



IFOY Award 2014 Intralogistics Solutions

**Warehouse Navigation – Logistics Interface
Connects VNA Trucks with Jungheinrich WMS**

**Reference Customer
Streng Plastic AG, Switzerland**

JUNGHEINRICH
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1 Customer Description: Streng Plastic AG

Streng Plastic AG has been manufacturing plastic tubing systems for 60 years for the areas of drainage technology, water and gas supply and cable protection. The company's principles of sustainability and quality apply to the production as well as warehousing and logistics. The Swiss company has two production sites in the province of Zürich. To increase its storage capacity, a high bay warehouse with space for approx. 4,100 pallets has been built at its main site in Niederhasli.

2 Initial Situation and Challenges

The reason for building the new warehouse was an increased requirement for storage capacity. The new pallet warehouse is used for storing injection moulded and vendor parts and for picking customer orders. Streng Plastic AG was faced with several challenges and limiting circumstances here.

The lack of space at the parent plant in Niederhasli limits the storage capacity. The designated space at the entrance to the site is located such that Streng Plastic is looking to create a corporate design to represent it to the outside world. Aesthetic standards have also been stipulated for the warehouse interior and the forklift trucks.

Possibly the greatest challenge was complexity of the project and the numerous different logistic functions involved. Even before the start of the project, Streng Plastic AG recognised the need for an integral logistic system. This includes a racking system, forklift trucks, a warehouse management system including IT infrastructure, fire prevention regulations and a warehouse with a wide range of requirements.

Streng Plastic AG's logistics, too, are operated according to the group's guiding principles of sustainability and a focus on quality. These standards apply to both logistic processes and to the logistics system that enables them.

3 Project Implementation

The key to successful project implementation at Streng Plastic AG was holistic, integrative project work and taking all logistic functions into consideration at an early stage. With its ability as a full-range intralogistics provider, Jungheinrich is a single-source supplier for project planning and services for logistics systems projects. Deputy CEO Urs Hänseler explains the decision to choose Jungheinrich as general contractor: "Jungheinrich offers a broad spectrum of products and services that none of its other competitors can match. Jungheinrich's consultation and implementation were very good right from the outset and met our requirements. With major expertise in constructing high bay warehouses, its support also went beyond intralogistics."

Various possible solutions for a logistics system were modelled during the planning phase. The decision was made to go with a narrow-aisle warehouse, with its reliable, transparent and highly efficient processes thanks to Jungheinrich WMS and Warehouse Navigation. The warehouse layout provides a high pallet rack (narrow-aisle), a cantilever rack and an incoming and outgoing goods area. The narrow-aisle warehouse is used for storing and retrieving full pallets as well as

for picking. The Jungheinrich Warehouse Management System (WMS) manages the entire material flow. Goods are moved semi-automatically in the narrow aisles using Warehouse Navigation, connected to the WMS. Jungheinrich supplied the entire racking system, the two VNA trucks with Warehouse Navigation, the counterbalanced trucks, the Jungheinrich WMS with radio data transmission components, in addition to various support services over and above project management.

Despite considerable hurdles in obtaining building approval and elaborate fire safety regulations, Jungheinrich managed to adhere precisely to the agreed project schedule. Jungheinrich's After Sales Service continues to support the customer to the present day.

4 Description of Reference System

4.1 Warehouse Construction and Material Flow

This new installation comprises a narrow-aisle warehouse with space for approx. 4,100 pallets. Streng Plastic AG's range consists of approx. 700 items to be stacked in the new warehouse.

Project planning for the warehouse is based on the following estimated material flow: approx. 100 full pallet movements ("normal storage volume") per day (EKX order picker/tri-lateral stacker), approx. 150 individual picks from pallets per day (EKS vertical order picker), approx. 1 movement per day on cantilever rack, approx 4-8 lorry loads

delivered per day, approx. 10-20 orders picked per day.

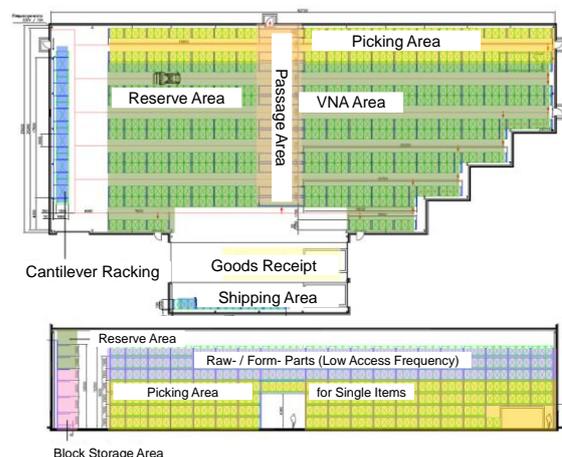


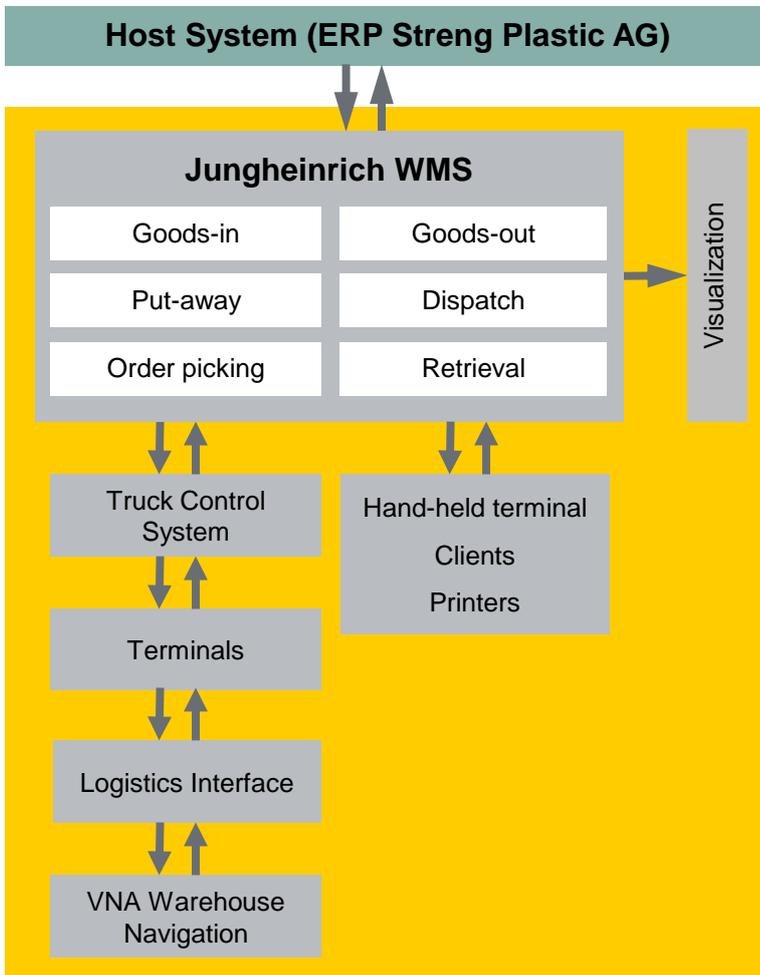
Illustration 1: Warehouse layout divided into zones

4.2 Jungheinrich WMS and Radio Data Transmission

4.2.1 Jungheinrich WMS

The Jungheinrich WMS warehouse management system allows you to control any warehouse: block / pallet warehouses, drive-through / adjustable pallet racking warehouses, modular racking systems and fully automatic systems with rack operating and materials handling equipment. All areas of the warehouse (e.g. goods receipt, outgoing goods, reserve areas and picking areas) are managed, the entire material flow is controlled and optimised.

The Jungheinrich WMS is a flexible system. It can be adapted to intralogistics processes through a range of parameters and settings that can be adjusted even during operation.



During both the introduction and commissioning of the Jungheinrich WMS, Jungheinrich focused on fulfilling the following requirements: ergonomic, multi-lingual, reliable, high degree of flexibility, future-proof, more efficient, more transparent and industry independent.

For special functions, there is also a range of additional modules available. These can be extended, modified or even completely reproduced if required.

As well as the “Truck Guidance System” module, which can be used to optimise and coordinate the allocation of transport orders in the warehouse, the Jungheinrich WMS also offers the option of managing warehouse areas with materials classified as hazardous substances due to particular characteristics, using the “Hazardous Material Warehouse” module.

Illustration 2: System context

The “Warehouse Accounting” module can be used to invoice charges for services and work e.g. in goods receipt or order picking provided for one or more clients (using the client module). Even work that is not directly linked to warehousing (e.g. repackaging, labelling and washing) can be specified and charged for.

The “Container Pre-calculation” module enables the Jungheinrich WMS to calculate the required container size in advance. The “Material Flow Controller” can be used for controlling every automatic system (materials handling, RBG, curve operating equipment etc.).

An extensive reporting system and a whole host of evaluation options individually configured using an integrated SQL generator ensure complete transparency.

The Jungheinrich WMS can be connected to many existing higher and lower level system environments via standard interfaces.

On 1. January 2013, Jungheinrich AG acquired the remaining 75 percent of ISA – Innovative Systemlösungen für die Automation GmbH – A Jungheinrich company based in Graz, Austria, enabling it to continue to build on its position as a supplier of logistics system. ISA has for years been one of the leading software houses in the warehousing and material flow equipment sectors, and is run as a standalone group within Jungheinrich distribution logistics systems.

4.2.2 Use of Jungheinrich WMS at Streng Plastic AG

Assembly and parametrisation of the modular Jungheinrich WMS was tailored to Streng Plastic AG's specifications. The basic module is supplemented by the "Truck Guidance System," "Warehouse Visualisation" and "Host Interface" modules. The system is parametrised to the warehouse-specific warehouse model and set to the different warehouse processes. Various documents and GS1 labels are implemented. The system is integrated into the hardware environment (see Section 4.2.3). Detail on how the WMS works can be found in Section 5.

The interface between the Jungheinrich WMS and the customer's existing Host System (a MAPICS ERP system) enable the exchange of item master data, goods receipt and outgoing goods advice slips, inventory comparison or order picking status. The interface between these two software systems is based on ASCII file transfer. All relevant data is sent in the form of files and loaded by the other system. To do this, the Jungheinrich WMS interface module accesses the WMS database.

4.2.3 Radio Data Transmission

The remarkable process security, warehouse transparency and efficiency of this Jungheinrich system solution are founded on synchronising information and material flow. This holistic approach requires continuous checking of physical material movements against their digital mapping. On the one hand, the Logistics Interface ensures this by connecting forklift trucks to the WMS, and on the other hand, provides options for manual interaction.

The technical basis for this is reliable radio coverage and being equipped with radio data transmission components. Radio coverage has been ensured through incorporation of WLAN requirements, a WLAN simulation, provision of access points and, finally, radio measurement and performance analysis. This guarantees that all forklift trucks and hand-held terminals have radio access everywhere. In particular, this ensures reliability, process security, efficiency and availability of Warehouse Navigation.

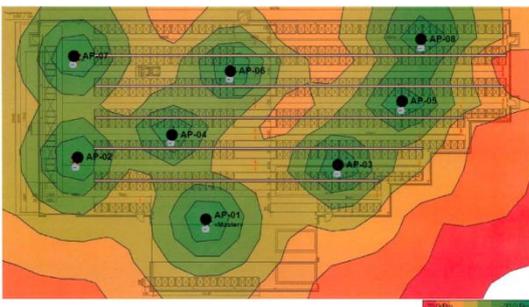


Illustration 3: WLAN simulation of warehouse

Jungheinrich 2475 truck terminals are used on the three Jungheinrich forklift trucks. The Jungheinrich 2475 truck terminal has been specifically developed for heavy-duty use on forklift trucks and in the warehouse. The large high-contrast touchscreen permits intuitive operation directly on the screen. Even complex information – such as lists – can be clearly displayed. This device stands out particularly due to its robust construction, secure operating systems and wide variety of

interfaces. The Jungheinrich WMS client and Jungheinrich Logistics Interface are designed to operate on this terminal. All Streng Plastic AG terminals are equipped with high-quality barcode scanners.

Besides the forklift trucks, three Motorola MC9090-G hand-held terminals are used, which are likewise connected by WLAN and via a Jungheinrich WMS client.

4.3 Very Narrow Aisle Trucks

4.3.1 Warehouse

Narrow-aisle warehouses are characterised by their low space requirement for working aisles and large lift heights – qualities that make them well suited for a high space utilisation. Each pallet position can be accessed without restriction. If necessary, the order can be picked from directly in front of the pallet compartment. Throughput of goods according to the FiFo principle is also possible. The aims here are to: minimise space requirements and maximise throughput efficiency, make best possible use of performance profiles through optimal design of forklift truck, rack and floor interfaces. In planning, it should be taken into account that low safety distances and travel and lift performance for forklift trucks require particular that attention be paid to planning and implementation. It is crucial here that Jungheinrich, as the general contractor and full-service provider can offer all components and services.

4.3.2 Guidance System

The guided truck follows a guidance wire routed in the ground. A frequency generator feeds the guidance wire with a high frequency AC current, this generates a concentric electromagnetic alternating electrical field.

Sensors mounted on the truck detect this field. Any change in the truck's position with respect to the guide wire is therefore recorded. Steering is automatically compensated. The truck is guided safely along the aisle.

Jungheinrich wire guidance systems always feature extremely high precision levels. This is achieved through the three-phase AC steering transmission which undergoes continual undetectable adjustment. A decisive advantage over traditional hydraulic steering systems with inactive steering patterns.

Wire guidance provides specific advantages: Guide wire approach up to an angle of nearly 90°, space saved in the apron, short wire acquisition routes, high travel speeds on guide wire, adaptation to a wide range of frequencies in the floor system and different frequency states on a wire.

4.3.3 RFID Ground Control

Even the best fork lift truck will not be able to apply its full capacity on poor warehouse floor surfaces. Even a few 'poor' areas of flooring will cause a reduction in performance throughout the entire warehouse. Here, too, the Jungheinrich system forklift trucks' RFID technology offers the best solution for maximising performance levels: It saves details of damaged areas and uneven

floors in the warehouse and automatically reduces speed accordingly when it next drives over them. Small RFID transponders in the warehouse floor contain position data. The forklift trucks are equipped with RFID reading and writing devices that communicate with the transponders in order to establish their own position and reference the route measurement. Optimised speed profiles, depending on the floor topology for maximum possible performance and required safety, serve two purposes at Streng Plastic AG: On the one hand, forklift trucks reduce speed in the central passageway, where there is danger of collision; on the other hand, the positioning is used for semi-automatic travel to destinations using Warehouse navigation.

4.3.4 EKS 210 Electric Vertical Order Picker

The EKS 210 order picker offer maximum picking performance in high bay warehouses. With a maximum capacity of 1,000 kg and an order picking height of up to 7,845 mm, it is specifically suited to Streng Plastic AG's specifications. Its narrow frame size starting from just 900 mm offers the maximum turning capability. The EKS 210 order picker sets the standards on the market in terms of flexibility, cost-effectiveness and ergonomics.

The special EKS 210 truck configuration for Streng Plastic AG provides a 4,250 mm two-level mast and a 48 volt third generation 3-phase AC motor. This helps to achieve a high order picking performance, low energy consumption through double energy recovery with regenerative braking and lowering, more effective thermal economy, less maintenance and wear, high torque, high travel and lifting speed and faster main and additional lifts, with unrivalled low power consumption at the same time. The advantage of this modern device is that it is fully usable over a 2 shift operation without having to change the battery.



Illustration 4: The two VNA forklift trucks EKS 210 and EKX 515k (right) in use

The customer-specific configuration also includes special painting in purple at the customer's request, control version with control elements separated into load direction, height-adjustable operator controls including large screen display, wire guidance, a rear-view mirror on the overhead guard in the load direction, an adjustable terminal mount to the right on the overhead guard, including power supply and interface cables for Warehouse Navigation and the integrated Jungheinrich personal protection system.

4.3.5 EKX 515k Electric High Level Combination Picker/Stacker

The EKX 515k high rack stacker represents high performance in the “high end area” of narrow-aisle warehouses. With a capacity of 1,500 kg and lift height of up to 17,000 mm, the EKX 5 Series is by far the market leader with a share of 40%. It sets the standards on the market in terms of flexibility, cost-effectiveness and ergonomics.

The EKX 515k's specific truck configuration for Streng Plastic AG includes a three-level 7,750 mm mast for stacking and retrieval within a height of 10 metres. Simultaneous lifting and lowering of the main and additional lift (1,780 mm) is also possible. The 80 volt third-generation 3-phase AC motor helps to achieve a high order picking performance, low energy consumption through double energy recovery with regenerative braking and lowering, effective thermal economy, less maintenance and wear, high torque, high travel and lifting speed and faster main and additional lifts, with unrivalled low power consumption at the same time. The advantage: fully usable over a 2 shift operation without having to change the battery.

This forklift truck can also be specially painted purple at the customer's request. The other details of this configuration are the electrically adjustable control panel with large screen colour display, wire guidance, a rear-view mirror on the overhead guard in the load direction, workspace illumination with energy-saving LED design, an adjustable terminal mount to the right on the overhead guard, including power supply and interface cables for Warehouse Navigation and the integrated Jungheinrich personal protection system.

4.4 VNA Warehouse Navigation and Logistics Interface

4.4.1 Jungheinrich Logistics Interface

Several years ago, Jungheinrich AG, as a manufacturer of trucks and intralogistics provider, discovered the potential for optimisation arising from connecting the forklift truck to the customer's IT infrastructure. That is why we developed a universal communication interface between forklift trucks and warehouse management systems: the Jungheinrich Logistics Interface.

The Jungheinrich Logistics Interface is a piece of interface software (middleware) installed on the truck terminal or a warehouse server. From there, it communicates with the forklift truck or other fitted sensors, on the one hand. On the other hand, the standard Logistics Interface software also has a range of standard connection ways, enabling connection to any warehouse management system (WMS).

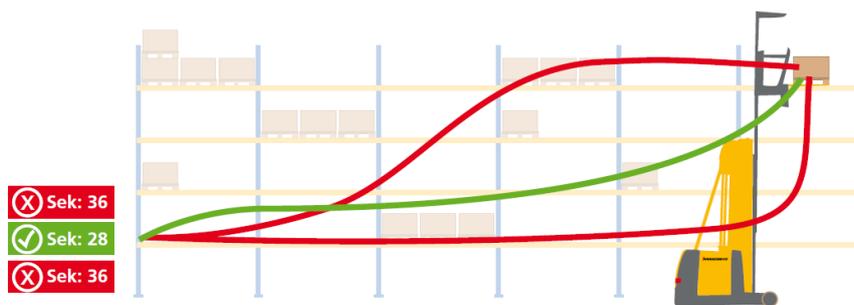
The Jungheinrich Logistics Interface's standard connection ways enable simple connection to any warehouse management system. One of the most important technical connection paths is file transfer: Both the WMS and the Jungheinrich Logistics Interface write simple text files on the radio data terminal or the WMS server, which is loaded by the other part. For this, the standard software is just configured for the specific case, without having to program new software. In practice, communication is entirely possible in around half of all cases without making any changes to the WMS. Since the Jungheinrich Logistics Interface is available for different operating systems found in the warehouse, terminal independence is also guaranteed.

If you intend to use the Jungheinrich-own WMS in conjunction with forklift truck technologies, the Jungheinrich Logistics Interface can also be used here. However, the integration will already be fully implemented, and will not require any additional efforts for specific projects. Hence the Jungheinrich Logistics Interface is also used at Streng Plastic AG as an interface between the Jungheinrich WMS and the system trucks.

4.4.2 VNA Warehouse Navigation

The performance levels of high rack stackers have improved rapidly in recent years as a result of AC technology. Lift speed is currently over 0.5 m/s and travel speed is 12 km/h. This represents a doubling of the values achieved over the past 20 years. It is highly unlikely that these levels of improvement will be repeated, since the physically acceptable limit has more or less been reached. The forklift trucks of the future will not only have to be powerful performers, they will need to have intelligent technology on board to interface with the IT and integrate them into logistic processes.

Initially, transponder technology was used for truck management, i.e. ground control and communication with the rest of the warehouse; it therefore governed all the switching functions and speed profiles. In the second stage, transponder technology offers optimum preconditions for Warehouse Navigation. This is based on both the permanent positioning of the trucks and the interfacing of the truck control system with a higher level control system. This system takes the load off the operator, increases turnover and helps avoid picking and stacking errors.



Using the Logistics Interface, Jungheinrich has succeeded in sending transport and picking orders from the warehouse management system directly to the truck connector. In combination with the transponder technology, the Warehouse Navigation

Illustration 5: Saving time with optimised approach using W. Navigation

makes it possible to approach pallet positions semi-automatically and with pinpoint accuracy. All transport and picking orders are initially loaded by the Jungheinrich Logistics Interface on the forklift truck terminal. From here, the x, y and z coordinates of the location are received directly by the truck controller via a serial RS232 interface. This enables the truck to identify the respective target location and approach it semi-automatically. The operator sees the travel and lift directions on the display and when the semi-automatic approach is confirmed, the forklift truck automatically approaches the position with pinpoint precision, with optimum diagonal travel for optimum timing. When the forklift truck has been positioned, a spotlight illuminates the picking position and shows the operator on which side and which location he should pick from.

The truck operator no longer needs to concentrate on things like approach routes, searching for pallets, "ideal times" for initiating diagonal travel and scanning barcodes as confirmation for the WMS. The Warehouse Navigation does all that for him. Wrong journeys and adjustments are therefore eliminated.

Both types of VNA forklift trucks in the Streng Plastic reference system operate with Warehouse Navigation: the EKS 210 vertical order picker and the EKX 515k order picker/tri-lateral stacker. The detailed process flow with Warehouse Navigation is considered in Section 5.

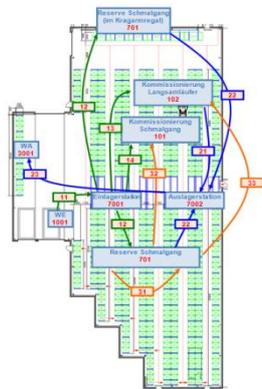
4.5 Racking System

As a full-service provider of logistics systems, Jungheinrich offers a wide range of racks and warehouse equipment. Both a pallet racking system and a cantilever rack have been supplied in accordance with the warehouse design.

The pallet racking system consists of multi-bay pallet racks in 12 racking rows with 6 narrow aisles. A max. permitted pallet load of 500 kg is stored on 6 levels in addition to floor bays. The loading positions at the row ends have pallet centering. The cantilever rack supplied extends to 17.60 m in length. The 10 m height is divided into 7 levels, although these are being treated partly as a bulk storage area and partly as a pallet reserve area.

The complete racking system includes approx. 4,100 pallet positions. 4,300 self-adhesive labels and 26 rack row boards are used for extensive labelling in the warehouse. All racks come in white special paint as per the customer's request. Safety verification has been obtained for the complete racking system. Moreover, the customer opted for racking inspections by Jungheinrich racking inspectors.

5 Warehouse Processes



The Jungheinrich WMS and Logistics Interface map the warehouse's logistic processes and control material flow in accordance with the defined processes. For this, material flow is first analysed, and then modelled for the warehouse management system and stored in WMS as strategy. This is the starting point for the process logic of the "Truck Guidance System" module in particular.

The essential processes are described below.

Illustration 6: Material Flow Analysis for Process Design

5.1 Goods-In

Two different types of incoming goods are processed: scheduled incoming goods provided with an advice slip in advance by the Host System and unscheduled incoming goods without an advice slip from the Host System. All deliveries are recognised by default as scheduled incoming

goods with an advice slip from the Host System. These include material from Streng Plastic production, deliveries of raw and moulded parts from suppliers and also material for the cantilever rack (octabins and plastic sheets). The raw and moulded parts are stored as complete pallets in the reserve area of the narrow-aisle warehouse. They can likewise only be retrieved as complete pallets. The materials delivered from Streng Plastic production are stored in the reserve area of the narrow-aisle warehouse. Returns are also recognised as a scheduled goods receipt. Pallets that have been produced over and above the actual production order (surplus pallets) are recorded as an unscheduled goods receipt, without an advice slip being sent from the Host System to the WMS. In the event that no advice slip has been sent in advance for a return, this may also be recognised as unscheduled.

Illustration 7: Goods Receipt overview

Goods receipt is booked using a WMS client PC. Various masks allow incoming goods to be displayed, entered and revised.

5.2 Stacking

The Jungheinrich WMS truck guidance system works out stacking in two transport stages: Firstly, the approach truck moves the pallet to the transfer area of the narrow-aisle warehouse, then the VNA truck transports the pallet to the destination within the warehouse using the Warehouse Navigation.



Illustration 8: Warehouse Navigation receives stacking order from the Jungheinrich WMS

The WMS client on the approach truck displays the transport order worked out by the truck guidance system. The mask firstly gives the order to lift a pallet with a particular identification number (ID) at the source (Goods-In). In fact, the operator can scan any pallet in order to obtain the order for this pallet. The terminal then shows the transport order at the appropriate transfer area of the narrow-aisle warehouse. The operator acknowledges the depositing of the pallet at the transfer area by scanning the transfer area barcode.

In the second stage of transport, the EKX VNA truck receives the goods for stacking at the destination. The transport order calculated by the truck guidance system for the transfer station is displayed on the forklift truck terminal. The Jungheinrich Logistics Interface simultaneously sends the destination coordinates to the forklift truck. From this point on, the Warehouse Navigation assumes control. The operator merely activates the travel lever and the forklift truck take the fastest route to the

destination and stops there automatically. Because the Jungheinrich Logistics Interface also communicate the type of order to the forklift truck, the forks are already at the correct height for lifting the pallet. After confirmation from the operator, the forklift truck performs the automatic stacking operation.

The Jungheinrich Logistics Interface confirms the pick-up of the pallet to the Jungheinrich WMS. The transport order is now displayed at the destination and communicated simultaneously to the forklift truck using the Jungheinrich Logistics Interface. The Warehouse Navigation now assumes control of travel to the destination and the depositing of the pallet by the same system. A crucial advantage here is that the forklift truck feeds back the destination to the WMS via the Jungheinrich Logistics Interface, meaning that a manual scan at the bay is not required.

The second stage of transport is semi-automatic thanks to the Warehouse Navigation. Because the Jungheinrich Logistics Interface sends the transport orders directly to the forklift truck controls, the burden on the operator is eased considerably. There is no need for any destination search, adjustment runs or bay scans. The Warehouse Navigation saves crucial time here compared to manual operation. In addition to the energy savings, optimised approach routes help to improve efficiency by up to 25 %.

Stacking on cantilever racks, which is relatively infrequent, is controlled manually for optimal stacking of sheet materials of varying sizes and optimal use of available space.

5.3 Goods-Out

Outgoing goods can also be scheduled or unscheduled. For scheduled outgoing goods the ERP system sends a outgoing goods advice slip via the host interface. The corresponding packing slip is generated by the ERP system and printed. The order is approved manually in the WMS and a retrieval destination is added. Then, the retrieval or picking order is triggered. Goods that have been fully picked and retrieved are then finally loaded.

5.4 Retrieval and Order Picking

5.4.1 Retrieval

Retrieval from the narrow-aisle warehouse is the same as the 2 stage stacking process described, but in reverse order. Here, also, the Warehouse Navigation enables efficient, semi-automatic transport of full pallets to the transfer area.

5.4.2 Order picking

As well as retrieval of full pallets, individual items are picked in the narrow-aisle warehouse. Either the scheduled order picking has been triggered via an advice slip from the Host System, or the order picking has been initiated unscheduled by the operator via the forklift truck terminal. The EKS 210 vertical order picker with Warehouse Navigation and order picking spotlights is the ideal fork lift truck for these orders.

The warehouse management system works out a picking order and displays the item, quantity and storage location on the EKS truck terminal. The picking order is simultaneously sent to the

forklift truck controls. After activation using the travel lever, the EKS reaches the destination at the ergonomic order picking height and indicates the items to be picked using the picking spotlight. Thanks to the Warehouse Navigation, the operator can concentrate fully on the order picking activity without having to search for the storage location. The items are picked and placed into special sacks. Once completed, the sack is deposited in the transfer area.

5.5 Other Processes

The WMS also provides relocation as an additional process, typically in order to supply full pallets from the reserve area to the order picking area for individual items. From a technical point of view, relocation is a retrieval followed by stacking. This process is supported accordingly by the Warehouse Navigation. The Warehouse Navigation's route between the two storage locations, selected in order to optimise time, makes particular use of its optimisation potential.

Empty pallet collection is another example of the seamless interaction between the components in this logistics system. In the course of executing picking orders, pallets are emptied in the order picking area. The WMS stores the position of the empty load carrier and orders its collection. To do this, the Jungheinrich Logistics Interface sends consecutive retrieval and stacking orders with the position of the empty pallets to the forklift truck controller. Using the Warehouse Navigation, these pallets are then collected into a stack of empty pallets on the fork and finally set down at the front of the rack. In particular, this makes searching for empty pallets and the time-consuming travel to these positions via non-optimised routes unnecessary.

Retrieval and stacking in the bulk storage area of the cantilever rack are likewise supported by the Warehouse Management System. Flexibility is guaranteed here by the fact that stacking orders are not issued, but can be carried out unscheduled via the truck terminal. Retrieval from the bulk storage area can be carried out unscheduled (hand-held terminal or PC client) or by scheduling using the host interface.

6 Innovation

The Jungheinrich VNA Warehouse Navigation is a unique product innovation in several ways. The interaction between high-performance forklift trucks with state of the art sensors, intelligent controls and, in particular, connection to the warehouse management system provides great benefits in relation to process security, efficiency and ergonomics. For this reason, Jungheinrich's Warehouse Navigation was awarded „Best Technological Innovation” with the “Award for Logistic Efficiency and Corporate Social Responsibility” issued by the Spanish journal “Logística Profesional” in 2013.

The Jungheinrich Logistics Interface enables complete integration of information and material flows by connecting the forklift trucks to the customer's IT infrastructure. On the one hand, this standardised software, unrivalled in the industry, provides connection of Jungheinrich forklift trucks to any warehouse management system. On the other hand, it can be used to integrate various forklift trucks, warehouse processes and identification technologies and connect them with the flow of information. This helps to eliminate stacking errors, travel in search of the right location, order picking errors, incorrect barcode scans and manual procedures.

The Jungheinrich WMS also has special novelty value. This software sets new standards as far as ergonomics, multi-lingual functioning, flexibility, transparency and applicability across different industries are concerned. The interaction between Jungheinrich WMS, Jungheinrich Logistics Interface and the forklift truck in this form is also unique.

The use of the warehouse as a heat sink for waste heat from the attached production is both rare and innovative. Water piping more than a kilometre long has been built under the warehouse floor, in order to exchange waste heat using a controlled cooling circuit and heat the warehouse at the same time.

7 Customer Benefit

In view of the company's motto – quality and sustainability – Streng Plastic AG sets high targets in relation to the quality and reliability of its deliveries. The new logistics system from Jungheinrich guarantees this by means of a thorough, reliable and efficient supply of materials.

The Jungheinrich WMS has the warehouse processes under control. Orders are reliably received and carried out through seamless communication with the customer's ERP system. All material flow processes in the warehouse are controlled and supported by the Warehouse Management System.

Jungheinrich's Warehouse Navigation can be relied on in narrow aisles. Semi-automatic functioning ensures that control and acknowledgement are always at the right place. Deputy CEO Urs Häseler notes: "Without Warehouse Navigation, the operator's concentration starts to wane after three or maximum five hours. With Warehouse Navigation, the operators maintain their concentration until the end of the shift and pick orders with a much lower error rate." Warehouse Navigation reduces wrong put-aways and retrievals to 0%. Warehouse Navigation significantly increases efficiency. The time-optimised approach and ability to dispense with scans at storage locations and journeys made in search of correct locations and in error, and to quickly train in new operators all mean that operation using Warehouse Navigation achieves 25% higher productivity compared to manual operation. The investment in Warehouse Navigation is paid off within few months in case of Swiss personnel and operating costs.

Warehouse Navigation improves warehouse and work safety. The personnel protection system and speed regulation at the ends of aisles provide technical help to prevent forklift truck collisions. Fire safety is ensured by a detailed fire safety plan with several emergency exits. The racking system is checked by Jungheinrich racking inspectors. Jungheinrich has investigated all risks in the warehouse as part of the safety verification.

8 Sustainability

As one of Streng Plastic AG's guiding principles, sustainability is an important consideration in designing the new warehouse. It is taken into account on the one hand, through the flexibility of the logistics system. Although the processes can be controlled by the Jungheinrich WMS with high degree of optimisation, the warehouse management system can also be adjusted flexibly after being commissioned, with many modifications even without support by Jungheinrich. Due to

the wide variety of parameters which can be performed by the Jungheinrich WMS, it is possible to map any changes within the company in the Jungheinrich WMS at any time without the need for programming. A warehouse extension is just as easily incorporated as the connection of an additional VNA truck or use of further hardware, such as hand-held terminals, or further transfer areas.

Using the existing reports, the warehouse manager will have the opportunity to continually optimise the warehouse, for example moving slow-moving articles from the picking area to the reserve area, or storing fast moving goods at an ergonomically optimal height.

Through usage of the GS1 standard for barcodes, a globally valid standard has been introduced that will have long-term validity and can define all extensions in the WMS.

The Warehouse Navigation also takes sustainability into account. Although it orders all movements semi-automatically, the flexibility of manual operation still remains. The forklift truck programming and the Jungheinrich logistics interface support any changes required.

Jungheinrich's self-conception as a sustainable intralogistics partner includes after sales service. Based on the motto "Active, not reactive," the forklift truck maintenance and racking inspection service are aimed at ensuring long-term usability of the system. A worldwide spare part availability of over 98 % using overnight express shipping guarantees reliable operation.

9 Solution Marketability

The solution presented is tailored to Streng Plastic AG's needs and thus achieves maximum benefits for the customer. However, this tailored solution consists solely of standard components from the Jungheinrich product portfolio. This applies to the Jungheinrich WMS: Parametrisation of the WMS modules did not require any special programming. The same applies to the Jungheinrich Logistics Interface for connecting the forklift trucks: By having a modular, flexible software structure, a broad spectrum of applications can be covered by parametrisation and configuration. The forklift trucks and racking system, too, are based purely on standard price list options.

Marketability through capable system sales: As a full-service provider, Jungheinrich finds the right logistics system to suit the customer's application, with access to a comprehensive product range that is unique within the industry.

Jungheinrich Warehouse Navigation, with WMS connection via the Jungheinrich Logistics Interface, has already succeeded in establishing itself across the industry as a very new and innovative product. More than 140 international reference systems on four continents are already using this technology. The Jungheinrich WMS, too, is suited to all industries and can boast more than 250 installations completed worldwide. Seven of these systems have been successfully validated by the "Fraunhofer Institute for Materials Flow and Logistics" in Dortmund.