



Reliable Robots & Manufacturers

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Introduction

This framework introduces you to the principles of reliable robots as well as reliable manufacturers. The current market of mobile robots is very fragmented and immature. Furthermore, the number of companies bringing these robots to market is accelerating at a huge pace. As a consequence, a lot of uncertainty regarding the manufacturers of the robots and the robots themselves arises.

The *Reliable Robot & Manufacturers Framework* provides guidance and support on how to identify a reliable robot. Also regarding the manufacturer of the robots, it shows you how solid documentation should look like, how incidents should be handled, and even more. WAKU Robotics offers professional assessments of mobile robots to ensure their reliability and availability.





Two Aspects of Reliability

The first part that has to be reliable during operation is the robot itself. If the robot is not working reliable, employees in your company will get frustrated and have a bad experience with the robot. The problems of unreliable robots can be manifold, ranging from a broken sensor to software with a bad user experience.

But to be honest, there is a second aspect of it. If the robot breaks, which can happen in different ways, you need professional support. Most of the problems that can occur are easy to solve. But of course, there are also problems that are hard to solve on your own. For this, you need a reliable partner who will help you with solving the problem. The second aspect of reliability is the manufacturer or a knowledge partner, who can help you very quickly and is well informed about the robot.

This is the reason why we structured this framework to cover both aspects, the **robot** as well as the **manufacturer**.





Reliable Mobile Robot Principles

This chapter deals with everything that makes a mobile robot reliable in setup, operation, and maintenance. We will describe how to set up the robot, what is necessary to operate the robot successfully, and how you make sure to get informed about problems or the performance of the robot.

Certified hardware & software

Before we start with principles regarding the setup and operation of the robot, we need to take a closer look at the actual robot. This means that we are focusing on the hardware and software parts. The hardware part of the robot can be certified via CE certification or others. It is important that the manufacturer can provide certification of the device. These certifications should cover the construction of the robot, sensors, actuators, and all visible parts of the robot. On the other hand, also the software should be certified. The possibilities of certification of such a system can range from assessment of the software stack (high-level) to the test of emergency functionalities (low-level). In some cases, it could be necessary to get a certification of a specific interface that is needed to duly operate the robot in a facility - a third-party system (like a WMS) for instance.

Intuitive Getting Started procedure

Most robots are delivered in a box or another packaging system. To unpack the robot without any complications and use of force, a manual should be provided. Make sure that you find out how the robot gets delivered to your facility and if necessary and possible provide guidance to the manufacturer or sender of the robot. All packaging systems used should be reusable after unpacking the robot. In some cases, you have to send back the robot (e.g. you are trying the robot first in a proof of concept or the robot is not working properly).





Another important point to the *getting started procedure* is that the manufacturer provides you with instructions on how to assemble the robot. In most cases, the battery is not attached to the device during transport. Also, other parts are mostly disconnected from the device during the journey. To mount all these parts correctly, instructions are needed.

Your Checklist

- [] Find out how the robot will be packed
- [] Find out if the packaging is reusable in case you send it back
- [] Clarify terms and legal for shipping of the device
- [] Ask for instructions to unpack
- [] Ask for instructions to mount parts and assemble the robot

Customer-centric setup procedure

After you have received the robot and it is unpacked in your facility, the setup procedure begins. Setting up the robot in most cases starts with starting the robot (which comes with the battery having enough power for this setup). After that, the robot needs to be connected to the local Wifi and the device starts with different self-checks. If everything was successfully completed you usually start mapping. This means that the robot gets to know his new environment. Driving through the facility the robot uses SLAM (Simultaneous Localization and Mapping) or a derived algorithm to create a map and to localize itself. Also, the position of the loading station needs to be determined by a robot.

To do all that quickly and efficiently the setup procedure needs a customer-centric design. This means that the procedure needs to be well guided and supported by well-written documentation. On top of that, a video that explains the setup can be very helpful. Robots are complex products with a lot of parts, hardware as well as software that can fail during the first steps.





To overcome all occurring problems the manufacturer has to provide a solid FAQ (Frequently Asked Questions) and material that helps the person who sets up the device.

Your Checklist

- [] Ask the manufacturer to provide documents and media for the setup procedure
- [] Ask the manufacturer to provide a contact person that is available during the setup

User-centered interface design

During the whole process of setting up the robot and the operation of the robot, the device shall provide a user-centered interface. This means providing all necessary information that the operator of the robot needs in the situational context that is currently happening.

Other principles of user-centered interface design are:

- Solid navigation through the software interface
- Error-free (descriptive messages if an error occurs)
- Assistance while using the software for the first time
- Present information clearly to the user
- Provide feedback if something is not working or other steps are necessary
- Consistency in language and dialogs
- Avoidance of overloaded views or screens with unnecessary information

In the past, the interfaces of machines were often built to serve computer scientists or workers with a background in engineering. With robots hitting the mainstream this has to change. Today's use of mobile robots in production or logistics often has none of these backgrounds.

Your Checklist





- [] Inspect the interface of the robot before delivery
- [] Check if the software applies these user-centered design principles

Reduce complexity & cognitive load

Whether the robot is running and you need performance reporting or an error occurs, the robot shall provide fast & contextual information in order to lower the complexity and cognitive load of the employee who is responsible for the device.

If an error occurs, and production or processes have to stop because of it, every second counts to bring the device back. In this case, the robot has to provide the source of error as well as possible solutions to the problem. If this is not the case, the operator coming in and trying to fix the machine could be overwhelmed by the pressure of bringing the device back.

All in all, the complexity that the device brings with it can also be a huge factor when it comes to educating new employees and onboarding new robot operators to the device.

Your Checklist

- [] Learn about how errors are handled and how supportive the interface is
- [] Simulate the onboarding process you would perform for new robot operators

Flexible operations

Only in a very few cases, does a robot (during its lifetime) operate in just one process. In most cases, robots will be shifted from process to process - depending on the current needs. This is also one of the clearly recognizable advantages of employing robots.





For this, the robot shall have a well-documented workflow to easily change the process and behavior. Changes in the process (often called mission or job) are usually executed via using a web interface to the robot. This interface should also guide you through all the changes and perform plausibility checks for the changes you have made.

Robots that are very flexible when it comes to changing workflows and processes are more valuable since they can work in different areas on various tasks and therefore provide a higher workload which is significant in terms of amortization of the device.

Your Checklist

- [] Find out how easy you can change the workflow of the robot
- [] Consider possible other cases where you can employ this robot

Instant alerting

If the robot is experiencing an error or has some trouble, the device shall communicate this problem immediately via various communication channels. Imagine a robot is working on a process that no one is watching. After several minutes or even hours, you'll finally find out that the robot is broken and standing around in the facility (often without any indication of what happened). The source of errors can be manifold. Robots can lose their position on the map, some sensors can break, or something unexpected just happened to the robot.

To overcome these problems different channels of communication can be used. Basic communication tools could be email or SMS. But also channels like Microsoft Teams, Slack, or other collaboration and communication tools are possible. It is crucial to choose the right channel and to define who should get an alert when different problems occur. For some problems, it could be relevant that the operator resets the robot. Other errors may require another employee to come by and help to solve the problem. If you want to include the robot in your daily mission-critical





operations, this topic is probably one of the most important ones for you. Also, make sure that procedures are clearly defined when a specific error happens.

Your Checklist

- [] Ask the robot manufacturer if the robot supports instant alerting
- [] Make sure to use the right communication channel for different types of errors

Resilient to change

If something is changing in your facility the robot shall adapt to the environment.

Robots normally work in a process in an environment that they know. Good technology divides from bad technology that some robots are resilient when something in the environment changes. This has to do with specific points that robots need to orientate. Some technologies are working with reflectors, QR-codes and some can live without these markers.

The understanding of these technologies and their implications is important. The implications could be that if you remove some internal or external markers that the robot is using, the system breaks.

Your Checklist

- [] Make sure you ask the manufacturer how resilient the robot is to changes
- [] Understand the technology and implications of the used technology

Reporting of data

During operations of the robot, a lot of data is being generated. The robot should collect this data (or let it be collected by another service). This data can be used for reporting afterward. For this, the robot needs an interface / API (Application





Programming Interface) that allows third parties to capture the relevant data from the device.

With a robot that allows data concerning the condition and performance of the device can be used by the operator for different purposes, the operations can be optimized and valuable insights about the robot and the process can be generated.

This topic gets more and more important if you run different types of robots that you want to monitor in one system. Not having a zoo of tools for every robot vendor reduces complexity.

Your Checklist

- [] Has the robot an open interface / API that a third party system can use
- [] Is all relevant data available through these APIs

Analytics for reporting and improvement

Analytics of data and diagnostics of processes are important to improve iteratively.

Data from the robot can be used in various ways. The most obvious way is to create reports for the top-level management. But also real-time insights into the operations of the robot are important. This can be achieved if all robots offer an interface / API where an analytics tool can get the data from, evaluate the data, and is able to analyze all relevant KPIs.

Diagnostics is another important aspect. With analytics covering all the KPIs in real-time and historical, the diagnostics part uses the data from the analytics to find out actionable insights on how the process can be optimized. If the robot is not supporting these kinds of functionalities, maybe third-party software is able to do this. A common misconception is that robots are working optimally from day one.





Analytics & diagnostics of processes and the robot itself are needed to improve your robot operations from time to time.

Your Checklist

- Define relevant KPIs for your robot operations
- Does the robot offer data to conduct and analyze your relevant KPIs
- Does the robot offer analytics & diagnostics functionalities
- Is the analytics & diagnostics system able to connect to other vendors

Maintenance notification & procedure

Get notified and plan with regular maintenance cycles.

Every robot needs time for maintenance. But mostly some parts of the robot just fail. To avoid that and also to check the health of the robots the robot should provide regular maintenance cycles and procedures. For this, the robot should implement a procedure to check if everything is working properly and if all components are in a good shape.

For this maintenance procedure information should be provided and the operator needs to be informed to perform maintenance.

Your Checklist

- Inform yourself about the procedure for maintenance
- Find out how the robot informs you about its maintenance cycles

Use top-notch technology

If you want to buy or rent a machine it is crucial to get an overview of the state-of-the-art technologies out there. Using top-notch technology ensures that the robot is working reliably and can navigate in difficult situations. Technology means





software and hardware. It is difficult to decide if the software is top-notch. But for the hardware part, it is pretty obvious.

An important specification of a top-notch technology is the battery lifetime and the duration of a loading cycle. This is crucial if you are planning a robot fleet and you want to know for how long a device can do its job before it is going to the dock and starts charging.

Your Checklist

- [] Explore the specification of the robot
- [] Ask for an extension or specific version if the robot doesn't fit your needs





Reliable Manufacturer Principles

In this chapter, we will focus on the manufacturer. In addition to the product itself, the manufacturer also needs to be reliable. When you are in the process of deciding on a device from a certain manufacturer you have to take into account some aspects. This ranges from the country where the manufacturer is located (potential supply chain uncertainties) to the documentation and material that you get to succeed with the integration of the robot.

Solid product portfolio

The robot manufacturer should have a solid product portfolio with robots that are installed in the field. Here it is important to have a look into the whole portfolio, the scope of the offered solutions, and the hardware as well as software parts that are robust. For most users of mobile robots, it is nearly impossible to get all the information needed for a well-informed decision. To mitigate the risk of choosing an immature product, you can always rely on experts that are familiar with the technology or the manufacturer in detail.

Your Checklist

- [] Explore the product portfolio of the manufacturer
- [] Ask an expert for help to mitigate risk and gather information

Success stories and customers

Since the market for mobile robots is rising very quickly, a lot of new manufacturers of robots appear on the landscape. Some of the new manufacturers bring in a lot of experience in building mobile robots but some of them do not. A good way to figure out where the robots were tested in the field, you can rely on the success stories of actual customers of the robot.





Your Checklist

- [] Find out where the robot is currently in use
- [] Ask the manufacturer for success stories and case studies

Buy versus rent

Especially when it comes to testing a mobile robot, a rental solution could be the game-changer.

If you are considering renting a robot before buying it, you can also ask the manufacturer if this is an option. Most of the manufacturers offer a renting solution for testing and proof of concepts. Some manufacturers are even using the renting model for a longer time and not just for testing. If renting fits better to your financials (because it is OPEX, no CAPEX allocation), then you should ask the manufacturer very early in the process, if this option exists. It is important to know that offering a rental solution can often be a sign of confidence in the own product.

Your Checklist

- [] Ask the manufacturer if a rental solution is available
- [] Find out if renting or buying is speeding up the process on your end

Customer-centric documentation

If something breaks, how many minutes or hours do you need to fix it?

If not done right, writing and reading the documentation can consume a lot of time. But at least writing documentation should be the hardest part of it, so that the reader is able to read, understand and act fast if something happens. To achieve this the manufacturer shall provide customer-centric documentation. In addition to that, the documentation should be up-to-date as well as available online (searchable). Imagine the situation where some problems with the robot occur and the operator





needs to find the written documentation somewhere and has to look up the problem manually.

Your Checklist

- [] Ask for the documentation of the robot upfront to check if it fits your needs
- [] Ask if the documentation is also available online and searchable

Support for setup

The manufacturer shall support the setup and integration of the robot. Some procedures of the integration are not that easy and some steps are tricky to do on your own. The support can basically happen in two ways:

- The manufacturer sends a person to integrate the robot and sets everything up as well as provides training to the people on the ground
- Multiple video calls can happen to set up the robot remotely and train the people on the ground through a webinar

Either way knowledge transfer has to happen with the end-users of the robot.

Your Checklist

- [] Ask what the integration process looks like and how you get supported during that process
- [] Find out if someone from the manufacturer is coming to your facility or the support will be just remote

Educational & enablement material

Enabling the people on the ground to operate and maintain the robot is very important to save time and money.





Besides the documentation that the manufacturer shall provide for setting up and maintaining the robot, another important aspect is the educational and enablement material. This means that in addition to regular documentation (such as a handbook and online manual) the manufacturer shall provide knowledge and insights about the technology that the robot is using.

This is important because the operator of the robot needs to get a solid understanding of the product. Educating the people on the ground also has an advantage for the manufacturer. By educating everyone working with the robot, the manufacturer and end-user are more likely to agree on necessary product updates. The end-user better understands why novel technologies and updates that cost money and effort are important.

Your Checklist

- Ask if further material and information is provided by the manufacturer
- Gather educational material about the device in order to understand the technology

Transparent product updates

Robots are not simple machinery. They are complex and from time to time updates are needed.

Robots are evolving and with that, the customer should also evolve and improve. Robot manufacturers develop mobile robots further to improve the software, sensors, wheels, and other components. It is important that the manufacturer transparently communicates product updates and is able to present the evolution of its product. For a long-term relationship, it is important that the customer of the robot understands the roadmap of the manufacturer.

Your Checklist





- [] Ask how the roadmap looks like on the manufacturer's site
- [] Ask which improvements are planned for the future

Transparent communication

During the whole process, transparent communication between the parties is key to success.

When talking to the manufacturer about delivery times, robot setup, robot operation, and all delivered material, the manufacturer should communicate in a transparent way. Mobile robotics is an immature industry and some things can take time and patience.

This should be communicated by the manufacturer up front to handle expectations well. Also from the end-user perspective, it is important to emphasize that transparent communication is key. The end-user and receiver of the robot also has a lot of things to plan, schedule, and execute. To align expectations and interests there is no way around transparent communication.

Your Checklist

- [] Emphasize that transparent communication is important for you
- [] Make sure the manufacturer knows your timeline and your expectations from the robot as well as the project you are working on

Servicing agreements for robots

The manufacturer should offer a variety of servicing offers. Most important is the supply of spare parts as well as the installation of these spare parts. Furthermore, it is important to have an agreement in place, that broken parts are fixed in a defined timeframe to ensure operational excellence in your facility.





Besides this, routine checks of the devices are needed. These routine checks should also be part of this agreement. A common way is to have a robot integrator close by, who is able to fix occurring problems fast and can also handle the routine checks of the robot.

Your Checklist

- [] Check if manufacturers offer servicing agreements
- [] Check if a robot integrator can help with servicing and routine checks

Guarantee and warranty

In case the robot or parts of the robot are not working properly, it is important to have agreements in place that cover the guarantee and warranty of the device. Durations of guarantee agreements are a minimum of 1 year, but can also be extended. The manufacturer should also provide a warranty agreement that covers all necessary cases.





Our Assessment Process

Based on the principles for reliable manufacturers and robots, we have created an assessment & certification process. This process can be divided into three parts:

- Assessment of manufacturer
- Assessment of the hardware of the robots
- Assessment of the software of the robots

For all principles that we assess and measure we have also created a rating mechanism. This assessment process can be requested by manufacturers as well as potential customers of specific robots.

If you need an assessment of a mobile robot and/or a manufacturer, please contact WAKU Robotics.

Assessment of manufacturer

During the assessment process for manufacturers, we will look at their product portfolios, scan product specifications, and check the current implementations of the robots. Furthermore, we clarify how guarantees and servicing are handled by the manufacturer. Another important aspect is the educational material that the manufacturer provides for integrating and operating the robot.

Assessment of hardware

Hardware assessments are focusing on the used sensors, actuators as well as other physical parts like the battery. Two aspects are important:

- Quality of the used hardware
- Use of hardware satisfies all regulatory requirements





The solid quality of the used hardware significantly increases the lifetime of the robot. Therefore it is important to know which hardware parts are used. To ensure that the robot can be operated safely, it should satisfy all regulations and norms.

Assessment of software

Software is the part that makes the robot smart. Therefore we also assess different parts of the software stack. Here we start with the operating system of the robot. The manufacturer should also offer software to access the robot for changing the missions (jobs that the robot is performing) and reprogram the robot if needed.

Here we focus on the following parts:

- Robustness of the software stack
- Options to change the behavior of the robot
- UI/UX of the provided interfaces
- APIs and interfaces to operate the robot





Conclusion

Having reliable robots working in your facilities is key for a successful transition from manual processes to automated processes. Choosing the right solution based on the criteria presented here can be a game-changer for your organization. But also, working with the right partner that supplies you with robots is important. This means choosing the best manufacturer that is able to deliver on your specific use cases is key, too.

Some criteria presented in this framework may be more important than others. So you should definitely consider which ones are relevant for you and prioritize them. This can vary from case to case and also from facility to facility. To make really profound decisions on prioritization, you should talk about it with the people on the ground, the top-level management as well as other stakeholders that are involved in the process. This also pays out when actually deploying robots, because all the people are well informed and supporting the mission. Employees that block the transition because they do not feel well informed, can bring such projects to fall. This is what we experienced from different clients already.

If things get too complicated or you need support on these topics do not hesitate to involve consultants and experts. WAKU Robotics for instance can help with selecting the most suitable manufacturers of robots as well as the robots themselves. With solid market intelligence and experience, WAKU Robotics is in the best position to accelerate your robot transformation.

Additional material on how a reliable robot, as well as a reliable manufacturer (robot vendor), looks, can be found at www.waku-robotics.com. There you can find checklists, posters, and handouts that you can use to set up everything you need. Also, don't forget to have a look at the [Robot Operations Framework \(ROF\)](#) that puts together everything you need to succeed with your first proof of concept and the further scaling of your robot fleet.





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