# axys | user guide



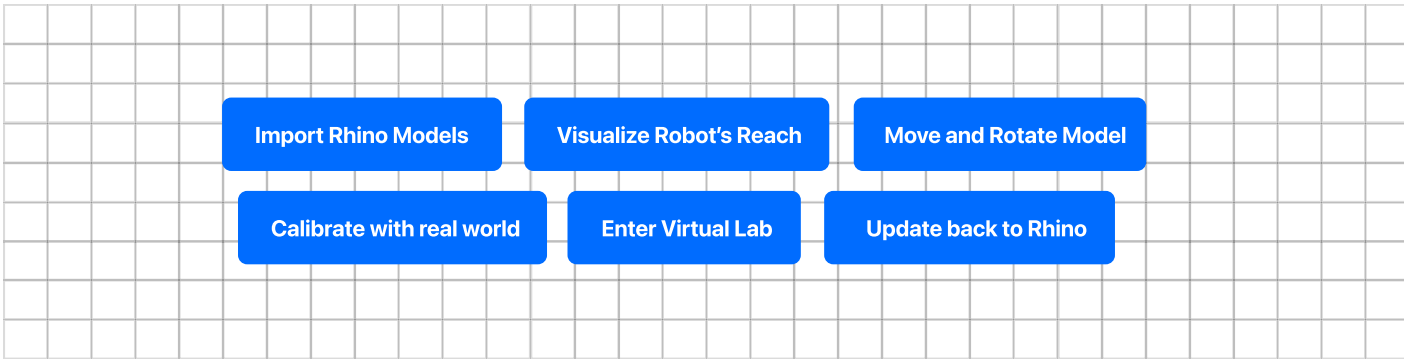
# Introduction 1.

**Welcome to the Axys User Guide**
This guide was created to help you get the most out of Axys, a visionOS app that works hand-in-hand with Rhino to bring your 3D models into real space. Whether you're just getting started or coming back for a refresher, you'll find everything you need to install, set up, and use Axys smoothly. We'll walk you through how to:

- Connect Axys with Rhino
- Use its core features for 3D concrete printing workflows
- Navigate the interface with confidence
- Save time and boost productivity using the Vision Pro during your printing processes.

→ Whether you're using Axys to visualize your Rhino models in the physical world or to simulate your setup in a virtual lab, this guide has you covered, step by step.

**Product Overview**
Axys is a hybrid solution combining a visionOS app with a Rhino plugin, designed specifically for the 3D concrete printing industry. It enables users to:



**In more details:**

- Seamlessly import Rhino models to Vision Pro in just seconds, no complex setup required.
- Calibrate your Rhino coordinate system with the real-world lab environment for perfect spatial alignment.
- Visualize 3D models in real space, exactly where they'll be printed, no more guesswork.
- Simulate the robotic arm's reach in a virtual lab, verifying placement feasibility before printing starts.
- Interact and reposition models with millimeter precision, directly within your AR environment.
- Sync every adjustment back to Rhino automatically, keeping your workflow smooth and up-to-date.

## Use Cases

### Primary Use: On-Site in the 3DCP Lab

Axys is especially powerful when used directly in the 3D concrete printing environment. By aligning virtual models with the physical setup, users gain real-time spatial awareness and confidence before starting a print. On this use case, the user can focus on:

- Model Calibration: Align digital models precisely with real-world reference points on the print table. This ensures accurate placement and helps avoid costly printing errors.
- Robot Reach Validation: Quickly visualize the robot's working envelope to confirm the model is within reach, reducing the need for manual measuring or trial-and-error adjustments.
- Last-Minute Adjustments: Easily reposition or rotate models using hand gestures in AR. All changes are instantly synced back to Rhino, ensuring the robot's code reflects the latest setup without additional recalculations.

Axys was main developed to fit in the printing setup phase, specifically helping 3D concrete printer better position their models in real space before printing.
Currently, they often need to adjust the model's placement but lack a precise way to verify its accuracy. This uncertainty leads to issues where the robot struggles to reach certain points, and researchers find it difficult to determine the correct location.
In 3D concrete printing, accurate setup is crucial. Without clear spatial feedback, users risk printing errors and robotic misalignment. Axys solves this by bridging the digital model and the real-world environment, reducing uncertainty and enabling fast corrections during the setup phase.

**Model Creation**

Model design on Rhino
Create toolpath with Grasshopper
Run simulations

**Printing Setup**

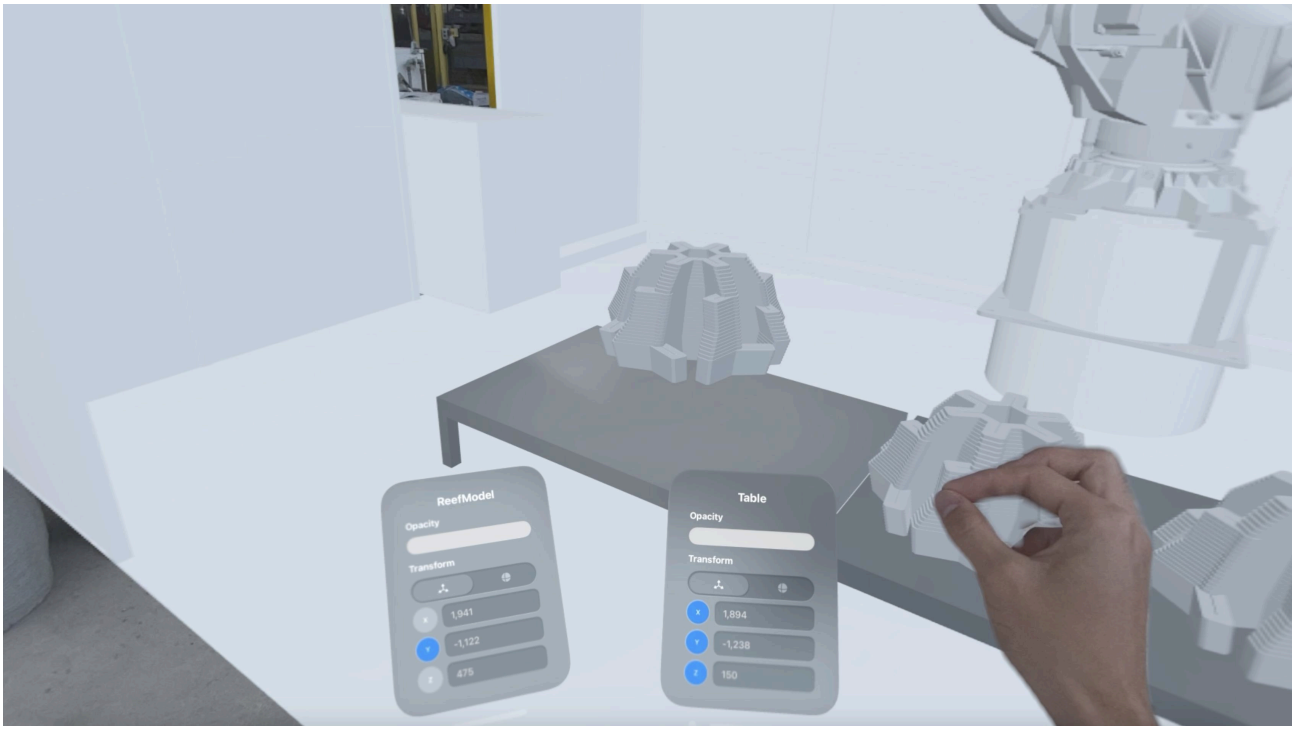
Test robot's reach
Adjust tables position
Run simulations

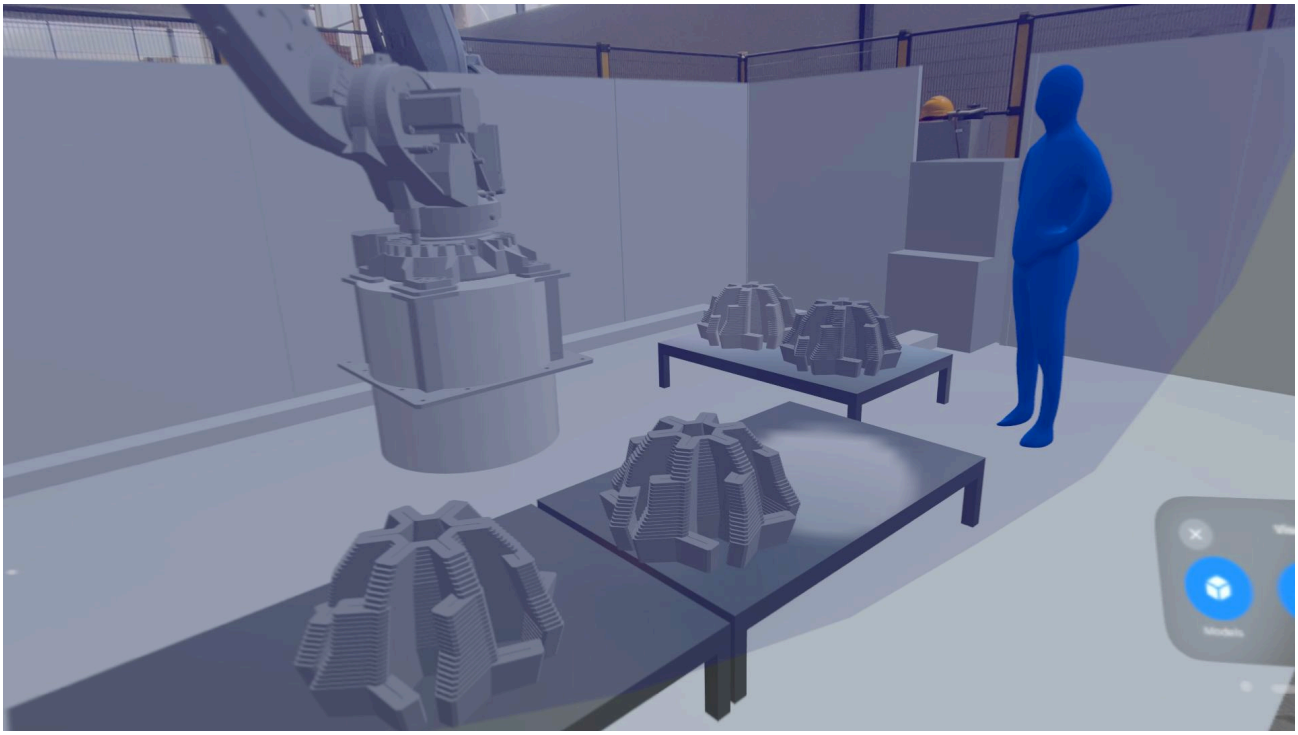
**Printing Session**

Prepare the concrete
Start to print
Monitor the session

**Secondary Use: On the Office or Studio**
Axys is just as valuable in the planning and presentation stages, helping teams and clients stay aligned before heading to the lab:

- Session Planning: Test and preview model placement in a virtual copy of the printing space, no need to be physically present at the lab.
- Client Presentations: Bring your designs to life by showing clients immersive, full-scale previews in mixed reality. It's clearer, more engaging, and helps communicate your vision more effectively than traditional renderings.
- Internal Reviews: Collaborate with team members by sharing the AR view during project meetings. Visualizing the setup early helps avoid misunderstandings and supports faster, better-informed decisions.



**Expected Impact**
This project introduces an innovative use of augmented and virtual reality to improve 3D printing processes in construction. By integrating these technologies both on-site and off-site, it enhances planning, speeds up verification, and allows real-time error correction — leading to more efficient and precise printing.
Beyond visualization, Axys helps optimize the full construction workflow, from design to execution. The research addresses a still underexplored area with strong potential to advance how structures are designed, planned, and built using 3D printing.

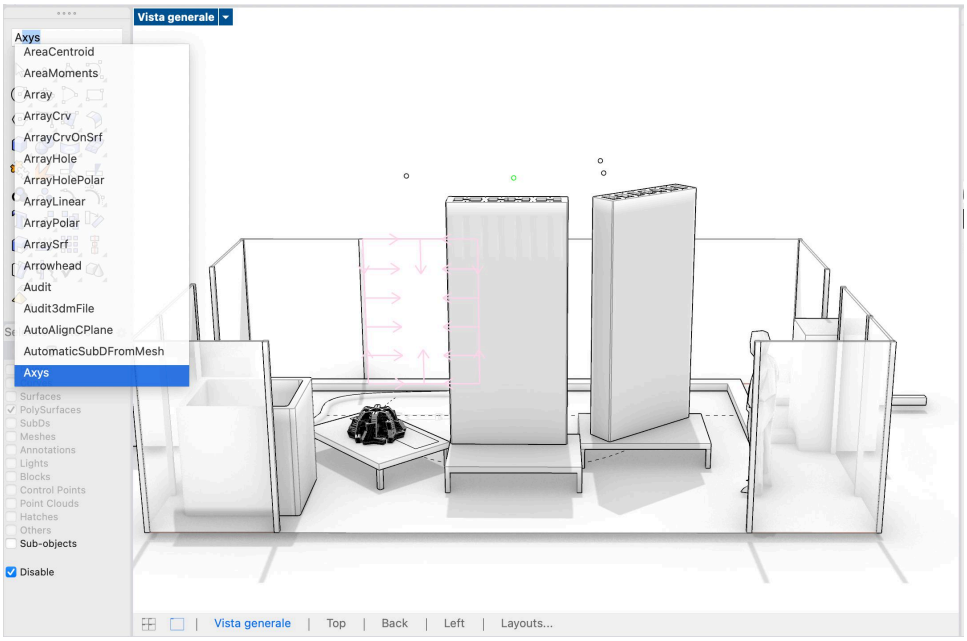
Potential Technological Impact
- Enhanced Positioning Accuracy through AR-based visualization.
- Robot Reach Simulation to prevent printing misalignment.
- Seamless Adjustment with real-time updates to printing control software.
- Remote Planning Capabilities enabling layout adjustments without being on-site.

# Getting Started 2.

## Initial setup

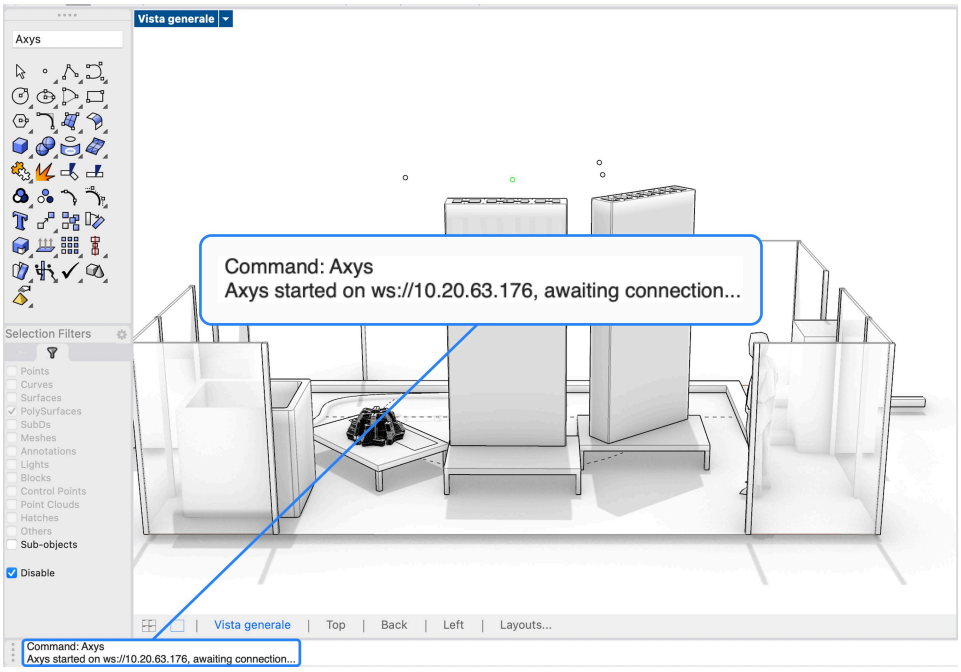
### Rhino Plugin
Before running Axys, the Vision Pro app, make sure you have our Rhino plugin installed and ready to go. But how to use the Axys Rhino Plugin?

### 1. Launch the Plugin Command
In Rhino, open the command line and type Axys to start the Axys plugin. This begins the connection process with the Vision Pro.



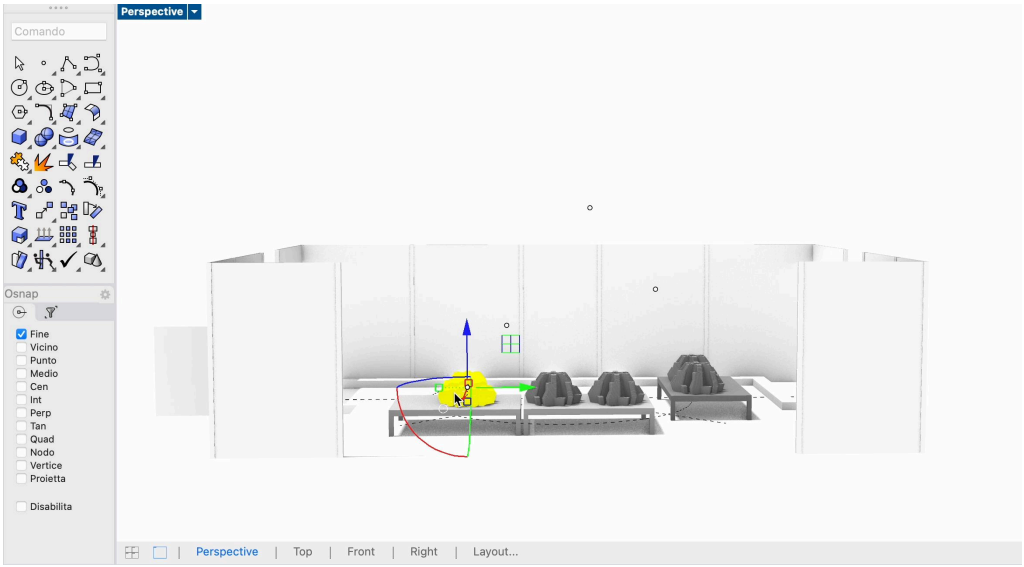
## 2. Enter the Vision Pro IP Address

The plugin will prompt you the IP address, so you can later input on your Vision Pro device. You can find this address displayed within the Rhino Plugin. This step ensures Rhino knows where to send the selected model.




## 3. Select Models to Track

Once connected, click on the model you want to export. A **yellow mesh** overlay will appear on the selected geometry, confirming successful selection.




**Attention**: Group Your Models Properly. Before selection, make sure each model is grouped appropriately in Rhino. The plugin exports and tracks one group at a time, so proper grouping is essential to ensure accurate transfer and visualization.
After completing this steps make sure to open our Vision Pro app and start the flow.

**2. Enter the Vision Pro IP Address**
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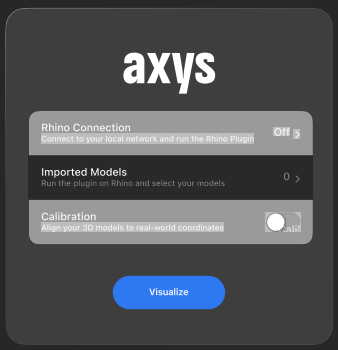
# User Interface Overview 3.

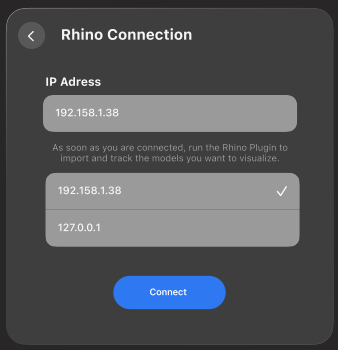
**Interface Overview**
The Axys interface on visionOS is designed to be simple, spatially intuitive, and aligned with the needs of designers, engineers, and researchers working in 3D printing environments. Here's a breakdown of the main steps you'll face when using the app on the Vision Pro.

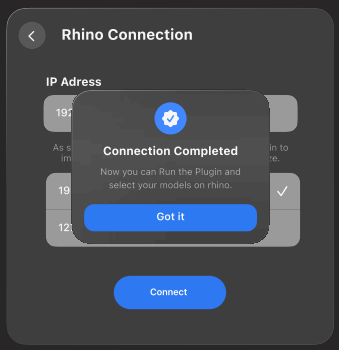
## Step 1

**Step 1:** Connect Vision Pro to Rhino. First, the user makes sure both the Vision Pro and the Rhino-running computer are on the same network. This allows the devices to communicate seamlessly.

To get started, select the first navigation link **Rhino Connection** and enter the IP address of your local network. The user can find this information after launching the Rhino plugin.



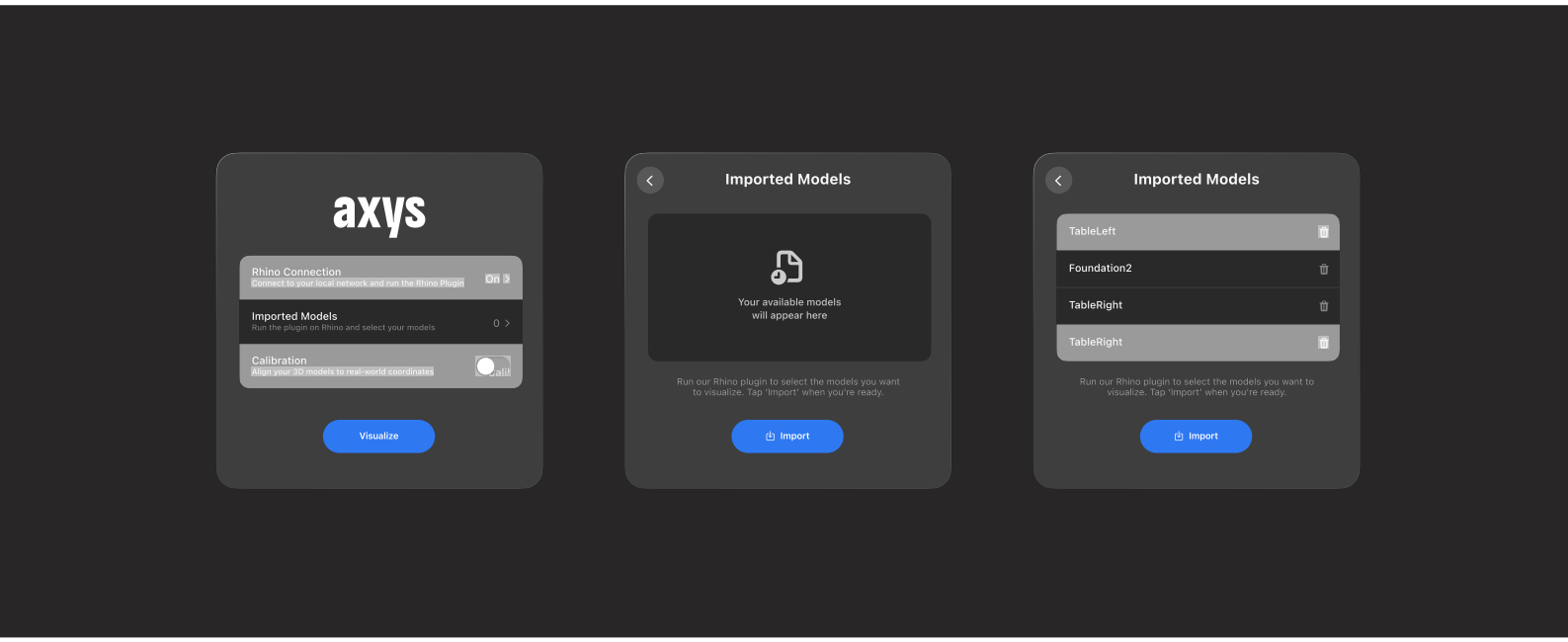



# Step 2

**Step 2: Import the Model from Rhino.**
Inside Rhino, the user selects the desired models and with just one click, the models are sent to the Vision Pro.

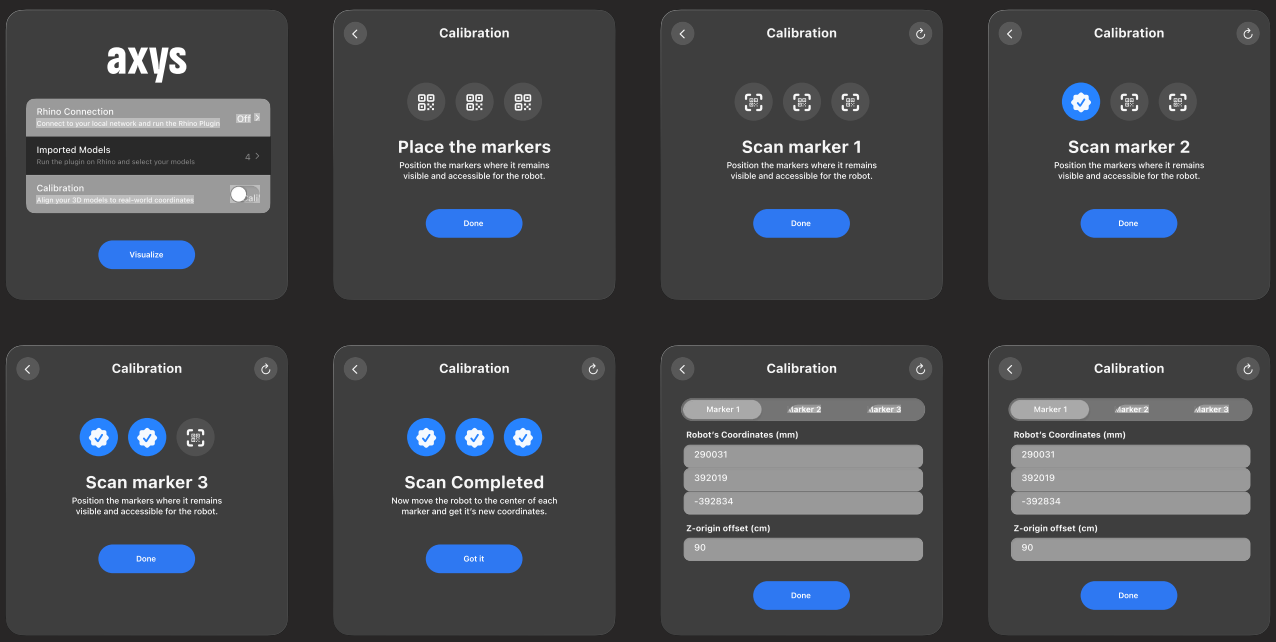
For that, open the **Imported Models** session and after selecting your model on rhino, tap import. The user can do this step as many time as he wants. After the upload all the model's will appear on a list, with their Name and Model's ID.




# Step 3

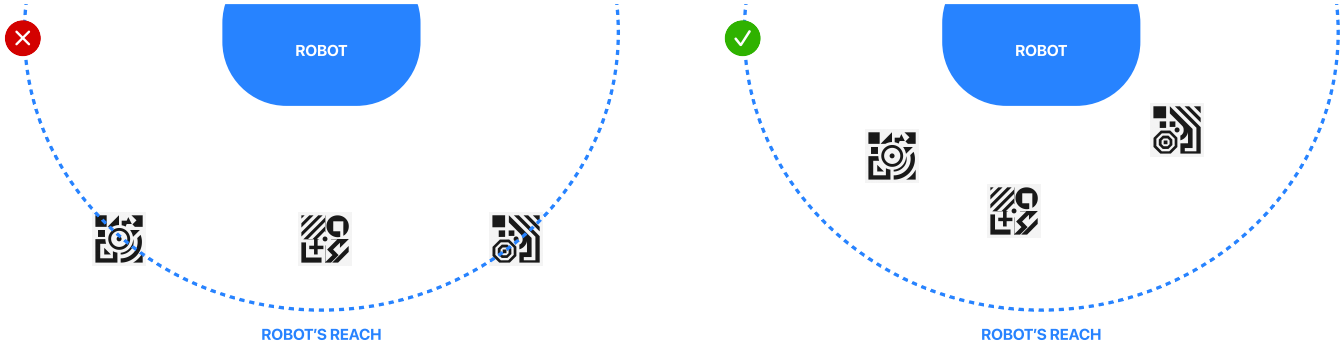
**Step 3: Calibration (Optional)**.
Before visualizing, the user can choose whether or not to calibrate the model to the physical space. This means aligning the digital model with the real-world environment using reference points, useful when working directly on the physical print table.
Now, switch the **toggle Calibration** to start the calibration process. Step by step, the user will place three physical markers (available in the Resources section of this guide) in positions within the robot's reachable area. Next, scan each marker individually, ensuring that a small virtual sphere aligns with the center of each marker before selecting next.

For that, open the Imported Models session and after selecting your model on rhino, tap import. The user can do this step as many time as he wants. After the upload all the model's will appear on a list, with their Name and Model's ID.




MARKER **1** MARKER **2** MARKER **3**

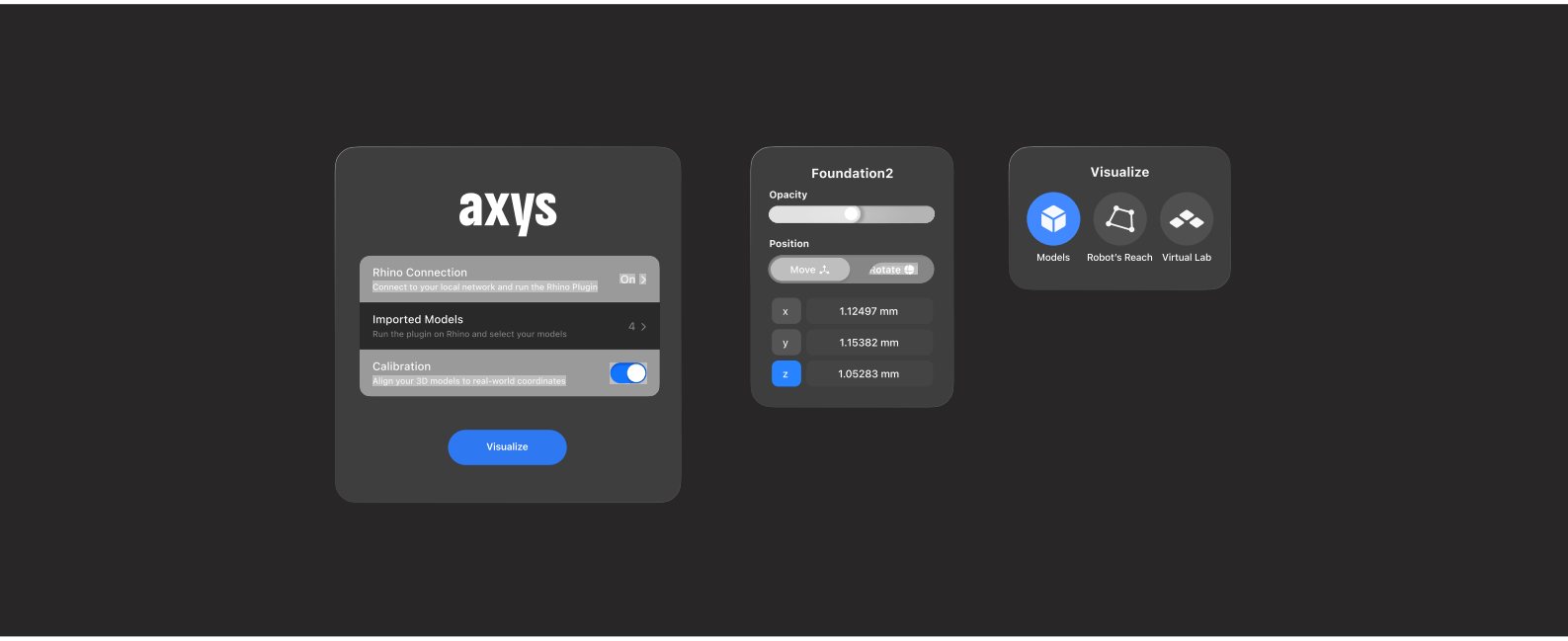
**Attention:** When placing the markers, make sure that at least one of them (or all) is positioned at a different height. This height variation helps the device track them more accurately.




Once this is done, it's time to retrieve the robot's coordinates for each marker. To do this, manually move the robot to the center of each marker and input the corresponding coordinates into the app. Finally, select Done, and the calibration is complete.

# Step 4

**Step 4: Visualize in Mixed Reality.**
Now, the user taps “**Visualize**” in the app. In seconds, the selected model appears in the real world, fully anchored and trackable. At the same time, two key layers can be added: The robot’s reach boundaries (as a visual overlay) and the virtual lab layout, including static objects like tables and frames.




# Step 5

**Step 5: Adjust Position: Move and Rotate.**
Let’s say it’s time for a printing session, but something’s slightly off, maybe the physical table was moved, or the model is just outside the robot’s reachable area. No problem. With simple hand gestures or intuitive inputs, you can easily move and rotate the model directly in AR. The updated coordinates are instantly synced back to Rhino, so the robot’s code reflects the new placement automatically, no manual recalculations needed.

To do this, simply look at the model and tap on it. A small window will appear, allowing the user to **adjust the model’s opacity** with a slider and choose between **Move** or **Rotate** modes using the segmented control. In each mode, users can also lock specific axes to gain more stability and precision when adjusting the model’s position.