ARMBRUSTER ENGINEERING

Consulting | Systems | Products

„Guidelines for a safe, efficient production“

Powerful industrial manufacturing systems through digital platforms

Ein ‘State of the Art’ Report von Armbruster Engineering

Dipl.-Ing. Norbert Armbruster, Dipl.-Ing. Henning Vogler

Armbruster Engineering GmbH & Co. KG

Neidenburger Straße 28
28207 Bremen

Tel: +49 (0)421 / 20 248-0
Fax: +49 (0)421 / 20 248-20

Email: info@armbruster.de
Internet: www.armbruster.de

Synopsis

These guidelines cover the way we create industrial manufacturing systems for manual production processes based on information provided by digital platforms. We achieve this through the systemic connection of all electrical system components and parts, either as a retrofit to existing systems or as a complete new installation. Manufacturing plants can start as stand-alone solutions and then be systematically expanded into composite systems and large infrastructures. We also present the steps involved in this process.

Industrial manufacturing systems facilitate agile and flexible production, where staff always have an overview of the scope and content of their tasks and receive ongoing support in their daily work. This is achieved with the digital platforms built on the ELAM system.

1) ELAM is an Armbruster Engineering GmbH & Co. KG software product and is used as a manufacturing system to rationalise production.

The ELAM system was initially started to electronically link assembly plant lines. Thanks to its continued systematic and consistent development, it has achieved a unique profile which, thanks to its wide range of functions and tailored staff guidance, meets all the requirements of Industry 4.0, with a clear visual language and seamless monitoring.

It is already in use on hundreds of plants in several countries and is highly valued by its users for its intuitive simplicity. Many customers have turned the system into an in-house standard system, either for single manufacturing areas or the entire production.

When manual work is performed with the help of a guided system on an industrial basis, many companies experience a leap in efficiency, especially since high levels of efficiency are achieved with low investment requirements.

With its help it is possible to achieve safe production, whereby these guidelines can serve as a guide for implementation.

Dipl.-Ing. Norbert Armbruster
Founder and CEO

Dipl.-Ing. Henning Vogler
Managing director and partner

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1. Guidelines, do I need them ...?

The six guidelines and how they were devised.

We often see that senior production staff are exposed to high levels of stress. Even maintaining ongoing production requires the full attention of all the specialist staff and management.

It becomes even more difficult when planning tasks are added to their daily tasks. New products often require a complete redesign within a very limited time frame. It is a good idea to have guidelines in place that can provide standards and instructions on how to carry out tasks.

For many years now, we have been installing systems in companies' manufacturing departments that aim to guide and support the production staff in their work, review and document completed operations and to support production as a whole. This enables us to evaluate the effectiveness of individual measures that have been implemented, even in the long term.

All these companies have reported exceptional business success in their restructured areas, resulting in strong customer loyalty.

That is why we have decided to describe the individual equipment and transformation steps that we usually go through and to formulate them as compact guidelines.

Our 6 Guidelines:

- ***Use standards for hardware and software***
- ***Record and store the expertise of professionals***
- ***Maintain staff satisfaction through instructions***
- ***Enable one-piece flow at the workstation***
- ***Create secure traceability in the workflow***
- ***Increase profitability through optimised availability***

Not a year goes by in production engineering without new concepts, methods and procedures such as poka-yoke, lean management, Industry 4.0 etc. being introduced and, sometimes, discarded again.

It's easy to lose sight of the main task, **making production simple, safe and profitable.**

In today's IT dominated world these characteristics – simplicity, safety and profitability – must be transformed and reformulated as strategies.

Strategy, in this sense, means the „further development of the original guiding thoughts according to constantly changing circumstances" (Moltke, 5).

According to this threefold strategy, simple production means avoiding laborious document flows. Safety means doing the right thing to achieve the goal, and profitability that the creation of value must be direct and avoid wasteful secondary processes.

To carry out a transformation quickly and safely, however, proven partial solutions – which can be used again and again and in combination – are indispensable. But which modern standards should be used?

Guideline 1: Adopt and use standards for hardware and software

It goes without question that, along with good technical facilities, reliable and competent employees are the most important factors in a reliable production unit. Finding and retaining them while keeping them up to date on a technical and organizational level is a difficult task. But what should we do if such specialists are so rare?

Guideline 2: Record and store the expertise of professionals

Even with the best staff, the hectic pace and stress of working life is usually very high, especially in the fields of logistics, assembly, test facilities and packaging, especially when additional tasks such as testing steps and documentation requirements have to be dealt with. We often observed that if employees are offered effective support and guidance, they will be more satisfied with their work and staff turnover will fall. How should this be achieved?

Guideline 3: Maintain staff satisfaction through instructions

But this is not enough. Customer wishes and the reaction of the internal departments constantly create new products to sell and variants which must then be produced. The quantities are usually so small that batch production is not economical. This means switching to a secure one-piece flow to minimise the quantities stored in the finished goods warehouse. But how can this be implemented at the workstations?

Guideline 4: Enable one-piece flow at the workstation

Once this has been accomplished, the task of securing installation and proving that the right processes have been followed and the right parts installed still remains. And all that without creating an additional cost burden with additional checks and records. How can a system of traceability for the manufactured products be implemented safely and inexpensively?

Guideline 5: Create secure traceability in the workflow

And all of this has to be implemented under ever-increasing cost pressure, which is built up by the competition and consequently by management. Analyses show that in this situation a lot of time is lost on site, searching for parts and information, and that losses are increased by numerous unproductive secondary activities. How can these weaknesses be remedied with constantly changing products?

Guideline 6: Increase profitability through optimised availability

Besides eliminating losses, reliable and competent employees are the most important factors in stable production.

But how can this be achieved? Let‘s start with the definition of standards.

2. Digital platforms and industrial manufacturing systems

What are platforms, how are they structured and what technology is required?

The installation of a new digital platform in a company allows employees to retrieve all the relevant information, such as orders, parts lists, work instructions and technical data sheets, wherever they are authorised to do so and wherever they can be used economically.

What are digital production platforms?

Armbruster Engineering develops and installs one-stop digital production platforms known as ELAM E4 platforms.

Digital production platforms are innovative, specialised IT products the software of which is effective in corporate networks. They can receive data, provide information, perform assistance functions and record production results at all workstations. All in all you, you get a stable, error-free production with low costs.

1. Assist

MANAGE VARIANCES

- Support staff

2. Secure

WORK FAULT-FREE

- Execute processes safely

3. Document

PROVIDE SAFETY

- Facilitate traceability

4. Inform

PROVIDE ORIENTATION

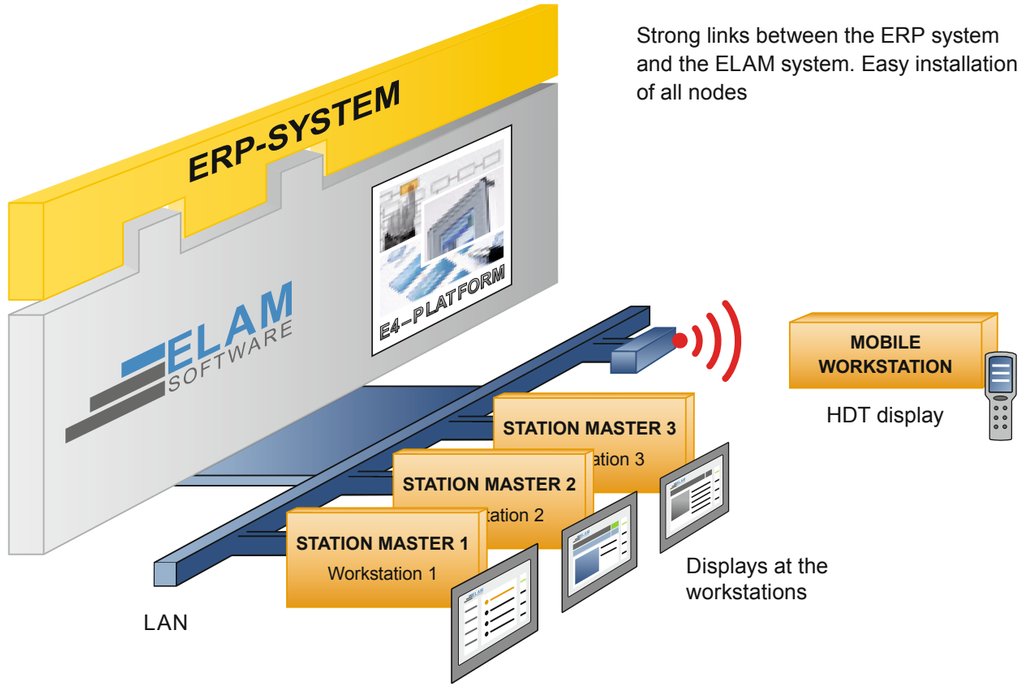
- Informed factory

The equipment in the factory is connected to controllers on the platform and the employees are guided by electronic assistants. The media interfaces with the ELAM system are bridged by selected hardware components and a suitable end device for each application. This creates units within the factory that enable both informed and secure work. These units can range from a single workstation as a cell, all the way through to entire lines and factory areas as ELAM compound plants.

We call the individual modernised areas themselves industrial manufacturing systems, which are characterised by their high reliability and cost-effectiveness. This is achieved, in part, through the use of web technology – which also guarantees high stability and flexibility.

These are modern standards in which hardware and software form a single entity. They are all connected to the platform all the time.

E4: The complete platform with web technology



Strong links between the ERP system and the ELAM system. Easy installation of all nodes

Web technology is the basis on which the individual units are easily and quickly adapted to operational requirements.

How do industrial manufacturing systems work in the individual functional areas of the company?

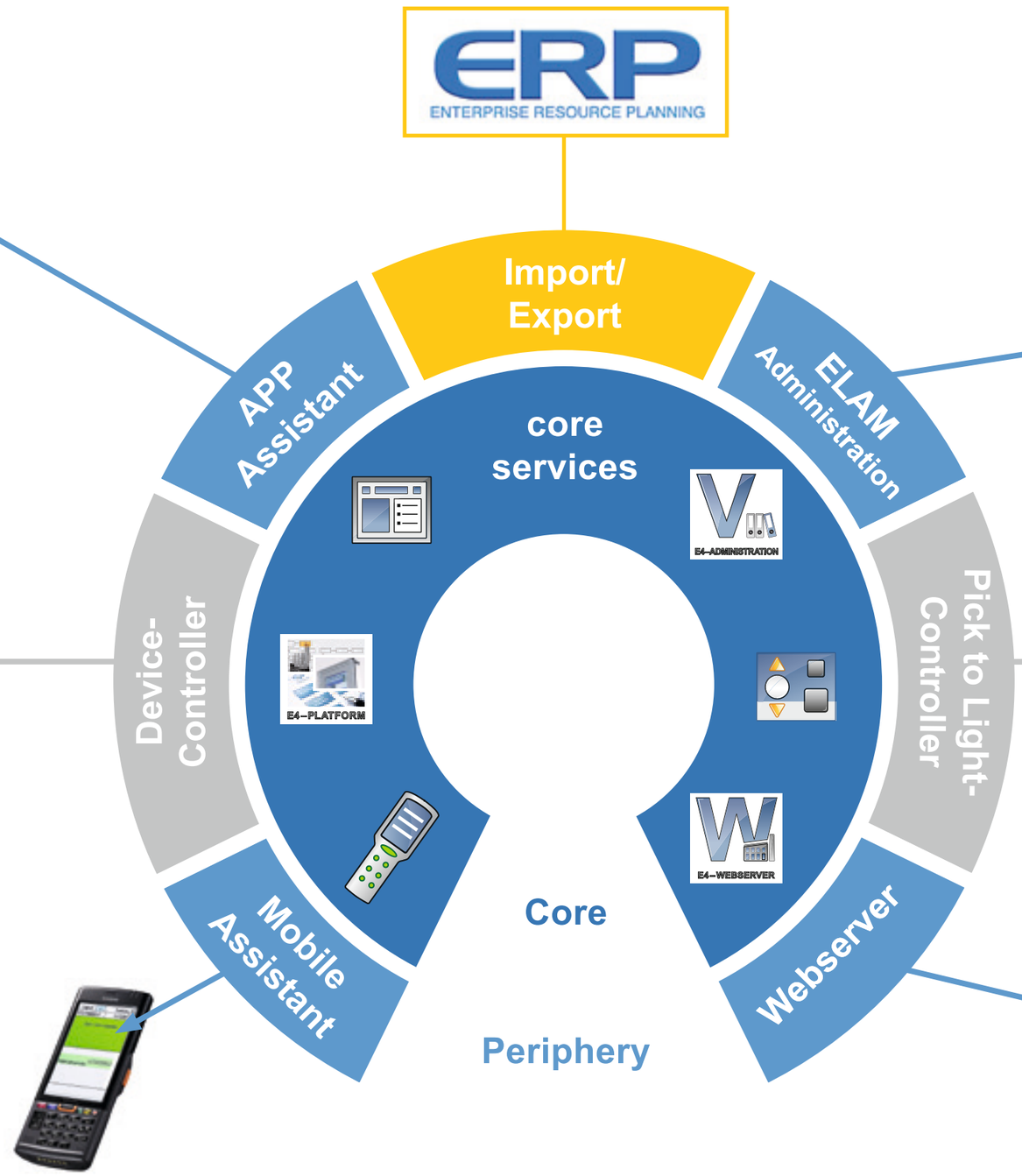
The ELAM E4 platform

The sources of information are leading ERP systems while the base of operations is the ELAM system.
These form the central units. The digital ELAM platform is bidirectionally linked to the ERP system.

Test facilities

Assembly workstations

Picking



Set up

Display

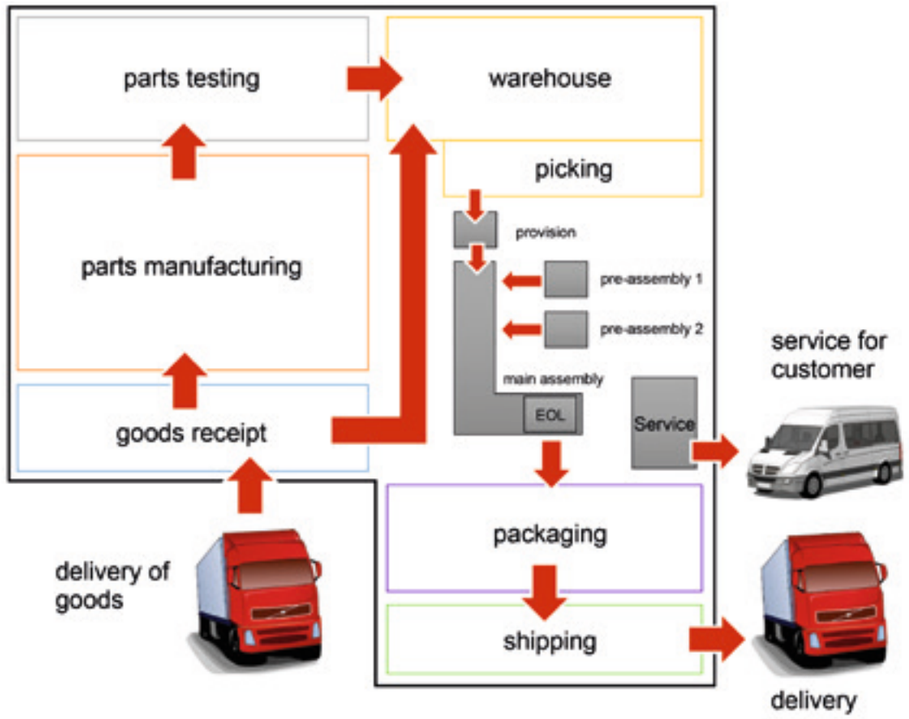
Evaluate

3. Functional areas in factories and workshops

A typical factory, from incoming goods to shipping/service, and a wide range of functions can be covered by ELAM.

If you look at individual areas in a typical production site, you often find patterns with a similar, recurring structure.

Production in a medium-sized company



In a typical company goods are usually moved step by step. From the incoming goods, the raw materials are transferred to the warehouse, from where they are picked and supplied to assembly. The component production department either delivers their products to the warehouse or directly to assembly.

There are often large areas in assembly that are entirely manually organised. Partly because automation is not technically functional or is simply not profitable due to high variance. Production is completed with end-of-line testing, followed by packaging and shipping.

As a result, individual production sites have the following system applications in keywords and connections to the platform:

Incoming goods: Inspect goods, incl. dimensions, for functionality and damage, initiate complaints, ELAM in use.

Component Manufacture: Plan machine allocation, data-technical PDA connections, „components ready" messages, quality „OK", ELAM seldom in use.

Warehouse: Mostly have their own computer and inventory control system, links to the ELAM system.

Picking: Pick list from parts list, centrally from warehouse, optimised route, picking task on mobile ELAM device.

Preparation: Picking trolleys, in-house production parts and bulk goods differ and usually treated separately, ELAM in use.

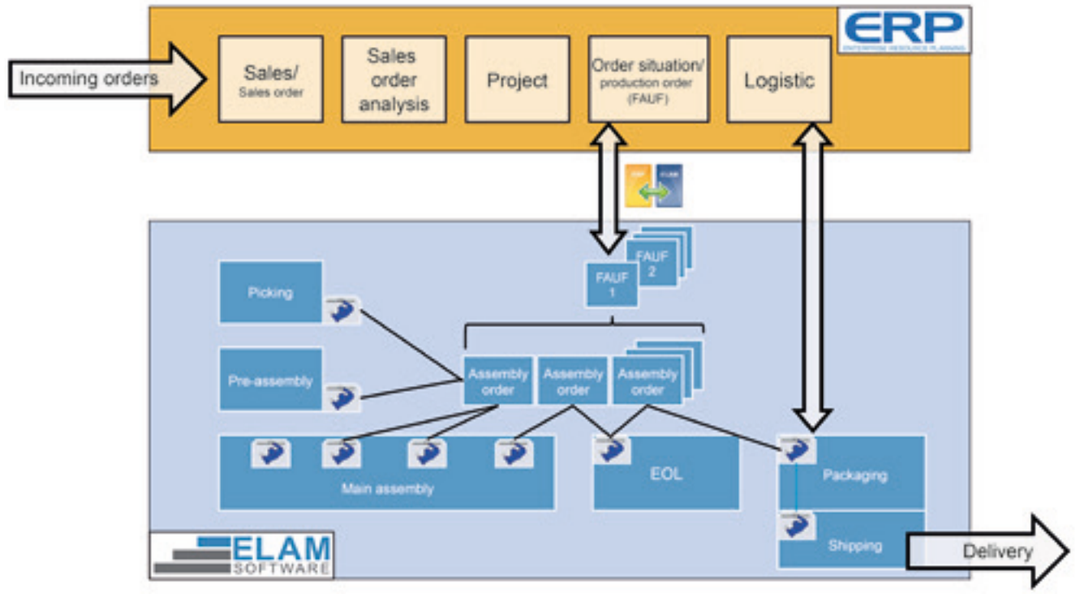
Assembly: Assembly of products, in some cases over several stages, many different processes and process equipment, control of the execution, accompanying inspection, signing, traceability. ELAM in use.

Inspection: Final central inspection, often carried out as an EOL check, apply end label with serial number, ERP link for feedback. ELAM in use.

Packing: Many different outer packaging types, additional and supplementary parts, brochures, labels, etc. ELAM in use.

Shipping: Often repackaging and palletising, shipping documents from ERP, mobile shipping logistics support. ELAM in use.

Service: Both in house and external repairs and product service must be carried out, full assistance functions on site. ELAM in use.

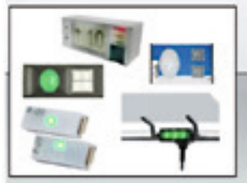


Assistance and work instructions are possible in each area, as the information in the assembly orders is specific to the workstation and can be changed dynamically. For example, it is possible to definitively determine the product definition immediately prior to assembly. This saves enormous job run times and minimises set-up work.

Another important factor is order sequence. Since all the individual areas of the factory are oriented to the same ERP-specified sequence and these are synchronised by the connection to the ELAM platform, compliance with the sequence can be achieved without additional manual coordination. This not only avoids expense, but also achieves a whole new level of scheduling and planning security.

Engineering performance | **Goods receipt** | **Component manufacture** | **Order picking** | **Provision** | **Assembling** | **Testing** | **Packaging** | **Shipping** | **Service/Repair**

IN THE FACTORY



Schedule orders

Load orders and report back

Specify processes and-monitor assembly

Inform staff and guide

Display inspection and query

Save Product lifecycle report

AT THE CUSTOMER

ELAM process control in service & repair

Logical control procedures

Fault-free components picking

All connections connected

Precisely assign work to the product

Physically support staff

Carry out inspection automatically

Route optimisation

With this arrangement, we achieve a uniform structure in all areas with visualisations for the staff and connections to the platform. This uniform structure is the prerequisite for defining workstations as modules that are easily changeable and adaptable thanks to their electronic basis. They can be used as standards throughout the factory.

Guideline 1: Adopt and use standards for hardware and software

In every situation, at every workplace in these production facilities, the necessary instructions and aids are displayed in a practical manner and the executions are accompanied and evaluated.

PICKING

- Secure provision of materials
- Find components quickly and avoid long search times
- Zero faults despite increasing variance

ASSEMBLY

- Process monitoring
- Transparent process evaluation
- Controlled assembly
- Tool connection
- Zero defect assembly

INSPECTION

- Traceability
- Flexible test facilities and final tests
- Inspections during assembly
- EOL checklists

INFORM

- Paperless, informed factory
- Utilisation of assistance systems
- Run production plants safely
- Secure order control
- Maintain quality

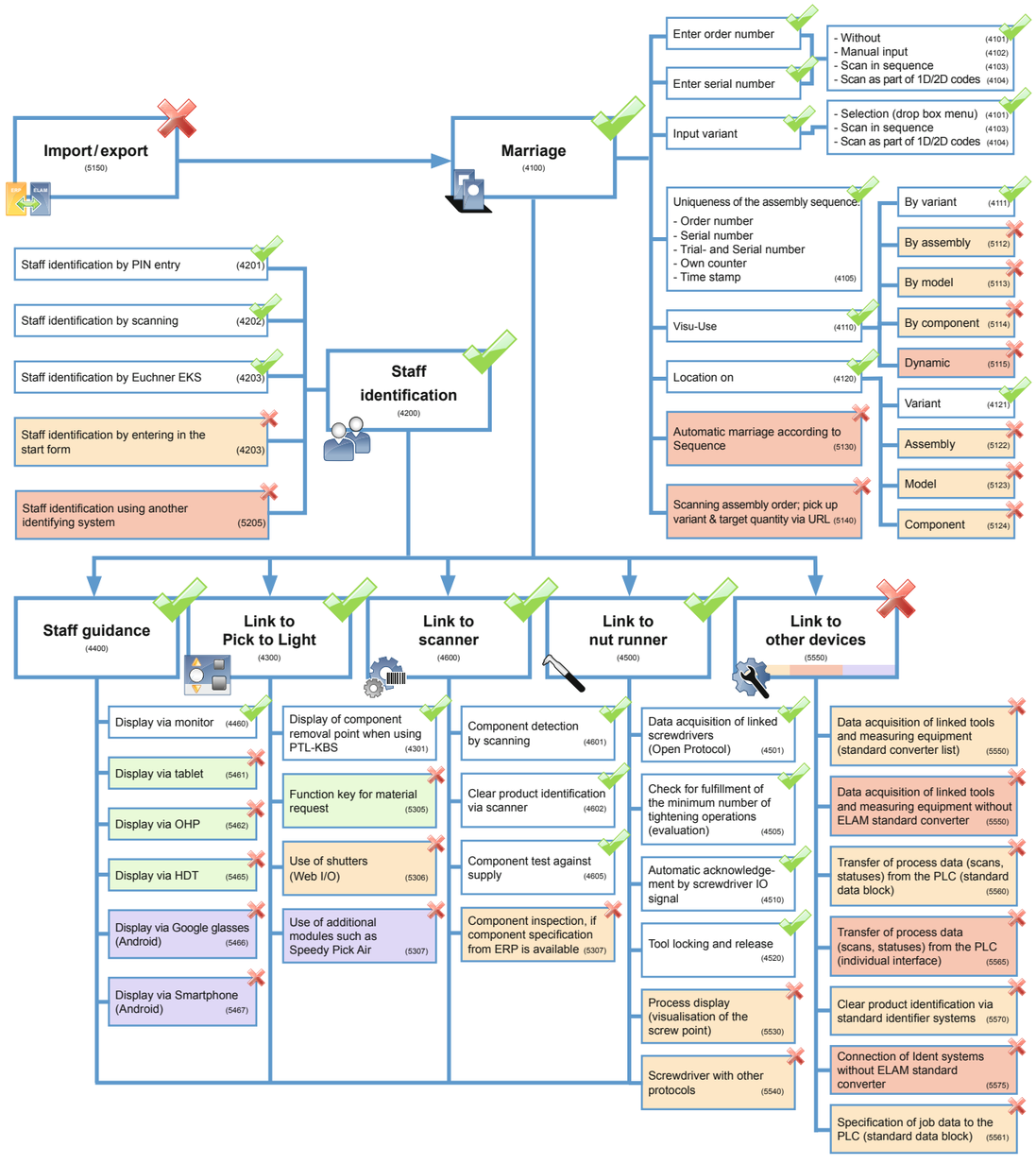
At individual workstations, the assistant guides, displays, measures, evaluates, corrects, documents, labels and signs all aspects of the process.

In addition to safeguarding process contents, it also makes it easier to instruct new employees if they change frequently. Expertise is stored and secured in the company.

Guideline 2: Record and store the expertise of professionals

This requires a large number of functions, but these are already stored as ready-made partial solutions in the ELAM system.

The following list of functions is an excerpt from the ELAM documentation and is intended to provide an insight into the functions that are available at the workstation and can be used without any programming effort, only configuration is required.

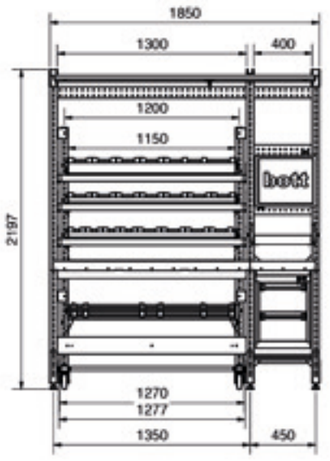


4. Workstations and industrial manufacturing systems design

Single stations, I-line, L-line, U-line, O-line, mechanical structure of places; examples

Every factory planner strives to find the optimal layout for their workstations. The arrangement of workstations has a major impact on the well-being of employees at work. Parts containers in easy reach and Pick to Light displays, unmistakeable well organised tools, a touch screen monitor in a central position and not too high and the facility to confirm actions simplified with a foot or a buzzer button. These are proven design tools.

Digital work instructions are structured in such a way that the handover from one sub-operation sequence to the next, following confirmation, is carried out automatically with a tool signal or a component signal.

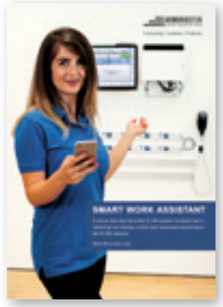


Additionally, the degree of information is reduced to a minimum and adapted to the complexity of the work step. The staff member should receive precisely the information they need to execute the pending sub-operation sequence correctly. Depending on the work step, a short text may be sufficient, or it may be necessary to display videos or diagrams. In any event, crucial information is provided to the staff member without them having to search for it first.

This visualised workflow gives the employee the degree of responsibility for which they can be held accountable: the proper execution of the tasks. This generates a higher level of staff satisfaction.

Guideline 3: Maintain staff satisfaction through instructions

Workstations equipped in this way form the central modules for the design of industrial manufacturing systems. To this end we have developed our own Smart Work Assistant brochure (SWA).



Request your SWA brochure:

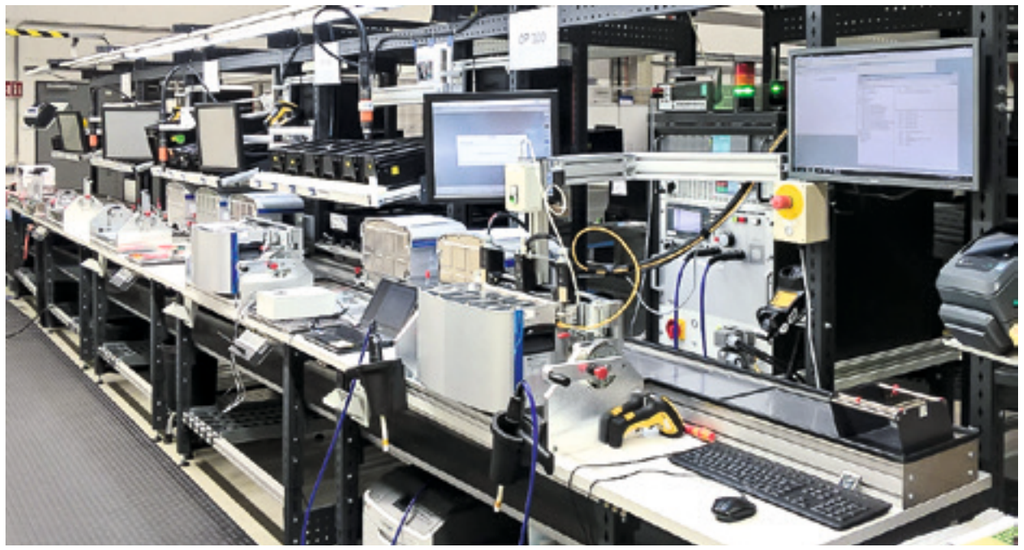
E-Mail: info@armbruster.de
Tel.: +49 (0) 421 20 24 8-0

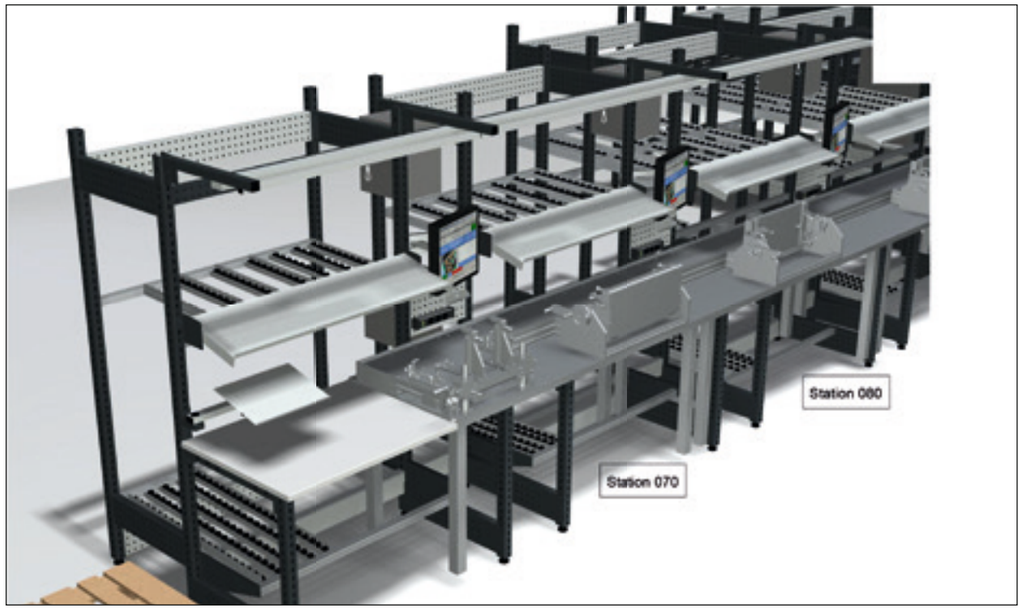
Finally, workplaces equipped in different ways are compared and evaluated according to application criteria.

	production form	efficiency primary secondary	variants	Necessary assistance	traceability	material supply
robotic cell	large series	very high	very limited	for changeover processes if necessary	depending on the identification of the parts	elaborate
magazine assembly	series	high	limited by magazine height	magazine circuit, tool connection	depending on the identification of the parts	elaborate
workplace assembly	medium series	medium	limited by partial quantity at workplace	work display with PTL tool connection	each identified component	simply from behind
workplace with shelf	medium series	small	very extensive	work display with PTL tool connection syncronized to the partial carriage tool connection	each identified component	simply backwards
workplace with shelving and trolley section	small series	small	extended by partial quantity on the shelf	work display with PTL tool connection syncronized to the partial carriage tool connection	each identified component	simply backwards

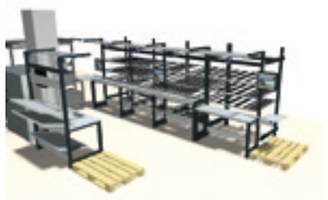
Robot and magazine assemblies have the highest level of efficiency, but are only of limited use for variable assemblies. Small series or even individual pieces can be assembled at workstations and, depending on parts requirements, extended with shelves and parts trollies and secured with Pick to Light.

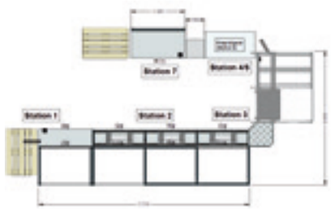
Linear arrangements are still preferred in workstation networks. The advantage is that the workpiece carrier can be returned linearly from below. Lift stations at both ends raise it back to working height.



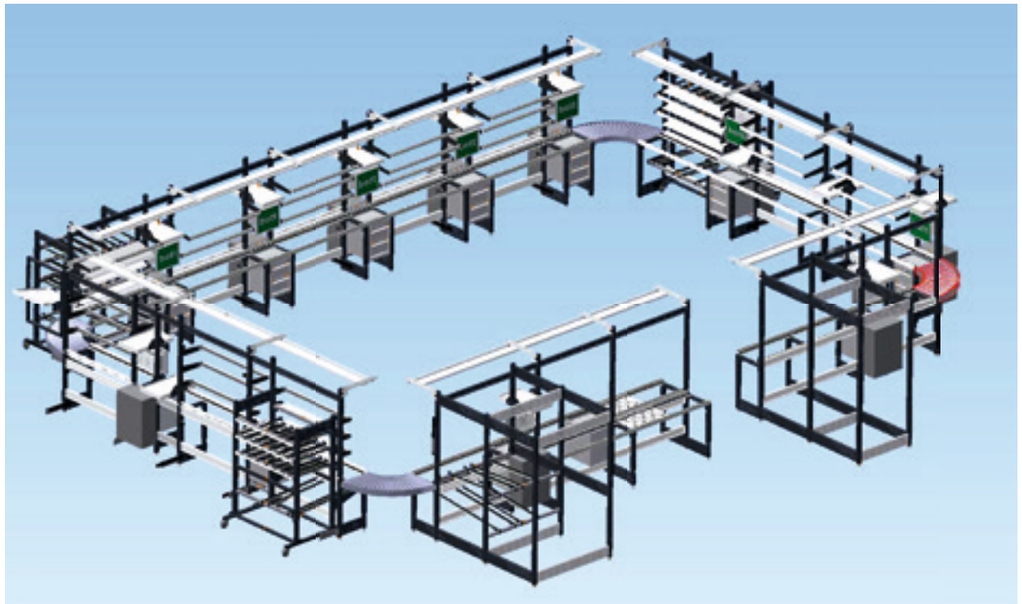


Arrangements in the form of an L or U offer the advantage of shorter distances and are good for teamwork.





This circular arrangement has the advantage of a closed loop for the workpiece carrier. This arrangement also allows for the possibility of a form of organisation wherein one member of staff builds one product.



The use of collaborative robots in industrial manufacturing systems is growing steadily. Both robots and automated transport systems are optimally supported by the ELAM platform and are indispensable for modern production. They also allow automatic and manual areas to be combined and spatially separated areas to be synchronised.

Collaborating robot
Universal Robots

Collaborating robot at Motek 2018

Industrial manufacturing systems can be adapted to company structures.

But how should the individual workstations be fitted and equipped?

5. Equipment of workstations and visualisation of work processes

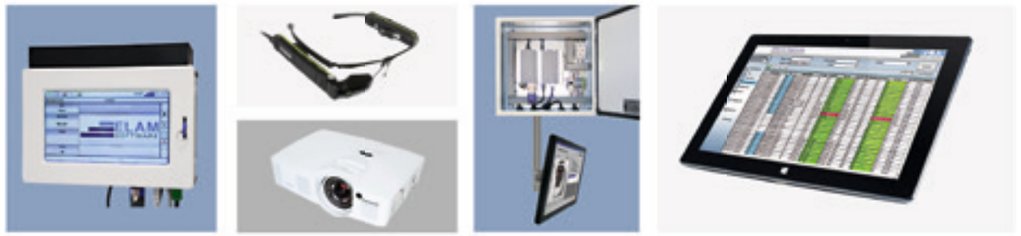
Display devices, equipping assembly stations, planning with an equipment plan, stationary and mobile workstations, process monitoring with PTL, closing the supervisory chain

Precise assembly work is always preferably carried out as a seated activity, whereas larger components require both standing and seated activities. Picking and testing tasks, on the other hand, are usually carried out standing.

In any case, it must be possible to connect and operate the displays for all working methods and arrangements on the platform.

Display world for Windows android

Station masters and devices

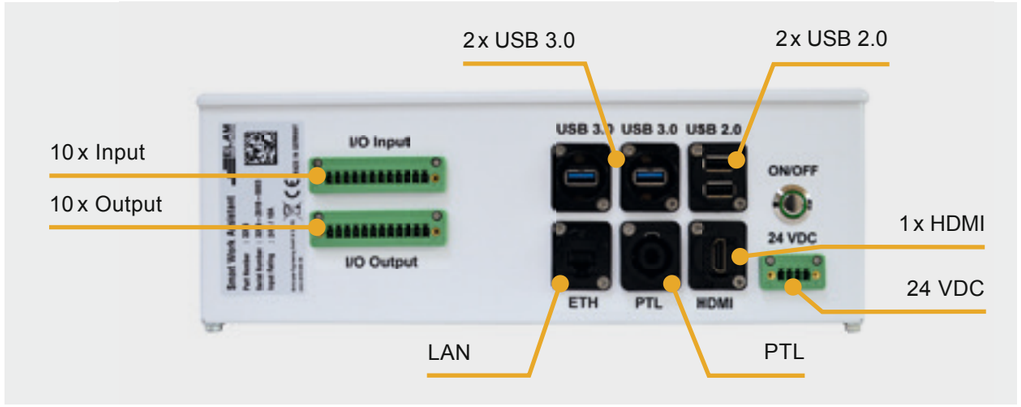


Depending on the task, the displays must also work synchronously with each other. For example, instructions should be displayed on stationary monitors and the staff member should then use the mobile device to process the instruction immediately. Finally they have to confirm on a stationary basis or with the data glasses.

This functionality should be executable with different media such as touch monitors, tablet PCs, laptops, hand-held terminals, cell phones, data glasses or projectors.

Data glasses for mobile solutions:

Smart Work Assistant




1


2


3


4


5

Connection options:

1 Power cable
2 Monitor
3 Scanner
4 Printer
5 Pick To Light

Data capture options

Devices, tools and controls

Extensive controller libraries are available on the platform for the user, as a separate controller is required for each device type. As the ELAM system was designed with the goal of being able be able to connect and query all means of production, connections are now available for every area of the factory and every type of work requirement.

If manufacturers launch new device types, the corresponding controller software is adapted to the new device or tool that is to be connected. (Additional adaptive electronic hardware is not required!)

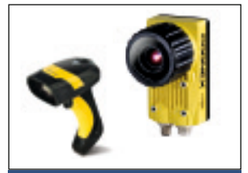
We have also succeeded in developing a uniformly structured form of controller, using a special type of programming. Our interface controllers are therefore „universal software sockets“ to connect our ELAM system to the process devices.

The ELAM administration allows the configuration of all controllers in consistently similar structures.


EC-nut runner


Display systems


Pick to Light


Cameras and scanners

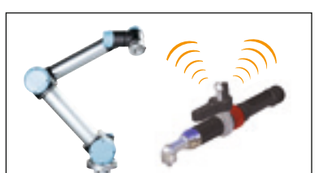

Printer


Identification systems

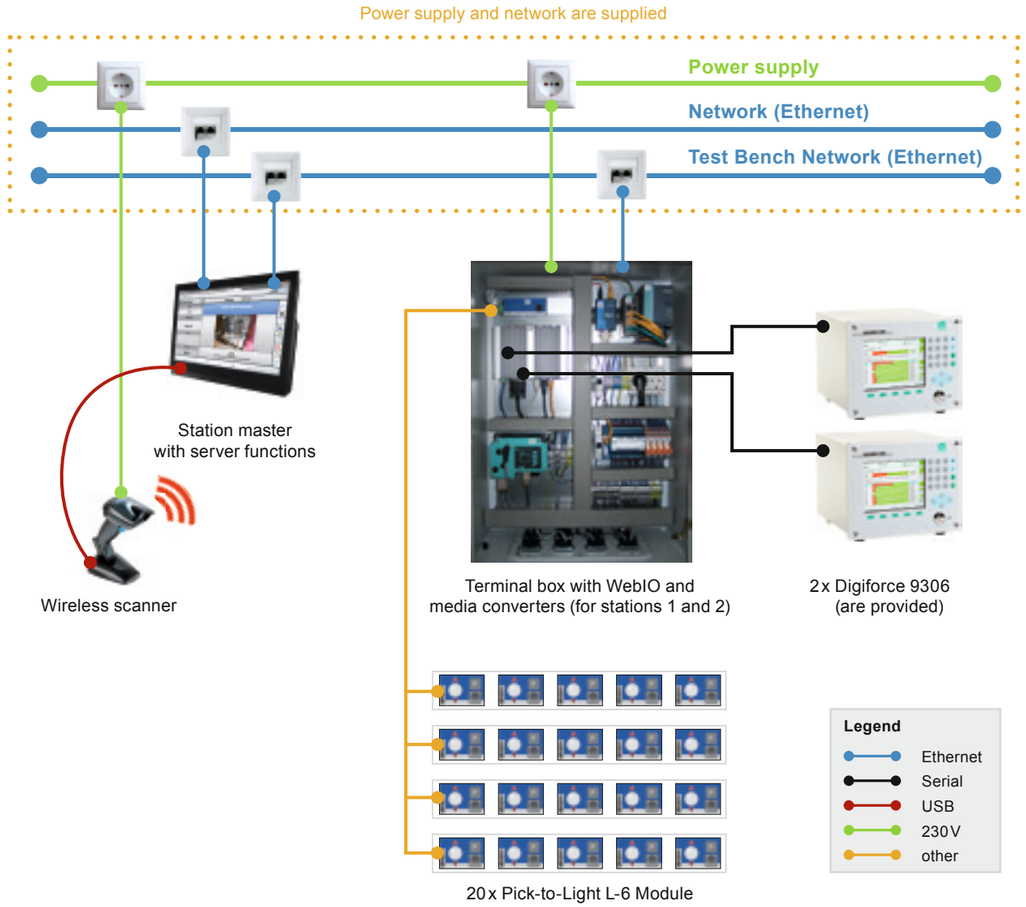

Measuring technology


Controls


Pressing / welding etc.


Robots and more

Equipment Plan: Equipment for assembly with the ELAM system



During step-by-step processing, data from the connected devices and tools is collected as measuring points in certain partial work sequences. These measuring points are nominal values for the process.

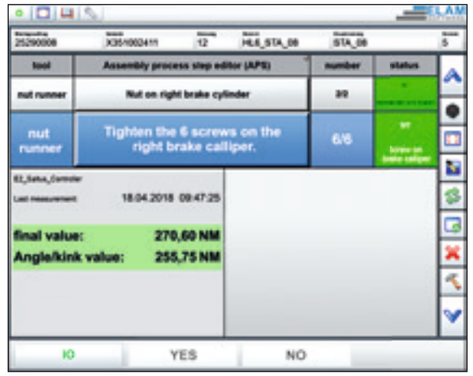
In addition to the display task, each sub-operation sequence also includes logical functions in which events are triggered and measuring points are recorded. If these all arrive, the sub-operation can be completed successfully. This creates a secure process chain that guarantees safe processing, even with many different and frequently changing variants.

This is the prerequisite for one-piece flow in production.

Guideline 4: Enable one-piece flow

If these displays, tool connections and pick-to-light systems are now mounted at the workstation, it is possible to control the visualized work instructions and the use of the production equipment according to type and synchronously with the workflow, in accordance with the pending order.

The networking of the individual devices is mapped in device plans.



Example: Grab part → Pick to Light intervention control → IO

If the measuring points do not arrive in the specified number and order of magnitude, an error message is issued in a graded response, depending on the significance of the partial operation sequence. From a simple hint to an absolute stop. Everything can be set and configured. If a sequence of operations has to be observed, this is also displayed.

All data, both the specifications and the recorded measuring points, are archived in the ELAM database with reference to the product. The same applies to the metadata so that, for example, the repetition of partial operation sequences is stored.

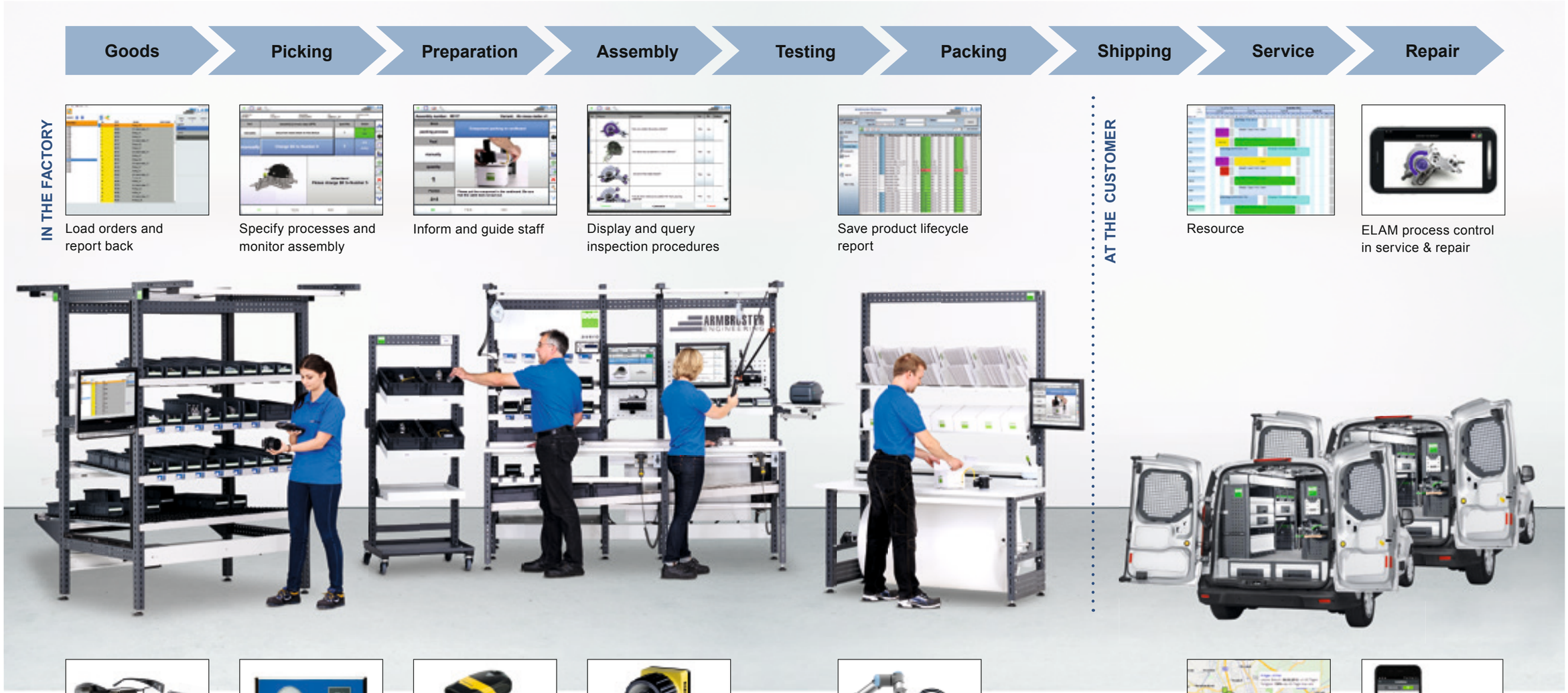
This creates a fixed data record that is automatically stored and ensures full traceability in the ELAM web server.

Working on site (mobile application)

ELAM systems offer full assistance support in mobile service applications, but can also manage tasks and assignments on mobile devices. A connection to common service order systems is possible.

Deployment in the service area with the subtasks diagnostics, disassembly, repair and completion can be carried out with full process monitoring. This solves complex service tasks especially if the assembly is already being carried out under the guidance of the system and the assembly data can be retrieved during the service operation.

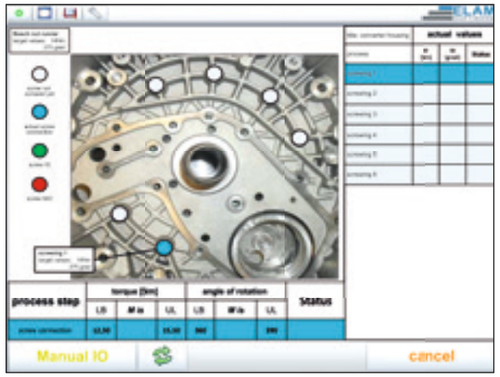
An assembly vehicle can then be supplied with data as a „mobile ELAM workshop“. Visualisations can be implemented differently with ELAM, depending on the task.

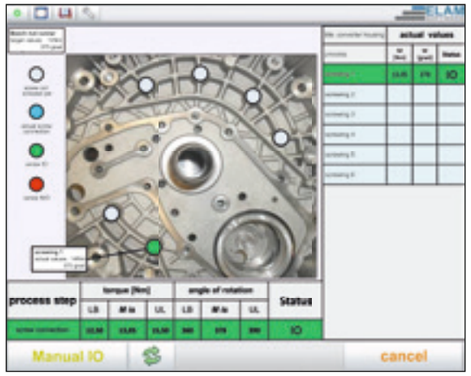


Guideline 5: Create secure traceability in the workflow

In principle, however, there is a design gap between the display and the measuring point. In the example shown, the instruction Remove Part X is displayed and the Pick to Light display shows the removal point, but the subsequent acknowledgement only indicates the correct removal. The measurement point for the acknowledgement is not completely secure. Should this is required, camera systems can be used to analyse the distances travelled by the employees‘ arms.

For ergonomic reasons or in the case of very complex processes, displays can also be projected directly onto the workstation or the product to be mounted using projectors or lasers.





In addition to these stationary operations, the ELAM system is also used as an „extended workbench“ in repair and service.

But how can the system be integrated into an existing IT structure?

6. IT structures and interfaces

ERP interface, controllers, controller list, IT requirements and system requirements

The ELAM platform has a modular structure. The administration forms the core performing the most important task, the creation of the partial operation sequences (TAF-Editor). The evaluation of the work results for each station and each workstation is carried out via the ELAM web server.

ELAM Software – how is ELAM structured?

After a brief configuration of the administration, work instructions can be created intuitively which can be used immediately at the workplace. The stored process values can be retrieved via the web server. Filter functions support the search.

ADMINISTRATION

- Plug ins for main functions
- Integrated user administration
- Adjustable order type

ASSISTANT

- Intuitively create work plans
- Quick change and customisation
- Insert pictures and videos directly

WEB SERVER

- Storage of data and parts
- Evaluation over 3 levels
- Search function via filter

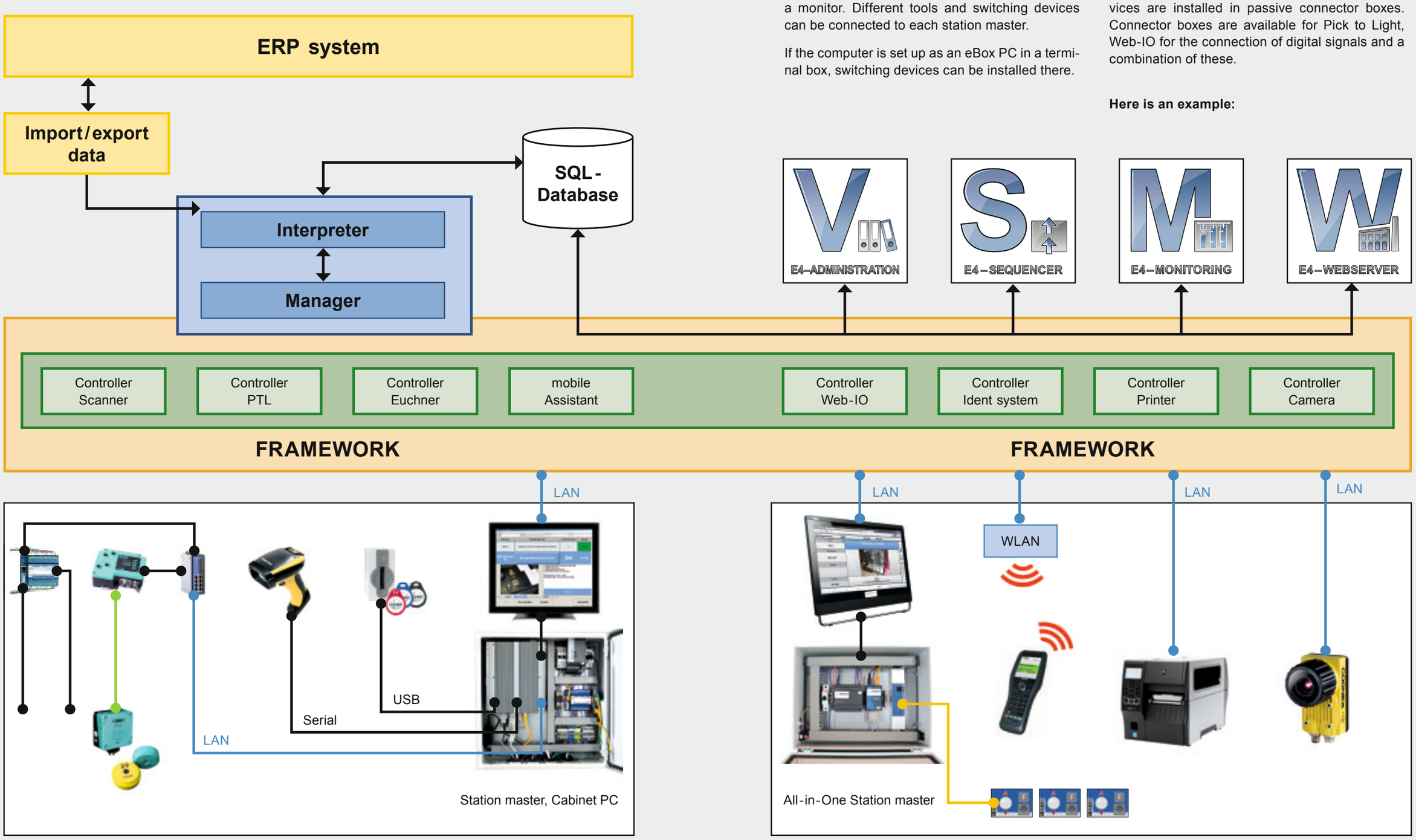
Connection of the equipment to the workstations

Station masters always consist of a computer and a monitor. Different tools and switching devices can be connected to each station master.

If the computer is set up as an eBox PC in a terminal box, switching devices can be installed there.

In the case of all-in-one PCs, the switching devices are installed in passive connector boxes. Connector boxes are available for Pick to Light, Web-IO for the connection of digital signals and a combination of these.

Here is an example:



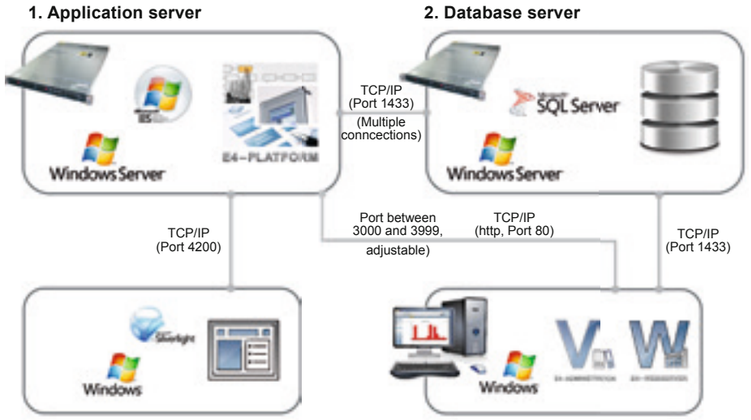
Workstation 1

Workstation 2

The platform's central interface is the bidirectional connection up to the ERP system. The user has pre-configured solutions ready for immediate use. Proven solutions are also available for proprietary solutions for all customer-specific IT systems and databases.

The ELAM system in your infrastructure

To integrate the ELAM software into your IT architecture, a customer side application server is required. The ELAM system services and the Internet Information Server run on this **first application server** to provide the ELAM web server. The **second database server** with its SQL database is accessed from the application server. The displays on the **station master (staff terminal)** are shown via a browser in the ELAM Assistant. Saved data is also retrieved via browser via the ELAM web server. The system is set up using the „ELAM Management" program which must be able to access the application server and the database server from the **operating computer**.



While hardware servers used to be installed in production, system integration can now be undertaken quickly and easily by servers provided in the customer's IT landscape.

The system requirements and settings for the application and database servers are described in detail.

Interfaces in the network

Interfaces:

- **Are the branch points in the network. They facilitate displays and actions.**
- **We have more than 100 controllers available for device connections.**
- **Some are universal.**
- **The MQTT interface is a new building block for standardisation.**
- **ERP connections are always very cost intensive. In order to achieve fast and cost effective ERP connections we have developed a standard interface.**

Integration in the customer's IT architecture ensures the physical prerequisites for establishing a platform.

But what is the best way to implement an ELAM project?

7. ELAM composite systems – Planning, delivery and service from a single source

Planning support, delivery from a single source, even in times of zero production, scope of service and service example

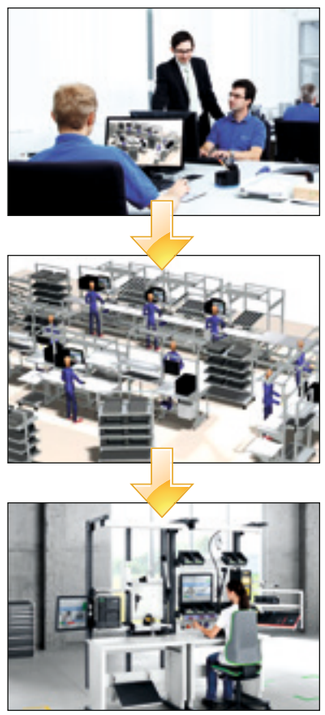
New ELAM platforms can either be retrofitted to existing plants or installed as new systems. In both cases – retrofitting or new installation – Armbruster Engineering can provide a one-stop solution.

Delivery of new systems with ELAM

Carefully planned, delivered on time – all from one source

We work closely with our experienced partners to deliver the overall design of a new plant. Together with you, we develop a solution that meets your requirements and framework conditions.

Realisation within 12 to 16 weeks from order placement. Pre-acceptance is usually after about six weeks at our premises. The installation takes between 3 and 4 days under production conditions – and then your new system is ready for production.



Our offer includes:

- A detailed description of procedures
- Licenses and software adjustments to the system
- Hardware with individual pricing
- Delivery by partner companies
- Configuration, installation and commissioning
- Staff instruction and training

We need:

- Specification of the total budget
- Agreement with the IT department for data coupling
- Provision of a virtual server
- Provision of the agreed hardware
- An appointment for instructing or training of employees

Equipping plants with ELAM

Install quickly – profit quickly

When retrofitting our ELAM system, we pay particular attention to its seamless integration into the existing production landscape. Installation takes place within 8 to 12 weeks from the order placement. The installation of the system takes between 2 to 3 days under production conditions. To prevent disturbances to ongoing operations, the systems are commissioned over the weekend, during the holiday season or on public holidays. Your new production can start as soon as Monday.

Our offer includes:

- Licenses and software customisation
- Hardware with individual pricing
- Configuration, installation and commissioning
- Staff instruction and training

We need:

- Specification of the total budget
- Consultation with the IT department for data coupling
- Provision of a virtual server
- Provision of the agreed hardware
- An appointment for instructing or training of employees

Our services – composite systems

01 PLANNING

02 ELAM SOFTWARE

03 HARDWARE

04 WORKSTATIONS

05 GENERAL CONTRACTOR

06 SERVICE

ELAM composite systems

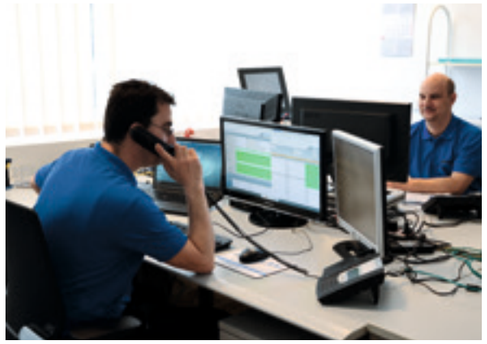
- Central server solutions
- Direct digital connections to control systems in the ERP system
- Can set up a distributed work sequence via stations
- Can provide all electrical equipment and tools with data technology
- Constantly provides digital assistance
- Are systematically expandable
- Provide documentation and reporting of operations
- Can exchange data with scheduling systems

A full service is available following installation.

Service agreement for installed systems

The service for production and IT systems differs fundamentally from the service that is commonly provided for machines. The most important factors in the service of networked production plants are fast response times and specialist network competence.

Today, as a result of networking, even small issues can have serious consequences and influence production. We have a lot of experience in this particular field and have developed special competences with networks that we use for our customers to ensure optimal availability.



Our services:

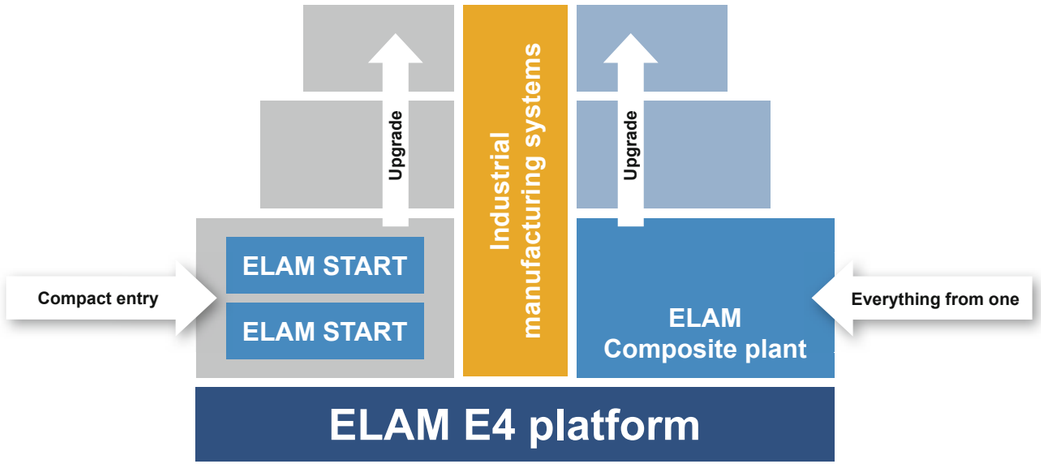
- Expert hotline
- Remote maintenance via internet or remote data transmission
- Regular inspection and care on site (monthly/half-yearly)
- On call service – 24/7
- Maintenance of IT equipment and systems
- Control, archiving and, if necessary, evaluation of data sets
- Update service
- Spare parts on request
- Training & workshops

Many companies are not looking for a „single source solution“ but, for a variety of reasons, would like to configure and install the system from scratch.

That is why there is an entry-level version of the ELAM system:

1. **ELAM composite system – everything from one source**
2. **ELAM START – compact entry-level system for expert DIYers**

Two routes, one goal!



But what does the ELAM START solution look like?

8. ELAM START – compact entry-level system for expert DIYers

Setup, configuration, quicksteps, documentation, pre-configuration, picking and assembly in one system.

As the ELAM START version is not connected to the ERP system, order data is stored in the ELAM database.

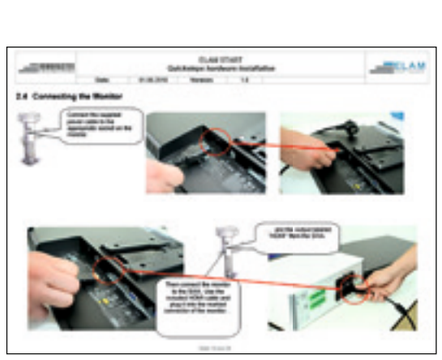
ELAM START solutions can be set up and installed as islands.

Inexpensive entry-level solution – ELAM START

Step-by-step using in-house skills

- All the benefits of a digital assistance system
- Lower costs for a smaller budget
- Rapid payback
- Expandable at any time
- Expertise remains in the company

Quicksteps manuals – ELAM START

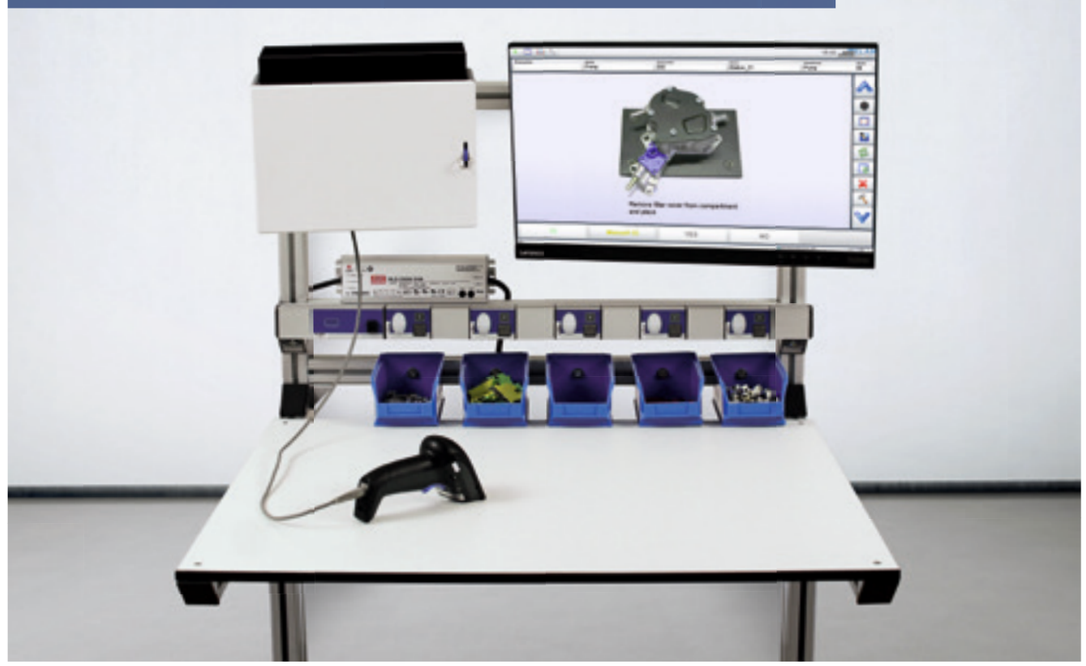


The following quicksteps assist you with your in-house project:

- Hardware installation
- Administration
- Assistant
- Scanner
- Pick to Light
- Start form

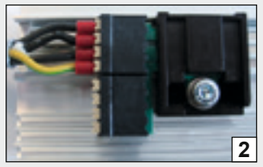
ELAM START
WORKSTATION

The compact ELAM START package can be used on a single workstation. Just put together the package that you need Plan, set up and commission yourself or with support from Armbruster Engineering.



Different devices and tools can be used at each workstation. Controllers are available for all devices with a STAMA number. Equipment can be connected either directly or with the help of connector boxes. There are standard connector boxes for common applications, and we can design and supply further connections tailored to your requirements.

Time and again our customers want to install something new in the ELAM system themselves, or want to change configurations. The new Quickstep instructions will help you here too.



Example of Quickstep instructions for commissioning

1.) Wire up the terminals

If you want to shorten your cables, please refer to the following additional sheet for cable assembly.

2.) Allocation of cables to terminals

Each terminal has connections for two cables one for the level before and one for the next level. Each cable has four cores of 1 mm².

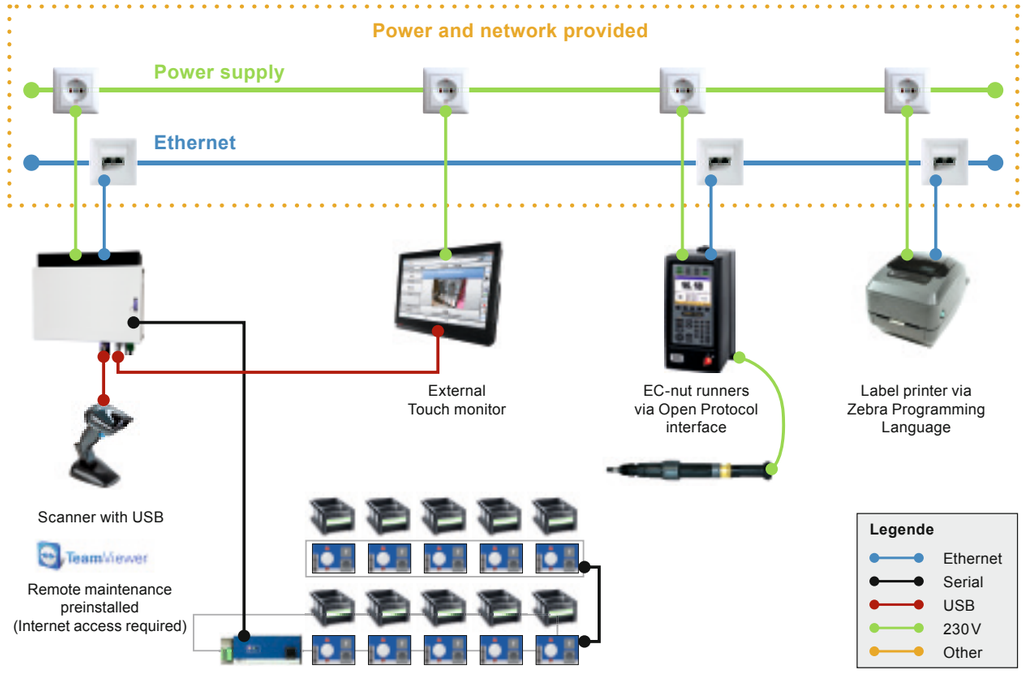
3.) Saw blind cover and attach

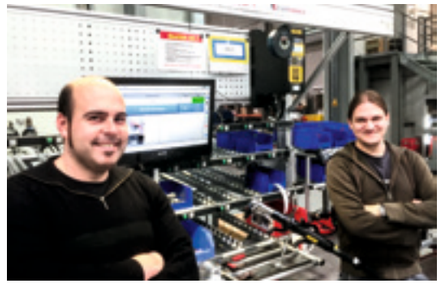
When clicking in the profile covers, proceed exactly as for attaching the compartment displays (see page 6).

ELAM START AT A GLANCE:

- Assistance system with all-in-one touch screen PC
- 2D scanner and Pick to Light shelf displays
- Modular with screwdriver and printer connection
- Memory functions and evaluations
- Self-sufficient network; Software is pre-installed
- Special package price; self-installation with instructions
- Commissioning by Armbruster Engineering possible

Case study of a medium-sized company:





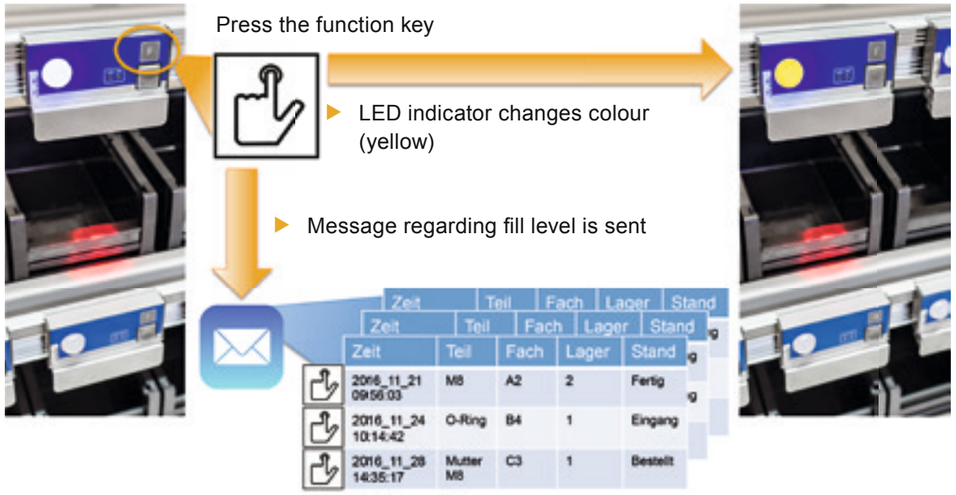
Everything self-built

In terms of hardware, the screwdriver/PC suspensions and holding devices had to be installed and the cabling had to be performed. The system is now running smoothly and my colleague and I are already real experts in the field.

In addition to assembly ELAM START can also be used for purchase requisition.

If an employee detects a parts shortage in a container, they can use the F-key on the shelf display to report this demand to the logistics specialist's portable device.

It is received there and the delivery process can proceed.



Pick to Light Notification Procedure Actual Status

Shelf display | **ELAM** | **Staff member**

Start

Triggering the requirement message

LED light indicates requirement message for 500 s (yellow)

Displays of the component requirement in Reportview (administration plugin)

Shelf display goes into normal operation

Conformation by staff member via Reportview

Deletion of the message in the Reportview

Filling the chute

End

Every ELAM installation, whether ELAM Composite Systems or ELAM START, requires suitable system training.

But what courses are offered?

9. Training, workshops, trade fairs, user meetings etc.

Training plan, workshops (incl. in companies), Motek trade fair, user meetings and other communications.

The prerequisite for the successful commissioning and successful operation of an ELAM system is suitable training courses.

When it comes to training courses, we differentiate between those for prospective buyers and those for beginners. Some of these courses are even free.

For existing ELAM Composite Systems customers, we differentiate between training courses for beginners and experts. These training courses are offered within the framework of the overall project offer.

Training by Armbruster Engineering

- New rooms have allow us to intensify our customer training
- Creation of work instructions
- Establishment of the administration
- Hardware configuration

- Decision maker
- Responsible personnel

Interested parties A

- Get to know ELAM
- What can you do with ELAM?
- How is ELAM structured?
- How does ELAM work?
- How is a workflow created?
- How is a workflow processed?
- ELAM system
- ELAM START

ELAM Allgemein

free

- Equipment construction / maintenance
- Interested parties wanting to do it themselves

Entry-level B

- Save costs by doing things yourself
- Setting up a workplace with the ELAM system
- Set up & connection of hardware
- Documentation of built-in components
  - Setting up and modifying the Pick to Light system
  - Changing the existing allocation
  - Incorporating new components
- Creation of workflows
  - Creation of variants

ELAM START

specific training – fee required

- ELAM system buyers
- New users at customers

Beginner C

- Setting up orders
- Setting up Pick to Light system and connecting of tools
- Creation of users and rights
- What functions does the ELAM Assistant provide
- Establishing workflows
- Evaluation options on the ELAM web server:
  - Product lifecycle report
  - Filter functions
  - First pass yield

ELAM composite plant

specific training – fee required

- Existing customers
- Additional training

Experts D

- Setting up signals for controlling tools such as screwdrivers or presses
- How are special functions processed?
- Establishing print layouts
- Export possibilities in the ELAM web server
- Evaluation options on the ELAM web server:
  - Torque data collection
  - Searching serial numbers
  - Print / export function

ELAM composite plant

specific training – fee required

User meeting 2018

Since November last year there has been an annual training schedule for all training topics, available both online and via newsletter.

Active exchange and „Best Practice“ lead to success: our ELAM user meetings.

The most convincing arguments for the implementation of these guidelines come from our customers‘ own mouths. This makes an active exchange all the more important for everyone involved.

Our partnerships with customers have grown over the years and have led to trusting mutual encouragement and joint further development. This is intensified by our user meetings.

Interested customers meet once a year, to exchange ideas and share experiences, regardless of the solution used and across all industries.

In addition to these events, there are newsletters, field reports and most recently an ELAM Update Report, in which users are regularly informed about system updates.

Facebook, YouTube and Xing are also directly accessible via www.armbruster.de

Newsletter

Field report

Reference report

ELAM Update reports

This extensive range of communications is maintained by Armbruster Engineering to keep customers informed.

But what are the economic benefits of the ELAM system?

10. Efficiency – rapid payback

We are often asked how the profitability of a project can be calculated. Customers are usually disappointed when we ask them questions back.

How should you determine the cost-effectiveness of a system that supports employees in their work, guides them in work processes, and helps them maintain quality? How can you determine the financial value of a situation where staff are not under excessive stress, who carry out processes safely and adhere to quality specifications?

Of course, there are example projects in which the cost-effectiveness of our assistance system can be measured using well-defined criteria. But these are always customer-specific and vary depending on the project focus.

One thing is clear: we can reduce extensive order documents to small information cards. Everything else is available digitally at the workplace.

It is easy to calculate that by saving on the production and distribution of documents alone, the investment will pay for itself within a short period of time. The achievable transparency for managers and the associated time savings in day-to-day business are not even taken into account here.

Other customers report that after the introduction of the system they were able to outsource certain assemblies to pre-assembly stations, employ temporary workers there and employ highly qualified personnel only where they were really needed, in final assembly and final inspection.

Implementation costs can often be recouped within a few months through the interaction between assembly structuring and personnel deployment.

All this with higher quality assurance!

ELAM in action – the advantages are clear

Conclusion:

Lower costs

Satisfied staff

Almost every customer has confirmed a reduction in training times. This will especially benefit companies with foreign locations or seasonal business.

What’s more, the benefits clearly outweigh the costs!

We are often asked what the „actual benefit“ of our system is, because apparently its introduction means an additional effort at first: you have to enter the work instructions, the operation of the system costs time in work preparation and sometimes even in assembly itself.

Once again, there are no easy answers. Of course, system maintenance always means work. Maintaining conventional work instructions means even more work, but traditional updates and optimisations take place in people‘s minds and are rarely recorded in writing.

And so we come to the benefits. We tell these customers: only once your assembly expertise is systematically available and independent of the assembly personnel will you have a basis for consistent quality!

Quality improvement

Speaking of quality. In many of our projects, we have observed an interesting development. Initially, customers often feel that the quality of their products deteriorates with the introduction of the system. The reason for this is, however, that processes and procedures that were never observed, registered and analysed before suddenly become visible

Need for traceability

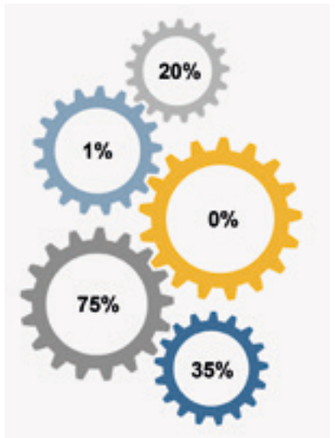
For many customers, the direct benefit often lies simply in the need to be able to prove complete traceability. But here too, our solutions are as exact, as our customers are varied.

Example of a converter assembly:

The customer produces electrical converters. With the introduction of ELAM, they reduced storage costs and throughput times, staff are trained faster, parts deliveries were optimised and cost savings of 32 % were achieved. The payback period was less than a year.

Opportunities for Savings:

- Material savings
- Personnel savings
- Cycle time reduction
- Fault minimisation
- Storage cost reduction



Conclusion:

The customer immediately ordered a second system and also introduced the system into their second plant. They plan to convert further plants

1. **Increased productivity**
   20 % higher productivity
2. **Fault rates**
   Production faults fall to almost zero
3. **Search times**
   Costly search times are eliminated completely
4. **Flexibility**
   Up to 75 % more flexibilty at lower cost
5. **Storage costs**
   Up to 35 % lower storage costs in the finished goods warehouse thanks to just-in-time production

Assistance is crucial to staff, because knowing what tasks are to be performed, as well as when, where and how saves search costs and production faults.

Guideline 6: Increase profitability with best availability

This concludes our journey through our guidelines for safe and economical production. We hope to have given you some ideas and to have contributed to you finding your own direction as you move forward.

All that remains for us to say that we hope to welcome you into our circle of customers as soon as possible.

Annex

The Company

We have been responsible to our customers for over 20 years.


Norbert Armbruster


Henning Vogler


The team

- Owner-managed company
- Established in 1994
- Years of experience
- Innovative products
- Continuous development
- Constant customer loyalty
- Agile and innovative
- Always one step ahead of the market

Back in 2013, in Armbruster Engineering's first white paper we reported on the fundamentals of industrial manufacturing systems.

The paper covered the first ten years of experience we had gained in the manufacture and operation of assistive manufacturing equipment. At the time, the intention was to justify the use of ELAM software and to describe the steps that lead to improvements in your company. This report was very effective and the implementation of the procedures described in it have proven to be major successes in a number of companies.

Today, 5 years later, we can see a steadily increasing acceptance of our concepts and the ELAM-system and report that some customers are already successfully using ELAM in the second decade and continue to expand it.

Since we have been able to steadily simplify the handling of the ELAM system, the self-installation of ELAM systems has continued to increase among users. To promote this trend we are continuously developing our entry-level version „ELAM START".

It shows how simple industrial manufacturing systems can also be created by the user and how this procedure can be facilitated through supporting documents.

When development of ELAM began, decentralised PC solutions were still common on the market, but our way of doing things has prevailed: connect simple, lean clients in production to central servers and set up and maintain the entire system via central administration. From the outset the ELAM software architecture was designed for a direct connection to the company's leading ERP system in order to exchange essential documents with the data centre.

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Abbreviations / legend / keywords

ELAM system	Acronym for Executive Level for Assembly Manufacturing processes
ELAM START	Entry-level solution for ELAM application
ERP system	Enterprise-Resource-Planning
MES system	Manufacturing Execution System
IoT	Internet of Things
Ind. Manu.	Industrial manufacturing system
Quicksteps	Graphical installation guides and Instructions

What can we do for you?

Contact

Address your enquiries to
Ms Angelika Miedtank.

Armbruster Engineering GmbH & Co. KG

Neidenburger Straße 28
28207 Bremen

Tel: +49 (0)421 / 20 248-26
Fax: +49 (0)421 / 20 248-20
Email: a.miedtank@armbruster.de
Internet: www.armbruster.de