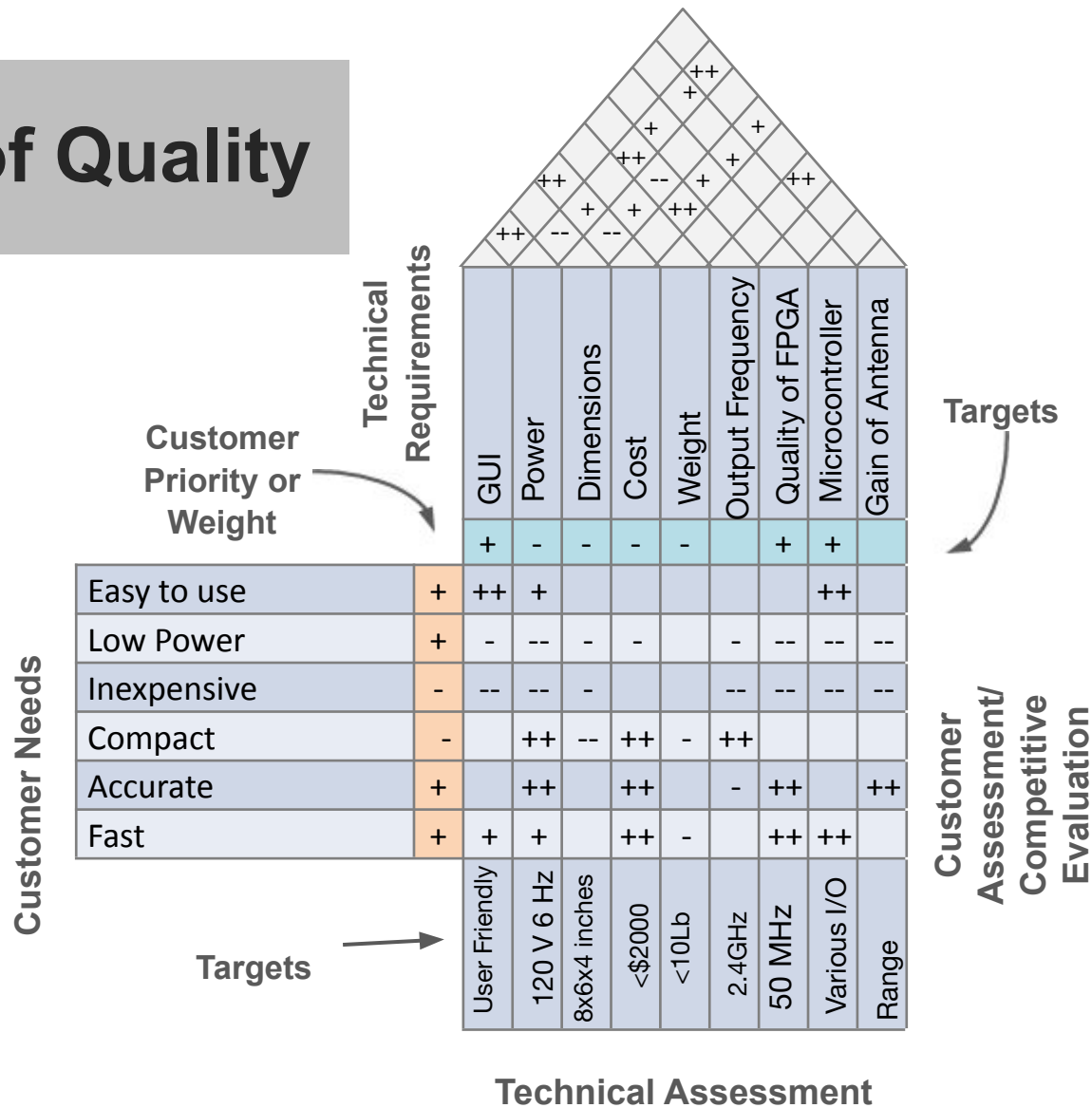# Concept Selection

Senior Design Team 311
FPGA Enhanced Digital Beam Steering Phased Array

House of Quality

House Of Quality Explanation

- **Easy to use** - Strong positive correlation with the GUI and the microcontroller because the GUI will be how users input values into the system and the microcontroller will offer input options like joystick or voice-control.
- **Low Power** - Overall had very low priority will all technical requirements as power supply will not be a big problem.
- **Inexpensive** - Strong negative correlation with GUI, input power, output frequency, quality of FPGA, microcontroller and the gain of the antenna. These devices are more expensive for a higher quality product that is reliable.
- **Compact** - Strong positive correlation with power, cost, and output frequency because with the frequency being at 2.4 GHz, the size of the spacing of the antennas will be relatively small.
- **Accurate** - Strong positive correlation with power, cost, quality of FPGA, and quality of antenna. Over almost everything, accuracy is extremely important as without accuracy, the whole project would be a complete waste of time and money.
- **Fast** - Strong positive correlation between GUI, power, cost, quality of FPGA, and Microcontroller. Overall, speed will be key here as the faster the FPGA and MCU, the quicker that the project can function.

FAMU-FSU Engineering

ELECTRICAL ENGINEERING

Analytical Hierarchy Process (AHP)

	Ease of Use	Compactness	Weight	Accuracy	Speed	Mean $\sqrt[n]{\prod a_i}$	Weights
Ease of Use	1	3	5	1/7	1/5	0.844	0.103
Compactness	1/3	1	3	1/7	1/7	0.46	0.056
Weight	1/5	1/3	1	1/9	1/7	0.254	0.031
Accuracy	7	7	9	1	3	4.21	0.515
Speed	5	7	7	1/3	1	2.412	0.295

AHP Explanation

- **Accuracy** - The most heavily weighted criteria. Thus, maximizing all other criterias leads to a functionally accurate system. For the design to be functional, it must accurately detect frequencies within in the beams range. Otherwise if we are detecting false signal, the functionality of our system is compromised.
- **Speed** - Apart from accuracy, this is an extremely important criteria, for the faster the FPGA and MCU, the faster the beam can shift and therefore the faster the experiment will be able to advance. Compactness and weight efficiency are direct improvements to speed.
- **Ease of Use** - A simple design with minimum controls allows for advancement in compactness and weight. Minimal controls leads to a compact design and lighter weight. A lighter weight will not require as much processing power whereas a compact design leads to enhanced overall efficiency.
- **Compactness** - Although compactness is not weighted heavily, its impacts should not be underestimated. A compact design leads to a simpler ease of use, and becomes more efficient when considering accuracy and speed.
- **Weight** - The least heavily weighted criteria. The design is aimed to be a size that can fit into a shoe box. The weight of the design is not significant, however, the design will ensure to not be above a weight where the design requires more processing power.

Pugh Chart

		Digital Antenna Array	Digitized Antenna Array	Analog Antenna Array
Ease of Use	0.103	-	0	-1
Compactness	0.056	-	0	-1
Weight	0.031	-	-1	-1
Speed	0.295	-	0	0
Accuracy	0.515	-	-1	-1
Score		0	-0.546	-0.705

Pugh Chart Explanation

- **Ease of Use** - The digital antenna array and digitized antenna array is going to be the easiest to use because you can use a GUI instead of using variable electronic components that the analog antenna array would require.
- **Accuracy** - The digital and digitized systems are going to be more accurate because analog systems can be finicky due to the generation of the signals being physically created.
- **Speed** - The speed throughout all systems will be around the same.
- **Compactness** - Using the digital and digitized systems require a lot less hardware, so it will be more compact than the analog antenna array.
- **Weight** - The weight of the digital antenna array is going to be the lightest because there are the least amount of physical components.

After multiplying by the weights we see that the digital antenna array is the best choice.

ELECTRICAL ENGINEERING

Final Selection

The digital antenna array is the best selection from the pugh chart on the previous two slides. The below figure shows a basic block diagram of how the digital antenna array is going to operate.