

Successful automation

The how, what and why of automating
a tugger train system



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Successful automation

The how, what and why of automating a tugger train system

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STILL GmbH

The efficiency potential of automated tugger trains



The digital revolution is making all production and supply chains more dynamic across all industries. This development is being driven by the online economy with its high demand for transport logistics and shorter product lifecycles together with rising wage costs and the skills shortage. Higher customer expectations with regard to customisation, delivery time and lower batch sizes are reinforcing this trend. As a result, irrespective of the specific industry, automated solutions in the form of driverless transport systems are a promising approach for improving your company's competitiveness. From supplying the production area through to distribution logistics: automated tugger train solutions will be an essential part of internal load handling in future.

This white paper therefore explains:

- the benefits of automated tugger trains
- when it pay to use an automated tugger train
- how to ensure smooth implementation
- the different tugger train concepts that are available and how they work
- how safe our automated tugger train systems are
- how automated tugger train solutions influence human resource planning
- and why STILL is your ideal partner for introducing an automated tugger train solution.

Do you want to get involved? We are your partner from the concept development stage right through to the implementation of your automated tugger train system.

Your STILL Advanced Applications team

What is a driverless transport system?

A driverless transport system (DTS) consists of one or more driverless transport trucks (DTT), a master controller, position recording and data transmission equipment, infrastructure detection equipment and various peripheral equipment. Their main task is the automated transport of material. Driverless transport systems are also used for service tasks, such as monitoring, cleaning, mobile information and visitor guidance.

What are driverless transport systems used for?

Driverless transport systems for automating internal logistics are now being successfully and profitably used by a range of industry leaders. The flexibly synchronised production supply with low material stocks guaranteed by these systems reduces internal traffic as well as the risk of accidents and ensures that employees are deployed according to the specific requirements.

Large load carriers (LLC) as well as small load carriers (SLC) are also automatically transported. In the latter case, the transported load is bundled into packaging units and placed on mobile shelves (trolleys with racking structure). The classic transport process includes loading, transport from the loading location to the defined unloading location and the unloading of the goods. Loading, transport and unloading can be automated. A look at three specific applications shows the efficiency potential of automated, internal transport solutions in various industries:

Application A:

Automated material transport in a very narrow aisle warehouse

The challenge:

Automatic storage and retrieval in the buffer storage area (VNA warehouse) as well as the automatic supply of the picking area in the European distribution centre of a furniture store.

The automated trucks:

The STILL MX-X VNA truck automatically retrieves goods and brings material to the transfer station at the rack, while an automated STILL FM-X reach truck is used for the long-distance transport.



➤ [More information on the example application](#)

User profile B:

Automated material transport in a channel and wide-aisle warehouse

The challenge: Automatic implementation of the shuttle trucks in a channel warehouse and long-distance transport of the retrieved big bags to be transferred to a materials handling system for onward transport to the point of use of a speciality chemicals company.

The automated trucks: Automated reach trucks automatically and precisely place the shuttles in the correct channels and transport the big bags to be retrieved to the transfer station of the materials handling system, which allows the big bags to be transported to the pumping machines for further processing. The reach trucks also dispose of the empty pallets.

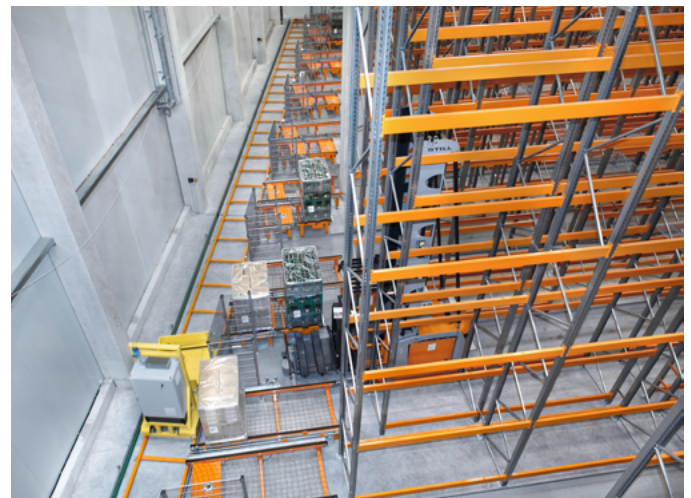


User profile C:

Automatic material transport with mobile and stationary transport systems

The challenge: Fully automatic pallet transport with mobile and stationary transport systems from production through to storage and retrieval as well the just-in-sequence route provision for a fruit juice producer.

The automation: A sophisticated materials handling concept (chain conveyors and transfer trolleys) connects the production area with the logistics centre and ensures the efficient use of the non-square building. Automated MX-Q VNA trucks take the goods from the materials handling system and are responsible for their storage and retrieval. The automated EGV-S pallet stackers arrange the trips.



What industries use automated tugger trains?

Automated tugger trains are primarily used by bulk manufacturers, assembly lines in series production, in port and hospital logistics as well as in the areas of recycling and retail. Typical applications include areas where long distances can be covered in conventional long-distance transport without a driver, as well as where heavy loads are involved in production supply.

The automotive industry is *currently* the forerunner in the efficient use of automated tugger train systems. But a cross-industry trend towards automated load handling with tugger trains is also apparent. This relates to driverless transport systems (DTS) in general, particularly in the automotive sector, in e-commerce, production, the food industry, the aviation industry, health care, logistics and retail.

What are the reasons for using an automated tugger train?

Should I be getting on board and where will the trip take me?

Leading experts in intralogistics agree: many internal transport operations will be automated in the long-term. In light of the shift towards digitalisation, all companies are under pressure to optimise processes in order to stay competitive. STILL is your competent partner that will help you find the most expedient solution for you at the right time. The first step involves analysing whether the use of automated tugger train systems is beneficial for you and which system will provide long-term added value based on your company's specific internal processes.



In 2019, the IFOY Award in the 'AGV & Intralogistics Robot' category was won by the LTX 50 automated electric tow tractor in combination with the LiftRunner frame with automatic loading and unloading function. When used as a tugger train, the innovative LTX 50 electric tow tractor pulls trailers with a total weight of up to 5000 kg through production facilities while staying firmly on track.

The benefits of automated tugger train solutions

How you can profit from automated concepts



1. Reduction of stock

The highly cyclical, synchronised supply with automated tugger trains enables the efficient provision of small lot sizes and a significant reduction in stock in the production area.



2. Increase in delivery frequencies

Automated tugger trains enable efficient production. Deliveries to the necessary locations are made just-in-time or just-in-sequence. The material flow is integrated into the demand situation on the production machinery with precise supply and removal from the machines.



3. Goods tracking in real time

The warehouse management software enables a significant increase in the quality and efficiency of the goods tracking in real time, while also eliminating search times and errors.



4. Minimisation of faulty processes

Small errors are often all that it takes to disrupt an entire process and therefore the flow of goods. The use of automated tugger trains with corresponding monitoring software helps the operator minimise the error rate.



5. Space savings

Space for industrial areas is becoming increasingly tight, while the size of operations is simultaneously increasing. This requires space-saving intralogistics. Automated processes in the warehouse allow the necessary operating widths for industrial trucks to be minimised. Mobile handover stations enable flexible handling during loading and unloading processes – even in the tightest of spaces.

The efficiency potential of automated tugger trains



6. Offset of staff shortage

Staff shortages have also been a significant problem in intralogistics for many years. Filling vacant positions with qualified staff is a huge challenge. Automated or autonomous tugger trains can help to compensate for this deficit.



7. Facilitation for employees

People play a key role in the classic use of tugger trains, as muscle power is required to load and unload the trolleys on the frame. An automatic tugger train solution that replaces strenuous manual processes (such as loading and unloading) provides genuine added value for employees. Employee productivity is increased as inefficient travel times are eliminated. Instead, value-adding activities are performed by the operator.

“Automatically unemployed?”

The topic of automation casts an ominous shadow in the minds of many employees. However, the implementation of an automated tugger train system is not at all associated with job cuts – on the contrary, it actually helps employees by taking over manual processes and counteracting staff shortages in other areas.



8. Financial benefits

Manual activities are reduced. The reduction of maintenance and damage to trucks and machinery, as well as the reduction of accidents involving personal injury to an absolute minimum, dramatically reduce costs. This increases the predictability of expenses while also reducing provisions for unscheduled maintenance measures.

Automated tugger trains – a versatile DTS

Automated tugger trains have a wide range of possible uses. But one thing they all have in common is their design: they generally consist of a tractor and, ideally, four trailers. The loading and delivery point do not necessarily have to be identical. The transport process involves different steps depending on the degree of automation. Loading as well as transport and delivery may be manual or automatic.

What counts is long-term success

Automated tugger trains are an investment in the future of your company. As a result, the key issue is not the pros or cons of the topic of ‘automation’, rather the response to the question of what your internal processes will look like in three to five years. Because, when transport operations are automated – like the supply of materials to the production area or loading and unloading in load-handling activities – the associated costs depend on various aspects. These include the current internal process logistics, the technologies used, the quantity and quality of the available data, whether this merely relates to a retrofit or whether an entirely new system is to be implemented. At its core, this therefore always involves a solution that is customised to your needs – from the number of trucks through to the master controller. Given the long-term and value-enhancing nature of the investment, the selection of the right partner for you is a critical step. The team at STILL has been an expert in the industry for 100 years and is continuously developing innovative, contemporary solutions. We have gained valuable experience in the concept preparation and implementation of tugger trains over many years, which we make available for the benefit of our customers.



Cost-benefit of an automated tugger train solution

Precision automation. Every project is tailored to the conditions at the specific company. The effort and financial expense will therefore differ in each case. As a result, we first analyse the local distinguishing features, the specific goods to be transported and determine the most appropriate number of automated tugger trains.

The investment costs include the equipment with trucks (equipment costs) as well as the project costs that arise from consulting and implementation activities. Equipment costs include:

- towing trucks as well as their energy supply
(e.g. manual battery replacement system or automatic battery charging system)
- the tugger train trailers (frames)
- software
- navigation system.

The costs of project implementation essentially include:

- concept preparation
- engineering and laying out
- truck and component manufacture
- software programming and parametrisation
- project management
- truck acceptance in the factory
- assembly and commissioning
- truck acceptance at the customer's location
- CE documentation and training
- product and application software licences
- and the transportation of the trucks to the final destination.

Our comprehensive experience shows: when introducing automated tugger train systems, it is impossible to make a blanket statement on the time required for all project steps from the initial consultation through to the operational implementation of an automated tugger train. Every user requirement is different. This is also the case for the return on investment. The amortisation rate of the investment depends on the number of shifts, the number of trucks used, the specific degree of automation as well as the amount of personnel costs saved.

The availability, quantity and quality of the available data also plays a role. Our goal is to clearly and transparently show you the long-term return of your investment in automated tugger trains as part of your individual offer.

The path to an automated tugger train

How to successfully switch to automation in production logistics

Making automation tangible and manageable in your company is a complex endeavour that requires a high level of expertise in this area. Each automated tugger train solution implemented must be considered individually.

Three critical questions on automated tugger trains

1. Do you have a warehouse management system?
2. Is your data on aspects such as material requirements, stock, consumption and availability of raw materials available digitally and in good quality?
3. Do all those involved in the success of the company have a common will to change existing processes?

If you can answer yes to these three questions with regard to your company, you are already on the right path to successfully implementing automated tugger trains.

How can I ensure automated tugger trains are successfully implemented?

The ticket to entering the internal transport logistics of the future includes seven key factors, which STILL's team of experts will scrutinise together with the company:

- Holistic understanding of the project and concept planning with foresight
- Technical design/technical requirement
- Strong requirements specification as the technical basis for the project
- Agile project management
- Realistic schedule with milestones
- Integration of the DTS into the peripheral equipment vs adaptation of the peripheral equipment to the use of the DTS
- Early integration of work safety, IT and production

We use our expertise to help you analyse your processes and identify automation potentials in order to set your company up for the future. Our tasks include: initial consultation, review of cost-effectiveness and technical feasibility, concept planning, drafting of the requirements specification, review of the functional specification, project monitoring and support during acceptance.

The path to your automation concept

Three key aspects need to be considered when planning a tugger train system customised to your specific needs:

- the standardisation of the processes and transport equipment
- the automation of the loading and unloading processes
- the increased flexibility of the system in relation to the modified transport requirements and faults

Our specialists in intralogistics consulting work together with you to answer the following question:
What does your automation system ultimately have to achieve?

The result: an individual requirements specification as the technical basis for your automation project, based on your requirements, which you can use for your invitation to tender.

The path to the successful operation of automated tugger trains

As soon as we receive your request for a requirements analysis and contact you, you decide whether you would like to take advantage of our additional consulting services.

The services are carried out by experienced STILL intralogistics experts and include the following steps in detail:



Potential analysis:

- comprehensive process and data analysis on-site
- determination of capacity and performance requirements
- analysis of the technical and economic feasibility of a DTS

The result is a transparent and informative representation of your material flow as well as a recommendation for your automation approach.



Concept preparation:

- development of a target concept in close collaboration with you
- proposals for layout and adaptations to the environment
- calculation of the expected truck requirements
- determination of budget prices



Preparation of the requirements specification:

- detailed project and process description (target concept)
- definition of requirements (incl. IT, safety, operational environment)
- development of a functional requirements specification as the basis for implementation

Operation and control



From semi- to fully automatic

When designing the automated [tugger train system](#), the question of how the system can be optimally planned for the specific application needs to be answered. The focus here is on standardising automated processes, loading and unloading as well as a flexible production supply and the structure of the route planning. While control via [kanban](#) is possible for the [static route](#), special software is required for the [dynamic route](#).

Different solutions are also possible for **navigation**, **load handling** and **transport management**.

Navigation

How do automated tugger trains find their way to the destination?

An automated tugger train is path-controlled, meaning that it travels to the destination along previously defined paths. Different models are available for control and navigation. In the case of **dynamic route guidance**, the tugger train system is linked to the company's warehouse management system (WMS). The STILL control software is used to complete tasks such as transport management and order creation, transport monitoring, visualisation and diagnosis.

Much less software is required for **static route guidance**. In this case, the tugger train system can also be controlled entirely based on the actual consumption figures of the materials at the relevant point of use (kanban methodology).

What are the different navigation models?

Magnetic track

- IT-based control necessary (++)
- Stations can be mapped with sensors
- Good positioning accuracy

Laser navigation

- IT-based control necessary (+++)
- Complex requirement due to the definition of stations
- Orientation using reflectors installed along the route
- Excellent positioning accuracy

Contour navigation

- IT-based control necessary (+++)
- Complex requirement due to the definition of stations
- Orientation using environmental features
- Average positioning accuracy

IT

What kind of software does an automated tugger train system need?

In each case, STILL offers the corresponding software for the use of its tugger train solutions with automated tractors. A driverless transport system (DTS) includes a DTS master controller. This controls all of the trucks operating in the system. The master controller helps the operator continuously optimise the operation. It connects a general host system, such as a warehouse control system (WCS) or a warehouse management system (WMS), and the deployed trucks. This software can, for example:

- select the right truck for material transport
- manage the battery and maintenance functions for all trucks
- prevent accidents during travel and respond in critical situations (e.g. obstacles on the track)
- manage the traffic in a facility as a stand-alone system
- prioritise orders
- ensure the goods tracking from the supply location up to the point of use in real time

Load handling

How does load handling work in automated tugger trains?

Whether manual or automated load handling is possible primarily depends on the spatial conditions at the production site. This requires the necessary area to be defined depending on the routes. The requirements of the different controller versions also play a role. The same applies for the interfaces between production and production supply (supermarket).

Manual load handling

- Loading and unloading of the frames and trolleys by logistics employees
- Sufficient space for frame, trolley and the operator
- The unloading point does not have to be directly accessible
- The route is roughly the same as for a conventional industrial truck
- Can be combined with manual or automated travel

Automated load handling

- The unloading point must be directly next to the train
- Space requirement of approx. 1.5 times the train length per unloading point
- For external load handling, equipment with the same technology as source (or manual)
- Can be combined with manual or automated travel
- Route can be significantly narrower as the space for the operator is no longer required



Automated tugger train: combination of automated travel and automated load handling

Internal automated load handling:

The frame is loaded and unloaded (triggered manually or by the system) by a device integrated into the frame (e.g. telescopic forks or roller tracks); the process is controlled and initiated by the driver.

External automated load handling:

Loading and unloading of the trolleys in the frame by external systems, such as pallet grippers.

Combined internal and external automated load handling:

All process steps are automated and controlled entirely by a higher-level control system.

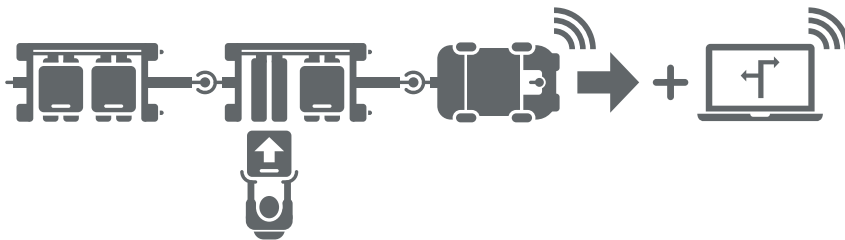
This is often the case in SLC handling in which, for example, shooter systems automatically load full load carriers onto the rack trolley levels when they come into contact with the transport system while also removing empty containers.

Operation and control

Levels of automation

Several levels of automation are available for selection with regard to travel and load handling. Which of the different versions will work best for your specific operation needs to be individually defined following a prior, intensive analysis by an expert.

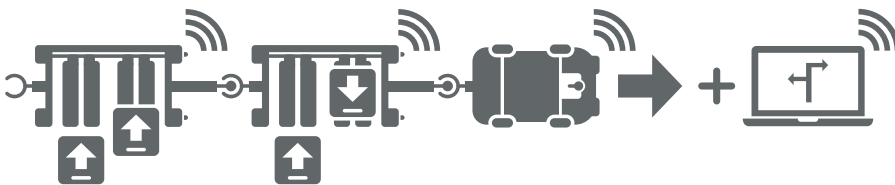
1. Automated travel and manual load handling



2. Manual travel with automated load handling



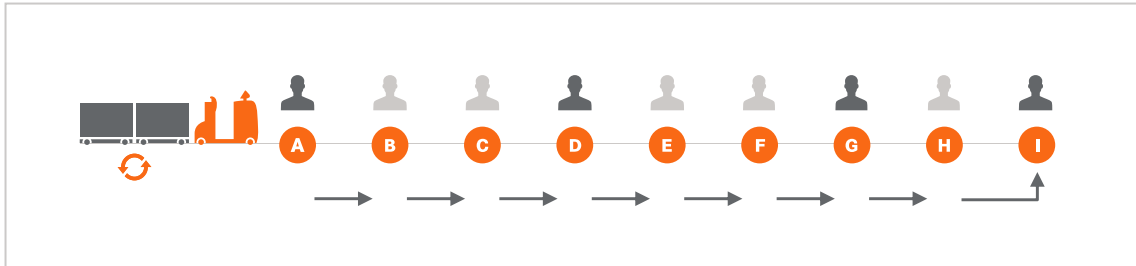
3. Automated travel combined with automated load handling



Model A: Automated travel and manual load handling

Three different options exist for automated travel. In each case, the train consists of an automated tractor with frames for manual load handling. These may be any of the [STILL LiftRunner](#) models (E, B, C frame) as well as the [STILL BaseRunner](#) models.

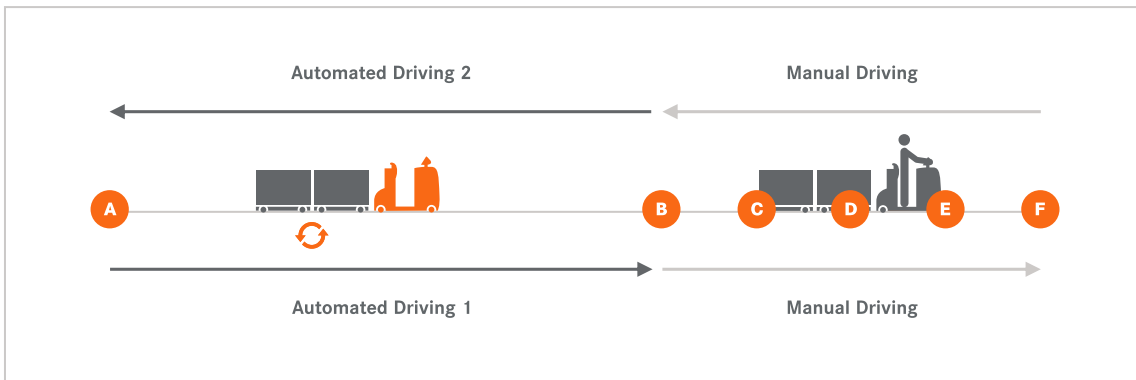
Option 1, which can be installed at lower cost,



- stops at every possible station
- where it must be loaded or unloaded by an operator or sent on to the next station without loading/unloading. This is done by pressing a button.

The advantage of this option is that a manual kanban system can continue to be used for replenishment control. Connection to a warehouse management system is not mandatory. The route guidance is static and always follows a defined sequence of stops, similar to a bus schedule.

Option 2 extends the first option with an element of manual travel. The dual use option.

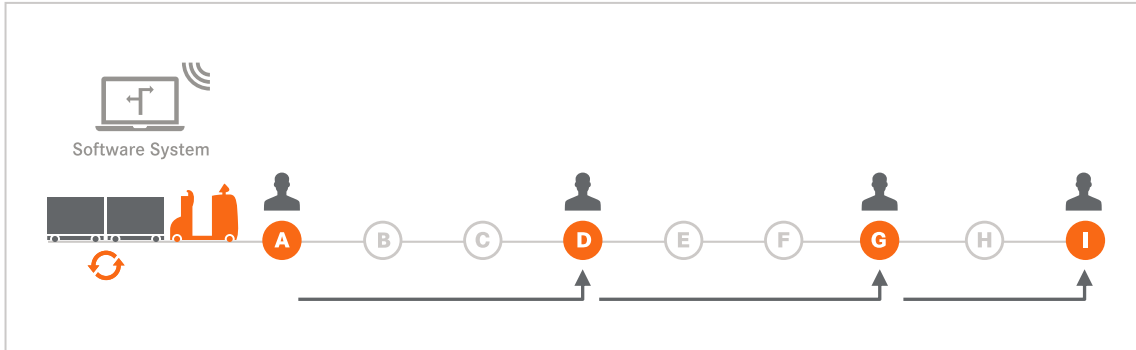


- For instance, the train automatically travels from the supermarket to the production area.
- There, the train is taken over by an operator. It is driven through the production area manually, frames loaded and unloaded manually.
- After completing their final activities, the operator automatically sends the train at the end of the line back from the production area to the supermarket.

This makes it possible for one operator to operate several tugger trains.

Operation and control

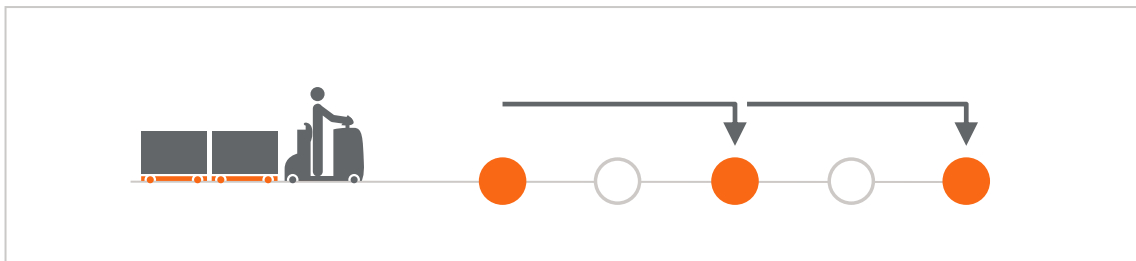
Option 3 requires connection to the warehouse management system. This enables the tugger train to be controlled based on requirements.



- The train automatically only stops at stations at which an activity (loading/unloading) needs to be performed.
- After completing their activities, the operator pushes a button to send the train to the next station.

This increases the utilisation of the train. Route guidance is dynamic, stations can be accessed in different sequences. Production requirements need to be entered and planned via a higher-level system (e.g. WMS).

Model B: Manual travel with automated load handling

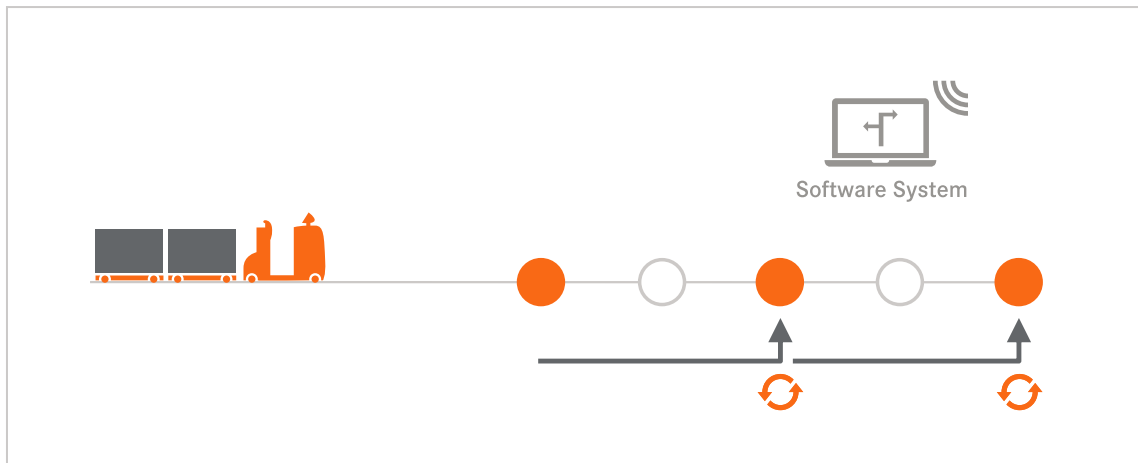


The train consists of a manual tractor with automated frames. These may be frames with integrated roller tracks or telescopic forks (internal automation), or external systems (such as pallet grippers) that load or unload the frames.

- The operator manually drives the train to the relevant stations
- Once there, they trigger the automated loading or unloading of the frames, e.g. by pushing a button

This model also enables large and/or heavy loads to be easily integrated into the tugger train supply to the production area.

Model C: Automatic travel with automated load handling



The automated tractor with the automated frames takes over the production supply controlled by a warehouse management system in conjunction with other traffic, storage space and order control systems.

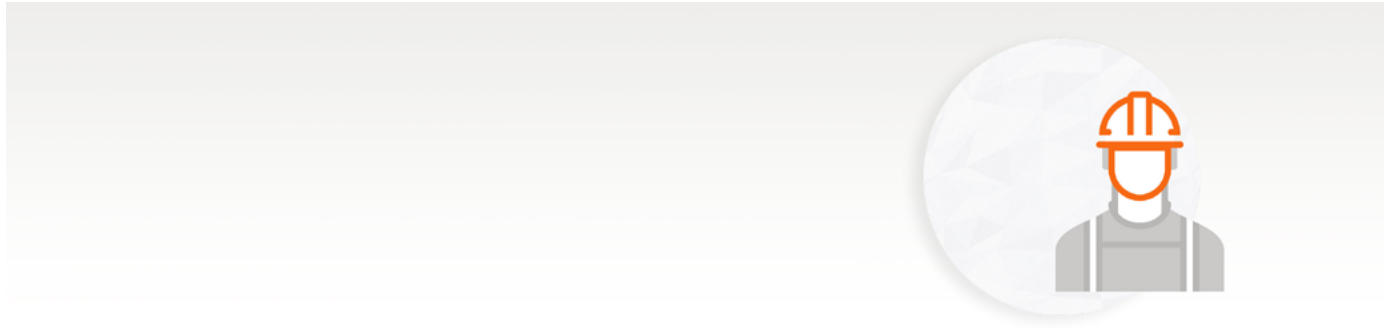
- Automated travel to the stations defined by the system
- Here, loading and unloading is automatically initiated by the system

What needs to be borne in mind?

For an automated tugger train (especially during automated load handling) more space is required with regard to the length of the train. It must be possible to approach unloading points absolutely so that the train is positioned entirely parallel to the unloading point. The implementation of a tugger train essentially connects supply to and removal from production. Automated trains therefore have a specific route planning requirement.

Safety

What makes STILL automated tugger trains so safe?



All STILL driverless transport systems have been extensively tried and tested. Just like all our automated trucks, our automated tugger trains also use reliable sensor technology. The safety of the operator, goods and equipment is therefore completely ensured at all times.

What safety equipment is installed on the truck?

In general, driverless transport systems are subject to strict safety requirements. STILL's driverless transport trucks are therefore fitted with a range of safety components that take account of these requirements. They help stop the truck in potentially dangerous situations, either automatically or by manual intervention.

Our trucks also have safety components that register different truck movements, such as turns or the raising and lowering of loads. These safety features make the driverless transport truck an extremely safe means of transport, especially compared to conventional forklift trucks. All safety components installed on the automatic tugger train comply with European standard EN 1525.

Safety

Trucks are equipped with different safety features depending on the type of truck, the area of application and individual system requirements. These include:



1 Visual and acoustic warning signals

An acoustic warning signal sounds when the truck moves, in case of faults or other irregularities. The warning lights and indicators indicate truck movements such as moving forward, turning, load handling, faults, etc.

2 Emergency stop button

The emergency stop button allows the operator to manually stop the truck in an emergency.

3 Safety laser scanners

Two safety laser scanners are fitted to protect the truck. These sensors were developed to identify unexpected objects within the horizontal scanner field. The laser scanner has two safety fields, a protective field and a warning field: the warning field is longer and wider than the protective field. Once an object is identified, the truck reduces its driving speed to below normal walking speed. If the object is identified in the protective field, an emergency stop is triggered via a safety relay.

The safety field is located at a height of 150 to 160 mm. Once the object has been removed from the scanner area or the person has moved away, the truck automatically resumes operation.

What are the safety rules for employees?

Besides the general safety provisions, which apply for all employees when handling industrial trucks, additional rules apply for the use of automated solutions such as driverless transport systems. These include the securing of possible crush and shear points during automatic lowering and lifting processes as well as automated loading and unloading processes together with the presence of emergency stop devices.

General safety provisions include, for example:

- The tractors may only be used by instructed and authorised employees with an appropriate driving licence and current G25 check-up.
- Safety gloves must be worn during loading and unloading (manual load handling).

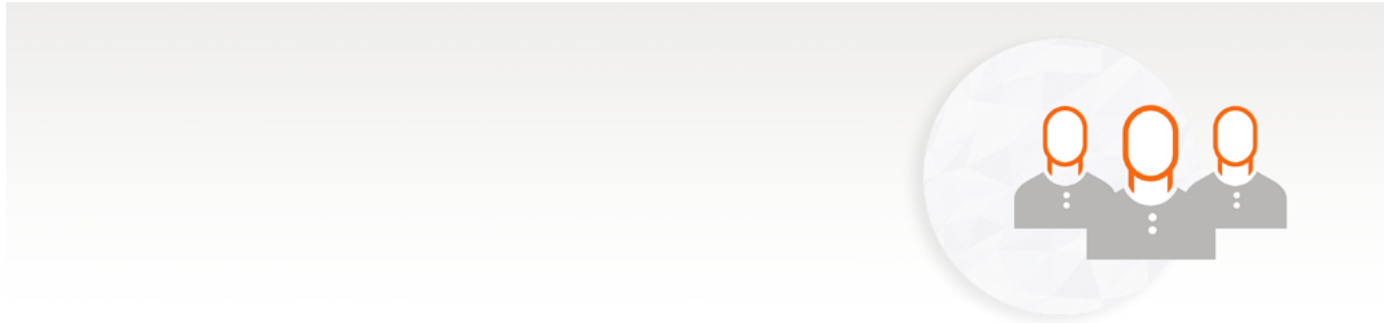
Semi-automated as well as fully automated tugger train concepts are already designed with numerous automatic processes to relieve the operator of the burden many safety aspects themselves. For example, they are fitted with a person recognition system and a start-up warning device as well as a very slow automatic acceleration to protect the trailers, all of which are mandatory for driverless systems pursuant to DIN EN 1525.

The following additional safety rules apply when using automated tugger trains:

- Only employees who have received intensive training in the handling of automated tugger trains may operate the equipment.
- Employees must have received training in the use of warehouse management systems and the relevant software.

Automatically unemployed?

Automation and human resource planning



Automation is often associated with the belief that ‘Automation destroys jobs!’.

The truth is that automation leads to the systematic optimisation of internal processes and therefore also has an impact on human resource planning. But, these effects are not always negative. Positive effects of automation include, for example: an increase in the value added by every employee, increased ergonomics and compensation for the increasing skills shortage caused by demographic change*.

Automatically better working conditions!

Qualified experts are a company’s most important resource. The focus of automation is not to reduce staff, but rather to use existing resources more efficiently while adding value. Automation relieves employees from the burden of performing physically demanding or repetitive tasks and creates new fields of application that require creativity and expertise.

This benefits the people in the company as automation opens up new fields of activity and responsibility. An example of this is the logistical responsibility for an entire production line as the section manager of an entire production area, rather than just a single process step. Together with the digital revolution, automation is creating new professions, such as the combination of logistics specialist and mechatronics engineer.

Job optimisation: work environment and ergonomics

The increasing average age of employees in intralogistics and the potential to make jobs in intralogistics more attractive with ergonomic work environments are reasons why companies are investing in better working conditions. The primary aim is to reduce physical strain. This affects the use of modern warehouse technology with regard to operation and comfort, and therefore the intralogistics processes themselves. This also includes the automation of load handling. This is because the switch from physically demanding to automated material transport has a positive effect on employee satisfaction, absenteeism due to illness, work quality and the efficiency of recruitment.

*Source: <https://www.bvl.de/dossiers/arbeitsgeber-logistik/umfrage-fachkraeftemangel-2017>

Automatically unemployed?

Automation means: bringing people on board

The success of an automation project lives and dies by the acceptance of all employees. People will only support an automation project if they recognise and appreciate the positive impact on their workplace. That is the reason why all the people involved in implementing automated tugger trains are included in the process at an early stage. This prevents reservations and fears from arising in the first place. Bringing people on board along the path towards automated transport logistics means identifying the added value for their personal work and securing their future at work with training courses and further development.

Companies were already using electric tow tractors to transport bundled loads back in the early 20th century. But lifting the goods into the trailers manually is a strenuous job. In 2008, STILL solved this problem with a ground-breaking innovation: the LiftRunner.

Fritz Berghammer, Technical Director at LR Intralogistik GmbH: “In the STILL LiftRunner, we have succeeded in developing a product that fully meets the needs of modern industry.”

Your expert partnership with STILL

Automating tugger trains with the STILL Advanced Applications team



What does the path to an automated tugger train look like in your company? Each tugger train automation is individual and depends on various factors, such as the floor, aisle widths, traffic situation, range of containers and the IT landscape. We use our expertise to help you analyse your processes and identify automation potentials in order to set your company up for the future.

Comprehensive expertise from a single source

Expertise and experience are key factors for the success of your automation project. The sustainable development of production logistics in the company requires a holistic view and a strong network of experts.

That's why STILL is your ideal partner for tugger train automation



Comprehensive system supplier

from the initial consultation through to implementation



20 years of experience

implementing tugger train systems



Inventor of the LiftRunner®

best in the industry for 10 years



In-house production

of tugger trains

We look forward to arranging an initial consultation with you!

Your STILL Advanced Applications team

Start your automation project

Contact for your tugger train automation



Automated tugger trains are implemented systematically and in accordance with your individual requirements. Automation solutions are always customised.

The first steps of the automation process focus on analysis, determining the specific requirements, concept preparation and the drafting of the requirements specification.

Contact us and take the first step towards your customised automation solution.

www.still.de/tugger-train-automation

We look forward to arranging an initial consultation,

Your STILL Advanced Applications team.

STILL GmbH

Berzeliusstraße 10

D-22113 Hamburg, Germany

Phone: +49 (0)40 73 39 20 00

Fax: +49 (0)40 73 39 20 01

info@still.de

For further information, please visit:

www.still.de

