

# 13 Questions to Ask Before Purchasing a Robotics Platform

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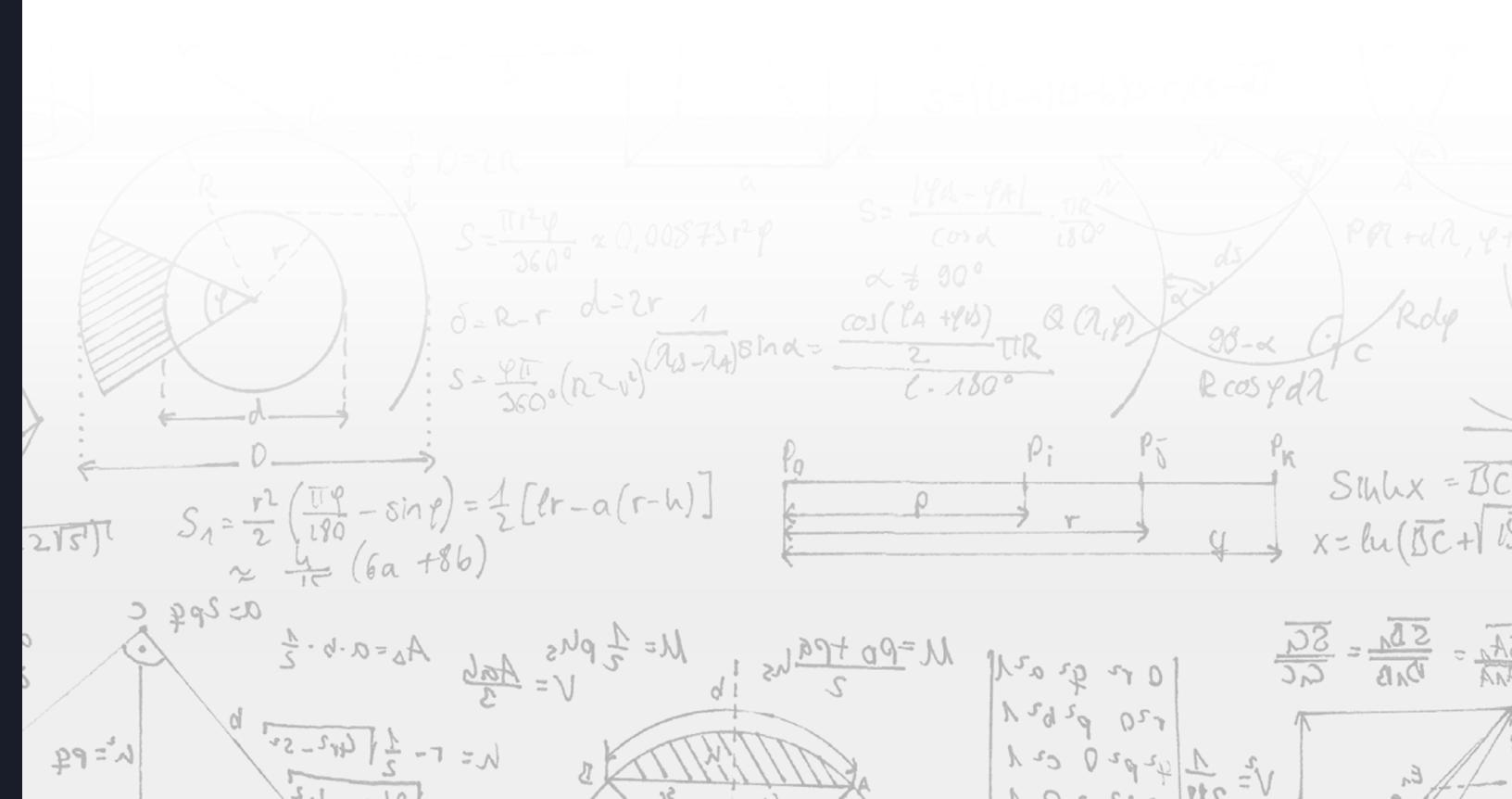
# So you're starting a robotics project and you need to know where to begin.

Whether you're new to the robotics process or have a team of experts in-house, you need to create a clear and complete specification to ensure a successful robotics project. Thinking through the basic requirements and capabilities of the robot is a good place to start. This process will not only help you and your robotics integrator choose the right platform, but will also help you determine what technology add-ons are required.

Finding the right robotics company to partner with is another very important part of the process. Depending on your own internal robotics team's experience level, you might not know where to start when interviewing a robotics company as a potential partner for your next project; choosing an experienced and reputable partner is important.

This eBook from Waypoint Robotics includes a list of questions to help define your robotics project, as well as some points to consider when looking at which robotics company will help you achieve your goals.

**Enjoy!**



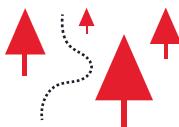
# 1. WHAT IS MY ENVIRONMENT?

In general, there are two types of environments your robot will encounter—structured and unstructured.

Understanding and identifying which type of environment your robot will be operating in will significantly impact the sensor specification, development, and navigation capabilities of your robot.



**Structured** — A structured environment is essentially a space that is clearly and meticulously defined. This type of environment has no variables and is rigid—meaning a robot knows what to expect when navigating through it at all times. A structured environment is predictable.



**Unstructured** — Take the structured environment mentioned above and add unexpected and infinite variables (i.e. humans, lighting, moisture, temperature etc.). This type of environment is challenging for a robot to navigate because it must be capable of identifying and adapting to these changes. In essence, an unstructured environment is chaotic and unpredictable.

Determining which environment your robot will be operating in eventually leads to a discussion on its functionality, but not until you've taken an even more granular assessment of your surroundings.

## Consider the environmental conditions in which your robot will operate.

The conditions in which your robot will operate determine the base platform and also affect other components and capabilities, like the battery and navigation. The following is a prime example of what conditions to look for within your environment:

**Know Your Floor** — A floor is for the most part flat, but what about those tiny imperfections and irregularities that could cause a robot to go off track? What is the color of your floor? Is it multicolored or uniform? Other things to take note of include:

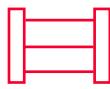
- Does it have any stress cracks or potholes?
- Is the floor abrasive or smooth?
- Is it painted?
- Does it have lines on it?
- How level is your floor?
- Are there any stains on your floor?
- Does it gather moisture?
- Is it cold or hot?

Knowing every intricate detail of your flooring is key in the development and strategy of your robot's function. Any unplanned anomaly (i.e. a crack in the floor) could impact the sensors' performance or the operation of the mechanical systems on your robot and consequently cause it to fail.

Other areas of detail to understand include:



**Lighting** — What is the lighting in your environment? Is it natural light? Is it fluorescent light? Are there shadows? Does it change throughout the course of the robots' mission?



**Furniture/Fixtures** — Does your space have racking? How high is the first rack off the floor? Do things stick out into the aisle?



**Employees** — Does your environment feature multiple employees flowing in and out? What are these employees wearing? Do they wear matching uniforms? Are there areas where they are always or never allowed to go?



**Variable Conditions** — Will your robot be exposed to the elements? Does this shift in exposure constitute changes in temperature/humidity? Will there be changes in weather?



**Hazards** — Is your robot expected to withstand certain levels of radiation or toxic waste?

Any of the conditions mentioned above could potentially wreak havoc on your robot's sensors and as a result impede its navigational abilities—which is why identifying them early on in the development of your robot is important.

## 2. WHAT ARE MY PLATFORM DIMENSIONS?

The footprint of your robot is critical so it will fit in the space where you intend to use it.

The size and weight of all of the hardware mounted on your robot (the payload) determines the platform size and construction. It will also determine whether you can maneuver the platform in tight spaces like a warehouse aisle or in a mine shaft with a low ceiling.



### 3. WHAT IS MY PAYLOAD?

Payload is a crucial element of your robotics project.

The amount of weight that your platform needs to carry impacts other factors. Payload is also directly related to speed, acceleration, size, and platform weight. Payload power requirements are also a critical factor. Make sure you communicate both payload weight and power requirements to your robotics integrator.



## 4. WHAT IS MY REQUIRED SPEED?

Depending on your project and objectives, the required speed will vary.

Keep in mind that the higher the payload, the slower it will go, and slower it will accelerate with the same motor configuration. To run the platform at a high speed or react faster as payload increases, you must alter the propulsion system.

If you're not sure how fast you need to travel or accelerate, it's a good idea to over-spec your prototype system so that you have plenty of power to execute your task. After you've succeeded at your application, then you can downsize the propulsion system if it makes sense.



## 5. WHAT GROUND CLEARANCE WILL MY ROBOT NEED?

Will it need to easily maneuver over brush or other low obstacles?

While obstacles on the ground can affect the mobility of the robot, it's also important to remember that some obstacles are above the robot as well. In addition to asking what the robot needs to travel over, you should also ask if it will need to move under low-hanging impediments or easily travel under equipment. This will determine the size and type of wheels and tires, as well as how they are mounted to the platform.



## 6. WHAT IS MY DESIRED MANEUVERABILITY?

You are building a mobile robot so having the capability to maneuver in your intended environment is critical.

Ask your robotics integrator what platform and type of maneuverability will fit your project needs. The basic types of AMR platforms that Waypoint Robotics offers, and their best use cases are:

- 2 wheeled – 0 turning radius, indoor tight spaces
- 4 wheeled skid steering – outdoor, rugged
- 4 wheeled omni-directional – indoor, heavy payload, moving in any direction or orientation
- 4 wheeled articulating – outdoor, rugged, inconsistent terrain



## 7. WHAT IS MY BATTERY TECHNOLOGY?

Most robotics solutions offer lithium-ion or lead acid batteries. Lithium-ion is considered the most advanced technology for transportation systems based on factors such as energy density, power density, capacity, charge time, efficiency, size/weight, and extended life cycle. Lithium-ion batteries combined with advanced sensing allow for even more efficient energy use leading to longer battery life.

AMR systems use regenerative braking to recharge the battery during deceleration, which also extends battery life. Equally important is that the battery chemistry used in AMRs is inherently safe and not subject to the kinds of dangerous malfunctions seen in many consumer products that use other lithium ion chemistries. You should consider all these factors when selecting a battery for your system.

## 8. WHAT IS MY PROPULSION SYSTEM?

There are many types of propulsion systems offered by mobile robot companies: direct drive, belt drive, and gear drive just to name a few. AMRs come with the same electric propulsion system used in the personal transporter, which includes smooth, quiet, helical gearboxes. In addition to being clean, quiet, and efficient, electric propulsion enables fine adjustments to each wheel (for accurate tuning), and a precise, software-based approach to traction control and braking.

The AMR propulsion system includes drive motor redundancy for maximum safety and reliability. Drive motor redundancy is unique to the platform. Redundancy is essential for certain robotics applications; for example, if your robot is performing dangerous work inside a nuclear facility, a redundant drive motor will ensure that if a motor fails, the backup motor will return the platform safely from the radiation zone.

## 9. WHAT ARE MY DESIRED NAVIGATION CAPABILITIES?

There are several basic types of navigation, including: tele-operated, semi-autonomous, or autonomous. The sensor set required to enable semi-autonomous or autonomous navigation will depend on whether you want to operate the platform in a structured indoor environment or outside, and whether you want to drive the robot, or have the robot drive itself.

## 10. WHAT IS MY CONTROL SOFTWARE?

Depending on the application of your project, and the amount of customization you plan on doing, you may need access to the operating system of your robotics platform. Depending on the platform, the software may be open source or proprietary. If you need access to the software, make sure you choose an open-source solution, or integrator with a robotics expert that has access to the proprietary software. Waypoint Robotics is the only robotics firm that has access to the AMR embedded software, and our founders were part of the team that developed this software. Our engineers continue to refine and update the embedded software to keep it on the leading edge of safety and performance.

## 11. WILL I NEED EXTRAS OR ADD-ONS?

You also need to consider add-ons that you plan on using for your robot. This can affect the weight of the overall platform, which will impact motor power and battery capacity. If you plan to integrate manipulators, sensors, or other devices, you need to consider factors like weight, duty cycle, and the degrees of freedom/maneuverability. These factors will determine placement and mounting options, as well as power requirements.

## 12. WHAT IS MY TIMELINE?

Your project timeline is a crucial element to include in your initial communication with a robotics integrator. Compressed project timelines may result in a significant increase in cost or limit development options for you and your robotics integrator.

Make sure your timeline is realistic, but keep in mind that an experienced robotics engineering team can accomplish your goals faster than a less experienced team, or a perfectly capable but over-committed team you may have in-house.

## 13. WHO CAN HELP ME ACHIEVE ALL OF MY ROBOTICS GOALS?

This is likely **the most important question** you will ask yourself when purchasing a robotics platform.

Finding the right robotics company to partner with in your next project is critical. This means your assessment should be well thought out and should involve the following considerations:

### EXPERIENCE

It's a good idea to get to know everything about the engineering team you're considering, as well as their previous experience. The following questions should help you get started:

- How long have they been working in the field of robotics?
- Does their current experience uniquely bring together the requisite background in mechanical, electrical, software, and vehicle dynamics?
- What are some recent projects they've worked on?
- What is their familiarity with the specific platforms you are considering for your project?

### TIME TO MARKET

Time to market is a key differentiator in robotics and engineering companies and becomes very important after your prototype has been built. Once the prototype has been completed, designs are set, and once you have funding; now you need to get your product to market. Be sure to consider the following criteria for your time-to-market needs:

- Will your robotics company be able to meet the demand and have the capacity to supply the number of robots you need to meet your forecast?
- Will the robots provided be reliable enough (down time is lost time) for your development needs, and your customers' needs?

## FACILITY CAPABILITIES

When evaluating robotics companies, request a corporate visit and ask for a tour of their facility. If an in-person tour is not feasible due to proximity, request a virtual tour of their facility. It's also a good idea to consider the following criteria in relation to their facility:

- Do they have all of the fabrication equipment necessary to customize parts and build and integrate all components on-site? For example, do they have a 3D printer, CNC mill, and circuit board modification equipment on site?
- What kind of software tools do they have?
- What kind of development and data management processes do they have?
- Are they able to customize and integrate a prototype in a rapid timeframe with guaranteed results and at a reasonable price?

## SAFETY ARCHITECTURE

When you're looking at a robotics company, it's crucial to understand their experience with the type of robotics platforms you need for your project. Make sure to consider the following:

- How many testing hours have gone into their platforms?
- How many testing hours has your assigned team actually spent developing on these platforms?
- Do they have any recent examples of prototypes or products that they have worked on that they can show you?

And, does the robotics company you are interviewing offer platforms with a proven "Safety Architecture" and redundancy at many different levels across the platform?

## SUPPORT

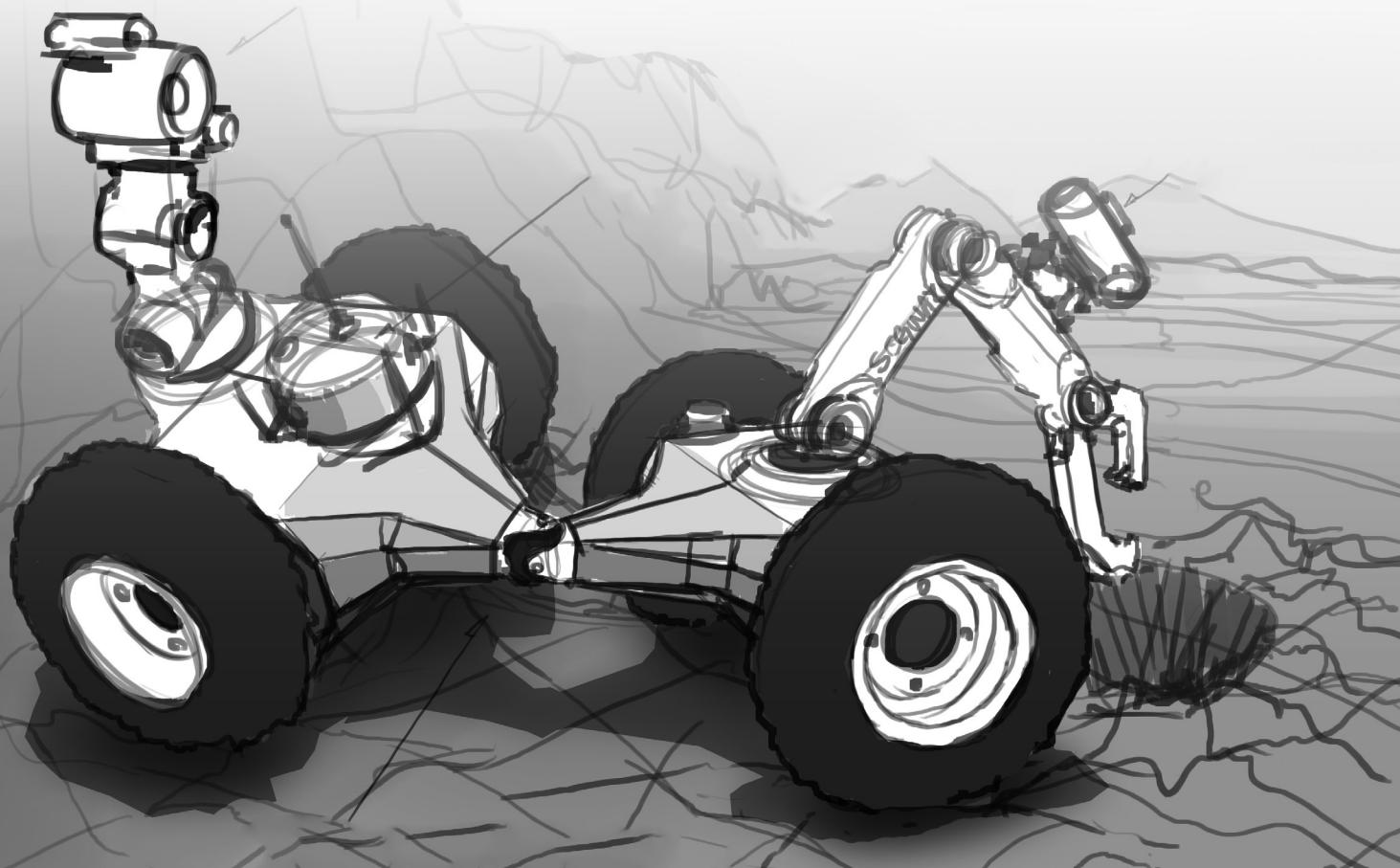
Will the robotics company you use be able to connect you with local support and warranty repair options across the globe? What if you need a replacement part for your robot – how long will it take to obtain the part and get the robot back to operational status?

Be sure to consider any location where your platform may be operating, both nationally and internationally.

## CONCEPT DRAWINGS

Before your robot is complete, it's important to consider if you will need to show executive sponsors and potential investors what it will look like. Ask the robotics company if they are able to get you concept drawings.

These concept drawings are the first step to a physical prototype, and are useful not only to show potential investors what the platform or completed project will look like, but also can help with many design spec details. Seeing a clear visual representation brings the project to life past the conceptual phase, and allows you to better communicate with the robotics engineers on expectations.



The questions outlined in this eBook only scratch the surface of the specs you will need to define the scope your robotics project.

However, a thorough grasp of these foundational elements is a great place to start the conversation with potential integrators.

Waypoint Robotics is a robotics engineering company headquartered just north of Boston, Massachusetts.—an area renowned for robotics. Founded by an engineering team that branched off from Segway Robotics, Waypoint engineers architected the embedded software and hardware for all the new Segway® RMP (Robotic Mobility Platform) platforms and prototypes.

From concept to delivery, our unique talents and in-house prototyping capabilities put your project on the right development path—fast. Functional prototypes are often necessary, not only for concept evaluation, but also for securing venture capital or grant money. We have the skills, tools and experience to deliver working prototypes quickly and efficiently.

If you would like more information on how our team handles new robotics projects, please contact us. We would be happy to send you a full project questionnaire to see if we are a good fit for your project.

**WAYPOINT** ROBOTICS

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