Robot Operations Framework

Version: 1.0
Provided by

WAKU
ROBOTICS

Robot Operations Framework

Table of Contents

Introduction

The future of logistics and production will be shaped by mobile robots, cobots, and other automation systems. To provide a holistic approach to master this change the Robot Operations Framework was built.

The framework can be divided into two different parts. The first part deals with the PoC (proof of concept, the first experimental test of a system onsite) and how to prepare, and execute this PoC. The second part deals with the holistic approach to automation with robots. Team, infrastructure, and processes need to change or adapt to be ready for the future. Also, the framework delivers checklists, posters and further material that can be used to keep track of everything and prepare for all important steps to come.

Three pillars of Robot Operation Excellence

The three pillars of operational excellence are team, infrastructure as well as processes (TIP). Every pillar requires another approach to change and adaptation but all of these pillars are important to master the change.

A well-educated, brave, and forward-looking team for instance is not able to execute on everything if the processes are not ready for it. Also, if the infrastructure was set up to be rock solid and ready to connect to automation systems but the team has no idea what to do with it, this can cause the project to fail. This demonstrates that all three pillars are equally important. The real competitive advantage just plays out if you are able to master all of them.

In the next chapter, we will talk about the proof of concept (PoC) and how to handle it. Some of the principles used in *The Initial Proof of Concept* chapter can also be found in the later chapters when we are going into more detail.

The Initial Proof of Concept

This chapter gives the first introduction to the Robot Operation Framework. In contrast to the following chapters on the team, infrastructure, processes (TIP), this chapter can be seen as a fast forward approach to master the first proof of concept using robots. What is needed to do the first steps? Who needs to be in the loop? All these are important questions and we will answer them in this chapter.
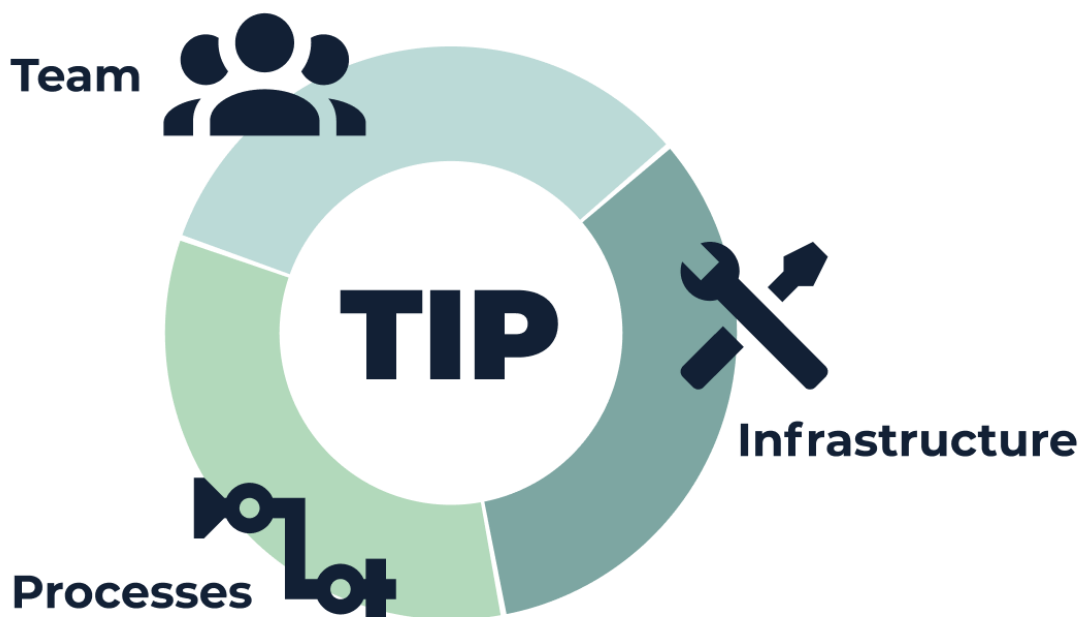
What is a proof of concept?

A lot of definitions of a proof of concept exist. Therefore alignment on one definition is important to understand what is meant when we use the term PoC in this framework.

A proof of concept is a trial of a robot for a limited time (for instance one month), usually without WMS or ERP integration. The implementation of an exemplary use case is tested and evaluated if it makes sense to scale this implementation.

Exploration phase

When trying to start with robots you are probably first looking for a robot or something that can help you. For these exploration steps, it is important to find someone familiar with the matter that can help you and save your time. Also, LotsOfBots.com[1] the largest comparison platform for mobile robots in logistics, production as well as cleaning and disinfection can help you with finding the right robotic solution. The platform offers solutions for different use cases like: box transport, cart transport, picking, goods to person systems among others.

It is important to note that a manual process can be automated using different solutions. This brings a lot of flexibility to realize automated solutions, but also raises the complexity of finding the right solution. With that in mind, the exploration phase can be a very hard process. If you feel uncomfortable with doing this on your own, get external help from independent consultants.

Finding a robotic solution is of course one of the first steps, but there are some more and also important steps when it comes to the tasks that have to be done before actually starting to look for a robot.

Identifying use cases for the proof of concepts and talking about expectations with all stakeholders as well as the employees onsite are two important tasks that shouldn't be neglected.

---

[1] https://lotsofbots.com

Managing expectations

Managing expectations is important to get green lights and support for the first PoC. To get the support you want and need to succeed you should talk about everything with the employees onsite. The **employees on site** will also need their time to explore the new colleague. All-hands meetings with the employees that are involved in operations are a good option to keep everyone involved in the process. If they are not part of the process and the planned PoC, they will not promote it. It also makes sense to provide information about the robot as well as the process to the shop floor workers. This can be done through a one-pager that describes all important facts. For this, you can also use the template: *Best Practice for shop floor worker communication.*

 It is also important to update the **top-level management**, invite them over to the facility to show progress, and also to share successes with them. On the other hand, it is also important not to overcommit to the first project. Employing robots is very new to all departments and people in an organization. The effort for technical and cultural integration should not be underestimated. Therefore managing the expectations of those controlling the budget for further projects is important.

Nurturing contact with the **works council** is also a crucial pillar of success. Of course, the works council is also interested in the health of employees, freeing them from repetitive tasks and ensuring a safe work environment. All of this can be achieved using (mobile) robots. But on the other hand, they also see the problem of reducing the workforce and of course this is a topic to talk about. Here our Sustainable Automation Journey can help you with facing these challenges. For now, please be aware that having a good relationship with the works council is key for success.

If you are working as a third party for a client, you should also think about having a **representative of your client** to communicate changes to the current process well. In case you are changing how you interact with the product, you need the buy-in of the client.

All in all, starting with robots and walking the first steps into your future facility will not be easy. Some problems will occur, either on the infrastructure side, regarding the involved team or the current processes. Also regarding the robot that is not always free of problems in the beginning. Integrating robots during a PoC requires the ability to learn, adapt and master challenges that will occur. If you are good at this, you will improve step by step every week.

Sharing and communicating this with all the stakeholders involved, can be the most important aspect if something is not working out perfectly and first concerns and doubts arise. In addition to that also make sure that you communicate what the scope of the robot operation is and explicitly what is not. With talking also about the limits of the robot you can earn a lot of trust and confidence.

Timeline

For a successful project and solid stakeholder management a timeline is needed. Reserve you all the time you need to explore robots, talk to experts and consultants, find your robotic solution and procurement. It is important to always get time ranges or deadlines from all external and internal partners.

Also plan in some buffer time if some deadlines are missed, as this is often the case. The timeline also is important because it is a basis for discussion when updating stakeholders (including the employees onsite and especially the employees responsible for the operations).

Phase	Milestone to reach	What to do	Duration
	Started research & preparations	- Handling expectations - Find supporters within the company	
Use case identification	Identified use cases	- Find use cases for the proof of concept - Talk about the possible cases with employees and management	4 weeks
Use Case Concretization	Final short list of use cases	- From long list to short list - Filter complex use cases from the use cases that can be realized more easily	2-4 weeks
Solution Design	Finished solution design	- Find a suitable robotic solution for the use case - Contact manufacturers of the robotic solutions and talk about all requirements and your use case	1-4 month
Offer Preparation	Final offer requested	- Prepare an offer for your preferred solution - It is also possible to contact more than one manufacturer	1-2 weeks
Negotiation Phase	Order confirmed	- Negotiation about the offers - Confirmation of your order - Time plan for PoC and arrival of the robot.	2 weeks
PoC Preparation	Robot arrives	- Ask manufacturer for instructions - Handle expectations of employees - Prepare network access and	2-5 month

		infrastructure for the robot	
Robot Integration	Robot runs	- Training with employees - Robot is running	1-4 weeks
Proof of concept	PoC evaluated & communicated	- Evaluate all KPIs - Talk to the employees and the management - Communicate your PoC within the company and external if needed	2 weeks

The framework also provides a downloadable timeline to manage a PoC.

Transparent Communication

Crucial for successful projects is good communication. Between all involved parties but even more with all the people who are affected directly or indirectly. Talking about 'Transparent Communication' we refer to the broader and open communication instead of the private direct communication.

Typical channels for transparent communication are digitally like the company wiki, social media, mails or others as well as the offline options like posters, flyers or all-hand meetings. Create a strategy on how to properly combine the channels and leverage the specific characteristics of them. Mails are very direct and mostly consumed by persons alone whereas posters or interactive screens can be consumed by groups, starting discussions.

As a starter you can use our PoC-Timeline-Poster and place it in break rooms or whiteboards which are used during your regular meetings on the shopfloor. Presenting the new robot with some capabilities of what it can do and what not, is as important as if you would introduce a new team member.

More interactive options are the daily stand-ups where you could show some video or talk about the upcoming devices and process. Taking the robot to a company event for example showcases and playing around lowers fear and reluctance.

Leverage existing knowledge

To accelerate the process of finding a use case and a robot as well as planning the PoC you can also talk to colleagues or other people that are in your position in other companies. Finding or creating a circle to exchange experiences could be one option. Also hiring a consultant or robot expert can help you build your project on the experience that an external consultant brings in.

Either way it is important to not learn and try to conduct everything on your own. With using the power of knowledge that exists you can significantly speed up the progress and therefore the whole automation journey you are facing.

Finding use cases

This sounds really simple but it is an important part of the project and can be a huge catalyzer or a pitfall for the PoC. What are the criteria for a suitable use case? For the first PoC you should find a solid balance between a) a viable case that can deliver insights and has the throughput to solidly test everything but b) are not that mission critical that if something went wrong you lose money or the backing from your stakeholders. Find a process that can bring you all the learnings you want to generate from the PoC.

Repetitive transport cases are often the ones that offer a suitable project case for the first proof of concept. Also employing a cleaning or disinfection robot that can work besides everyone else could be a good option for the first tests.

Your Checklist for finding suitable use cases (UC)

[   ] Go through the warehouse and create a long list of possible use cases

[   ] Create the short list of use cases based on your criterias (for instance)

      [   ] Is important enough but not mission critical

      [   ] Is viable enough to deliver solid insights

      [   ] Contains of repetitive work that provides a good entry point for a test

Explore possible robotic solutions

To explore robotic solutions you can use LotsOfBots.com which is the largest comparison platform for mobile robots. In case you need other robots or want to talk with robot experts regarding your case you can contact WAKU Robotics.

WAKU Robotics has experience in automation projects and can recommend a robot manufacturer (based on Reliable Manufacturer Operations principles) and a corresponding robot (based on Reliable Robot Operations principles). Also WAKU Robotics can help you with procuring this robot.

If you want to explore robots on your own using web search and LotsOfBots note that you compare different manufacturers and also contact them to find out what they are offering. Some manufacturers also offer a renting solution for a PoC. Others are not offering rental solutions for the PoC. In this case you need to buy the robot. Also be aware that different manufacturers offer different schemas of integrating the robot and different features for the operations.

Comparing robots and choosing the most suitable device is important. The importance of the parameters and the parameters itself can vary from case to case.

Solution design

Solution design is the process of finding the right solution for a given use case. It also takes requirements and constraints into account. Normally constraints are very manifold and exist in nearly every facility.

On the basis of your use case assessment you first have to decide which processes you want to automate with robots. If you have done so the next step would be to find out which robot solution is the best for your specific use case. In many cases there are different solutions for a use case. For example if you want to automate part of your picking process it would be possible to do this with a Goods-to-Person system or with collaborative Robots-to-Goods solutions. The best solution here depends on your specific needs and circumstances.

Constraints can be the dimensions of the floors or the number of employees or other devices crossing the paths, to name just a frew. Also the environment needs to be taken into consideration. In some cases you need robots that are ready for a cleanroom, frost environment or outdoor operations.

If you are doing it on your own, visit the facility and the area where you want to deploy the robot. Take all dimensions of the floors, talk with the employees onsite which constraints exist. Depending on the robot you want to choose, some requirements from the robot side also exist. For instance reflectors that some robots need to orientate themselves in the facility. Here it is key to ask the manufacturer or the integrator of the robot if they have requirements towards the infrastructure and the facility.

When you came to a technical feasible solution, in the next step you have to calculate the size of your robot system. Most robot suppliers or other experts can help you there, as each specific system has its own requirements and possibilities. But most of the time similar data for similar types of systems is required. To help you with this we developed data sheets for each kind of a system which makes it easier to contact suppliers and experts and give them the right kind of data from the beginning.

Find early supporters

Finding supporters and promoters early on is a very important topic for the first proof of concepts (PoC). If something new hits the facility - regardless if it is a new process or new technical solutions - it will bring headwinds and raise doubts as well as refusal.

To overcome this challenge involve all the people onsite very early on. Furthermore make them supporters of the new robot colleague and the change that comes with it. Some employees may find it interesting to learn about the tech behind the robot to get a better understanding. Others may be keen to learn about how the robot interacts and how it can serve them. Often, the change that comes into processes is perceived as a source of more friction and additional work. Don't let your employees be uninformed about what will happen.

A big part of mastering the change is the story telling behind the change. Finding ways to pack the change in a story that makes it more engaging for employees is an important point. It can show that if repetitive work as well as carrying heavy loads will be covered with robots, they will have more free mental and physical capabilities to deal with other tasks.

Assign roles & responsibilities

Now we are ready to build the team for the PoC. To be honest, a lot of people in the warehouse are involved in this project. But most of them are just loosely involved and most of the time they just ask for a status update. It follows that it makes sense to create a core team for the PoC and keep others in the loop on a regular basis.

The possible roles in a **core team** can look like this:
- **Innovation Management** brings in the idea or impuls to try something often in combination with a specific case
- **Project Management** to plan and observe the process
- **Logistics Planner** to plan the use case and do the solution design for the possible use cases
- Additionally, if you are able to get support from a higher position like the operations manager or the warehouse manager this could be of help, too.

In terms of reporting make sure that you are reporting to all important stakeholders and departments involved. Here are some of them:

- **Top Level Management** needs updates regarding KPIs and overall project progress.
- **EHS Management** (Environment, Health, Safety) needs to be updated if you need to adjust something in the environment of the facility
- **Quality Management** wants to know if standards and guidelines are sufficiently applied and if they need to adjust something.
- **Shift / Team Leads** are also in the loop. They have to update their employees as well as plan the robot process on the operational level.

When talking about the core team we mostly mean roles not employees. Some of the roles are maybe part of the job that one single employee can do. In order to reduce complexity in communication and decision making competencies it makes total sense if just 2 or 3 employees take all the roles.

Lastly, make sure that the core team has sufficient competencies to assign tasks to all involved parties and that the project is backed by all parties involved to avoid obstacles and dependencies of every kind.

Buy or Rent

Companies that want to invest into robotics are presented with the option to either buy or rent (also called Robot as a Service / RaaS) robots. In manufacturing traditionally equipment is generally brought whereas in asset light logistics machinery is preferred to be rented (as already is the case with most manual forklifts).

When assessing the best options at the core the question is if a robot is a fixed machinery or a movable workforce. In that sense general purpose machines like automated/self-driving forklifts for Euro-pallets are easily moved from one place to another (inside a factory or between factories or between companies). So this type of work force is rather a continuous expenditure and can be compared to today's expenses on salaries and rent of equipment. However in the automated setup one forklift-operator oversees the operation of many robots.

In contrast also in the future there will be specialised equipment - sometimes robots, sometimes traditional automation. That will continue to be a classical asset investment since it can't be easily moved or repurposed and will usually operate for many years in the same setup. Buying is then a logical consequence.

Especially companies in logistics have to recalibrate how they build up a tech-savvy, educated work-force that operates and works in conjunction with robots. The benefits are manyfold if managed well. Since the logistics market will continue to grow the existing employees can be trained on the new technology. This allows them to increase their productivity by 10x to 20x. As a side benefit their salaries can

be increased and straining tasks reduced. In that sense logistics operations will become much more tech-driven and structured - resembling then more an automotive production line.

Companies in that sense need to invest into their workforce to become the driver of this change. And in that sense for logistics companies renting equipment is a logical consequence since contract duration is often short and available funding tight.

So once the question of Capex vs Opex is on the table it quickly becomes a strategic discussion.

Define KPIs

Proof of concepts are experiments where you test something to prove that it works out for the organisation. To prove that it worked out, you need to measure indicators that mean success or no success.

It is important to find KPIs (key performance indicators) that are significant for your operations and that the management also understands to give the green light to continue with it. In an example transport case the KPI for the operations is probably the number of transports during an hour. Another example could be a process where the robot picks goods and transports them to a given location. Here your operational KPI is probably the picks per hour. Additionally an overarching KPI for both cases is the utilization of the robot. This actually means a ratio of time the robot was busy divided by the time the robot was operational.

We can divide the KPIs by:
-    Operational KPIs (like picks per hour)
-    Robot KPIs (like duration of charging)

If an operational metric is not reaching what you expect, this does not always mean that the robot is not suitable. It can also be interpreted as: the current process can be optimized or is not suitable for the robots. It is a very normal way to figure out that the processes that were planned for humans are not very efficient in robot operations. To optimize this process flow, you have to invest time and also ask experts to speed up this process.

In addition to the definition of KPIs, make sure that these KPIs are tracked and displayed to you. Also make sure that you can easily create reports of these KPIs. Tools like WAKU Sense can help you with that.

Robot arrival & integration

If everything went well with the robot manufacturer your robot will arrive at your facility. If you want professional help at this point you can ask the manufacturer to install the robot and do the integration or ask an integrator to do it.

In most of the cases the manufacturer offers to install and integrate the robot because the setup process requires things like:
- Mount battery and parts that were disconnect during transport
- Creating the map of the robot
- Connecting the robot to the network
- Setup the interface and create the first mission (or task)

If you can manage to bring in all key employees involved in this process for the first few days, that would be a great moment to recap the process so far and let the core team of the PoC participate on the first steps that the new robot is doing in your organization.

This integration process can take some days (depending on the complexity of the facility as well as the task). Make sure that the person integrating the robot always has access to a contact person with sufficient decision-making competencies. The worst case during integration could be that something is missing or an important decision cannot be made. In this case the person integrating the robot cannot continue with the work.

You can also think of celebrating this step and bring together all the employees who will have contact with the robot. Let them play around, see interfaces, and touch the device. If possible, show them what the robot is capable of and what the robot is not capable of. With doing this you probably raise awareness for the robot and mitigate the problem that employees feel neglected.

Please be fully aware that robot integration is not a one time shot. The setup of the robot needs to be improved if problems or inaccuracies occur. This iterative review and adaptation process, if done right, brings you towards your previously defined KPIs.

First days activities

The first days after the robot arrived and is being unpacked are crucial. With the arrival of a new co-worker groundbreaking things will change. Meetings and talking to people on the shopfloor are important actions to master this change.

Organize a kick-off meeting with key persons. You can plan this meeting before or after the integration of the robot. The purpose of this meeting is to align all the people involved, to recap the tasks and to make sure that everyone understands which KPIs mean success and which mean fail.

Walk around and talk to people on the shop floor, raise awareness for the robot, explain the experiment, the metrics and invite them to come and observe the robot for some time.

If you don't have an integration into WMS or other control systems, you need to announce one person that is responsible for feeding the robotic system with tasks. According to experience the Team Lead or Shift Lead is responsible for this.

The first days are mostly the period in the PoC where the most problems occur or the most changes happen (to the process, team, device and the environment). So make sure that at least the core team is present and fully engaged in everything that happens.

Alerting and incidents

During operations you expect the robot to work without someone having a close look at it all the time. To ensure that everything is working without you watching all the time you need alerting as well as a procedure to handle incidents.

Alerting means that you are getting informed, if something is wrong with the robot (robot breaks, software problems, etc.). For proper alerting it is advised to use tools that can reach you on all the channels that make sense for you. For some of the employees it makes sense to do it via SMS, for some it is another collaboration tool. The person that should get all the information about alerting and incidents is the robot operator on-site.

The alerting message should contain the location of the robot and the problem the robot is facing. After receiving this message you can go to the location where the robot is and fix the problem. If your team gets bigger you probably nominate someone with all the technical expertise to go there and fix the problem. For this it makes total sense to create different triggers of 'who to inform when' and delegate this to different employees.

A tool like WAKU Sense can help you with that since it provides alerting and incident management.

Track performance to improve

Having a robot that from day one starts with zero errors and all the processes are perfectly planned - this is a myth. As with every employee and every new process you need to watch, measure and improve. This is also true for robots.

To measure everything and compare the measurements you need some tooling. This can be done by writing down all the things the robot did and go over it manually. Another option would be to use a tool like WAKU Sense. The tool is able to track tasks, errors and the overall performance of the robot. It tells you how long the job took, how many times the robot experienced an error, how long the robot was busy with charging the battery, and many other things.

At the end, this tracking of KPIs and the performance of the robot helps you to decide for the robot or against it. WAKU Sense can be integrated in every mobile robot which helps you to compare different PoC projects and make an informed decision.

The PoC Weekly

Synchronization and alignment is important. To achieve that all involved roles are aligned on the progress of the PoC, you can introduce the PoC Weekly. This weekly can be used also for steering of the use case and the current robot operations.

These roles should be involved in the PoC Weekly:

- Warehouse management
- Operations management
- Project management
- Logistics Planner
- Shift Leader or Team Lead

The following activities are important during the PoC Weekly:

- Presentation of KPIs and report from the robot
- Which problems did occur during the week?
- What are the suggestions to optimize the robot operations further?
- Which processes (shift changes, incidents, etc.) can be improved?
- Are all responsibilities clear for the upcoming week?

All in all, this PoC weekly should feel like a look into the rearview mirror (last week) and a look through the windshield (upcoming week). The look into both directions should always be guided by the numbers from the report as well as from experience of the people attending.

Invite management & works council

During the period of the proof of concept, make sure to invite management, other departments as well as the works council to share successes. Involving everyone in the organization and showcasing the new robot should be part of your strategy.

Getting 'okays', 'green lights' and 'go ahead' signals from all of these people is important to bring more robots into your warehouse. Traditionally the works council comes in with a lot of concerns. Make sure to point out that working conditions will improve for human workers and also invite them to talk about the future warehouse and how they imagine a future where the organization is digitalized and ready to compete on the market.

Evaluate the PoC

After the period of the PoC it is important to make landmark decisions. Did the robot work out for you? Was the performance of the robot enough to convince all decision makers to continue with the process? All of these questions will come up and these questions are important to discuss.

If the robot is not fitting your needs you probably started looking for another robot during the PoC already. This makes sense since you are trying out and experimenting around. If the robot convinced you with everything, you should probably keep it and try to use this case as a success to promote the upcoming robot projects.

Communicate outcomes & next steps

After evaluating the PoC, it is time to communicate the outcomes and evaluation results to different stakeholders. Of course the top-level management needs an update on the topic. But also the warehouse management wants to know how the PoC went.

Talking to the shop floor workers also is an important puzzle piece of solid communication. If the robot disappears after the PoC this will raise questions. Also if another robot comes after a few weeks for a potential new test, questions will come up. To mitigate the risk that shop floor workers are confused about the progress, inform than about your findings and the next steps - and also why you are taking this action.
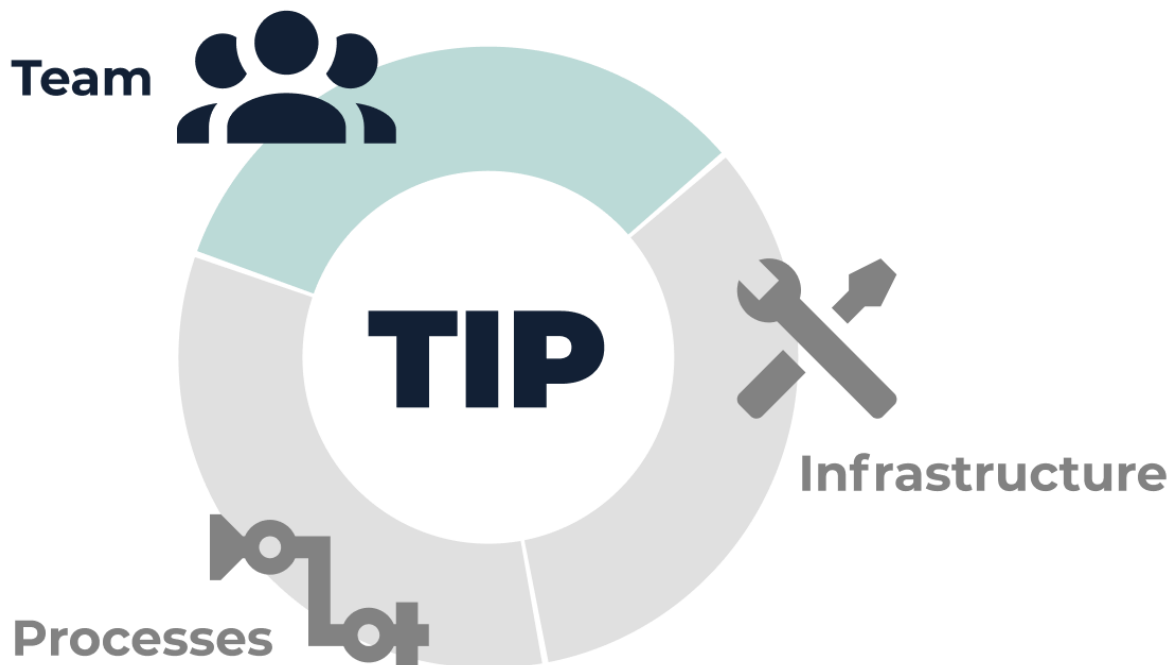
Communicate not just successes - also talk about a PoC that did not work out for you. In case you aborted the PoC due to constantly occurring problems, you can also communicate this to the shop floor workers.

1 - Team

One of the pillars of robot operation excellens is the team. The team in the warehouse, starting with the employees on the shop floor and ending with the employees in the management. Transforming the team is an important task. With transforming we mean mostly educating the employees. But education in this case becomes a very manifold adventure. This has to do with expectations among all departments, new or adapted roles for all employees, as well as a state of the art infrastructure with new processes where the employees have to fit in.

Handling expectations

People that are coming to work everyday have expectations. They mostly have a perspective and a purpose that they feel when going to work. With operations not changing for years the status quo remains as the expectation they have from their

working place. But this is rapidly changing. New technologies are coming to the facilities - new software, new sensors, new scanners and now new robots.

Therefore it is important to create new perspectives and purpose for all of the people. Show them how their role is going to change over time and make sure that they understand that their skill set as well as their responsibilities will change, too.

Being honest and open about the change to come really makes sense.

The Roles

To master the change and adapt to the future of work some roles within the facility have to change. Here we explicitly say roles not positions or job titles because some of the described roles can also be fulfilled by more than one person.

Of course every company has its own types of positions or roles. If this is the case then try to approximate the roles presented here with the ones in the organisation.

The table below shows which current roles should be included into a proof of concept (PoC) and how the roles will change with the robotization and automation of the facility.

Current Role	PoC Role	Future Role / Skills
Warehouse Management *Responsible for all warehouse activities*	- Change & expectation management, talking to the employees about the process	- Continuous change management
EHS Management *Environment, health, and safety management*	- Making sure the robot infrastructure can be applied to the warehouse	- Adjustments of rules and regulations in regard of robot operations

	(e.g. reflectors, QR codes, etc.)	- Observe health and safety of employees in collaboration with robots - Teach and nurtur employees
Operations Management *Responsible for all activities that happen on the shop floor*	- Define KPIs for PoC	- Added responsibility: for all robots on the shop floor - Observe KPIs of robots - Suggest new KPIs for robots if needed
Quality Management *Responsible for implementation of standards and quality guidelines*	- Making sure that robot integration is in accordance to all guidelines and standards	- Making sure that robot operations are in accordance to all guidelines and standards - Create and manage maintenance schedules for robots
Project Management *Planning and executing different kind of projects*	- Robot integration and learning to operate the robot - Knowledge transfer to logistics planning - Supplier management - Robot procurement - Organize PoC weekly to enable knowledge transfer and share learnings - Present KPIs in PoC weekly	- Suggestions for new robotic projects and PoCs / as well as technologies - Knowledge sharing to different roles of the team
Procurement *Responsible for procurement of equipment and consumables*	*Role not included*	- Procurement of new robots or capacity shifting of robots to other facilities - Asset management of robots
Logistics Planning	- Robot integration and	- Additional skill: Innovation

Planning of all processes and infrastructure	learning to operate the robot - Creating the mission of the robot - Business case evaluation	management, observing new technologies - Define & plan processes and needed infrastructure for (new) robots
Shift Leader *Responsible for worker related topics on the shop floor*	- Be informed about the process to educate people - Teach everyday collaborative operations between human workforce and the robot	- Continuously teaching human workforce in terms of robot operations - Knowledge sharing
Team Leader *Responsible for a specific part of the shop floor process*	- React if the robot has an incident (together with the In-House Technician) - Coordinate work load for the robotic system	- React if the robot has an incident (together with the In-House Technician) - Suggest new use cases for deploying mobile robots - Making sure that there are no obstacles for robot operations on the shop floor
Resource Planning *Responsible for optimal allocation of workforce*	*Role not included*	- Observing KPI dashboards (e.g. utilization) of the robots and adapt resource allocation
Robot Operator *Responsible for the technical aspects of the robot (software, hardware)*	*Role not existing yet* It is recommended to nominate a person to learn this role from the beginning in cooperation with robot manufacturers and the core team of the PoC.	- Responsible for creating and updating missions as well as maps - Well-informed about hardware and software - Install updates - In contact with the manufacturer, if need

In-House Technician *Responsible for maintenance of infrastructure and technical equipment*	- React if the robot has an incident (together with the Team Lead) - Install the physical infrastructure for the robot on the shop floor (e.g. reflectors, QR codes, etc.)	- Continuously maintenance of robot workforce - React if the robot has an incident (together with the Team Lead)
System Administration / IT *Responsible for all topics regarding network, software, and hardware devices*	- Provide technical infrastructure like wifi, network access, VPN (if needed)	- Monitoring of network access, information traffic and software updates of the robot

As you can see in the table, change and adaptation is needed everywhere. All roles are subject to change and learning during the years to come. Some roles will just change slightly, others will be created and offer an opportunity for new employees.

For instance the role of the Robot Operator. This position will deal with robot related technical things. Understand hardware and software as well as keep track of the robots. In the beginning this will not be a full-time job, but with robot fleets growing in your facilities, it makes sense to have someone working on this topic full-time or even create a team that gathers knowledge and expertise in-house.

Use PoC team as multipliers

At the beginning of your robot automation journey you will probably try a lot and have proof of concept experiments. Employees that engaged early on in the process and already gathered knowledge and experience with the robot are very valuable when it comes to scaling with robots.

These employees should build their information hub, that consists of their learnings as well as experiences. After creating this information hub, that acts as an incubator,

these employees can go out and multiply the knowledge to all the employees that will be involved in further projects. This makes a lot of sense, because you dramatically decrease effort and time for the next robot integration.

Enable your employees to learn

Constantly adapting to change will play a significant role in having success in an automated environment that uses a lot of technology to speed up processes and make them more efficient.

This requires employees to learn and keep learning technologies and technological tools. To enable this kind of environment, formats are needed that also unleash the creativity of your employees. These formats can be manifold.

For instance **regular learning sessions** as an offer from the organization to the employees where they can take part. These sessions should take place on a recurring basis. The learning session could be an inspirational talk (external guest or internal speaker) or an update of the technology. Combined with a reward system for participation (gamification options) this can create an environment for continuous learning.

Mental health sessions and training sessions for **personal development** is another important action you can take. Employees really like it if their employer takes care of their mental wellbeing. With this you invest in your employees which is very important. Imagine all the investments you will make to set up technology and robots. If you're not investing in your human workforce they will probably not grow with all the change that will happen in the near future.

Regular workshops about the change and input for the management and works council are an important tool to get feedback on how the change is progressing and

what your employees are thinking about it. Also the input can be used by the top level management to adapt and thrive organizational success. Furthermore your employees feel more valued when they have an opportunity to form the company.

Repetitive tasks are out

To master the change successfully you need employees that bring a solid mindset to work everyday. Some of the key attributes that are important are: **curiosity, courage, and passion**. An open mindset is crucial to discover all the paths to success in a changing environment.

The time where employees are doing repetitive tasks is finally over. For these kinds of tasks, robots were created primarily. New employees need to bring a sense for technology and creativity to ensure that the organization will remain profitable and competitive in the future.

New full-time scenario

Work models shifted always during the development of mankind. Back in the days it was pretty normal that people were working more than 40 hours a week in their jobs. Currently the full-time scenario describes a 40 hours model. With the advent of automation this will change. Some countries already tested 4 days a week models or even 32 hours a week.

With employees working more and more with their mental power instead of just physical power, work becomes more and more exhausting. Of course work that is done purely with physical power is also exhausting. But mental work has no beginning and no ending. Also mental stress can last longer and employees that are working mentally often take their thoughts to their homes. They do not stop

thinking about something that is going on in their brains when leaving the company.

That being said, a new full-time scenario is needed. And this makes also sense when thinking about a shrinking workforce. With employees going down with their working time, other employees can take over the working time that now needs to be reallocated.

Progressive works council

Current works councils are often very conservative when it comes to robot automation. They fear job loss of their employees despite other concerns. But with a changing world also works councils have to rethink their position and priorities.

It is common sense that just doing physical work and repetitive tasks during the whole career of an employee can bring problems when people get older. Physical workers often get disc problems or other wear related problems. People working on repetitive tasks often experience a mental drain and after years and years of repetitive tasks it becomes difficult to find other tasks for them.

Also with a shrinking workforce and some job losses are inevitable, the works council has to take the company into account to help these employees with finding new jobs. This could be the responsibility of the company. Every company has a network of partners on all their ends of the value chain. These companies could be a good new employer for some of the workers. Also, with a lot of baby boomers retiring in the next decades, new positions get free and offer a new opportunity to these workers.

The works council also should focus on further education, learning sessions, mental health and personal development training for the employees. In this manner the

whole organisation will undergo a change to an open-minded company that is ready for the future.

If you are interested in this topic, our Sustainable Automation Journey also provides you with information on this topic.

Meetings and synchronization

With a lot of automation going, like robots, sensors and new software systems orchestrating everything the need for meetings and synchronization cycles arises. Here we discuss this part of the team for a future warehouse.

Different types of robots in different areas of the facility need to be coordinated. Therefore a **Robot weekly** needs to take place. Here all the employees responsible for the robots should sit together and talk about possible improvements. This can be done using reports and analytics of the last week to optimize the current state and talk about shifts in robo workforce for the upcoming weeks. This is important for the people responsible for the robots, so they can set up the robots of the next week.

Operations improvement weekly (or bi-weekly) can help to think about new or other solutions to tackle the current challenges in operations. Based on the numbers the meeting participants have to find solutions to continuously improve the operations.

IT and infrastructure weekly needs to take place with the people responsible for the internal infrastructure (software, hardware) and the information infrastructure. The meeting deals with the technical requirements to successfully run robots. Also topics like information security and access management are important.
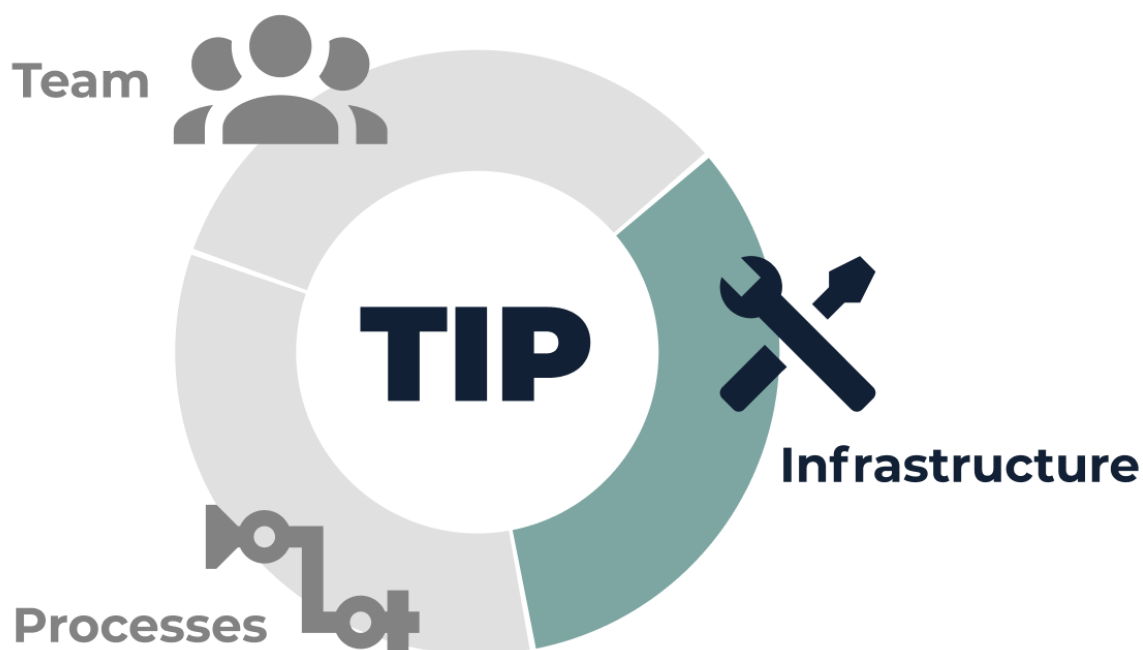
Procurement and asset management meetings do not need to take place every week. But this synchronization makes sense if you have more than one automated

warehouse. The purpose of the meeting is to talk about capacity shifting between warehouses. Also part of the meeting is to talk about the procurement of new software or sensors.

2 - Infrastructure

This chapter covers the physical infrastructure on site as well as wireless network, internet access and all other information systems. Here information systems also refers to data, analytics and all the mission critical infrastructure that is needed to successfully employ robots and other intelligent agents in your facility.

The Role of Data

The robot operations of the future are data-driven. The role of data cannot be underlined enough. Data points are artifacts of the real world - they describe experiences made on the shopfloor and measured performance of your team.

With all these data points and smart algorithms you can optimize your team, your processes as well as your infrastructure. Making use of data brings continuous improvement to all the actors, areas and departments that are involved in your operations.

Working on the infrastructure with all the sensors and technical devices also means to ensure that the infrastructure to work with these points is performant and reliable.

Network and internet access

To communicate with a central base or other systems robots need to have access to a network. These networks need to be secure and well-managed. Some systems also require access to the internet, to bring the data to the cloud.

Especially when scaling robot systems up and having more than one site with robots, a cloud solution makes perfect sense. This allows a single view into your global fleet with location overarching control, analytics and up to remote operations and support. If you want to scale your system in the future, the easy way would be to start in the cloud. Relocation of existing systems can bring a huge time-effort and friction to an operational system that can not be shut down for such an action.

Setup a well-managed VPN tunnel to the internet where you always know which data leaves the facility and what the third party provider (or an inhouse solution) is doing with the data.

Other Automation Software

Robots and their fleet management software is often not the first IT System which is introduced in your company. Widely used are Warehouse Management Systems (WMS), Warehouse Control Systems (WCS), Enterprise Resource Planning (ERP) and many more.

For a future proof setup of interconnected software systems you need to involve your IT Team early on and select tools which allow you to stay flexible by having full operational reliability. Intelligent software and an easy to use interface will reduce errors, increase efficiency and lower barriers for all employees to work with robots.

Software Layers like WAKU Sense provide an abstraction layer independently from your robotic hardware. This allows one time integration towards the main controller like WMS or ERP as well as robot specific process analytics, orchestration and other operation tooling.

Reflectors and markers

Some robots require reflectors or markers for orientation and navigation on the shop floor. These tools will be an important part of the shopfloor infrastructure, when robots are entering the warehouse. Shelves, corridors and passages need to provide a place for these parts of the robot infrastructure.

An additional challenge is that different robot manufacturers provide different reflectors or markers. Some of them use QR codes for the robot to orientate, others are working with reflectors that send back laser light.

Currently these parts are needed for many systems or can reduce navigation errors dramatically. In a possible future it could be the case that robots do not need these parts for their orientation anymore. But, especially to identify boxes and goods some identification systems will be needed.

Sensors and Cameras

Beside active automation systems like robots, the facility of the future also needs passive elements like sensors or cameras. Those systems can observe areas and stations to trigger a robot task (e.g. if pallets are available and ready to move).

For some use cases it is sufficient to use sensors, for example if just an occupied or not occupied is of interest. A camera on the other hand can deliver more information here. If done right, also sensors or an array of sensors can solve a task, where a camera would be the first choice.

To make the right decisions here, also take into account the energy consumption and the complexity of the solution that you have chosen. With WAKU Sense Eye a flexible and low energy camera solution comes in. It is configurable to detect for instance pallets or other objects of interest.

Additional robot infrastructure

With robots everywhere in your facility additional infrastructure for these robots is needed. This includes **charging stations**. Of course charging stations are in the facility first - they come with the first robot installation. Thinking on a big scale, more than one charging station is needed. Imagine the area you need to install charging stations that can serve 30 robots. This place needs to be reserved and filled wisely.

With a lot of new technologies coming into the warehouse you need a test environment where you can test everything before rolling it out. Therefore a **robot lab** is needed. This makes sense if you also want to test the different technologies combined like sensors and robots. These processes need to be tested carefully before going out of the sandbox environment.

Beside the robot lab think of a **robot pool**, where your robots pause or they are being transferred to another area. If a robot is experiencing problems with hardware or software or they are going to maintenance you need a replacement device. This replacement device is activated and leaves the robot pool to fulfil the tasks.

3 - Processes
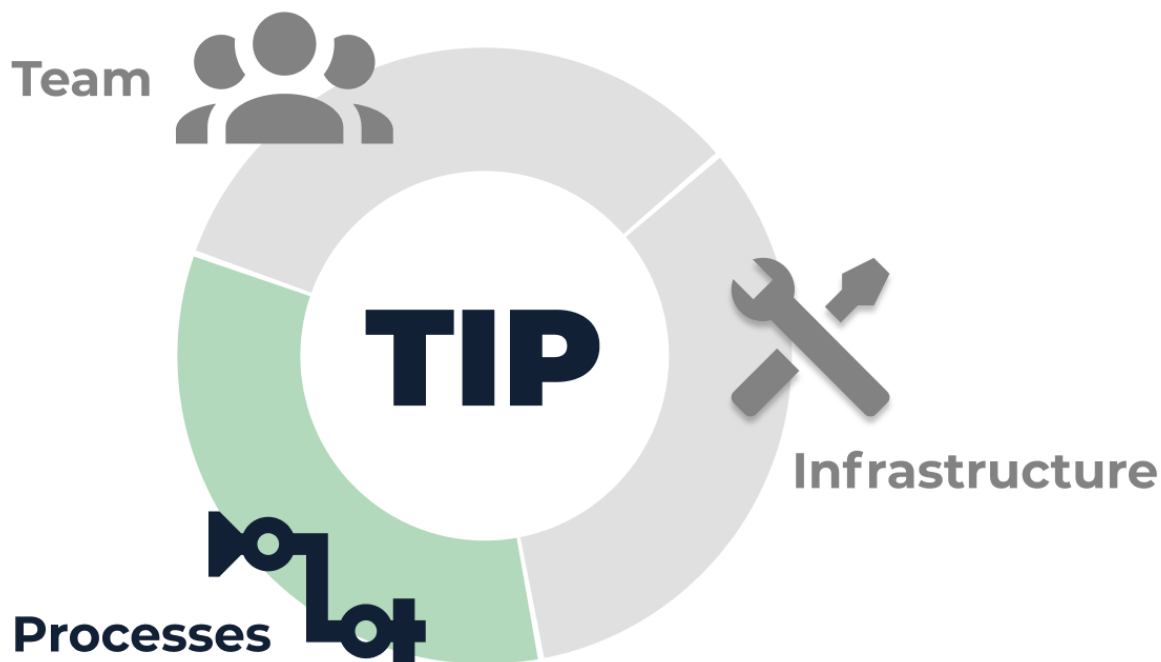
The third important pillar of robotic operations are the processes. We are talking about processes in two ways.

First of all the new processes to find and select potential use cases for robots, the KPI's and steps to successful PoCs and roll-outs, operational processes like handling alerts and incidents, working with real time analytics and up to maintenance of an increasing robot fleet.

On the other side you will notice a substantial influence to your existing processes by robotic automation. You will need to observe and adjust existing processes especially if manual and robotic tasks are interfering.

Continuous solution design

With a lot of robots already working in a facility, the solution design (meaning restructuring of processes and addition of new automated processes) the solution design will be an ongoing process. The logistics planner gets faster in designing solutions because all the gathered experience can be leveraged to speed up the planning process rapidly.

Also new robotic solutions will appear over time and need to be tested out. If the technology fits very well in the current state of the warehouse, it makes sense to run a pilot and think of employing the solution.

With all the robotic and automation solutions coming to life, having a solid solution design process inhouse or from external consultants makes sense.

Procurement process

To employ robots efficiently a solid and documented procurement process is necessary. For this we reserved an extra role in this framework. The job behind this role has a lot to do with paper work (like legal documents, contracts, etc.).

The process of procuring a robot via a rental solution or even buying can take a period of time. This process can be sped up if frame agreements with a manufacturer exist. In these frame agreements both parties commit to produce as well as to take off a specific number of robots in the next month or even years.

Asset management

Adding robots results in an increased amount of technical assets which need to be managed. Keeping an overview of all robotic devices, their related documents, contracts, areas of application, financials and history is one level. Another one is the management of peripherals, spare parts, service partners and similar.

Managing those assets needs to be done globally for your organization so that assets can be used most efficiently where they are needed. In combination with robotic analytics and orchestration tools like WAKU Sense, you are able to shift capacities between processes and even locations which allows higher utilization of all your robotic assets.

All about spare parts and servicing is also covered in the following maintenance section. Keeping an overview of that allows a financial optimization of single assets, reduces the time to ROI of it and allows long living hardware.

Maintenance

When adding robots you are increasing your technical assets which need continuous caretaking to secure healthy long living and reliable systems. Well organized maintenance routines combined with software tooling to identify broken devices and predict upcoming outages (e.g. predictive maintenance), are essential for a proper maintenance strategy.

Robotic hardware has sensible parts like sensors and cameras which need regular cleaning. Other parts are subject to heavy wear and must be replaced regularly (e.g. tires). Many errors in daily operation can be avoided if the robots are regularly maintained and consumable parts are replaced. Predefined maintenance plans with automatic reminders and digitally prepared instructions enable simple maintenance routines.

To use spare parts more efficiently and expose robot fleets to less downtime due to maintenance, software tools are available to analyze data and predict when certain parts potentially need maintenance.

WAKU Sense allows, through direct data analysis, to coordinate and document the maintenance tasks in an optimal way.

Setup & integration process

In an advanced and robotized facility the process of setting up and integrating robots should be optimized and well-documented. Robots will arrive and depart often (capacity shifting of robots to other facilities). A knowledge base on how to set up and integrate different robots from different manufacturers can help here. This is important to document everything and have a single source of information if new employees are coming in.

Standardization of all the process steps brings a huge advantage in terms of time spent. If a new robotic system enters the warehouse, the one who did the first integration needs to document everything to spread the knowledge to all the involved colleagues.

Analytics & Monitoring

It is worth mentioning that it needs measurable and meaningful KPIs to fully understand the processes going on in your operations. To ensure that questioning the defined KPIs with all stakeholders makes sense.

With all the predefined KPIs and processes in the warehouse the need to monitor them well arises. This can be done using agnostic robot analytics (Robot Control

Tower). This is a system that is able to capture data from different kinds of robots regardless of the manufacturer of the robot. A future warehouse will definitely consist of different types of robots, coming from different manufacturers, doing different things. To avoid a zoo of tools where every manufacturer brings in its own software, you need an agnostic tool.

Also the part of visualization between different types of robots is an important point. All of these systems work in a shared environment and you need to get an overview about all of them. Another important point is the diagnostics of the current processes. With a tool that optimizes not just for one type of robot but for all of the processes in the warehouse based on all robots that are present, you can iteratively optimize your warehouse.

WAKU Sense is an agnostic analytics software that can help you with analytics and monitoring of different robot fleets.

Alerting and mission critical actions

No matter how mature the robotic systems will be in the future, problems will occur. For that a solid alerting mechanism and incident management is needed. In order to minimize downtime of the systems all the people responsible for fixing a specific problem need to be informed through their favorite channel.

The information that is needed to (1) find the robot, (2) get a diagnosis and (3) fix the problem are location, error output and actions to take.

It is optimal to have someone responsible for that also seamless between shifts. A system that can do all of this is WAKU Sense. This tool provides alerting through all relevant channels.

Adding handovers to existing processes

Robotic systems are optimized to solve a specific task perfectly and automated. However, you will mostly need a diverse mix of different tasks like transporting things, storing items, picking, sorting and many more. As you won't find robotic systems doing all of this with one machine, you will need handovers and interfaces between different robot systems (also as software) and of course the manual process parts.

Adding those handovers start with adaptations to your shop floor environment as you need to create well defined stations, locations or even specific hardware. Keeping the real world situation (where items are positioned) in sync with the digital twin which robots need to work with, is important to prevent errors.

Next to hardware and environmental changes, you need to clearly define communication interfaces. For technical systems to talk to each other, the interfaces are mostly defined and documented and need to be connected by IT engineers.

Layers like WAKU Sense make this part way easier as your engineers just need to talk to one system and WAKU uses the multiple different interfaces to all the robots.
More critical is the communication between people and robots. They want to notify each other about new tasks, status of work, errors or even ask for help. This requires an easy to use software interface which allows people to simply interact with the robot but also allow robots to proactively communicate back to the people.

Changing existing processes

Sometimes it's not enough to just replace one part of your overall process with a robotic solution even if this is a good way to start with. Typically you will recognize

that an automated process could lead to other sub-processes being obsolete or new processes being necessary.

Previously you needed to optimize all your processes regarding human capabilities and number of available people. When adding robots you can improve processes based on robotic benefits like heavier load, easier capacity scaling, 24/7 availability and no need for light and heat, just to name a few.

Conclusion

After talking about the three important pillars of robotic operations: TIP (team, infrastructure and processes), we want to give final remarks. Composing the TIP components together and making them work smoothly is important to ensure reliable operations.

Compose everything together

In the previous chapters we talked about TIP (team, infrastructure and processes) and how these parts will change over time when employing robots and going towards an automated warehouse.

All TIP parts have intersections and touch points with each other. Therefore it is important to ensure that all of them are running solidly. If your team is not educated well, then you may face problems in infrastructure or the processes. If your processes are not working, then your team is probably not able to fullfil all tasks efficiently. And if your infrastructure is not state of the art and able to host robots and the new processes that are coming with automation, then you are in big trouble.

With applying this framework to your automation journey, the first step was made. Reviewing the implementation and auditing all TIP parts regularly is the second step to bring your automation plans to life.

Get external help

All changes need solid consulting. This is also the case with robotic automation. External help can support you and guide you through this challenge. To have an external eye looking at your company and giving advise is important. It helps your organization and you to face this challenge with confidence and gain knowledge from the consultants.

Consultants are often more experienced in their domain. For instance they saw proof of concepts succeeding and maybe also failing. The gathered experience can help you, to not make the same mistakes again.

Make it happen - Start your PoC now!

The first step to an automated warehouse is to start with the first PoC (the PoC chapter helps with that). "Big things start small". This also counts for robotization and automation.

The process of your first PoC can be very exciting and inspirational. The robotic space is very fragmented and a lot of solutions exist. For the first PoC it is important to pick one simple use case that can be automated quickly and get support from the management and the people on the shop floor. Start your journey and make it happen!

WAKU Consulting can help you with all steps along the whole automation journey.