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DEPARTMENT OF  
MECHANICAL ENGINEERING

**Mechanical  
Engineering  
Design Day**

Date: November 30, 2010

# Napkin Set Roller

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## Objective

### General Need for Product:

Current method of rolling silverware into napkins by hand is time consuming and inefficient.



### Market:

Approximately 25,000 businesses in D.C. Metro area - fine dining - sit-in restaurants - catering companies

### Customer Requirements:

- Capable of mass production
- Low maintenance
- Accepts varying utensil types
- Price between \$200-\$300
- Easy to use
- Safe
- Mobile
- Durable

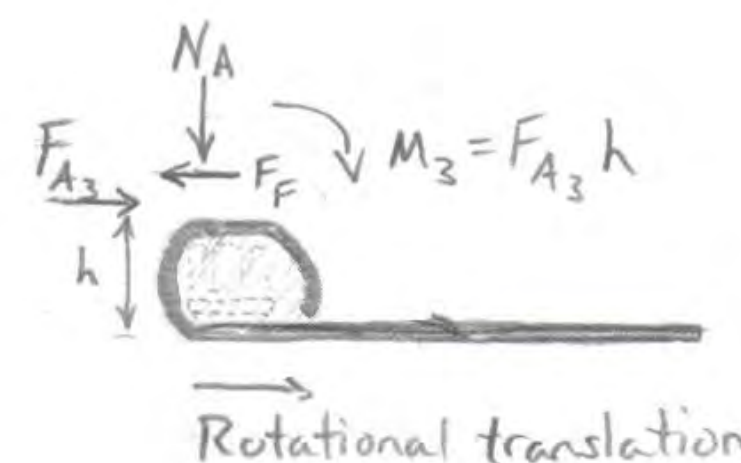
### Engineering Characteristics:

- Power from motor
- Simplicity of design
- Machine efficiency
- Power consumption
- Material choices
- Weight
- Roller Strength

### Constraints:

- Interface with other subsystems
- High-volume production without jamming

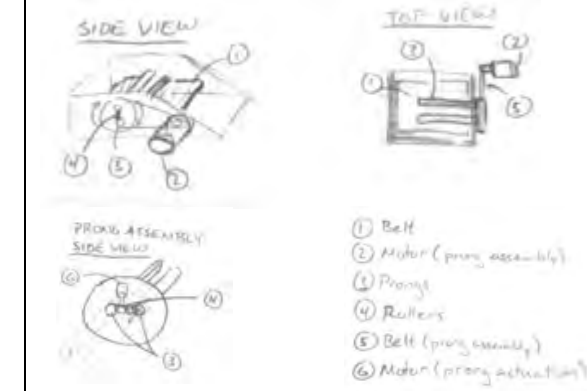
**Physics:**  
Required moment less than 1 in-lb (Quantity  $M_3$  in figure).



## Concept Generation

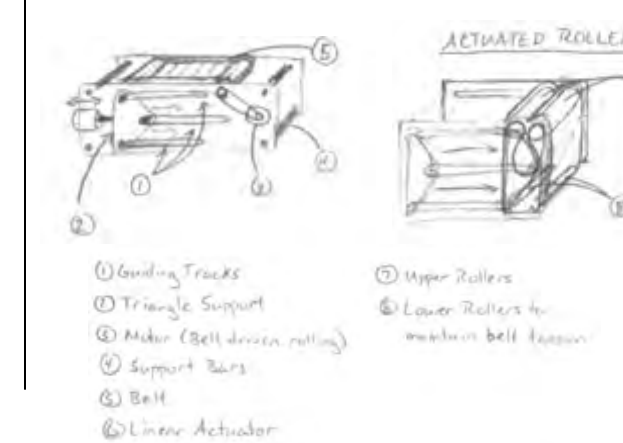
### Concepts:

#### Prong Driven Napkin Roller



- Strengths:** Simple design and easily manufactured and cheap parts.
- Weaknesses:** Placement of napkin into the system is difficult and removal of napkin from the system not considered.

#### Variable Tension Belt Roller



- Strengths:** Simple design with few moving parts and easily serviceable.
- Weaknesses:** Belt might potentially jam the system and distance between actuated rollers must be exact in order to facilitate rolling.

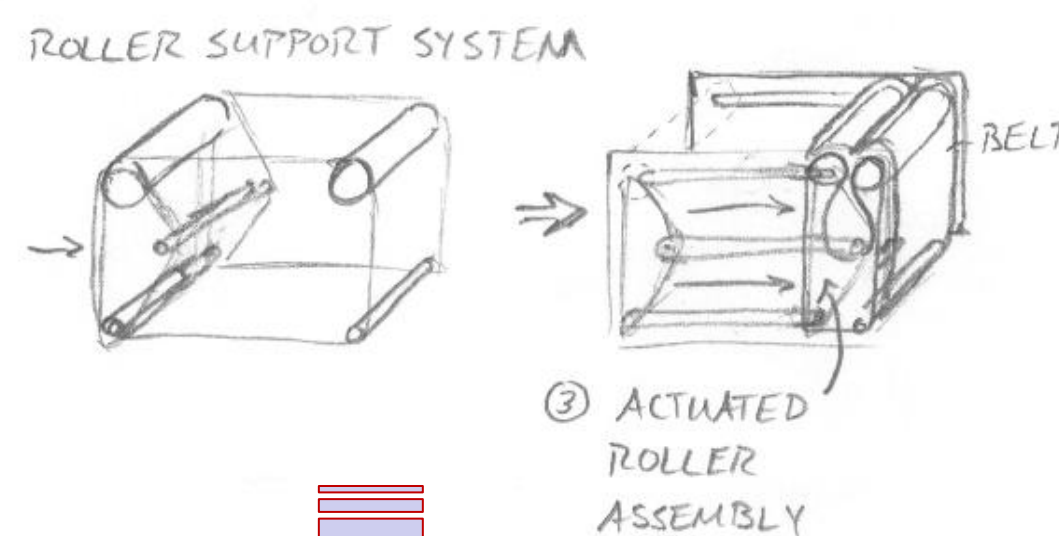
### Decision Matrix:

Decision Characteristics	Weight	
	Concept 1: Prong Driven Napkin Roller	Concept 2: Variable Tension Roller
Mass Production Capability	0.02	0
Durability	0.12	-1
Ease of Maintenance	0.09	0
Price	0.03	1
Versatility in Utensils	0.06	-1
Versatility in Folds	0.06	-1
Mobility	0.05	1
Ease of Use	0.18	0
Safety	0.38	0
<b>Weighted Totals:</b>	<b>-0.16</b>	<b>0.49</b>

**Variable Tension Belt Roller chosen**

## Design

- Subsystem of larger product
- 4 Roller 1 belt system ( 2 translational / 2 stationary)

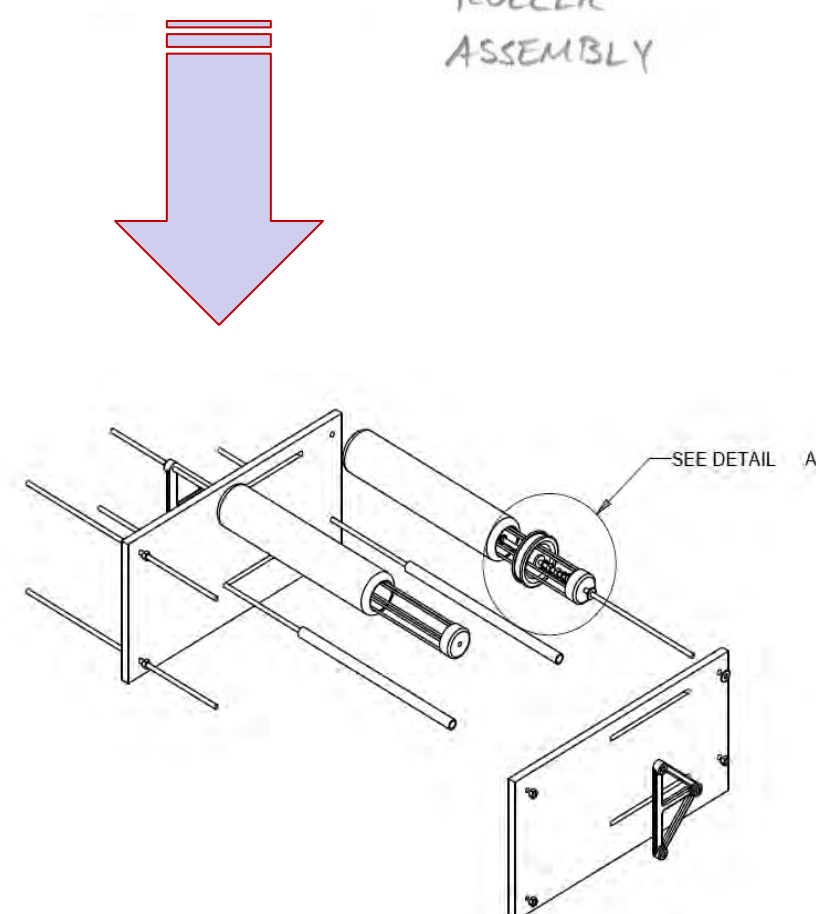


### Key Functionality

- Compactly roll silverware and napkin with low user input
- Reduces time necessary to complete silverware setting

### Satisfying Customer Requirements

- All lightweight cheap material
- Simple design and method of completion



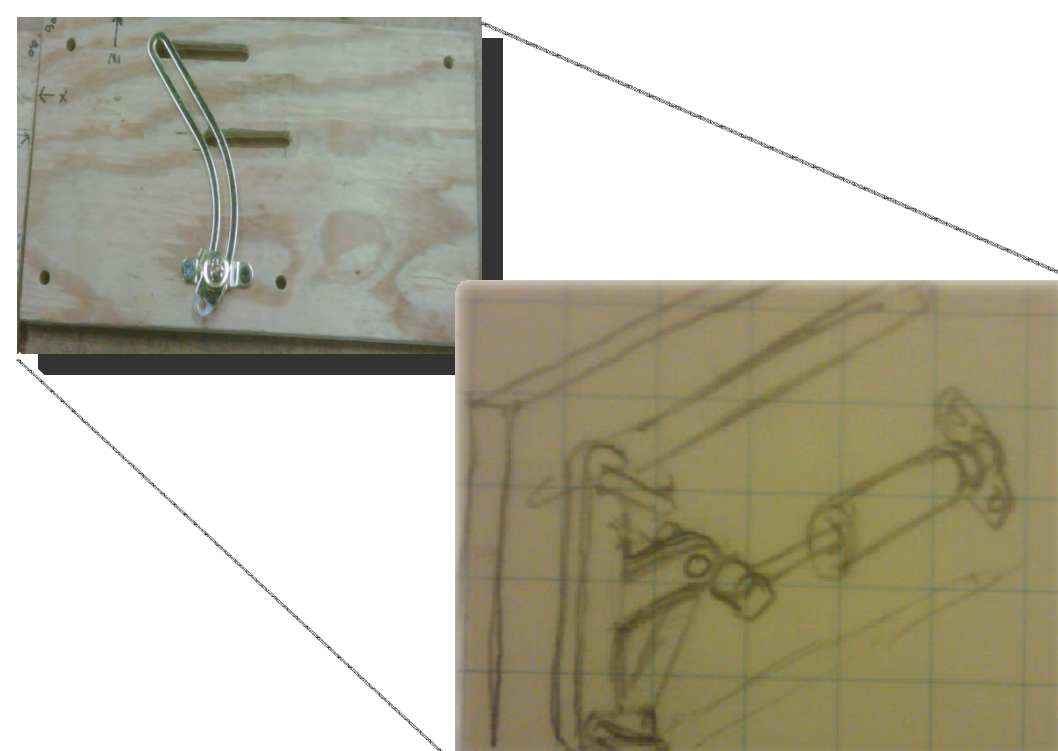
## Prototype and Testing

- Initial design:**
  - No lower rollers
  - Method of actuation
- Updated design**
  - Placement lower rollers
  - Triangular slider



### Testing Functionality

- Actuator displacement
- Revolutions per fold
- Folded napkin sets/minute
- Life cycle testing
- Varying silverware and napkin sizes
- Ramp materials & angles

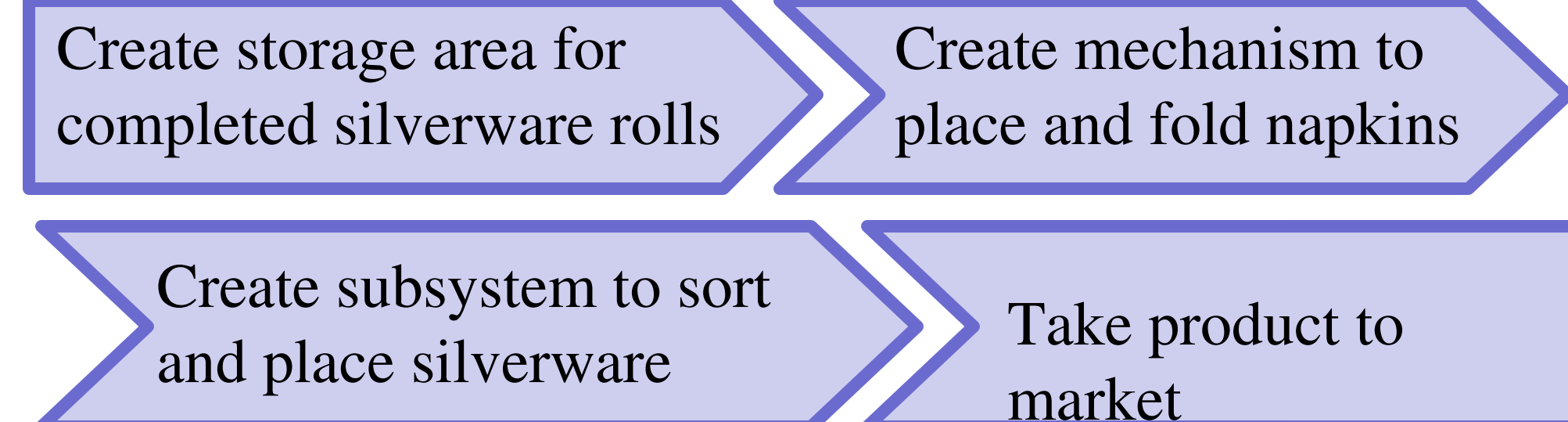


## Results and Future Work

### Summary of Design Project

- Machine design that automatically rolls silverware into napkins
- Open-ended design allows easy interface with other subsystems

### Future Work: Next steps



### Process Reflection

Prototyping and testing was most valuable steps for optimizing design project, allowing design flaws to be addressed and corrected.