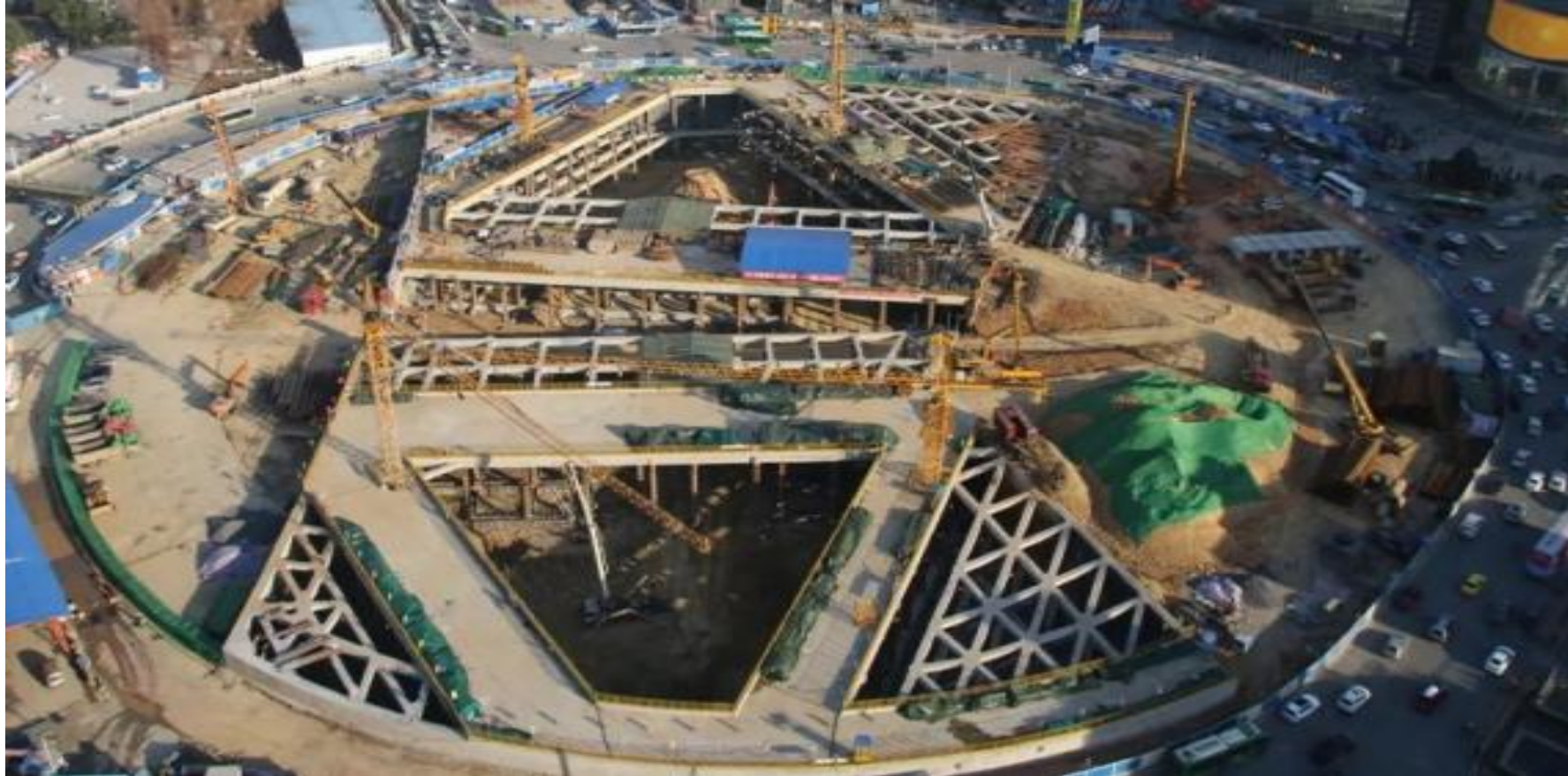# Foundation pit Monitoring Solution

SOUTH Deformation monitoring team was founded in 2007, with more than 10 years development, monitoring team now have 200+ people, more than 600 project experiences.

Foundation pit Monitoring Solution
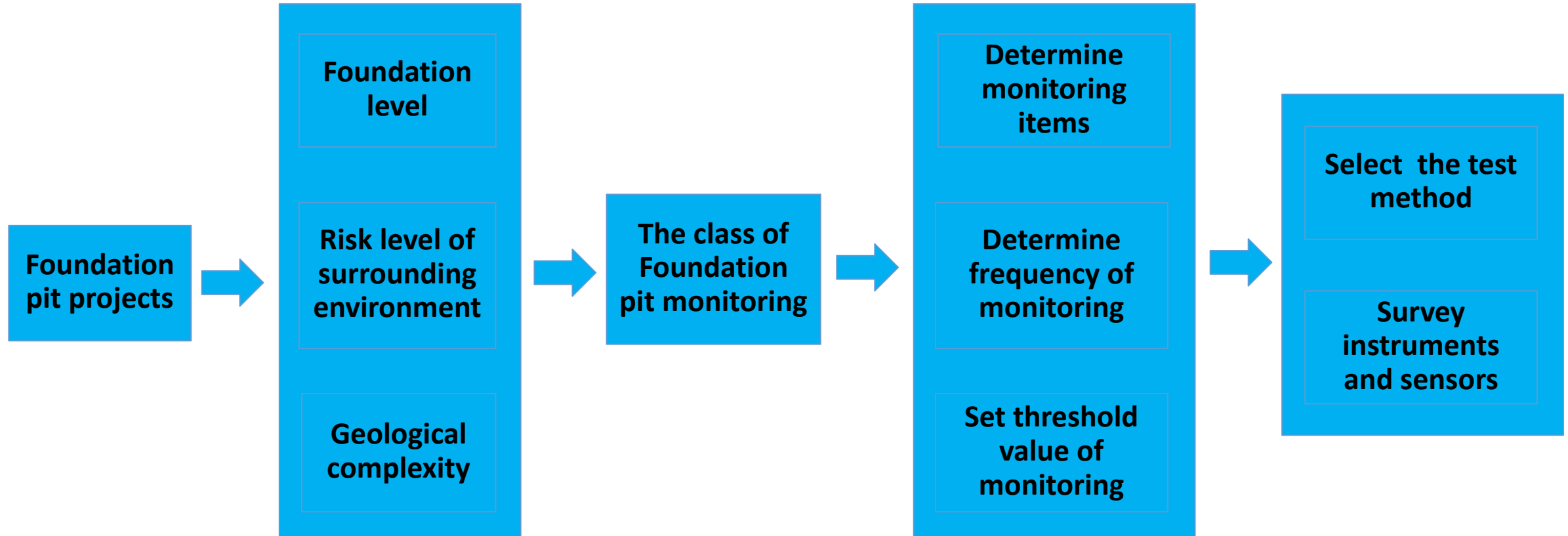
◆ **Profile of foundation pit monitoring**

The foundation pit is the space dug down from ground for the construction of the underground part of the building. Foundation pit monitoring refers to the inspection, measurement, and monitoring of foundation pit and its surrounding during the construction and using period

The main purpose of foundation pit monitoring are as follow:

● Effective monitoring for Foundation pit supporting system and surrounding.

● Provide the parameters for the digitalization construction.

● Verify the design parameter of foundation pit and the construction.

◆ Foundation pit monitoring Workflow

◆ **Foundation pit construction site**

Construction technology of foundation pit roughly include 9 types: step slope excavation, Soil Mixing Wall, drilled filling pile, soil nailing wall, … etc. The monitoring items are slightly different in different projects.

Step-slope excavation

Diaphram wall

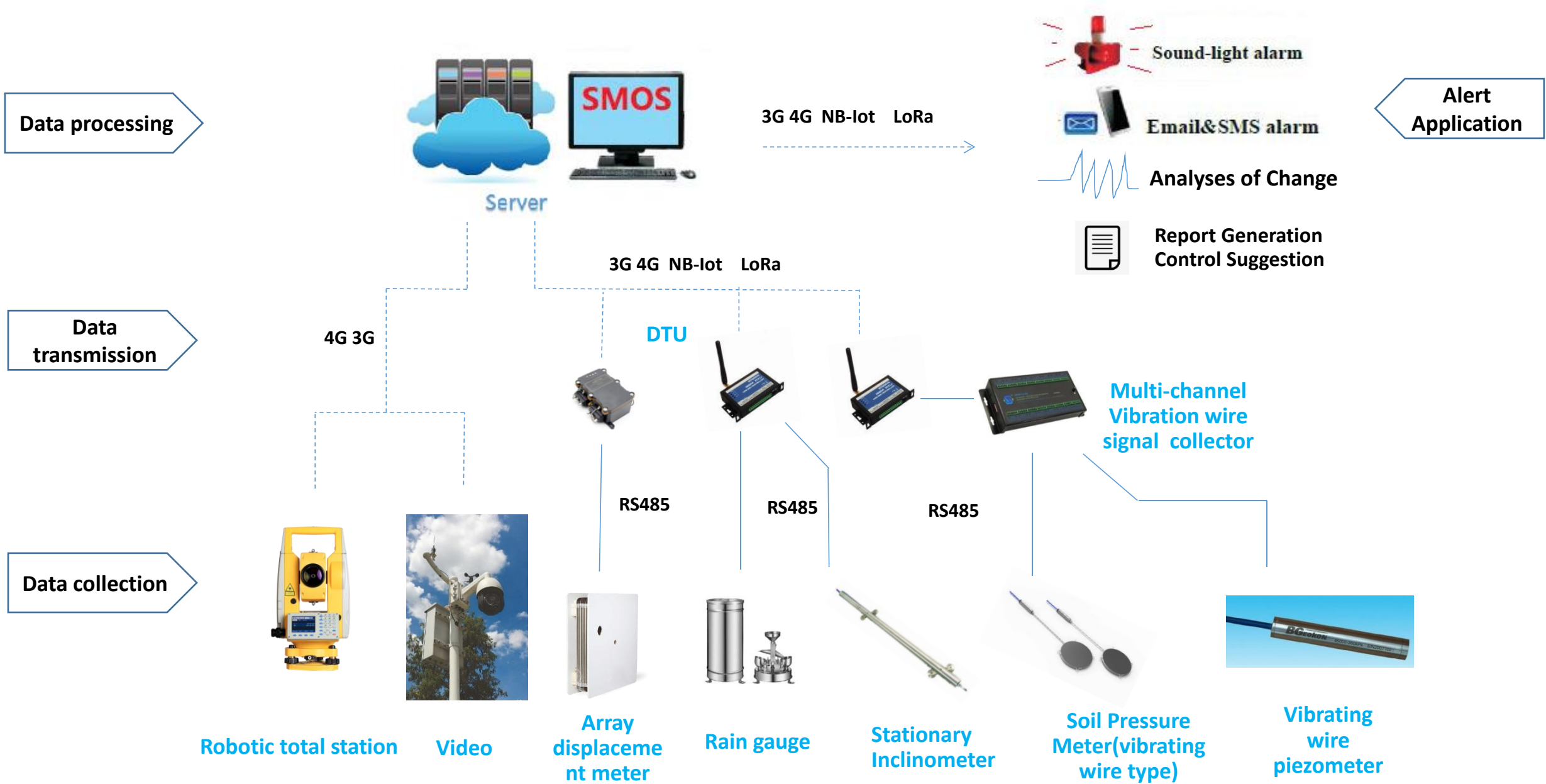Soil Mixing Wall

Drilled filling pile

◆ **Monitoring Items**

The items of foundation pit monitoring are as below. Generally，Manual and automatic methods are adopted for foundation pit monitoring.

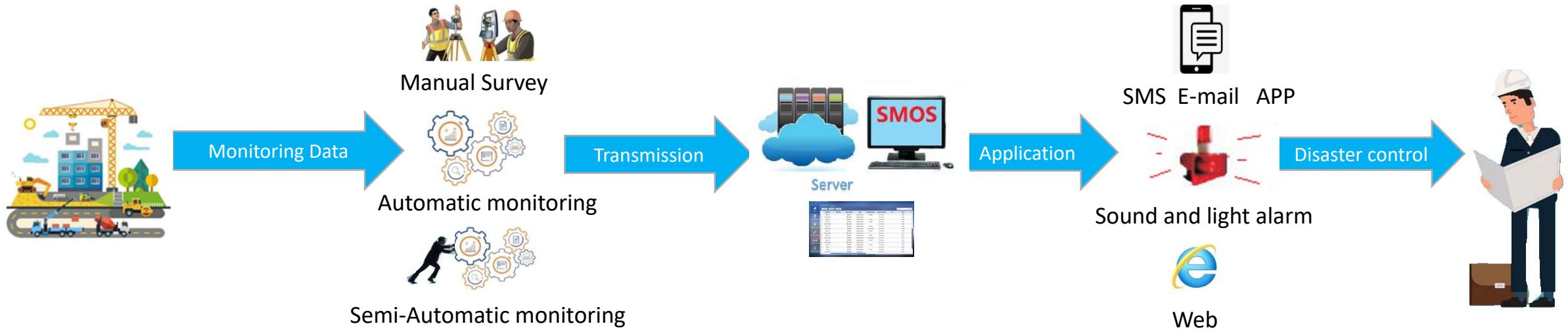| Monitoring Objects	Monitoring Items
Foundation pit supporting structure	Horizontal displacement
	Vertical displacement
	Displacement of depth clay mass
	Stress and strain
Rock and soil	Underground water level
	Displacement of depth clay mass
	Soil pressure
Surroundings	Horizontal displacement
	Vertical displacement

◆ Monitoring Items and Related Equipment

Monitoring Items	Automatic Monitoring Instruments	Monitoring Items	Automatic Monitoring Instruments
Ground Displacement of enclosure wall top	Robotic Total Station	Vertical Displacement of enclosure wall top	Robotic Total Station and electric level
Displacement of depth clay mass	Stationary inclinometer, Array displacement meter	Underground Water	Water Level Sensor
Internal force of enclosure wall	Stress-strain of concrete	Internal force	Stress-strain gauge for rebar and concrete
Anchor internal force	Anchor dynamometer	Surrounding ground subsidence	Stationary inclinometer
Surrounding buildings subsidence	Tilt sensor, Hydrostatic Level	Deformation of surrounding pipeline	Manual detection

◆ The frame of monitoring system

SOUTH

Data processing

SMOS

Server

3G 4G NB-Iot LoRa

Sound-light alarm

Email&SMS alarm

Alert Application

Analyses of Change

Report Generation
Control Suggestion

Data transmission

3G 4G NB-Iot LoRa

4G 3G

DTU

Multi-channel
Vibration wire
signal collector

RS485

RS485

RS485

Data collection

Robotic total station

Video

Array displaceme nt meter

Rain gauge

Stationary Inclinometer

Soil Pressure Meter(vibrating wire type)

Vibrating wire piezometer

◆ Workflow

Manual Survey → Monitoring Data → **Automatic monitoring** → **Semi-Automatic monitoring** → Transmission → SMOS Server → Application → SMS E-mail APP / Sound and light alarm / Web → Disaster control

Application Field

- ◆ **Geological Disaster**
- ◆ **Bridge health**
- ◆ **Foundation Pit**
- ◆ **Dam safety**
- ◆ **Tailing Pond**
- ◆ **Highway Slope**
- ◆ **Tunnel**

- ● **Monitoring Units**
- ● **Construction Organization**
- ● **Natural resource Dept.**
- ● **Regulators**
- ● **Electrical power**

Monitoring items Access

GNSS | Robotic Total station | Electric level | Rain of environment

Inclinometer | Stress and strain | Crack | Vibration

Horizontal Displacement of enclosure wall top

Vertical displacement of enclosure wall top

Deep horizontal displacement of enclosure structure

Shaft internal force monitoring

Level of underground Water

Surrounding constructions subsidence

Stand column settlement

◆ **Monitoring Sensors for Supporting Structure**

Vibrating wire
Reinforcement meter

Anchor cable
dynamometer

Axial force meter

Soil pressure sensor

Hydrostatic Level

Vibrating wire crack gauge

Array displacement
meter

Robotic Total
Station

Multi-channel Vibrating
wire signal acquisition

◆ **Monitoring Sensors for Supporting Structure**

SOUTH

Ground Displacement	**Settle Monitoring**	**Vertical Displacement of depth clay mass**	**Underground Water**	**Stress-strain**
Robotic total station Semi-automatic collection or automatic monitoring by SMOS	Electrical level +APP information collection	Tilt sensors +Collection Terminal Automatic monitoring	Osmometer collected terminal Automatic monitoring	Sensors collection terminal Automatic monitoring
Total Station	**Electronic Level**	**Stationary Inclinometer**	**Water Level Sensor**	**Frequency Meter**

◆ **Foundation pit Monitoring Solution**

SOUTH

Horizontal and vertical displacement

1. 24 hours automatically collecting unattended operation.

2. Real time three-dimensional synchronous monitoring, solved the problem that can't synchronously monitor the horizontal and vertical displacement.

3. Repeated monitoring delay function (when some monitoring points are blocked, repeated monitoring can be made for the points) .

4. Complete the monitoring task with high efficiency.

Robotic total station with SMOS hardware and prisms

◆ **Foundation pit Monitoring Solution**

Robotic total station with APP and prisms

Horizontal and vertical displacement

1. After setting monitoring station，it can survey by one key，so it's able to greatly improved the collection efficiency.

2. Reduced the error of manual intervention, improved the survey accuracy.

3. The monitoring equipment can be taken back after work. It avoids the risk of theft and damage.

4. Just one set can be used on different projects. service efficiency will be improved.

Total station

Prism

◆ **Foundation pit Monitoring Solution**

Vertical displacement

Electronic level with controller and leveling rod, match up with the mobile controller, the collected data can be recorded directly, data can be upload to platform by one key. Data calculation in second level , settlement observation data can be checked without data export and post processing which can save time. Whole efficiency is improved.

Electronic level

High accuracy vertical displacement monitoring

1. Hydrostatic leveling is adopted to monitoring the vertical displacement, it can collect the settlement data of targets and transmit the data by smart wireless transmission module in a fixed time.

2. Hydrostatic leveling is suitable for monitoring settlement of buildings around the foundation pit. This monitoring way is affected by surroundings, such as the surrounding temperature, pipeline of hydrostatic leveling whether is intact. So pipeline must be protected to avoid the external interference.

Hydrostatic leveling

Automatic Inclinometer：It is able to monitor the horizontal displacement of depth clay mass

1. Automatic inclinometer includes current micro displacement sensor, and high sensitive stress sensor.

2.Without pre-embedded inclinometer pipe, this embedded way is high success rate. When adopt the pre-embedded inclinometer pipe way to operate, the sensor can cycle use to reduce the cost, it can realize automatic measurement of soil-mass's depth displacement.

Automatic inclinometer

Array displacement meter

It's a new and smart three-dimensional deformation monitoring sensor, which is suitable for different field. Mainly applied in omnidirectional deformation (displacement) monitoring of three dimensional space. It is mainly applied in geologic disaster monitoring, foundation pit monitoring, hydropower dams monitoring, tunnel convergence, settlement monitoring and other deformation monitoring.

Array displacement meter
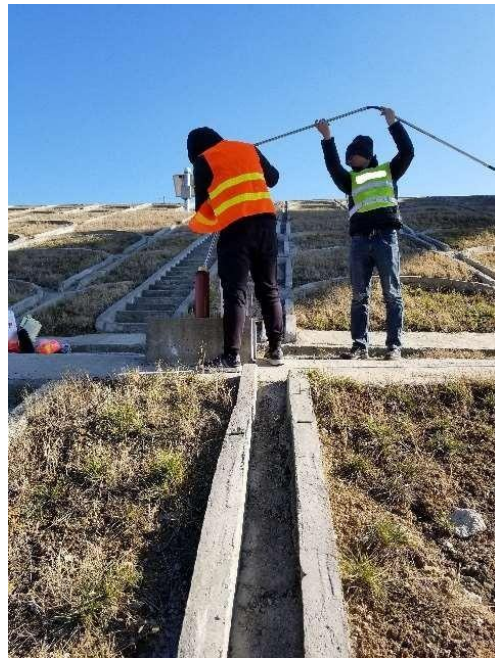
Tacking type automatic wireless water level gauge

1. Tacking type automatic wireless water level gauge measured the water level via measuring the change values of water resistance, changed value of water level was measured by servo motor in real time, and the measured values were transmitted by 4G mobile network .

2. High accuracy, it can transmit in real time, measuring without water quality effect, it can automatically measure.

Tacking type automatic
wireless water level gauge

Smart wireless data collection terminal

1. Smart wireless data collection terminal mainly applied in data automatic collection and wireless transmission of multiple sensors, the field collected data is transmitted in real time by the wireless network.

2. Four vibrating wire sensors and one RS485 sensor can be connected by each Smart wireless data collection terminal , there is no leader-member relation between the terminals, realize the data independently collect and transmit.

3. The terminal can response the functional command comes from server, can transmit the recording data from each channel of the sensors, and report the position and the identification information synchronously.

4. Can realize the ultra long standby with the low power consumption, if configure the solar panel for it, it' able to collect data for long term

Smart wireless data
collection terminal

Automatic deformation monitoring solution

South deformation monitoring solution is a fully automatic monitoring system based on advanced IOT technology, which is compatible with conventional monitoring solutions. It can achieve real-time and effective dynamic analysis and safety early alert of the monitoring target by various means, improve the accuracy and credibility of the monitoring data while reducing the workload of personal.

Solved pain points that man-made more factors in conventional monitoring and automatic monitoring.

Using sensors to monitor the targets (include geologic disasters, highway & railway slope, foundation pit, dam safety, trailing pond, bridges health, tunnel…etc.) for all-weather automatic real-time monitoring. Transmit all status and data of monitoring targets to the data processing center in real time by various wired or wireless network technology. To complete analysis, judgment, alert. Terminal devices can passively receive the alert information，also can actively log in the platform to acquire various status and data of monitoring targets, which is the basis for decision-making.

Road Slope Monitoring

Geological Disaster monitoring

Dam Monitoring

Tailings pond Monitoring

Foundation Pit Monitoring

Bridge health Monitoring

Select the appropriate modules according to the project type (foundation pit, highway slope, bridge, tunnel and other constructions), also can administrate the multiple projects in the mega projects

Software South monitoring system (SMOS)

SMOS software includes different functional modules to meet the user's demand, geological disaster, highway & railway slope, foundation pit, dam, trailing pond, bridge health, tunnel...etc.

◆ **Software interface**

Multi-user management

Powerful Data analysis and chart show

Software South monitoring system (SMOS)

◆ **Software interface**

Smart alert model

User define report export

Thanks!