The story of Ubiquity Robotics

Why you might want to underfund your next important initiative.

Designing the Future Summit 2019

lppd Lean Product & Process Development

How many of you love chores?

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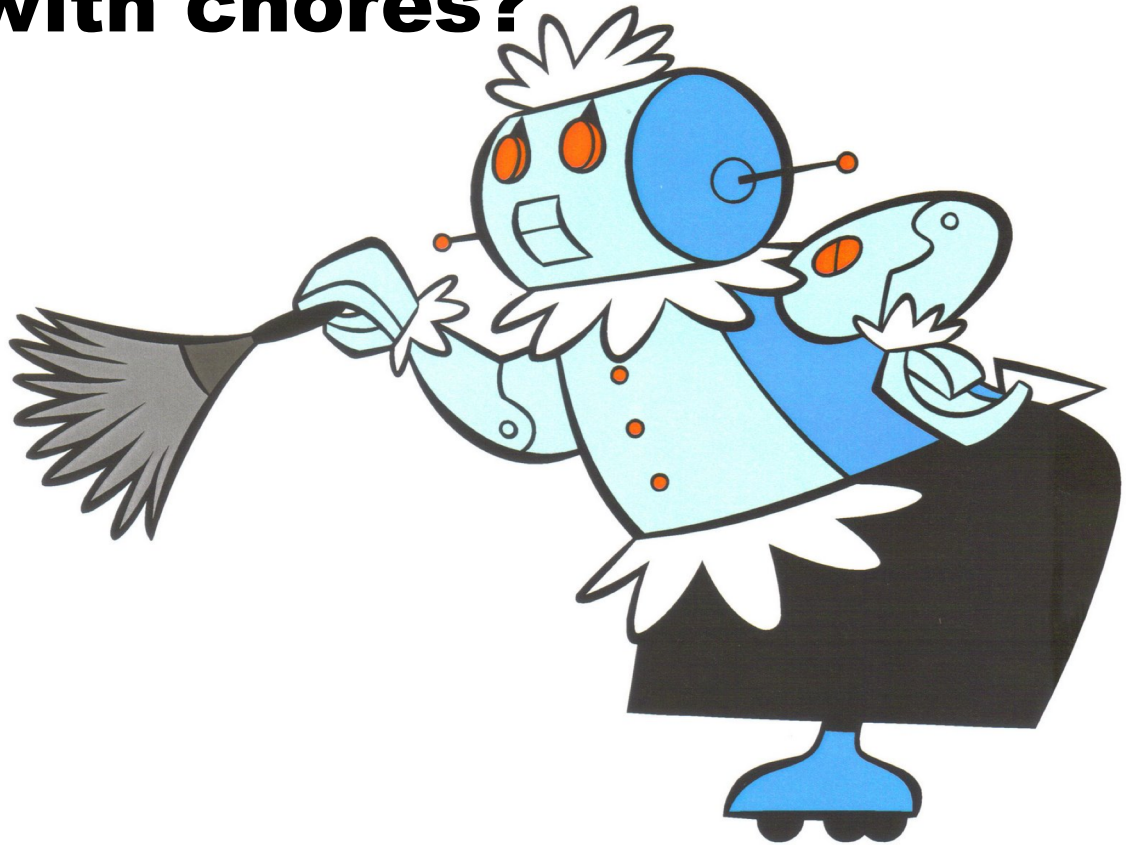
How many of you would love a machine to help with chores?



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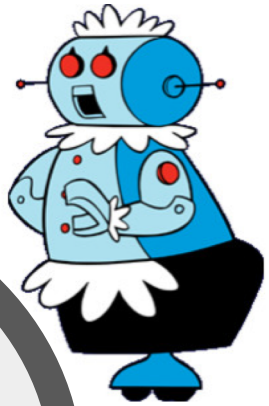
Vision



“Let’s build a custom robot for XYZ application”

“Isn’t it quaint that people used to build custom robots for each application”

Today

2030

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The Problem

It takes 2 years and between $500K-$5M to put together the foundational things that any general purpose robot needs:

- **Mobility Hardware**
- **Localization**
- **Navigation**
- **Compute Infrastructure**
- **Artificial Intelligence / Perception**

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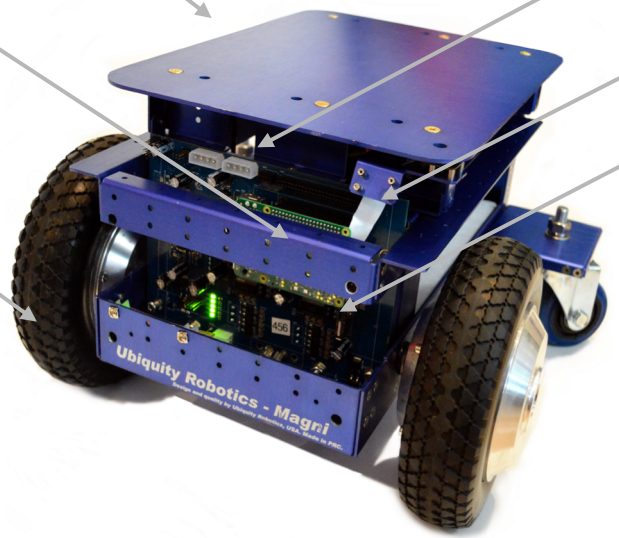
Our Solution - Magni

Fully certified robot in production - sold since Aug 2018

Payload: 100kg

Localization
& Navigation

Mobility



Power

AI: Object
awareness

Compute
infrastructure

BRITISH STANDARDS

GEPRÜFT BY AUSTRIAN STANDARDS

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Warehouse and logistics video

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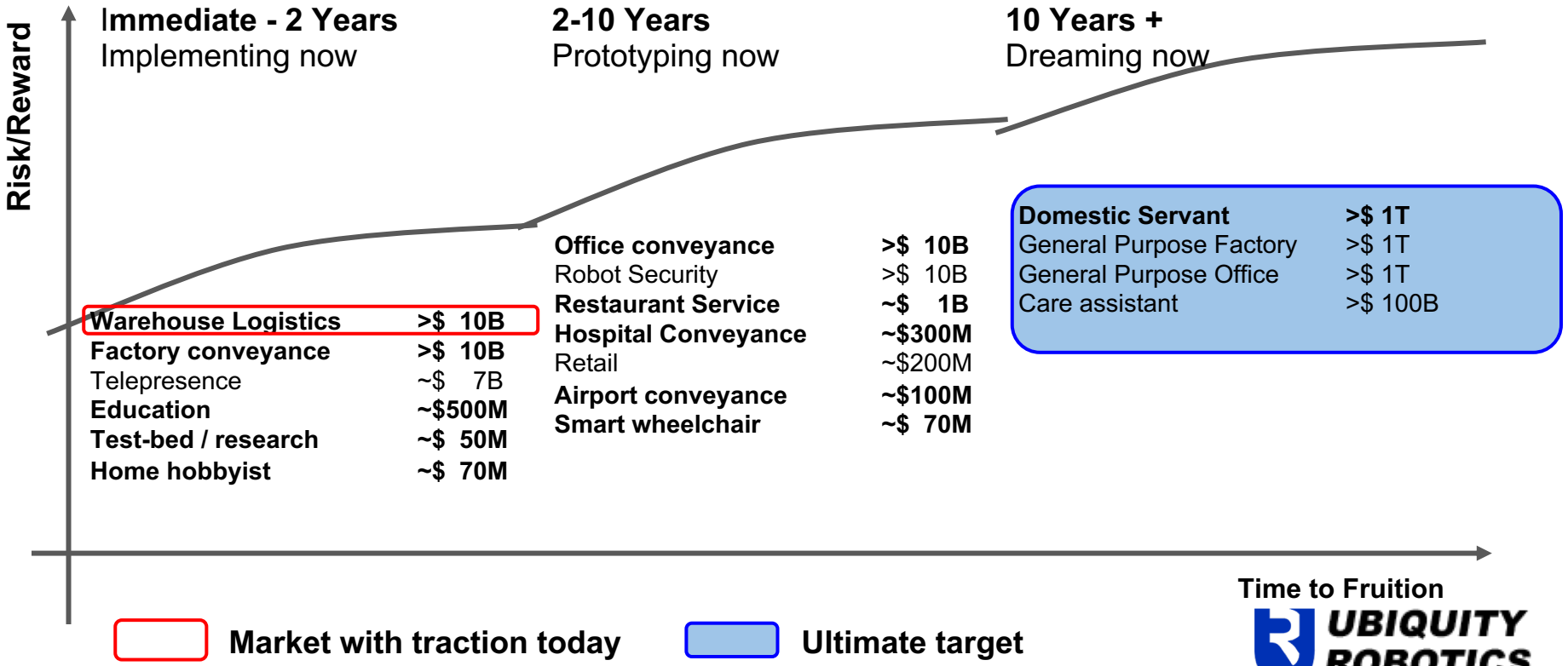
The markets of interest



The story of Ubiquity Robotics

Background

Tools & Methods

- Step 1: Identify an interesting problem
- Step 2: Build an interesting team
- Step 3: Break the problem down
- Step 4: Create and manage learning cycles
- Step 5: Do it again but more simply

Key learnings

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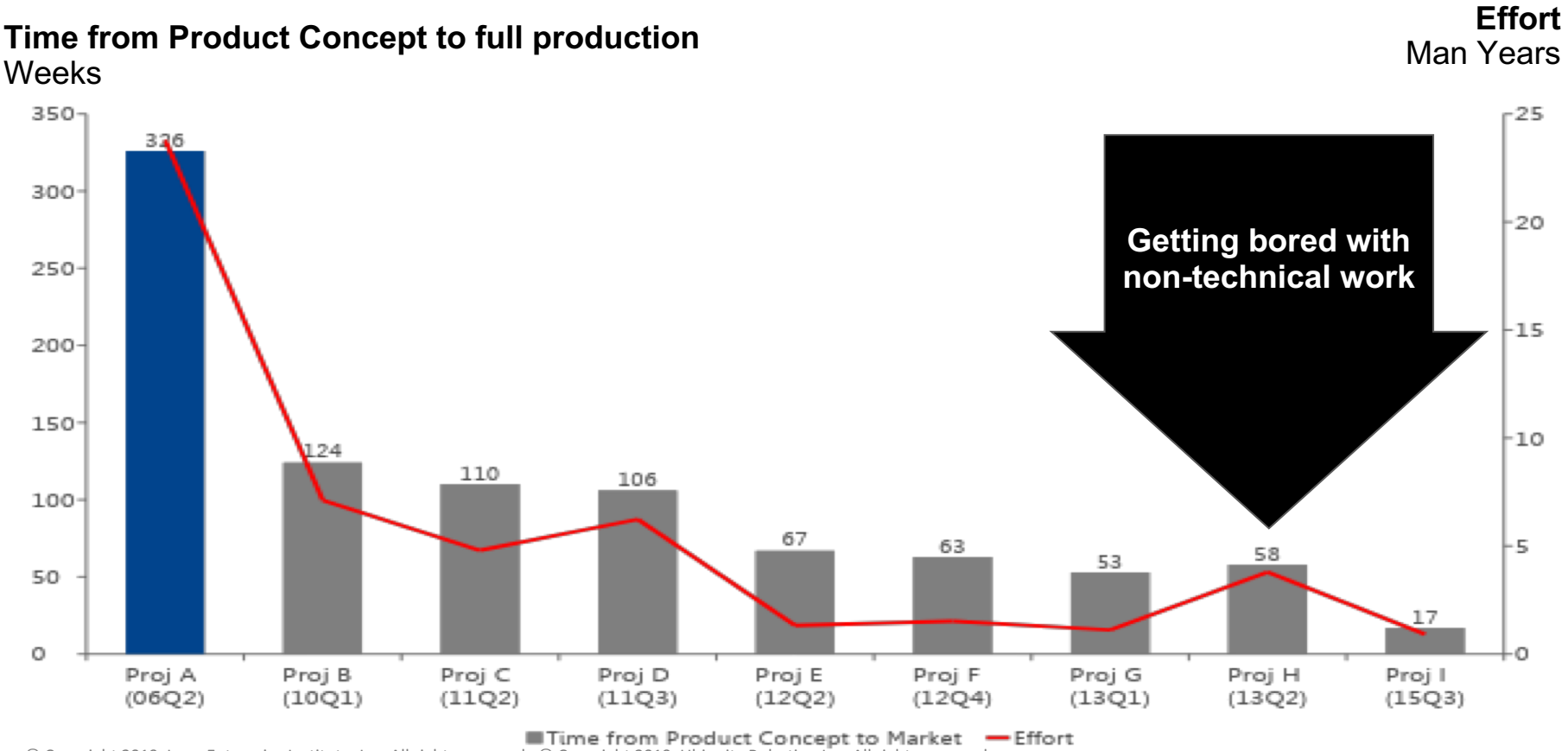
Before robotics I was improving PD lead times



The “Herman Hauser” Challenge

Build a product and bring it to market with no money and no resources

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Step 1: Identify an interesting problem

Ubiquity Robotics Problem Statement

Ultimate Goal

Create a low cost robotics platform with meaningful capability to enable a broad range of applications

Current Situation

Current generic robots are costly -$1500 for turtle-bot, between $2-10K for telepresence robots. These robots have limited functionality, with short endurance (45mins for turtle-bot) and small payloads (a few lbs)

Desired Situation

A robot that costs <$500 to build and thus can be sold for <$1000 can handle substantial payloads (>50lbs) and can go anywhere in the built environment (anywhere that is ADA compliant) and navigate for several hours.

Problem Statement

How can we build a robot with high endurance, payload, vision and navigation capabilities for $<500.

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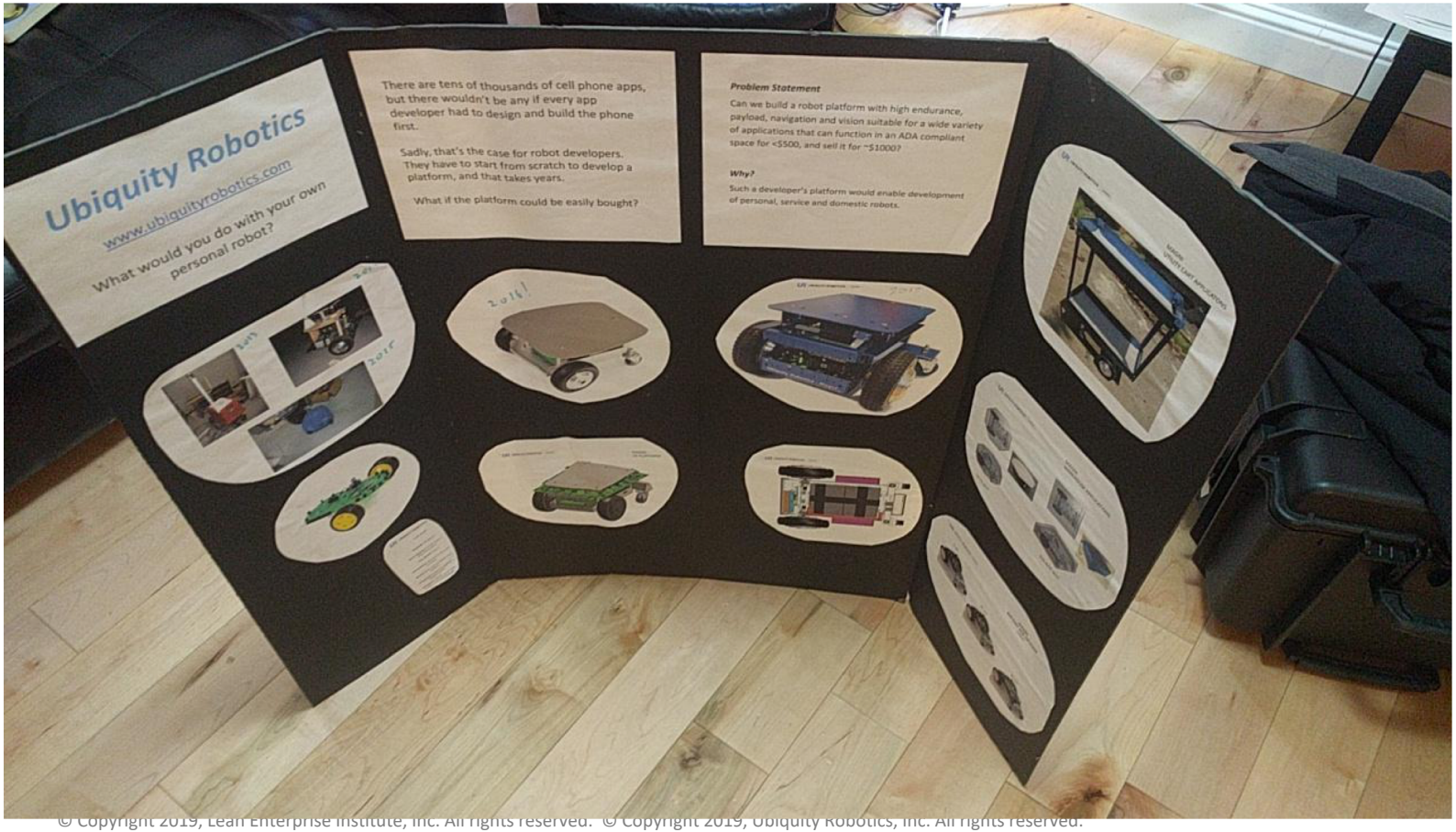
The board of seduction



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Step 2: Build an interesting team

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Recruiting for a “bet the company” innovation initiative

Method A	Method B
-Put out an attractive job advert to get many candidates -Winnow down candidates through a selective interview process -Offer an attractive compensation package -Usher them through the best parts of your campus -Require normal levels of administrative duties	-Talk only about the tough engineering challenge -Be completely non-selective anyone can participate only those who like hard engineering problems stay -Offer them no salary only really hard engineering problems -Show the candidates the most chaotic corner of your local hacker space -Try to eliminate all administrative work “More hacking less yakking”

ROBOTICS

Some of the people we recruited

Wayne Gramlich

-Compiler Designer
-Eric Schmitt's former technical lead
-President of Homebrew Robotics
-40 Years in technical design

Fun Fact: Wrote his own variant of the C programming language designed a compiler and then wrote an entire codebase in this new language that no-one else understood

Rohan Agrawal

-Building robots since age 8.
-Featured on multiple national news outlets for robot exploits.
-Coding professionally since he was 13 years old at Willow Garage, Savioke, OSRF and Google

Fun Fact: Developed new method for digital transmissions in the VHF age 14.

Alan Federman

-30 years building robots
-Physical Sciences PhD
-Ex-NASA.

Fun Fact: built the first video conferencing systems on the Web

Bill Preetz

-Former Lockheed Martin.
-Attitude control engineer for Hubble.

Fun fact: Every system he built for Ubiquity robotics he tried out in space first

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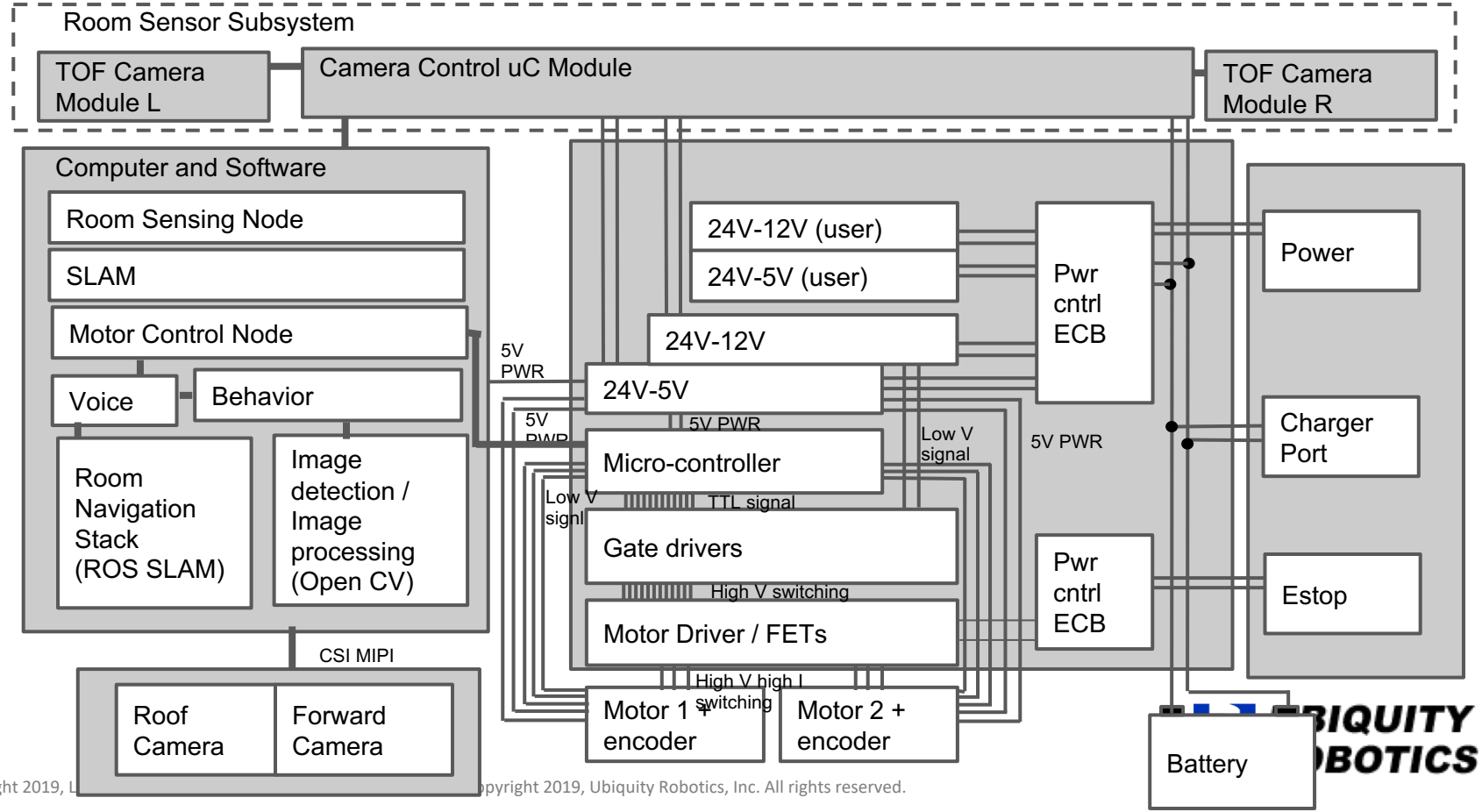
Step 3: Break the problem down

Basic Architecture

To get started go to:
www.ubiquityrobots.com
-> Wiki
-> Epics for project



Montessori Boxes

Necessary Hardware

Link to wiki-page & Repo

Architecture diagram with area of interest circled

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Step 4: Create and manage learning cycles

Knowledge Repository

NEW Convert your site to the new Google Si

5.3) Design Calcs Updated Feb 12, 2013, 9:42 PM

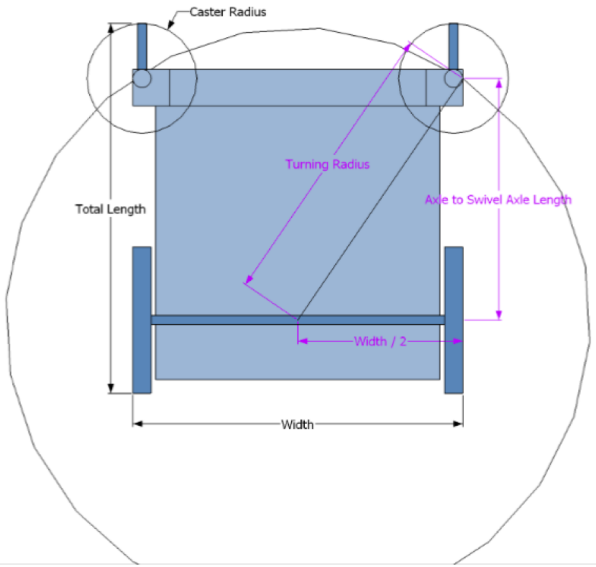
Ubiquity Robots

- Problem Statement
- Actions and other Trellos
- Epics for Project
  - 1) Computer / Operations
  - 2) Navigation
  - 3) Vision
  - 4) Main Control System - Electro Mechanical
  - 5) Mechanical Design
  - Robots
  - Room Sensor
  - System Integration
- FAQ
- How To Guide
  - How to Drive Herc V3 Around Using XBee or WiFi
  - How to make telepresence work
  - How to run navigation
  - Installing ROS
  - ROS Training
  - Running Pi Face Tracker
  - Running XV-11 LIDAR
- People Involved
- Ubiquity Administrative
  - Backlog Pages
  - Kickstarter Plan
  - Kickstarter Publicity Plan
  - Parts ordering / BOMS
  - Problem Breakdown
  - Records and Accounts
  - Reference and Useful
  - Standard Method For Running Meetups
  - Target Problems
- Videos, Photos, &

Epics for Project > 5) Mechanical Design >

5.3) Design Calcs

The calculation below show the maximum length for the robot for a given width in order to meet the required turning ra
the ground. The data is presented in tables below.



https://sites.google.com/site/ubiquityrobots/container-ship-of-projects/mechanics/53-design-calcs/Turning sketch.png?attredirects=0

Robot Sizing Calculation

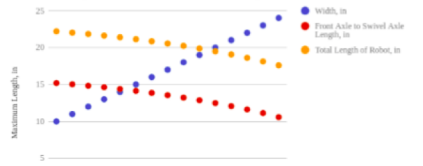
Width, in	Front Axle to Swivel Axle Length, in	Total Length of Robot, in	Side Tipping moment, ft-lb	Front Tipping Moment, ft-lb	Back Tipping Moment (Casters reversed), ft-lb	Base Area, ft^2
10	15.2	22.2	4.2	6.3	5.1	1.54
11	15.0	22.0	4.6	6.3	5.0	1.68
12	14.8	21.8	5.0	6.2	4.9	1.82
13	14.6	21.6	5.4	6.1	4.8	1.95
14	14.4	21.4	5.8	6.0	4.7	2.08
15	14.1	21.1	6.3	5.9	4.6	2.20
16	13.9	20.9	6.7	5.8	4.5	2.32
17	13.6	20.6	7.1	5.6	4.4	2.43
18	13.2	20.2	7.5	5.5	4.3	2.53
19	12.9	19.9	7.9	5.4	4.1	2.62
20	12.5	19.5	8.3	5.2	4.0	2.71
21	12.1	19.1	8.8	5.0	3.8	2.78
22	11.6	18.6	9.2	4.8	3.6	2.84
23	11.1	18.1	9.6	4.6	3.4	2.89
24	10.6	17.6	10.0	4.4	3.2	2.93

Chosen Width:	18.0
Calc CM to Front Dist, inches	6.6
Chosen CM Height, inches	12.0
CM Angle	61.1
CM Distance	13.7

Calc | Deceleration | Tipping Chart | Width Chart

Open Robot Sizing Calculation

Length Chart



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Set Based Methods: Localization

	Description	Cost	Local Performance	Long Range Performance
Typical Lidar Based	Use LIDAR sensor + wall matching to localize	~$1.2K		
Low Cost Lidar Based	Use low cost LIDAR sensor + wall matching to localize	$400		
Array Sensor	Build array of low cost sensors use AI to “synthesize” LIDAR like data use wall matching	$100		
Ceiling Lights	Use ceiling lights like stars to localize	$25		
Fiducial Markers	Use QR code like fiducial markers to localize	$25		

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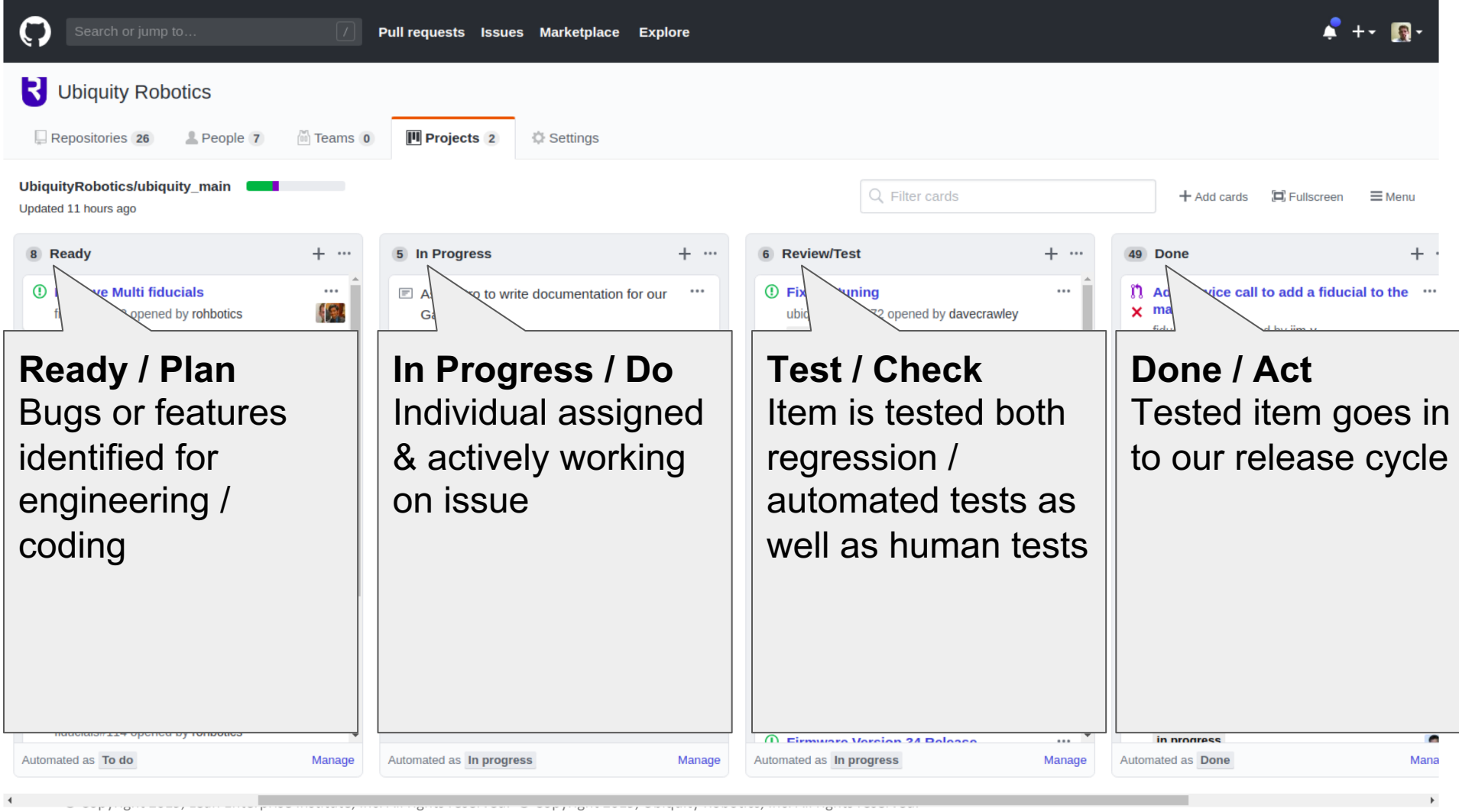
Search or jump to…
Pull requests
Issues
Marketplace
Explore
Ubiquity Robotics
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People 7
Teams 0
Projects 2
Settings
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Updated 11 hours ago
Filter cards
Add cards
Fullscreen
Menu
8 Ready
ve Multi fiducials
opened by rohbotics
5 In Progress
to write documentation for our
6 Review/Test
uning
72 opened by davecrawley
49 Done
ice call to add a fiducial to the
Ready / Plan
Bugs or features identified for engineering / coding
In Progress / Do
Individual assigned & actively working on issue
Test / Check
Item is tested both regression / automated tests as well as human tests
Done / Act
Tested item goes in to our release cycle
Automated as To do
Manage
Automated as In progress
Manage
Automated as In progress
Manage
Automated as Done
Mana

Project Management in Action

- PDCA cycle visible publicly
- Anyone worldwide can add an issue
- Resolution of issues visible to all
- Anyone can take up and resolve any issue
- Incorporation in to build cycle only by Ubiquity Robotics build manager
- Weekly review

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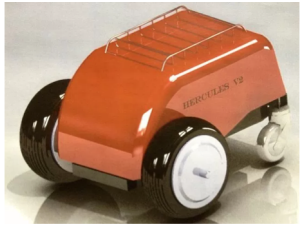
Step 5: Do it again but more simply

Iterate

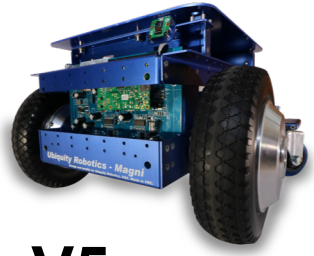
V1



V2

V3

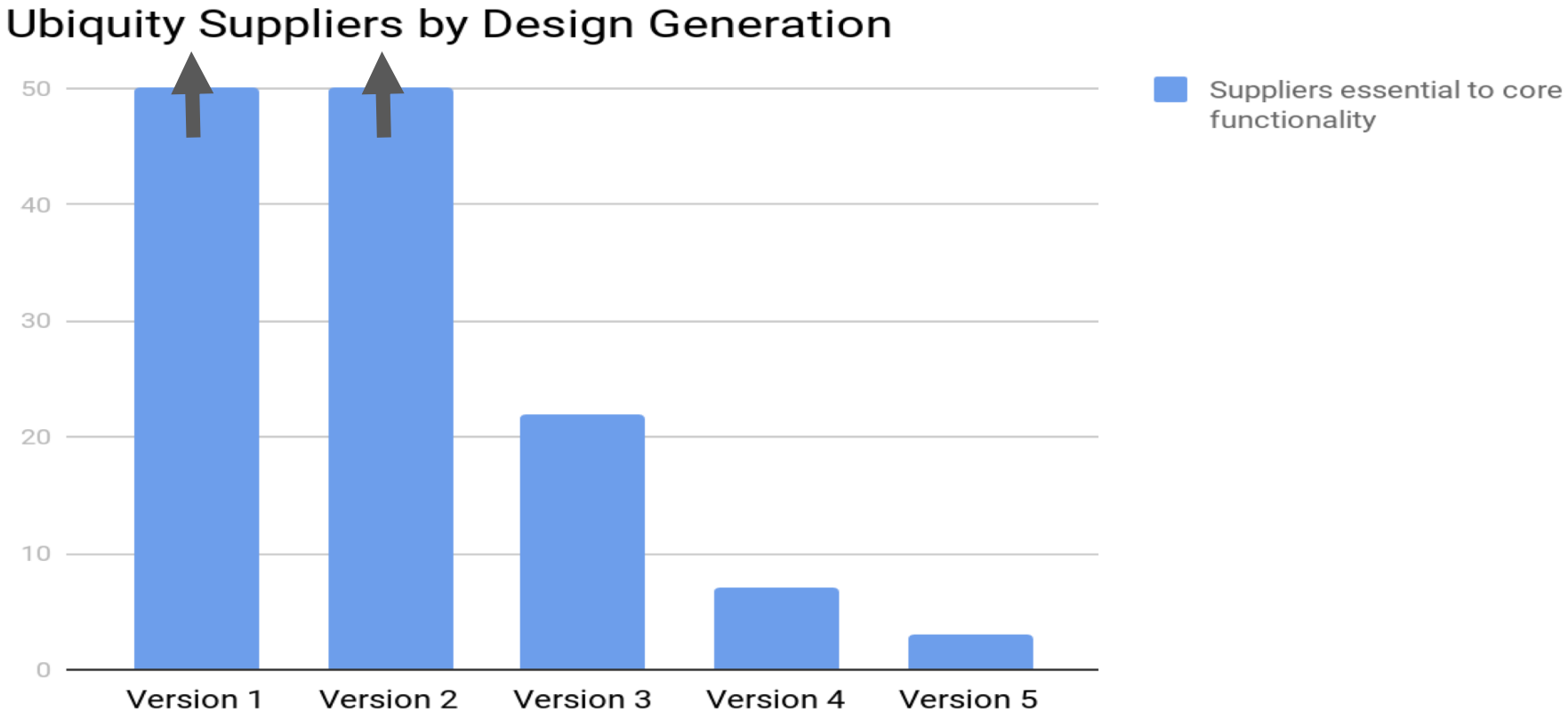
V4



V5

V5 UBIQUITY ROBOTICS

Supplier Reduction



"Simplify, then add lightness”

Colin Chapman

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Key learnings

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Key Learnings

Articulating an interesting problem is more important than gathering resources

Independent challenge is more useful than direction

The best people aren't in it for the money

A proper learning cycle helps you move faster

Simplify and add lightness is a useful mantra

"Practice not-doing and everything will fall into place" - Lao Tzu

UBIQUITY ROBOTICS

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