Passively Rotating Living Wall for Soilless Agriculture

Overview
With rising populations of cities, the availability of fresh, local food is a major concern for the near future. Rotating vertical gardening systems allow all the plants to have an equal amount of sunlight while using less space than a normal horizontal garden. GreenTowers, LLC has built and tested five Rotating Living Walls, which are soil based vertical growing systems, and tasked the project team with developing a soilless system.

Objectives
Develop a soilless (hydroponic) rotating vertical gardening system to show major investors and sell to commercial greenhouse producers. Essentially, the weight of the water should drive the rotation of the wall, allowing for equal sunlight distribution and ease of access.

Approach
- Throughout the course of the project, the team was in close contact with GreenTowers, LLC. They provided customer needs and helped the team solve problems that arose.
- The team used Analytical Hierarchy Process and Quality Function Deployment to determine the weight of customer needs and relate these needs to product specifications.
- Through a patent search, the team discovered that there are a small amount of businesses working on vertical gardening, however there are none focusing on rotating hydroponic vertical gardening systems.
- After coming up with many concepts, the final concept was chosen by using a Pugh Concept Scoring Matrix. This concept best fit customer needs and the team began construction of the prototype.
- CAD models were made and prototypes were constructed from them. Both went through many iterations because changes needed to be made from problems that arose.
- The system was split into different subsystems in order to narrow the scope of each step of construction: the pipe system, frame, track system, wheel carriages, solenoid valves, and plant beds.

Outcomes
The team created a five foot prototype that GreenTowers, LLC can adjust as seen fit by vertically scaling it up, and it can be taken investors and customers to promote the product. The prototype uses a wheel and track system that the beds rotate on and a pumping system with a manual valve and solenoid valves to control the flow of water throughout the system. With this prototype, GreenTowers, LLC can change the food industry by growing more food, in less space.