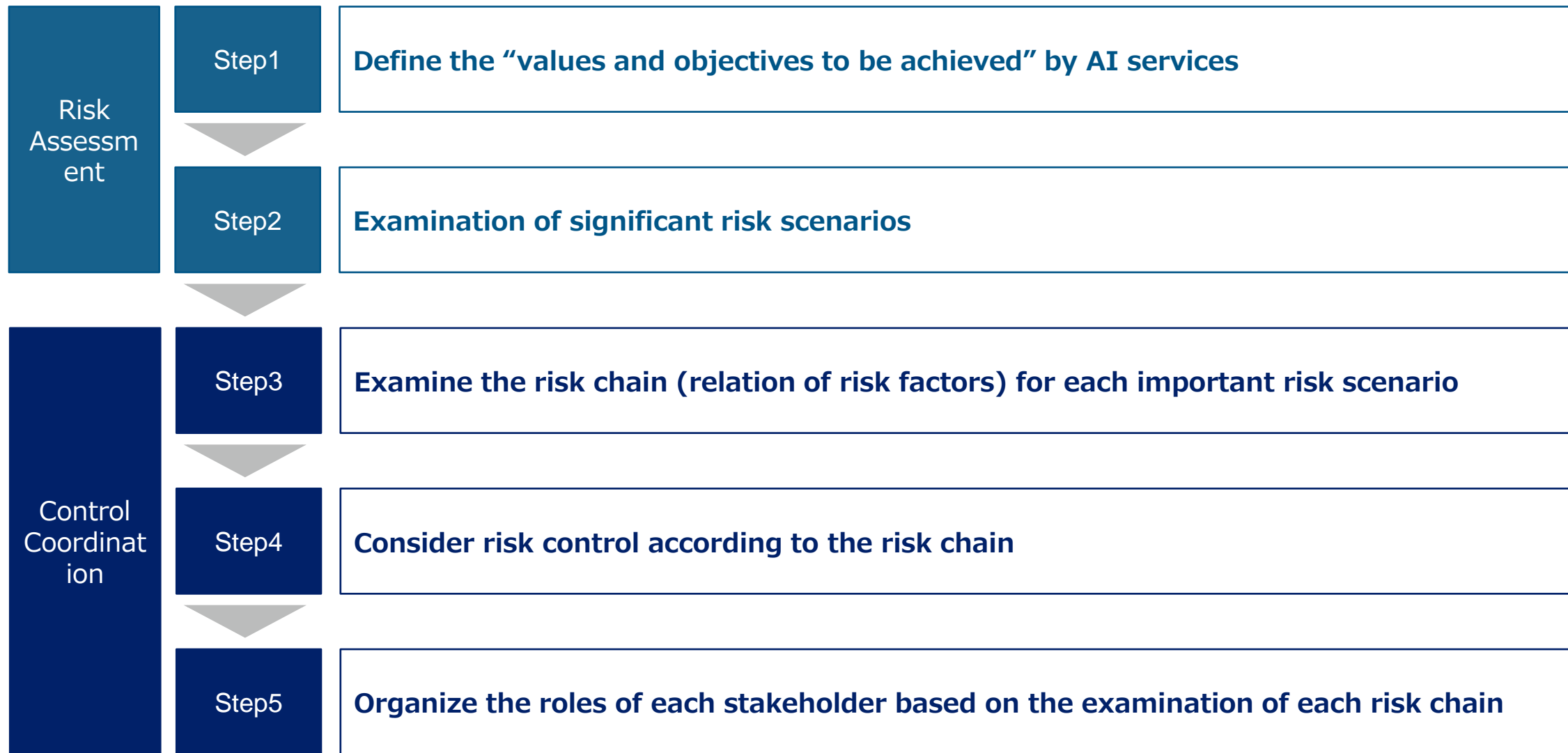# Risk Assessment & Control Coordination for AI services :
Case10 Driverless Bus

Institute for Future Initiatives, The University of Tokyo
Technology Governance Research Unit
AI Governance Project

How to operate the RCModel
# - Risk Assessment & Control Coordination -

Risk Assessment

Step1 — Define the "values and objectives to be achieved" by AI services

Step2 — Examination of significant risk scenarios

Control Coordination

Step3 — Examine the risk chain (relation of risk factors) for each important risk scenario

Step4 — Consider risk control according to the risk chain

Step5 — Organize the roles of each stakeholder based on the examination of each risk chain

Guide book and Case Studies of Risk Chain Model

AI Service and Risk Coordination Study Group

https://ifi.u-tokyo.ac.jp/en/projects/ai-service-and-risk-coordination/
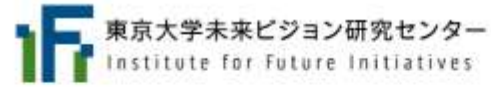
東京大学未来ビジョン研究センター
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How to use Risk Chain Model

Risk Chain Model (RCModel) Guide Ver1.0

Case Study

*These are fictional case studies below and don't raise issues or assure for any company or AI service.

Case01.Recruitment AI (2021/07)

Case Study

Case10 : Driverless Bus
- Define the "values and objectives to be achieved" by AI services -

This is an autonomous bus service that operates on public roads in town A. Company B is contracted to operate the service, Company X manufactures the vehicles and develops the automatic driving algorithm and Company C sells and maintains the vehicles. The route is predefined, and there are several traffic signals and pedestrian crossings along the way. The average speed of the buses is about 20 km/h.

Users wait at the bus stop and board the bus when it arrives. In addition to remote monitoring, Company B also has staff members riding in its autonomous buses. The event of an emergency, the bus can be operated either by a staff member or remotely. Company X's vehicles are equipped with various cameras, LIDAR (light-based detection and ranging technology), radar, GPS, inertial navigation units (INU), and other sensors to acquire data on the vehicle's surroundings. Location and other information is also obtained from timing markers set up along the road. The acquired data is fed into the AI model, which performs the following tasks: ①perception, ②prediction, and ③action.

The automated buses follow a set route and drive autonomously so as not to come into contact with any person or object. They stop when they recognize a person waiting at a bus stop or a passenger wanting to get off, and depart for the next destination when boarding/alighting is complete. Interaction with passengers is accomplished through fixed voice guidance, with staff or remote intervention as appropriate. The operation plan is modified (buses are automatically started) depending on the number of passengers waiting at stops.

In addition, an in-vehicle anomaly detection model is used to alert the support team when there is a problem inside a vehicle or with a passenger.

[Values & Objectives]

- **Safe transportation services**

- **Adherence to the transit schedule**

- **Accessibility for the transportation disadvantaged**

- **Corporate social responsibility**

[Contents of the AI model (Driving)]

① Perception: An object detection algorithm based on a deep learning model developed by Company X

② Prediction: A prediction algorithm based on deep learning that predicts the near-future movement of objects detected in ① above

③ Action: An algorithm (reinforcement learning) to determine the appropriate travel route for the bus based on the prediction results in ② above

[Contents of the AI Model (In-Vehicle Anomaly Detection)]

Anomaly Detection: An object detection algorithm based on a deep learning model developed by Company X

Case10 : Driverless Bus

- System Overview -

AI System	Company C) Transportation Systems Dept	Develops and trains AI models for transportation systems
AI Service Provider	Company B) Land Transportation Services Dept	Provides citizens with transportation services using driverless buses
Users	Town A) Citizens	Use the driverless buses
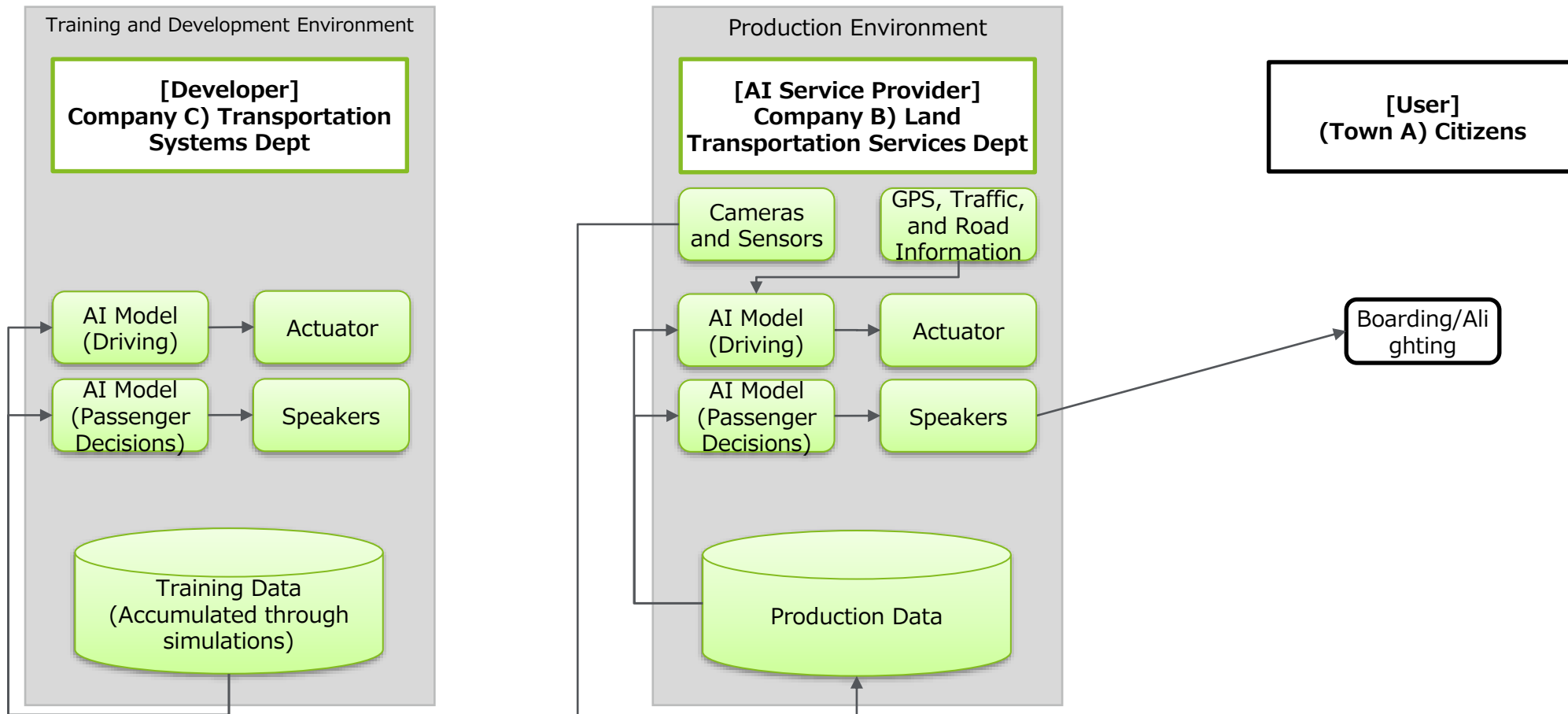
Case10 : Driverless Bus
- Input & Output -

[Input Data]

Data	Purpose	Collection Method	Data Manager	Including Privacy Data
Sensor information, simulations	Learning	Company C's experiments and simulations	Company C	Yes
Sensor information	Production	Upon each use (including inside the vehicle)	Company B (possibly in conjunction with Company C)	Yes
GPS information	Production	Constant acquisition of bus GPS information	Open data	No
Traffic information	Production	Obtained from VICS (Vehicle Information and Communication System)	Vehicle Information and Communication System Center	No
Road information	Production	Acquired from magnetic markers (treated as road appurtenances) placed on the road	Road administrator(s)	No
Situation inside the vehicle	Production	Acquired by cameras installed in the bus	Company B (possibly in conjunction with Company C)	Yes

Case10 : Driverless Bus
- Input & Output -

[Output]

Users	Users	Users
Output	Automatic driving	Alerts when anomalies are detected (support team)
Output Method	Operation of the vehicle via actuators	Notifications sent to the support team's remote terminals
Expected Accuracy	Indicators of safe driving (accidents and dangerous behavior based on simulations) Time of arrival at destination	99%
User judgment	Absent (status is monitored by staff or remotely)	Present (remote team makes the final decision and announces it to passengers)
Output of evidence information	No	Yes (video highlights)
Safety Risk	Yes	Yes
Connection with external system	Yes	No
Protocol	V2X	No

Risk Assessment

Risk Assessment
- Examination of significant risk scenarios -

Values & Objectives		Service Requirement		Risk No.	Risk Scenario	
1	Safe transportation services	1-1	Ensuring road safety	■ AI accuracy ■ AI robustness ■ Appropriate behavior	R001	Dangerous driving and traffic accidents	Dangerous driving causes traffic violations and accidents
					R002	Changes in the road environment	Changes in weather and roadway conditions and the introduction of noise degrade identification accuracy
					R003	Changes in vehicles	Changes in vehicle sensors and software can lead to errors in decision making
					R004	Miscommunication with other vehicles	Accidents/problems occur due to poor communication with other vehicles on the road
		1-2	Ensuring safety inside the vehicle	■ Passenger status recognition ■ Interaction	R005	Passenger injuries	Continued operation despite passengers feeling unsafe/unwell in the vehicle results injury or aggravation
		1-3	Safeguarding against external factors	■ Safety precautions ■ Communication	R006	Problems caused by malicious vehicles/pedestrians	Malicious vehicles (e.g., aggressive drivers) and pedestrians cause traffic accidents and problems
		1-4	Information security management	■ Security protection	R007	External hacking	Someone with malicious intent takes control and causes a traffic accident
2	Adherence to the transit schedule	2-1	Adherence to the schedule	■ Appropriate operating speed	R008	Failure to adhere to the schedule	Automated driving results in little to no adherence to the timetable
		2-2	Responding to increased waiting times	■ Revision of operation plans	R009	Long wait times	Failure to properly revise operation plans results in an increase in the number of users waiting for long periods of time

Risk Assessment
- Examination of significant risk scenarios -

Values & Objectives		Service Requirement			Risk No.		Risk Scenario
3	Accessibility for the transportation disadvantaged	3-1	Services for the transportation disadvantaged	■ Fairness ■ Explainability	R010	Lack of consideration for the transportation disadvantaged	Passengers who take a long time to get in and out of the vehicle are unable to do so correctly (the vehicle starts before they finish boarding/alighting)
					R011	Support in case of problems	Passengers with handicaps cannot be evacuated in the event of an accident and are left in the vehicle
4	Corporate social responsibility	4-1	Service maintenance costs	■ Cost management ■ Explanation of ROI	R012	Excess costs	Excessive service maintenance costs result in higher resident taxes
		4-2	Accountability	■ Explainability ■ Legal compliance	R013	Inadequate explanations	Inability to properly explain and respond to accidents when they occur
					R014	Compliance with safety standards and laws and regulations	Inability to keep up with changes in safety standards and regulations

Risk Assessment & Control Summary
- Organize the roles of each stakeholder based on the examination of each risk chain -

Values & Objectives		Risk No.	Risk Scenario	Uncerta inly	Environ mental change	Caused by user	RC	Control Summary		
								AI System	AI Service Provider	User
1	Safe transportatio n services	R001	Dangerous driving and traffic accidents	○	○		●	Predictive accuracy of AI models Collision prevention using sensors Support coordination in case of anomalies Drive recorders	Definition of dangerous behavior Driving with support Display of necessary information Studies with experts	Alert buttons inside automated buses
		R002	Changes in the road environment	○	○		●	Updating traffic information Data quality Ensuring robustness of AI models	Sensor maintenance Verification of errors in decision-making AI re-learning	
		R003	Changes in vehicles	○	○		●	Securing training data after updates Recording verification results during training	Performance verification of new models Update decisions	
		R004	Miscommunication with other vehicles	○	○	○	●	Collision prevention using sensors Support coordination in case of accidents	Display of actions to other vehicles Determining priority among automated buses	Recognizable display of automated buses Honking in case of danger
		R005	Passenger injuries	○	○	○	●	Prediction accuracy of anomaly detection Automated bus deceleration and stopping	Rules for dealing with passenger anomalies Stopping instructions for support Coordination of support and passengers	Alert buttons inside automated buses
		R006	Problems caused by malicious vehicles/pedestrians	○	○	○	●	*Same as R001	*Same as R001	*Same as R001
		R007	External hacking	○	○		●	Encryption of system infrastructure Updating access rights Unauthorized access detection Preservation of security logs	Security monitoring system Access rights management for automated buses Security assessments Review of security measures	

Risk Assessment & Control Summary

- Organize the roles of each stakeholder based on the examination of each risk chain -

Values & Objectives		Risk No.	Risk Scenario	Uncertainly	Environmental change	Caused by user	RC	Control Summary		
								AI System	AI Service Provider	User
2	Adherence to the transit schedule	R008	Failure to adhere to the schedule	○	○		●	Updating schedules Arrival delay alerts	Consideration of acceptable arrival delays and alternatives to arrival delays Updating the in-vehicle arrival schedule Verifying the cause of arrival delays	Understanding the impact of arrival delays Announcements to passengers Consideration and communication of alternative methods
		R009	Long wait times	○	○	○	●	Understanding the number of people waiting at stops Updating waitlist data Waitlist alerts	Maintenance of bus stop sensors Periodic monitoring of stops Addition of automated buses	
3	Accessibility for the transportation disadvantaged	R010	Lack of consideration for the transportation disadvantaged	○	○	○	●		Passenger support rules Accessible vehicle design Comprehensibility of route location	Awareness of proximity to destination Situational awareness of other passengers Alert buttons inside automated buses
		R011	Support in case of problems	○	○	○	●	*Included in R010	*Included in R010	*Included in R010
4	Corporate social responsibility	R012	Excess costs						Cost management Explanation of ROI	
		R013	Inadequate explanations	○			●	*Included in R001	*Included in R001	*Included in R001
		R014	Compliance with safety standards and laws and regulations		○			Improvement of system specifications	Understanding of laws and regulations to be complied with Education related to legal compliance	

Organization

- Organize the roles of each stakeholder based on the examination of each risk chain -

- Responsible Persons -
Town A) Mayor

- Assessment of values and objectives to achieve
- Risk control method approval

Ministry of Land, Infrastructure, Transport and Tourism

Company B) Legal/Compliance

- Display of necessary information
- Studies with experts
- Education related to legal compliance

Company B)
Safety Management Department

- Definition of dangerous behavior
- Rules for dealing with passenger anomalies
- Consideration of acceptable arrival delays
- Verification of errors in decision-making

- AI Service Provider -
Company B) Land Transportation Services Dept

- Updating traffic information
- Updating schedules
- Updating waitlist data
- Updating arrival schedules
- Remote support
- Remote stopping
- Consideration of alternatives to arrival delays
- Periodic monitoring of stops
- Addition of automated buses
- AI re-learning
- Performance verification of new models
- Determining priority among automated buses
- Security monitoring system
- Access rights management
- Security assessments
- Cost management

Company X) Transportation Systems Dept

- Predictive accuracy of AI models
- Ensuring robustness of AI models
- Data quality
- Securing training data after updates
- Collision prevention using sensors
- Prediction accuracy of anomaly detection
- Automated bus deceleration and stopping
- Recording verification results during training
- Accessible vehicle design
- Display of actions to other vehicles
- Alert buttons inside automated buses

Company B) IT Services Department

- Arrival delay alerts
- Support coordination in case of anomalies
- Understanding and alerting on the number of people waiting at stops
- Encryption of system infrastructure
- Updating access rights
- Unauthorized access detection
- Preservation of security logs

- Users -
Town A) Citizens

- Understanding the impact of arrival delays
- Consideration and communication of alternative methods
- Awareness of proximity to destination
- Situational awareness of other passengers

Company C) Vehicle Maintenance Department

- Drive recorders
- Sensor maintenance
- Maintenance of bus stop sensors

- Others -
Town A) Other Drivers

- Honking in case of danger

Control Coordination

Control Coordination
- Examine the risk chain (relation of risk factors) for each important risk scenario -

R001 — **Dangerous driving and traffic accidents**
Dangerous driving causes traffic violations and accidents

Risk Control
- Consider risk control according to the risk chain -

R001	**Dangerous driving and traffic accidents** Dangerous driving causes traffic violations and accidents

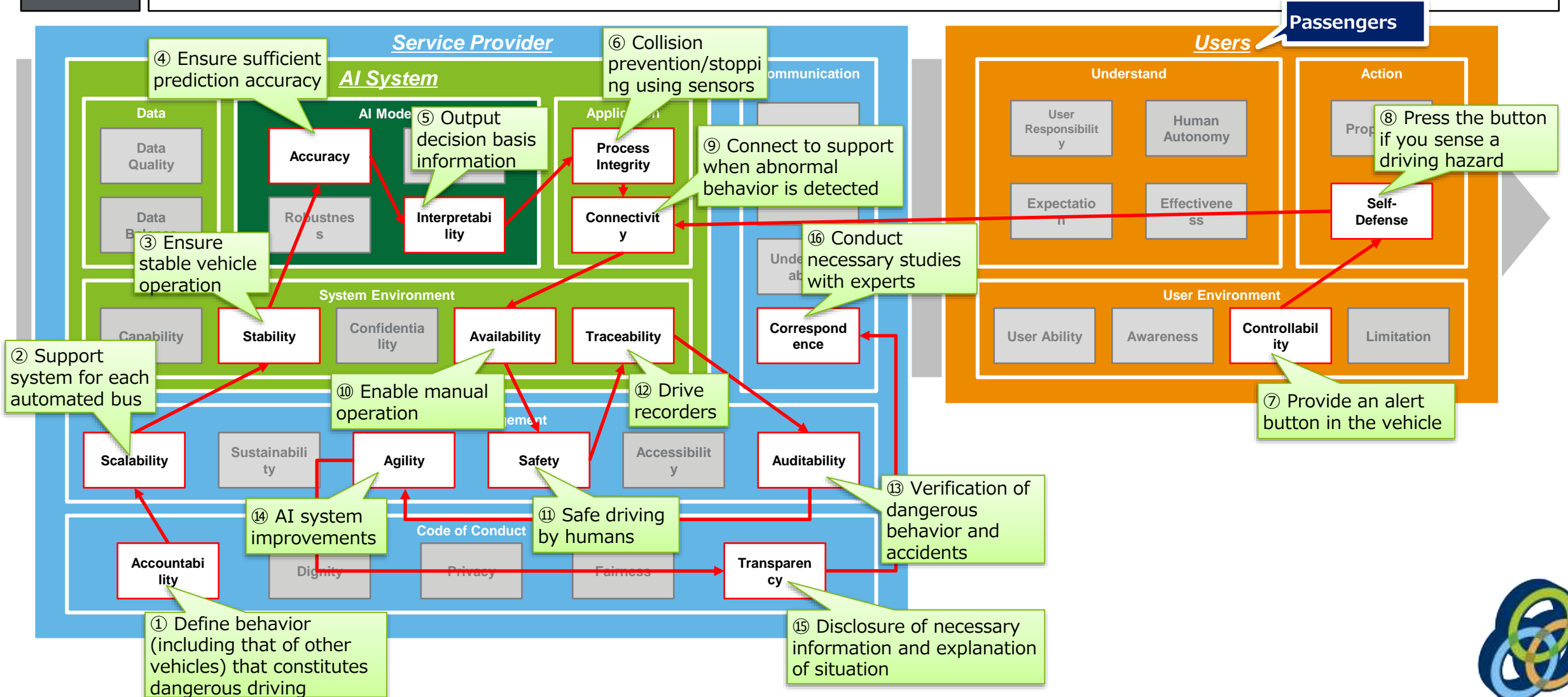| Risk Control		
AI System **(Transportation Systems Dept, Company X)**	**Service Provider** **(Land Transportation Services Dept, Company B)**	**Users** **(Citizens, Town A)**
③ [Stability] Ensure stable vehicle operation (Transportation System Development Department, Company X) ④ [Accuracy] Ensure sufficient prediction accuracy during model development (Transportation Systems Dept, Company X) ⑤ [Interpretability] Output the model's decision basis information (Transportation Systems Dept, Company X) ⑥ [Process Integrity] Implement sensor-based collision prevention (Transportation Systems Dept, Company X) ⑨ [Connectivity] Connect to the support team when an accident, abnormal driving, or hazard (including aggressive driving) is detected (Transportation Systems Dept, Company X) ⑩ [Availability] Enable manual operation (Transportation Systems Dept, Company X) ⑫ [Traceability] Install drive recorders in vehicles and store driving records (Transportation Systems Dept, Company X)	① [Accountability] Define behavior (including that of other vehicles) that constitutes dangerous driving (Land Transportation Services Dept, Company B) ② [Scalability] Establish a support system for each automated bus (Land Transportation Services Dept, Company B) ⑪ [Safety] Perform manual, safe driving with human operators (Land Transportation Services Dept, Company B) ⑬ [Auditability] Verify unsafe behavior and accidents (Land Transportation Services Dept, Company B) ⑭ [Agility] Implement improvements to the AI system (Land Transportation Services Dept, Company B) ⑮ [Transparency] Disclose necessary information depending on accident impact, etc. (Land Transportation Services Dept, Company B) ⑯ [Correspondence] Conduct necessary studies with experts on long-term measures, etc. (Land Transportation Services Dept, Company B)	⑦ [Controllability] Install alert buttons on board automated buses in case of emergency (Land Transportation Services Dept, Company B → Passengers) ⑧ [Self-Defense] Press the button if you feel unsafe/unwell about your own or another passenger's condition

Control Coordination

- Examine the risk chain (relation of risk factors) for each important risk scenario -

Step 3

R002 — **Changes in the road environment**
Changes in weather and roadway conditions and the introduction of noise degrade identification accuracy

Service Provider

⑤ Ensure sufficient prediction accuracy

⑧ Collision prevention/stopping using sensors

④ Ensure the quality of training data

⑦ Output decision basis information

③ Update traffic information

⑥ Ensure robustness of the model

② Ensure stable vehicle operation

⑨ Drive recorders

① Sensor maintenance

⑪ AI system improvements

⑩ Verification of errors in decision-making

Data: Data Quality, Data Balance

AI Model: Accuracy, Robustness, Interpretability

Application: Process Integrity, Connectivity

Communication: Consensus, Understandability, Correspondence

Capability, Stability, Confidentiality, Availability, Traceability

Scalability, Sustainability, Agility, Safety, Accessibility, Auditability

Accountability, Dignity, Privacy, Fairness, Transparency

Users

Understand: User Responsibility, Human Autonomy, Expectation, Effectiveness

Action: Proper Use, Self-Defense

User Environment: User Ability, Awareness, Controllability, Limitation

Risk Control
- Consider risk control according to the risk chain -

R002	**Changes in the road environment** Changes in weather and roadway conditions and the introduction of noise degrade identification accuracy

Risk Control		
AI System **(Transportation Systems Dept, Company X)**	**Service Provider** **(Land Transportation Services Dept, Company B)**	**Users** **(Citizens, Town A)**
② [Stability] Ensure stable vehicle operation (Transportation System Development Department, Company X) ③ [Connectivity] Acquire the latest traffic information (Transportation Systems Dept, Company X) ④ [Data Balance] Include adversarial cases in the training data (Transportation Systems Dept, Company X) ⑤ [Accuracy] Ensure sufficient prediction accuracy during model development (Transportation Systems Dept, Company X) ⑥ [Robustness] Improve the robustness of AI models in adversarial cases (Transportation Systems Dept, Company X) ⑦ [Interpretability] Output the model's decision basis information (Transportation Systems Dept, Company X) ⑧ [Process Integrity] Implement sensor-based collision prevention (Transportation Systems Dept, Company X) ⑨ [Traceability] Install drive recorders in vehicles and store driving records (Transportation Systems Dept, Company X)	① [Sustainability] Perform maintenance of sensors and other equipment (Land Transportation Services Dept, Company B) ⑩ [Auditability] Verify errors in decision making (Land Transportation Services Dept, Company B) ⑪ [Agility] Implement improvements to the AI system (Land Transportation Services Dept, Company B)	

Verifying Risk Control According to Risk Chain
- Verify risk controls in components associated with risk chains -

R003	**Changes in vehicles** Changes in vehicle sensors and software can lead to errors in decision making

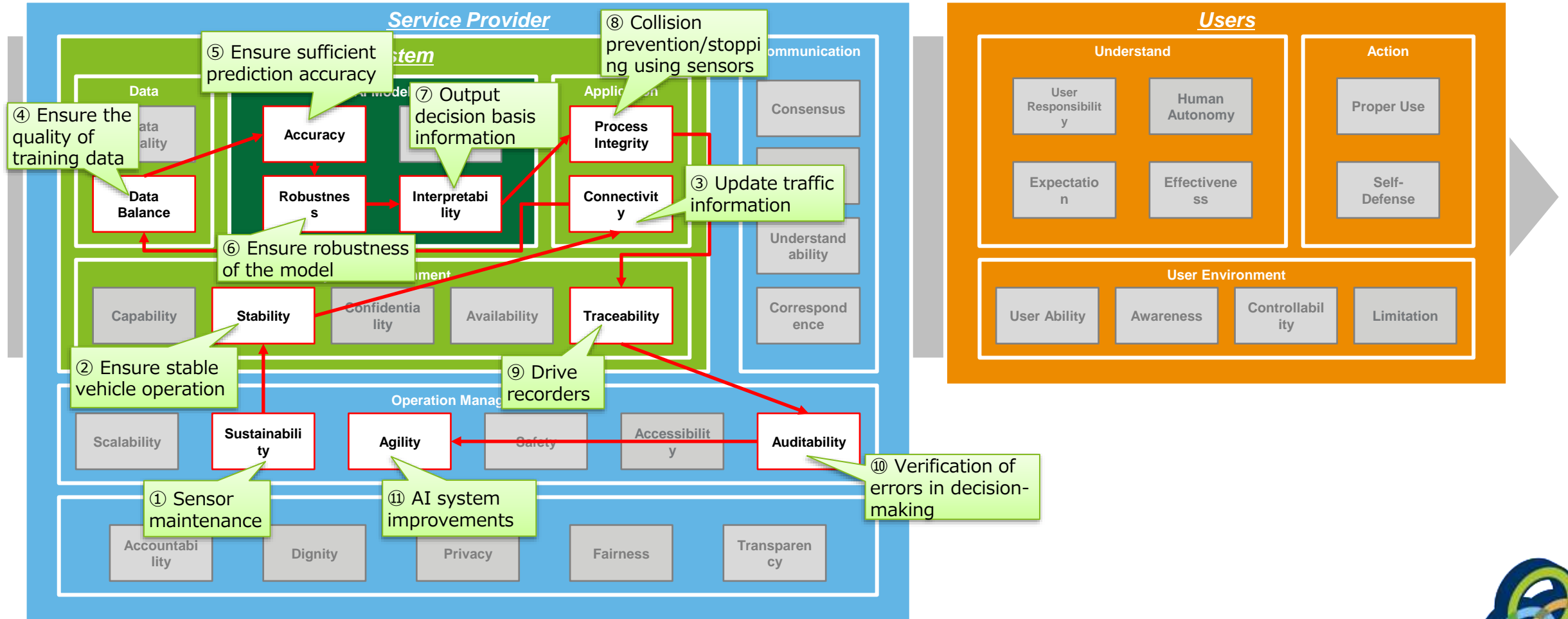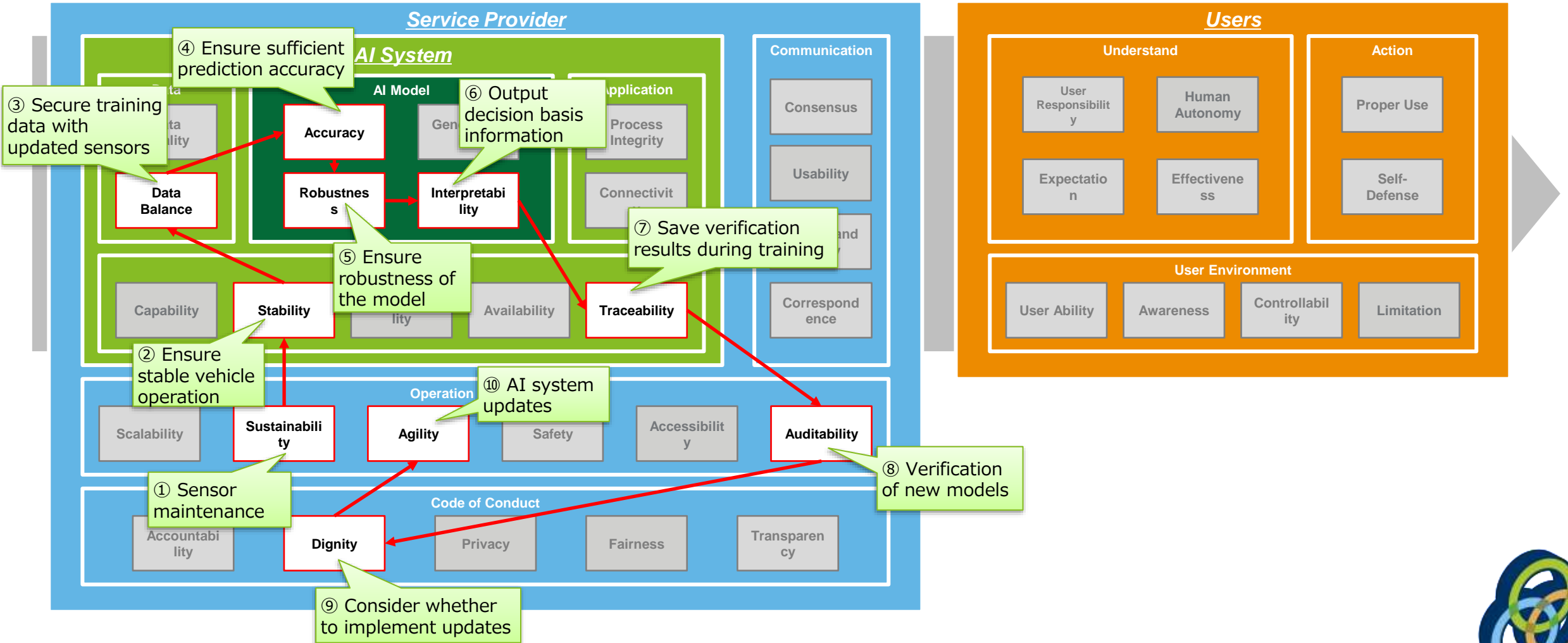| Risk Control		
AI System **(Transportation Systems Dept, Company X)**	**Service Provider** **(Land Transportation Services Dept, Company B)**	**Users** **(Citizens, Town A)**
② [Stability] Ensure stable vehicle operation (Transportation System Development Department, Company X) ③ [Data Quality] Secure training data using updated sensors and software (Transportation Systems Dept, Company X) ④ [Accuracy] Ensure sufficient prediction accuracy during model development (Transportation Systems Dept, Company X) ⑤ [Robustness] Improve the robustness of AI models using adversarial cases, etc. (Transportation Systems Dept, Company X) ⑥ [Interpretability] Output the model's decision basis information (Transportation Systems Dept, Company X) ⑦ [Traceability] Save verification results associated with retraining (Transportation Systems Dept, Company X)	① [Sustainability] Perform maintenance of sensors and other equipment (Land Transportation Services Dept, Company B) ⑧ [Auditability] Verify prediction performance using the new model (Land Transportation Services Dept, Company B) ⑨ [Dignity] Determine whether an update to the AI system should be implemented (Land Transportation Services Dept, Company B) ⑩ [Agility] Perform updates on the AI system (Land Transportation Services Dept, Company B)	

Control Coordination
- Examine the risk chain (relation of risk factors) for each important risk scenario -

R004

Miscommunication with other vehicles
Accidents/problems occur due to poor communication with other vehicles on the road

Other vehicles

Service Provider

AI System

③ Ensure sufficient prediction accuracy

⑧ Collision prevention/stopping using sensors

Users

AI Model

Data

Data Quality

Accuracy

Generalization

Application

Process Integrity

Communication

Consensus

Usability

Understand

User Responsibility

Human Autonomy

Action

④ Indicate next action to other vehicles (use turn signals, etc.)

⑥ Honk the horn if you sense danger

② Ensure stable vehicle operation

Robustness

⑨ Connect to support in the event of an accident

Connectivity

Expectation

Effectiveness

Self-Defense

System Environment

Understand ability

Capability

Stability

Confidentiality

Availability

Traceability

Correspondence

User Environment

User Ability

Awareness

Controllability

Limitation

① Support system for each automatic bus

⑩ Enable manual operation

⑫ Drive recorders

⑦ Determine priority among buses

⑤ The other party recognizes it as an automated bus

Scalability

Sustainability

Agility

Safety

Accessibility

Auditability

⑭ AI system improvements

de of Conduct

⑪ Safe driving by humans

⑬ Verification of dangerous behavior and accidents

Accountability

Dignity

Privacy

Fairness

Transparency

⑮ Disclosure of necessary information and explanation of situation

Risk Control
- Consider risk control according to the risk chain -

R004	**Miscommunication with other vehicles** Accidents/problems occur due to poor communication with other vehicles on the road

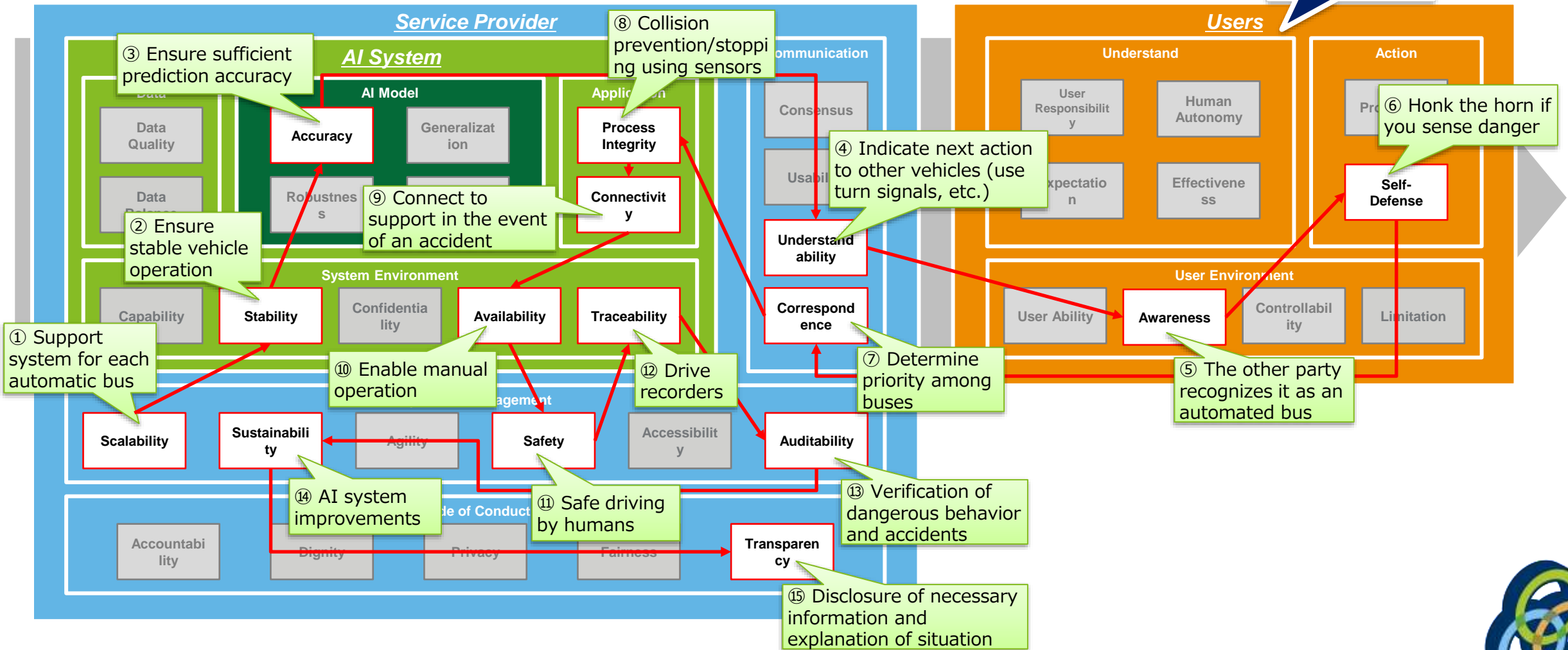| Risk Control		
AI System (Transportation Systems Dept, Company X)	**Service Provider** (Land Transportation Services Dept, Company B)	**Users** (Citizens, Town A)
② [Stability] Ensure stable vehicle operation (Transportation System Development Department, Company X) ③ [Accuracy] Ensure sufficient prediction accuracy during model development (Transportation Systems Dept, Company X) ⑧ [Process Integrity] Implement sensor-based collision prevention (Transportation Systems Dept, Company X) ⑨ [Connectivity] Connect to the support team in the event of an accident (Transportation Systems Dept, Company X) ⑩ [Availability] Enable manual operation (Transportation Systems Dept, Company X) ⑫ [Traceability] Install drive recorders in vehicles and store driving records (Transportation Systems Dept, Company X)	① [Scalability] Establish a support system for each automated bus (Land Transportation Services Dept, Company B) ④ [Understandability] Indicate next action to other vehicles (use turn signals, etc.) (Land Transportation Serviced Department, Company B) ⑦ [Correspondence] Determine priority the among buses and act accordingly (Land Transportation Services Dept, Company B) ⑪ [Safety] Perform manual, safe driving with human operators (Land Transportation Services Dept, Company B) ⑬ [Auditability] Verify accident occurrence (Land Transportation Services Dept, Company B) ⑭ [Sustainability] Implement improvements to the AI system (Land Transportation Services Dept, Company B) ⑮ [Transparency] Disclose information depending on accident impact, etc. (Land Transportation Services Dept, Company B)	⑤ [Awareness] Display the mark of an automated bus so that other drivers can recognize it as an automated vehicle (Land Transportation Services Dept, Company B → other drivers in Town A) ⑥ [Self-Defense] Honk the horn if you sense danger in the automated bus' driving (other drivers in Town A)

Control Coordination
- Examine the risk chain (relation of risk factors) for each important risk scenario -

R005

Passenger injuries
Continued operation despite passengers feeling unsafe/unwell in the vehicle results injury or aggravation

Passengers

Service Provider

Users

AI System

AI Model

Application

Communication

Understand

Action

③ Ensure prediction accuracy of the anomaly detection model

④ Output decision basis information

⑦ Connect to support when an anomaly is detected

⑥ Press the button if you feel unsafe/unwell

⑪ Support team connects with the cabin via voice

Data
- Data Quality
- Data Balance

Accuracy

General

Robustness

Interpretability

Process Integrity

Connectivity

Consensus

User Responsibility

Human Autonomy

Expectation

Effectiveness

Self-Defense

System Environment

Capability | Stability | Confidentiality

Availability

Traceability

Correspondence

User Environment

② Support system for each automated bus

⑩ Execute deceleration and stopping

⑧ Drive recorders

⑤ Provide an alert button in the vehicle

User Ability | Awareness | **Controllability** | Limitation

Scalability

Sustainability

Agility

Safety

Accessibility

Auditability

Code of Conduct

⑨ Remote stop command

Accountability

Dignity

Privacy

Fairness

Transparency

① Clarify rules for responding to passenger anomalies

Risk Control
- Consider risk control according to the risk chain -

R005	**Passenger injuries** Continued operation despite passengers feeling unsafe/unwell in the vehicle results injury or aggravation

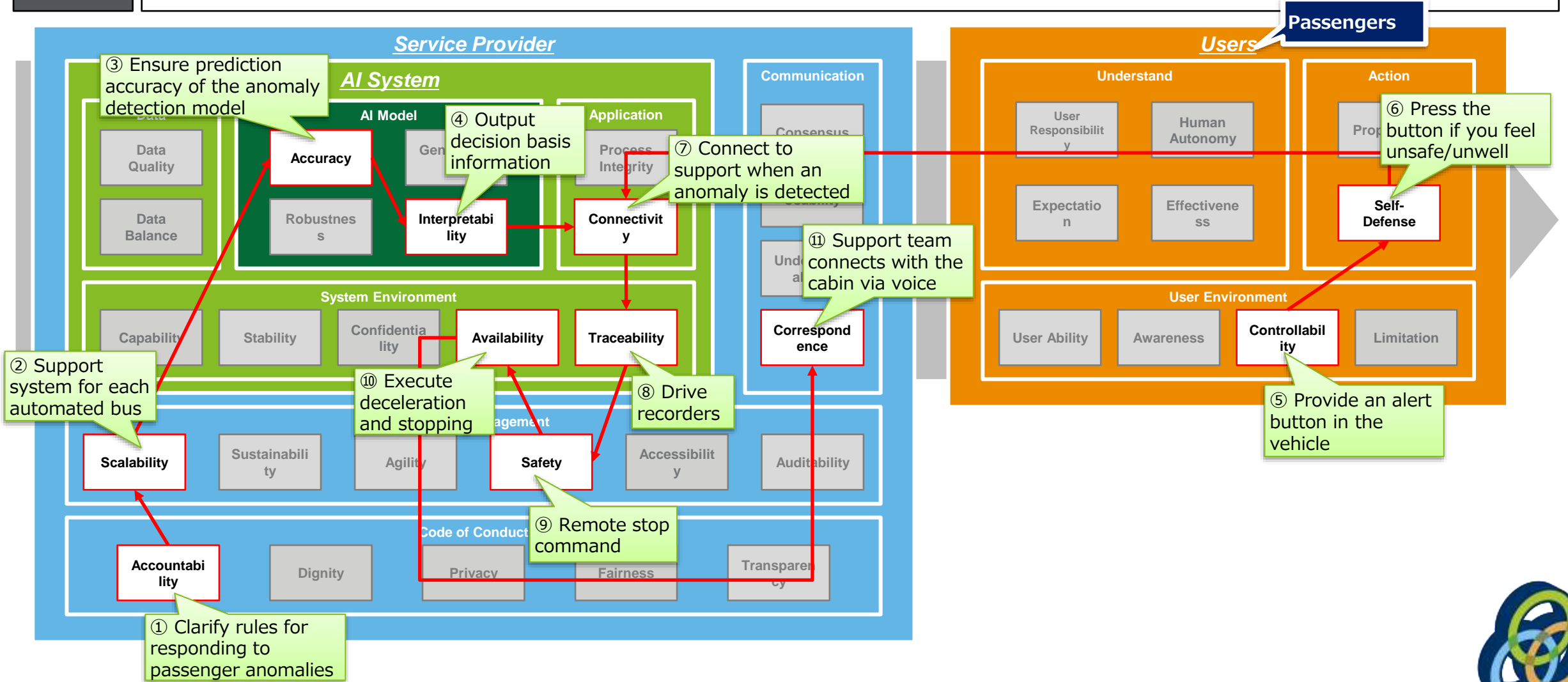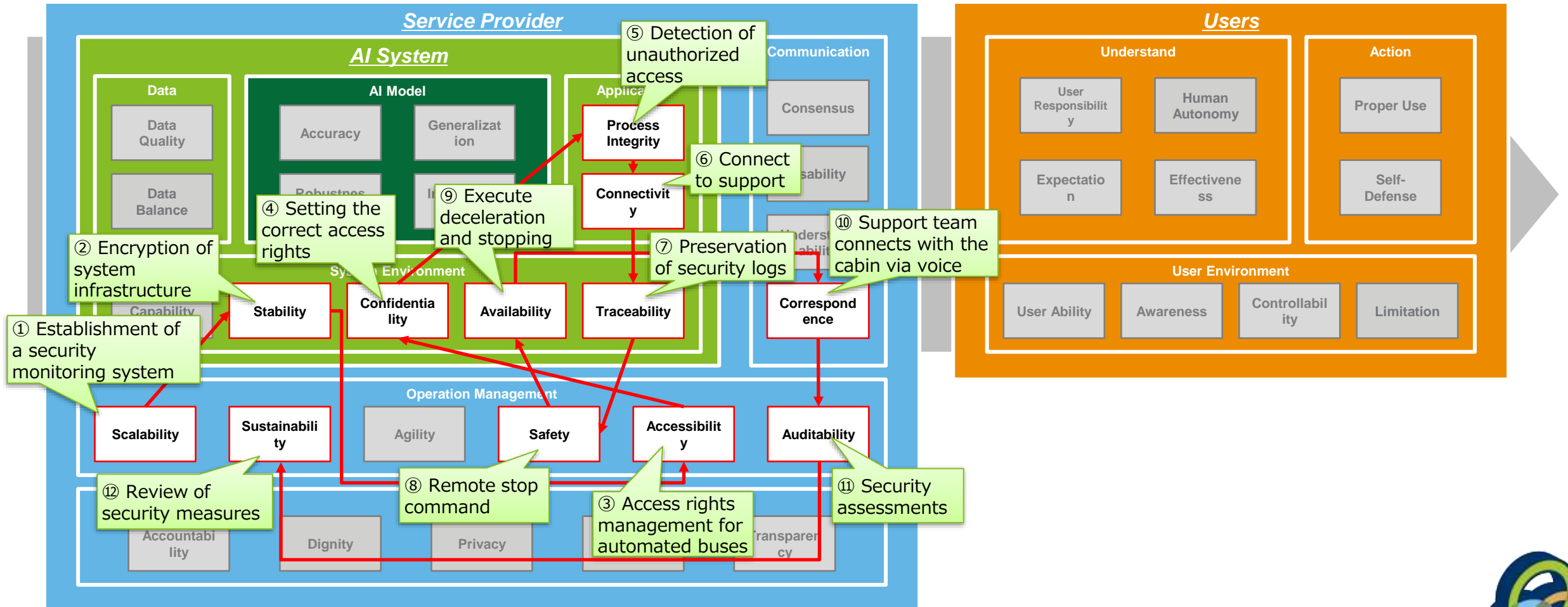| Risk Control		
AI System **(Transportation Systems Dept, Company X)**	**Service Provider** **(Land Transportation Services Dept, Company B)**	**Users** **(Citizens, Town A)**
③ [Accuracy] Ensure the prediction accuracy of the anomaly detection model (Transportation Systems Dept, Company X) ④ [Interpretability] Output the model's decision basis information (Transportation Systems Dept, Company X) ⑦ [Connectivity] Connect to the support team when an anomaly is detected in the vehicle (Transportation Systems Dept, Company X) ⑧ [Traceability] Install drive recorders in vehicles and store driving records (Transportation Systems Dept, Company X) ⑩ [Availability] The automated bus decelerates and stops (Transportation Systems Dept, Company X)	① [Accountability] Clarify rules for responding to passenger anomalies (Land Transportation Services Dept, Company B) ② [Scalability] Establish a support system for each automated bus (Land Transportation Services Dept, Company B) ⑨ [Safety] Support team gives stop command to the automated bus (Land Transportation Services Dept, Company B) ⑪ [Correspondence] Support team connects with passengers in the vehicle by voice (Land Transportation Services Dept, Company B)	⑤ [Controllability] Install alert buttons on board automated buses in case of emergency (Land Transportation Services Dept, Company B → Passengers) ⑥ [Self-Defense] Press the button if you feel unsafe/unwell about your own or another passenger's condition

Control Coordination
- Examine the risk chain (relation of risk factors) for each important risk scenario -

R007 | **External hacking**
Someone with malicious intent takes control and causes a traffic accident

Risk Control
- Consider risk control according to the risk chain -

R007	**External hacking**
	Someone with malicious intent takes control and causes a traffic accident

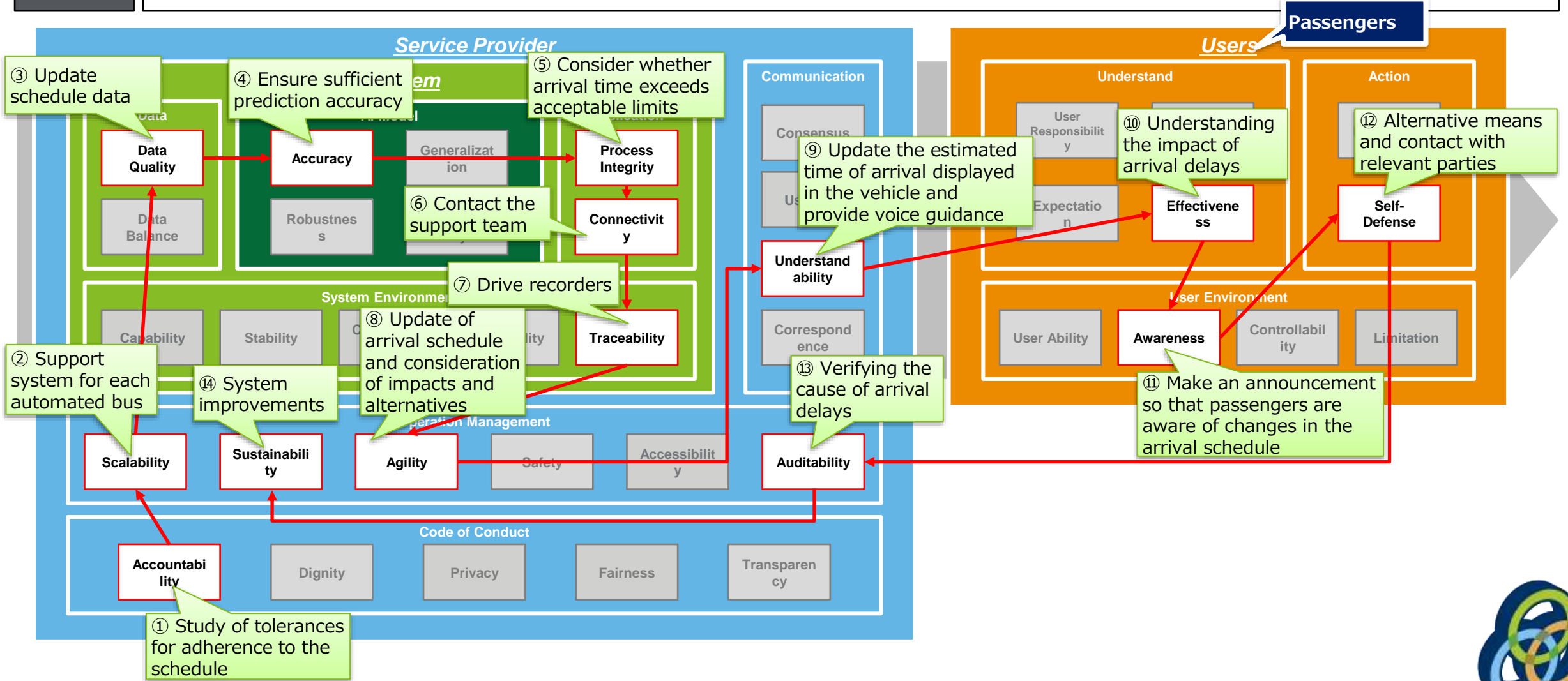| Risk Control		
AI System **(Transportation Systems Dept, Company X)**	**Service Provider** **(Land Transportation Services Dept, Company B)**	**Users** **(Citizens, Town A)**
② [Stability] Adequately encrypt the system infrastructure (Transportation Systems Dept, Company X) ④ [Confidentiality] Update the access rights set in the system (Transportation Systems Dept, Company X) ⑤ [Process Integrity] Detect unauthorized access (Transportation Systems Dept, Company X) ⑥ [Connectivity] Connect to the support team when unauthorized access is detected (Transportation Systems Dept, Company X) ⑦ [Traceability] Save security logs on the system (Transportation Systems Dept, Company X) ⑨ [Availability] The automated bus decelerates and stops (Transportation Systems Dept, Company X)	① [Scalability] Establish a security monitoring system (Land Transportation Services Dept, Company B) ③ [Accessibility] Properly manage access rights for automated buses (Land Transportation Services Dept, Company B) ⑧ [Safety] Support team gives stop command to the automated bus (Land Transportation Services Dept, Company B) ⑩ [Correspondence] Support team provides audio guidance to passengers in the vehicle (Land Transportation Services Dept, Company B) ⑪ [Auditability] Verify and assess security (Land Transportation Services Dept, Company B) ⑫ [Sustainability] Review overall system security measures (Land Transportation Services Dept, Company B)	

Control Coordination
- Examine the risk chain (relation of risk factors) for each important risk scenario -

R008

Failure to adhere to the schedule
Automated driving results in little to no adherence to the timetable

Passengers

Service Provider

③ Update schedule data

④ Ensure sufficient prediction accuracy

⑤ Consider whether arrival time exceeds acceptable limits

⑨ Update the estimated time of arrival displayed in the vehicle and provide voice guidance

⑩ Understanding the impact of arrival delays

⑫ Alternative means and contact with relevant parties

Data Quality

Accuracy

Generalization

Process Integrity

Consensus

User Responsibility

Effectiveness

Self-Defense

Data Balance

Robustness

Connectivity

⑥ Contact the support team

Understandability

Expectation

⑦ Drive recorders

Traceability

⑧ Update of arrival schedule and consideration of impacts and alternatives

② Support system for each automated bus

⑭ System improvements

Capability

Stability

Scalability

Sustainability

Agility

Safety

Accessibility

Auditability

⑬ Verifying the cause of arrival delays

User Ability

Awareness

Controllability

Limitation

⑪ Make an announcement so that passengers are aware of changes in the arrival schedule

Code of Conduct

Accountability

Dignity

Privacy

Fairness

Transparency

① Study of tolerances for adherence to the schedule

Risk Control
- Consider risk control according to the risk chain -

R008	**Failure to adhere to the schedule** Automated driving results in little to no adherence to the timetable

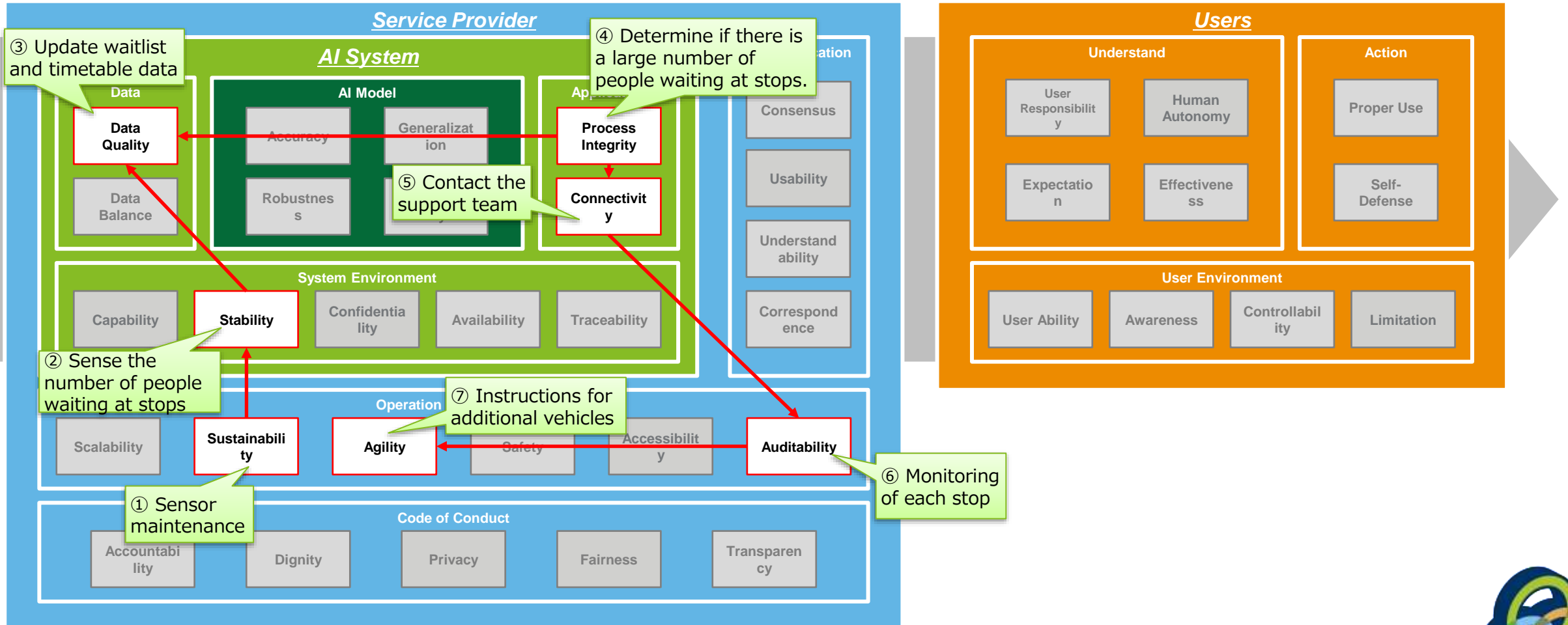| Risk Control		
AI System **(Transportation Systems Dept, Company X)**	**Service Provider** **(Land Transportation Services Dept, Company B)**	**Users** **(Citizens, Town A)**
③ [Data Quality] Update the schedule data (Transportation Systems Dept, Company X) ④ [Accuracy] Ensure sufficient prediction accuracy during model development (Transportation Systems Dept, Company X) ⑤ [Process Integrity] Consider whether arrival times exceed acceptable limits (Transportation Systems Dept, Company X) ⑥ [Connectivity] Connect to support team when arrival time exceeds acceptable limits (Transportation Systems Dept, Company X) ⑦ [Traceability] Install drive recorders in vehicles and store driving records (Transportation Systems Dept, Company X)	① [Accountability] Consider tolerances for adhering to the schedule (Land Transportation Services Dept, Company B) ② [Scalability] Establish a support system for each automated bus (Land Transportation Services Dept, Company B) ⑧ [Agility] Update the arrival schedule in the vehicle and consider alternative measures (e.g., request cooperation from related transportation agencies) if the impact is significant (Land Transportation Services Dept, Company B) ⑨ [Understandability] Update the estimated arrival times displayed in the vehicle and provide voice guidance (Land Transportation Services Dept, Company B) ⑬ [Auditability] Verify the cause of arrival delays (Land Transportation Services Dept, Company B) ⑭ [Sustainability] Implement improvements to the system (Land Transportation Services Dept, Company B)	⑩ [Effectiveness] Understand the impact of arrival delays (Passengers) ⑪ [Awareness] Make an announcement so that passengers are aware of the change in arrival schedule (Land Transportation Services Dept, Company B → Passengers) ⑫ [Self-Defense] Consider alternative means of transportation and contact those affected by the delay (Passengers)

Risk Control
- Consider risk control according to the risk chain -

R009	**Long wait times** Failure to properly revise operation plans results in an increase in the number of users waiting for long periods of time

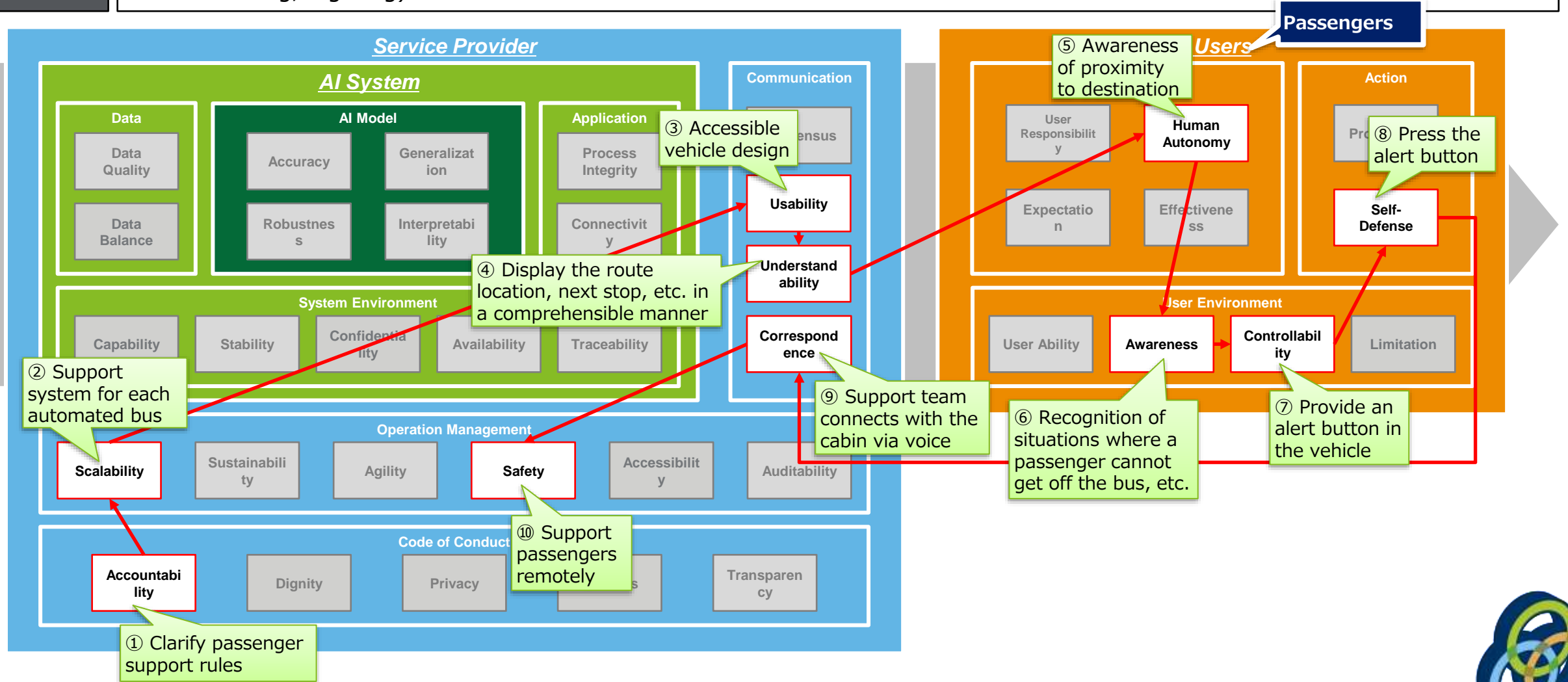| Risk Control		
AI System **(Transportation Systems Dept, Company X)**	**Service Provider** **(Land Transportation Services Dept, Company B)**	**Users** **(Citizens, Town A)**
② [Stability] Sense the number of people waiting via image recognition at stops (Transportation Systems Dept, Company X) ③ [Data Quality] Update waitlist and timetable data (Transportation Systems Dept, Company X) ④ [Process Integrity] Determine if there is a large number of people waiting at stops (Transportation Systems Dept, Company X) ⑤ [Connectivity] Connect to support team when arrival time exceeds acceptable limits (Transportation Systems Dept, Company X)	① [Sustainability] Perform maintenance of image recognition at stops (Land Transportation Services Dept, Company B) ⑥ [Auditability] Regular monitor each stop with the support team (Land Transportation Services Dept, Company B) ⑦ [Agility] Add automated buses so as to eliminate wait lists (Land Transportation Services Dept, Company B)	

Control Coordination
- Examine the risk chain (relation of risk factors) for each important risk scenario -

R010 | **Lack of consideration for the transportation disadvantaged**
Passengers who take a long time to get in and out of the vehicle are unable to do so correctly (the vehicle starts before they finish boarding/alighting)

Risk Control
- Consider risk control according to the risk chain -

R010	**Lack of consideration for the transportation disadvantaged** Passengers who take a long time to get in and out of the vehicle are unable to do so correctly (the vehicle starts before they finish boarding/alighting)

Risk Control		
AI System **(Transportation Systems Dept, Company X)**	**Service Provider** **(Land Transportation Services Dept, Company B)**	**Users** **(Citizens, Town A)**
	① [Accountability] Clarify passenger support rules (Land Transportation Services Dept, Company B) ② [Scalability] Establish a support system for each automated bus (Land Transportation Services Dept, Company B) ③ [Usability] Design accessible vehicles (Land Transportation Services Dept, Company B) ④ [Understandability] Display the route location, next stop, etc. in a comprehensible manner (Land Transportation Services Dept, Company B) ⑨ [Correspondence] Support team connects with passengers in the vehicle by voice (Land Transportation Services Dept, Company B) ⑩ [Safety] Connect with passengers remotely from the support team (Land Transportation Services Dept, Company B)	⑤ [Human Autonomy] Be aware of the proximity to your destination (Passengers) ⑥ [Awareness] Recognize situations such as other passengers not being able to get off the bus (Passengers) ⑦ [Controllability] Install alert buttons on board automated buses in case of emergency (Land Transportation Services Dept, Company B → Passengers) ⑧ [Self-Defense] Press the button when you sense that you or another passenger cannot get off the bus (Passengers)