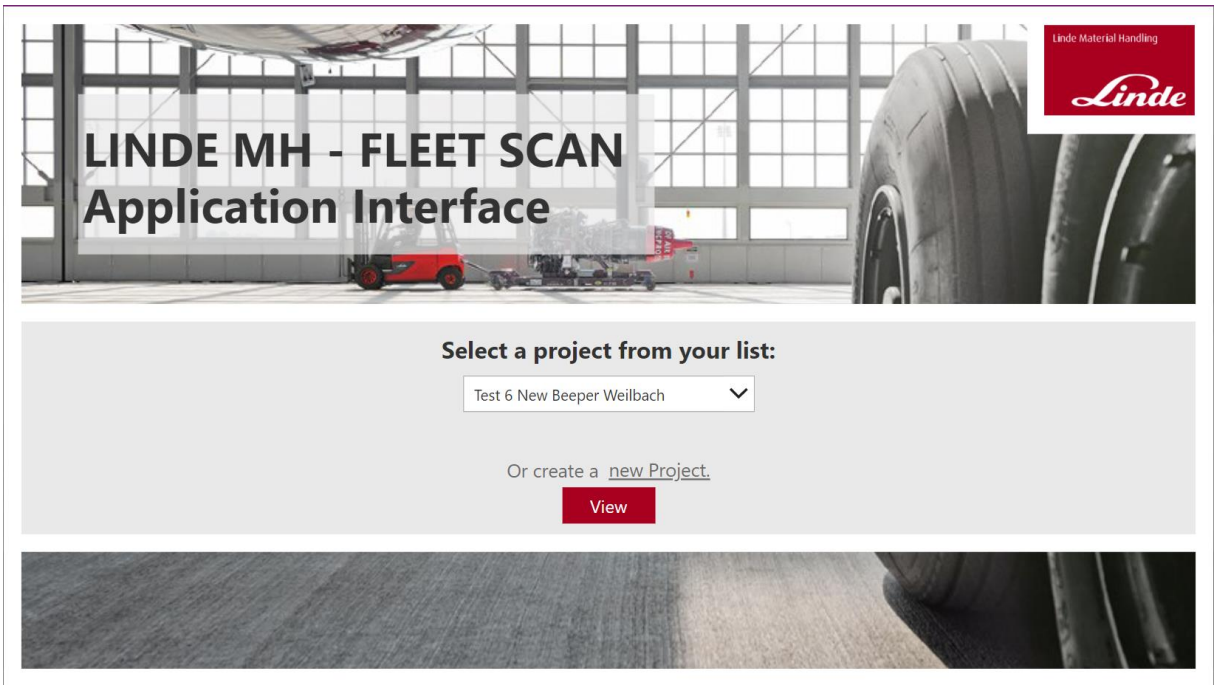

Linde Fleet Scan

Original operating instructions

I

Linde Fleet Scan

Comnovo - Your partner for special solutions in assistance systems for industrial vehicles

As a manufacturer of innovative assistance systems for industrial vehicles, we stand for quality and reliability.

Our solutions are marketed by our parent company Linde-Material Handling under the name Linde Fleet Scan. We are continuously developing new solutions, which can also develop their solution power independently.

We are your partner for special requirements.

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info@comnovo.de

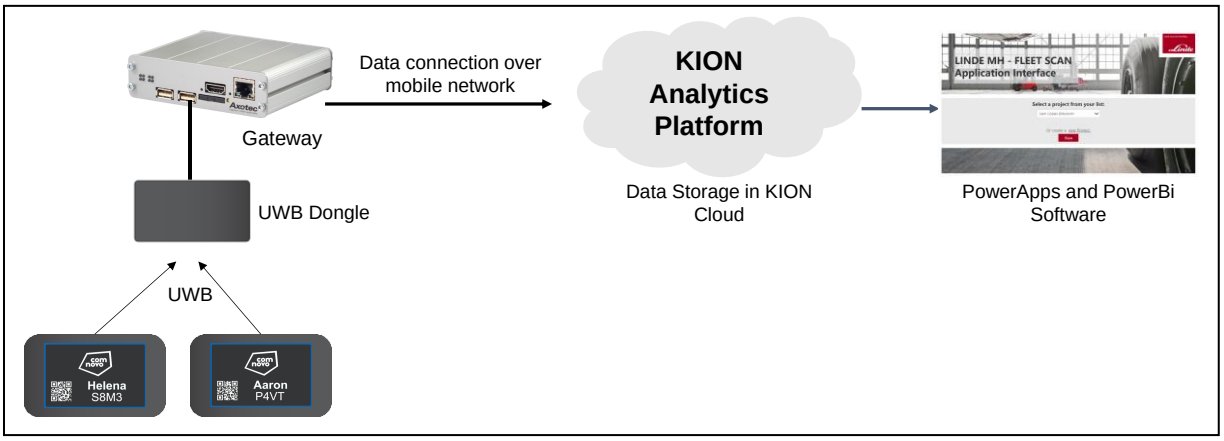
Contents

1 Introduction Linde Fleet Scan

The Linde Fleet Scan is a system for recording and documenting fleet activity for forklift trucks and other industrial vehicles. It is the first product in Comnovo's new Digital Fleet Optimisation (DFO) product range. By evaluating the movement of the truck, conclusions can be drawn for the improvement of performance and increase of efficiency.

1.1 Functional description

First, battery-powered activity trackers are installed on vehicles. With the help of a motion sensor, activity times are recorded at discrete intervals. At the end of the measurement period, the recorded data is transferred to a cloud database via ultra-wideband radio using a gateway.



The performance evaluation in the web-based user interface provides statistical data for the utilisation of the trucks individually and in groups. The evaluation is carried out over defined periods of time with operational and break times in order to obtain realistic statements on the actual truck utilisation..

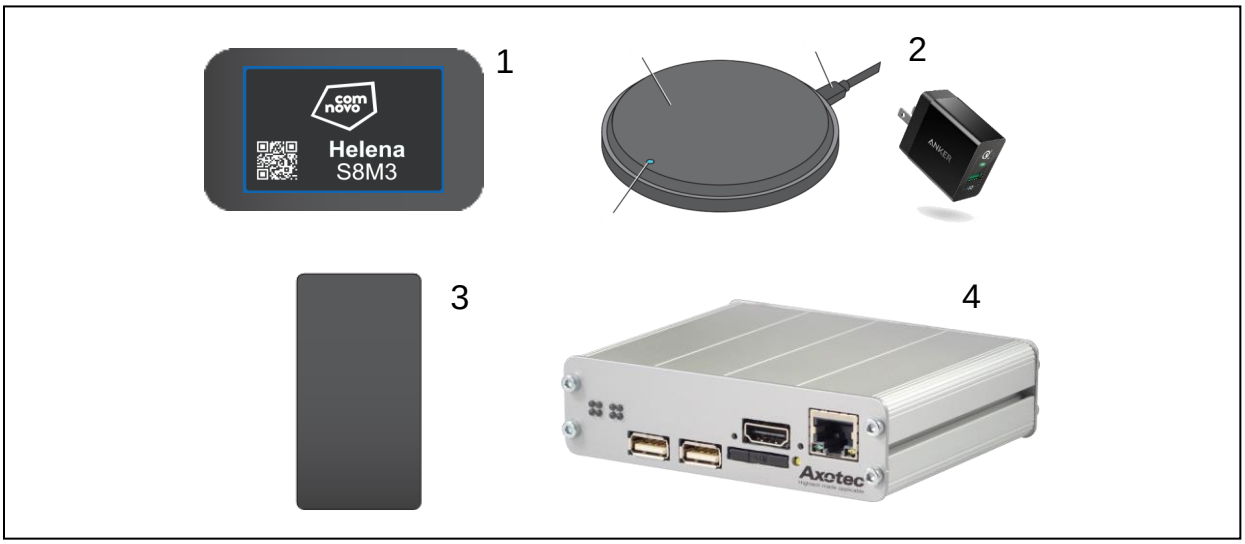
NOTICE

We expressly point out that the optimisation results must always be evaluated with regard to the customer processes and the current operating situation.

NOTICE

We expressly point out that no personal data is collected. If an assignment of forklifts to drivers is made, the data protection requirements must be observed.

1.2 Devices of Linde Fleet Scan



1. DFO Activity Tracker
2. Qi Charging Station with power supply
3. UWB Dongle
4. Gateway with accessories

1.3 Software components of the Linde Fleet Scan

A Microsoft PowerApps application is used to configure the project. The evaluation is carried out with a Power BI dashboard.

The applications are interconnected and can be accessed with a Microsoft user account.

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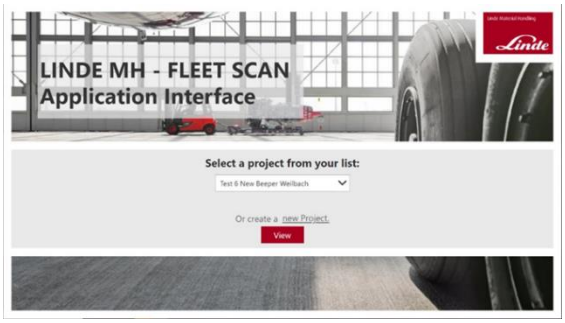
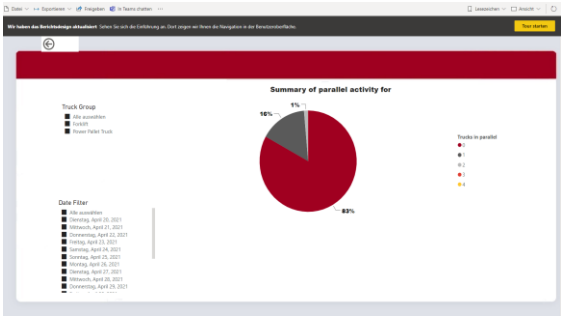




1.4 Intended use

The components of the Linde Fleet Scan may only be used as intended. The safety instructions must be observed.

1.4.1 Limited release for use

As of 03.2022, the Linde Fleet Scan is only approved for use in countries of the European Economic Area and may only be used in these countries. The use of the Linde Fleet Scan in other countries is not authorised by Comnovo.

We will be happy to send you the current EU declarations of conformity on request.

1.4.2 General

The Linde Fleet Scan is designed to analyse vehicles at defined locations in industrial environments.

The components of the system can be used indoors, mobile or at fixed locations.

If adjustments are made to match local conditions in the event of radio interference at the site of operation, re-registration and approval may be necessary.

1.4.3 Installation

The battery-powered activity trackers can be attached to the vehicle using a magnet. Make sure that the activity trackers are fully charged before installation. Make sure that the activity trackers are installed in the cabin protected from environmental influences. They should not injure anyone, especially the driver, if they fall.

The gateway and the charging station are installed in an office for data transmission. The components supplied must be used.

1.4.4 Limitation for distribution and permission for operation

Changes or modifications to the equipment not expressly approved by Linde Material Handling GmbH or Comnovo GmbH could void the RED/CE approval to operate this equipment. Operation on board or in the vicinity of aircraft, ships or satellites is prohibited, as is use within a specified distance of a specific radio astronomical location. In addition, the use of equipment mounted on outdoor structures (e.g. a fixed outdoor location), such as the outside of a building or fixed outdoor infrastructure, is prohibited. Only portable devices may be used in mobile scenarios in mixed indoor/outdoor mode.

FCC and ISED regulatory specification

This equipment has been tested and found to comply with the limits of a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

⚠ WARNING

There is no guarantee that interference will not occur in an installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult KION NORTH AMERICA or your qualified reseller for further assistance

Important Note

Changes or modifications made to this equipmentnot expressly approved by KION NORTH AMERICA or its authorized reseller respectively WILL void the FCC authorization to operate this equipment.

Note

The use of devices mounted on outdoor structures, e. g. Static Units mounted on the outside of a building or any fixed outdoor infrastructure is prohibited. Only handheld devices may be used in mobile scenarios in mixed in-/outdoor mode. For example, Truck Unit together with external sensor nodes, Distance Beeper, Truck Unit Small etc.

1.5 Symbols used

The signal terms DANGER, CAUTION, ATTENTION, NOTE and ENVIRONMENTAL NOTICE are used in these operating instructions for information on special dangers or for unusual information requiring special labelling:

DANGER

means that there is a danger to life and/or considerable damage to property would occur if this is not observed.

WARNING

means that there is a risk of serious injury and/or considerable damage to property if this is not observed.

CAUTION

means that damage or destruction could occur to the material if not observed.

NOTICE

means that special attention is drawn to technical contexts because they may not be obvious even to professionals.

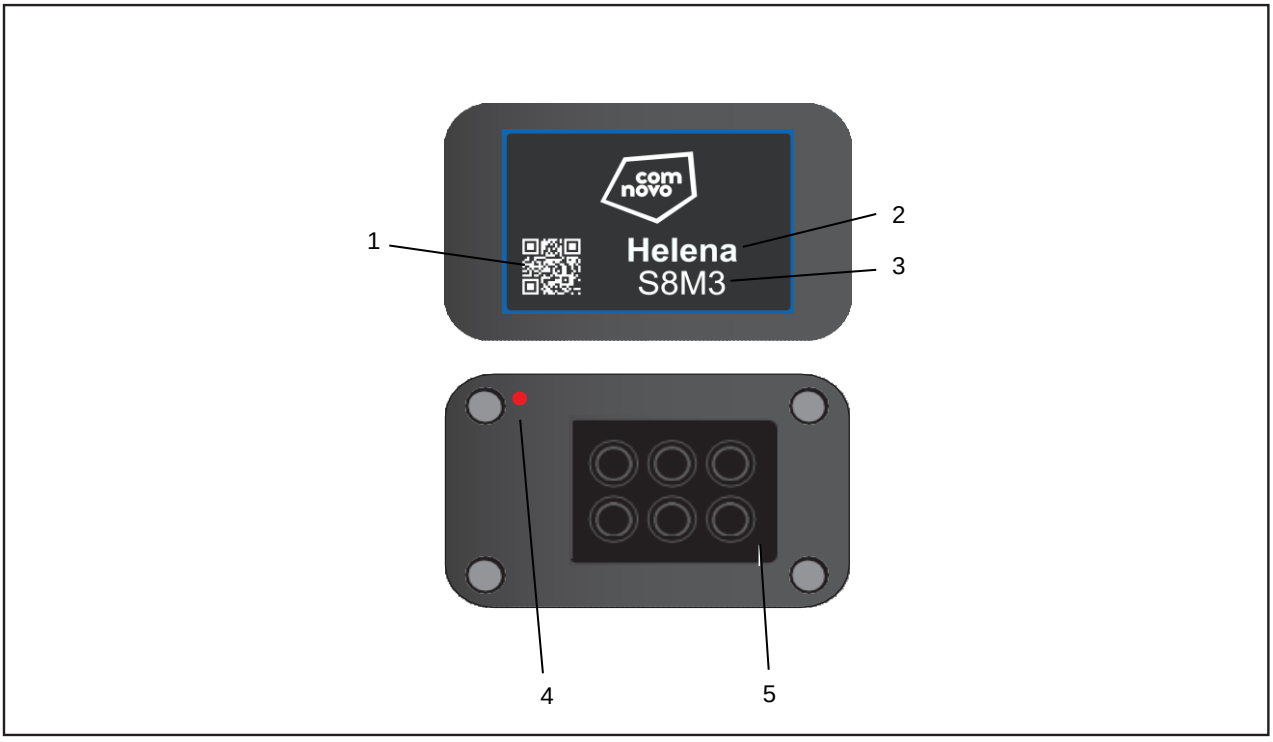
NOTICE

The instructions listed here must be observed, otherwise environmental damage may occur.

This sign is attached to the truck in places that deserve your special attention. Read the corresponding passage in these operating instructions.
Other signs are used for your safety. Please pay attention to the various symbols.

2 Components

2.1 Activity Tracker



1. QR Code
2. Name des Geräts
3. Eindeutiger Identifier
4. Status LED
5. Magnet

The Linde Fleet Scan is a system for recording and documenting fleet activity for fork lift trucks and other industrial vehicles. With a battery life of 14 days, the Activity Tracker measures the activity of the truck via an integrated motion sensor.

CAUTION

A lithium polymer battery can be damaged by deep discharge. If the battery is stored for one year or more, it must be charged in between.

DANGER

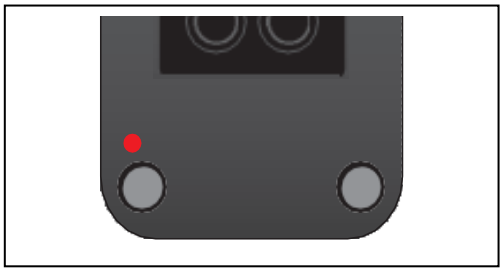
The trackers must not be permanently exposed to direct sunlight. The battery may be destroyed or explode

Labels and name

The name and a uniquely assigned short ID are printed on the front foil of the Activity Tracker. The name or the ID is used later to assign the measurement data to the vehicle.

The activity tracker has a QR code on the front in which the following information is stored:

1- Name
2- ID



Status LEDs

The status LED supports the operator during the charging process, commissioning and data transmission as follows:

- LED is off: The unit is active in the measurement or the unit is deactivated due to an empty battery.
- LED flashes red (1 time per second): The battery is being charged and has a charge level below 80%.
- LED flashes red (3 times per second): The battery is being charged and has a charge level below 80%. Measurement data is available on the device.
- LED flashes green: The battery is charged and has a charge level above 80%.
- LED is constantly green: the battery is fully charged and the internal time is set.
- LED flashes alternately between green and red: data is being transmitted to the gateway

Activate measurement

The units activate the measurement automatically when the following criteria are met:

- Battery has enough capacity
- The internal time is set

When commissioning, it is important that the battery is fully charged. This is the only way to achieve the maximum runtime.

The gateway automatically sets the internal time of the activity tracker as soon as the activity tracker is within a range of 10m around the gateway.

If the activity tracker is brand new or has been completely discharged, e.g. after a long period of storage, the time must be reset.

NOTICE

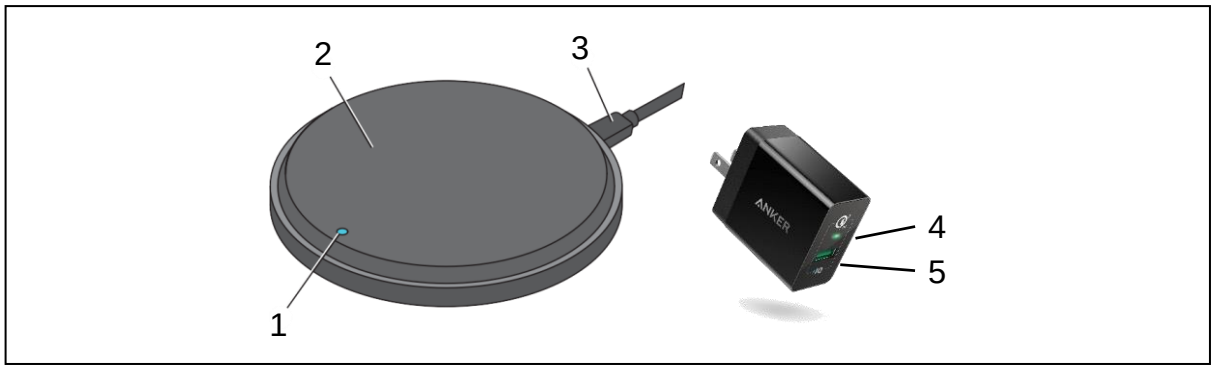
The activity tracker is always active. The transport of the tracker is therefore also recorded. To ensure that the full memory capacity can be used for the measurement, we recommend fully charging the activity tracker directly next to a gateway immediately before the measurement. In this way, all data is transferred from the memory and deleted.

Battery life

The battery life of the Activity Tracker depends largely on the activity of the vehicle due to the measurement method used.

With a fully charged Activity Tracker, a minimum runtime of 14 days can be expected. If the battery life is less, please check the FAQ section

2.2 Charging station



1. Charging indicator LED
2. Charging surface
3. Micro-USB cable
4. Power supply status LED
5. USB connector

To charge the Activity Tracker, the unit must be positioned on the charging surface (2). The front side must be on the charging station. The charging station must be connected to the power supply at the USB connection (5) with the micro USB cable (3).

The following components can be charged with the inductive charging station:Activity Tracker:

- Activity Tracker

Charging indicator LED

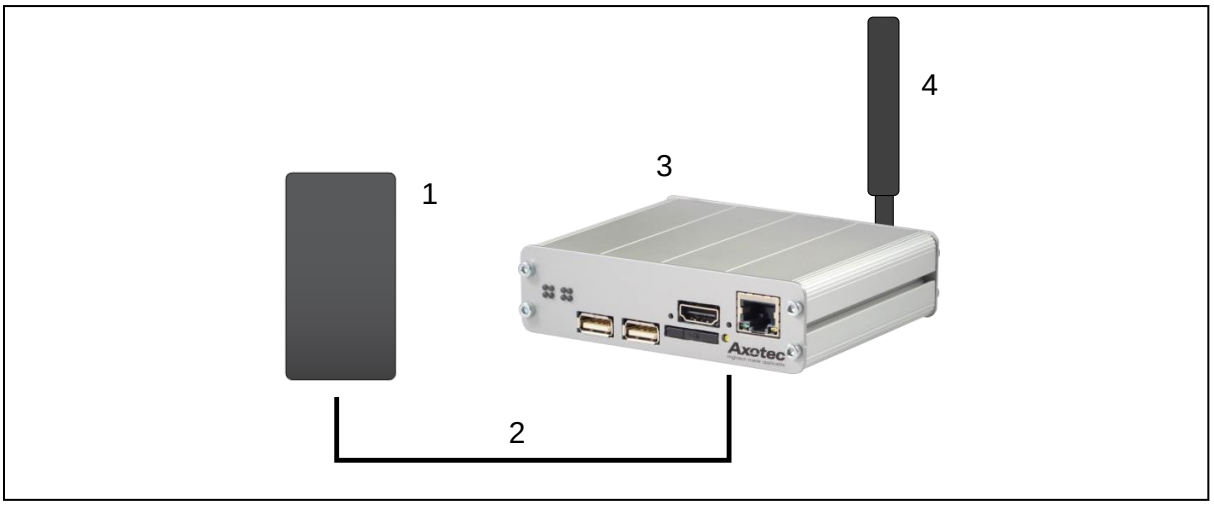
The LED lights up for 3 seconds: the charging station is connected to the power supply.

- The LED lights up blue: active charging process of an activity tracker.
- The LED flashes blue: an unidentified object is on the charging station. No charging process is possible
- The LED flashes green: The charging station has activated the overvoltage protection.

Status display from the power supply

- LED lights up green: The power supply is supplied with voltage and ready for use.

2.3 Gateway



1. UWB Dongle
2. USB-Adapter cable
3. Gateway
4. LTE-Antenna

The gateway receives the measurement data from the trackers and sends it to the cloud. As the activity trackers do not have an integrated cellular module to save energy, the ultra-wideband radio channel is used to transmit the data from the activity tracker to the gateway. The gateway has a cellular connection and can thus upload the data to the cloud database without interfering with the local IT infrastructure.

The data transfer is secured by an encryption mechanism. The data is already encrypted on the activity tracker and then only decrypted after arrival in the cloud. In this way, the data is transported via the local data network to the cloud in a tamper- and eavesdropping-proof manner.

The operating instructions for the gateway can be downloaded directly from the manufacturer's website.

Comissioning the gateway

To put the gateway into operation, the supplied UWB dongle is connected to the gateway. In addition, the mobile radio antenna supplied must be screwed on. After connecting the power supply and plugging it into the socket, the status LED of the gateway lights up as follows:

- LED lights up green constantly: unit is switched on
- LED flashes yellow: the connection to the Internet has been established.

NOTICE

If the connection to the Internet cannot be established, try an alternative set-up position. If the mobile network cannot be reached due to local shadowing at the set-up position, it is also not possible to connect to the Internet.

NOTICE

The radio range of the UWB radio is approx. 10m around the antenna. If the distance is greater, the data transmission may be disturbed.

2.4 Performance Evaluation Software

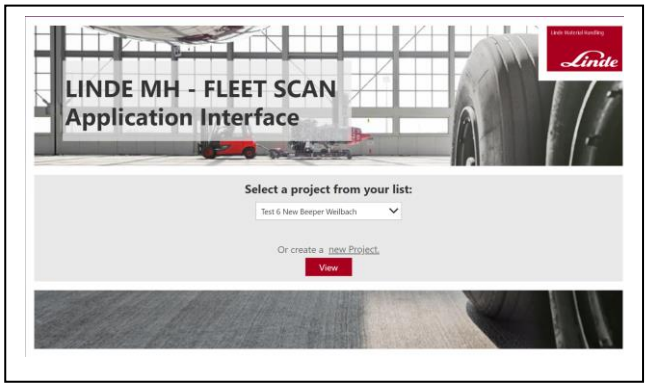
Two tools are available for analysing the data. Projects can be created in the web based PowerApps Linde Fleet Scan application. Data evaluation takes place in a linked Power BI dashboard.

Create a user

A Microsoft Windows account from the KION network is required to use the Linde Fleet Scan app. Please get in touch with your contact at Comnovo to set up a new user account. We will be happy to help you.

Homescreen

On the start page, you as a user have the option of selecting projects that have already been carried out or creating a new project. All projects assigned to you or your organisation are displayed.



NOTICE

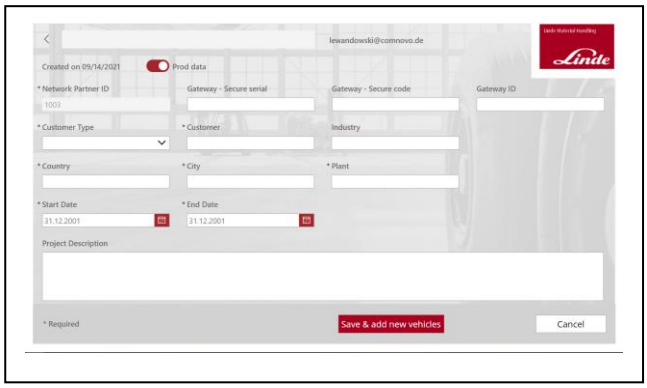
If you are not authorised to view the project's data, you may be in breach of the General Data Protection Regulation. If you are unsure, speak to your supervisor or contact person at Comnovo.

Create a new project

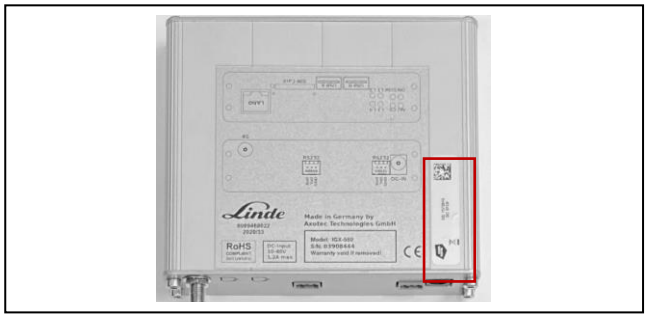
When creating a new project, it is mainly a matter of entering the customer data and assigning the gateway.

Your network partner ID is taken from the login data.

You do not need to change anything here. You then start and enter the relevant client information and the planned measurement period for your project. You also have an area for further notes

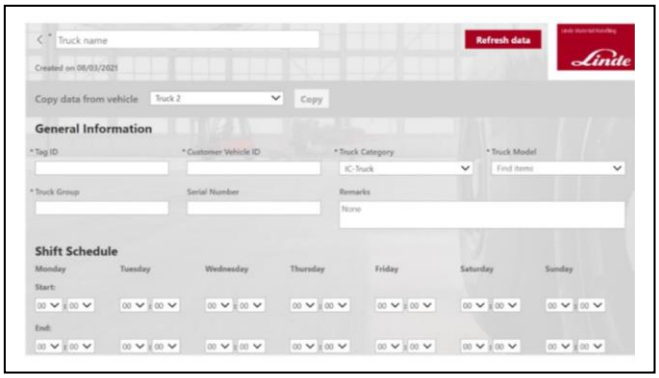


The gateway is assigned via the Secure Serial and the Secure Code. Both values can be found on the label on the back of the gateway. The assignment ensures that the data can also be assigned to the project. Thus, no data mixing can occur. If the gateway is not assigned, no data will be accepted or uploaded.



Clicking on the Save & add new vehicles button takes you to the next dialogue.

Entering the fleet data and assigning the activity trackers



In this dialogue you can enter the fleet data. You can assign a name for the vehicle. Then enter the 4-digit code of the Activity Tracker for the corresponding vehicle. In the Workflow chapter, we present you with tools and descriptions for integration into the set-up process.

On the same page, you can enter further information from the vehicle.

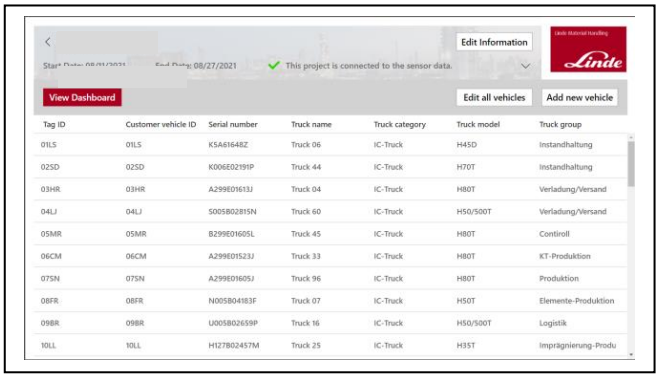
NOTICE

The entry of break times is mandatory for the later evaluation of the workload. If break times are unknown or not present, please fill in a "0".

NOTICE

For the first vehicle, take the time to enter the operating and break times correctly. You can then use the "Copy" button to process the next vehicle more quickly by adopting the configuration. Errors in the input will then cost twice as much time in the end.

Fleet list



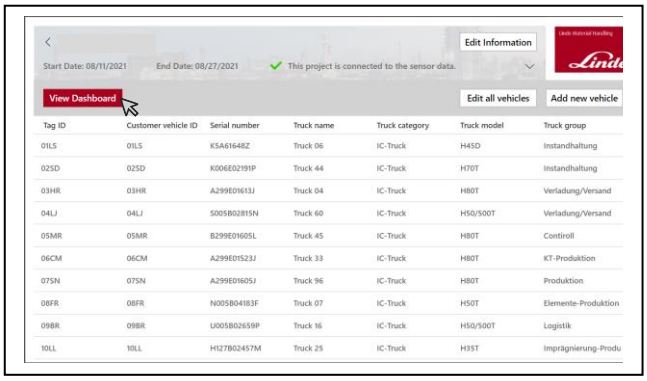
After entering the fleet data, you are automatically taken to the fleet list. Here you can make changes to your configuration and add more vehicles. You can still change project-specific information using the Edit Information button. Use the arrow to expand the detailed information to see the connection to the sensor data. The "View Dashboard" button automatically opens the linked Power BI Dashboard

NOTICE

After creating the project, you can upload the data via the gateway. As soon as data is assigned to the project, this is shown via the display *„This project is connected to sensor data"*.

2.5 Data Analysis

The data analysis is realised in a linked Power BI Dashboard. The Power BI Dashboard is accessed via the "View Dashboard" button in the PowerApps application.

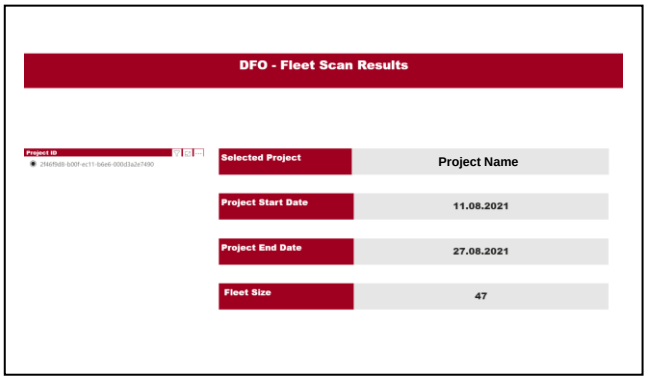


NOTICE

Achten Sie darauf, dass dem Projekt bereits Sensordaten zugeordnet sind. Ohne Sensordaten ist das Power BI Dashboard leer. Der Haken *„This project is connected with sensor data“* muss auf grün stehen.

Start screen

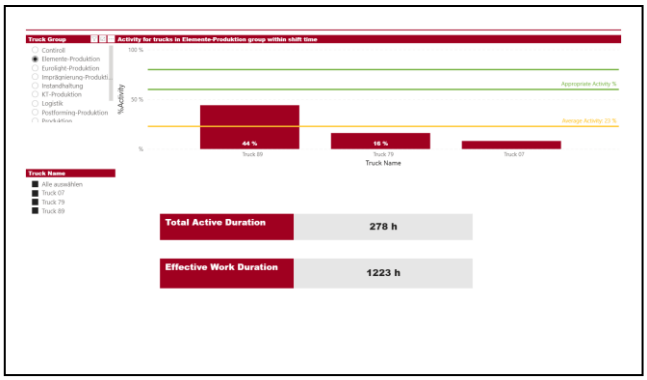
In the start screen, the essential parameters of the fleet recording are displayed. The data is based on the available sensor data, i.e. if more vehicles are created than sensor data available, the number of actually available data in the selected period is referred to here.



Activity analysis

The measurement method of the activity trackers enables the analysis of activity times. By moving the tracker at the start of the journey, the start time is recorded.

Afterwards, the activity tracker switches back to energy-saving mode and measures in a 4-minute cycle whether the vehicle is still moving. When the movement is complete, this period is counted for activity. At the end, the activity analysis shows in a bar chart the percentage activity of the vehicle compared to the maximum operating time over the day. The operating times and break times were considered here. For better classification, adequate activity times for benchmarking are also shown.



The presentation of the activity analysis follows two variants:

1. Breaks and shift times are taken into account (Shift Activity). Travel times outside the shift schedule are ignored in the calculation.
2. The percentage activity is related to 24h of the day (24h).
3. Percentage activity as in 1 with consideration of driving times outside shifts. (24h related to shift times)

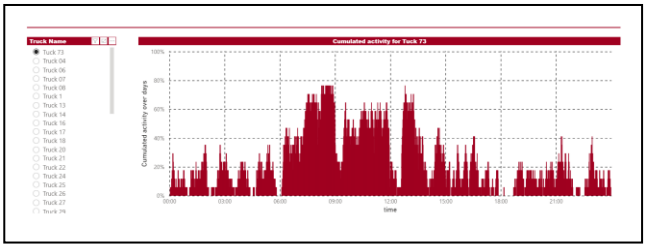
The presentation of the activity analysis follows two variants:

1. Breaks and shift times are taken into account (Shift Activity). Travel times outside the shift schedule are ignored in the calculation.
2. The percentage activity is related to 24h of the day (24h).
3. Percentage activity as in 1 with consideration of driving times outside shifts. (24h related to shift times)

NOTICE

The data from the PowerApp is used as a basis for the shift and break times. If the entries there are incorrect, this can lead to erroneous results in the workload analyses.

Aggregated visualisation of thr activity over the measurement period

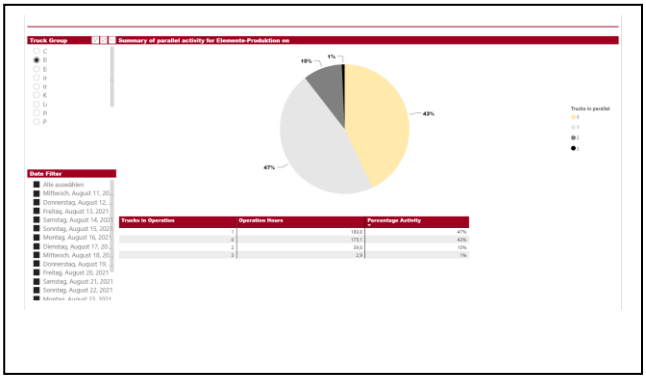


The following can be read in the aggregated representation of the activity:

Over the entire measurement period, the activity was analysed via the daily profile. The graph now shows the probability of the vehicle being active at the corresponding time of day. In this example, the truck is active at 10 a.m. with a probability of 80%.

The evaluation can help to identify certain patterns in the shift patterns.

Parallel activity in the pie chart



The individual activities of the trucks already give a good first impression for potential optimisations. However, the group behaviour of the trucks is crucial for identifying potential savings.

That is why it is important to pay attention to the grouping of the trucks when creating the fleet data. Forklifts that perform an equivalent activity in the direct vicinity of each other with the same equipment have a great potential to achieve a bundling gain.

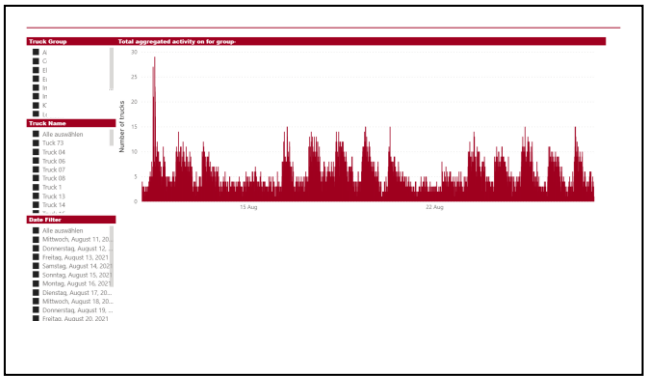
This illustration shows the percentage of the time how many forklifts of a group were active in parallel.

To identify optimisation potential, look at the number of trucks in the group compared to the percentage of activity time of these stackers. It can happen that only a small percentage of all trucks in the group are active at the same time. All trucks belonging to the same group must have the same shift and break times.

Parallel activity animated and aggregated

This illustration provides a better understanding of the parallel activity. Here the number of parallel active stackers is shown over the measurement period. After the initial guess in the pie chart, the period can be analysed here to determine peaks in the utilisation of the forklift group. You can use the analysis to discuss the peak loads with the customer. This allows the customer to develop strategies to relieve the peak periods.

To increase the understanding of the peak utilisation, the animated version of the display is used. Changes over the different days of the week can be traced in the animation.

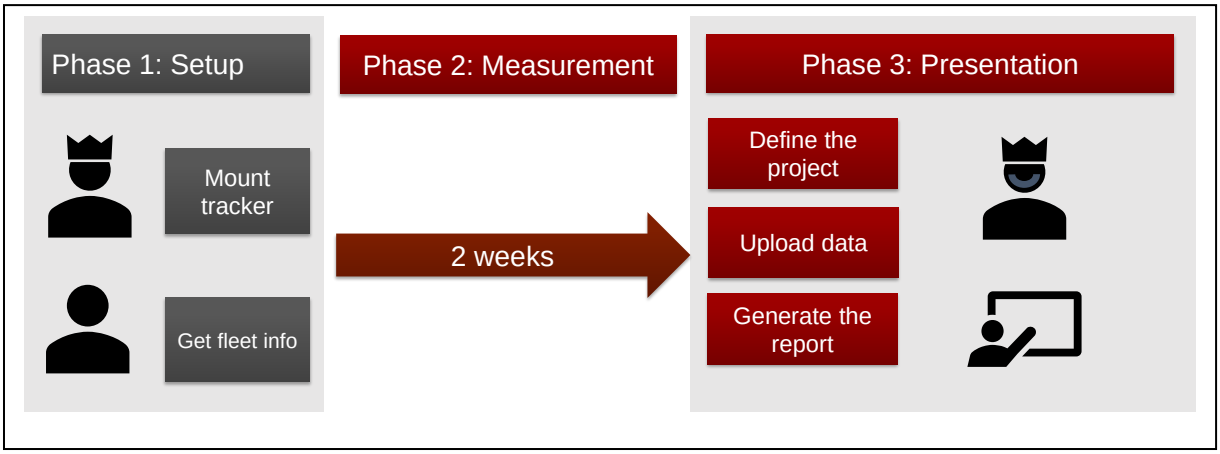


3 Workflow- installation to evaluation

The Linde Fleet Scan is based on:

1. the Activity Tracker, which is installed on vehicles to measure activity.
2. the gateway to transfer the data to the cloud
3. data analysis software.

In this chapter, the components are explained based on the workflow.



3.1 Phase 1: Mounting

Installation of the activity trackers

The installation of the trackers on the vehicle is designed to be simple. The following points must be observed:

1. make sure that the activity trackers are fully charged and have a set time. For details, see chapter 2.1. The status can be read from the blink code of the LED on the back of the activity tracker.
2. The devices can be attached by magnet and do not require an electrical connection to the vehicle.
3. Make sure that the Activity Tracker is installed inside the cab when the truck is used outdoors. Make sure that the Activity Tracker cannot injure anyone if it falls. A good position is e.g. behind the seat or behind a panel.

Collect fleet info

To be able to assign the tracker to the vehicle later, make a note of the short ID of the Activity Tracker and the corresponding designation of the truck. The assignment is important for the correct allocation of the data.

You can store the data directly in the PowerApps project system, or you can enter the data afterwards.

3.2 Phase 2: Perform measurement

The measurement runs automatically after installation. No interaction is necessary. As the activity trackers are designed for energy-efficient operation, no LED is active to indicate a running measurement.

3.3 Phase 3: Presentation

After the measurement period, the activity trackers are removed. The removal of the activity trackers does not require any interaction. It can therefore also be carried out by the client at the end.

Create a project

After or during installation or after dismounting the activity trackers, the project must first be created. The project creation is described in detail in chapter 2.5.

NOTICE

During commissioning, care should be taken not to include the day of set-up and dismantling in the analysis.

Uploading the data

The data is then uploaded via the gateway next to the charging station. It is important that the gateway has been assigned to the project beforehand. A detailed description can be found in chapter 2.5.

Generate the report

The reports can then be generated. Via the button View Dashboard the data can be displayed in the Power BI report. The detailed description of the evaluation graphics can be found in chapter 2.5.

4 Care and disposal

4.1 Care

CAUTION

Damaged surfaces due to incorrect cleaning agents.

- **Do not use aggressive cleaning agents.**
- **Do not use cleaning agents with abrasive particles.**

Regular cleaning of the Linde Fleet Scan components increases the service life of the system. Carry out the following steps after daily use:

- **Check components for dirt.**
- **Remove coarse dirt with a soft brush**
- **Remove fine dust and coating with a damp cloth**

4.2 Disposal

NOTICE

Electronic waste and batteries are raw materials and do not belong in household waste. Disposal with household waste is not permitted.

At the end of its life, dispose of old appliances and batteries in accordance with national regulations.

NOTICE

It is recommended to work with a specialist disposal company for disposal

5 Technical data

5.1 Activity Tracker

Performance data	Unit	Value
Operating voltage	VDC	3,3V
Max. Power consumption	W	max. 2.5
Range	m	Max. 25
	ft	Max. 82
Rechargeable Battery capacity	mAh	950
Ultrawide band Channel	MHz	No.5 (CF = 6.4896)
Frequency (Occupied Bandwidth)	MHz	6153 to 6812
Transmission Power	dBm/MHz	Max. -42.7
Operating temperature	°C	-20 up to +45
	°F	-4 up to +113
Air Humidity	%	10-85
Dimensions	mm	51 x 82 x 14
	In	2 x 3.22 x 0.55
Weight	g	105
	Oz	3.7

5.2 Programmer/UWB Dongle

Performance data	Unit	Value
Operating voltage	VDC	5
Max. Power consumption	W	1
Range	m	max. 25
	ft	Max. 82
Ultrawide band Channel	MHz	No.5 (CF = 6489.6)
Frequency (Occupied Bandwidth)	MHz	6166.2 to 6804.8
Transmission power	dBm/MHz	Max. -41.95
Operating temperature	°C	-20 up to +45
	°F	-4 up to +113
Air Humidity	%	10-85
Dimensions	mm	85 x 45 x 22
	in	3.34 x 1.77 x 0.86
Weight	G	81
	Oz	2.86

5.3 Gateway

Type:	IGX-560
Power	12W, DC12V
Processor	1,2GHz Cortex A53 Quad core
Flash	4 GB eMMC onboard alternatively up to 128GB onboard Flash memory
Main Memory	1GB Low Power DDR2 memory
Linux Operating System	Debian 9/Stretch based Raspbian system with full access to software, tools and know-how of the Raspberry Pi
LTE/4G/UMTS/2G	Dual-Band TDD-LTE B38/B40, Five-Band FDD-LTE B1/B3/B7/B8/B20, Dual-Band UMTS/HSDPA/HSPA+ B1/B8, Dual-Band GSM/GPRS/EDGE 900/1800 MHz The module can be reset via software interface NOT USED IN USA and CANADA
4G Antenna Connector	SMA female connector for connecting an external antenna, Optional: Auxiliary antenna connection NOT USED IN USA and CANADA
CAN-Bus	2
Network	1 x 10/100 BaseT Ethernet Interface
USB Host	2 x USB host 2.0 high speed 480MBit/s
RS232 Terminal	1 x RS232, TxD, RxD for use as the console interface
RS232 / RS485	
Digital Input	
HDMI	Optional: HDMI Interface Typ A connector
RTC	Battery-buffered RTC
WiFi integrated	Option: WiFi 802b/g/n with external antenna connector (combined with external Bluetooth antenna if option present)
Bluetooth integrated	Option: Bluetooth V4.1, V3.0+HS, V2.1+EDR (combined with external WiFi antenna if option present)