VanJee Technical Proposal for High Speed Weigh in Motion (HSWIM) Systems for Enforcement and Data Collection

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Dear Customer,

We appreciate the interest in collaborating and looking for new business opportunities in the client project for the application of Weigh-In-Motion(WIM) in global, we hope you will accept this letter, the required documents, the technical proposals and the project implementation plan as the best provider for this project. VanJee believes that our experience and leadership in WIM, enthusiasm for traffic technology, and willingness to make a contribution to the WIM industry in global would make us a strong candidate.

VanJee has been in the dynamic weighing industry for 30 years. VanJee is still putting great efforts into WIM research and innovation to provide the best weight regulation method for trucks. VanJee is confident that his leadership and experience provide the ability to bring this project together.

1. Objective

VanJee has strong ability to develop a vehicle oversize and overweight traffic violation automation system. The VanJee system collects not only accurate truck weight data, but also the full chain of legal evidence to perform overload identification and sanction proceedings. VanJee has extensive experience in this area, more importantly, VanJee is the only company in the world that can manufacture WIM sensors (digital strain gauge sensors).) and 3D scanners (LiDAR sensor) for this scenario. In addition, VanJee has been building more than 100 WIM sites in the world. VanJee would love to provide the most advanced WIM application site for Customer.

VanJee WIM System 's main objective is to regulate overloaded trucks in a free flow scenario with a speed of 0-120 km/h. VanJee system takes the state-of-the-art WIM approach, including the algorithm matching method between the weight result and the ANPR, the stepped design, and the digital signal output of WIM sensor to ensure the accuracy of weight measurement and the accuracy of the application. This WIM system consists of a high-speed dynamic weighing system, LiDAR for vehicle dimension measurement and classification, ANPR, and the WIM data management platform. VanJee WIM front system (weighing system and LiDAR system) would collect and update traffic data in real time so that the customer can have valuable information such as location, date and time, vehicle classification, vehicle dimensions, vehicle image, vehicle license plate number, number of axles, wheelbase, gross vehicle and axle weight, speed of single or dual tires, driving direction of the vehicle on the VanJee WIM platform.

VanJee WIM platform can automatically determine whether the truck is overloaded or not, as well as perform a legitimate sanction procedure. More importantly, if the driver does not agree with the sanction, VanJee platform can provide a short video of the overloaded truck to help client manage

reports of the contest requirements. In addition, VanJee has connected the most local weighing station database to the platform to achieve WIM big data service. The traffic officers would have the ability to search specific license plate number and violation records to improve enforcement efficiency. In addition, the VanJee platform would help client generate a blacklist for trucks that have too many violation records. In conclusion, VanJee WIM system would help the client to improve efficiency, effectiveness and reduce the number of catastrophic accidents related to overloading.

Figure 1: VanJee WIM Application in Europe

2. Purpose of VanJee WIM

VanJee WIM System meets all Customer requirements for the project at the federal roads. VanJee has the great ability to make truck oversize and overweight traffic violation automation system. It is important to establish the vehicle classification categories for this project in order to deliver a specific solution.

1) Reduce human intervention and improve application integrity.

VanJee WIM can perform automatically with human intervene. The system is profitable because it would operate in 24 hours. No overloaded truck could escape the application of weight. Another point to note is that a relatively small amount of construction can be considered compared to the static weight station. In addition, VanJee system would achieve enforcement of the violations requested by the client. The system would completely solve corruption problems in the app, including bribery overloading of drivers

to police officers or abuse of the sanctioning power of police officers to truck drivers. As a result, VanJee system meets the client requirement to reduce human intervention and improve the integrity of the application as well as road safety.

2) Complete legitimate compliance process from inspection to insurance and collection

VanJee WIM system meets client contest requirements. VanJee WIM management platform can help client to monitor each truck on the road and perform the application procedure. The platform would provide necessary and sufficient evidence of WIM compliance, including vehicle license plate number, axle weight, gross weight, time, and location . In addition, VanJee platform has various traffic data supporting applications, including traffic data collection, traffic data storage, application workflow processing, and information management for vehicle overload. In addition, the platform would provide powerful WEB service applications including vehicle search, statistics, station management, and optimization of compliance operations.

3. System Requirements

1) Equipment Requirements

VanJee products meet technical specification requirements for our global customers. All VanJee equipment has CNAS (China National Accreditation Service for Conformity Assessment) certification, ISO certifications and OIML-R134 certifications. All VanJee equipment can work at ambient temperatures ranging from -40 ℃ to 80 ℃ and 100% relative humidity. The VanJee system would collect and operate traffic data at vehicle speeds of up to 120km /h . VanJee Digital Strain Gauge Sensor , which is a high-speed WIM sensor, is installed on every lane of the highway. VanJee designs WIM sensor base on strain gauge technology and develops a specific stepped sensor design in the WIM system to meet the accuracy requirement of weight compliance with 2.5% accuracy with metrological certification OIML-R134. Two ANPR cameras would be installed per lane to meet license plate identification requirements. VanJee would use LiDAR to achieve 3D dimension measurement and would cover all lanes. VanJee LiDAR would return 5% error in either direction for vehicle identification.

2) Data and Software Requirements

VanJee WIM system has high capacity and flexibility to change allowable weight and dimension limits through the use of a digital strain gauge sensor and LiDAR . VanJee would use fiber to transmit the collected data from the vehicle in real time to the selected server and a database. VanJee would use a high-end industrial computer to store all the data for more than 12 months.

4. General Solution

1) General Solution and Description

VanJee WIM system is legally enforcing weight rather than simply collecting weight data. VanJee WIM system would collect sufficient and necessary legal evidence to overload the trial, including the license plate number and full view of the truck images. Firstly, the weighing subsystem is installed in the middle of the highway to collect the weight of the truck. The weighing subsystem of each lane is made up of two loop detectors and digital strain gauge sensors. When the vehicle enters the weighing area, the loop detectors would position the vehicle and activate the digital strain gauge sensors and ANPR cameras. The weighing subsystem consists of six digital strain gauge sensors with three rows that would measure the weight of each axle three times. VanJee develops a sandwich design for six WIM sensors to minimize the effect of truck vibration on weight accuracy. Meanwhile, thANPR camera would take pictures of the vehicle and extract the license plate number on the pad. At the same time, the platform would transfer information between the weight information and the license plate number. Second, the LiDAR subsystem would measure the dimensions of the vehicle (length, width, and height) to regulate large trucks and collect information about the truck's profiling. Third, the monitoring subsystem would operate around the clock to collect information from the trucks and monitor WIM equipment. Fourthly, the platform subsystem would integrate the weighing subsystem and the plate recognition subsystem to get the final overload decision. Finally, VMS would display the overloaded trucks' license plate number information and ask them to go to the next weigh station for further investigation. In addition, the traffic officers could also receive the real-time message to overload truck information if the overloaded truck ignores the VMS notice. At this point, the client officials have sufficient and accurate legal evidence to make the application of the overload.

2) Training Plan and Program

VanJee would arrange on-site professional training for Customer and provide product manual, product operation and maintenance manual, user manual and any other professional materials to Customer. Training includes: 1. System operation management, 2. Problems and countermeasures, 3. Product performance and indicators, 4. Product operation, 5. Product maintenance, 6. Fault determination and handling, 7. Feedback correctness of fault information, etc.

Through high-quality VanJee training , Customer engineers will acquire:

- The ability to properly use and operate VanJee WIM system in order to reduce the probability of system failure caused by improper use or operation.
- The ability to handle common or simple failures,
- The ability to properly maintain systems,
- The ability to accurately describe failures, to facilitate VanJee timely development of Customer-specific solutions.

After the training, the trainees will master the theoretical knowledge of the VanJee WIM system and improve the level of practical operation. VanJee would answer any questions from Customer at any time through a special hotline to bring maximum benefits to Customer.

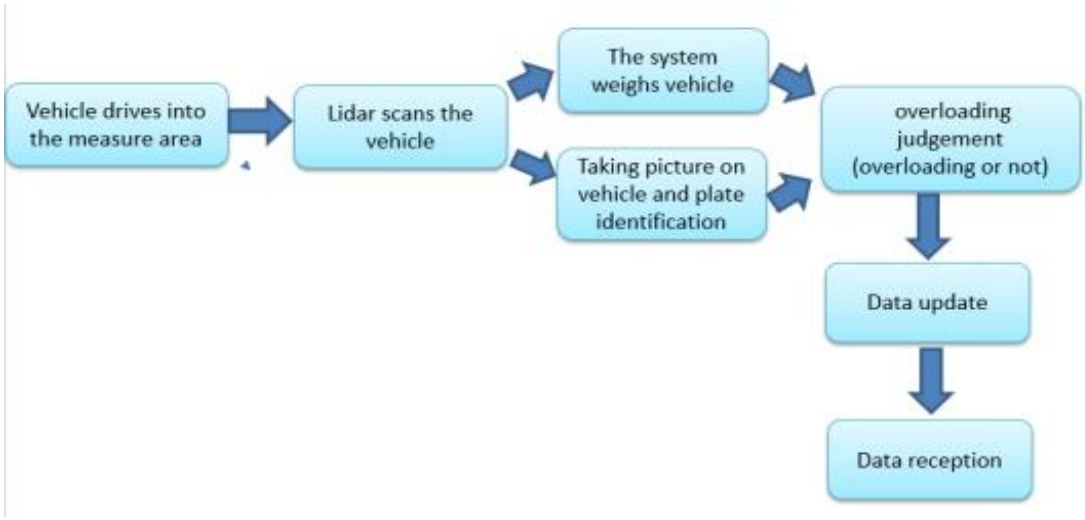

Figure 2: VanJee WIM System Workflow Diagram

5. WIM Experience

1) VanJee WIM Experience

VanJee has built the largest number of WIM sites in the world and has been in the dynamic weighing industry for over 29 years. Until 2023, VanJee has finished 400 lanes of WIM direct enforcement sites. VanJee prides itself on providing the most effective and comprehensive WIM system for Customer. Here VanJee provides the most suitable project for your reference with similar application, scales and complexities. Besides, VanJee has applied Weigh -In- Motion in other comprehensive scenarios including WIM pre-selection, toll by weight, data collection for axle weight, vehicle overload no-entry, and bridge protection. Until 2022, VanJee has distributed more than 20,000 WIM system to the market and obtained more than 500 intellectual property rights in WIM industry.

2) VanJee WIM Systems in Europe

Figure 3: VanJee WIM System in Europe

6. Civil Works and Services

1) General

VanJee WIM System construction content that includes five parts: 1. Excavate and pour 16 meters of hard concrete pavement; 2. Install strain gauge sensors ; 3. Install 2 sets of gantries and a cabinet; 4.Install ANPR cameras and LiDAR; 5. Connect the transmission cables (between the system and the equipment) and integrate the whole system.

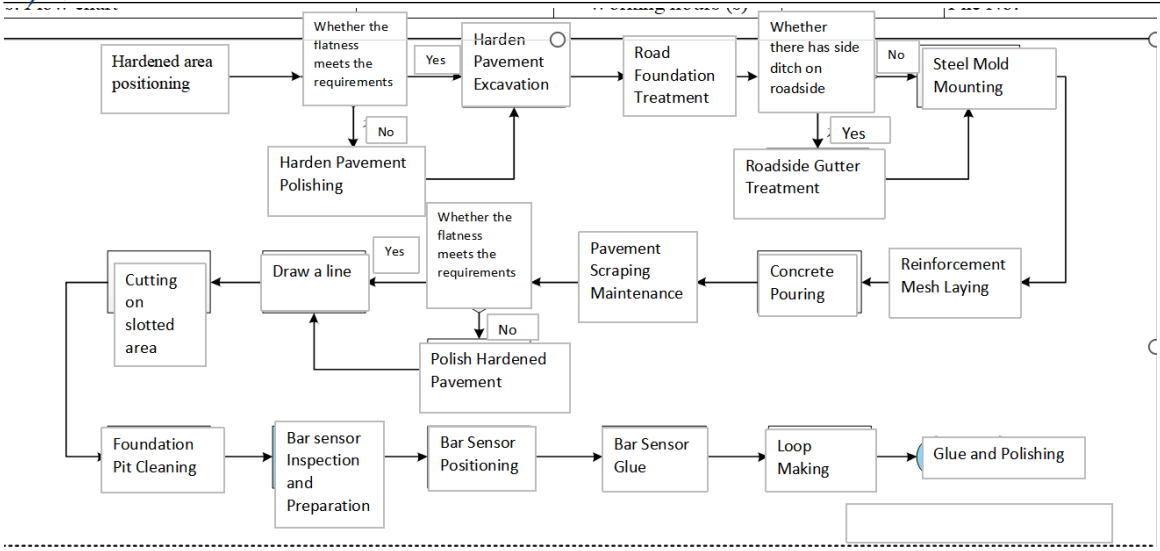

Figure 4: VanJee WIM Civil Works Procedure

2) Portals

VanJee needs an extra gantry or L-pole in the civil works and the connection of public services. A VanJee WIM site requires two gantries. The first gantry is to install ANPR and one LiDAR per lane that measure the height and width of the vehicle. The second gantry consists of installing one LiDAR per lane to measure the length of the vehicle.

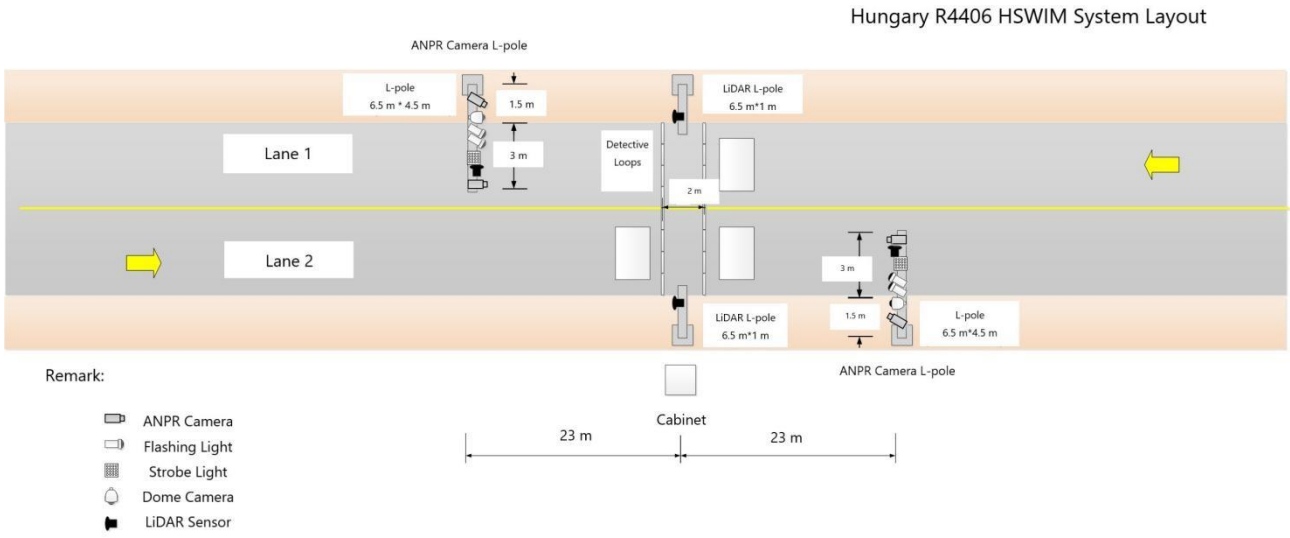

Figure 5: VanJee WIM system with 2 directions and 2 lanes design example.

3) Power Supply

The power supply and data transfer control cabinet can be installed on the gantry. 220v power supply and data is diverted from the VanJee data logger to the gantry. This can save signal lines and power lines, and a lot of work for threading. The system becomes more simplified. Engineers should pay attention to

the size of the openings and the positions of the holes in the posts and crossbars of the door frame, and try to determine the position. The equipment cables are less exposed, safer and better to carry out the execution of the project.

4) Data Connectivity

client would provide according to 220v stable power supply interface power distribution cabinet, and the bandwidth is more than 20M for data, image and video sharing. The interface is placed in the VanJee cabinet . VanJee would also place the interface in a separate cabinet, and then the tubing would connect to the VanJee data collector chassis and the client data access and power distribution cabinet.

VanJee would determine the direction of the mast, header and pipe, excavation of the mast foundation pit, positioning of the flange, processing and installation of the mast according to the position and size of the drawing.

7. Equipment

1) Equipment List

ITEM	DESCRIPTION OF SERVICE	QTY
1	**Weight Measurement Sensors**	
1.1	VanJee Digital Strain Gauge Sensor in 90cm size	20
1.2	Loop Detectors	2
1.3	Detective Loops	4
2	**Data-logger Device**	
2.1	VanJee Intelligent Data-logger	1
2.2	Field Cabinet (Including air conditioning)	1
2.3	Data Processing Computer (Including operating system and database software)	1
2.4	High-speed Data Inspection Software	1
3	**Cables and other Auxiliary materials**	
3.1	Cables and other Auxiliary Materials	1

Note: above equipment list may be adjusted when the project is implemented

2) VanJee WIM Sensor-Digital Strain Gauge

The elastomer of the VanJee WIM sensor is only 3 cm, which means that the sensor has a small pressure area and has fewer shape changes. VanJee WIM sensor has a great competitive advantage in terms of durability and service life. The sensor is not limited by the width of the road lanes and is flexible to install at any position on the road.

Figure 6: VanJee WIM strip sensor-digital stain gauge

Material	Steel alloy
Size	900*50*125 mm
Input electrical resistance	3.0 KΩ output electrical resistance: 2.8 KΩ
Sensitivity	0.415mV / V
Nonlinear relationship	0.2% LO
Repeatability	0.1% FS
Insulation resistance	5X109
Rated load (wheel load)	35t

Overload capacity	150%
Protection class	IP68 can be used in water
Temperature range	-40℃~ +80℃
Sensor life	≥20 million axles
Sensor Weight (975mm)	40kg
CE certification	Obtained
OIML certification	OIML-R60 and R134

Figure 7: VanJee Digital Strain Gauge Sensor

3) VanJee WIM Data-logger

WIM data logger is for processing the weighing signal and information from WIM sensors. Data-logger would transform the weighing data and update the data in real time in the database, In addition, it has its automatic fault detection and alarm mechanism to reduce maintenance costs.

Model	WDH866; has 64 channels to connect the WIM sensor
Signal Range	±10mVDC
Sample Rate	6kHz
Signal Transmission Mode	Support TCP/IP protocol and provide various interfaces such as RS422/RS485
Working Temperature	-40℃~80℃

Figure 7: VanJee WIM Data-logger and outdoor cabinet

4) VanJee LiDAR Sensors for Dimension Measurement (3D profiling)

VanJee LiDAR would perform three main functions: 1. Vehicle classification 2. Traffic data collection (vehicle counting, speed measurement, and vehicle classification) 3. Vehicle dimension measurement (length, width, and height).

Figure 8 : VanJee WLR-711 LiDAR for Vehicle Dimension Measurement in Europe

Dimensions and Weight	120×130×221mm/3.4kg
Scan Angle	180°
Scan Frequency	50 HZ or 100Hz (711A)
Angle Resolution	0.5°/0.25°
Range Capability	0.5m to 30m @10% reflectance
Range Error	≤3cm
Supply Voltage	DC24V±4V
Communication Interface	ethernet
Laser level	Class I human eye safety
Wavelength// laser class	905nm// Class 1 (eye safety)
Operating Temperature	-40°C~80°C

Protection Class	IP68
CE SGS Certification CE	Q/IN-WH-5805-18005
Automatic heating function	Reliable detection in rain, snow, fog and other adverse weather conditions.

5) Loop detectors

Loop detectors are installed at the front and rear of the WIM sensors and cooperate with each other to detect vehicle speed, wheelbase and lane number. The loops are also used to provide activation signals for license plate recognition cameras.

- Tuning: fully automatic;
- Self-adjusting induction range: 20 - 1000μH;
- Sensitivity: four levels on the panel are adjustable;
- Four frequency level switch is optional;
- Mode: The output relay can work in presence (with safety function), pulse or direction logic mode;
- Response time: ≤100ms;
- Drift compensation rate: about 1% ΔL/L per minute;
- Visible indication: 1 × red power LED, 2 × green channel status LED;
- Relay output: 2 × relay support current range 5A / AC230V;
- Reset: press the switch on the front and bottom of the case;
- Protection against overvoltages: coil input: protection by isolation transformer, voltage regulator and gas discharge tube;
- 120V AC +/- 15% (48 to 60Hz), 230V AC +/- 15% (48 to 60Hz);
- Protection : coil isolation transformer, input voltage regulating diode and gas discharge tube protection
- Connector: 11-pin single rear plug (86CPII);
- Storage temperature: -40℃~ +85℃;
- Operating temperature: -40℃~ +85℃;
- Humidity: non-condensing at ≥95%.

8. Data and Software

1) Data Management Platform

VanJee system would collect and store vehicle data for EMC, including location, date and time, vehicle classification, vehicle image, vehicle license plate number, number of axles, wheelbase, gross vehicle and axle weight, single or dual tire speed, vehicle driving direction for platform.

The platform shows vehicle picture and corresponding vehicle information such as plate number and gross weight

Traffic authority adopts VanJee WIM platform to monitor most truck on the road

Figure 9: VanJee Big Data Management platform

2) User Interface

VanJee WIM software interface displays weighing data and other vehicle information.

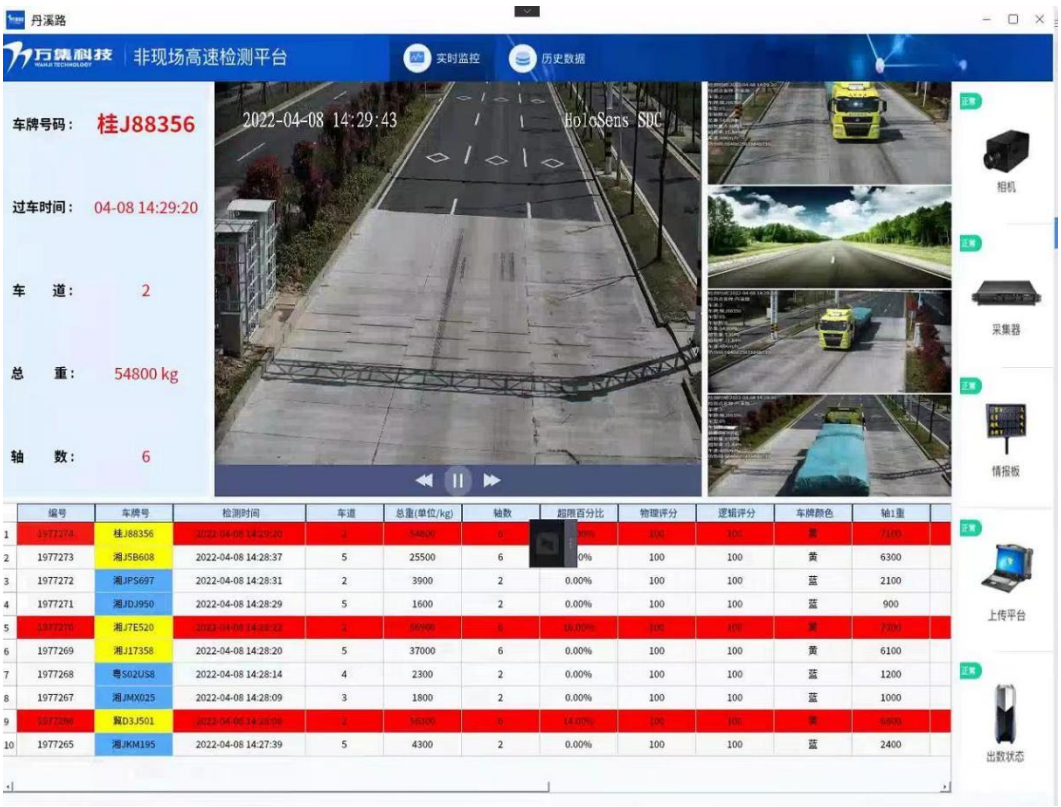

Figure 10: VanJee WIM Software Interface

VanJee affirms that all applicable software developed by VanJee in this project may be licensed for use for the life of the system in accordance with the scope of system functions agreed upon in the contract between VanJee and Customer.

9. Operation and Maintenance

1) General

The warranty period of VanJee WIM is 12 months since the system completion. If there is a fault or defect in any equipment or any material, VanJee will provide the necessary service to remedy the fault or defect in accordance with Customer's needs.

VanJee will provide detailed and professional instructions of operations and maintenance user guides and other necessary documents for Customer staff. VanJee will offer professional training to enable Customer's administrative staff, technical staff, and O&M staff to master their theoretical knowledge of WIM System and improve their level of practical operation.

2) Operations Support

VanJee will prepare professional and experienced technical personnel, reserving maintenance tools to quickly respond to Customer's requirements. VanJee will promptly respond to Customer's contact within 24 hours and promptly provide services to resolve any issues needed.

3) Maintenance and Calibration

VanJee would propose the preventive and corrective maintenance of the equipment for 12 months after system completion.

VanJee would provide WIM calibration 2 times within 12 months after system completion in accordance with the global environment.

10. System Requirements

1) General

VanJee products meet all Customer technical specification requirements. All VanJee equipment has CNAS (China National Conformity Assessment Accreditation Service) certifications. All VanJee equipment can work at ambient temperatures ranging from 0 ℃ to 80 ℃ and 100% relative humidity.

The VanJee system would collect and operate traffic data at vehicle speeds of up to 120 km/h.

2) High Speed WIM Sensors

VanJee Digital Strain Gauge Sensor , which is a high-speed WIM sensor, is installed on every lane of the highway.

VanJee designs the WIM sensor base on strain gauge technology and develops a specific stepped sensor design in the WIM system to meet the weight compliance accuracy requirement with 2.5% accuracy and is metrologically certified OIML-R134. The accuracy class is 5 E and 10 F.

3) LiDAR Scanners

VanJee would use LiDAR to achieve 3D dimension measurement and would cover all lanes.

VanJee LiDAR would return 5% error in either direction.

4) Road Side Unit- Data-logger and outdoor cabinet

All VanJee Road Side Unit achieve IP65 or IP68.

5) ANPR Cameras

VanJee recommends installing one ANPR camera per lane .

ANPR system will achieve an accuracy of more than 95% by using a high-end camera and perfect calibration.

ANPR provides clear images of the vehicle and extracts the license plate.

ANPR system would work to the same specifications day and night by using a powerful flash.

11. Data and Software

1) General

VanJee WIM system incorporates the flexibility to change the allowable weight and dimension limits .

2) Data transmission

VanJee WIM system will transmit the data collected from the vehicle in real time to a server/database owned by client.

3) Data storage

VanJee claims that all data will be stored locally on the platform for at least 12 months.

12. Civil Works and Utilities

1) General

There is no significant variation between 14 locations in terms of road width, road structure and traffic situation.

2) Road Surface

VanJee recommends using C40 hard concrete paving.

3) Power Supply

Electrical connections from the point provided in the vicinity of the gantry to the equipment. The power supply and data transfer control cabinet can be installed on the gantry. 220V power supply and data is diverted from the VanJee data logger to the gantry.

4) Data Connectivity

The data connectivity must reach the bandwidth with 20M to share data and images and videos. The interface is placed in the VanJee cabinet . VanJee would also place the interface in a separate cabinet and then the tubing would connect to the VanJee data collector chassis and the client data access and power distribution cabinet.

5) High Speed WIM Sensors

VanJee requires the road surface to be C40 hard concrete to ensure WIM's accuracy and service life for more than 10 years.

13. Maintenance and Calibration

The focus of maintenance and calibration activities will be the network cables and equipment. VanJee will prepare enough resources and technical experts to provide the most reliable technical support to Customer.

· Prepare experienced technical staff for Customer to respond quickly to any need.

· Prepare massive funds and equipment maintenance tools to quickly respond to maintenance and calibration activities.

· Provide professional training to enable Customer staff to master the theoretical knowledge of WIM system and improve the level of practical operation.

· Provide detailed and professional instructions from Operations and Maintenance user guides and other documents to Customer staff.

VanJee recommends 2 times maintenance and calibration in 12 months for WIM sites of the client according to the environment of global beyond the evaluation phase. The focus of maintenance and calibration activities is on network cables and equipment.

VanJee would prepare experienced technical personnel and professional training as well as instruction documents for Customer to quickly respond to any need.

14. Additional Information

1) Safety and Health Plan

VanJee recommends taking the following steps:

2) Training and Security system

- Conduct rigorous safety training and testing for construction personnel;
- Supervise construction staff to have a safety meeting every week to raise safety awareness;
- Supervise the construction personnel for the delivery of safety works in written form, signed by the person in charge;

- Supervise construction site inspectors to wear conspicuous bracelets;
- Use red warning lights in dangerous construction areas;
- Post the construction information to facilitate the driver to know about the road closure in time, make the arrangement of the driving route in advance;
- Formulate response measures for construction at night and in severe weather;
- Contact the local Highway Repair and Rescue Unit in advance;
- Prepare the necessary first aid supplies.

3) Security Inspection Measures

The inspection form is divided into regular inspection, routine inspection and special inspection.

4) Quality Management Plan

By the long experience in quality management of WIM system, VanJee will analyze error-prone processes in advance and handle the project in strict accordance with the requirements of the Standard Quality Assurance System.

VanJee would ensure the quality of the project from 5 parts: organization guarantee, product quality guarantee, technical guarantee, construction management guarantee and economic guarantee.

VanJee would design:

- Strictly comply with the requirements of the Standard Quality Assurance System;
- Establish experienced project team and establish project responsibility system;
- Strengthen quality training for site construction personnel;
- Test all equipment before delivery. Inspect all equipment upon arrival;
- Adopt safe and efficient means of transportation;
- Ensure that the technician conducts a search of construction personnel before each work procedure begins;
- Carry out rigorous acceptance prior to completion of construction;
- Carry out the quality control plan, measurement control plan, engineering team management plan, vehicle management and site management plan and other plans during the construction phase.