



Robotic Arm Platform

TEAM VICTORY LAP

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Introduction

Suez Water Advanced Solutions is a water service provider that focuses on providing clean drinking water and wastewater management

Provides water services to 7.5 million people

Maintain over 6,000 water tanks to provide service



Market Research

Maintaining tanks requires sandblasting and repainting

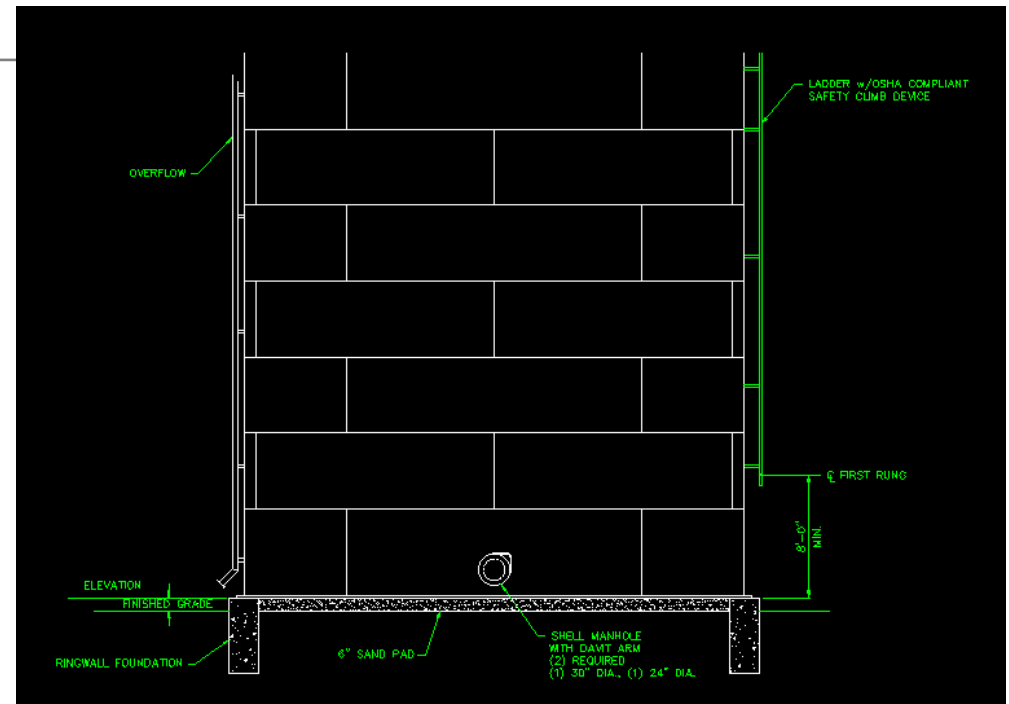
Tanks cleaned every 8-10 years

Clean over 100 tanks per year

Cost per tank: \$50K-\$200K

Time required: 4 weeks

SABRE's autonomous arm increases sandblasting efficiency by 70%



Problem Statement

The current process for sandblasting and painting water tanks is inefficient and costly to the company.

SABRE's autonomous sand blasting arm provides an opportunity to reduce cost and downtime associated with cleaning the water tanks.

There is no current way to support and mount the autonomous arm rendering the robot useless to Suez.

Capstone Project: Suez Water Advanced Solutions requires a stable platform to support SABRE's autonomous robot arm while the machine is sandblasting. The platform should be able to be repositioned, via remote control, in order to sandblast the floor and vertical walls of the tank.

Sabre Autonomous Solutions



Customer Requirements and Specifications

Requirements

- Support 25kg robotic arm
- Resist movement and rotation
- Easily assembled/maneuvered

Potential features

- Remote control in horizontal plane
- Vertical reach to higher elevation

Constraints

- Must fit 30" diameter entry hatch
- Powered by 120V single phase generator (if applicable)



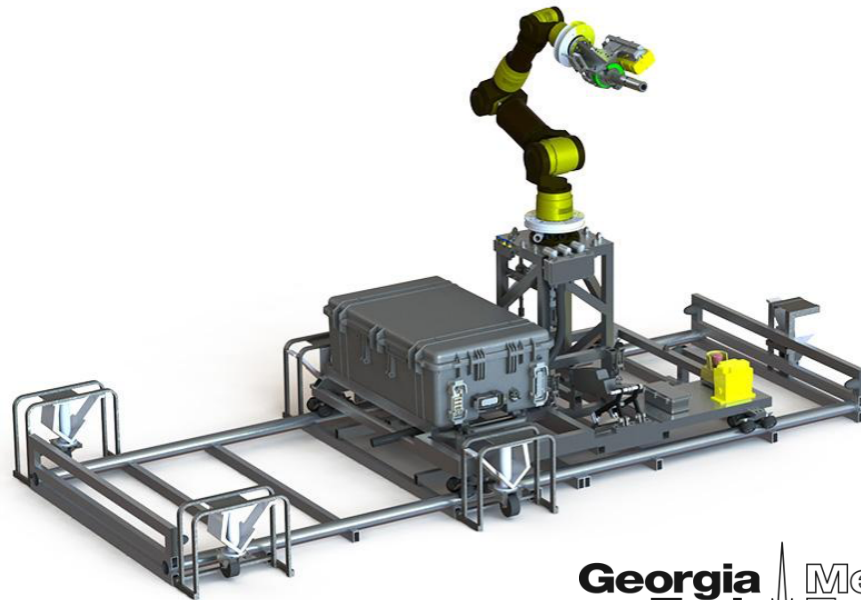
Current Applications

Relevant expired patents

- US4518437A: Method for underwater cleaning of water tanks
- US3527336A: Guide Rail system for moving device horizontally and vertically

Robotic arm mounting solutions

- Fixed frame mount
- Rail system
 - Current Sabre solution



Capstone Proposed Solutions

The following concepts were developed to address the requirements and constraints of the project:

1. Rail Guided Solution
2. Elevated Platform Solution
3. Wall Climbing Solution
4. Modular Scaffolding Solution
5. Outrigger Solution

Rail Guided Solution

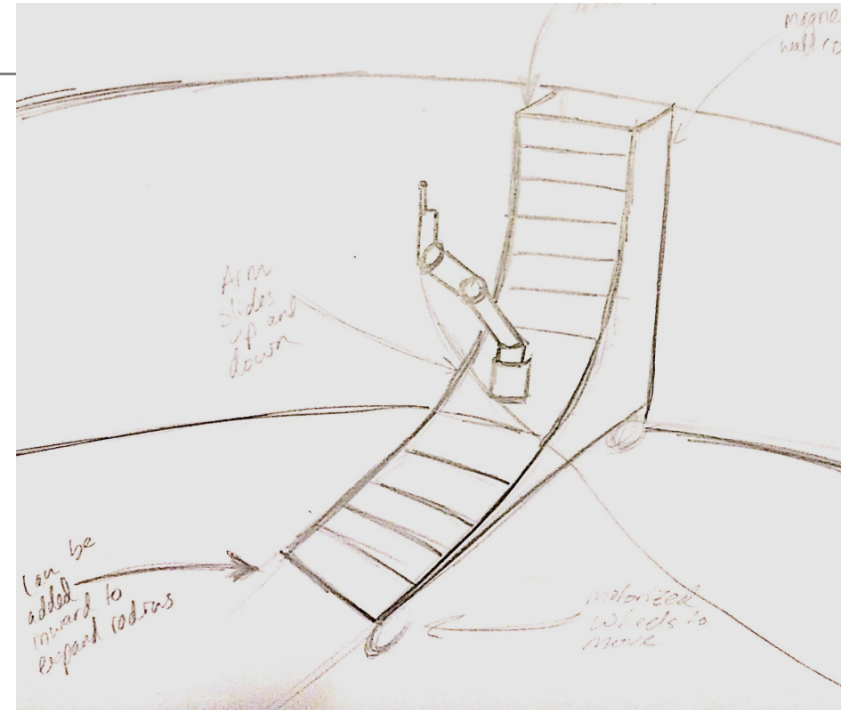
Inspiration: Library ladder, roller coasters

Positives:

- Relatively easy locking
- Modular for different tanks
- Arm reaches multiple heights

Negatives:

- Requires decent assembly in tank
- Complicated build with many parts



Elevated Platform Solution

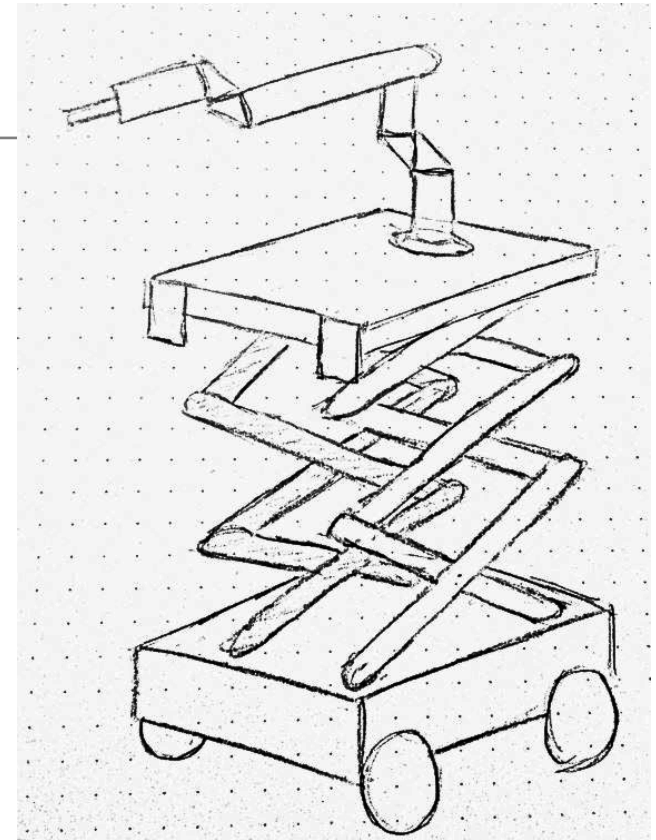
Inspiration: Scissor lifts

Positives:

- Vertical mobility
- Controlled remotely from outside of the tank

Negatives:

- Compromised stability during blasting
- Difficult to apply to tall tanks
- Difficult to disassemble



Wall Climbing Solution

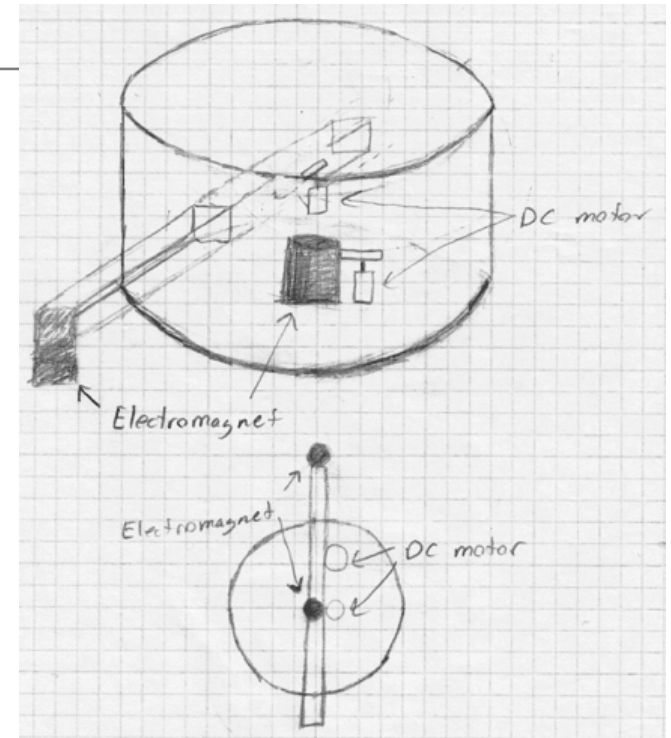
Inspiration: Lizards, research robots

Positives:

- Small, portable
- Access to all surfaces of any tank
- Limited human interaction required

Negatives:

- Relatively difficult to build
- Power failure will likely result in destruction of robot and arm



Modular Scaffolding Solution

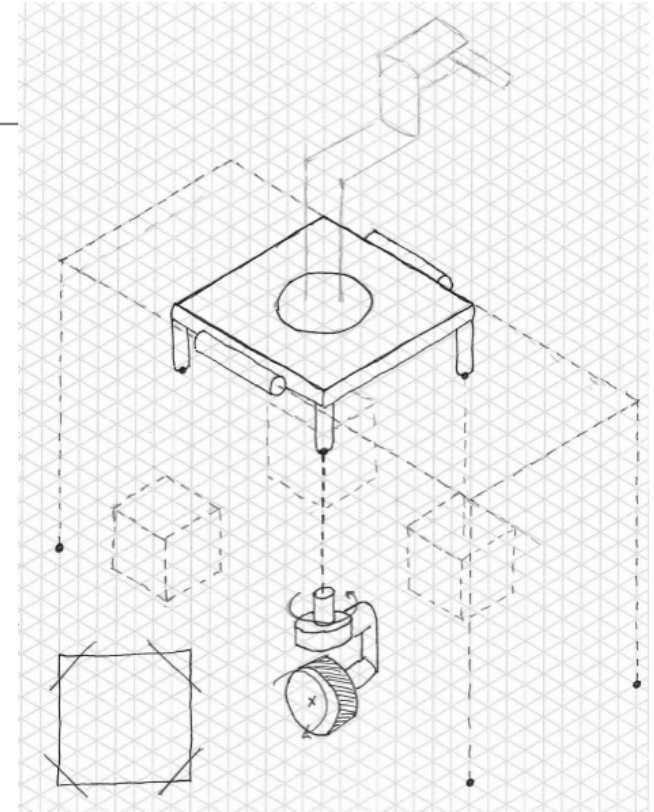
Inspiration: Construction scaffolding

Positives:

- Vertical mobility
- Modular system for height capabilities
- Breaks to small components
- Simple position locking with wheel positioning
- Commercially available components

Negatives:

- Manpower needed to build next level
- Arm needs to be lifted to next level
- Possible instability at tall heights



Outrigger Solution

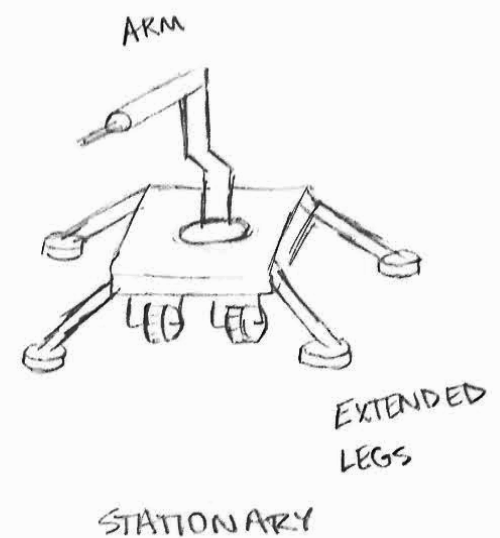
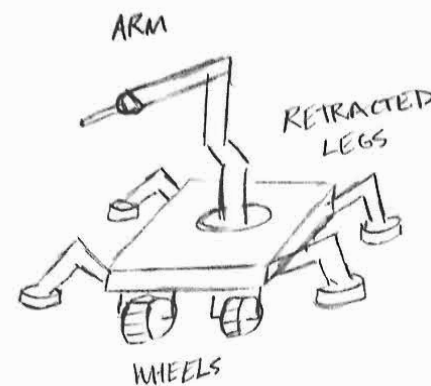
Inspiration: Cranes, ladder trucks

Positives:

- Stability with multiple legs
- Relatively simple motions

Negatives:

- Hydraulics to operate legs
- Limited vertical height capability



Design Selection and Justification

Table to be updated and inserted here

Conclusion

Discuss design proposals with Suez Water Advanced Solutions

Design review with Dr. Lipkin

Feasibility analysis

Preliminary CAD

Material Selection

References

- Jason Saylor

 - Suez Engineering Director
- Water tank picture:
 - https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwiZ-o2E1J7PAhXHJiYKHQj-ASQQjB0IBg&url=http%3A%2F%2Fnavajopublicwater.org%2Fpublic_notification&psig=AFQjCNEBbuwuHPxV64BAAdjf2Sc8b_tQFDg&ust=1474485308571289