



CWICAR

CLEMSON UNIVERSITY INTERNATIONAL CENTER FOR AUTOMOTIVE RESEARCH



Where innovation gets the green light.



Sustainability and New Car Development

- CU-ICAR background
- Targeting integration
- Dedicated Product
- Dedicated Production

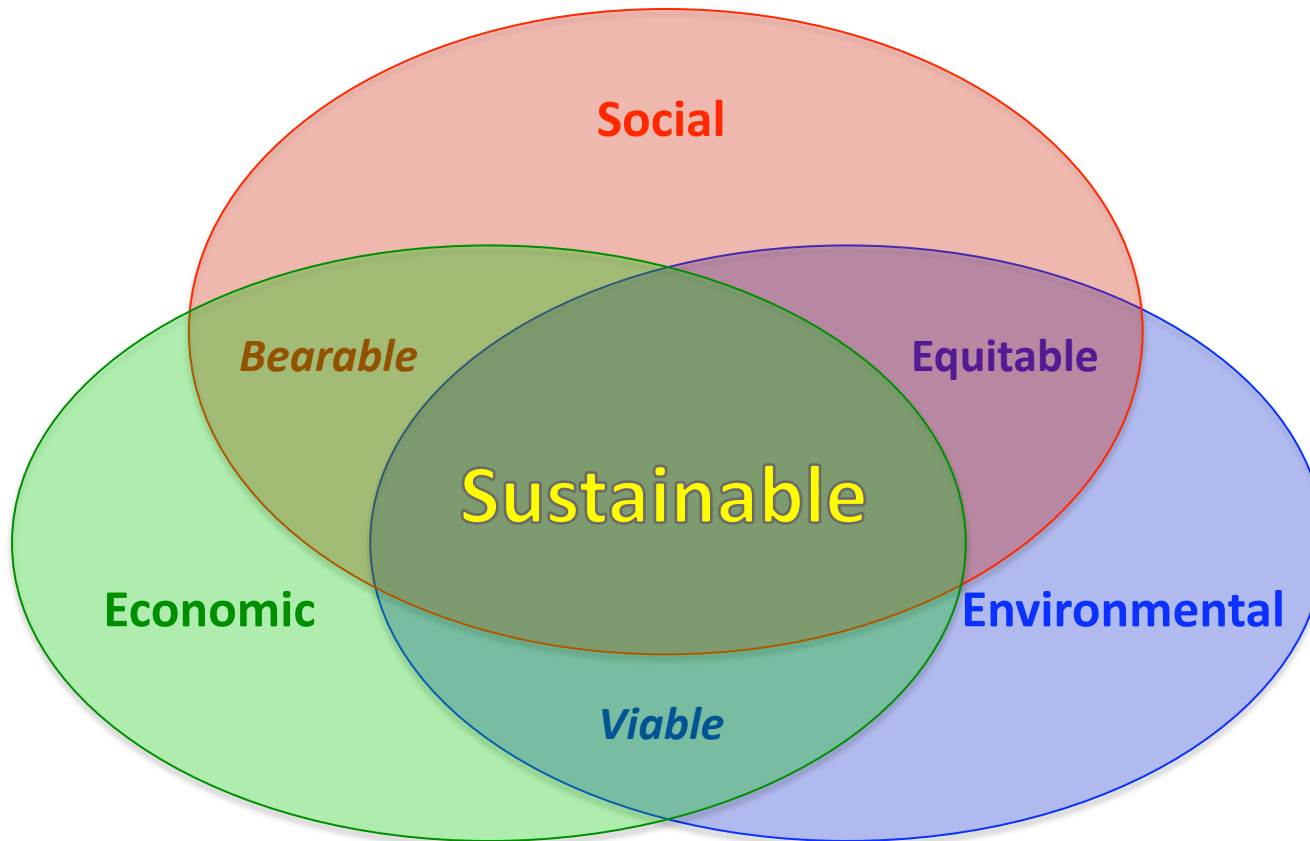


CU-ICAR: Why and How

- 2001: Clemson University reached out to SC industry for input on how to facilitate a “sustainability model” for SC.
- Message from study: need to embrace change
 - Static industries/companies are vulnerable
 - State needs to facilitate industry adoption of innovation.
- Automotive industry was/is a target sector.
 - State and Clemson asked industry for input.
 - CU-ICAR is the result of industry feedback.



Sustainable means...

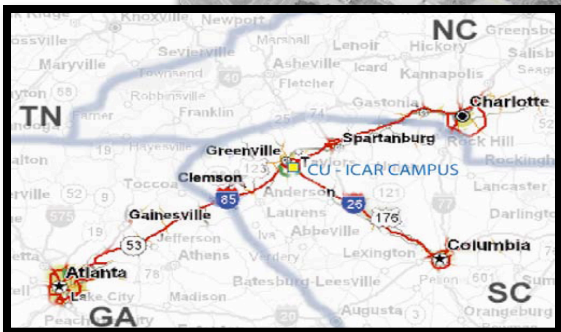
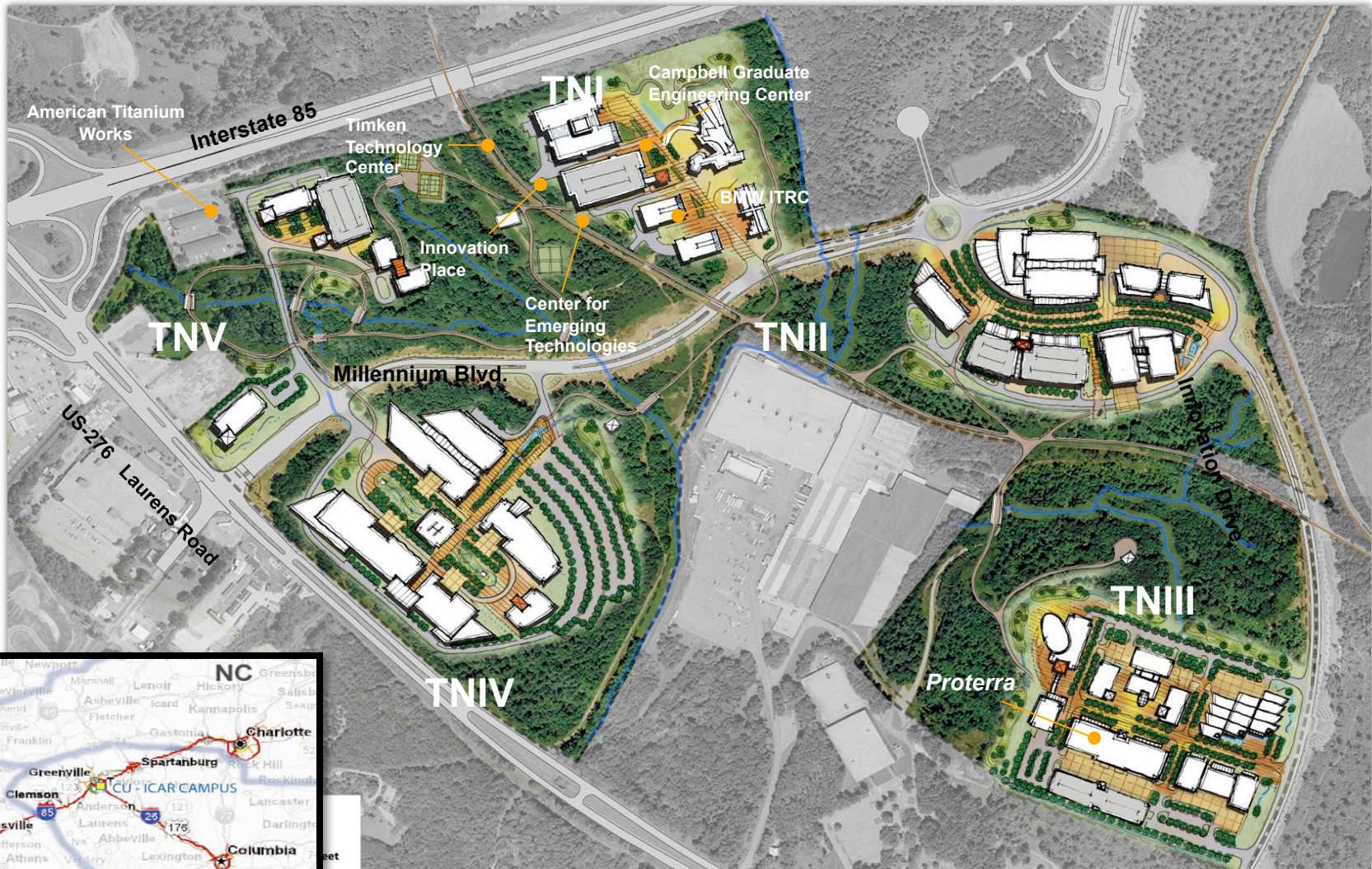


Adapted from UCN. 2006. *The Future of Sustainability: Re-thinking Environment and Development in the Twenty-first Century*. Report of the IUCN Renowned Thinkers Meeting, 29–31 January 2006.



Industry feedback: need integration focus

- New Technology System Integration
 - Too many options for OEMs to track
 - Too much risk for Suppliers to invest
 - Absolutely necessary for innovation to reach the market
- CU-ICAR's role
 - **Research**: developing **methods**
 - **Education**: developing **people** to apply the methods
 - **Collaboration** with Industrial **Partners**



250 acres; 5 Collaborative Technology Neighborhoods.



- Research: 4 Chairs of Excellence
 - Design & Development
 - Manufacturing
 - Vehicular Electronics
 - Systems Integration
- Education
 - MS and PhD in Automotive Engineering with purpose-built courses and curriculum
- Collaboration with Industrial Partners
 - Research, Curriculum/Instruction, and Entrepreneurial Networking

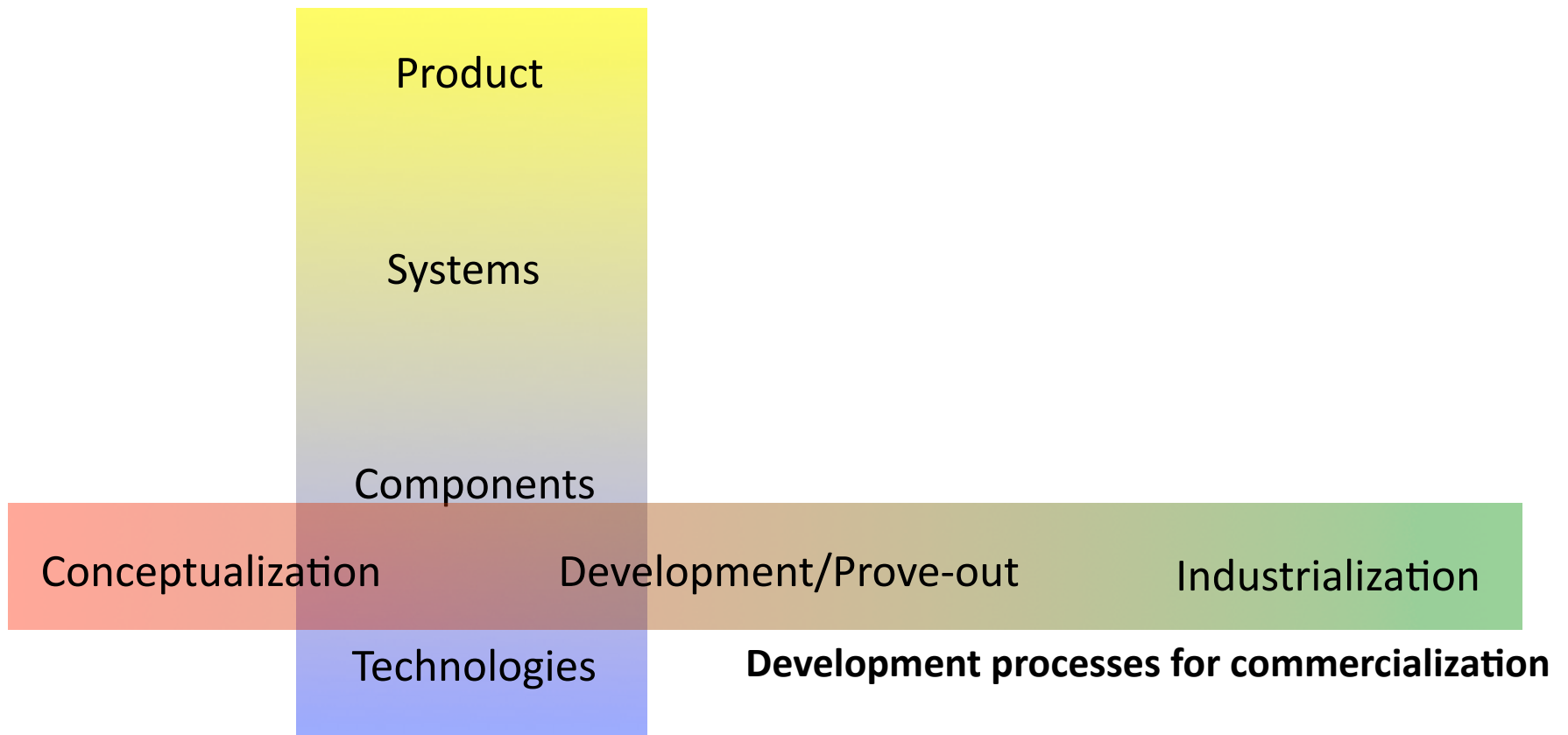


The Carroll A. Campbell, Jr., Graduate Engineering Center (CGEC) at CU-ICAR



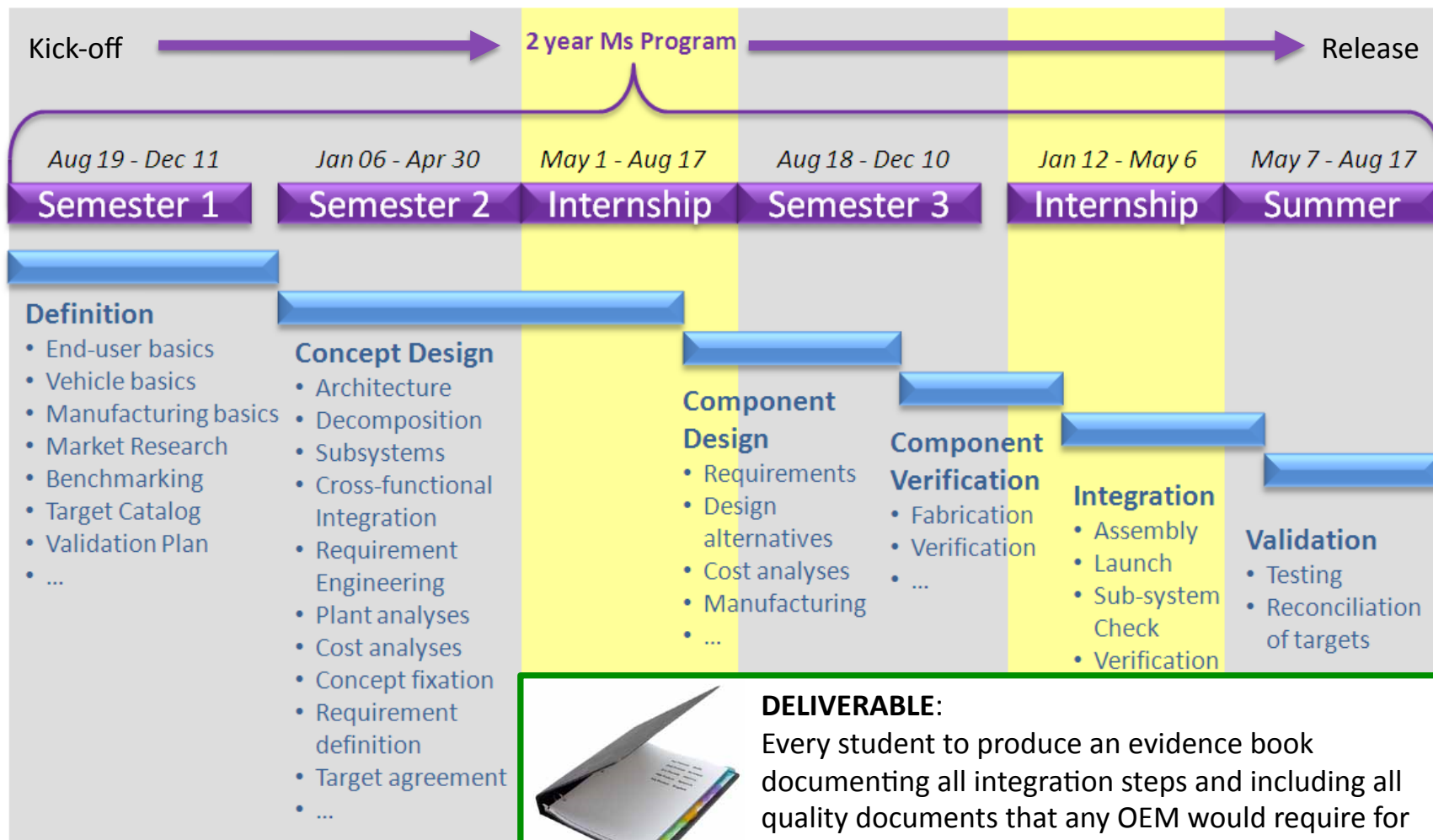
New Technology Integration

Architectural relationships



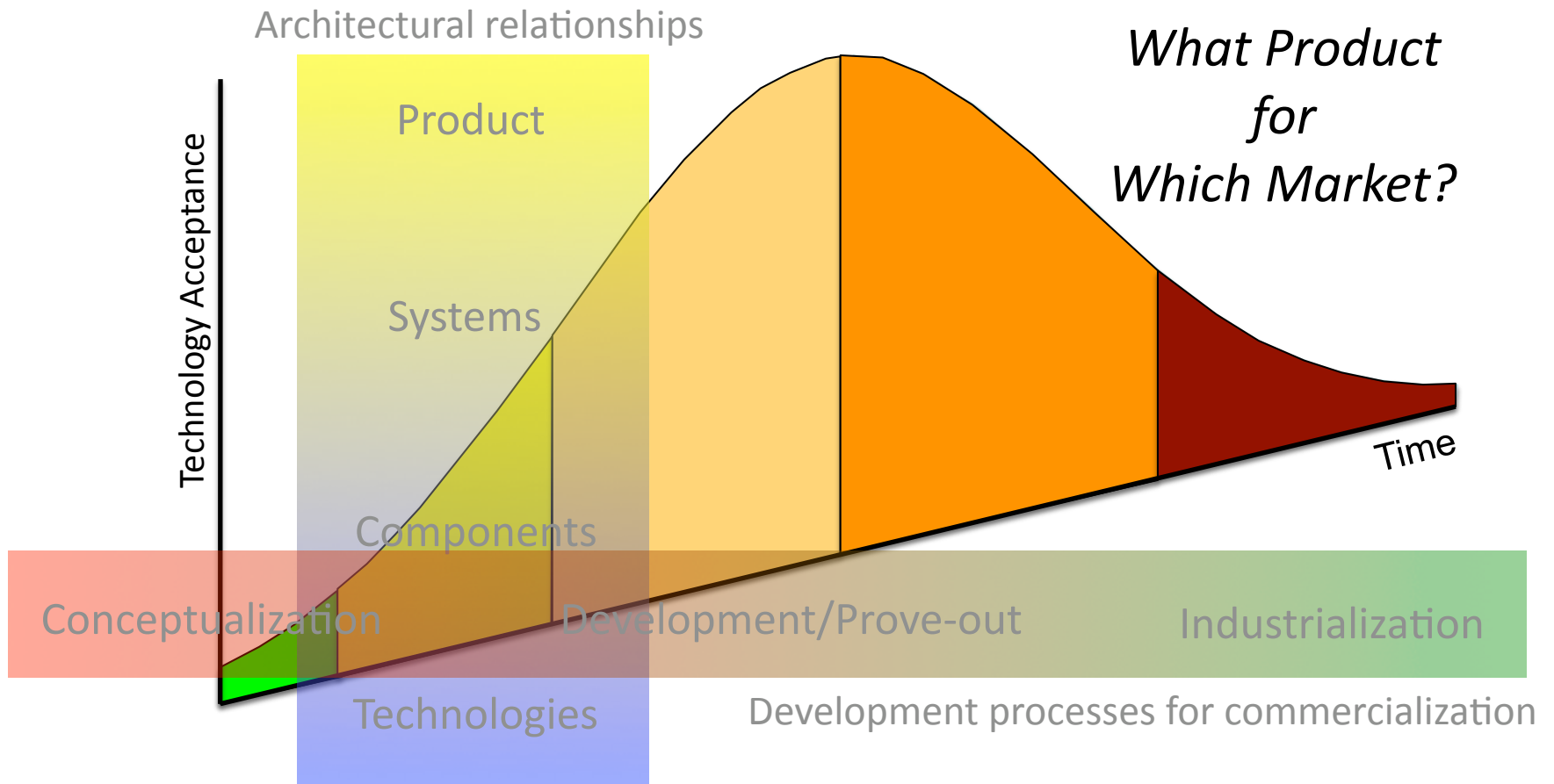


Deep Orange: Purpose-built curriculum



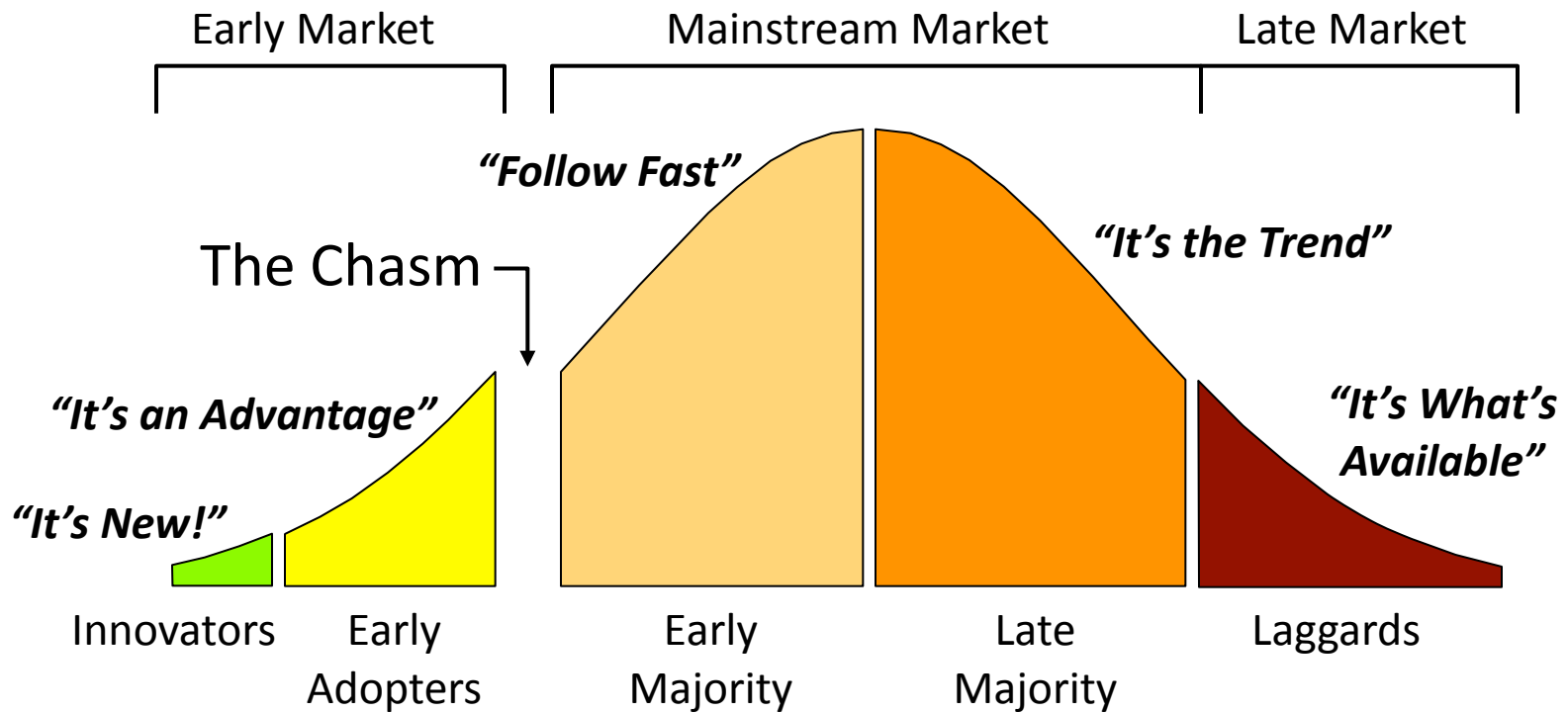


New Technology Integration





Technology Acceptance by Market Segment



Adapted from Geoffrey Moore's *Crossing the Chasm*, 1991



Technology Acceptance

Market Group Characteristics

- Early Market -
 - Technology-proficient
 - *Complexity is part of getting ahead.*
- Mainstream Market -
 - Other factors already create high complexity.
 - Additional *complexity is undesirable.*

***Products need to be different for
the different market groups!***



Legacy Car Product Development Issues

- Legacy: Research & development of technologies alone does not address **structural** problems
 - Present automotive production volume assumptions volumes (100,000s/ platform) are too high for rapid introduction of new technologies.
 - High volume introductions imply **higher incremental investment risk** in facilities.
 - Containing high risk requires longer, more-thorough development cycles.
 - Markets demand shorter development cycles and greater customization.
- Legacy: Manufacturers resort to high levels of flexible automated equipment to adapt high-volume facilities for fragmenting markets.
 - Maintenance of flexible automation can result in higher overhead costs.
 - Flexible automation is incrementally more expensive than dedicated automation, resulting in **higher incremental investment risk**.



Alternative Approach: **Dedicated Product**

- Focus.
 - Address **tightly-aligned** consumer segment(s).
 - Service values, not immediate transient desires.
- Minimize content of marginal end-consumer value.
- Maximize compatibility with end-consumer options.
 - The “upgrade” may be the primary product.
 - Design for market-realistic product life. Renewal in-service may be desirable.

A Simple Philosophy: **Dedicated Product**

less is more

Less is More: less **mass-market** vs more **individual**



Less is More: Infotainment **complexity** vs **capability**





Predominant Automotive Production

- Present industry habit
 - High-volume facility capacities
 - Flexible production systems to handle variations.
 - Multiple degrees of freedom in automation systems.
 - Automated fixturing.
- Inherent risks
 - More controls necessary to control repeatability.
 - High initial investment cost.

Less is More: facility investment vs consumer choice



**CUSTOM
CAR SKINS
COMPETITION**

www.local-motors.com



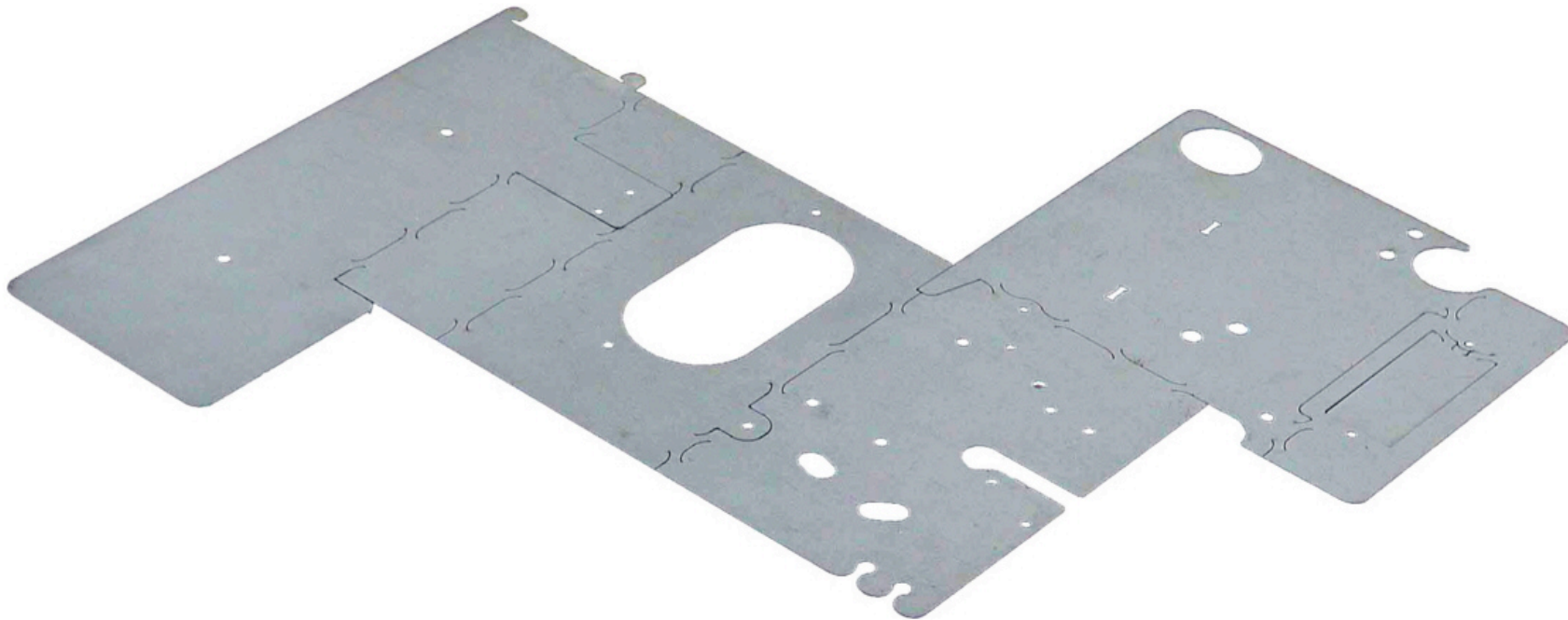


Dedicated Production

- Multiple, lower-volume facilities to handle variations.
 - Lower incremental investment cost
 - Quicker implementation timing
- Re-usable but not flexible
 - Standardized steps
 - Multiple, *simple*, standard automation systems
 - Self-fixturing workpieces (including fixtures).

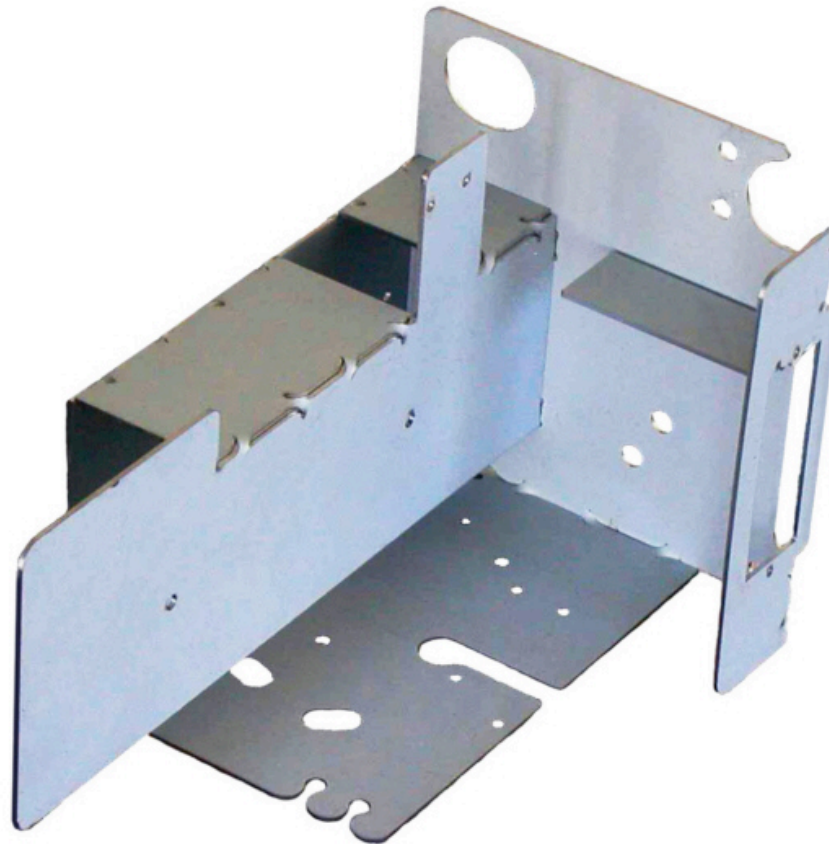


Example: **Industrial Origami**





Example: **Industrial Origami**



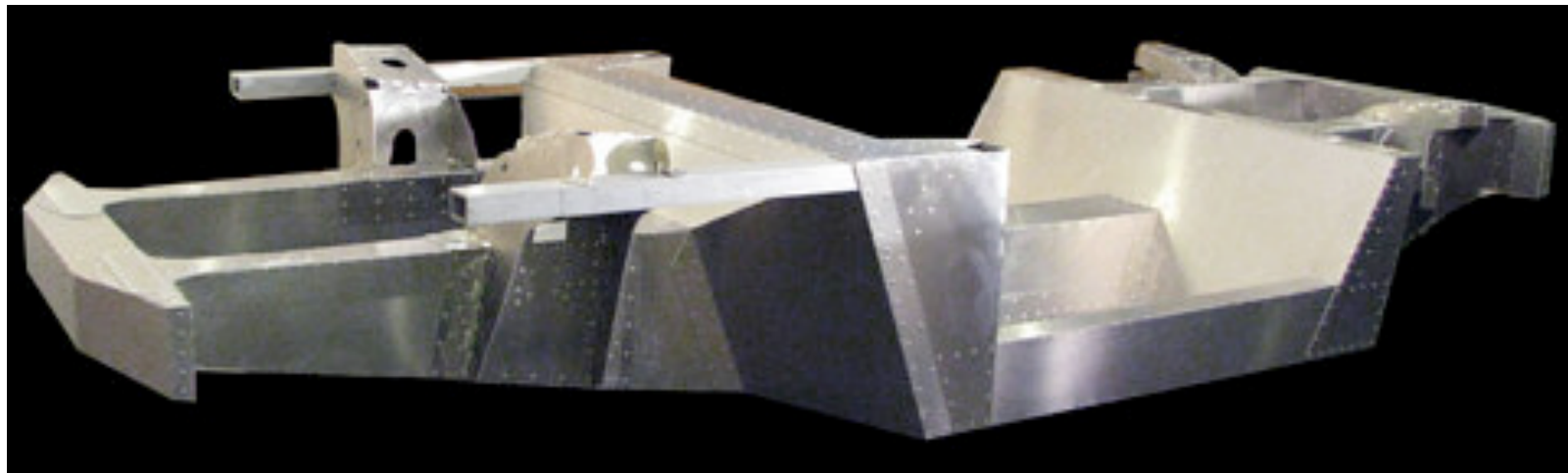


Example: Industrial Origami



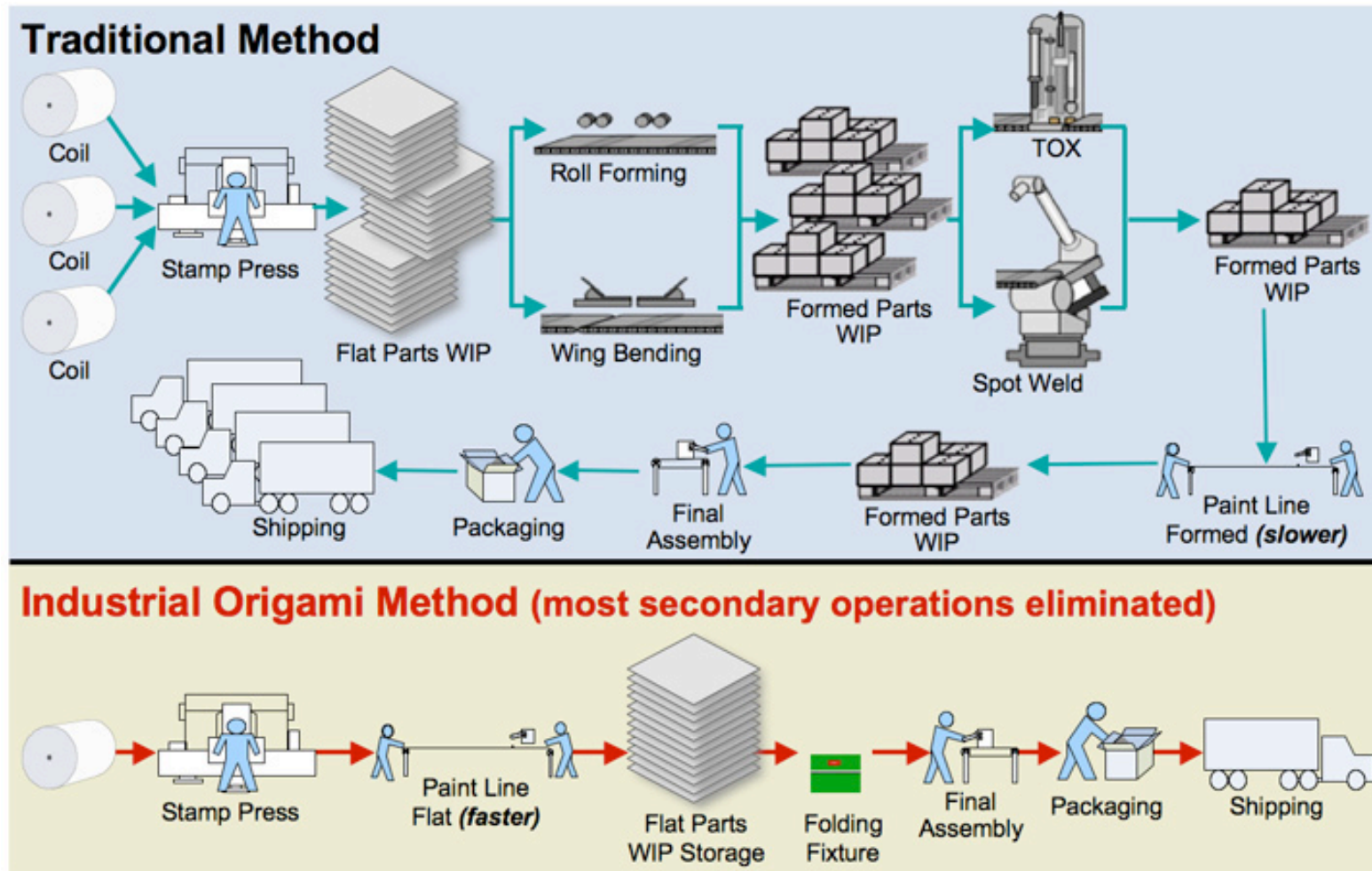


Example: **Industrial Origami**





Example: Stamping v. Industrial Origami





Summary

- Economic sustainability of a technology requires proper product definition in a sequence over time.
- Production sustainability requires examining methods from design phase.
- *less is more* is a philosophy that applies to both product and production during the introduction of new product and production technologies.

Thank You!