Conceptual Design Review

HARRIS

Group 12: Bevel Gear Test Bed

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Customer

- Harris Corporation
  - International communications and information technology company
  - Serves government and commercial markets in more than 150 countries
  - Headquartered in Melbourne, Florida
  - Annual revenues of $5.3 billion and 16,500 employees
    - About 7,000 Engineers and Scientists

Problem Statement

- Harris Corporation ran tests on bevel gears needed for a project
  - They did not achieve the expected standards
- Possible problems
  - Misalignment
  - Anodic coating failure
  - Test bed issues: vibration, heat generation
- Our team needs to design a very accurate bevel gear test bed
  - Used to test a variety of bevel gear sizes and materials

Project Scope

- Methodology
  - Research previous Test Bed designs and the associated calculations
  - Brainstorm on whether to modify existing design or start from scratch
  - Create actual design of the Test Bed
  - Decide whether to buy parts or to machine our own
  - Build a working Test Bed and make adjustments as necessary

Customer Needs

- Main focus of our design
  - Adjustable features
    - Mounting Distance
    - Speed
    - Torque
    - Surface Treatments
    - Shaft Angles
    - Vibration Detection
- Some extended goals
  - Heat Generation
  - Test non-90 degree bevel gears

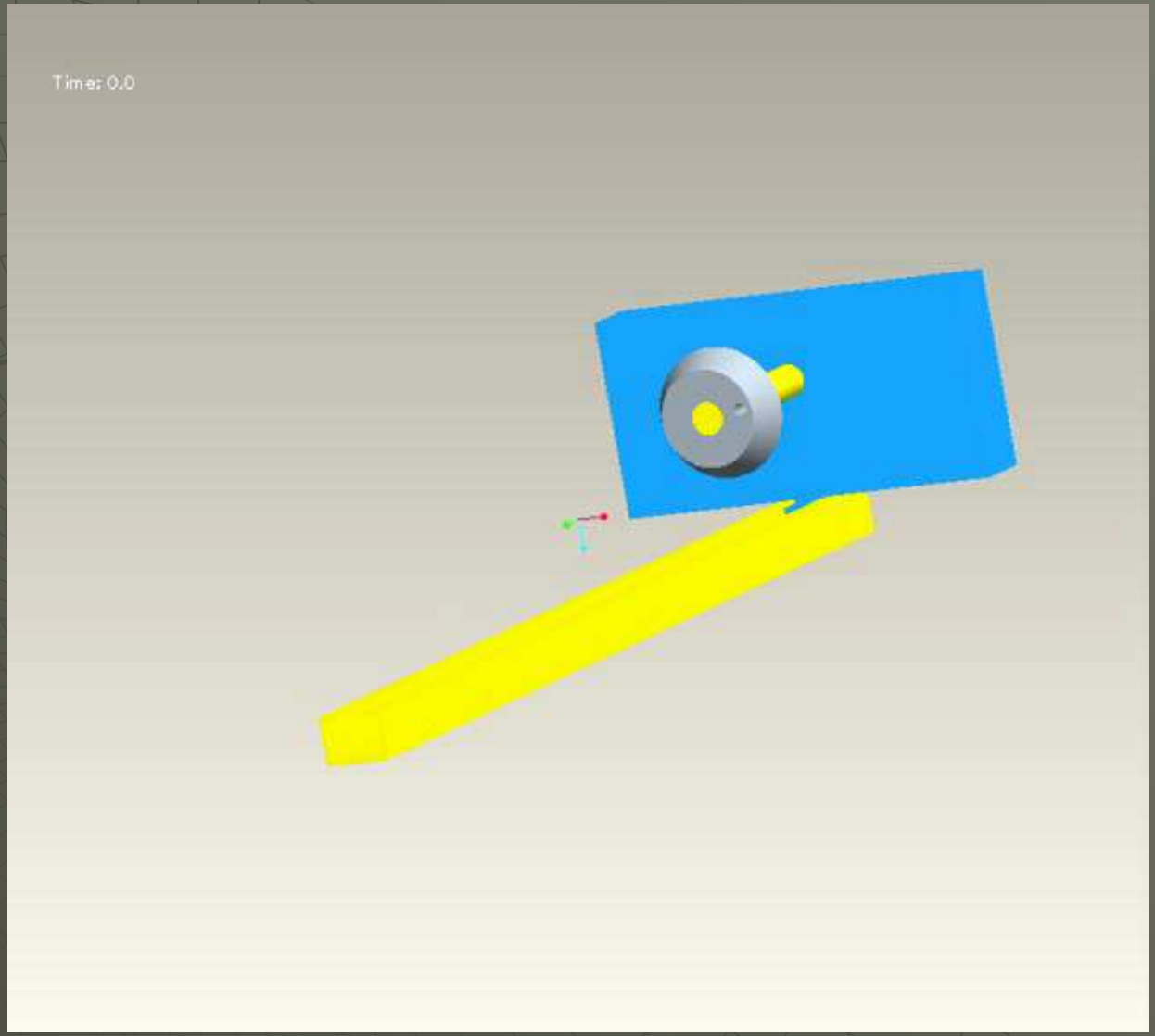
Product Specifications

Specifications	U.S. Units	SI Units
Variable Torque	0 in.-lb - 50 in.-lb.	0 Nm – 5.6 Nm
Variable Speed	0 rpm – 100 rpm	0 rad/s – 10.4 rad/s
Gear Size Range	1/3 in. – 5 in.	8.467 mm – 127 mm
Mounting Distance Accuracy	+/- 0.001 in.	+/- 0.0254 mm
Variable Shaft Angle	+/- 0.5 degrees (0.001 degree increments)	+/- 0.00873 rad

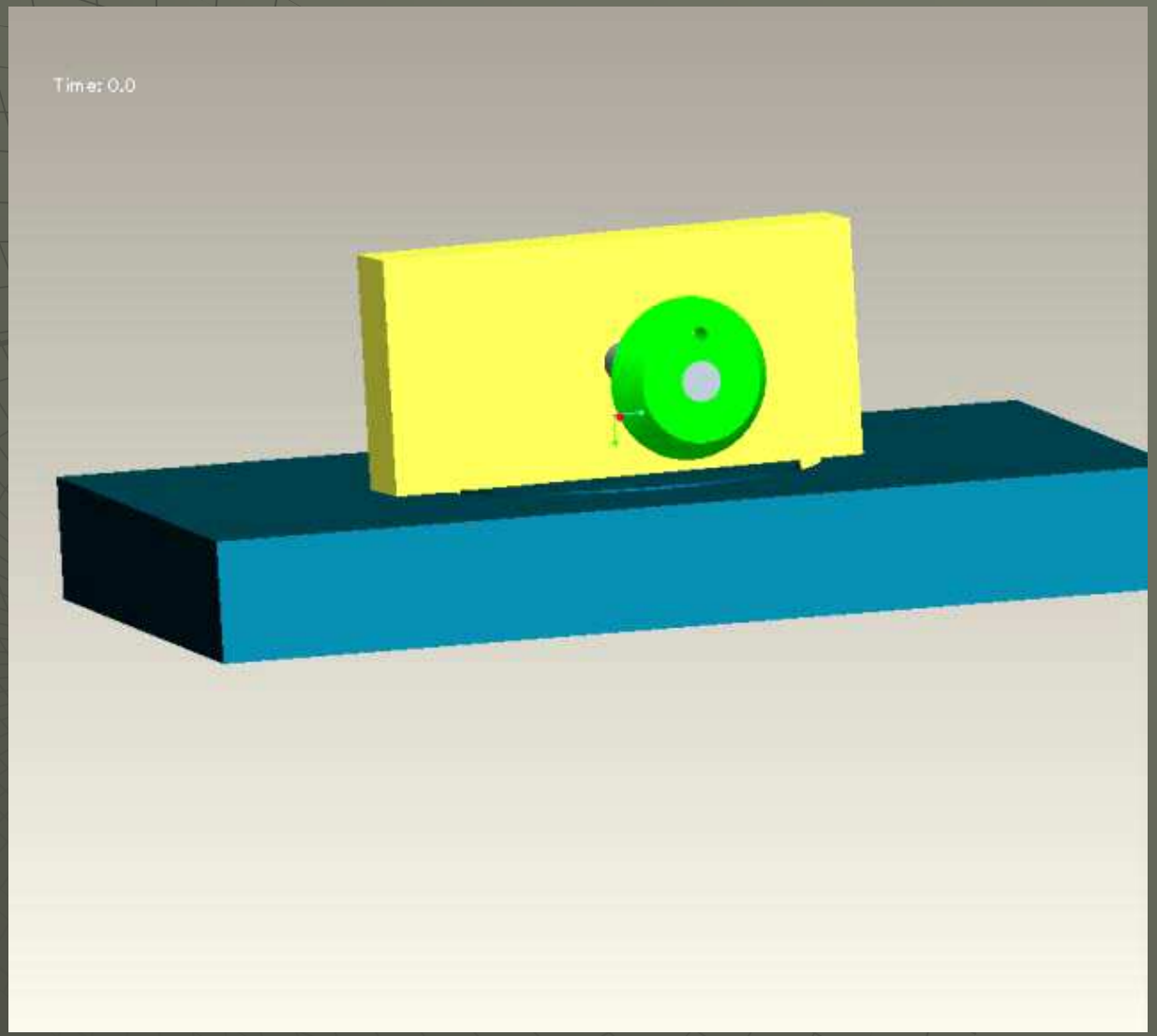
Conceptual Design

- Drawer Slider Concept
- Rotator Concept
- Combination Rotator Slider Concept
- Curved Wall Concept
- Rack and Pinion Concept
- Worm Gear Concept
- Shaft and Gear Connection Concept

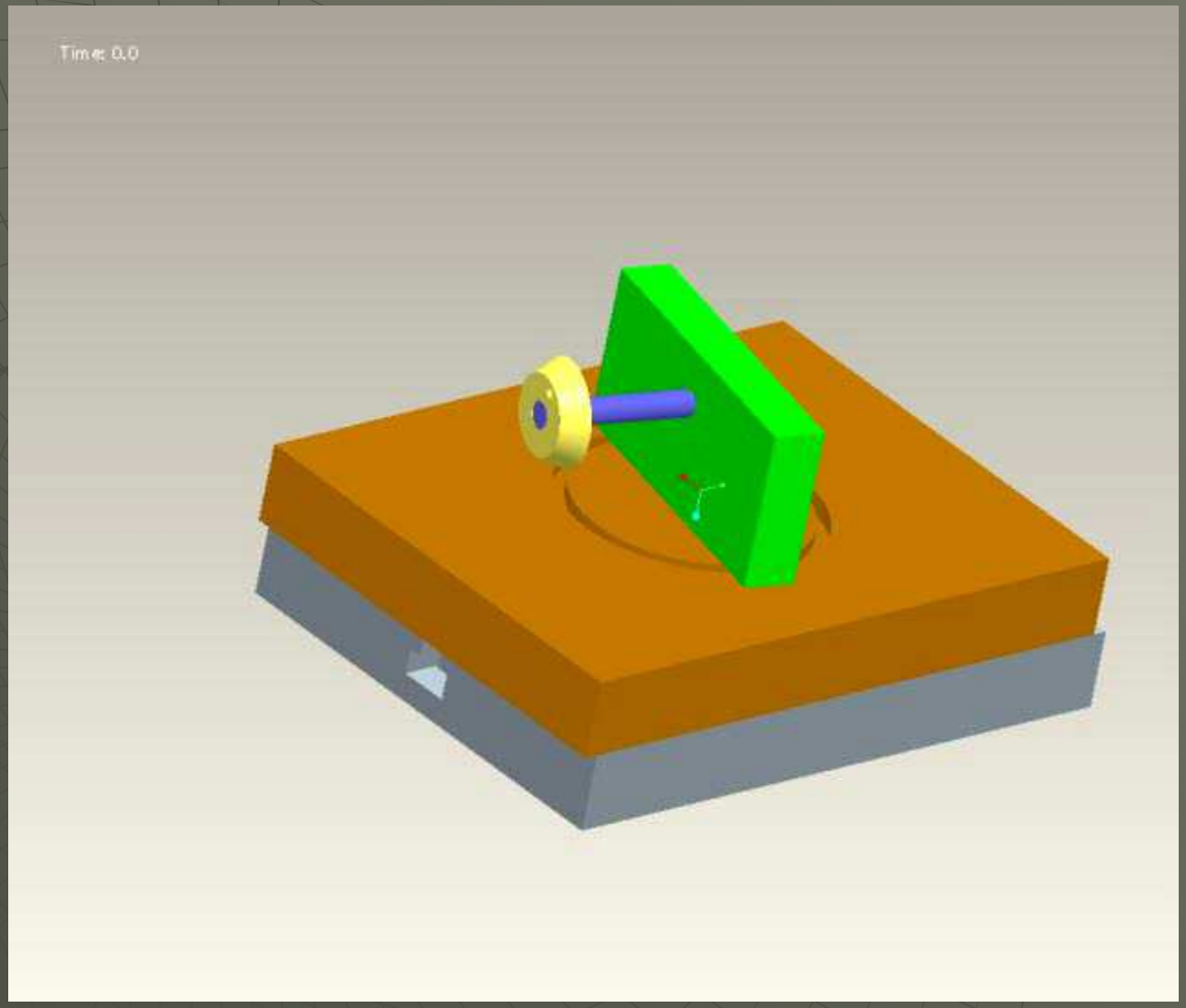
Drawer Slider Concept



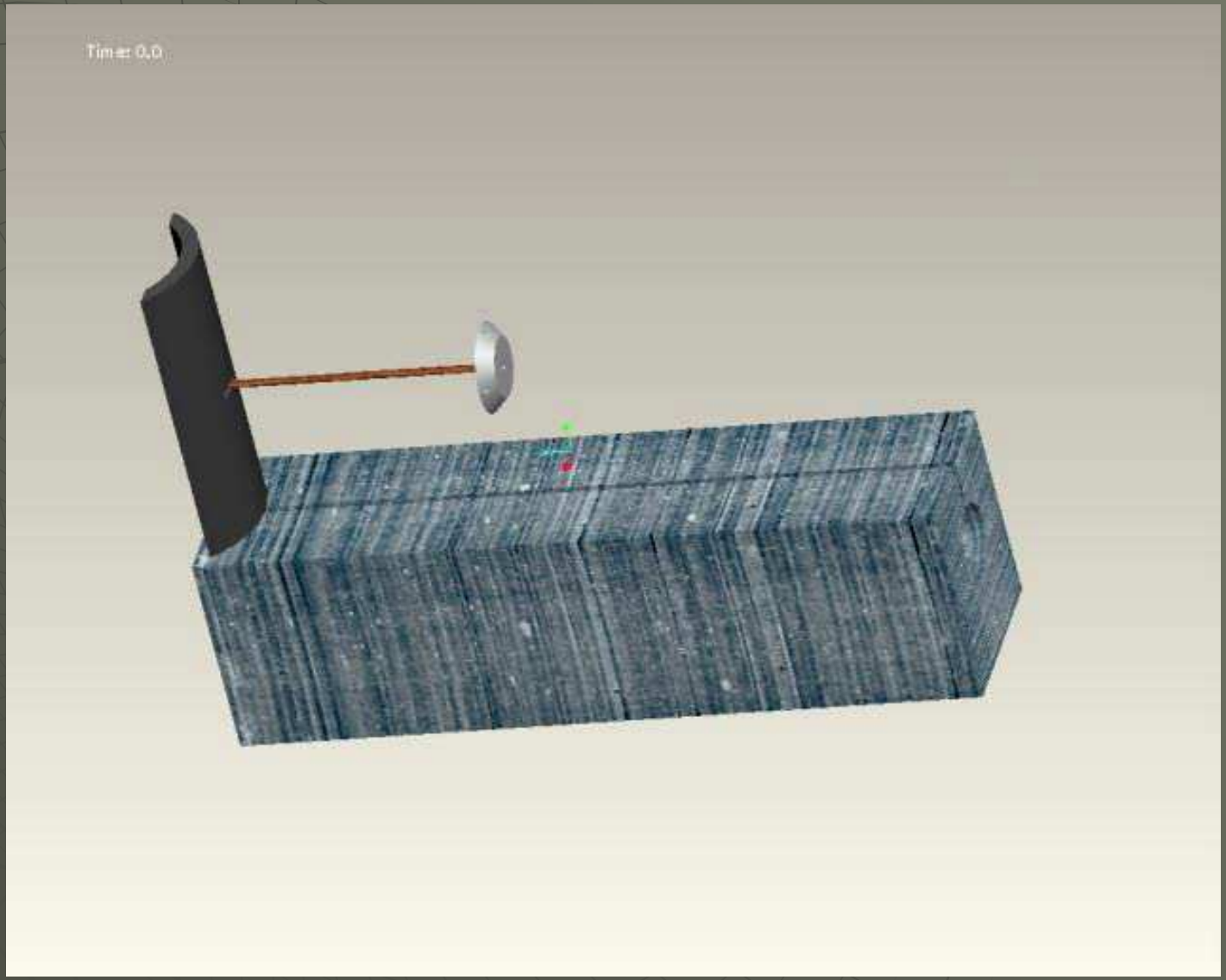
Rotator Concept



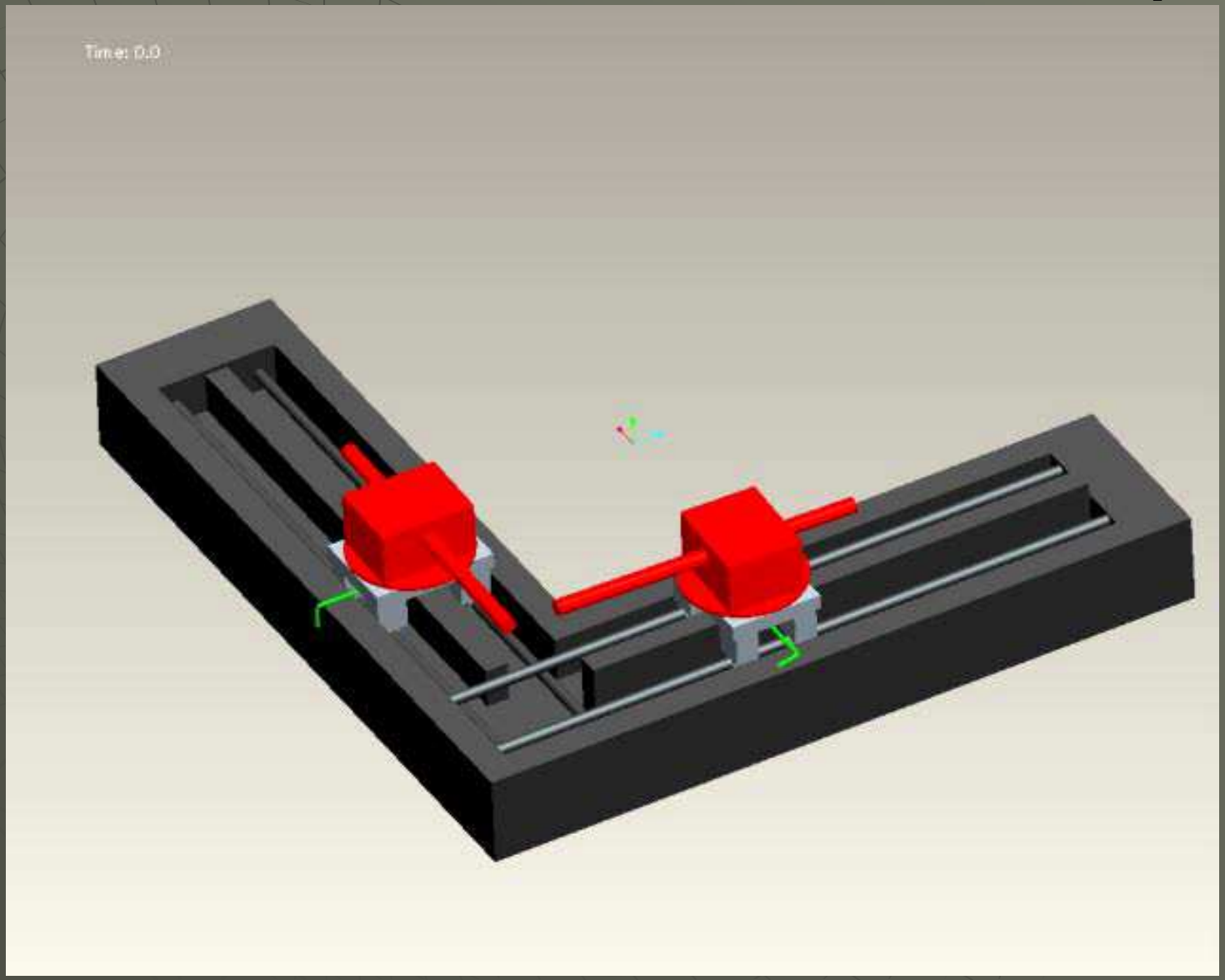
Combination Rotator Slider Concept



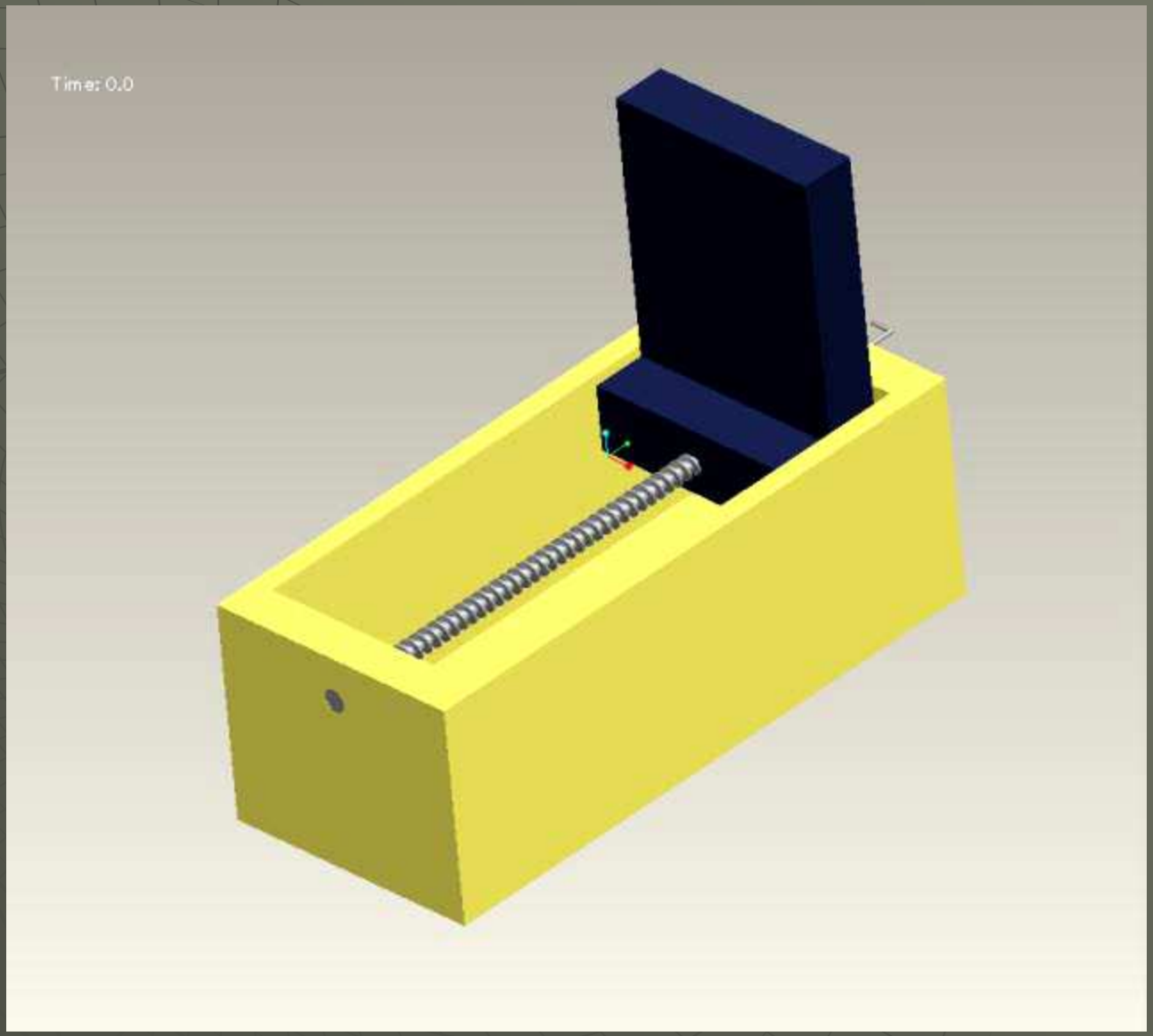
Curved Wall Concept



Rack and Pinion Concept



Worm Gear Concept



Shaft And Gear Connection Concept

- Variable Shaft Diameters with Adjustable Chuck
  - Easy to Operate
  - High Reliability & Repeatability
  - High Cost
- Constant Shaft Diameter, Variable Adapters
  - Set-screw connection method
    - Low cost
    - Easy to machine and assemble
    - May not be rigid enough → Could lead to wobble
  - Self-tightening threads
    - Low cost
    - Easy to machine and assemble
    - Very rigid → No wobble

Quality Function Deployment

		Engineering Requirements								
		rotational velocity	resistive torque	elastic modulus	anodic coating thickness	weight	deflection	yield strength	Mounting Shaft Distance	cost
Customer Requirements	Machinable			x	x	x		x		x
	Durability						x	x		x
	Looks Good			x	x					x
	Accuracy				x	x	x	x	x	x
	Reliability	x	x			x	x	x	x	x
	Assembled	x	x	x	x					
	Power Source	x	x							x
Units										
		rpm	in.-lb.	MPa	µm	lb.	mm	MPa	in.	$
		1000	100							≤1500
		Engineering Targets								

Concept Selection

Criteria	Weight	Concepts													
		Drawer Slider		**Rotator**		**Slider-Rotator**		**Curved Wall**		**Rack and Pinion (Pinion Driven)**		**Rack and Pinion (Rack Driven)**		**Worm Gear**	
		Rating	Rating x Weight	Rating	Rating x Weight	Rating	Rating x Weight	Rating	Rating x Weight	Rating	Rating x Weight	Rating	Rating x Weight	Rating	Rating x Weight
Machinability	10%	4	0.40	3	0.30	3	0.30	1	0.40	4	0.40	4	0.40	4	1.40
Looks Good	5%	3	0.15	3	0.15	2	0.10	4	0.20	4	0.20	4	0.20	5	0.25
Cost	10%	3	0.30	2	0.20	1	0.10	2	0.20	2	0.20	2	0.20	2	0.20
Reliability	25%	2	0.50	2	0.50	2	0.50	2	0.50	4	1.00	3	0.75	4	1.00
Ease of Assembly	10%	4	0.40	4	0.40	3	0.30	3	0.30	2	0.20	2	0.20	3	0.30
Accuracy	40%	2	0.80	2	0.80	2	0.80	2	0.80	4	0.60	4	1.60	5	2.00
Total Score		**2.55**		**2.35**		**2.1**		**2.1**		**3.6**		**3.35**		**4.15**	

Conclusion

- Final selection
  - Worm Gear Concept
    - Best Rating
      - Accuracy
      - Looks good
      - Machinability
      - Reliability
    - Average rating
      - Cost
      - Ease of Assembly

Future Plans

- Design a more accurate Pro-E model
  - Worm gear
  - Accurate walls
- Part selection and cost analysis
  - Primary focus
    - Accelerometers
    - Power source
    - Bearings
    - Power output controller and display
    - Select bevel gears and shafts
  - Secondary focus
    - Travel to Melbourne, FL to visit Harris
    - Update project plan

Questions