

# Product Realization of a Child's Occupational Therapy Device Using NASA's Systems Engineering Processes

*Chris Beckham & Greg Duke, Mentor: Dr. Christina Carmen*  
*Mechanical and Aerospace Engineering (MAE) Department*

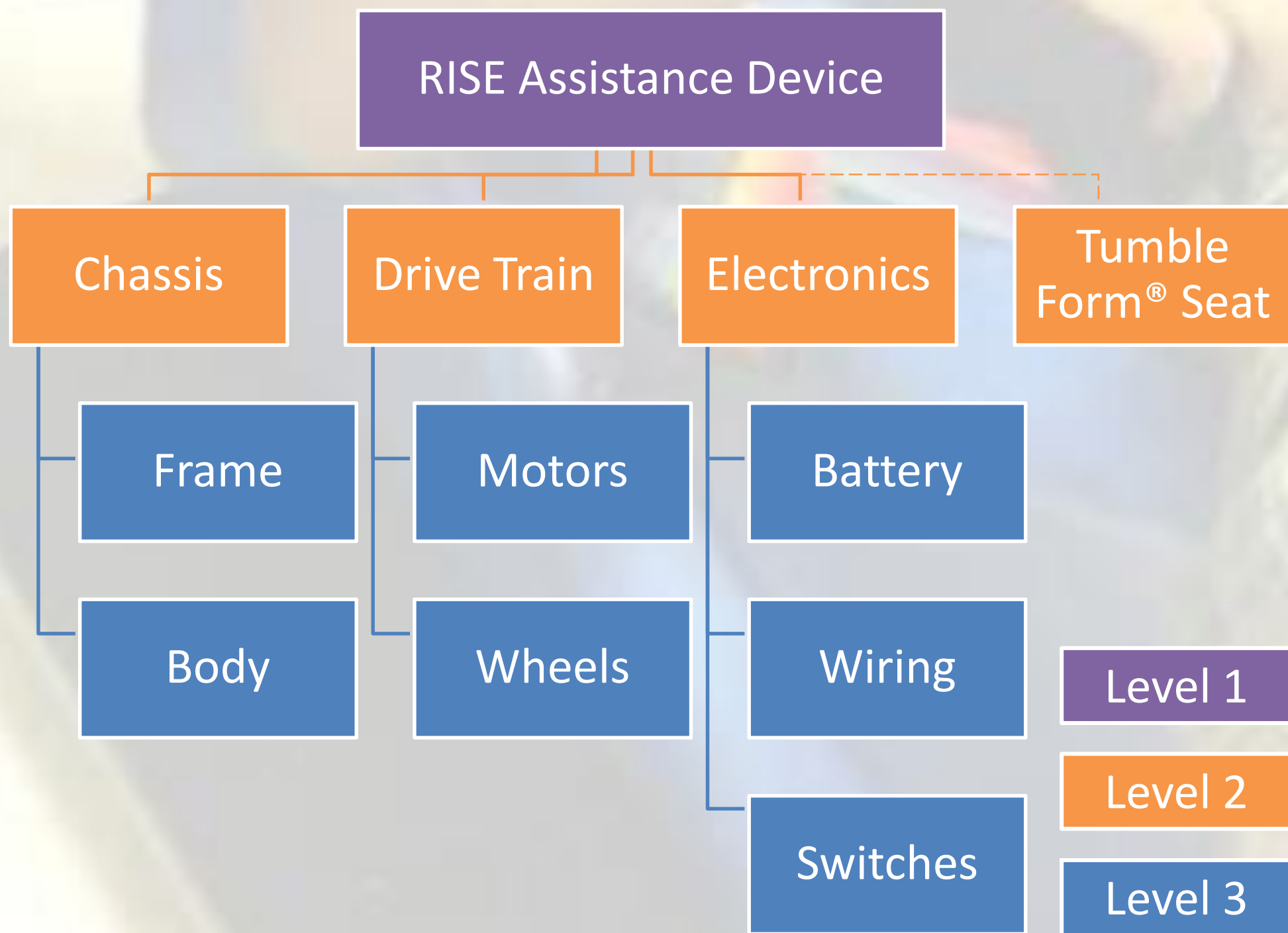
## Overview

- A student design team from the MAE Department will design and develop a product to assist a four-year-old Rural Infant Stimulation Environment (RISE) School student who possesses a physical disability gain independent mobility.
- The RISE Assistance Device (RAD) will have an electric powered differential drive that will be operated by the RISE student's feet.
- The RAD will incorporate the RISE student's favored Tumble Form® seat.

## Methodology

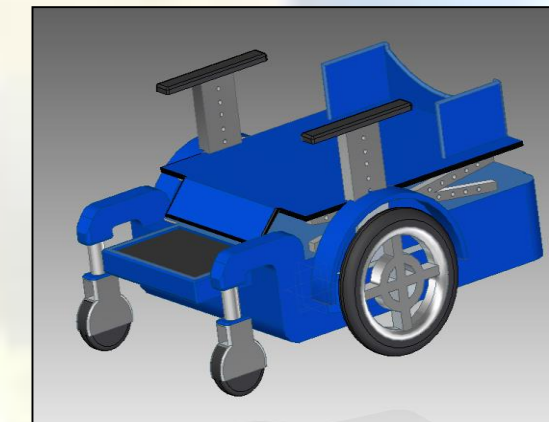
The student design team will utilize the National Aeronautics and Space Administration (NASA) Systems Engineering Handbook to guide the following processes:

- Product Development Schedule
- Customer Questionnaire
- Market Surveys
- Patent Searches
- Benchmarking
- Product Requirements Document
- Concept of Operations
- Product Breakdown Structure
- Evaluation Matrices
- Technical Analyses
- Risk Assessment with Mitigation
- Manufacturing Process
- Hardware/Software Test Plans
- Cost Analysis
- System Definition Review
- Preliminary Design Review
- Critical Design Review



Product Breakdown Structure

**Adjustable Height Concept #1**  
 • Adjustable height via scissor system



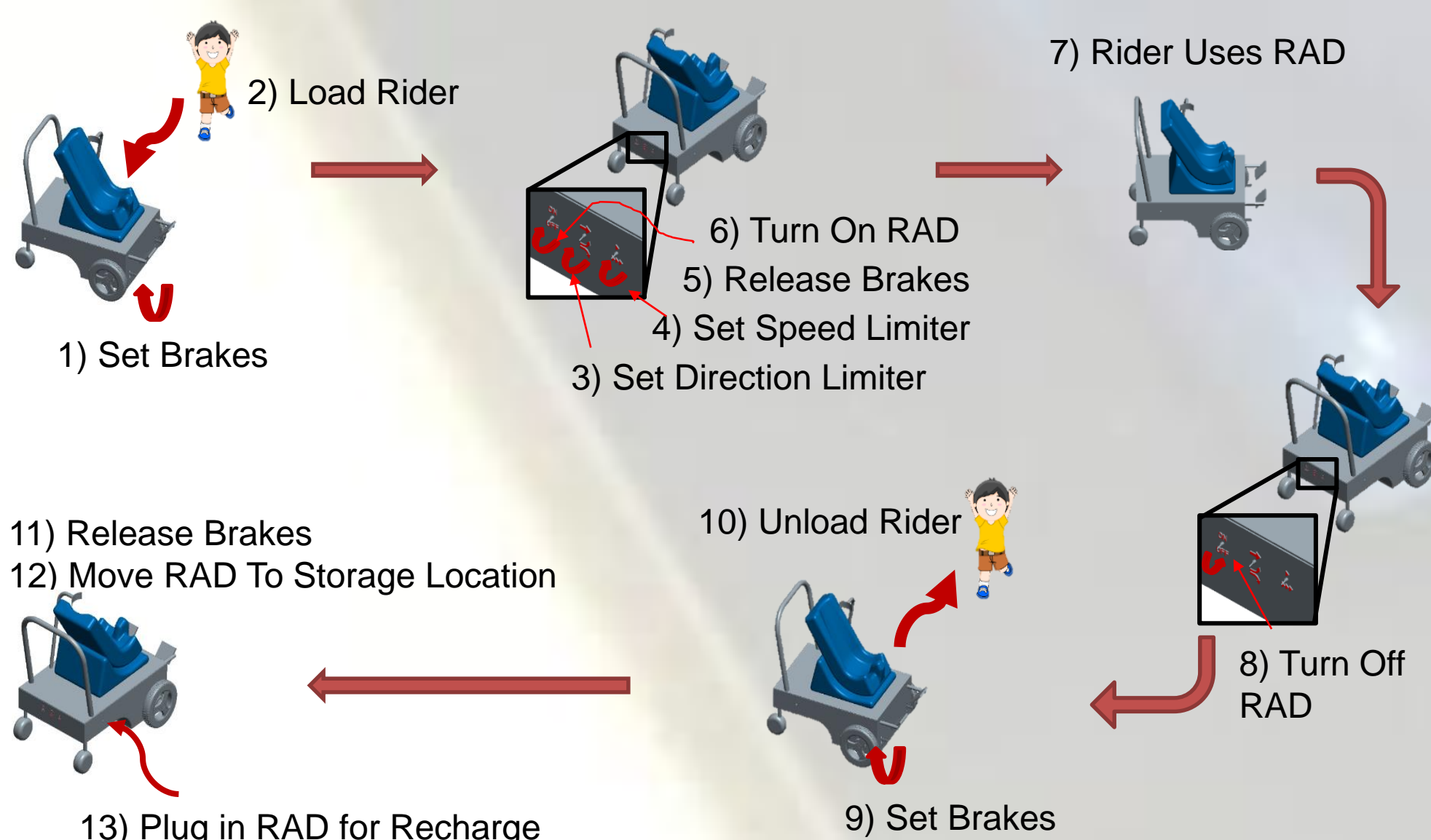
**Sheet Metal Body Concept #2**  
 • Sheet metal construction  
 • Independently hinged leg controls

**Molded Body Concept #3**  
 • Fiberglass or composite body  
 • Prevalent Safety Features



**Front Wheel Drive Concept #4**  
 • Fully integrated motor in each wheel assembly  
 • Front mounted drive system

Concept Designs



Concept of Operations

RISE Assistance Device System-Level Concepts				Adjustable Height Concept #1	Sheet Metal Body Concept #2	Molded Body Concept #3	Front Wheel Drive Concept #4
CRITERIA	Mandatory (Y=1/N=0)?	Weight	SCALE (1-3)				
Design complexity	0	20%	3=Least complex 1=Most complex	1	3	2	3
Maintainability	0	10%	3=Easiest main. 1=Most difficult main.	1	2	2	3
Performance	0	12%	3=Best performance 1=Worst performance	2	2	2	3
Safety	1	27%	3=Most safe 1=Least safe	2	2	3	2
Cost	0	12%	3=Lowest cost 1=Highest cost	1	3	2	1
Aesthetics	0	7%	3=Most appealing 1=Least appealing	2	1	3	2
Reliability	0	12%	3=Most reliable 1=Least reliable	3	2	2	3
<b>WEIGHTED TOTALS in %</b>				56.7%	75.0%	78.0%	80.7%

Evaluation Matrix

## Results

The student design team is ensuring a methodical approach to the design and development of a quality product by learning to apply important concepts that are practiced in industry.

## Impact

The RAD will facilitate an increase in the RISE student's educational and social involvement with his teachers and typical peers and can be shared with many RISE students possessing similar capabilities.

## Acknowledgements

- Team Members: Michael Delp, Adam Elmore, Anthony Jones, Joshua Minott
- Dr. Christina Carmen, UAH MAE Department
- Deana Aumalis, RISE School UAH
- Gerald Lanz, Teledyne Brown Engineering
- Steve Burks, The Boeing Company