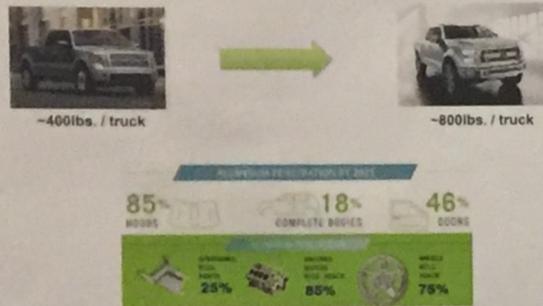
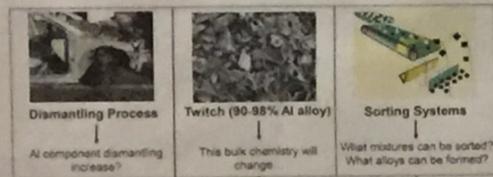


## THE NEED:



How will this added aluminum be recovered and recycled?  
What do the material collectors, processors and consumers need to know?

## MEETING THE NEED:



We need to... Determine what will not be shredded (component-based) | Project what this composition will be | - Characterization and efficiency/capability study - Blending model

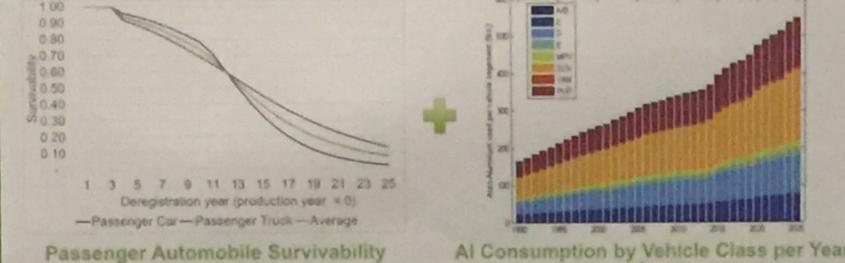
## OBJECTIVES:

- Dynamic Material Flow Analysis (dMFA)
  - 1) Determine the amount of alloys reaching end of life (2016-2025)
  - 2) Determine how dismantlers will handle added aluminum (i.e. body & closures)
- Blending Model (Optimization Model)
  - 3) Investigate how LIBS/XRF sorting systems will be implemented and used within the auto-shred recycling process
  - 4) Develop a linear program to model how auto-shred should be blended after sorting
  - 5) Temporal Twitch Analysis
    - a) dMFA model verification
    - b) Capability/efficiency study of commercially viable sorting systems

## METHODOLOGY:

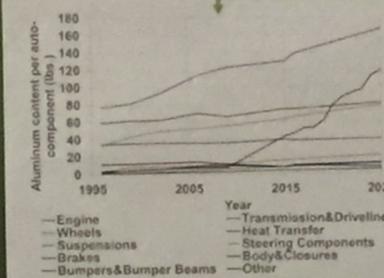
### 1 - 2) Dynamic Material Flow Analysis (dMFA)

#### INPUT DATA:



Passenger Automobile Survivability

Al Consumption by Vehicle Class per Year

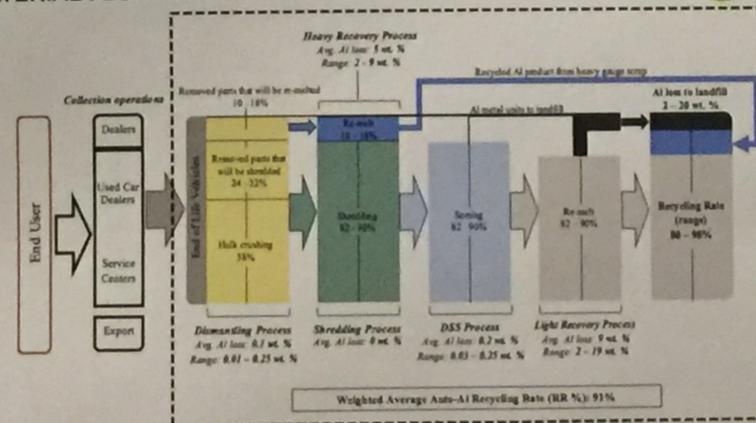


Auto-component Market Penetration

Al Alloy	Material (wt.%)	Aluminum (wt.%)	Iron (wt.%)	Other (wt.%)	Aluminum Content per Auto-component (wt.%)
A319	90.0	10.0	0.0	0.0	10.0
A356	90.0	10.0	0.0	0.0	10.0
6011??	90.0	10.0	0.0	0.0	10.0
5754??	90.0	10.0	0.0	0.0	10.0
A319	90.0	10.0	0.0	0.0	10.0
A356	90.0	10.0	0.0	0.0	10.0
6011??	90.0	10.0	0.0	0.0	10.0
5754??	90.0	10.0	0.0	0.0	10.0
A319	90.0	10.0	0.0	0.0	10.0
A356	90.0	10.0	0.0	0.0	10.0
6011??	90.0	10.0	0.0	0.0	10.0
5754??	90.0	10.0	0.0	0.0	10.0

Auto-component Alloy Matrix

## MATERIAL FLOW MODEL:



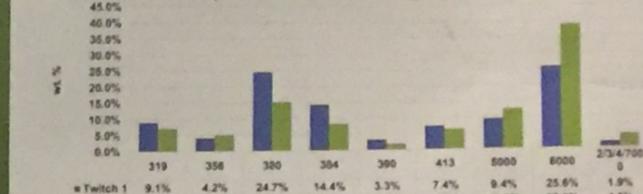
Twitch Tweak = 86%

Aluminum @ = 14%

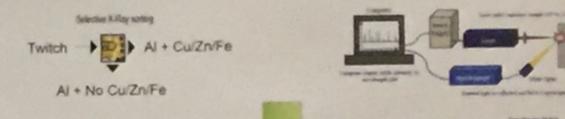
## METHODOLOGY:

### 3 - 4) Optimization Modeling

Annual chemical composition of auto-shred (from dMFA)



Sorting system implementation planning, capabilities and efficiencies:



Broadening of the secondary Al alloy spectrum:



## IMPACT:

1. Understanding of the current and future material flow of ELV scrap within the secondary aluminum production industry
2. Understanding of the future recycling rate of aluminum form automobiles
3. Potential broadening of the secondary Al spectrum with auto-shred as charge (CLOSING THE LOOP)
4. Predictions of the potential scrap surplus timeline
5. Blending and economical suggestions

## FOCUS GROUP/"CUSTOMER":



## ACKNOWLEDGEMENTS/REFERENCES:

I would like to thank Dr. Diran Apelian, my advisor, and the CR3 Industrial members for funding this project.

[1] Fluxus Worldwide LLC, "2015 North American Light Vehicle Aluminum Content Study," Fluxus Worldwide (2015), 1-24. Web.  
[2] Lark, Ahmad N., Mohamed, Aya, and Mulla, Samir B. "Long Term Strategies for Increasing Recycling of Automotive Aluminum and Its Alloying Elements." Environmental Science & Technology 48, (2014), 4271-4280. Web.  
[3] Kelly, Sean, and Apelian, Diran. "Automotive Aluminum Recycling at End of Life: A Green-to-Green Analysis." (2014), 1-12.