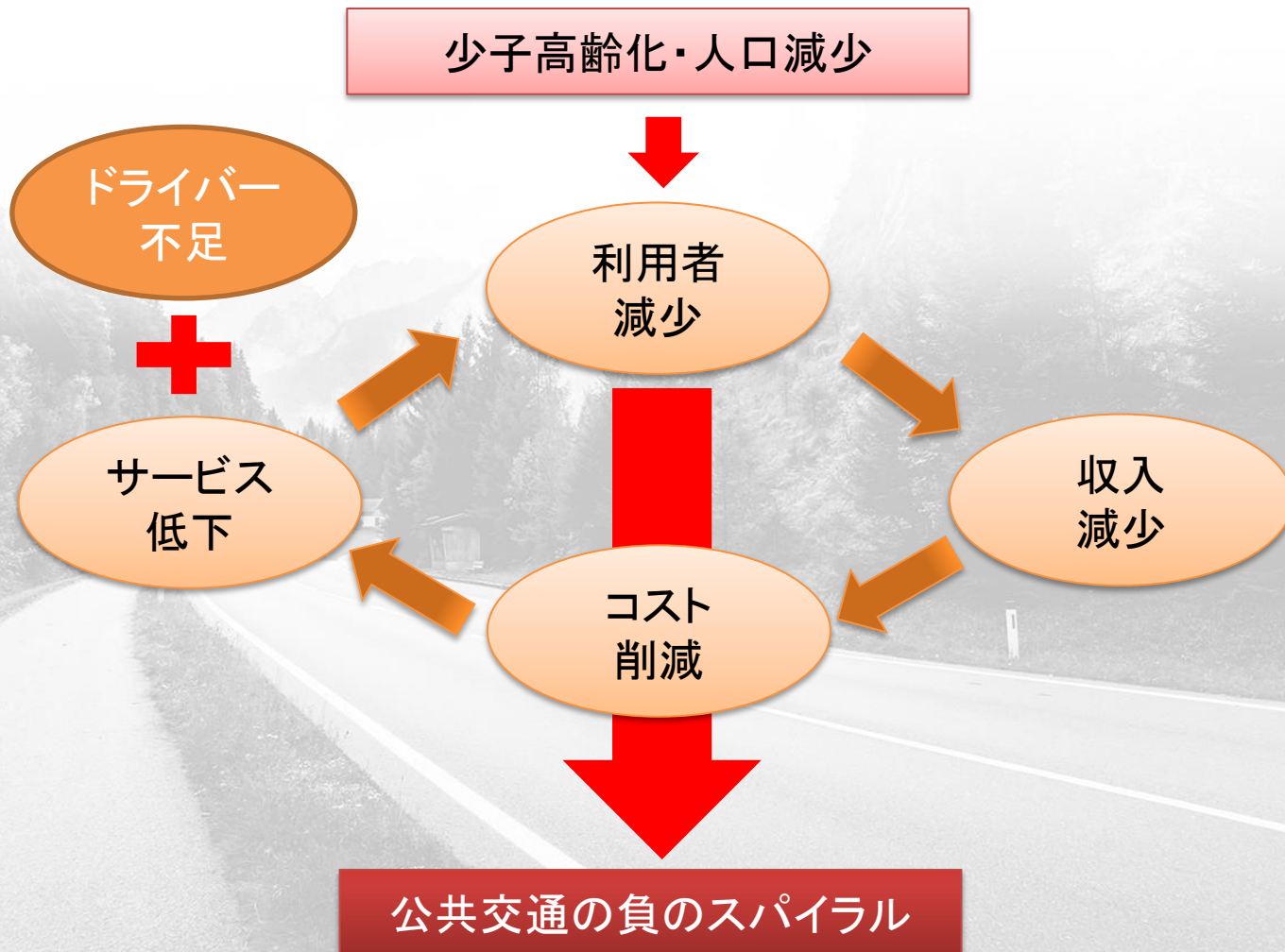
1. 公共交通の負のスパイラル
2. 公共交通空白地域の拡大





公共交通の負のスパイラル

少子高齢化・人口減少・ドライバーの不足に伴い、路線バスの維持が困難になり、廃止や減便による公共交通の負のスパイラルに陥っている。





公共交通空白地域の拡大

- 2007年度以降で、14,795kmのバスの路線が廃止。
(全国のバス路線合計41万7,400km(2009年度末)の約3.5%を占める。)
- 公共交通空白地域の拡大が深刻化している状況。

年度	廃止されたバス路線キロ
2006	2,999
2007	1,832
2008	1,911
2009	1,856
2010	1,720
2011	842
2012	902
2013	1,143
2014	1,590
合計	14,795km

	空白地面積	空白地人口
条件1 バス 1km 鉄道 1km	17,084km ² (14.2%)	236.2万人 (1.8%)
条件2 バス 600m 鉄道 1km	30,122km ² (25.0%)	531.1万人 (4.2%)
条件3 バス 500m 鉄道 1km	36,477km ² (30.3%)	735.1万人 (5.8%)
条件4 バス 300m 鉄道 500m	62,982km ² (52.2%)	2,651.0万人 (20.7%)
日本全体	120,544km ²	12,776.8万人
※韓国面積は、100,363km ² ※空白地面積は居住地メッシュのみ。0.25km ² /メッシュとして算出。		



02 シェアリングエコノミー(ライドシェア)の動向

1. シェアリングエコノミー協会設立 (2015)
2. 日本のライドシェアサービス
3. 自家用有償旅客運送事業者向け自動車保険の販売開始
4. ライドシェア新法
5. 1.5種免許





シェアリングエコノミー協会設立(2015)

- シェアリングエコノミー(共有経済)とは
場所・乗り物・モノ・人・お金などの遊休資産をインターネット上のプラットフォームを介して個人間で貸借や売買、交換することでシェアしていく新しい経済の動き
- 2016年1月15日、**各シェアリングサービスの普及、業界の健全な発展**を目的とする一般社団法人シェアリングエコノミー協会が設立
 - ✓ すべての人が様々なカタチで、経済行為に参加できる社会の実現
 - ✓ 新しい経済行為を活性化させ、日本経済全体の発展に寄与すること
 - ✓ プラットフォーム事業者の健全なるビジネス環境と利用者保護体制の整備
- 協会は、シェアサービスガイドライン作成などを視野にいれつつ、以下の活動を行うことでシェアリングサービス市場の活性化に取り組んでいる。



❖ 活用内容

1. シェアリングエコノミー普及活動
既存事業者、及びユーザーへの普及活動を実施
2. 事業者間の交流・勉強会
ユーザー活用事例や運営ノウハウ共有など実行
3. 会員向けサービスの提案と開発
協会団体保険、シェアリングエコノミーに特化した保険の提案など



日本のライドシェアサービス

- シェアリングエコノミー市場の中核を占めるのがライドシェア市場の急伸
(**ライドシェアの経済効果: 約3.8兆円**)
- 自動運転車とユーザーマッチングの仕組みは、ライドシェアと共通性があるため、ライドシェアで蓄積したデータは自動運転にも生かされる。



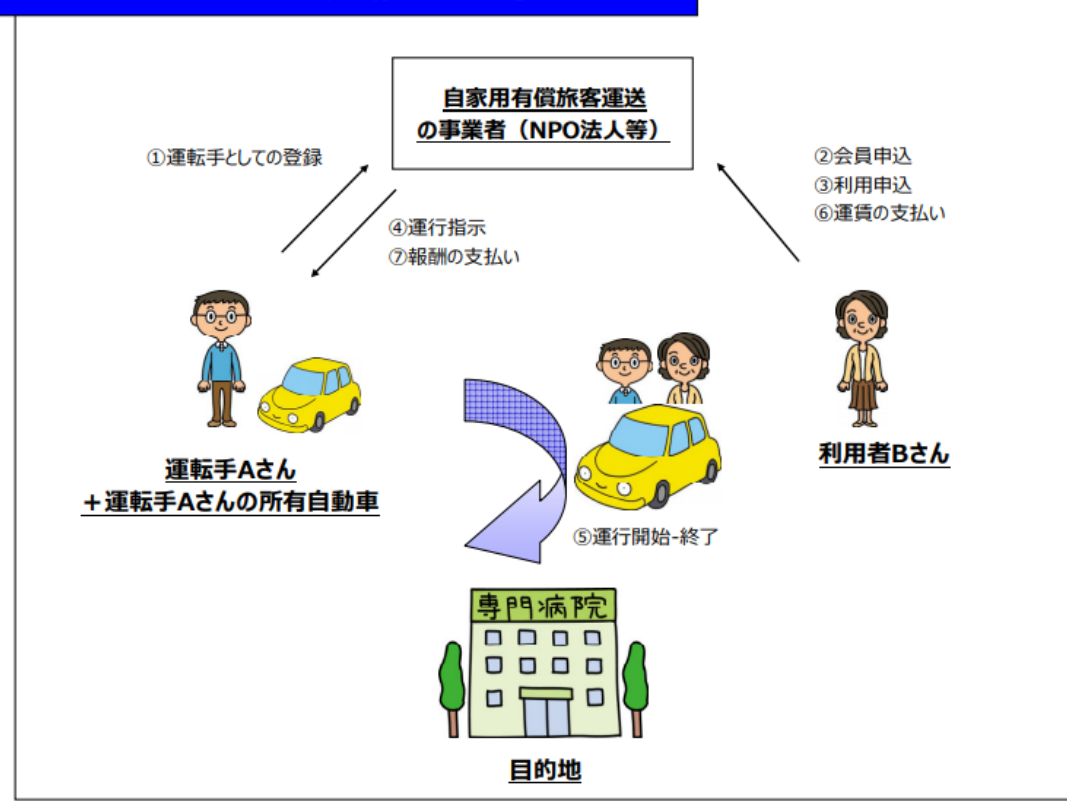


自家用有償旅客運送事業者向け自動車保険の 販売開始

東京海上日動火災保険、三井住友海上は、バス・タクシーによるサービスが提供されない地域(「公共交通空白地」)における「自家用有償旅客運送」の利用拡大を受け、「自家用有償旅客運送」の事業者向け自動車保険を新たに開発し、販売開始中。

- 一般的に事故発生時、運転者が加入している自動車保険を使用するが、運転者の自動車保険で補償が不十分のため、事業者も損害賠償を負担しなければならない場合に「自家用有償旅客運送事業者向け自動車保険」で補償を受けることが可能である。
- 具体的に本保険でお支払いが想定されるのは以下の通りです。
 - 損害賠償責任額が運転手本人の自動車保険でお支払できる限度額を超過する場合
 - 運転手本人の保険加入が漏れているなど、運転手が損害賠償責任額を支払うことができない場合等

持込み自動車を活用した「自家用有償旅客運送」のイメージ図





ライドシェア新法

- 一般社団法人 新経済連盟は、2018年5月に**国土交通大臣、経済産業大臣、規制改革担当大臣、情報通信技術政策担当大臣、経済再生担当大臣**宛てに下記の「ライドシェア新法」の提案を提出
 - 1) 訪日外国人の増加や人手不足(2025年までにタクシー運転手10万人の減少)などにより、ライドシェア導入の必要性が存在
 - 2) プラットフォームとドライバー双方に責任を課す制度設計により安全性の担保は可能
 - 3) 政府は、速やかにライドシェア新法策定に向けた議論を開始すべき

①需給構造の変化

②観光立国

③経済効果

④生産性向上/
一億総活躍

⑤消費者利便性

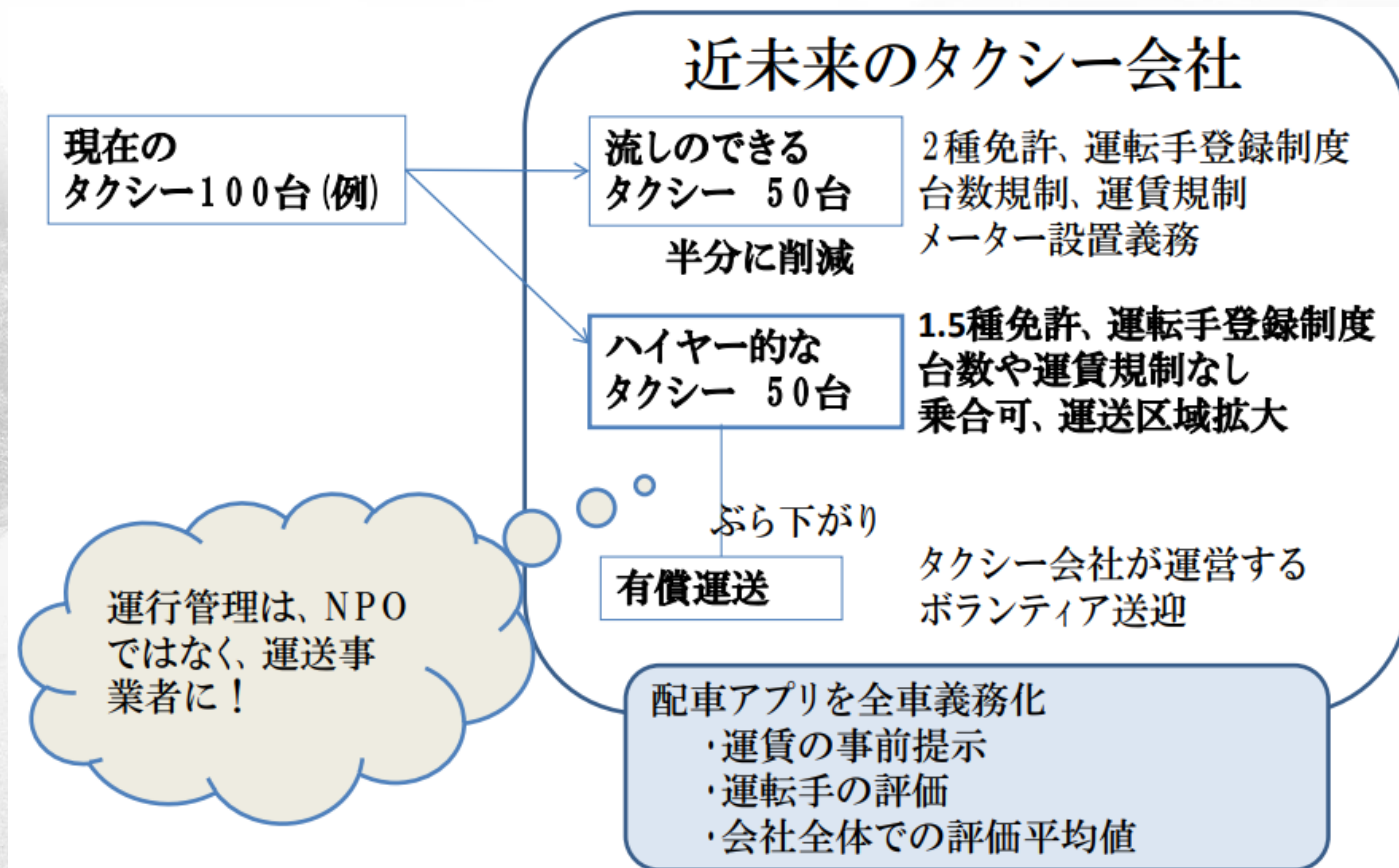


ライドシェア導入の必要性



1.5種免許

- 有限会社 三ヶ森タクシー貞包健一代表取締役、安全性や事故の補償が十分担保されていないもライドシェアの上陸は断固反対。
- しかしながら、ライドシェアの良さを研究し、取り入れるべきものは積極的に取り入れ、日本のタクシーをより良くしていくべき。





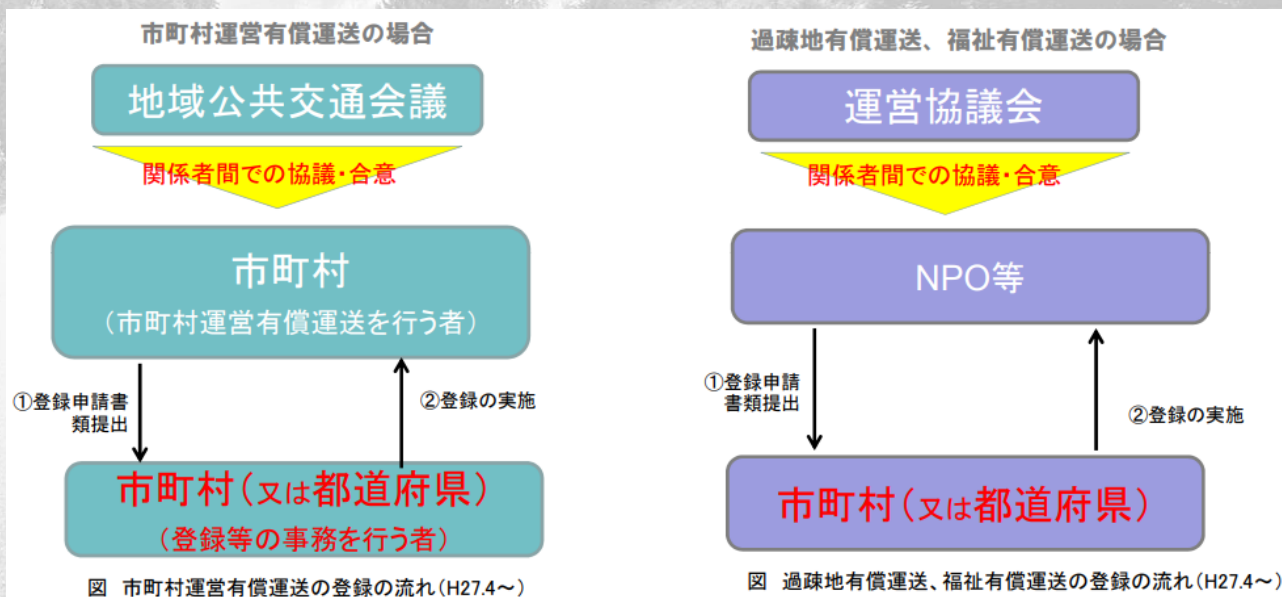
03 日本政府の政策動向

1. 自家用有償旅客運送の
事務・権限の移譲
2. 過疎地有償旅客運送
サービスの改称
3. 自家用有償旅客運送事務実施
マニュアル、自家用有償旅客運送
ハンドブックの作成
4. 貨客混載の規制緩和



自家用有償旅客運送の事務・権限の移譲

- 過疎地域の移動手段、介護等福祉を支える輸送といった地域住民の生活維持に必要な自家用有償旅客運送に関する事務・権限については、**地域で判断できる裁量を拡大するため、希望する市町村に移譲する。**
- 自家用有償旅客運送の事務・権限の移譲に際しては、**輸送の安全**を確保し、**利用者保護**を図りつつ、**地域の実情に応じた運送を実現**する観点から、以下の3点を踏まえて具体的な制度設計を行う必要がある。
 - 地域の特性や利用者のニーズに応じた輸送が実現されること
 - 地域の幅広い関係者の意見を反映できる仕組みを充実させること
 - 市町村が事務・権限を担う際に、必要な輸送の安全確保が担保されること
- 事務・権限の移譲により、**登録の申請先が市町村または都道府県**とすることが可能となる。





過疎地有償旅客運送サービスの改称

- 「過疎地に限らず、都市部でもバス・タクシーの運行が困難で、有償運送が必要なエリアが存在する実態がある」ため、2015年4月1日から過疎地有償旅客運送サービスの名称を「**交通空白地有償運送**」に変更

- 実施主体の弾力化 → 法人格がなくても運行できるようになる。
- 旅客の範囲の拡大 → 地域住民や利用者名簿に登載していない人も利用可能になる。
(訪問者や観光客なども利用可能)



東京交通新聞 2015.1.19号

NPOボランティアなど自家用車による過疎地有償旅客運送サービスの法令上の名称が4月1日、「交通空白地有償運送」に改められる。国土交通省は道路運送法施行規則(省令)を来月中旬に改正し、制度創設以来初の種別の名称変更に踏み切る。過疎集落に限らず、都市部でもバス・タクシーの運行が困難で、有償運送が必要なエリアが存

過疎地有償運送の名称

「交通空白地」に変更

国交省令案 対象客拡大も

在する実態を踏まえた。旅客の範囲と運送団体の国交省は「希望する市町村・都道府県」を対象とした4月開始の地方分権に併せ、全国一律の登録要件を緩和・弾力化する考え。昨年4月の「有償運送事務・権限の地方移譲あり方検討会」(座長||後藤春彦・早稲田大学創造理工学部長)の最終取りまとめをベースに、8日付で省令案の概要を策定した。

「希望する市町村・都道府県」を対象とした4月開始の地方分権に併せ、全国一律の登録要件を緩和・弾力化する考え。昨年4月の「有償運送事務・権限の地方移譲あり方検討会」(座長||後藤春彦・早稲田大学創造理工学部長)の最終取りまとめをベースに、8日付で省令案の概要を策定した。

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自家用有償旅客運送事務実施マニュアル、 自家用有償旅客運送ハンドブックの作成

















- 国土交通省自動車局旅客課は、新たに「自家用有償旅客運送」の事務・権限を担おうとする**市町村等の業務が円滑に進むように手続きや関係者の合意形成方法**を分かりやすく解説する**マニュアルやハンドブック**を作成

自家用有償旅客運送事務実施マニュアル (2015)	自家用有償旅客運送ハンドブック (2018)
<ul style="list-style-type: none">I. 自家用有償旅客運送について<ul style="list-style-type: none">1. 自家用有償旅客運送の概要2. 自家用有償旅客運送の種別3. 登録の流れ4. 対価についてII. 自家用有償旅客運送の事務・権限の移譲について<ul style="list-style-type: none">1. 移譲される事務の概要2. 事務・権限の移譲の基本的な考え方III. 自家用有償旅客運送者の登録に係る事務手続きについて<ul style="list-style-type: none">1. 登録について2. 届出対応3. 是正措置命令・業務停止命令・登録の取消し4. 報告、検査及び調査(法第 94 条)	<ul style="list-style-type: none">I. 自家用有償旅客運送について<ul style="list-style-type: none">1. 自家用有償旅客運送とは2. 自家用有償旅客運送を実施する者3. ニーズに応じた自家用有償旅客運送の種類4. 自家用有償旅客運送の登録の流れII. 地域における関係者の合意<ul style="list-style-type: none">1. 地域公共交通会議、運営協議会2. 合意の方法3. 協議における留意点4. 地域の関係者の役割III. 道路運送法に基づく登録(登録等の手続き)



貨客混載の規制緩和

- 旅客運送・貨物輸送分野におけるドライバーの人手不足が言われる中、政府はこれまで乗客と貨物に分けてきた運送事業のあり方を転換して、2017年9月1日からバス、タクシー、トラックが旅客と貨物を同時に運ぶことができるように規制を緩和した。
- 今回の規制緩和を通じてドライバーの人手不足という問題の解決と、公共交通機能が低下している過疎地域の公共交通に新たな事業展開の道を開き、路線を維持できるようにすることを大きな期待としている。

	以前の状況	規制緩和後
乗合バス	350kg 未満 の貨物運送可 (道路運送法第82条)  	350kg 以上 の貨物運送を可能とする ● 貨物自動車運送事業の許可取得が必要 ● 350kg以上は貨物の運行管理者の選任が必要   
貸切バス	旅客運送に特化 	過疎地域に限り貨物運送を可能とする ● 貨物自動車運送事業の許可取得が必要 ● 貨物の運行管理者の選任が必要   
タクシー	旅客運送に特化 	
トラック	貨物運送に特化 	過疎地域に限り旅客運送を可能とする ◇ 旅客自動車運送事業の許可取得が必要 ◇ 旅客の運行管理者の選任が必要   
自家用有償旅客運送者	過疎地域に限り自家用自動車で350kg未満の貨物運送が可能 (道路運送法第78条第3号の許可取得が必要) *例：自家用有償旅客運送者＝京丹後市丹後町の「ライドシェア」など(Traffi-Cation No.45 / 2017年・夏号)	 

過疎地域：人口3万人に満たない地域



04 自家用車を活用したライドシェア事例

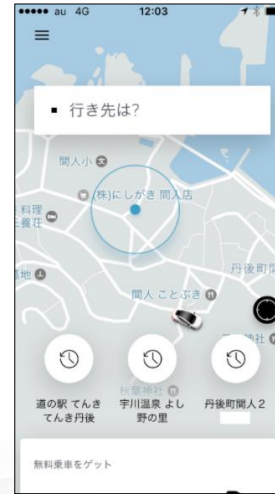
1. (Uber) 丹後町のささえ合い交通
2. (notteco) 天塩町～稚内市の相乗り交通
3. (Fujitsu) 福島県伊達市の支え合い交通





(Uber) 丹後町のささえ合い交通

- 運行主体：NPO法人 気張る！ふるさと丹後町
- 運行区域：乗車は丹後町のみ、降車は京丹後市全体
- 運賃：最初の1.5kmまで480円、以遠は120円/kmを加算（概ねタクシー料金の半額）
- 支払方法：当初は「クレジットカード支払い」のみであったが、2016年12月21日から利用時に即「現金支払い」も可能となった。
- 運行時間：午前8時～午後8時（年中無休）
- 配車方法：スマートフォンでUber（ウーバー）のアプリを使って即時配車（事前予約は不可）。2016年9月18日から代理サポーターが利用者に代わって配車も可能となった。
- ドライバー：地元住民（18名、ボランティア）
- 車両：ドライバーが所有する自家用車（マイカー）を利用
- 認可標示：各車両の側面に認可標識を標示
- 利用者：丹後町住民、観光客等来訪者



ウーバーアプリの配車依頼画面



業務中のドライバー（オレンジ色のベストを着用）



・車内に運転者証を掲示



・全車両にドライブレコーダーを設置



・運賃表の車内掲示



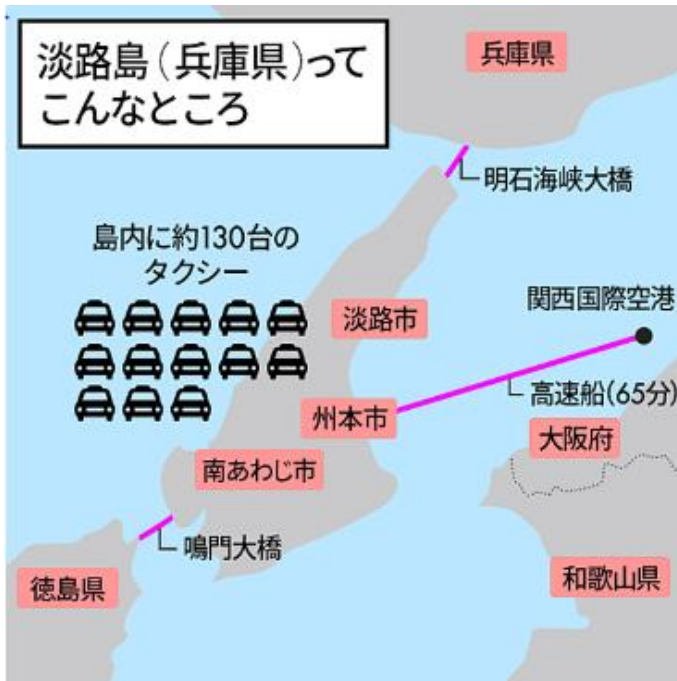
・毎朝の対面チェックの実施



(ご参考)

Uberアプリを活用した淡路島のタクシー配車

- 配車区域：原則として淡路島内での乗降車（島内から乗車し島外での降車は可）
- 実証実験期間：2018年7月～2019年3月31日
- タクシー事業者：淡路島内タクシー事業者から公募
- 利用対象者：観光客を含む来島者全般および淡路地域住民を含む全て





(notteco) 天塩町～稚内市の相乗り交通

- 北海道天塩町人口は、約3,200人、面積は353.3km²
- 1955年人口は、1万人
→ 60年後1/3に減少
(少子高齢化)
- 町民の生活圏(総合病院・商業施設など)は、**70km離れた「稚内市」**
- 「空席があり移動するクルマ」に相乗りして移動する仕組みを検討した結果、天塩町では、**「コストシェア型」のライドシェア(相乗り)**を選択



バスと鉄道を乗り継ぐと片道約**3時間**かかる (日帰り往復不可)

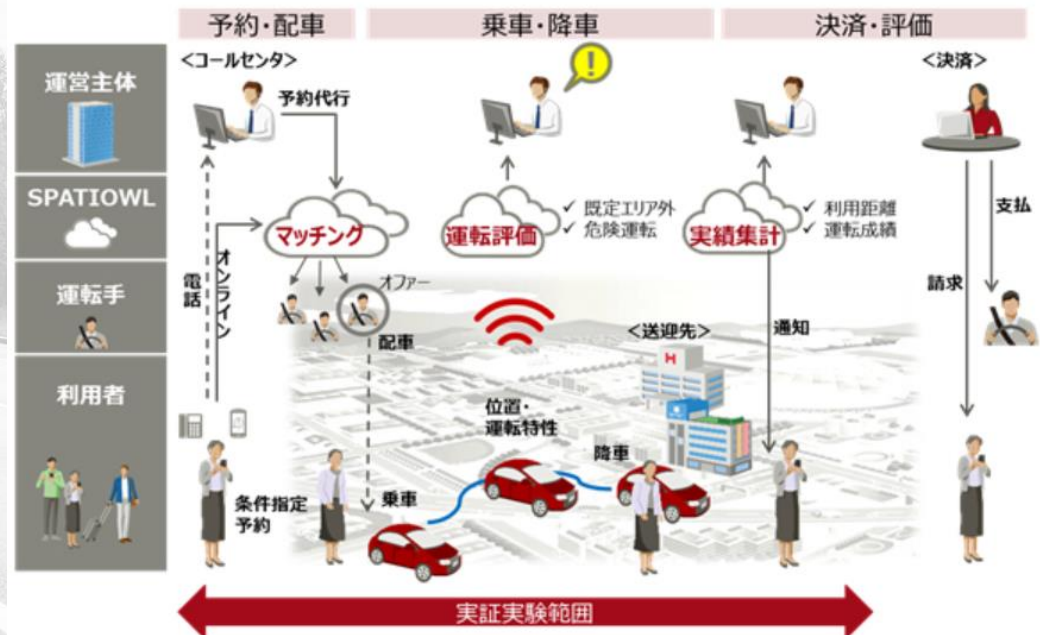
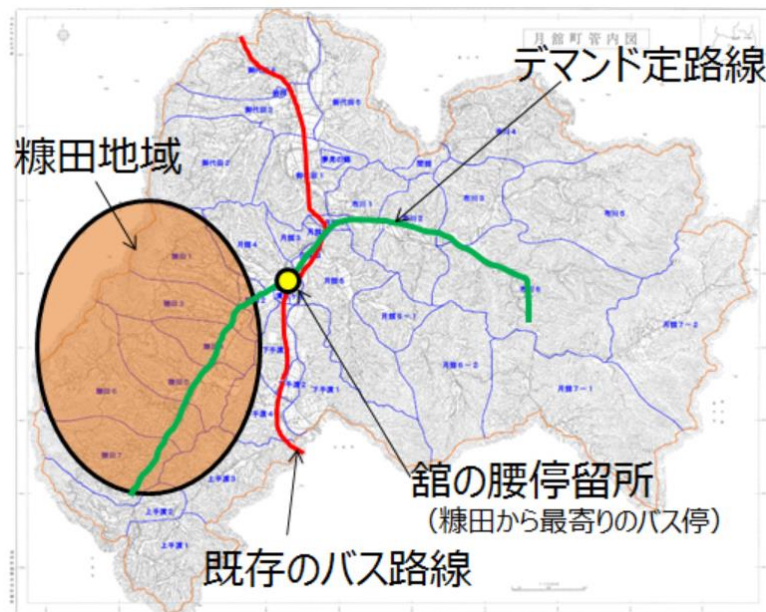
	コストシェア型	オンデマンド配車型
料金体系	実費に基づき算出	ドライバーに運賃支払い
運行距離	長距離中心	短距離中心
予約の可否	○	×
サービスの例	BlaBlacar	Uber



(Fujitsu) 福島県伊達市の支え合い交通

- 予め登録された運転手となる地域住民の送迎可能な時間や現在位置と、移動を希望する利用者ごとの **目的地から最適な車両をマッチングさせ、利用者に効率的かつ安全な乗合送迎サービス**を提供し、その有効性を検証
- 送迎車両には、位置や速度などのデータを収集する端末を取り付け、アクセルやブレーキの操作など、様々な視点から分析した **安全運転評価データ**を作成し、このデータの有効性も評価

■運転評価デバイス





05 まとめ





自家用車有償旅客運送の成功ポイント

- 国土交通省は、『**今後の共助による地域づくりのあり方検討会**』などを通じて、過疎・中山間地域の交通・物流の確保に向けて自家用有償旅客運送や貨客混載に係る制度を活用するなど、**シェアリングによる合理化・効率化の可能性を検討している**。
- 公共交通空白地有償運送を導入する地域は、基本的にバス・タクシー事業において、交通サービスを確保することが困難な地域であり、**地域の実態を正確に把握した上で導入を判断する**。
- 公共交通空白地有償運送による移動手段の確保が望ましいとなった場合、住民、交通事業者及び市町村の相互間で**課題を共有**し、それぞれが果たすべき**役割を整理、分担**する必要がある、その上で、**交通事業者との間で合意形成**を図る。
既存の交通事業者との調整には、下記の方法が活用できる。
 - 既存の公共交通機関と運行区間が重ならないようにする
 - サービスを提供する曜日や時間帯を他の公共交通機関と分担する
 - 運行区間が重なる既存の公共交通機関の運賃よりも運送の対価を高く設定する
- 運転者の確保は、高齢の運転者だけではなく、**若者や女性の活用**など、**短時間でも活動**できるような仕組みが必要である。
- 多くの利用者に利用してもらえるような広報活動も重要である。**サービスを本当に必要としている人に情報が届くよう、広報活動を積極的に行う**必要である。



参考文献

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- 自家用有償旅客運送者による過疎地域等における少量貨物の有償運送に係る道路運送法第78条第3号に基づく許可に係る取扱いについて, 2016
- 東京海上日動火災保険ホームページ (<http://www.tokiomarine-nichido.co.jp/>)
- 新経済連盟提言「シェアリングエコノミー活性化に必要な法的措置に係る具体的提案」(2015年10月公表)
- 有限会社 三ヶ森タクシー代表取締役 貞包健、一多様な運転手が旅客運送サービスを提供する新たなタクシー事業の実現、2017
- 伊達市と富士通、遊休車両を有効活用した乗合送迎サービスの実証実験を開始 (<http://pr.fujitsu.com/jp/news/2018/01/17.html>)
- 天塩～稚内「相乗り交通」取り組み (https://www.kantei.go.jp/jp/singi/it2/senmon_bunka/shiearingu/dai8/shiryoku8-7.pdf)
- 国土交通省自動車局旅客課, 自家用有償旅客運送ハンドブック, 2018
- 国土交通省自動車局旅客課, 自家用有償旅客運送事務実施マニュアル, 2015
- 岡山県、公共交通空白地有償運送の導入検討の手法

A scenic photograph of a winding asphalt road through a mountainous landscape. The road curves from the bottom left towards the right. On the right side of the road, there is a steep, rocky hillside covered with dense green vegetation and trees. In the background, more mountain peaks are visible under a hazy, yellowish sky. On the left side of the image, there is a large, white, semi-transparent circular graphic that partially obscures the road and the sky. The text 'THANK YOU' is written vertically inside this circle.

THANK YOU

金載烈(キムゼヨル) 連絡先 :
jae1025@gmail.com



일본 지방도시의 이동수단 확보를 위한 자가용차 활용에 대해서

2018년 9월 11일

김 재열



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03 | 일본 정부의 정책 동향

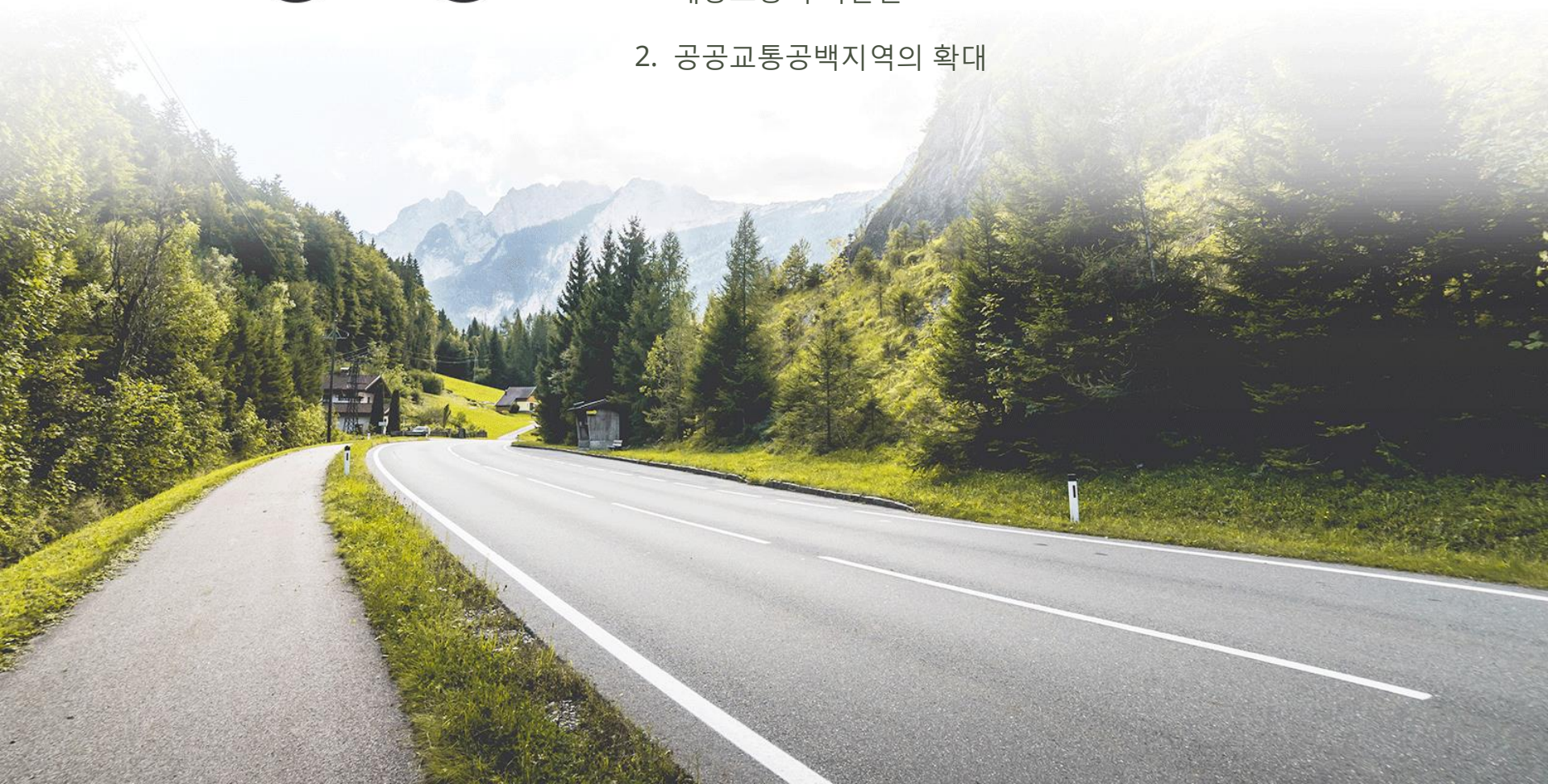
04 | 자가용을 활용한 라이드셰어 사례

05 | 결론



01 서론

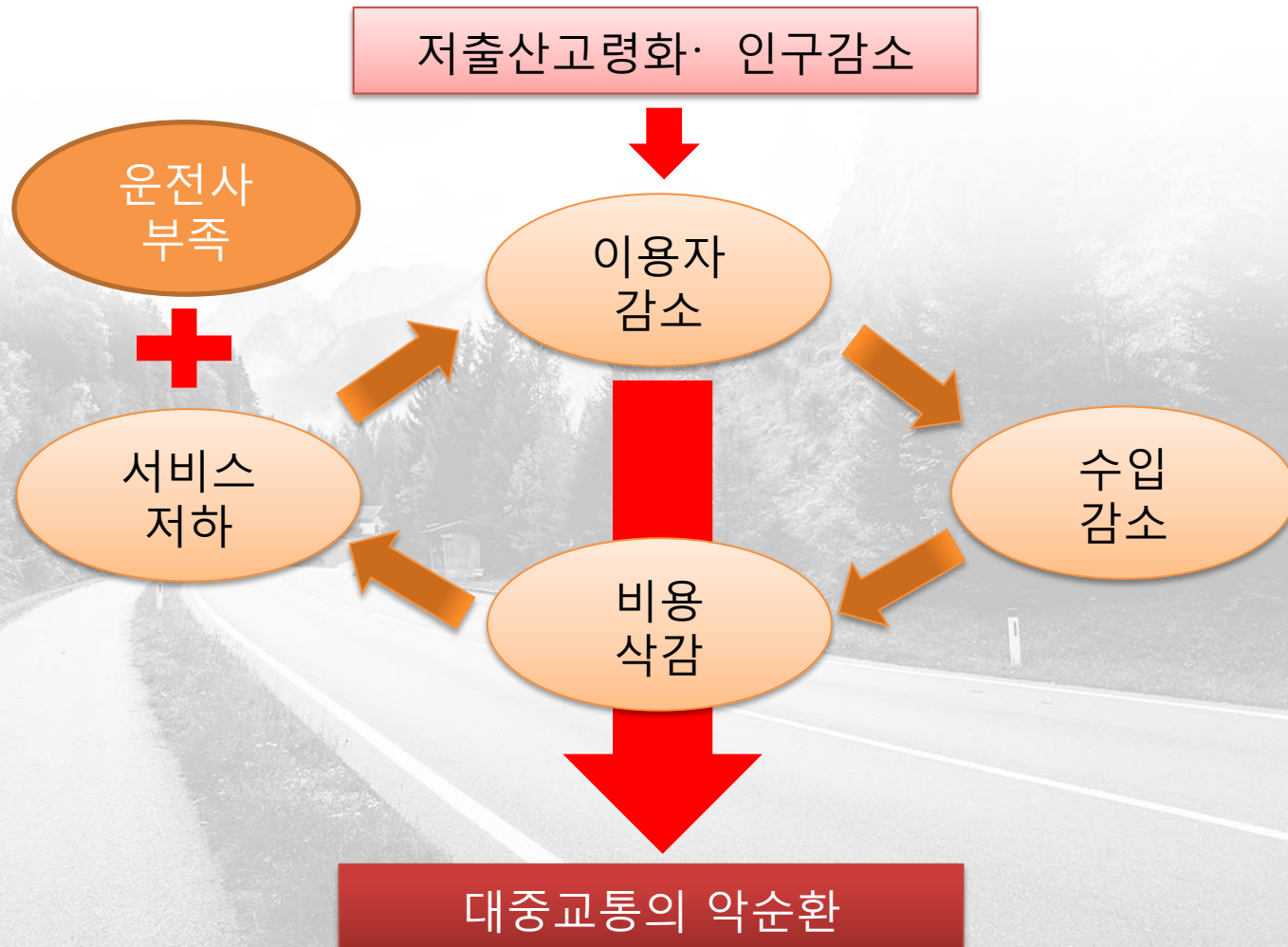
1. 대중교통의 악순환
2. 공공교통공백지역의 확대





대중교통의 악순환

저출산고령화·인구감소·운전사의 부족에 따라 노선버스의 유지가 어려워지면서 노선폐지와 감편에 따른 대중교통의 악순환이 반복되고 있다.





공공교통공백지역의 확대

- 2007년 이후, 14,795km의 버스노선이 폐지.
(전국 버스노선 총 41만 7,400km(2009년 말)의 약 3.5%를 차지)
- 대중교통공백지역의 확대가 심각한 상황.

년도	폐지된 버스의 노선거리(km)
2006	2,999
2007	1,832
2008	1,911
2009	1,856
2010	1,720
2011	842
2012	902
2013	1,143
2014	1,590
합계	14,795km

	공백지역면적	공백지역인구
조건1 버스 1km 철도 1km	17,084km ² (14.2%)	236.2만 명 (1.8%)
조건2 버스 600m 철도 1km	30,122km ² (25.0%)	531.1만 명 (4.2%)
조건3 버스 500m 철도 1km	36,477km ² (30.3%)	735.1만 명 (5.8%)
조건4 버스 300m 철도 500m	62,982km² (52.2%)	2,651.0만 명 (20.7%)
일본 전체	120,544km ²	12,776.8만 명
※우리나라 면적은 100,363km ² ※공백지역면적은 거주지매쉬만 합산. 0.25km ² /매쉬로 산출		



02 쉐어링에코노미(라이드쉐어)의 동향

1. 쉐어링에코노미협회 설립 (2015)
2. 일본의 라이드쉐어서비스
3. 자가용 유상여객운송사업자를 위한 자동차 보험 판매 개시
4. 라이드쉐어신법
5. 1.5종 면허





쉐어링에코노미협회 설립(2015)

- **쉐어링에코노미(공유경제)란?**
장소 · 차량 · 물품 · 재능 · 자금 등의 유희자산을 인터넷상의 플랫폼을 통하여 개인 간에 대여,매매, 교환으로 공유하는 새로운 경제 움직임
- 2016년 1월 15일, **공유서비스의 보급과 산업의 건전한 발전**을 목적으로 일반사단법인 쉐어링에코노미협회가 설립 됨
 - ✓ 모든 사람이 다양한 형태로 경제활동에 참여할 수 있는 사회를 실현
 - ✓ 새로운 경제활동을 활성화시켜 일본경제 전체의 발전에 기여
 - ✓ 플랫폼사업자의 건전한 비즈니스환경과 이용자보호체제의 정비
- 협회는 공유서비스의 가이드라인 작성 등을 시야에 넣어가면서 아래의 활동을 실시하여 공유서비스시장의 활성화에 노력



❖ 활동내용

1. 쉐어링에코노미의 보급 활동
기존 사업자 및 사용자를 대상으로 보급활동을 실시
2. 사업자 간의 교류· 연구회
사용자의 활용사례 및 운영노하우의 공유 등을 실시
3. 회원전용서비스의 제안 및 개발
협회단체보험, 공유경제에 특화된 보험제안 등



일본의 라이드셰어서비스

- 공유경제시장의 핵심이 되는 라이드셰어시장이 급성장 중
(**라이드셰어의 경제 효과 : 약 3.8 조엔**)
- 자율주행차량과 이용자의 매칭은 라이드셰어율과 공통성이 있기 때문에 라이드셰어에서 축적한 데이터는 자율주행에도 활용가능.

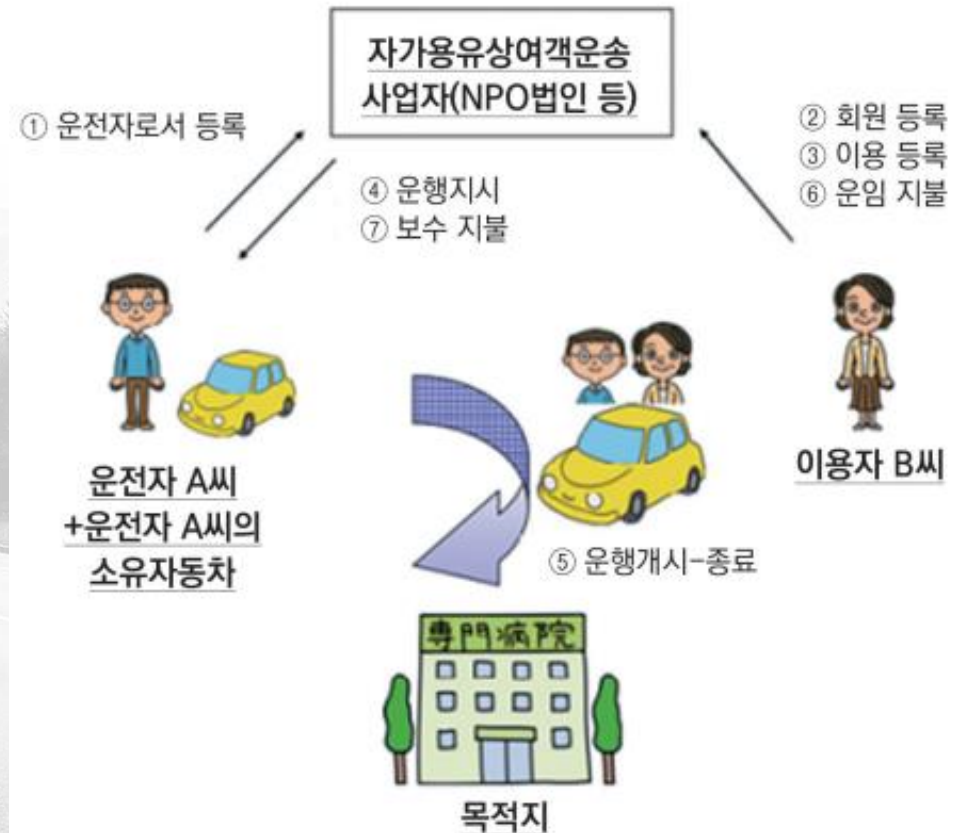




자가용 유상여객운송사업자를 위한 자동차 보험 판매 개시

동경해상일동화재보험, 미츠이스미토모해상은 버스·택시서비스가 제공되지 않는 지역(『대중교통공백지역』)을 대상으로 자가용유상여객운송의 이용 확대를 위해서 자가용유상여객운송사업자를 위한 자동차보험을 새롭게 개발하여 판매 중.

- 일반적으로 사고발생시 운전자가 가입한 자동차보험을 사용하지만, 해당 운전자의 자동차보험으로 보상이 불충분하여 사업자도 손해배상을 부담해야 하는 경우에 「자가용유상여객운송사업용 자동차보험」에서 보상을 받는 것이 가능하다.
- 구체적으로 보험의 보상을 받을 수 있는 경우는 다음과 같다.
 - 손해배상책임액이 운전자 본인의 자동차 보험에서 지불 할 수 있는 한도액을 초과하는 경우
 - 운전자가 보험에 가입되어 있지 않거나 운전자가 손해배상책임액을 지불 할 수 없는 경우 등





라이드쉐어신법

- 일반사단법인 신경제연맹은 2018년 5월에 **국토교통대신, 경제산업대신, 규제개혁담당대신, 정보통신기술정책담당대신, 경제재생담당대신**에게 아래의 『라이드 공유 신법』의 제안을 제출
 - 1) 방일외국인의 증가와 일력부족(2025년까지 택시운전자 10만 명 감소) 등으로 라이드쉐어의 도입이 필요함.
 - 2) 플랫폼과 드라이버 모두에게 책임을 부과하는 제도를 설계하여 안전을 확보하는 것이 가능함.
 - 3) 정부는 신속하게 라이드쉐어신법 제정을 위한 논의를 시작하기 바람.

①수요구조의 변화

②관광입국

③경제효과

④생산성 향상/
1억 총활약

⑤소비자의 편리성

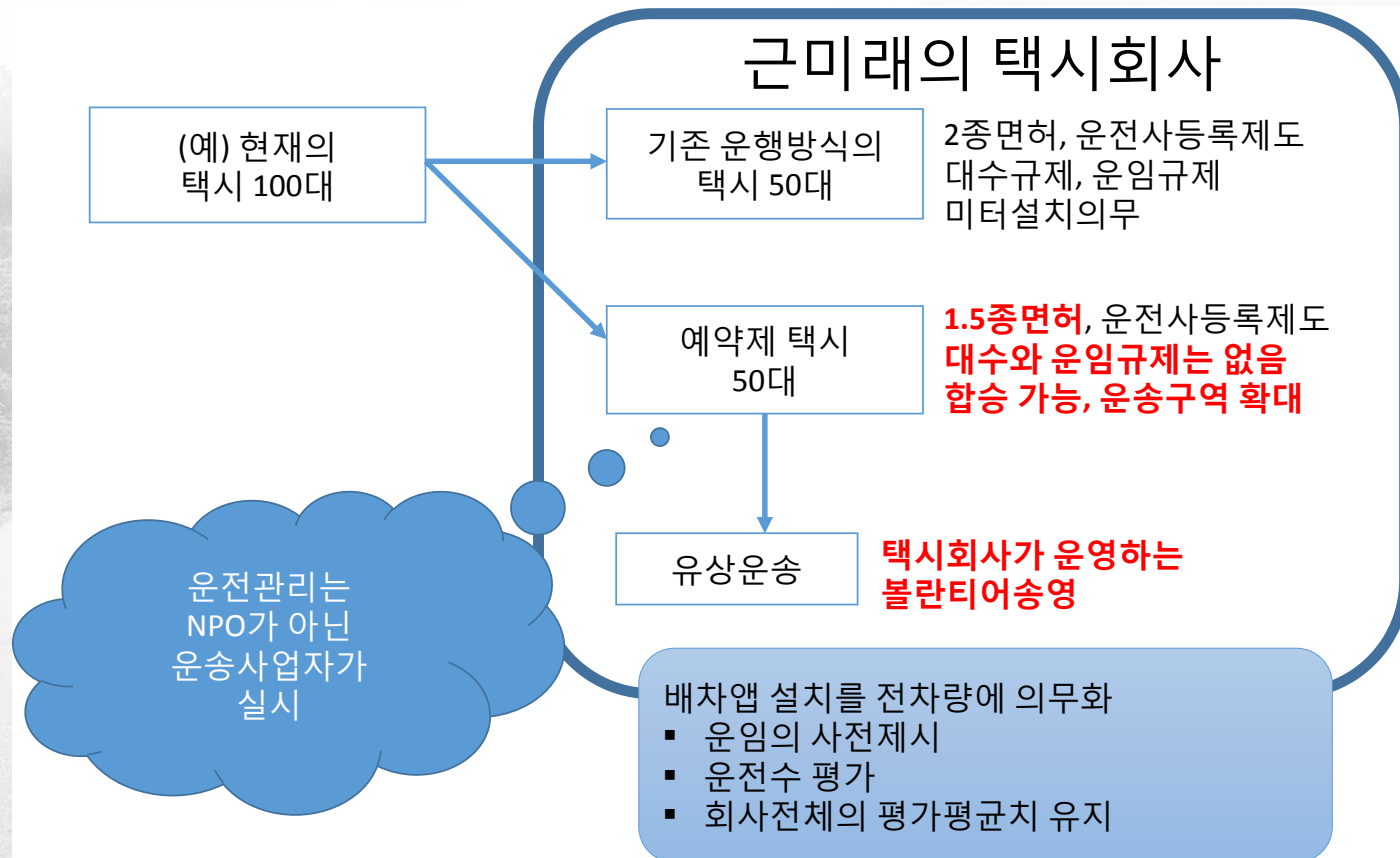


라이드쉐어 도입의 필요성



1.5종 면허

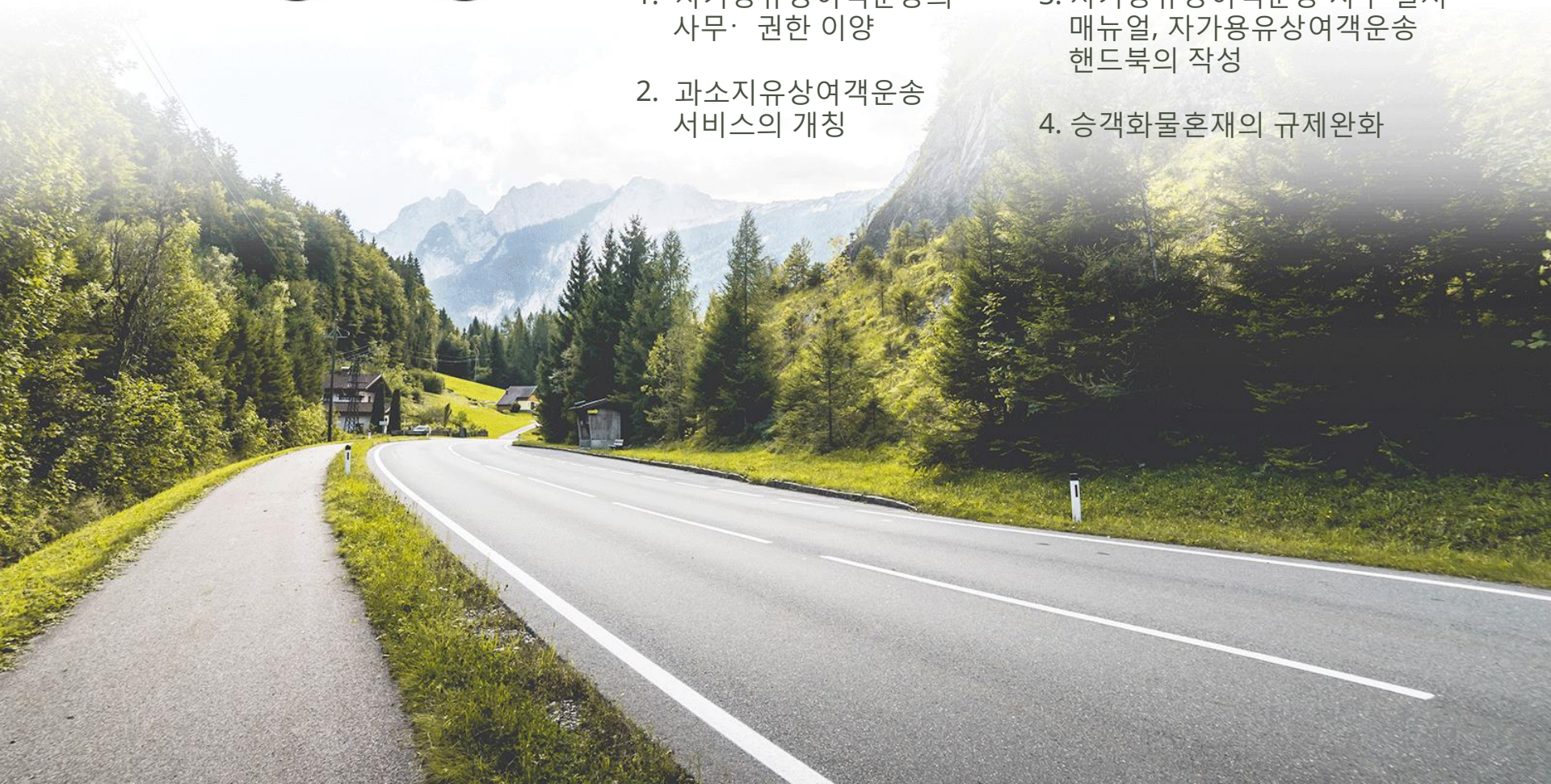
- 유한회사 산가모리택시 사다카네켄이치 대표이사가 안전성과 사고보상이 충분히 확보되지 않은 라이셰어의 일본 상륙은 단호히 반대함.
- 그러나 라이드셰어의 장점을 연구하고, 도입 할 것은 적극적으로 받아들여 일본의 택시서비스를 더욱 발전시켜 나가야 함.





03 일본 정부의 정책 동향

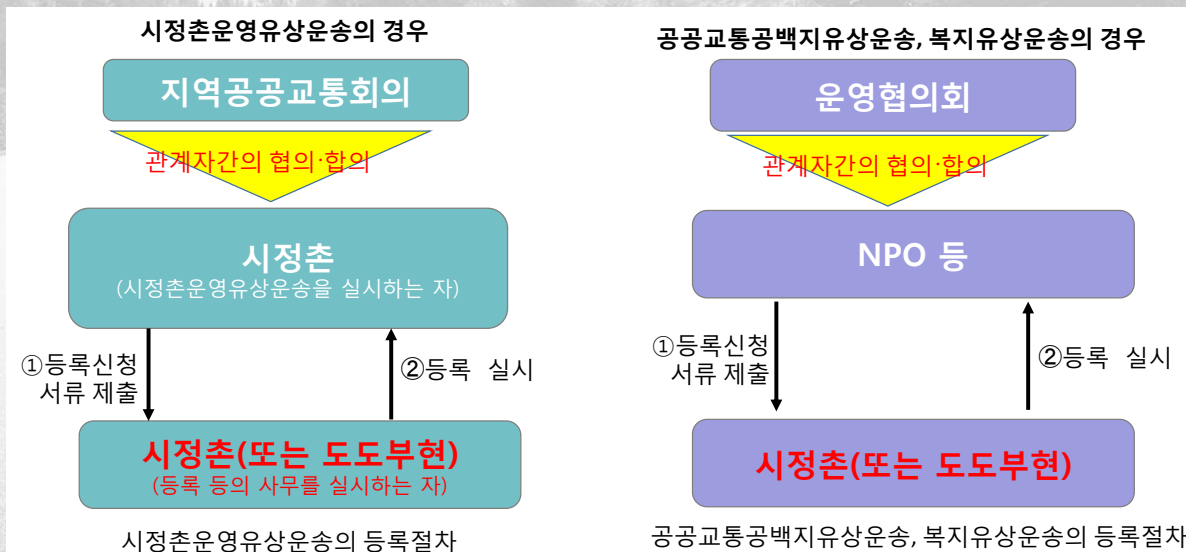
1. 자가용유상여객운송의 사무·권한 이양
2. 과소지유상여객운송 서비스의 개칭
3. 자가용유상여객운송 사무 실시 매뉴얼, 자가용유상여객운송 핸드북의 작성
4. 승객화물혼재의 규제완화





자가용유상여객운송의 사무권한 이양

- 과소지역의 이동수단, 개호 등 복지를 지원하는 수송 등 지역주민의 생활유지에 필요한 자가용유상여객운송에 관한 사무·권한은 **지역에서 판단 할 수 있는 재량을 확대하기 위해서 희망하는 시정촌에 이양한다.**
- 자가용유상여객운송의 사무·권한 이양시에는 **수송의 안전**을 확보하고, **이용자의 보호**를 도모하면서 **지역의 실정에 따라 운송을 실현**한다는 관점에서 다음의 3가지를 감안하여 구체적인 제도설계를 실시 할 필요가 있다.
 - 지역의 특성과 이용자의 요구에 따라 운송이 실현 될 수 있을 것
 - 지역의 다양한 관계자 의견을 반영 할 수 있는 방법을 충실히 마련할 것
 - 시정촌이 사무·권한을 담당할 시에는 필요한 수송의 안전확보가 담보 될 것
- 사무·권한 이양함으로써 **등록신청대상을 시정촌 또는 도도부현**으로 하는 것이 가능하다.





과소지유상여객운송서비스의 개칭

- 과소지역뿐만 아니라 도시지역에서도 버스·택시의 운행이 곤란하고, 유상운송이 필요한 지역이 존재하기 때문에 2015년 4월 1일부터 과소지유상여객운송서비스의 명칭을 **교통공백지역유상운송으로 변경**
- 실시주체의 탄력화 → 법인자격이 없이도 운행이 가능하다.
- 여객범위의 확대 → 지역주민과 이용자명부에 등재하지 않는 사람도 이용이 가능하다.
(방문자와 관광객도 이용가능)



東京交通新聞 2015.1.19号

NPOボランティアなど自家用車による過疎地有償旅客運送サービスの法令上の名称が4月1日、「交通空白地有償運送」に改められる。国土交通省は道路運送法施行規則(省令)を来月中旬に改正し、制度創設以来初の種別の名称変更に踏み切る。過疎集落に限らず、都市部でもバス・タクシーの運行が困難で、有償運送が必要なエリアが存

過疎地有償運送の名称

「交通空白地」に変更

国交省令案 対象客拡大も

在する実態を踏まえた。旅客の範囲と運送団体の国交省は「希望する市町村・都道府県」を対象とした4月開始の地方分権に併せ、全国一律の登録要件を緩和・弾力化する考え。昨年4月の「有償運送事務・権限の地方移譲あり方検討会」(座長||後藤春彦・早稲田大学創造理工学部長)の最終取りまとめをベースに、8日付で省令案の概要を策定した。

「希望する市町村・都道府県」を対象とした4月開始の地方分権に併せ、全国一律の登録要件を緩和・弾力化する考え。昨年4月の「有償運送事務・権限の地方移譲あり方検討会」(座長||後藤春彦・早稲田大学創造理工学部長)の最終取りまとめをベースに、8日付で省令案の概要を策定した。

「希望する市町村・都道府県」を対象とした4月開始の地方分権に併せ、全国一律の登録要件を緩和・弾力化する考え。昨年4月の「有償運送事務・権限の地方移譲あり方検討会」(座長||後藤春彦・早稲田大学創造理工学部長)の最終取りまとめをベースに、8日付で省令案の概要を策定した。



자가용유상여객운송 사무 실시매뉴얼, 자가용유상여객운송 핸드북의 작성









- 국토교통성 자동차국 여객과는 새롭게 『자가용유상여객운송』의 사무·권한을 담당하는 **시정촌 등이 업무를 원활하게 진행할 수 있도록 절차와 관계자의 합의 형성방법**을 알기 쉽게 해설한 **매뉴얼과 핸드북**을 작성

자가용유상여객운송 사무 실시매뉴얼 (2015)	자가용유상여객운송 핸드북 (2018)
<p>I. 자가용유상여객운송에 관하여</p> <ol style="list-style-type: none"> 1. 자가용유상여객운송의 개요 2. 자가용유상여객운송의 종별 3. 등록절차 4. 대가에 대해서 <p>II. 자가용유상여객운송의 사무·권한의 이양에 대해서</p> <ol style="list-style-type: none"> 1. 이양되는 사무의 개요 2. 사무·권한 이양의 기본방침 <p>III. 자가용유상여객운송업자의 등록에 관한 사무 절차에 대해서</p> <ol style="list-style-type: none"> 1. 등록에 대해서 2. 신청 대응 3. 시정조치 명령·업무정지 명령·등록의 취소 4. 보고, 검사 및 조사 (법 제 94조) 	<p>I. 자가용유상여객운송에 관하여</p> <ol style="list-style-type: none"> 1. 자가용유상여객운송이란 2. 자가용유상여객운송을 실시하는 자 3. 수요에 따른 자가용유상여객운송의 종류 4. 자가용유상여객운송의 등록절차 <p>II. 지역관계자의 합의</p> <ol style="list-style-type: none"> 1. 지역공공교통회, 운영협의회 2. 합의의 방법 3. 협의에 있어서의 유의점 4. 지역관계자의 역할 <p>III. 도로운송법에 따른 등록(등록 등의 절차)</p>



승객화물혼재의 규제완화

- 일본정부는 여객운송·화물운송분야의 운전수 부족문제가 계속해서 제기되면서 지금까지 여객과 화물로 나누어 온 운송사업을 전환하여 2017년 9월 1일부터 버스, 택시, 트럭이 여객과 화물을 동시에 수송할 수 있도록 규제를 완화함.
- 이번 규제완화를 통해서 운전수 부족문제뿐만 아니라 대중교통기능이 저하되고 있는 과소지역에서 새로운 사업을 전개하여 노선이 유지될 수 있도록 하는 것에도 큰 기대를 가지고 있음.

	규제완화 전	규제완화 후
승합버스	350kg 미만 의 화물운송 가능 (도로운송법 제82조) 	350kg 이상 의 화물운송 가능 <ul style="list-style-type: none"> • 화물자동차여객운송사업 허가취득이 필요 • 350kg 이상은 화물의 운행관리자 선임이 필요 
전세버스	여객운송에 특화 	과소지역에 한하여 화물운송 가능 <ul style="list-style-type: none"> • 화물자동차여객운송사업 허가취득이 필요 • 화물의 운행관리자 선임이 필요 
택시	여객운송에 특화 	
트럭	화물운송에 특화 	과소지역에 한하여 여객운송 가능 <ul style="list-style-type: none"> • 여객자동차여객운송사업 허가취득이 필요 • 여객의 운행관리자 선임이 필요 
자가용 유상여객 운송	과소지역에 한하여 자가용차량으로 350kg 미만 의 화물운송 가능 (도로운송법 제78조 제3호의 허가취득이 필요)	

과소지역 : 인구 3만명 미만 지역



04 자가용을 활용한ライド쉐어 사례

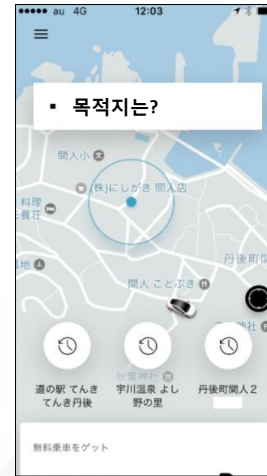
1. (Uber) 교탄고초의 사사에아이교통
2. (notteco) 텐시오쵸~왓카나이시의 아이노리교통
3. (Fujitsu) 후쿠시마 다테시의 사사에아이교통





(Uber) 교탄고초의 사사에아이교통

- 운영주체 : NPO법인 気張る! ふるさと교탄고초
- 운행지역 : 승차는 탄고초만 가능, 하차는 교탄고시 전체 가능
- 요금 : 최초의 1.5km까지 480엔, 1.5km 이후부터는 120엔/km를 가산(대략 택시 요금의 반액)
- 지불방법 : 처음에는 신용카드결제만 가능하였지만, 2016년 12월 21일부터 현금 지불도 가능해짐.
- 운행시간 : 오전 8시~오후 8시(연중무휴)
- 배차방법 : 스마트폰에서 **Uber 앱**을 이용하여 즉시 배차(사전 예약불가). 2016년 9월 18일부터 **대리서포터**가 이용자를 대신하여 배차하는 것도 가능해짐.
- 드라이버 : 지역주민(18명, 자원봉사자)
- 차량 : 드라이버가 소유하고 있는 자가용차량(승용차)을 이용
- 인증표지 : 각 차량의 측면에 인증표식 부착
- 이용자 : 탄고초 주민, 관광객 등의 방문객



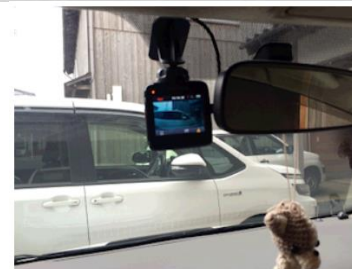
우버 앱을 이용한 배차요청 화면



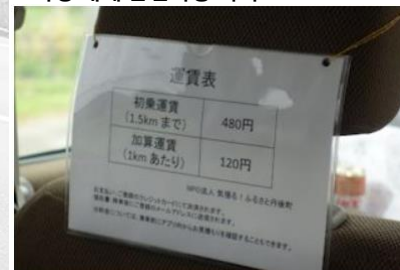
드라이버(오렌지색 베스트 착용)



·차량 내에 운전자증 비치



·전 차량에 드라이브레코더 설치



·차량 내에 운임표 비치

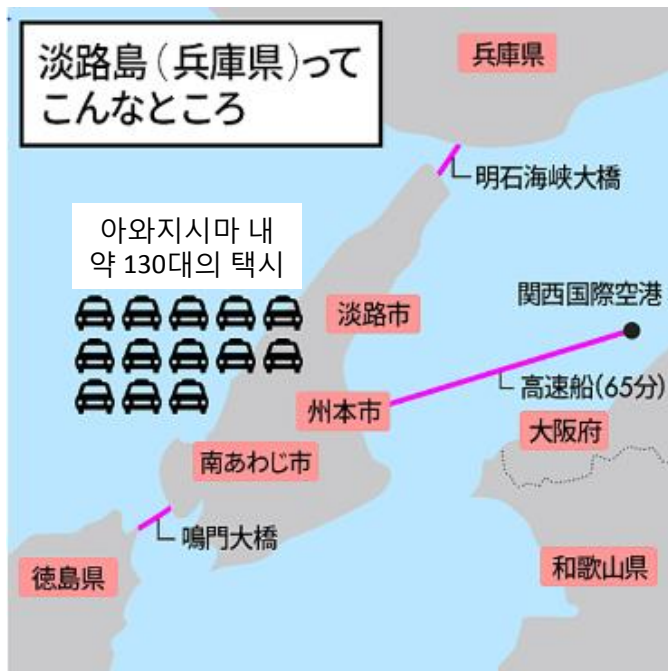


·매일 오전 점호 실시
·6개월마다 자동차정검정비결과 보고서 제출



(참고) Uber앱을 활용한 아와지시마의 택시배차

- 배차지역 : 원칙적으로 아와지시마에서의 승하차(아와지시마에서 승차하여 아와지시마 밖에서 하차가 가능)
- 실증실험기간 : 2018년 7월 ~ 2019년 3월 31일
- 택시사업자 : 아와지시마에서 택시사업자를 공모
- 이용대상자 : 관광객을 포함한 섬방문자 및 아와시마 지역주민





(notteco) 텐시오쵸~왓카나이시의 아이노리교통

- 홋카이도 텐시오쵸 인구는 약 3,200명, 면적은 353.3 km²
- 1955년 인구는 1만 명 → 60년 후 1/3로 감소 (저출산고령화)
- 초민의 생활권(종합병원·상업 시설 등)은 **70km 떨어져 있는** 왓카나이시
- 빈 좌석으로 이동하는 자동차에 합승하여 이동하는 방법을 검토한 결과, 텐시오쵸에서는 **코스트쉐어형의 라이드쉐어 (아이노리)**를 선택



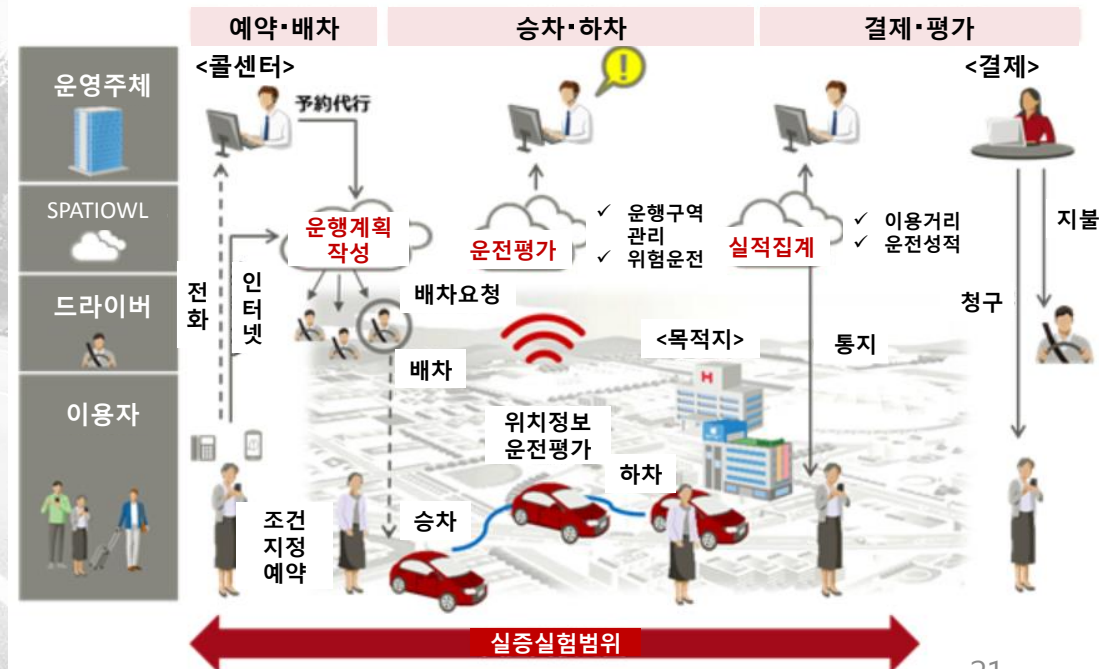
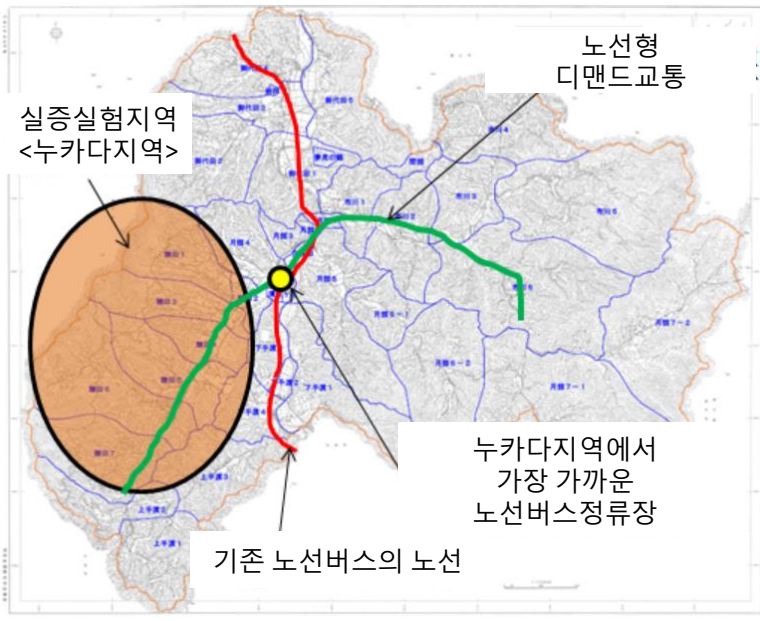
버스와 철도로 환승하면 편도 약 3시간 소요(당일치기는 불가능)

	코스트쉐어 형	온디맨드 배차형
요금체계	실비에 근거하여 산출	드라이버에게 운임지불
운행거리	장거리 중심	단거리 중심
예약 유무	○	×
서비스 예	BlaBlacar	Uber



(Fujitsu) 후쿠시마 다테시의 사사에아이교통

- 미리 등록된 드라이버가 지역주민의 수송가능한 시간과 현재 위치, 이동을 희망하는 이용자를 **목적지에 따라 최적의 차량을 매칭** 시켜 **이용자에게 효율적이고 안전한 합승서비스를 제공**하고, 그 유효성을 검증
- 승영차량에는 위치, 속도 등의 데이터를 수집하는 장치를 설치하여 엑셀과 브레이크 조작 등을 다양한 관점에서 분석한 **안전운전 평가데이터를 작성**하고, 이 데이터의 유효성도 평가





05 결론





자가용유상여객운송의 성공포인트

- 국토교통성은 『**향후 공조에 의한 지역만들기의 방향성 검토회**』 등을 통해서 과소지역·중산간지역의 교통·물류 확보를 위한 자가용유상여객운송과 승객화물운재에 관한 제도 활용 등 **공유에 의한 합리화·효율화의 가능성을 검토하고 있다.**
- 공공교통공백지역유상운송을 도입하는 지역은 기본적으로 버스·택시사업자가 교통서비스를 제공하는 것이 곤란한 지역으로 **지역의 실태를 정확하게 파악한 다음에 도입을 판단해야한다.**
- 공공교통공백지역유상운송에 의한 이동수단 확보가 바람직하다고 판단된 경우, 주민, 교통사업자 및 시정촌 상호간에 **과제를 공유**하고, 각자가 해야 할 **역할을 정리, 분담**한 다음에 **교통사업자간의 합의 형성**을 도모한다.
기존의 교통사업자와의 조정에는 아래와 같은 방법을 활용할 수 있다.
 - 기존의 대중교통기관과 운행구간이 중복되지 않도록 함
 - 서비스를 제공하는 요일과 시간대를 타 공공교통기관과 분담하도록 함
 - 운행구간이 중복되는 기존 대중교통기관의 요금보다 운송의 대가를 높게 설정하도록 함
- 운전사의 확보는 고령운전자뿐만 아니라 **청년, 여성의 활용과 단시간에도 활동할 수 있는 방법**이 필요하다.
- 많은 이용자의 이용을 유도하기 위해서는 홍보활동도 중요하다. **서비스를 필요로 하는 이용자에게 정보가 전달 될 수 있도록 홍보활동을 적극적으로 실시**하는 것이 필요하다.



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- 東京海上日動火災保険ホームページ (<http://www.tokiomarine-nichido.co.jp/>)
- 新経済連盟提言「シェアリングエコノミー活性化に必要な法的措置に係る具体的提案」(2015年10月公表)
- 有限会社 三ヶ森タクシー代表取締役 貞包健、一多様な運転手が旅客運送サービスを提供する新たなタクシー事業の実現、2017
- 伊達市と富士通、遊休車両を有効活用した乗合送迎サービスの実証実験を開始 (<http://pr.fujitsu.com/jp/news/2018/01/17.html>)
- 天塩～稚内「相乗り交通」取り組み (https://www.kantei.go.jp/jp/singi/it2/senmon_bunka/shiearingu/dai8/shiryoku8-7.pdf)
- 国土交通省自動車局旅客課, 自家用有償旅客運送ハンドブック, 2018
- 国土交通省自動車局旅客課, 自家用有償旅客運送事務実施マニュアル, 2015
- 岡山県、公共交通空白地有償運送の導入検討の手法

A scenic mountain road with a large white circular graphic on the left containing the text 'THANK YOU'. The road is paved and curves through a lush green landscape with steep, forested hillsides. In the distance, more mountains are visible under a hazy sky. The overall color palette is dominated by greens and yellows, giving it a warm, natural feel.

THANK YOU

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Utility and disutility of time spent traveling in the era of self-driving



Akimasa Fujiwara, Hiroshima University

Contents



Hypothesis

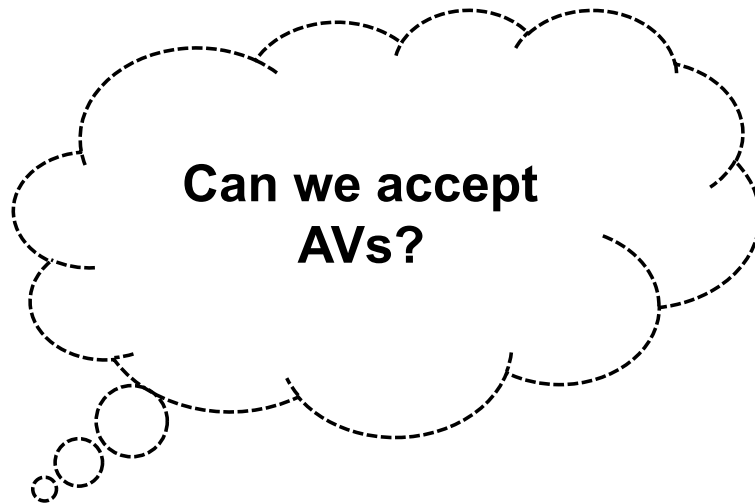
1. The risk perception for AVs is high, but may disappear with time
2. Ownerships of AVs may change urban form
3. The public may accept connected multimodal AVs

**The coming of age of auto-sapiens is inevitable.
The diffusion of self-driving cars bring the antinomy between
transport planning and urban planning.**



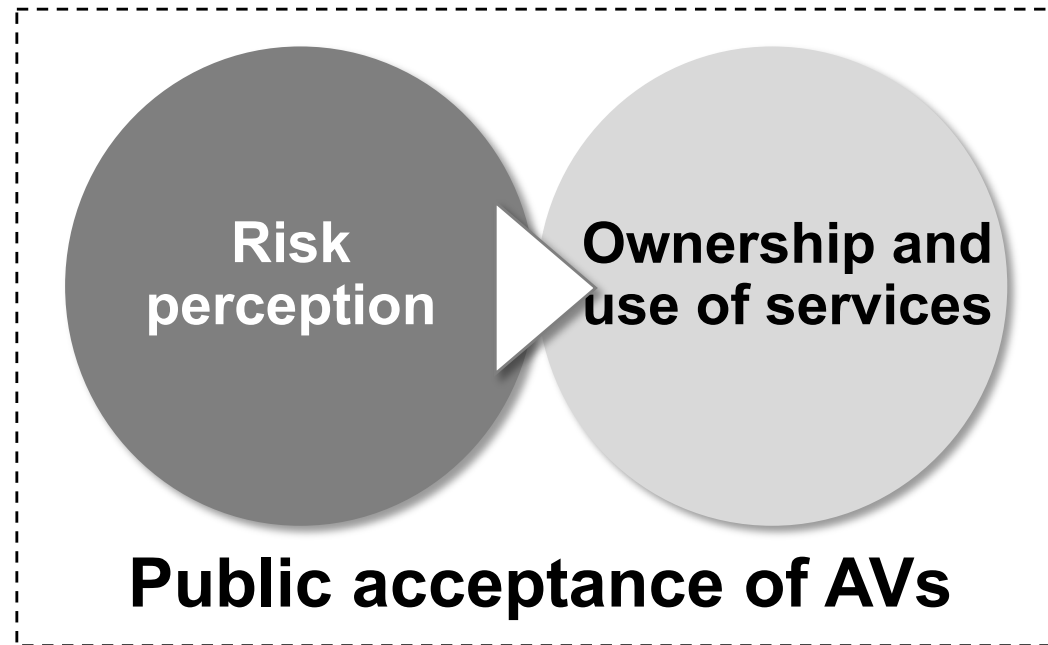
Risk perception map for AVs

Coming of age of auto sapiens



Change of behavior -> Change of norm/value?

1. Increase of discretionary trips
More space for elderly's facilities
Increase of short distance trips to destination surrounding home
Neighborhood planning, land use change
1. Increase of **mobility as a service** (MaaS)
Ride Sharing expansion, reduction of **parking space**
2. More "effective" route choice
New barrier free tool by reduction of **temporal and spatial resistance**
3. Relocation of resident in outer
Re-sprawl of urban area
4. More investment for goods flow than passenger flow
Activate of freight terminal



- 1. Relative evaluation of the perception of AVs risks**
2. Estimation of purchase intention for instrument of private AVs
3. Estimation of use intention for public AVs (i.e. autonomous bus service)

Types and level of AV technology

Type	Use and ownership
Private	AVs possessed by individuals or households
Shared	AVs shared by others
Public	AVs used by the public

Level	Autonomy technology	Unmanned	License
1	A computer can control either steering or acceleration/braking , but it is not programmed to do both at the same time. Drivers still have full responsibility to monitor road situations and assume all driving functions.	no	need
2	Cars that can control steering and speed simultaneously . Driver still has to be doing the driving and paying attention to the road.	no	need
3	System manages most of the driving and assesses what's going on in traffic around you . Driver only has to intervene whenever the car is not able to handle a situation and asks for the user to take over	no	need
4	Vehicles do it all, that is perform all safety-critical driving functions and monitor all roadway conditions for the duration of the trip . However, driver still need to be aware while you're traveling in the vehicle	yes	No need

Slovic Experiment: Psychometric Paradigm

Slovic, P. (1987) Perception of Risk, Science 236, 280-285

1. Dread factor

uncontrollable, dread, global catastrophic, consequences fatal, not equitable catastrophic, high risk for future generations, not easily reduced risk increasing involuntary

2. Unknown factor

not observable, unknown to those exposed, effect delayed, new risk, risks unknown to science (e.g. BSE)

Web survey in 2017: 1,442 residents in Hiroshima Prefecture	
Activities or technology (20)	Nuclear power, motor vehicle, handguns, smoking, alcoholic beverages, general (private) aviation, large construction, mountain climbing, bicycles, electric power (non-nuclear), skiing, railroads, prescription antibiotics, energy drink, amusement attraction, drone, AVs-bus (level 3), AVs-bus (level 4), AVs-car (level 3), AVs-car (level 4)
Q1 Benefit of AVs	Rating of all activities and technology from 10 to 100
Q2 Risks of AVs	Rating of all activities and technology from 10 to 100
Q3 Acceptance intention	a) Acceptable even if risks become higher. -> up to () times b) Acceptable as the case stands c) Acceptable if risks become lower. -> up to () times
Q4 Perception indicators	Rating all activities and technology with 7 scales from the viewpoint of each indicator: (1)initiative, (2)instantaneousness of impacts, (3)awareness of risks, (4)scientific knowledge, (5)controllability, (6)innovativeness, (7)acute and chronic catastrophe, (8)dread, (9)lethality

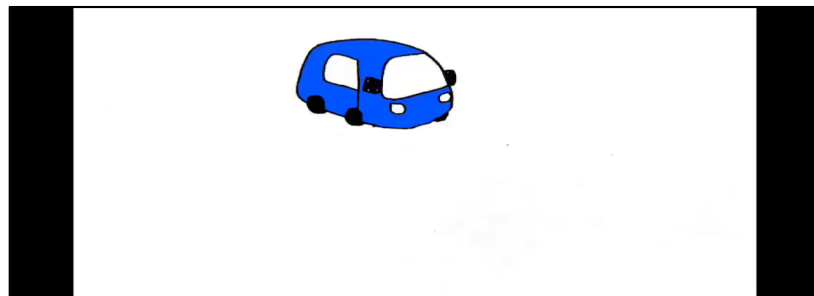
Ingenious questions

To avoid the biased image for non-existing AVs, various combination of the following short movies are provided to explain the benefit and disbenefit:

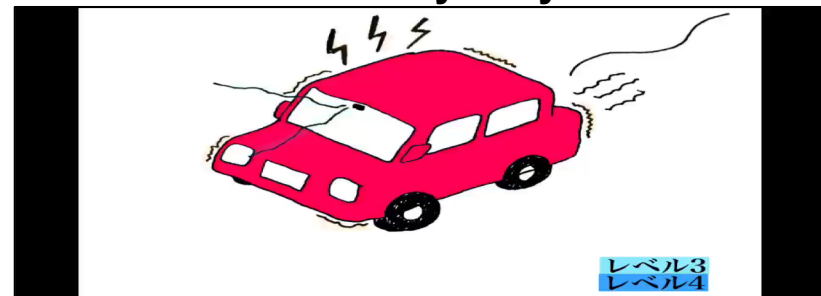
- ① Introduction of AVs
- ② Probability of system error
- ③ Probability of hacking
- ④ limitation of adapting unexpected hazardous events

Framing effect: Biases of risk perception caused by the above information provision will be alleviated by providing different combination among respondents

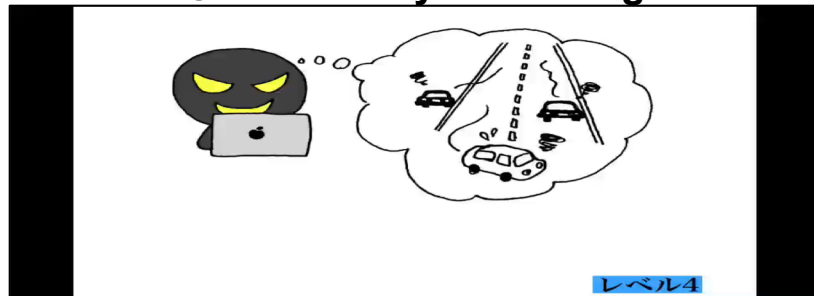
① Introduction of AVs



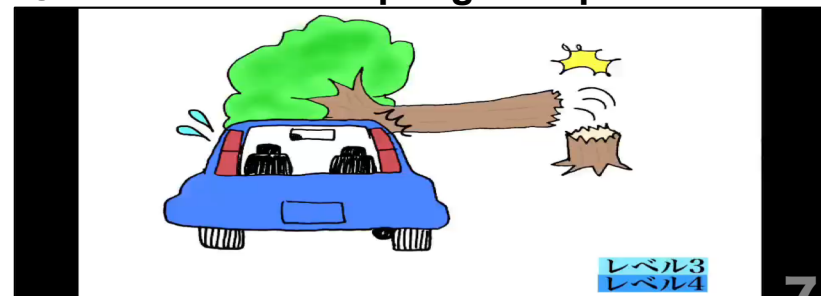
② Probability of system error



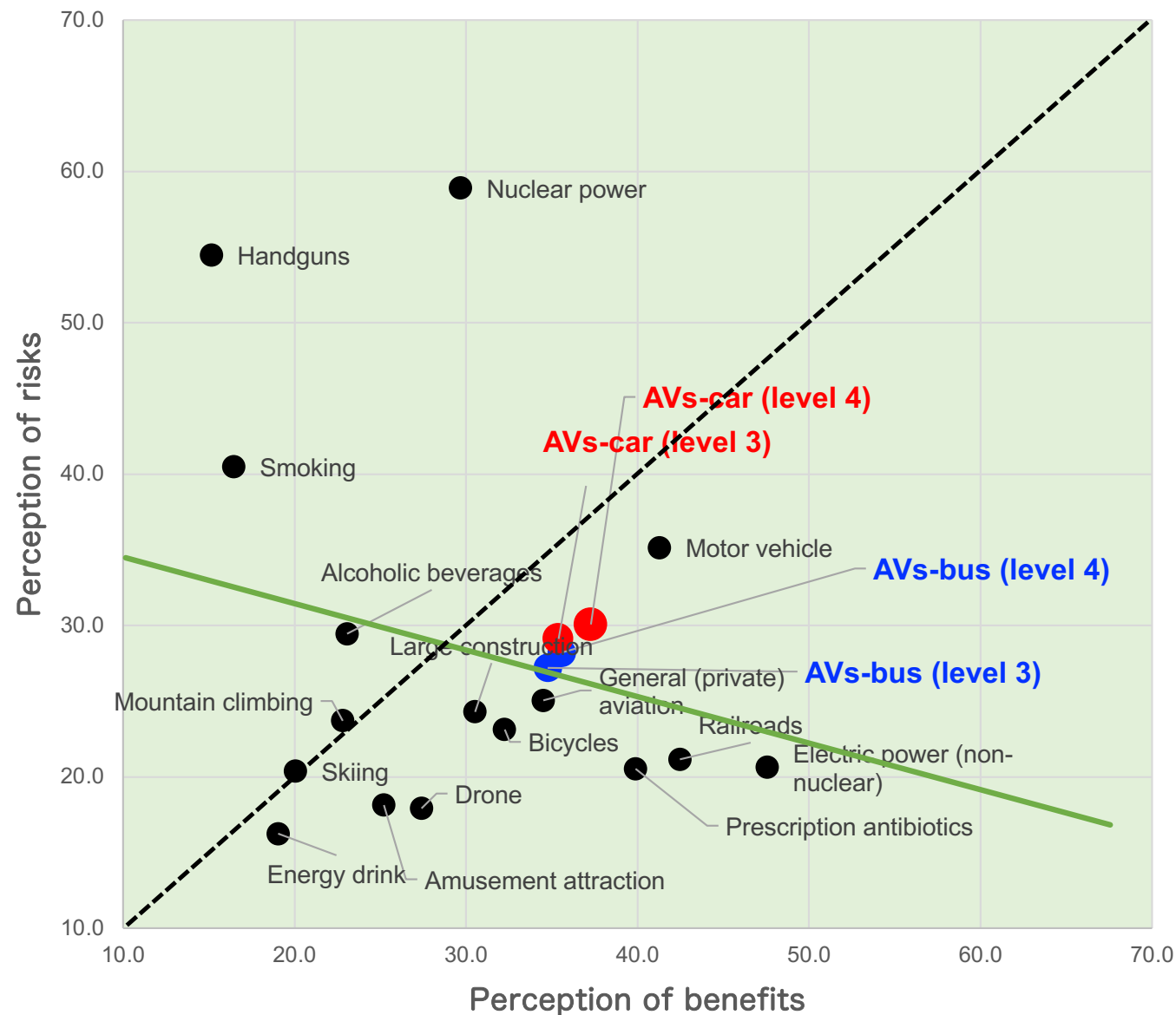
③ Probability of hacking



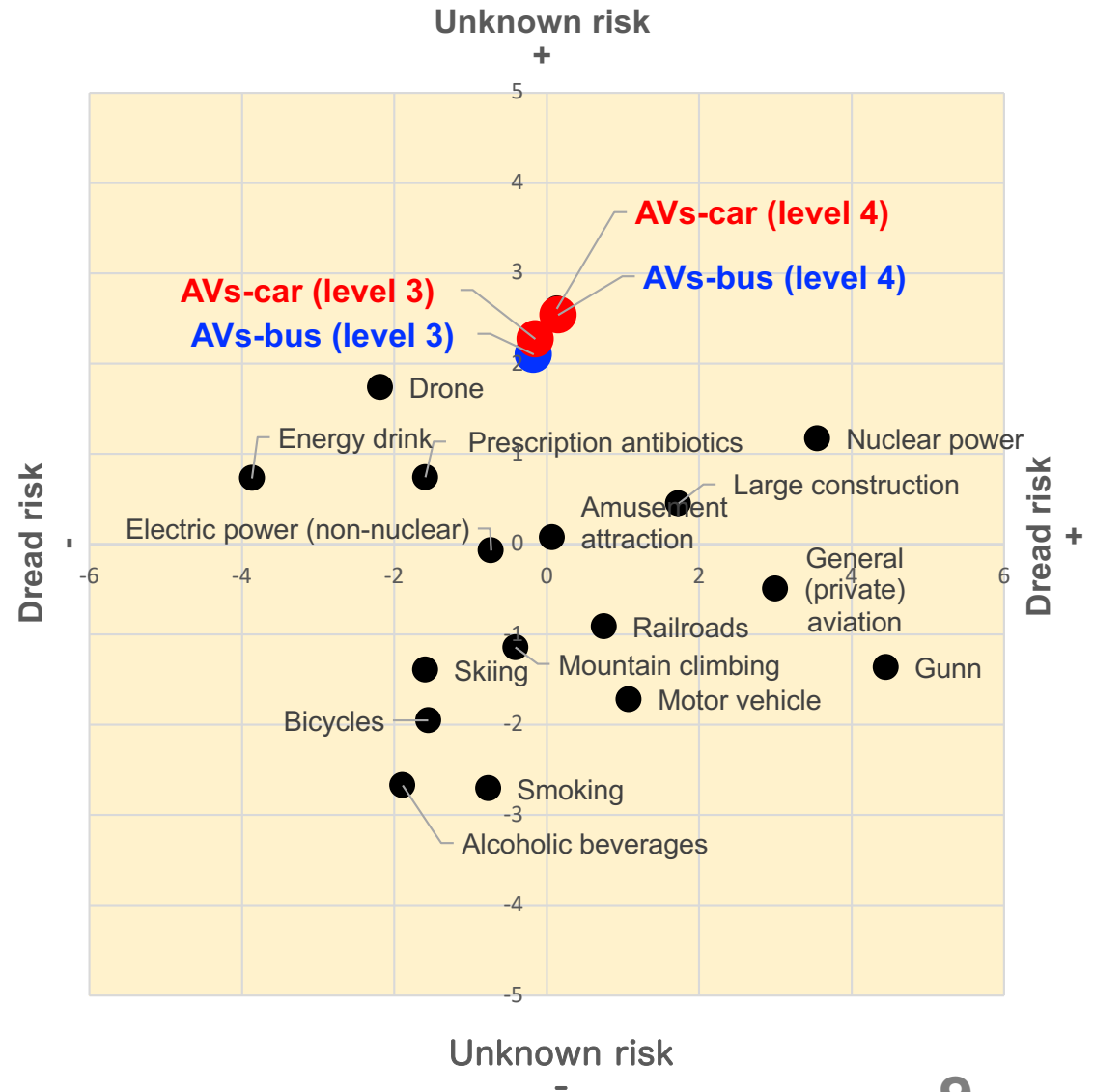
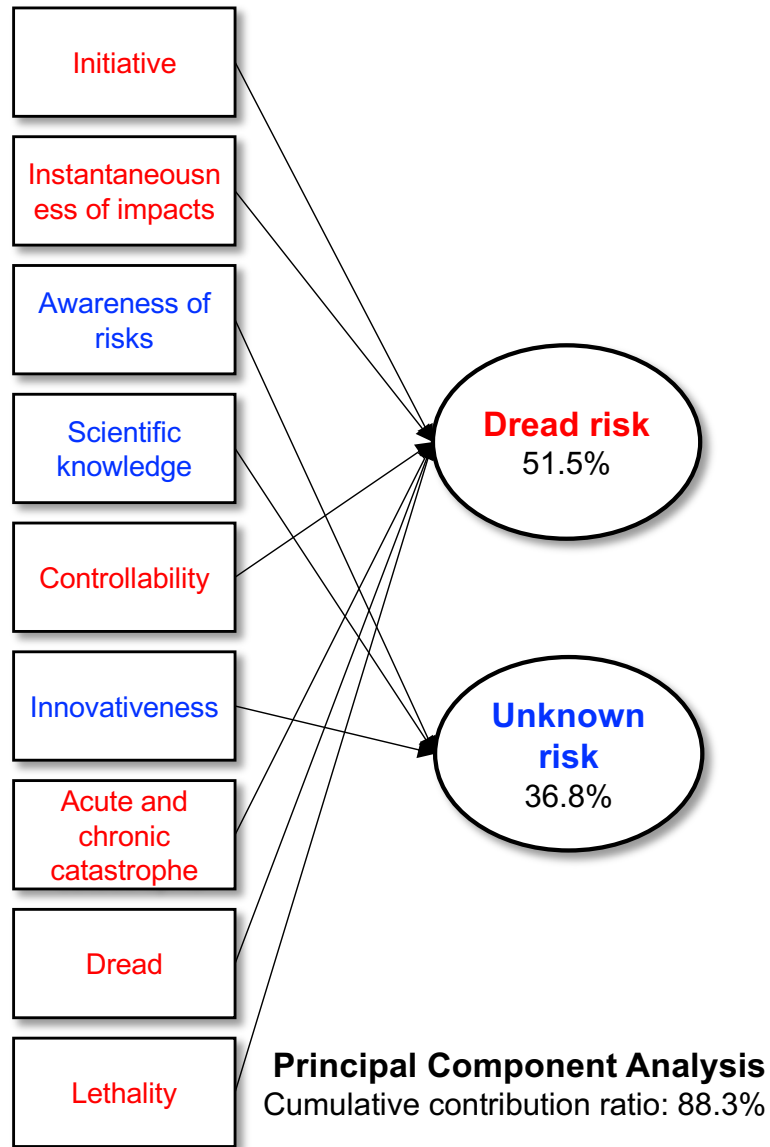
④ limitation of adapting unexpected events



Perception of risks and benefit

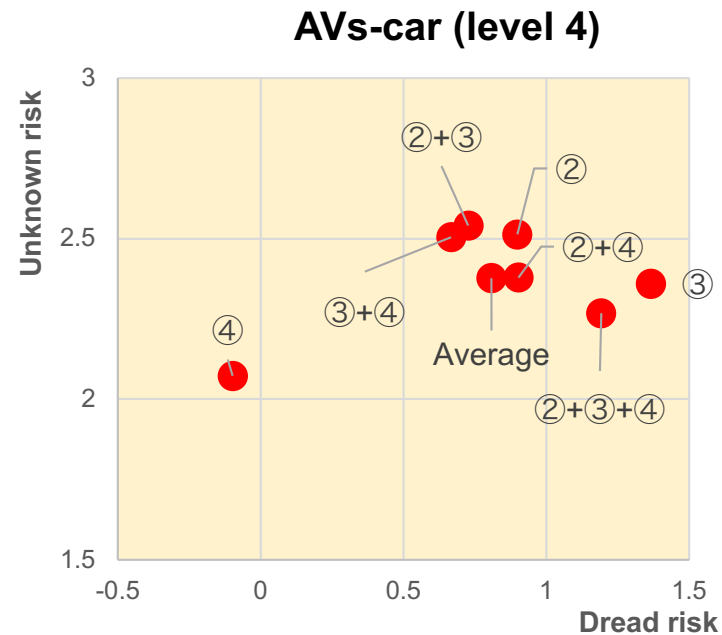
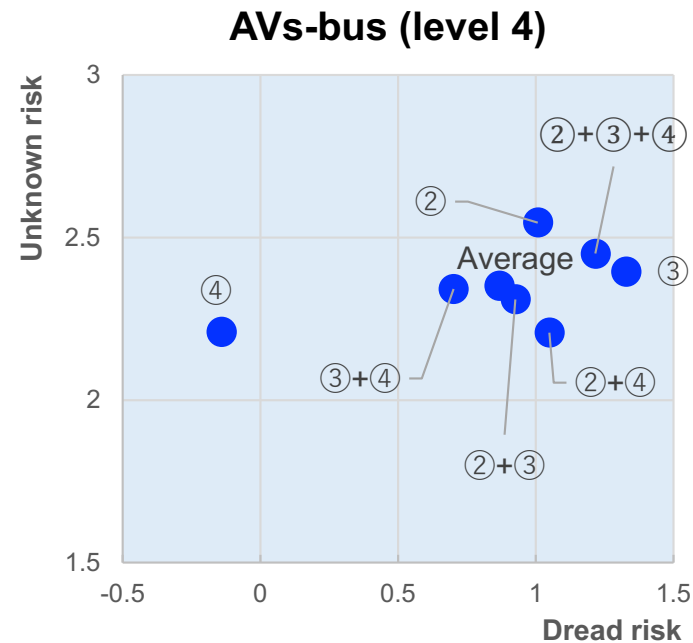


Perception map of risks



Framing effect

	Movie	Information			# samples
I	②	System error			206
II	③	Hacking			206
III	④	Unexpected events			206
IV	②+③	System error	Hacking		206
V	②+④	System error	Unexpected events		206
VI	③+④	Hacking	Unexpected events		206
VII	②+③+④	System error	Hacking	Unexpected events	206
X	Average				1442



Factors affect on AVs acceptance

Binary logit model (Accept 1 vs not accept 0)

	AVs-bus (level 3)			AVs-bus (level 4)			AVs-car (level 3)			AVs-car (level 4)		
	Coefficient	t-value		Coefficient	t-value		Coefficient	t-value		Coefficient	t-value	
Constant	0.492	2.60	**	0.322	1.73		0.527	2.80	**	0.323	1.73	
Male*middle age (40~59)	-0.306	-1.96	*	-0.242	-1.58		-0.241	-1.55		-0.184	-1.21	
Female*middle age (40~59)	-0.386	-1.96	*	-0.426	-2.17	*	-0.542	-2.76	**	-0.251	-1.29	
Male*elderly (60~99)	-0.408	-2.19	*	-0.403	-2.17	*	-0.338	-1.81		-0.357	-1.92	
Female*elderly (60~99)	-0.855	-2.50	*	-0.531	-1.56		-0.862	-2.50	*	-0.377	-1.11	
Lane keeping assist device user	0.549	2.62	**	0.519	2.58	**	0.585	2.82	**	0.438	-0.20	*
Movie: system error	-0.074	-0.58		-0.238	-1.86		-0.250	-1.93		-0.307	-2.40	*
Movie: hacking	-0.059	-0.45		-0.160	-1.24		-0.158	-1.21		-0.148	-1.15	
Movie: unexpected event	0.090	0.69		0.089	0.69		0.115	0.89		0.075	0.59	
Likelihood ratio	0.270			0.261			0.268			0.259		
No. of samples	1442			1442			1442			1442		

Findings

- Cannot say that the public do not want to accept AVs
- Highly perceive “unknown risks” on AVs
- Have a perception of “dread risk” on that AVs technology is potentially damaged by hacking.

Future works

- Analysis of purchase and use behavior of 3 types of AVs
- Positive/negative impacts of AVs on urban planning: i.e. facility capacity, location, tour routing, time allocation of activities, urban form, social network, etc.
- Better understanding of the value of mobility (i.e. VTTS, VDL) changed by multi-tasking.

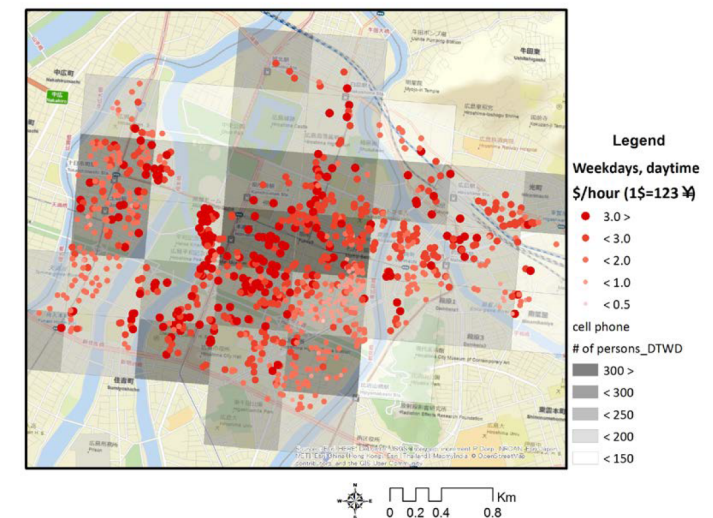


Influence of AVs on residential choice behavior

- **Development of AVs**
 - Social meaning: accident reduction, support of elderly's mobility, reduction of congestion
 - Economical meaning: Building new market, increase of international competition
- **Impacts of AV systems (Milakis et al., 2017)**
 - Primary impacts: modal shift, changes in congestion pattern
 - Secondary impacts: land use, employment
 - Tertiary impacts: Energy consumption, public health, equity
- **AVs and multi-tasking behavior**
 - No driving during travelling
 - On-board activities (multi-tasking)
 - Willingness to long-distance travel

Existing literatures

- **Impacts of AVs on residential choice**
 - Meyer et al. (2017)
 - Accessibility improvement -> urban sprawling
 - Sousa et al. (2017)
 - Reduction of parking space -> effective use of urban space
 - Zakharenko (2016); Larson and Zhao (2017)
 - Urban impacts depend on parameters
 - Parking distribution (supply side decision making)
 - Relocation of offices and commercial facilities
 - Value of travel time saving -> residential choices



- **Shortage of empirical studies (Milakis et al., 2017)**

Objective and methodology

- **Purpose**

- Evaluating the impacts of AVs on residential choice behavior
 - Types of AVs
 1. AVs private ownership (single occupied)
 2. AVs ride-sharing (multiple occupied)

- **Hypothesis**

1. Drivers have willingness to driving for long distance if daily activities are substituted by multitask activities during travelling, and consequently they will inhabit suburbs away from downtown.
2. The significance of impacts depends on AV types, the feasibility of multitask activities

- **Methodology**

- Model analysis based on SP data
 - Difference of WTP for commuting time

Web-based questionnaire : Multitask activities in vehicle and residential choice

Period	2017/12/08 ~2017/12/13
Respondents	Car commuters in Hiroshima and Fukuoka
Surveyor	Macromill Inc.
Number of samples	615

Items	Contents
Individual characteristics	age/gender/occupation/working pattern/work place/house rent/household income/household size/education level/travel time to office/floor area/distance to closest shop store/time to closest railway station/time to closest bus stop
In-house and in-vehicle activities	Time spent activities at home and in vehicle
Feasibility of activities in vehicle by types of AVs	<ul style="list-style-type: none"> • Rating on feasibility in vehicle for single occupied • Rating on feasibility in vehicle for ride share with others
SP residential choices (4 repetition per respondent)	<ul style="list-style-type: none"> • Choice of rental housing location in case of traditional vehicle driving • Choice of rental housing location in case of ride shared self-driving • Choice of rental housing location in case of single occupied self-driving

Which do you prefer to live the following two rental housing?

attributes	A	B
Floor area	100 (m ²)	120 (m ²)
House rent	100 (thousands JPY)	80 (thousands JPY)
Commuting time to office	50 (min)	60 (分)
Distance to closest superstore	1000 (m)	1300 (m)
Time to closest railway station	10 (min)	13 (min)
Time to closest bus stop	5 (min)	8 (min)

↑ ↑
Increase/decrease the current levels by
-30%, -10%, 0, +10%, +30% at random

Which do you prefer to live the following two rental housing?

attributes	A	B
Floor area	100 (m ²)	120 (m ²)
House rent	100 (thousands JPY)	80 (thousands JPY)
Commuting time to office	50 (min)	60 (分)
Distance to closest superstore	1000 (m)	1300 (m)
Time to closest railway station	10 (min)	13 (min)
Time to closest bus stop	5 (min)	8 (min)

Please choose one option in the following three cases of

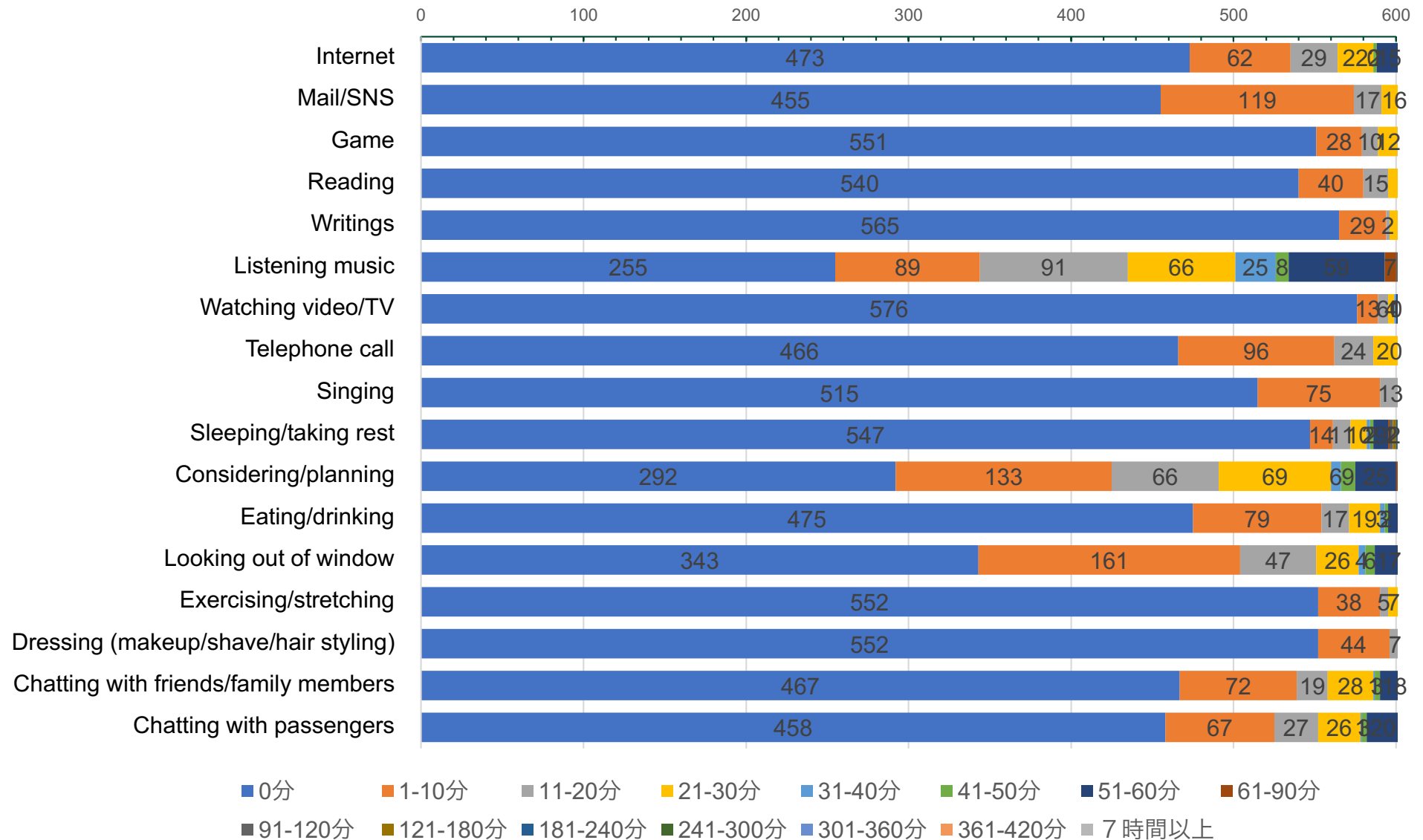
- (1) Conventional car driving by your-self (current)
- (2) AVs ride-sharing (multiple occupied)
- (3) AVs private ownership (single occupied)

Multitask activities

How many minutes do you spend to the following activities a day? How long do you spend their activities in vehicle during commuting?

	Activities	Current time use a day (min)
1	Internet	Total _____min (multitask on board_____min)
2	Mail/SNS	Total _____min (multitask on board_____min)
3	Game	Total _____min (multitask on board_____min)
4	Reading	Total _____min (multitask on board_____min)
5	Writings	Total _____min (multitask on board_____min)
6	Listening music	Total _____min (multitask on board_____min)
7	Watching video/TV	Total _____min (multitask on board_____min)
8	Telephone call	Total _____min (multitask on board_____min)
9	Singing	Total _____min (multitask on board_____min)
10	Sleeping/taking rest	Total _____min (multitask on board_____min)
11	Considering/planning	Total _____min (multitask on board_____min)
12	Eating/drinking	Total _____min (multitask on board_____min)
13	Looking out of window	Total _____min (multitask on board_____min)
14	Exercising/stretching	Total _____min (multitask on board_____min)
15	Dressing (makeup/shave/hair styling)	Total _____min (multitask on board_____min)
16	Chatting with friends/family members	Total _____min (multitask on board_____min)
17	Chatting with passengers	Total _____min (multitask on board_____min)

Current time use for multitask activities



Feasibility of multitask activities on board

AVs (private ownership)

Suppose you can drive AV alone. What level (1 to 10 scale) do you expect the quality of multitask activities comparing with current same multitask activities with 10 scale?

		Cannot do on board									Can do on board same as in house
	Multitask activities	1	2	3	4	5	6	7	8	9	10
1	Internet										
2	Mail/SNS										
	.										

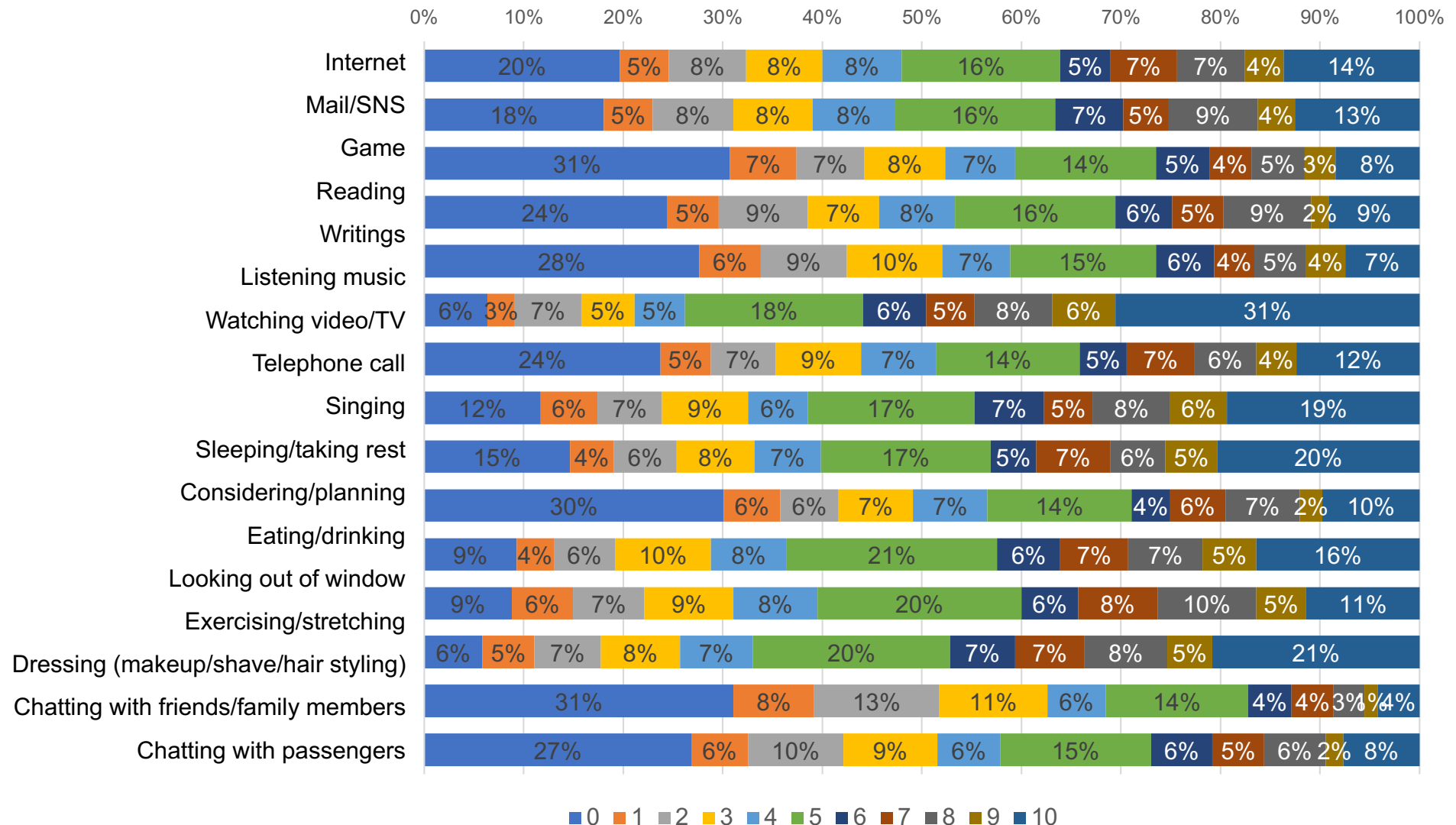
AVs (ride-sharing)

Suppose you can drive AV alone. What level (1 to 10 scale) do you expect the quality of multitask activities comparing with current same multitask activities with 10 scale?

		Cannot do on board									Can do on board same as in house
	Multitask activities	1	2	3	4	5	6	7	8	9	10
1	Internet										
2	Mail/SNS										
	.										

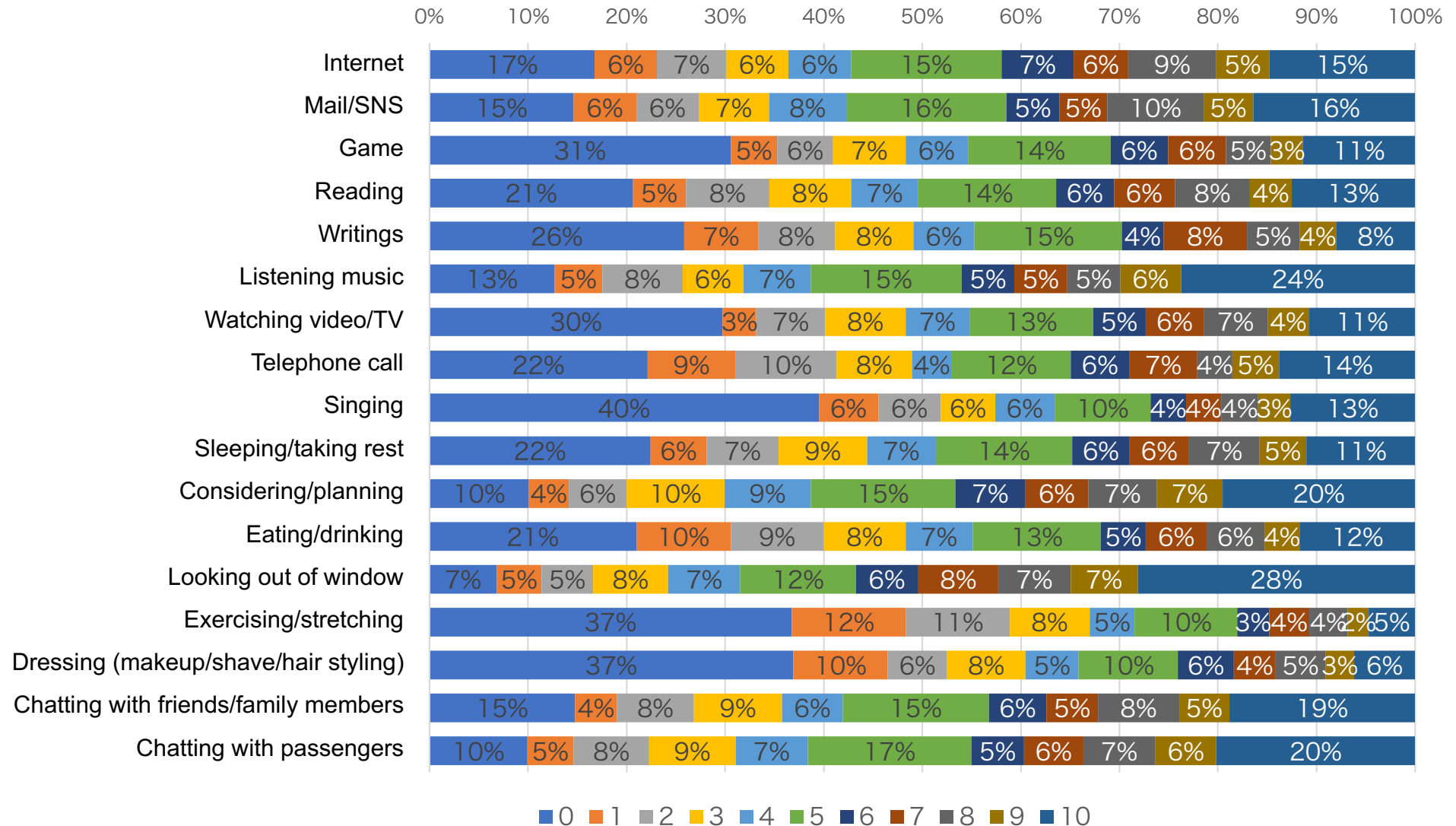
Feasibility of multitask activities on board

All types of AVs



Feasibility of multitask activities on board

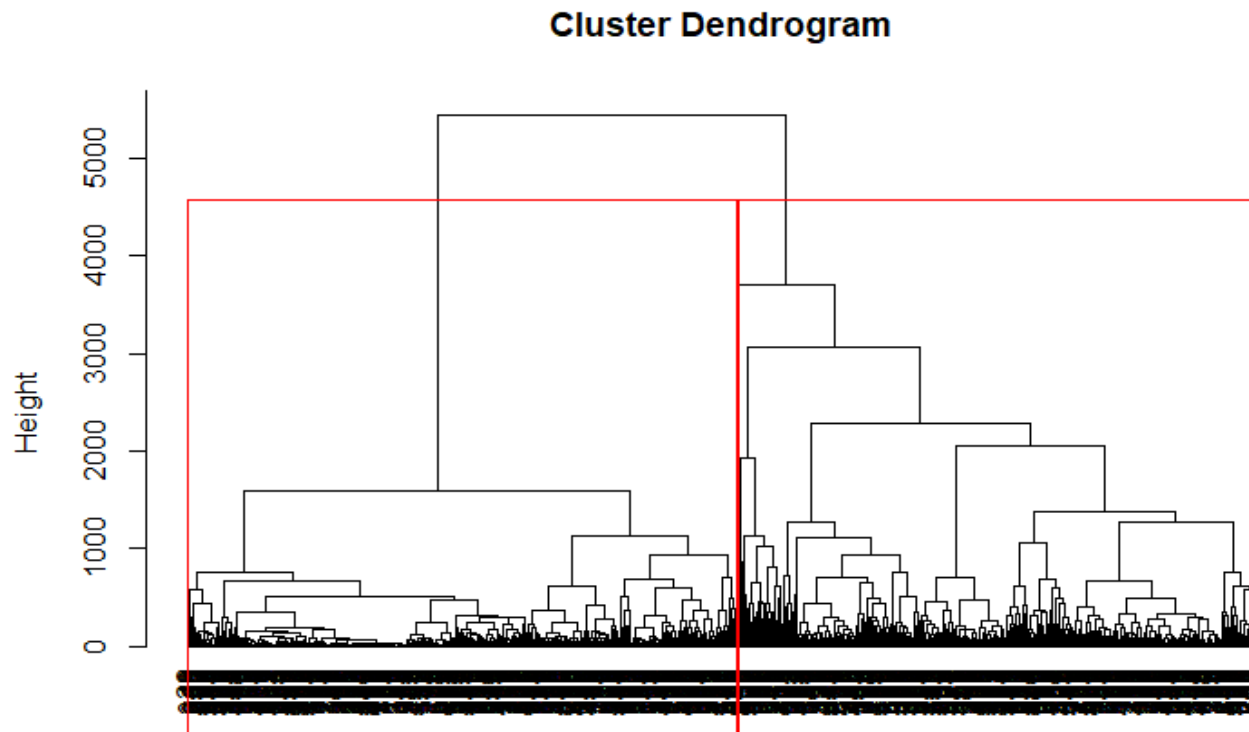
Shared AVs



Cluster Analysis

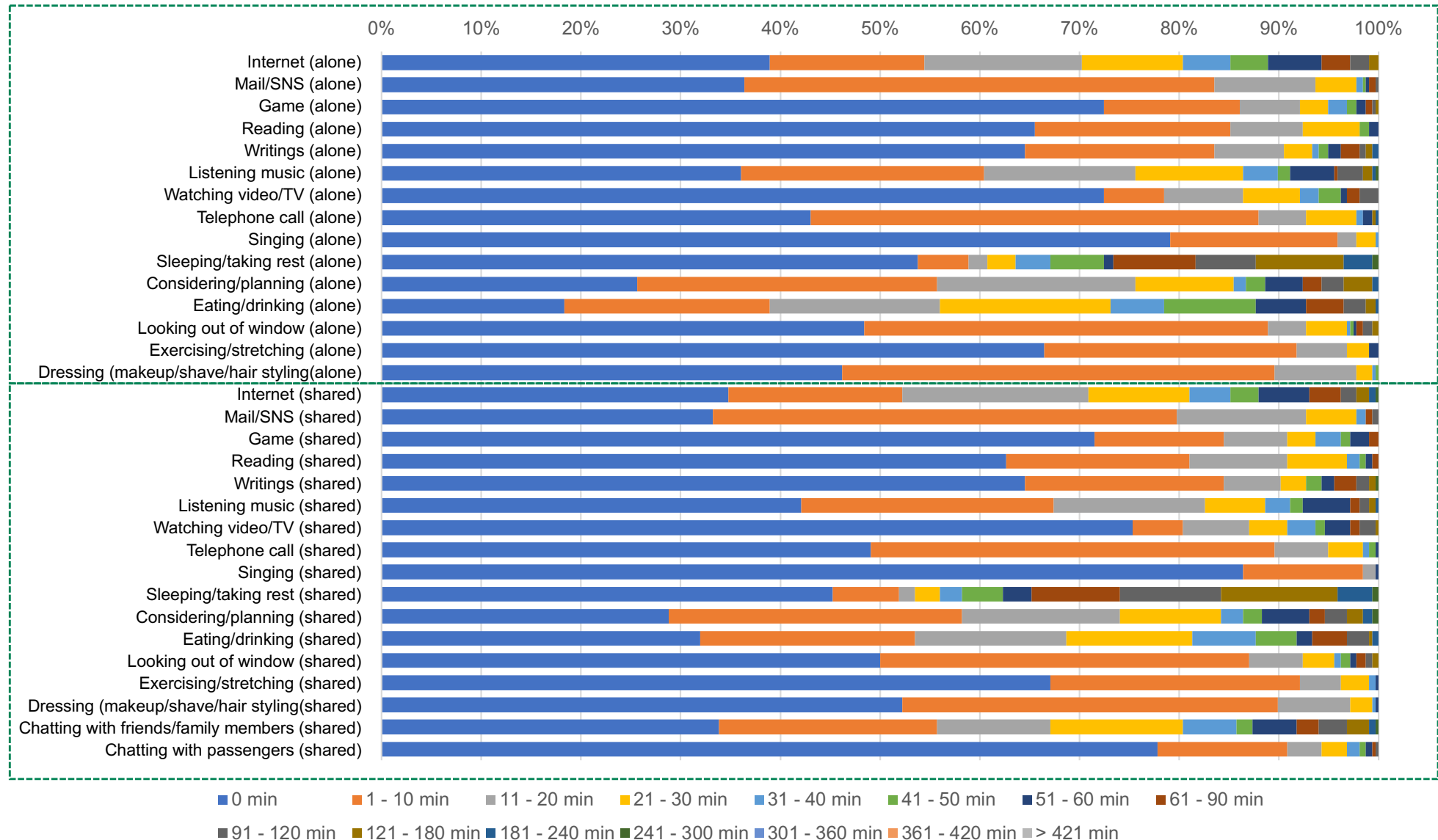
Classification into heterogeneous samples of feasibility of multitask activities

- Group 1: Lower feasibility
- Group 2: higher feasibility



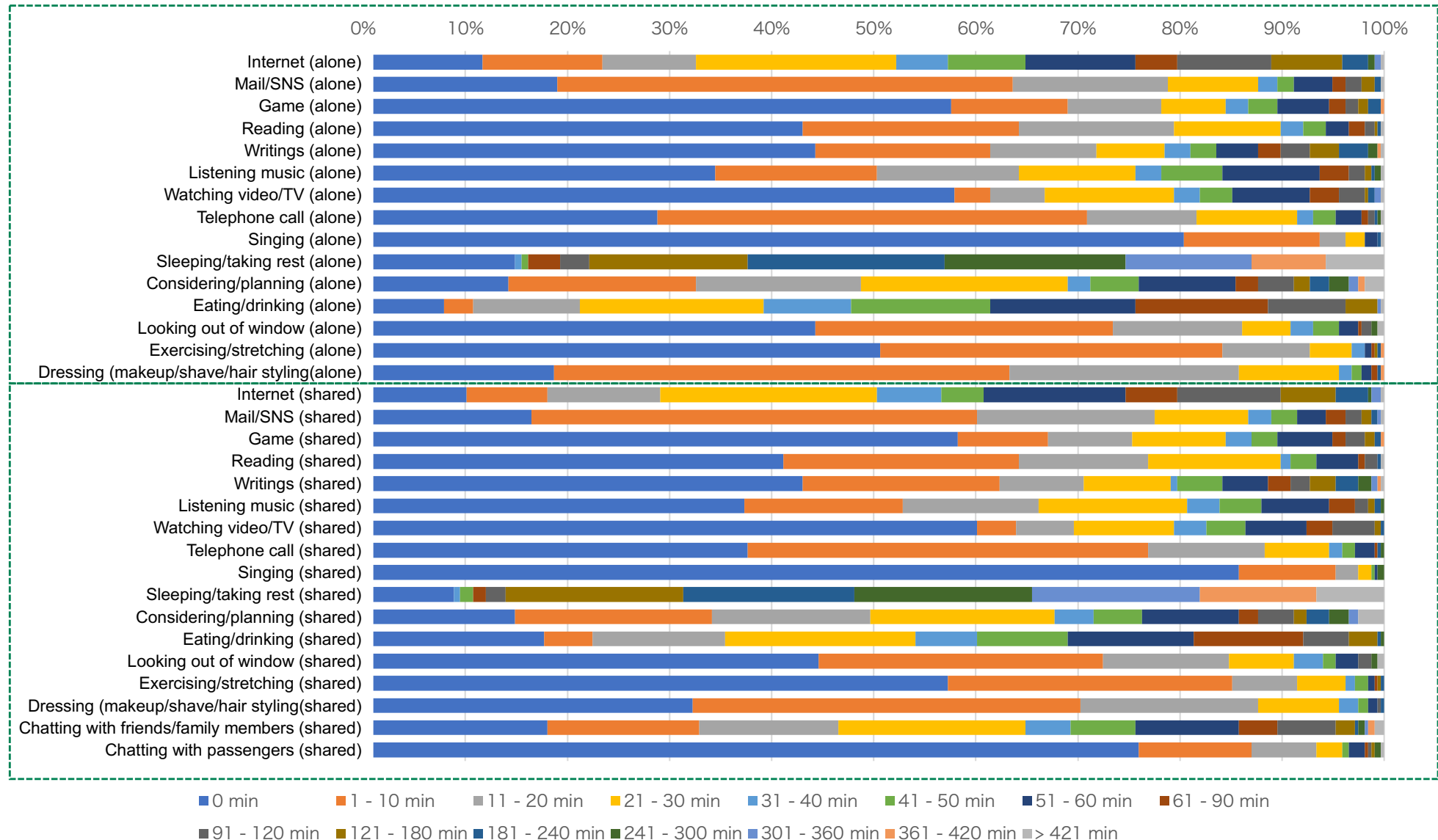
Feasibility of multitask activities on board

Group 1



Feasibility of multitask activities on board

Group 2



Residential (rent house) choice model

Panel binary mixed logit model

$$P_{1it} = \int_{b_i} \left[\frac{\exp(V_{1it} + b_i)}{\exp(V_{1it} + b_i) + \exp(V_{0it})} \right] f(b_i) db_i$$

P_{jit} : choice probability for individual i to choose alternative 1 (house A) at t th choice condition

V_{jit} : systematic term of utility for individual i alternative j at t th choice condition

b_i : random effect representing influence of unobserved factors for individual i
(suppose to follow normal distribution $f(b_i)$)

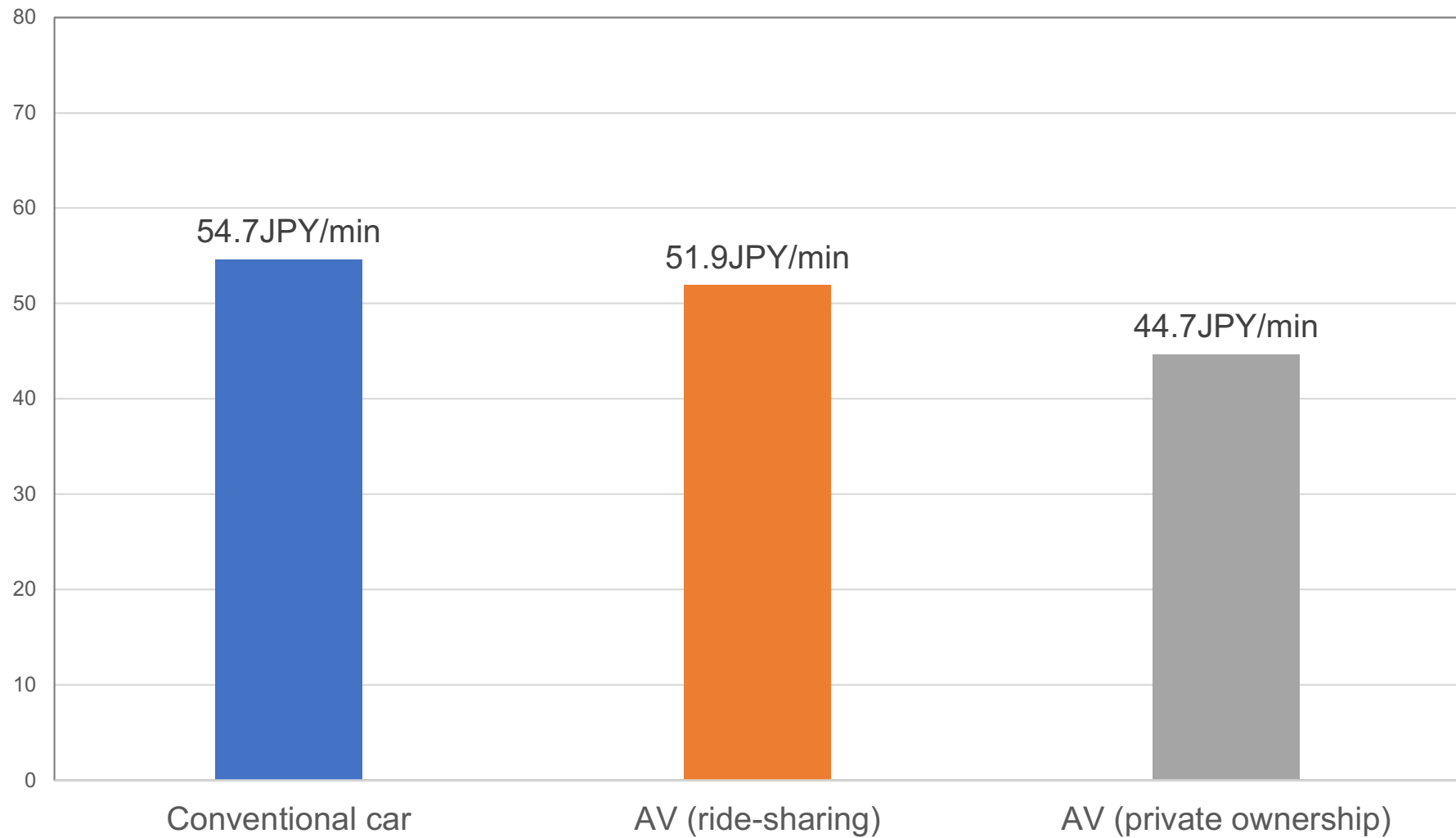
$V_{1tj} = \beta x_{1it}$	←	commuting time to office (min)
$V_{0tj} = \beta x_{0it}$		house rent (thousand JPY)
		floor area (m ² /100)
		Distance to closest superstore (km)
		Time to closest railway station (min)
		Time to closest bus stop (min)

Estimation result of residential choice models

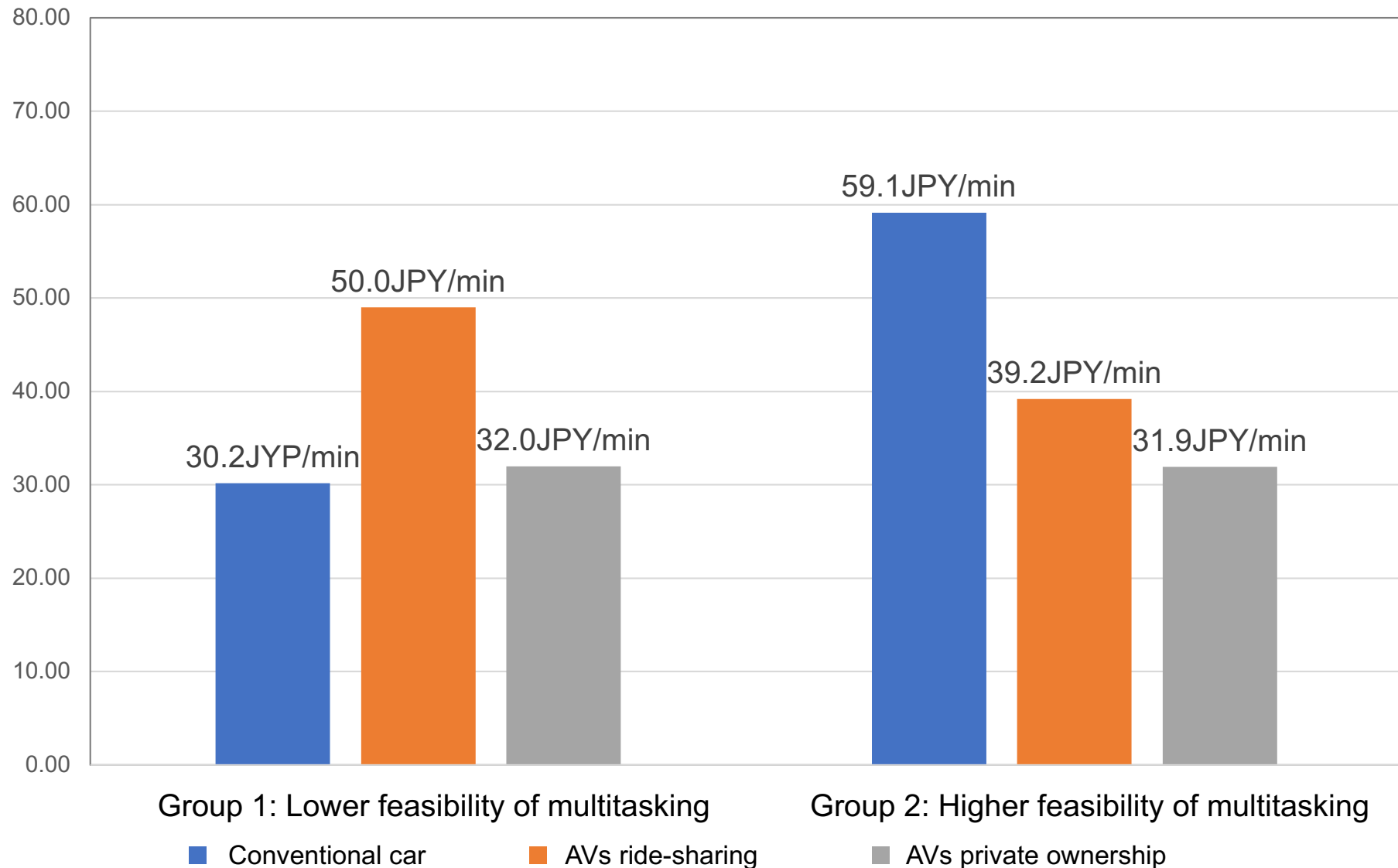
Variables	Conventional car			AVs (ride-sharing)			AVs (private ownership)		
	Parameter	Z-value		Parameter	Z-value		Parameter	Z-value	
Commuting time to office (min)	-0.0155	-3.03	**	-0.0152	-2.99	**	-0.0120	-2.35	*
House rent (10 thousands JPT)	-0.352	-15.6	**	-0.343	-15.10	**	-0.374	-16.01	**
Floor area (m ² /100)	2.091	12.4	**	1.812	11.12	**	1.648	11.69	**
Distance to closest superstore (km)	-0.328	-2.4	*	-0.290	-2.17	*	-0.290	-2.14	*
Time to closest railway station (min)	0.0110	0.17		-0.0177	-0.28		0.00941	0.15	
Time to closets bust stop (min)	-0.246	0.20		-0.0572	-0.30		-0.162	-0.84	
Random effect (variance of b_i)	0.0719			0.0544			0.0470		
Number of samples	229			2294			2294		
Initial log-likelihood	-1576.9			-1577.3			-1580.1		
Maximum log-likelihood	-1356.0			-1380.4			-1355.4		
Rho ratio	0.1401			0.1248			0.1422		

** : 99% confidence level, * : 95% confidence level

Willingness to pay for travel time saving



Willingness to pay for travel time saving



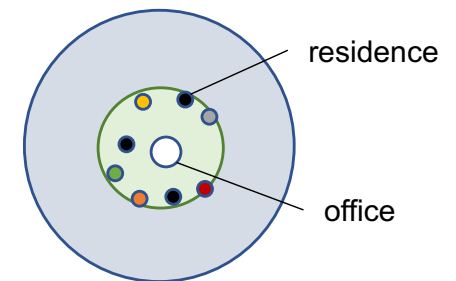
Main findings

- While introducing AVs ride-sharing has a smaller impact on urban form (residential distribution), AVs private ownership will make commuters inhabit suburb areas away from downtown.
- The higher feasibility group of multitask activities on board tends to change their residence by AVs.

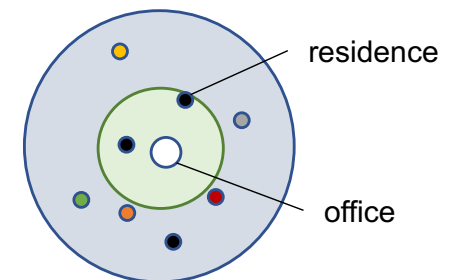
Future works

- Simulation analysis in real space

Conventional cars



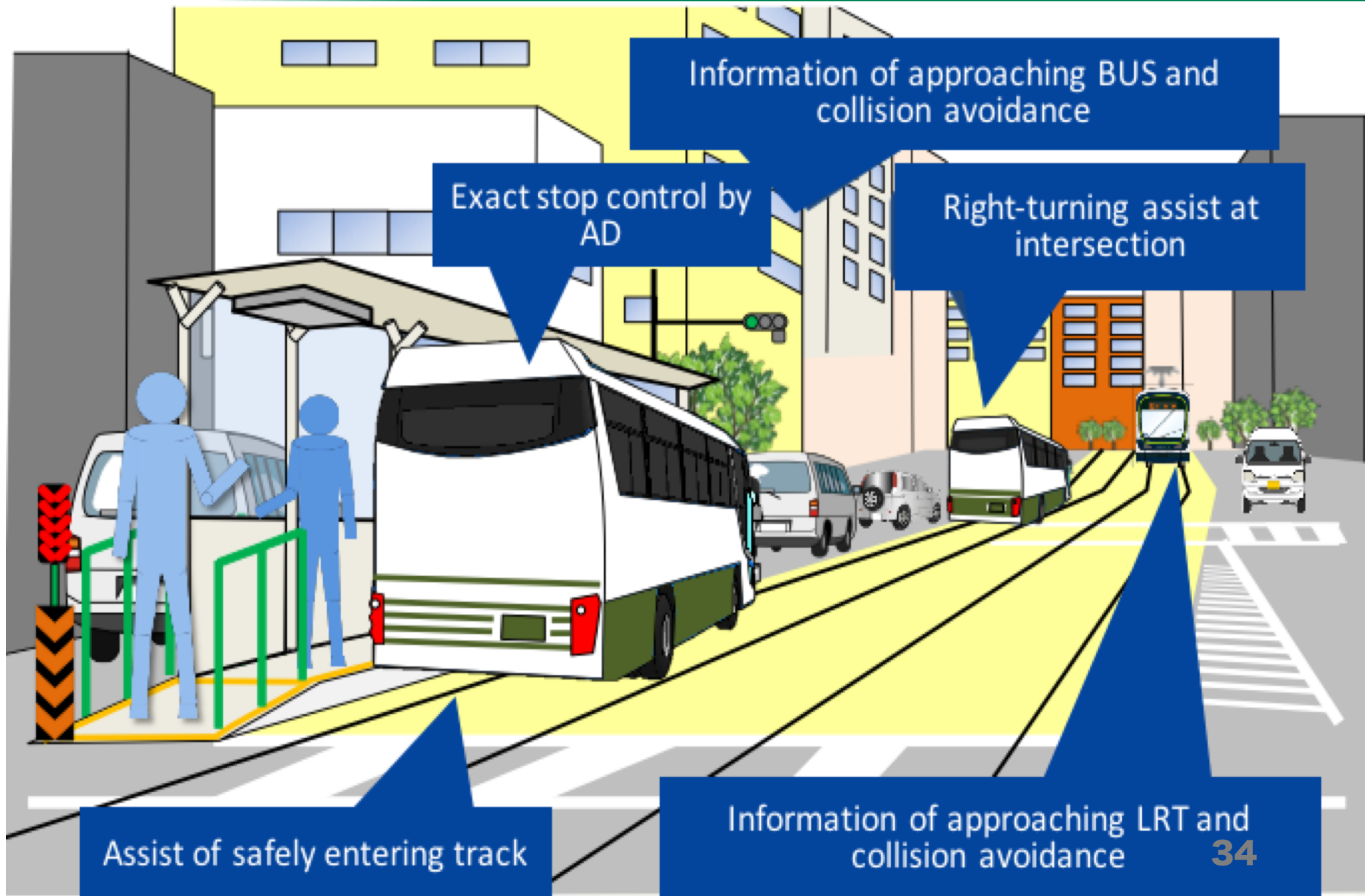
AVs ride-sharing/
private ownership



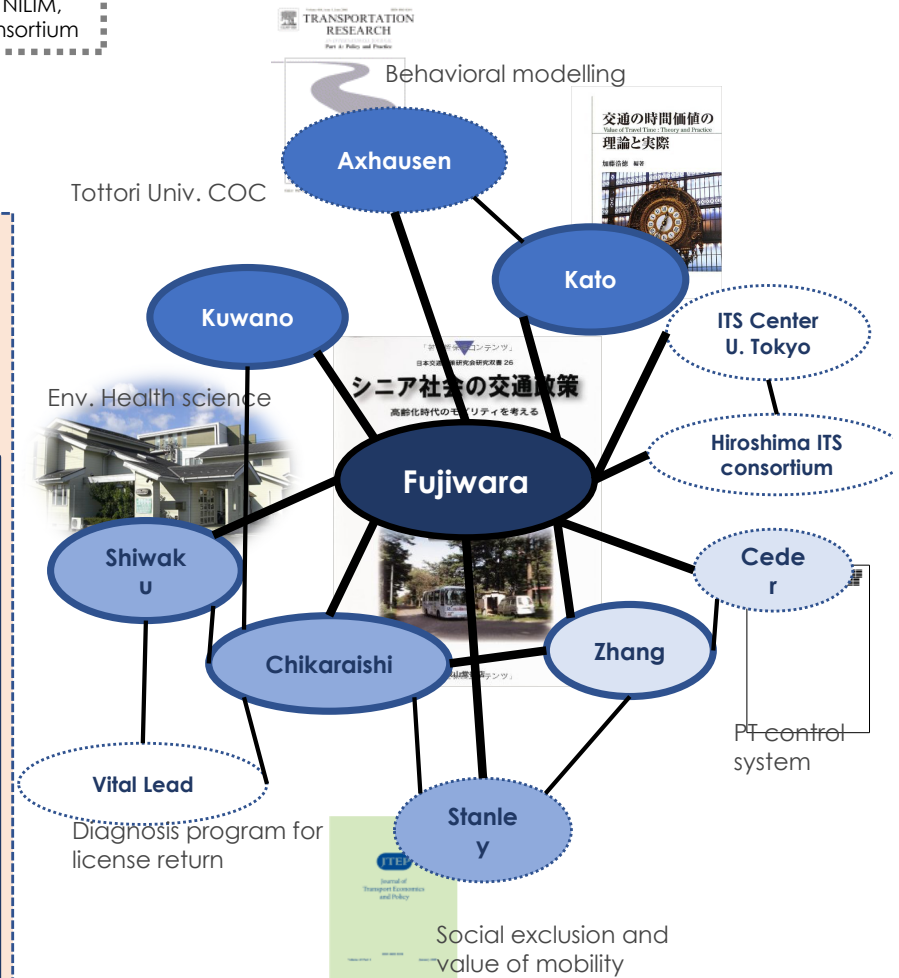
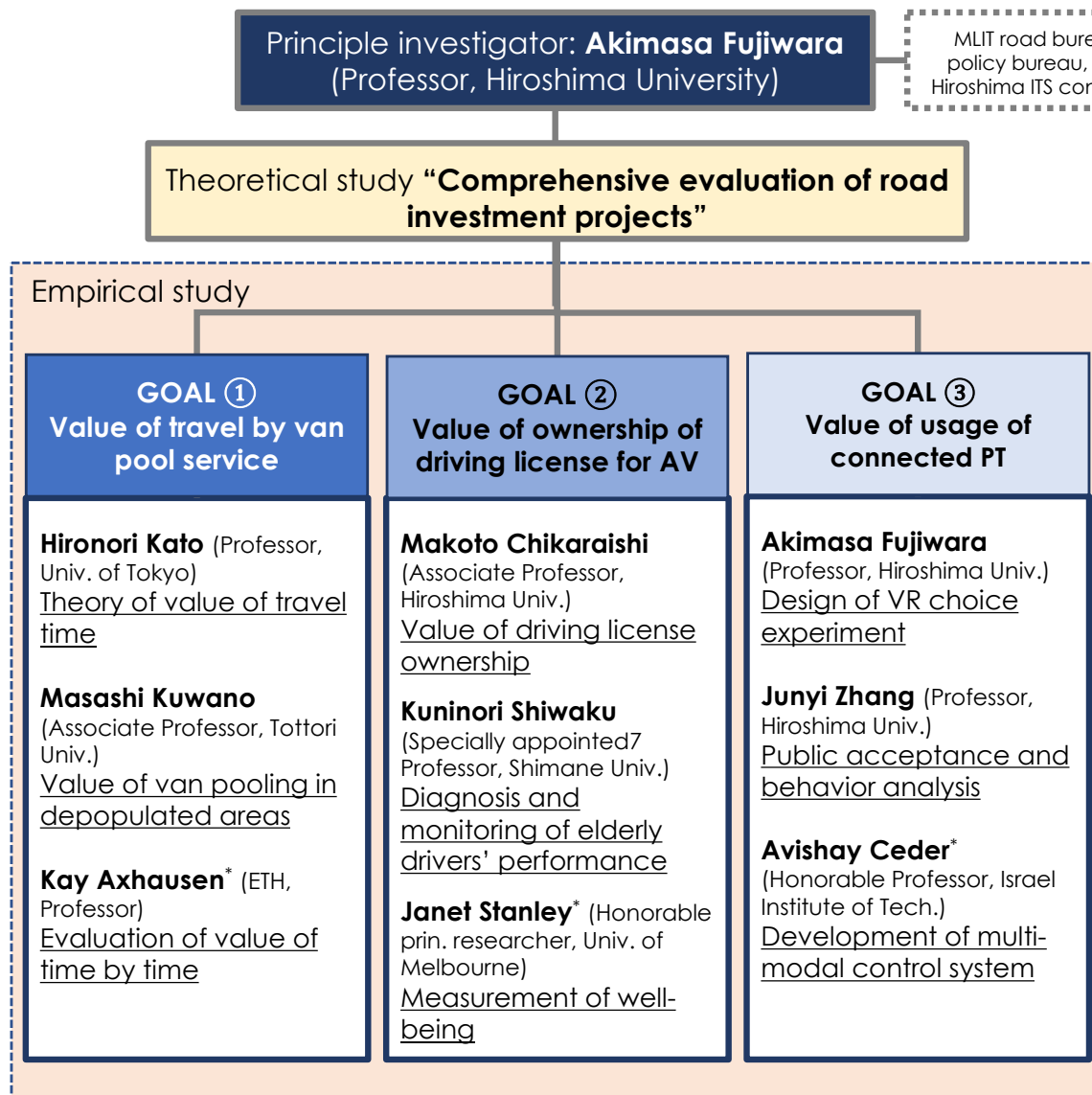


Measurement of Public Acceptance of Connected Multimodal AVs

Connected AVs

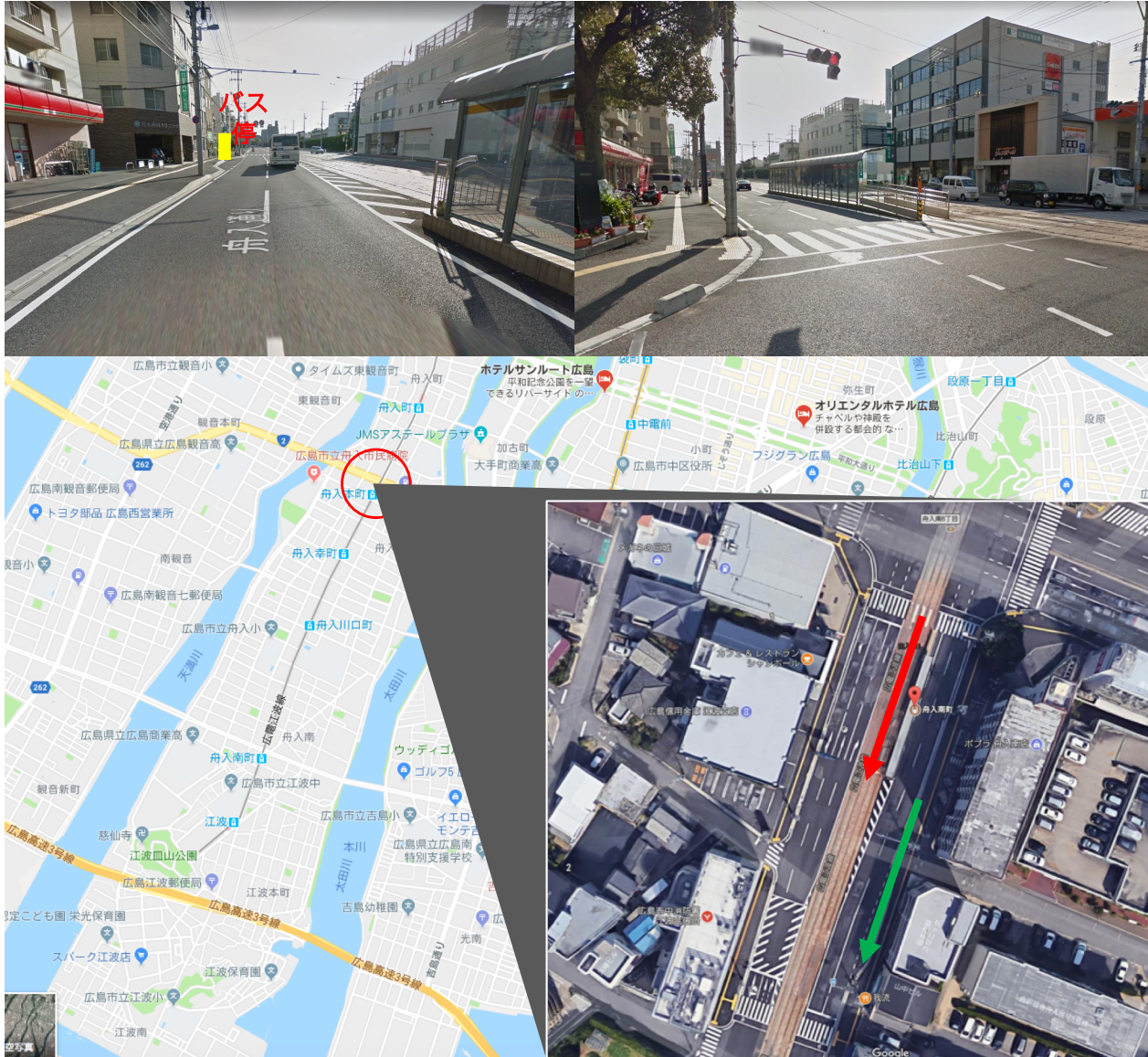


Project team



Note: Domestic researchers from the fields of transportation planning, urban engineering, preventing medicine put in charge of this project. In addition, distinguished overseas researchers (*), who are current and former visiting professors in Hiroshima University will also join us.

Design of VR Choice Experiment



Sampling

- Stratified sampling (age, car availability)

Control variables

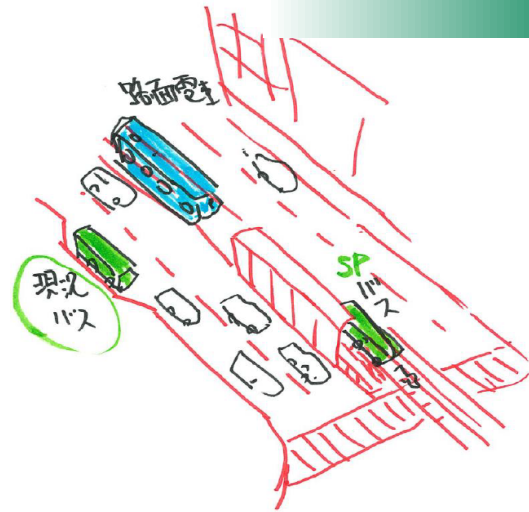
- Risk perception (car following, exact stop, self-driving)
- LOS (waiting time, waling distance)

Experiment

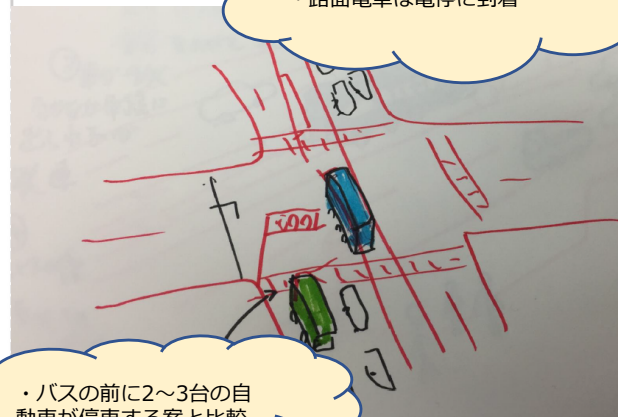
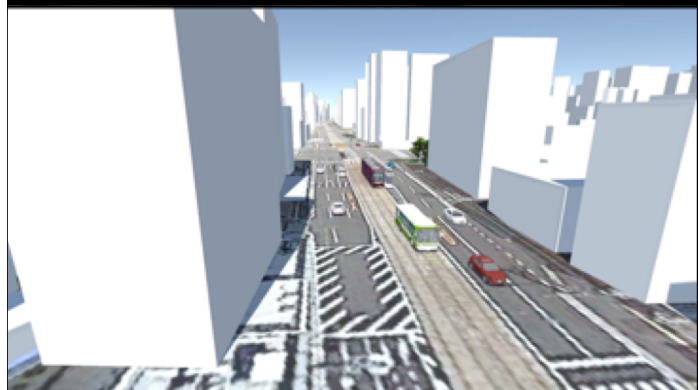
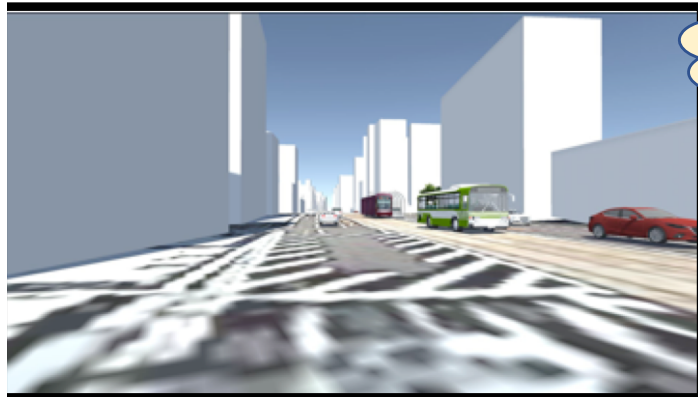
- Choice intention (repeated) and point-of-regard measurement

Bird's eye images

Scenario 1: without



3D image
(Bus running on LRT track)



- ・バスの前に2~3台の自動車が停車する案と比較



- ・電車は乗客を乗せて発車
- ・路線バスは、前をゆっくり走る軽トラックの横を走り、バス停に停車後、乗客を乗せて発車
- ・車が多く時間をかけて車線に出る
- ・バスの発車後、車が少し渋滞

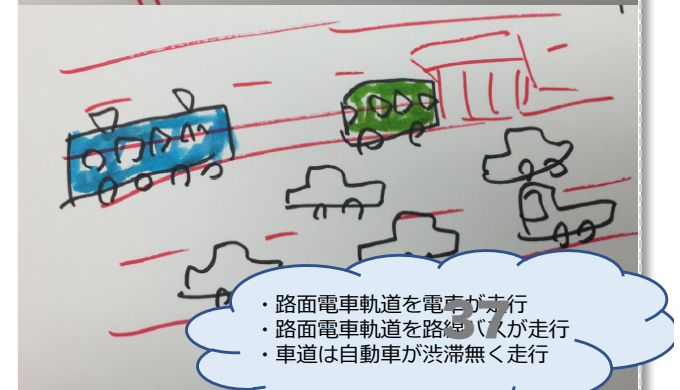
Scenario 2: with



- ・赤信号直前に路面電車軌道に路線バスが進入
- ・電車に続いて、路線バスも交差点を通過



- ・電車で路面電車に乗客が乗降
- ・路面電車が出発後に、路線バスが電停に入り乗客が乗降



- ・路面電車軌道を電車が走行
- ・路面電車軌道を路線バスが走行
- ・車道は自動車が渋滞無く走行

VR experiment (current)

Scenario 1-1: Just before yellow sign, a LRT can go ahead because of PTPS, while a bus must stop due to congestion.



VR experiment (current)

Scenario 1-2: The bus still stays at same position, but the LRT collects passengers at stop ahead.



VR experiment (current)

Scenario 1-3: The Bus is approaching a bus stop after green signal, but cannot enter the bus bay because of congested cars ahead. The LRT has gone.



VR experiment of autonomous bus

Autonomous Bus Scenario 1-1: A bus on road automatically enters LRT track and runs behind a LRT just before signalized intersection.



VR experiment of autonomous bus

Autonomous Bus Scenario 1-2: Just before yellow sign, a LRT can go ahead because of PTPS. A bus also can pass the signal behind the LRT.



VR experiment of autonomous bus

Autonomous Bus Scenario 1-3: Both LRT and autonomous bus exactly stop at the stop to collect passengers at the same time. The passengers can choose a preferable mode at the same stop.



VR experiment of autonomous bus

Autonomous Bus Scenario 1-4: LRT follows the track. But bus comes back to road lane after passing an intersection and operates ordinarily.



AVs which realize multi-tasking behavior during travelling change the value of travel time saving. On-board activities increase efficiency and consequently increase the demand of long-distance travel at some point not far in the future.

This implies that the coming of age of auto-sapiens is inevitable. We need to be ready for the antinomy between transport planning and urban planning.



Development of a GPS-enabled Smartphone app for improving driving safety

Junyi ZHANG (Prof., Dr. Eng.)

zjy@Hiroshima-u.ac.jp

International Seminar of Chungnam Institute: Sustainable
(Eco-Friendly and Advanced) Transport for Mobility,
September 11, 2019

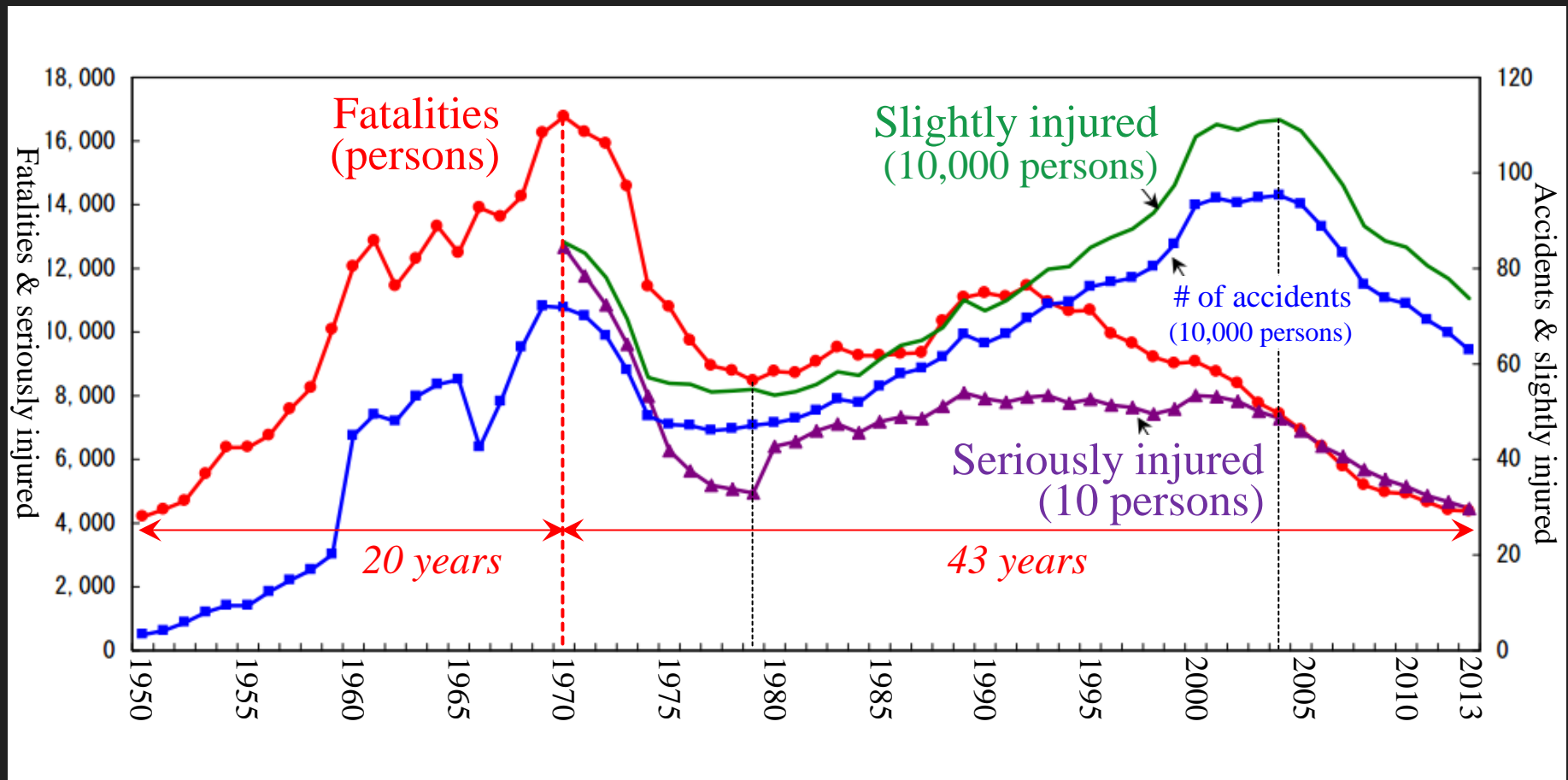


Background

Traffic accidents in Japan

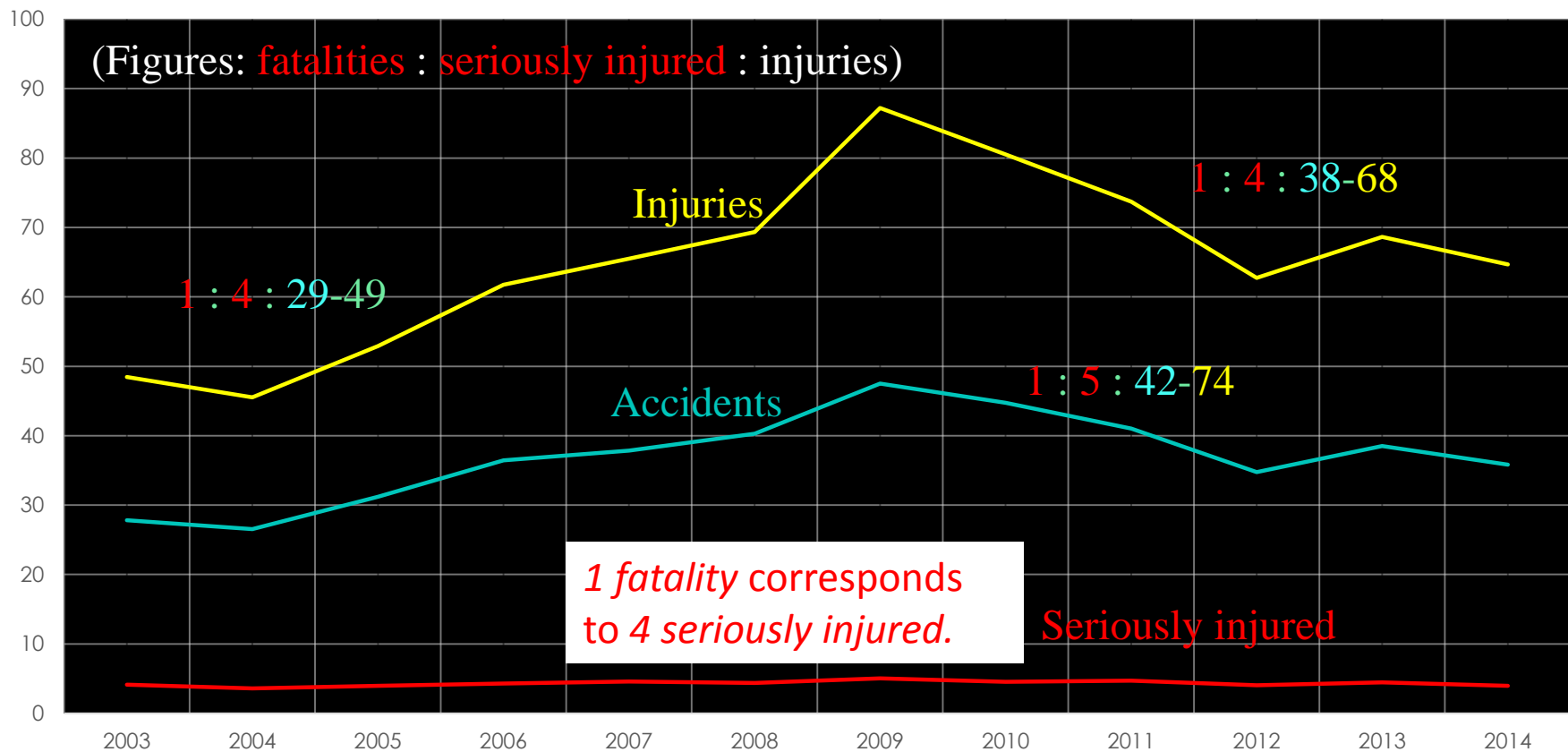
Background

Trend of traffic accidents in Japan



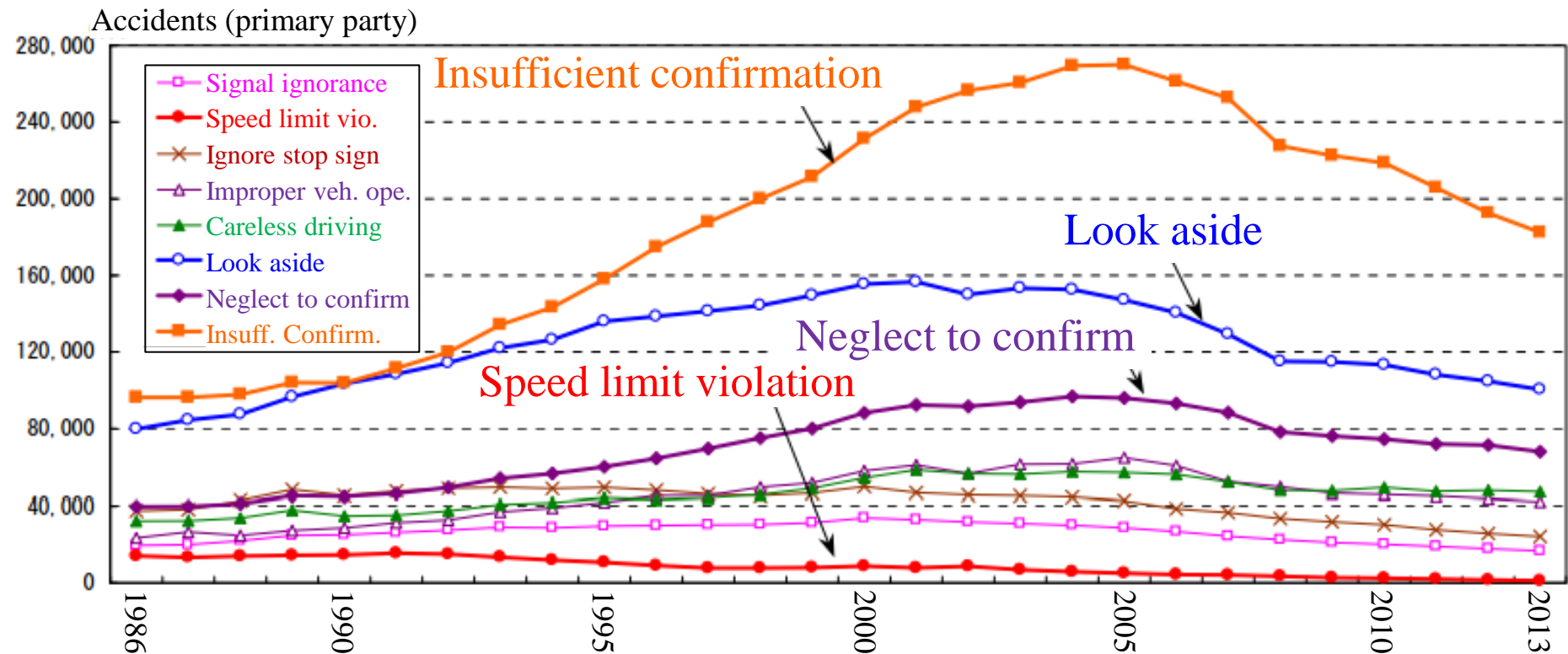
Background

Ratios of numbers of accidents, injured, and seriously injured to fatalities



Background

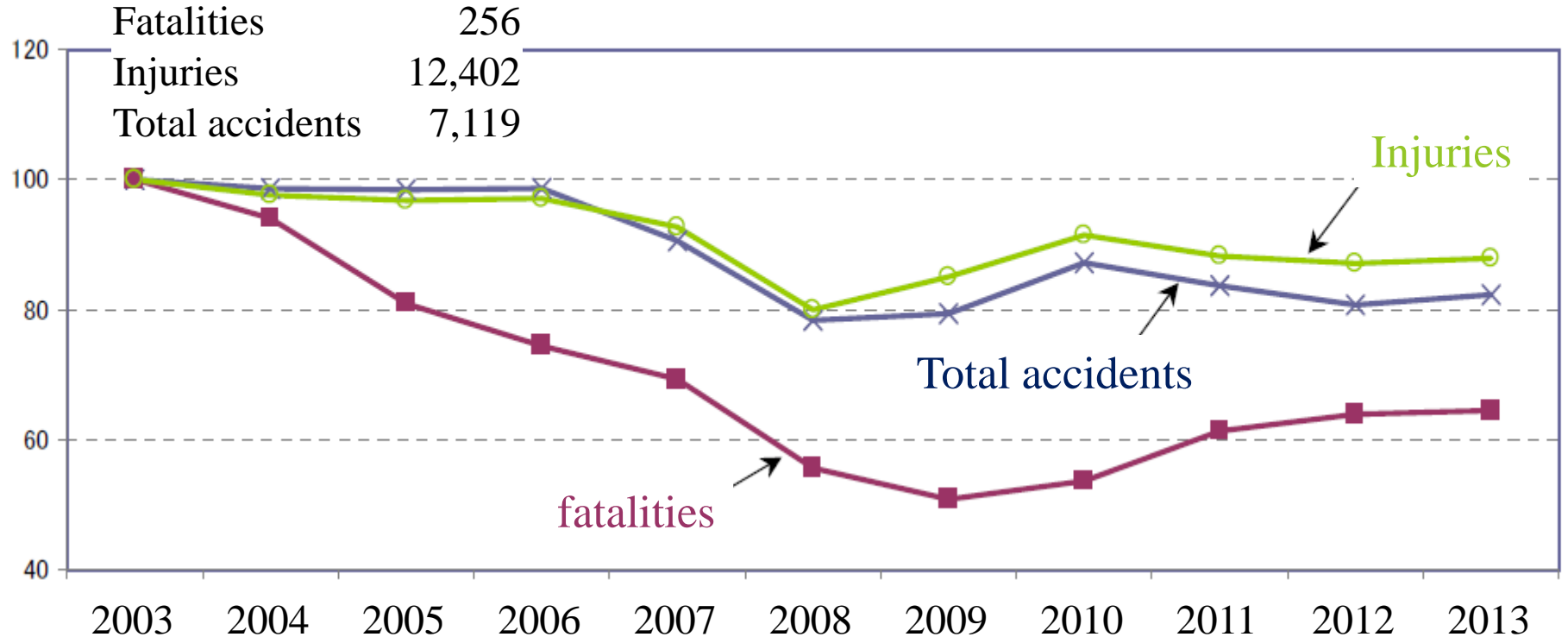
Traffic accidents by human errors in Japan



Background

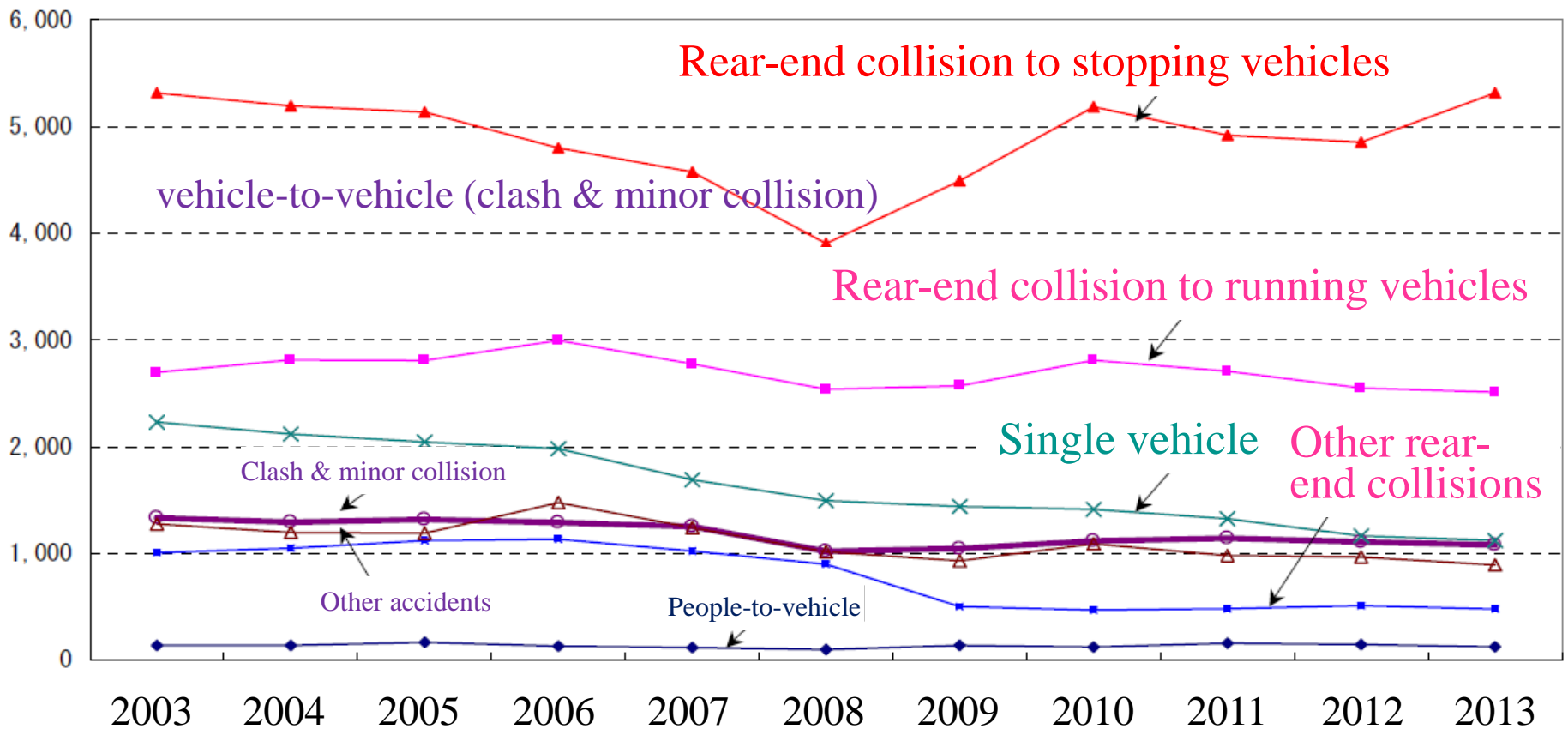
Fatality rate on expressways is more than **2 times** higher than that on other roads.

Traffic accidents on expressways in Japan



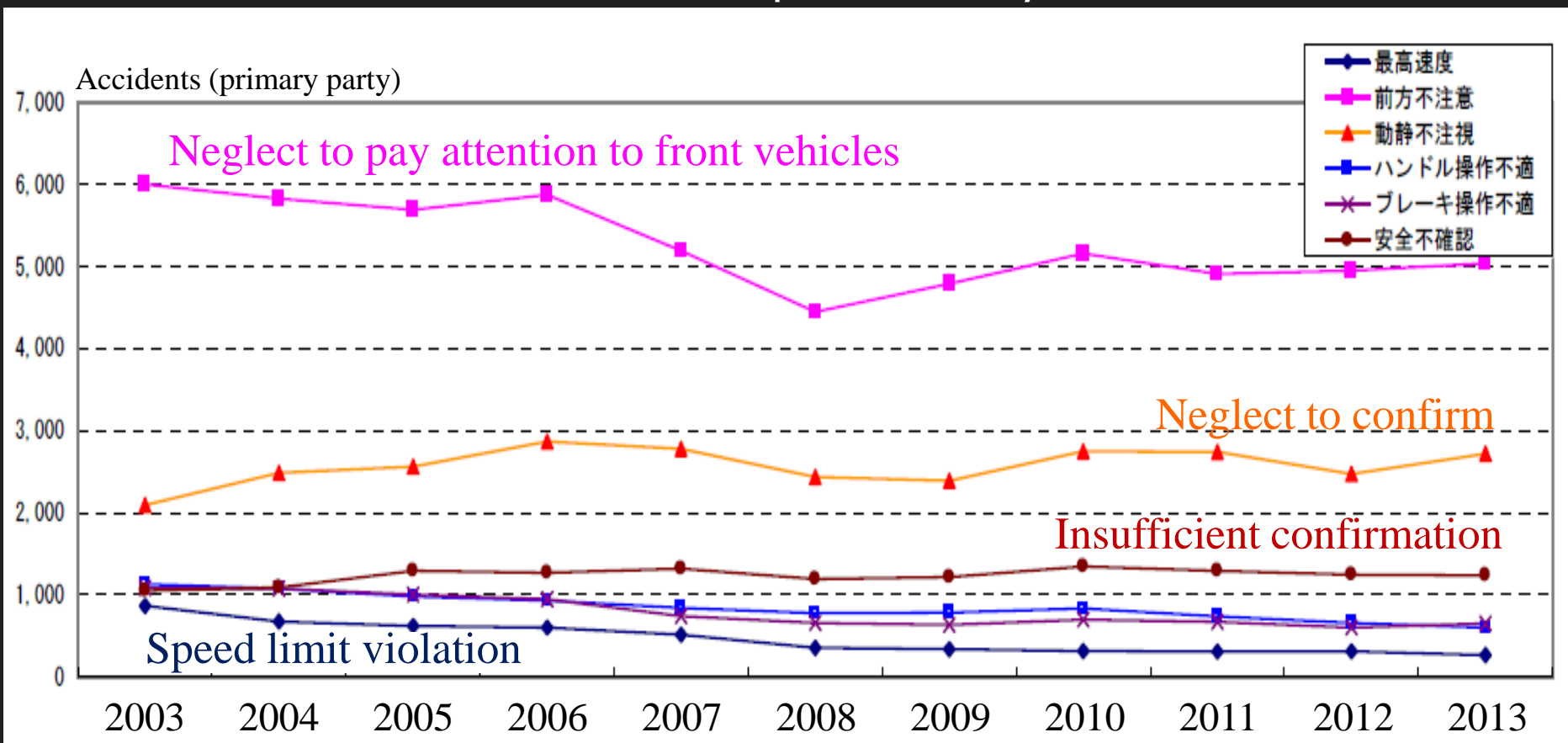
Background

Traffic accidents on expressways in Japan



Background

Traffic accidents on expressways: Human errors



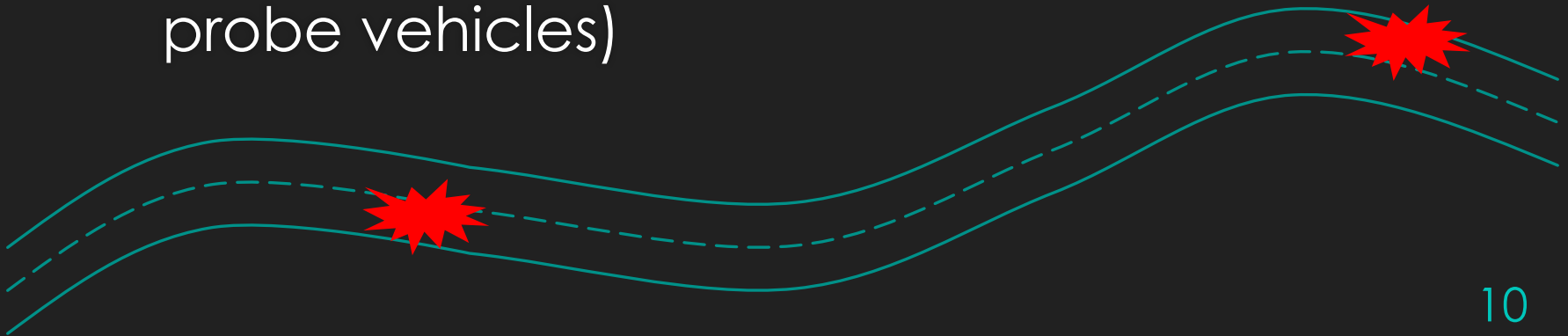
Why smartphone apps?

Needs of traffic management

Data for traffic management

○ Realities

- ✓ Accidents can occur at any point of a road.
- ✓ But, fixed-point observations are dominant: traffic situations within a road section can be observed.
- ✓ Continuous observations over time and across space are required, but limited efforts (e.g., probe vehicles)



Data for traffic management

- Do traffic safety managers know where are dangerous in the road sections under control?
 - Yes, because they know where accidents occurred. They are *reactive* to the occurrence of accidents, but too late!
 - However, they don't know where and when next accidents will occur. They must be *proactive* to prevent the occurrence of accidents in advance.

Are drivers aware of their safety level?

- Traffic safety education
 - At elementary schools
 - Updating of driving licenses (every 3 – 5 years): video-based and instructor-guided for an arbitrary group of drivers (30 – 120 min).
 - Community-based traffic safety education: no-show of dangerous drivers
 - Traffic safety campaigns (spring and fall) to the general public.
- Unfortunately, drivers' safety consciousness may change as time passes.
- Are drivers aware of their safety level?
 - Unclear: where, when, how dangerous, ...

Opportunities

- Core concept of service science
 - Value co-creation for sustainable service!
- Rapid diffusion of smartphones
 - GPS function
 - Download: free & simple
 - App download service are widely used



Driving safety diagnosis apps

○Japan

Insurance Company	Name of App
Sony Assurance Inc.	Japanese name: ドライバーズナビ (DriversNAVI)
Sompo Japan Insurance Inc. Nipponkoa Insurance Co., Ltd.	Japanese name: セーフティサイト (Safety Sight)
Mitsui Sumitomo Insurance Co., Ltd.	Japanese name: スマ保 (SumaHo)
Aioi Nissay Dowa Insurance Co., Ltd.	Japanese name: サポNAVI (SaPoNAVI)

Driving safety diagnosis apps

○ Other countries:

- ✓ Drivesafe.ly Pro
- ✓ Canary
- ✓ Drive Smart
- ✓ DriveScribe
- ✓ MamaBear
- ✓ Sprint's Drive First
- ✓ FleetSafer Mobile
- ✓ Textecution
- ✓ Cellcontrol
- ✓ Kyrus Mobile, ...



More apps
will be in
the market
in future!

Questions

Should we promote the use of smartphone apps for improving traffic safety?

Purposes

- To answer the research question, it would be better if data from existing apps were available. BUT, the reality is “unavailable”!

Then, how to do?

- To develop a simplified GPS-enabled driving safety diagnosis tool (called **Safety Supporter: セーフティサポーター©**).
- To implement a three-month driving experiment on expressways.



Safety Supporter セーフティサポーター©



Basic Functions

- Safety diagnosis based on three indicators of driving risks; advices are given accordingly.
 - (1) violation of speed limit
 - (2) sudden acc. & dec.
 - (3) driving stability
- Driving trajectory and advices on safer driving
- Provision of black spot information on expressways (voice & image)



Definitions and measurements

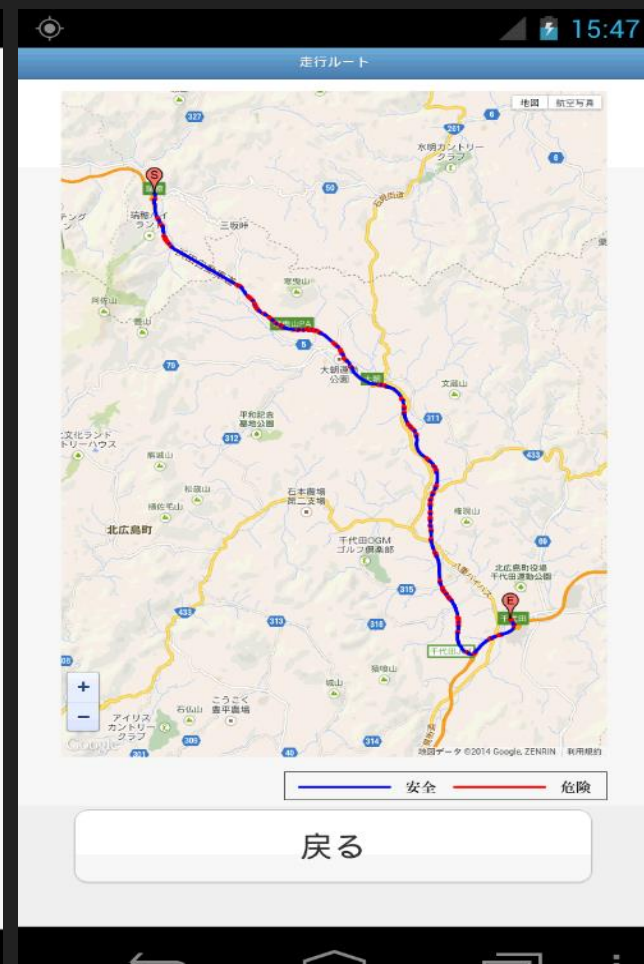
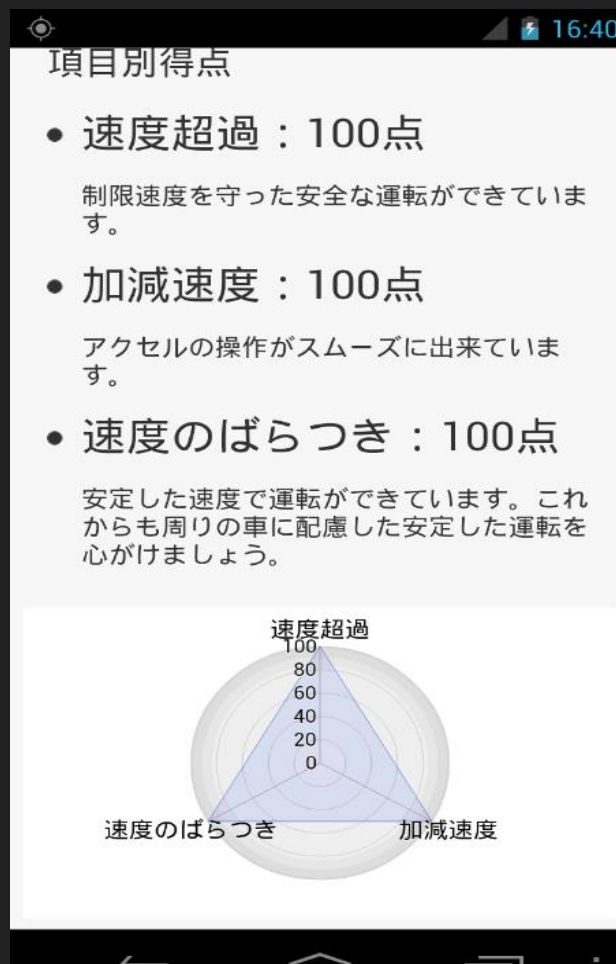
- Compliance level of speed limit: The safest level is given 100 points when driving speed is equal to or slower than speed limit plus 5 km/h and the most dangerous level is given 0 point when driving speed exceeds speed limit by more than 50 km/h. Other driving speeds are scored depending on how much speed limit is violated. The scoring is given by reflecting the levels of fines determined by policy agencies.
- Abrupt acceleration and deceleration: If the absolute value of acceleration or deceleration is larger than 0.3 G or 2.94 m/s², the safety level is judged to be the most dangerous level, i.e., the score is set to 0 point. If the absolute value is 0.0 G, the score of safety level is 100 points, i.e., the safest level. Other instantaneous speed changes are scored depending on how large of the acceleration/deceleration.
- Driving smoothness: We define a time period that covers four seconds before and after a second under study, and the second, i.e., the total time period is nine seconds. If the driving speed is 80 km/h, the nine seconds correspond to the distance of 200 m. If the driving speed at a second within the nine seconds is equal to the median (Y) of all the nine speed values, the score of safety level is set to 100 points, i.e., the safest level. If the driving speed is beyond the range of $Y \pm 2\sigma$, where σ is the standard deviation, then the score of safety level is set to 0, i.e., the most dangerous level. Other speed values are scored between 0 and 100 points depending the deviation from the median.

Safety Supporter

セーフティサポーター©



Basic Functions



Safety Supporter

セーフティサポーター©



Additional Functions

- Provision of service area (SA) and parking area (PA) information for preventing drowsy (long-distance) driving
- Ranking of driving safety among drivers
- Average score display
- Driving propensity diagnosis
- Online safety campaign



Safety Supporter セーフティサポーター©



Driving experiment on expressways

Chugoku Region,
Japan

Total length > 1,200 km



Driving Experiment			Sample	100 drivers
			Requirement	More than 4 times expressway usage in western part of Japan (Chugoku area (Tottori, Shimane, Okayama, Hiroshima, Yamaguchi Prefecture))
Week	Duration	APP Ver	Additional APP function	Questionnaire survey date
Before experiment	—	—	—	First: 2/10
1~4 week	2/14~3/13	Ver1	①Driving data collection (no info)	2nd: 2/28 3rd: 3/7
5~6 week	3/14~3/27	Ver2	②diagnose results and advices ③driving trajectory ④black spot information provision	4th: 3/28
7~8 week	3/28~4/10	Ver3	⑤SA/PA information provision	5th: 4/11
9 week	4/11~4/17	Ver4	⑥ranking among drivers ⑦self-diagnose (scoring)	6th: 4/18
10~11 week	4/18~5/1	Ver5	⑧driving propensity diagnose	7th: 5/2
12~13 week	5/2~5/15	Ver6	⑨Drive & love	8th: 5/16
After experiment	—	—	—	9th: 5/18 10th: 5/20

Driving experiment on expressways

Questionnaire surveys

- for capturing temporal changes
- for capturing time-invariant factors

Driving survey
(Each Trip)

- Multitasking Behavior
- affective experience

Safe Driving
Self-evaluation

- Safe Driving Evaluation
 - ✓ Driving Skill Inventory
 - ✓ Driving Tasks
- Driving Status Evaluation
 - ✓ Stage of change model

Safe Driving
Awareness

- Positive Safety Reinforce
 - ✓ Driving social desirability scale
- Negative Dangerous Avoidance
 - ✓ Driving avoidance behavior
- Safe driving intention
 - ✓ Theory of Planned Behavior
- Aberrant driving behavior
 - ✓ Driver Behavior Questionnaire

Driving
related
items

- App function evaluation
- Accident and fatigue driving experience

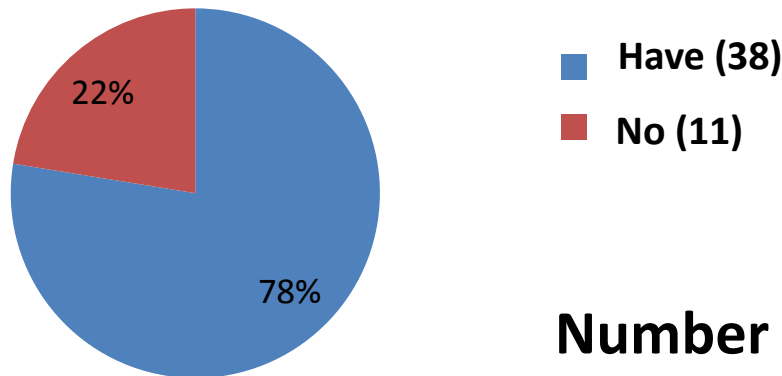
Data

APP Version	Additional APP function	SAMPLE
Ver1	①driving data collection	85 persons
Ver2	②diagnose results & advices ③driving trajectory ④black spot information provision	57 persons
Ver3	⑤SA/PA information	48 persons
Ver4	⑥ranking among drivers ⑦Average score display	37 persons
Ver5	⑧driving propensity diagnose	35 persons
Ver6	⑨Drive & love	31 persons

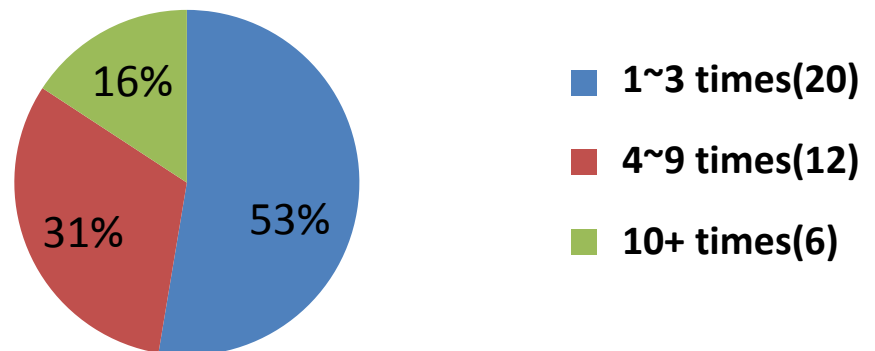
 31 drivers participated in the experiment for all 6 versions and data were collected.

Driver profiles: Relatively risky drivers (frequent users)

Punishment Experience Caused by Traffic Rule Violation



Number Of Punishment Experience Caused by Traffic Rule Violation



Multilevel modeling analysis of driving risks

Free traffic flow situations: > 70 km/h; two or more lanes
→ 187,549 epochs (two-second) from 201 trips made by
15 drivers (all male; 30~59 years old: average 42)

Results: Independent models

Driving risks (smaller > safer) Diagnosis functions	Speed limit compliance	Acceleration / deceleration	Driving stability
Basic function * driving propensity			
Irritable driver (73%)	-0.75	0.46	0.28
Careless driver (60%)	-0.08	-0.04	-0.47
Aggressive driver (60%)	1.44	-0.32	-0.51
Excessively confident driver (60%)	-0.54	0.17	0.20
Additional app function			
Function_1 (SA/PA information)		0.15	1.72
Function_2 (Ranking/self-diagnose)	0.52	1.55	-0.12
Function_3 (Driving propensity)	-0.47	-0.41	0.07
Function_4 (Traffic safety campaign)	-0.10	0.05	

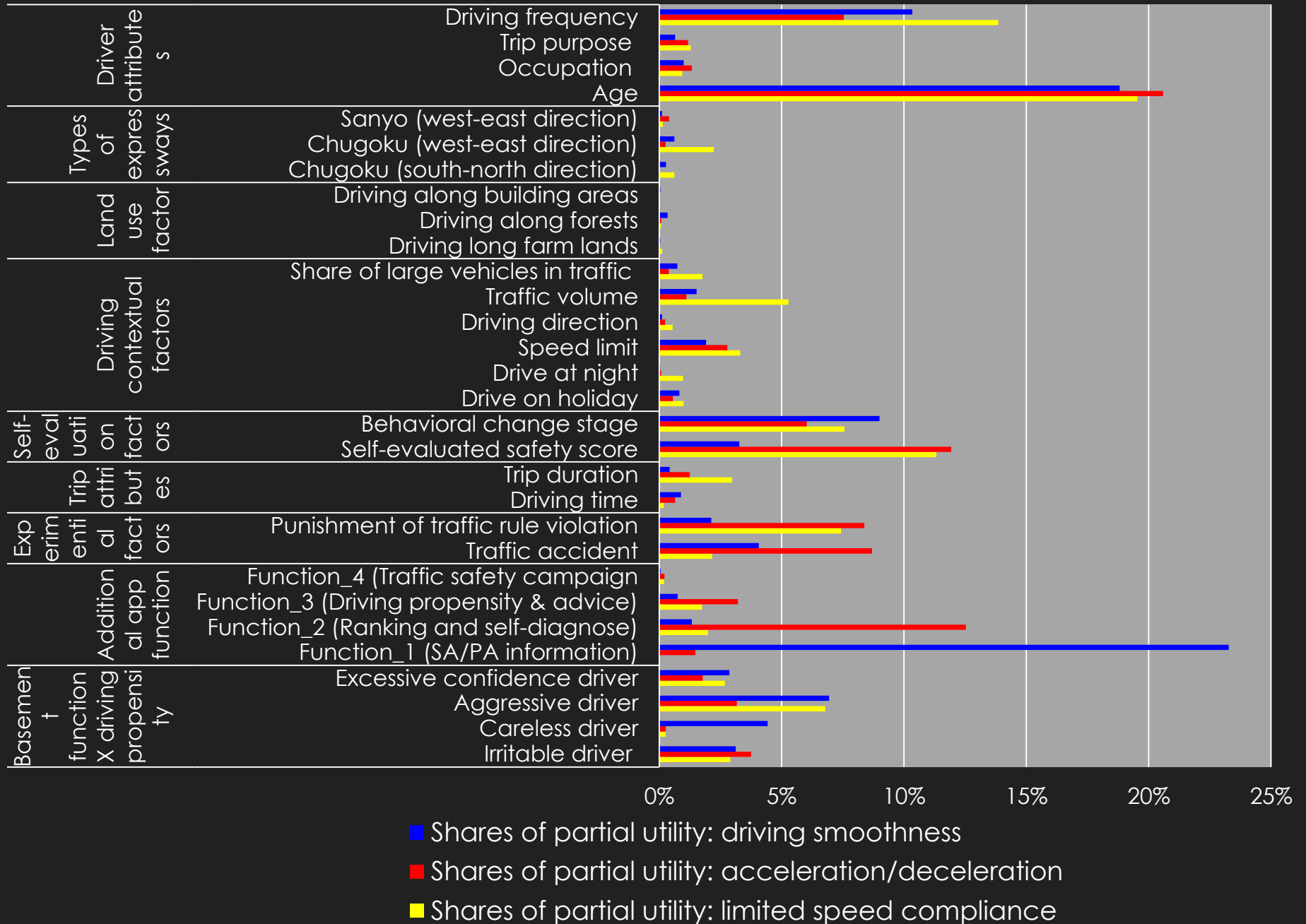
Results: Independent models

Driving risks (smaller > safer) Contextual factors	Speed limit compliance	Acceleration / deceleration	Driving stability
Driving time-period factors			
Drive on holiday	0.49	-0.13	-0.14
Drive at night	-0.27		
Traffic factors			
Speed limit	0.005	0.002	0.001
Driving direction	0.14	-0.03	0.01
Traffic volume	-0.01	0.001	0.001
Share of large vehicles in traffic	-0.96	-0.10	-0.14
Land use factors			
Driving long farm lands	0.08		
Driving along forests	0.02		0.03
Driving along building areas	-0.03		-0.02
Types of expressways			
Chugoku (south-north direction)	-0.83		0.13
Chugoku (west-east direction)	-0.72	-0.04	0.07
Sanyo (west-east direction)	-0.04	-0.05	

Results: Independent models

Driving risks (smaller > safer) Driver factors	Speed limit compliance	Acceleration / deceleration	Driving stability
Experiential factors			
Traffic accident	0.43	0.82	0.28
Punishment of traffic rule violation	-1.01	-0.54	-0.10
Trip attributes			
Driving time	-0.05	0.08	0.08
Trip duration	-0.0001	-0.00002	-0.000005
Self-evaluation factors			
Self-evaluated safety score	-0.02	-0.01	-0.002
Behavioral change stage	-1.19	0.45	0.49
Driver attributes	(young driver: more risky)		
Age	-0.06	-0.03	0.02
Occupation	-1.45	0.97	0.53
Trip purpose	-0.23	0.10	-0.04
Driving frequency	-0.89	0.23	0.23

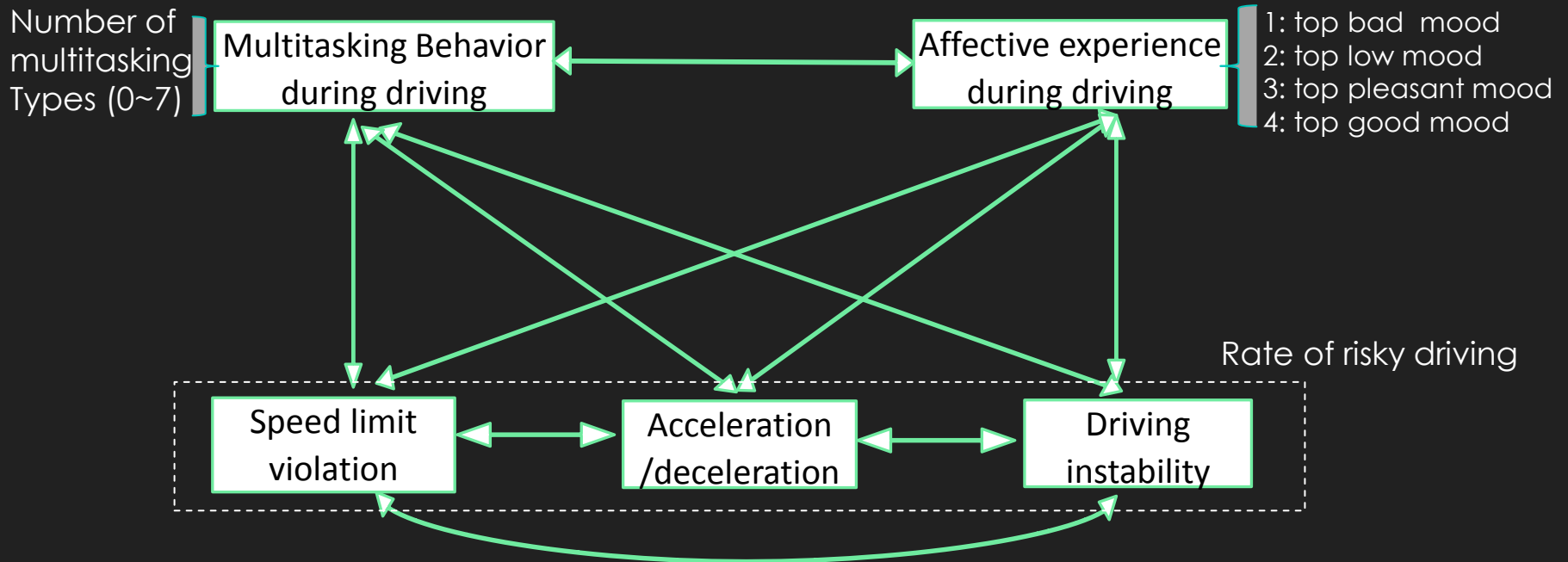
Partial Utility



Influences of multitasking and affective experience

SUR modeling estimations

Seemingly Unrelated Regression (SUR)



Interrelated Dependent Variables

SUR estimations

**Feeling during driving
does matter!**

	Value (large → risky)	Speed limit violation	Driving instability (2 sigma)	Acc/dec (0.3G)	Affective experience (1-bad; 4-good)	# of multi- tasks
<i>Driving violation</i>						
Speed limit violation			0.05	0.07	0.60	-
Acceleration and deceleration		0.34	0.58		0.94	1.71
Driving instability		0.35		0.85	-	-3.67
<i>Affective experiences</i>						
Happy mood		-0.08	-	-		0.27
Top of bad mood		0.11	-	-		-0.39
Top of low mood		-0.09	-	-0.05		0.81
Top of good mood		-0.09	-	-		0.44
<i>Multitasking behaviour</i>						
Operation of radio or car navigation system		0.16	-0.09	0.05	-0.38	
Cell phone operation		-0.08	-	-	-0.38	
Eat and/or smoke		-	-	-	-0.41	
Doze and/or think		-	-	-	-0.49	
Look around and/or turn-back talk		-0.06	-0.04	0.03	-	

Summary: Evaluation of driving risks

- The basic functions: effective in improving the safety levels of 60.0% of drivers (i.e., careless drivers) in terms of speed limit compliance, acceleration/deceleration, and driving stability.
- Focusing on speed limit compliance, the use of the App with basic functions leads to an improvement in driving safety of 60.0%–73.3% of drivers (i.e., irritable drivers and excessively confident drivers).
- As for aggressive drivers (60.0%), their acceleration/deceleration and driving stability could improve when using the app.
- Similarly, additional functions of driving propensity diagnosis and driving advice feedback also contribute to speed limit compliance and better control of acceleration/deceleration.
- The ranking of drivers' diagnosis and self-diagnosis results is useful for improving driving stability. Unfortunately, the provision of SA/PA information did not improve driving safety.

Summary: Evaluation of driving risks

- Traffic safety campaign via smart phones is influential to speed limit compliance, but the influencing power is almost ignorable.
- Traditional enforcement of traffic rules (here, punishment for traffic rule violations) is still a very powerful influence in forcing drivers to drive safely.
- Age is highly influential in relation to driving risks. Moreover, behavioral change stages of driving safety affect driving risks, but only those who desire to improve their driving safety are more likely to obey the speed limit.

Smartphone app as a tool of collecting Big Data

Public acceptance

Psychological resistance

Do you have any psychological resistance to provide personal driving data?

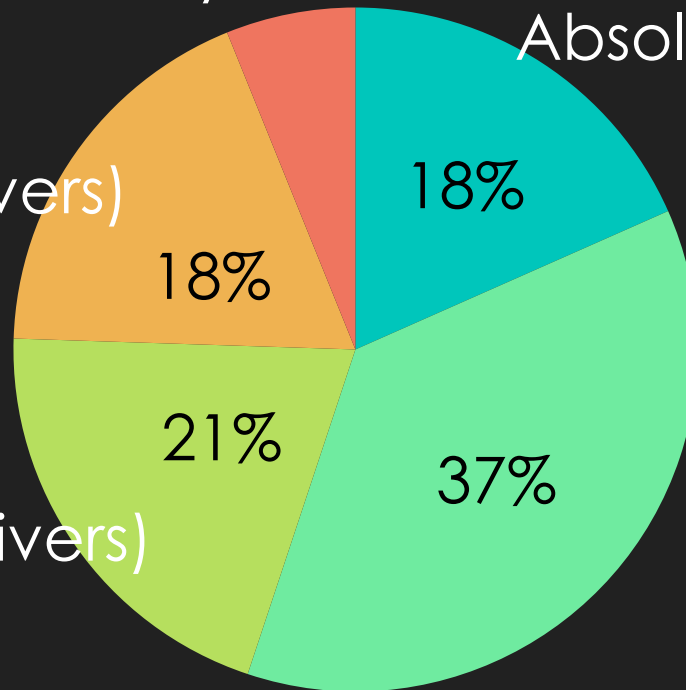
Absolutely yes (3 drivers) 6%

Absolutely no (9 drivers)

Yes (9 drivers)

No (18 drivers)

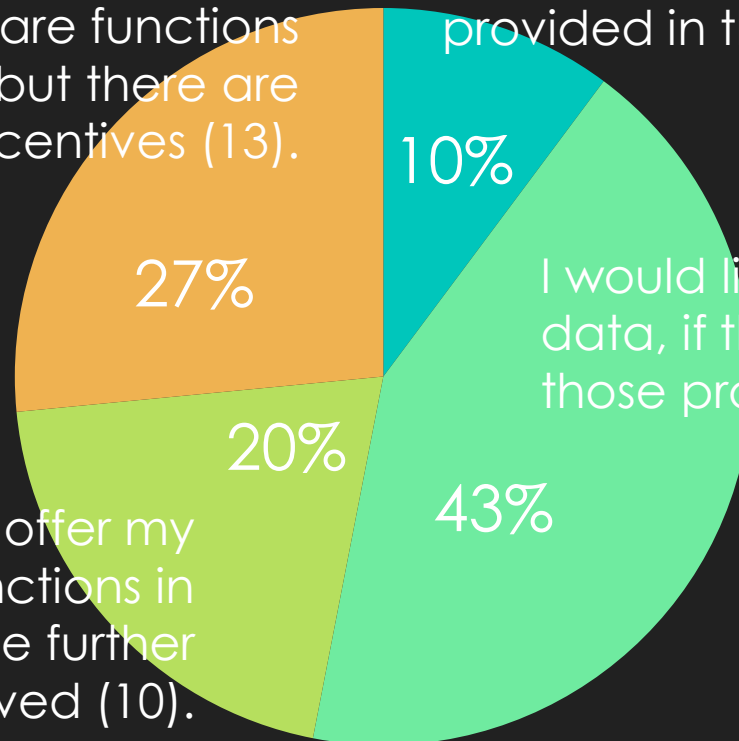
Neutral (10 drivers)



Incentives

I do not want to offer my driving data, even if there are functions provided in this app, but there are no incentives (13).

I would like to offer my driving data, even without functions like those provided in this app (5 drivers).



I would like to offer my driving data, if functions in this app could be further improved (10).

In addition: Discount of the expressway toll (12)

Summary: App Evaluation

- Function evaluation : satisfied > unsatisfied; but “neutral” takes the majority.
- 40% of the respondents agree that this app could contribute to higher safety.
- Respondents with intention to use in future: 16%; but “neutral” takes 40%.
- Recommend to others : about 20% (neutral: 45%)
- Psychological resistance of data provision
 - ✓ No resistance : more than 50% (can become a Big Data source for traffic safety control and management)
 - ✓ Resistant to provision: 24% (27% prefer incentives)
- Function improvement: 60% required, 40% satisfied.

Conclusions

- Traffic safety measures should be taken by targeting individual drivers.
- Well-designed smartphone apps can be used to promote safer driving, especially in terms of speed limit compliance, but other safety effects are limited and mixed, which are highly heterogeneous.
- Driving safety diagnosis does not encourage drivers' distraction, but information provision may do.
- Smartphone apps should allow drivers to choose their preferred functions when/after installing.
- Traffic safety and subjective well-being should be further studied.
- Smartphone apps as a Big Data collection tool for traffic management!

Future challenges for clever use of smartphone apps

- Rules of smartphone usage should be further enforced!
- Mechanism design for *value co-creation*
 - Measurement of driving risk levels using Big Data
 - Williness to accept (WTA) for providing personal driving information
 - “Give & Take”: what to give & take?
 - Give: How much detailed information can be provided?
 - Take: Receive information? Voluntary activity? (how incentives?)
 - Issues: Silence of risky drivers
 - Use of apps:
 - Monitoring of young drivers by family, truck drivers by managers
 - For discounted insurance
 - Discounted toll or credits for use of expressways
- PPP: ICT businesses for public sectors (users' voices should be carefully reflected)

Q & A

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