Cost Model Analysis with Advanced High Strength Steels

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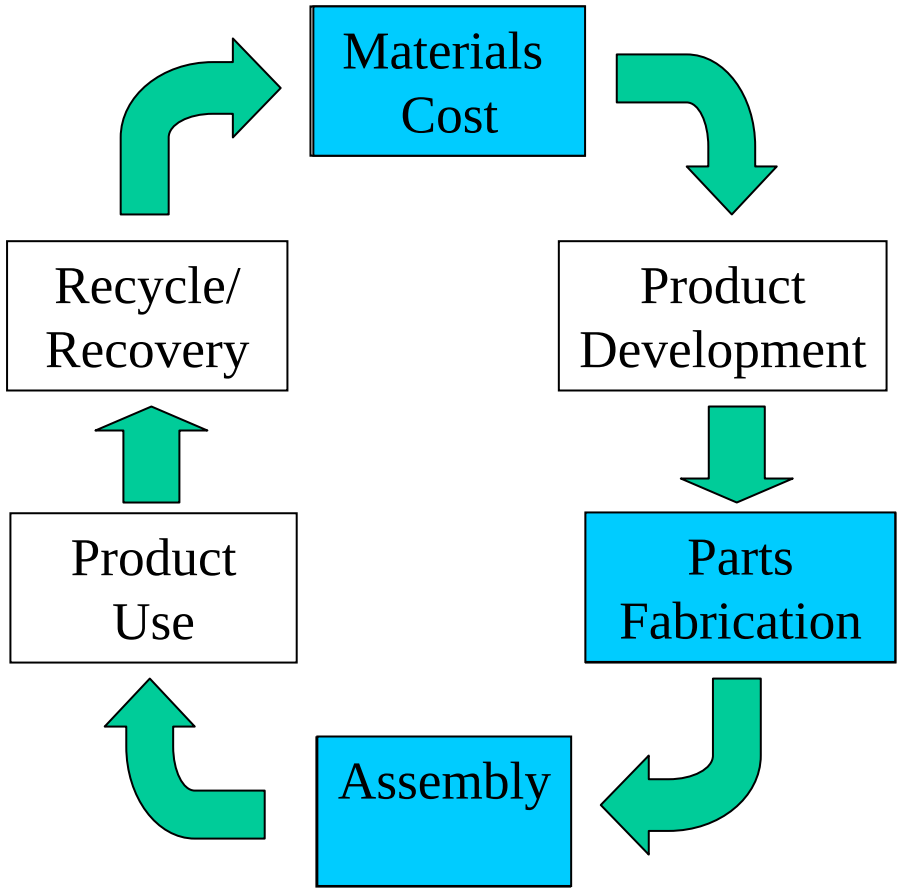
Understanding Production Costs

- Cost is a critical element when deciding on a material or design
- But, cost is sometimes difficult to assess particularly for new materials & process technologies
  - Historical accounting data often unavailable
  - Inconsistent treatment of the data
- And, cost for new materials & technologies often rapidly changing
  - Improved processing conditions/learning
  - Technological development

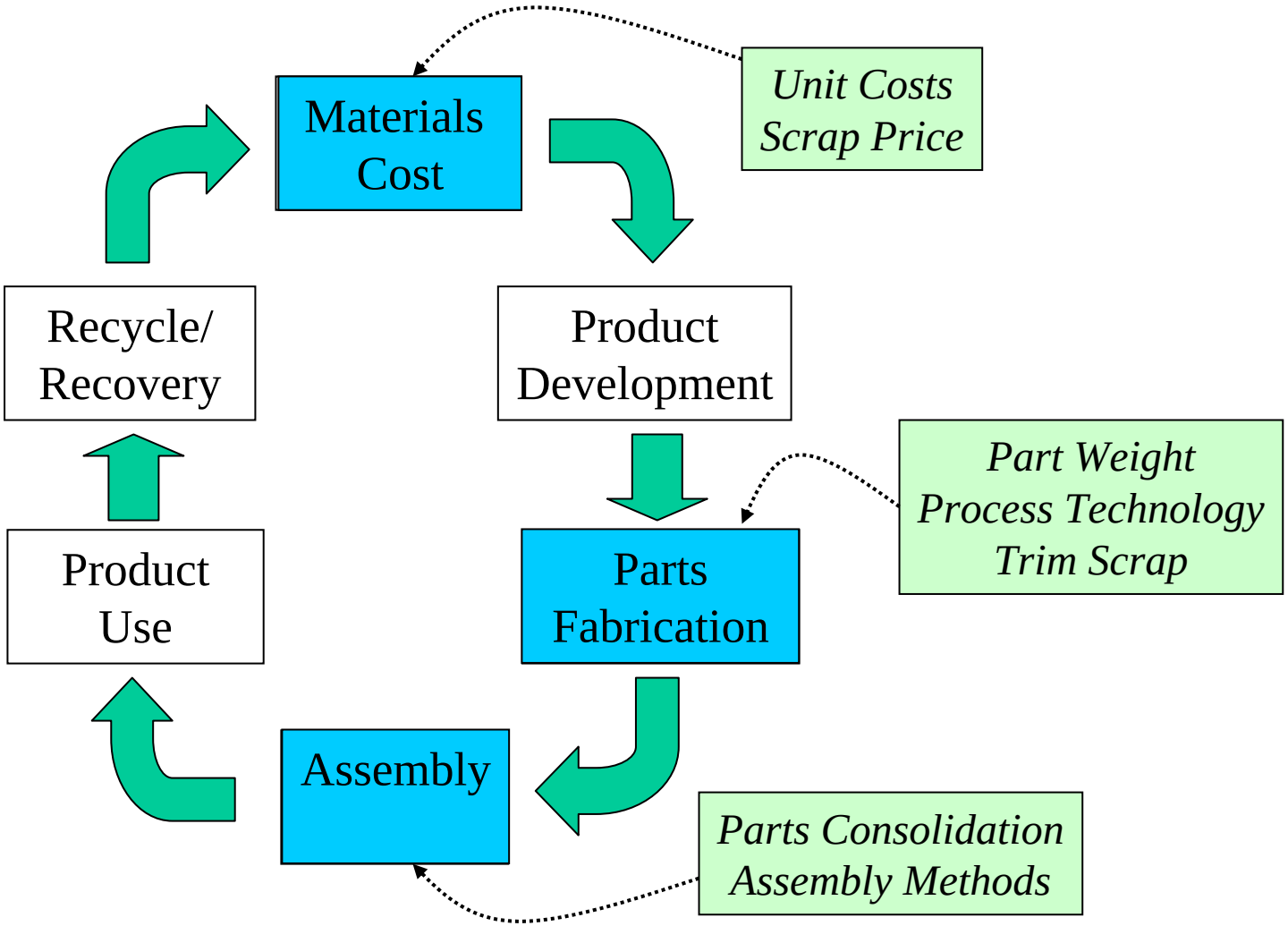
Need for Process Based Cost Models

- Provide consistent basis for analysis
- Explicitly defined boundaries for the problem
- Based on technology assessment and therefore can be used to investigate the impact of:
  - Process improvements
  - Using different materials
  - Alternate designs

Cost Modeling Entire Product Lifecycle



Influence of Materials Choice



Impact of High Strength Steels

	Advantages	Disadvantages
Materials Cost		Higher Unit Cost
Parts Fabrication	Parts Consolidation: *Fewer tools, presses & other resources*	Formability Issues: *More expensive tools, slower cycle times, etc.*
Assembly	Parts Consolidation: *Less assembly required* *Reduced space & logistics*	

Need to Balance These Competing Factors: **COST MODELS**

Case Study: Benefits of High Strength Steel

Lightweight Front End Structures

- Front end structures are prime candidates for redesign
  - Lightweight design allows a shift of vehicle weight from front to rear
  - Many opportunities for parts consolidation
- Approaches in steel include
  - High strength steels
  - Tailored blanks
  - Hydroformed tubes

Front End Study: Design Issues

	Baseline		High Strength	
	# of Parts	Weight (kg)	# of Parts	Weight (kg)
Stampings	32	30.77	14	12.75
Tailored Blanks	2	5.36	6	18.90
Rollformings	1	6.39	---	---
Hydroformings	---	---	---	---
TOTAL	**35**	**42.52**	**20**	**31.65**

Front End Study: Materials Distribution

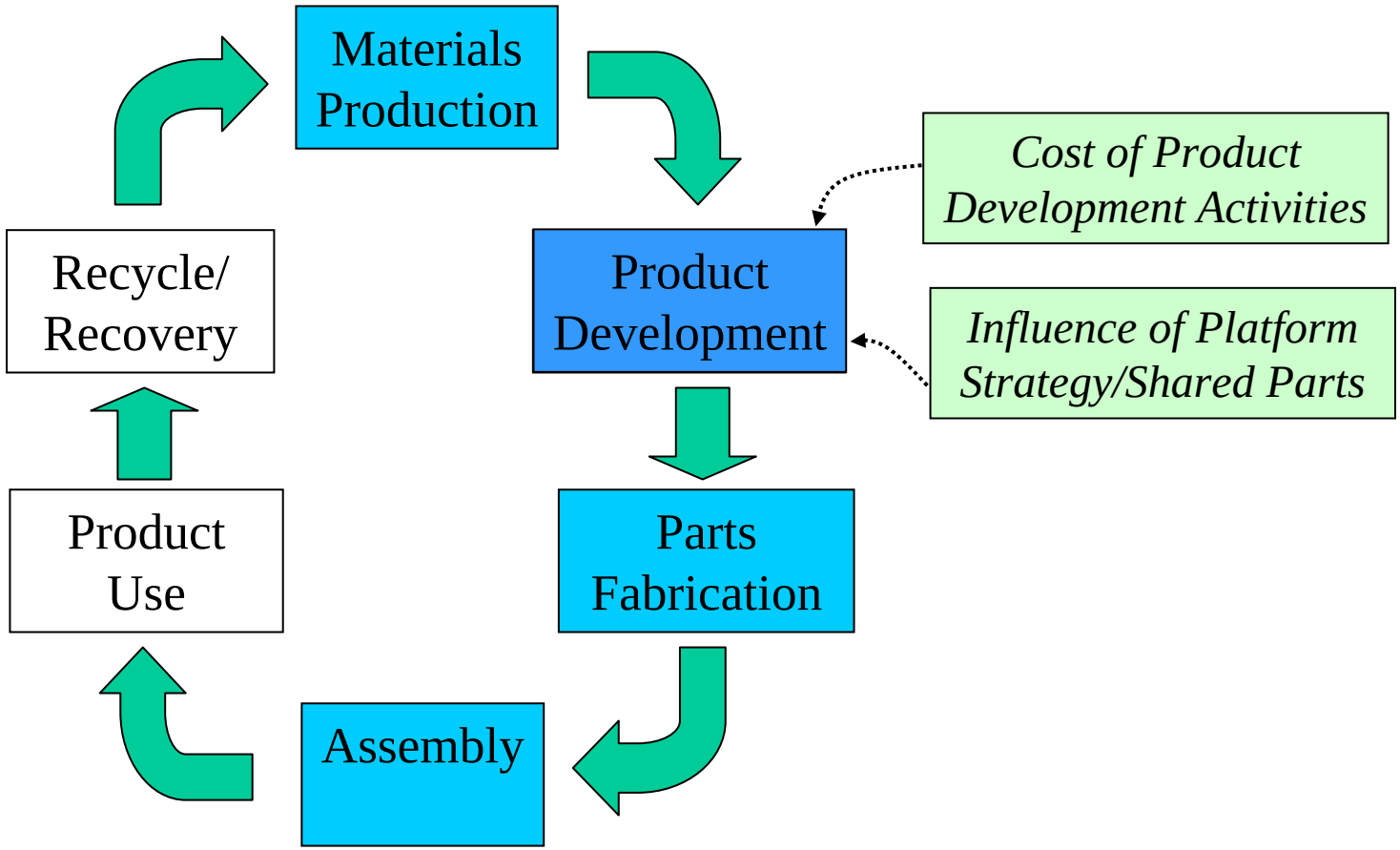
	Baseline	High Strength
Mild Steels	29.48 kg	2.63 kg
HSLA Steels	13.04 kg	---
Dual Phase Steels	---	29.02 kg

TOTAL	42.52 kg	31.65 kg

Front End Study: Overal Results

	Baseline	High Strength
Materials	$49	$53
Blank Production	$7	$22
Forming	$64	$52
Assembly	$77	$57
TOTAL	**$197**	**$184**

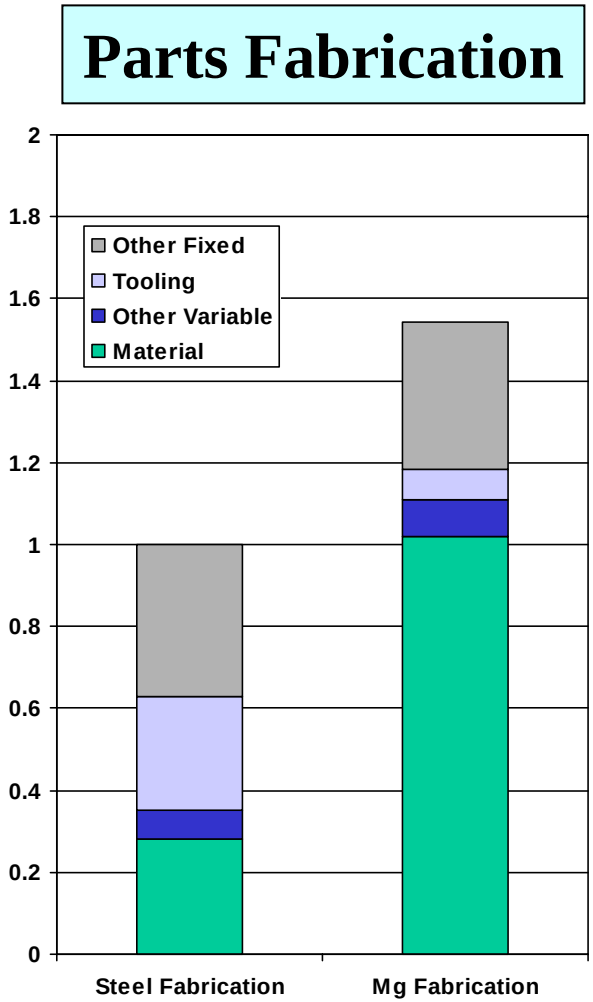
Considering Other Parts of the Lifecycle

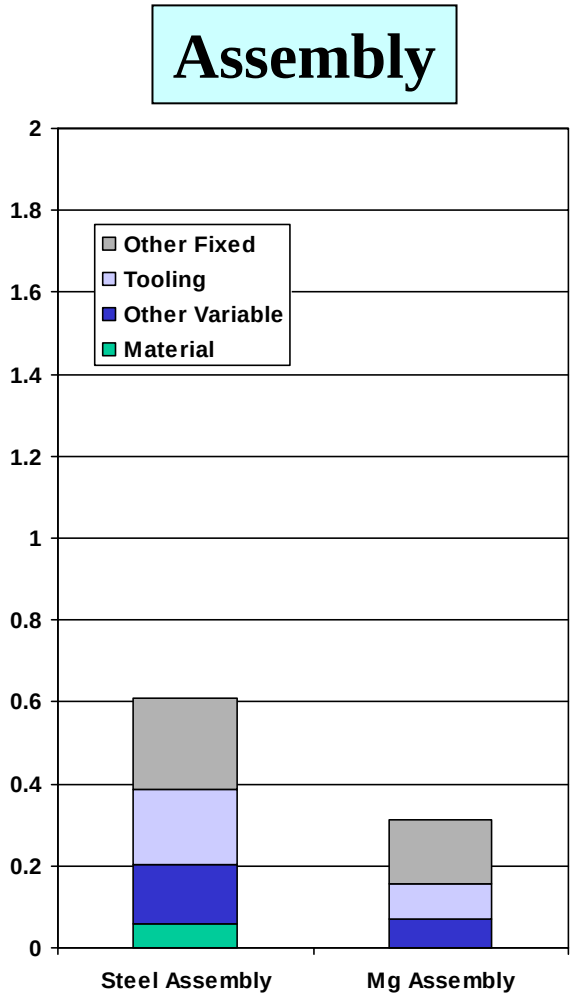


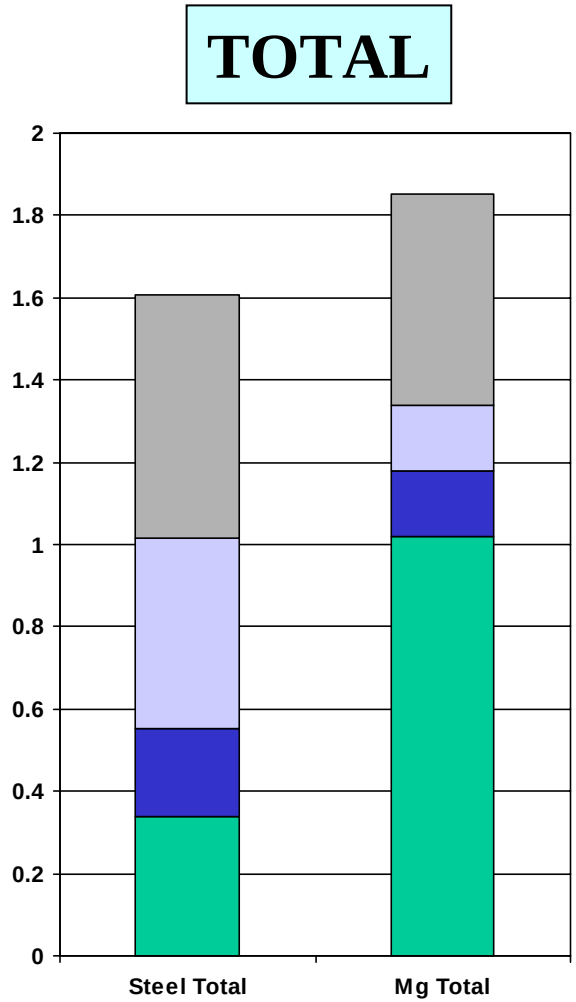
Product Development Issues:
Instrument Panel Beam Designs

- Two Functionally Equivalent IP Beams
  - Steel:
    Tubular structure + 24 brackets
  - Magnesium:
    Die Cast structure + 4 brackets
- Base Case:
  - 75,000 units/year per variant
  - 5 year product life
  - Mg Price: $3.10/kg
- Variants: Original design + variant 10% longer

Direct Manufacturing Costs: IP Beams

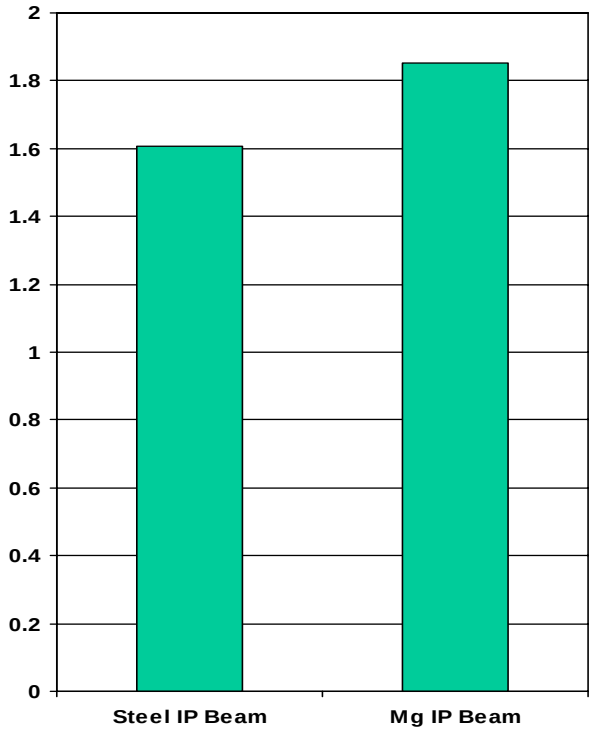




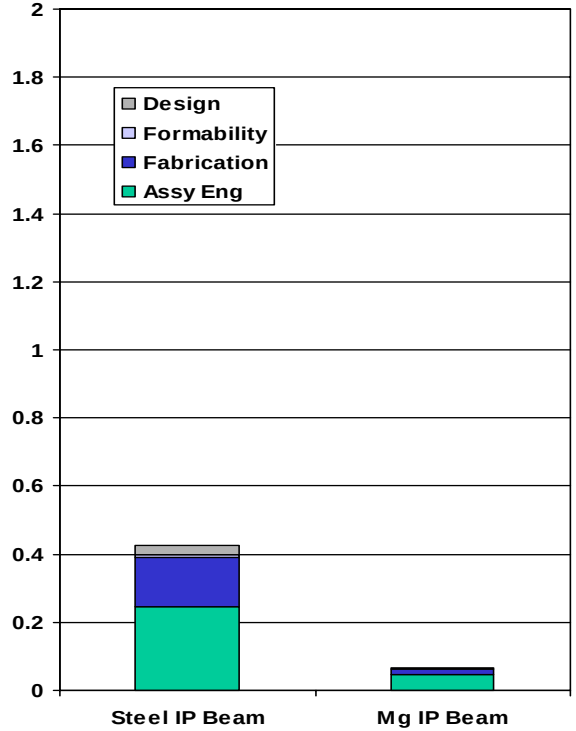


Product Development Costs Added

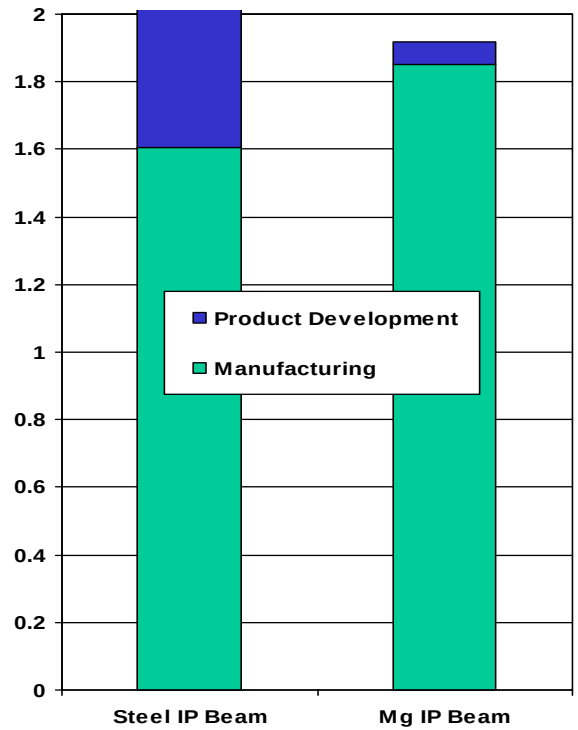
Manufacturing



Product Development



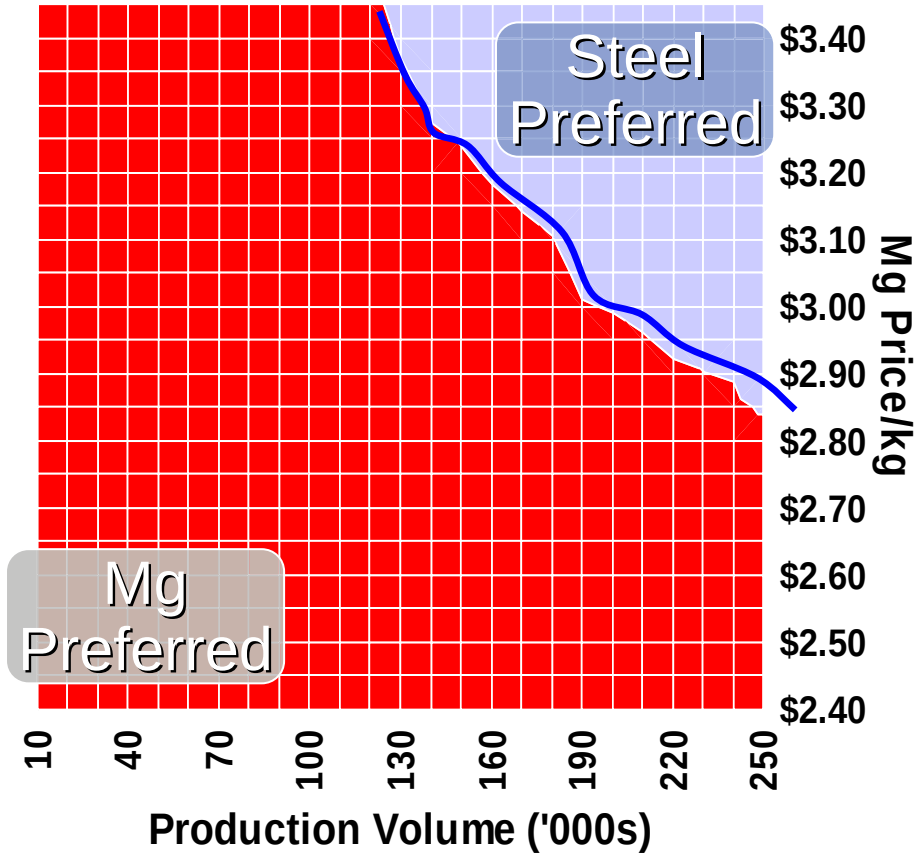
TOTAL



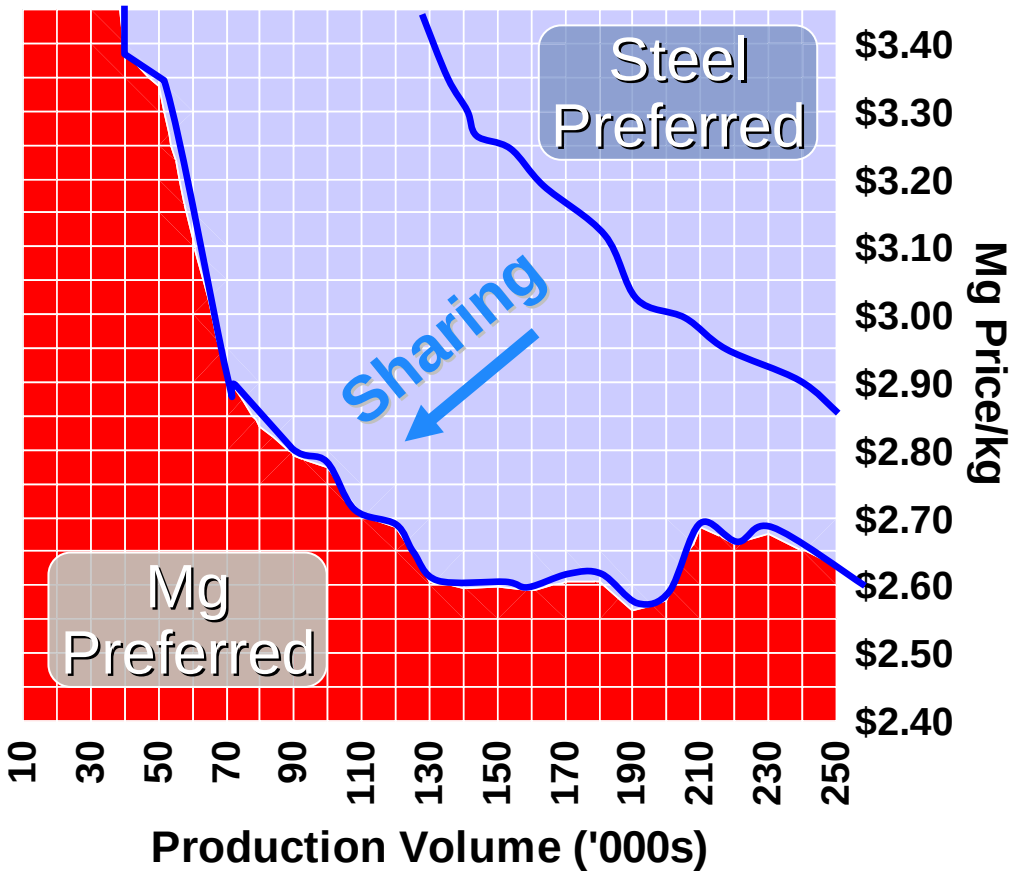
Major magnesium beam had over 3x development cost versus steel tube

Overall steel design over 4x number of parts, thus higher total development costs

Production Volume & Mg Price Sensitivity



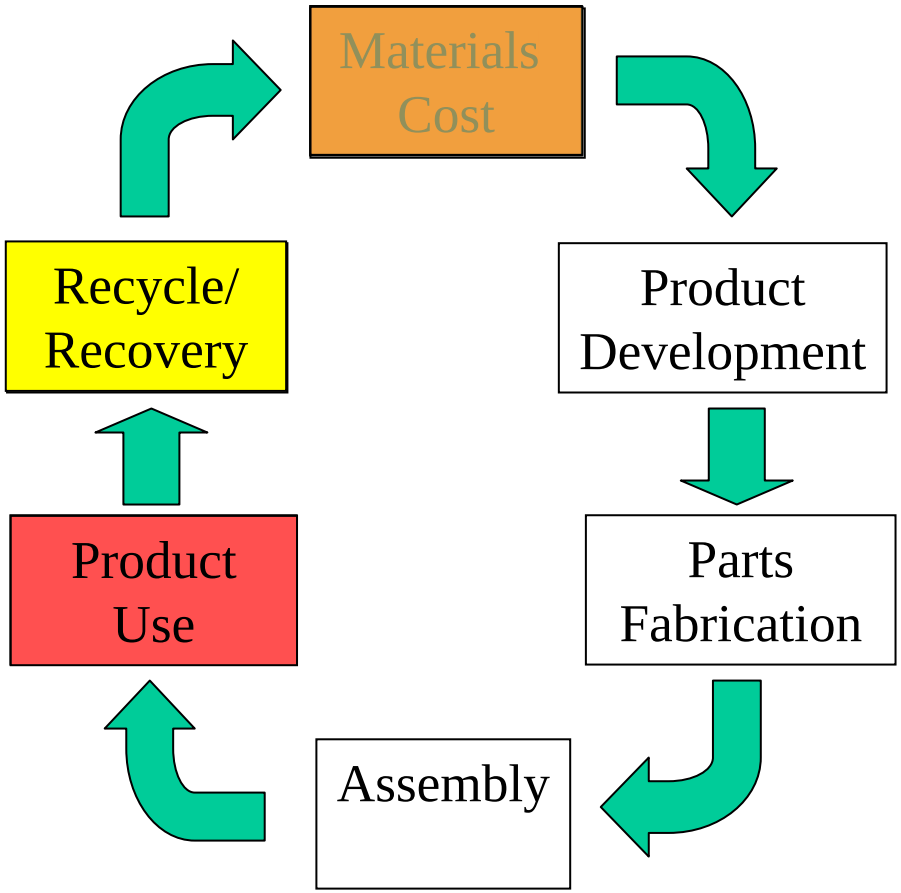
Influence of Shared Components



IP Beam Case Summary

- Manufacturing cost does not always provide complete answer
  - Product development costs
  - Platforming issues
- Parts consolidation key to competitive position of Mg
  - But additional parts consolidation also possible in steel
  - Using higher strength steels and tailored tubes could reduce the need for reinforcements
    - Lower costs in manufacturing
    - Lower development costs

Other Important Considerations



Energy Issues

Recycling