



***State – of – the – Art in
Manufacturing Strategy and Education
in the US***

by

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Introduction to Clemson University

- ❖ A Land-grant University
Founded in 1889
 - Focus on Agriculture and Engineering
 - Tradition of Economic Transformation in Agriculture, Textiles, Ceramics, Chemicals
- ❖ Technically Oriented Public Research University
 - 17,000 Graduate and Undergraduate Students
 - \$180 Million in Research Expenditures
 - Strength in Engineering, Architecture, Agriculture, Entrepreneurship and Communication



CU – ICAR Campus



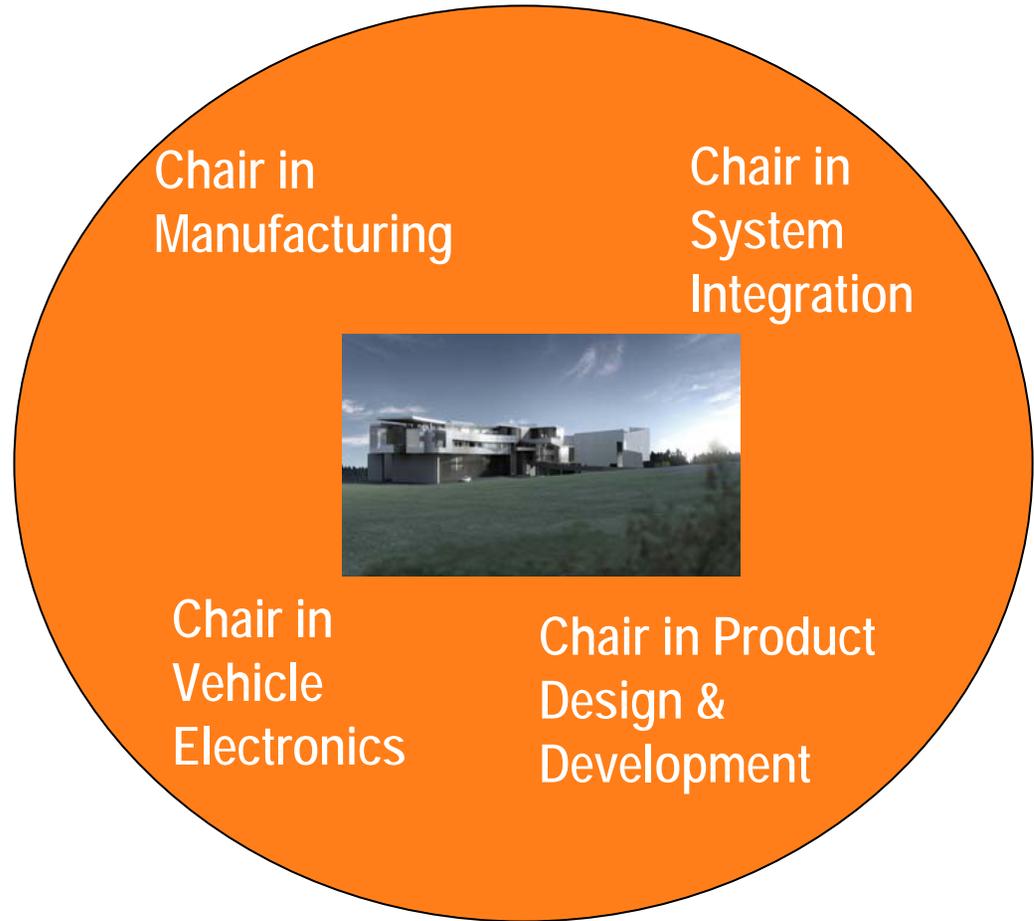
The Carroll A. Campbell Jr. Graduate Engineering Center

- ❖ An 90,000 sq. ft. building
- ❖ Systems Integration Research Activities
 - Passenger Vehicles
 - Heavy Vehicles
- ❖ Graduate Program in Automotive Engineering
 - Industry focused
 - Interdisciplinary
- ❖ Facilities
 - Full vehicle testing
 - Engine/powertrain testing
 - Faculty, student, staff offices
 - Industry partner offices
 - Conference facilities



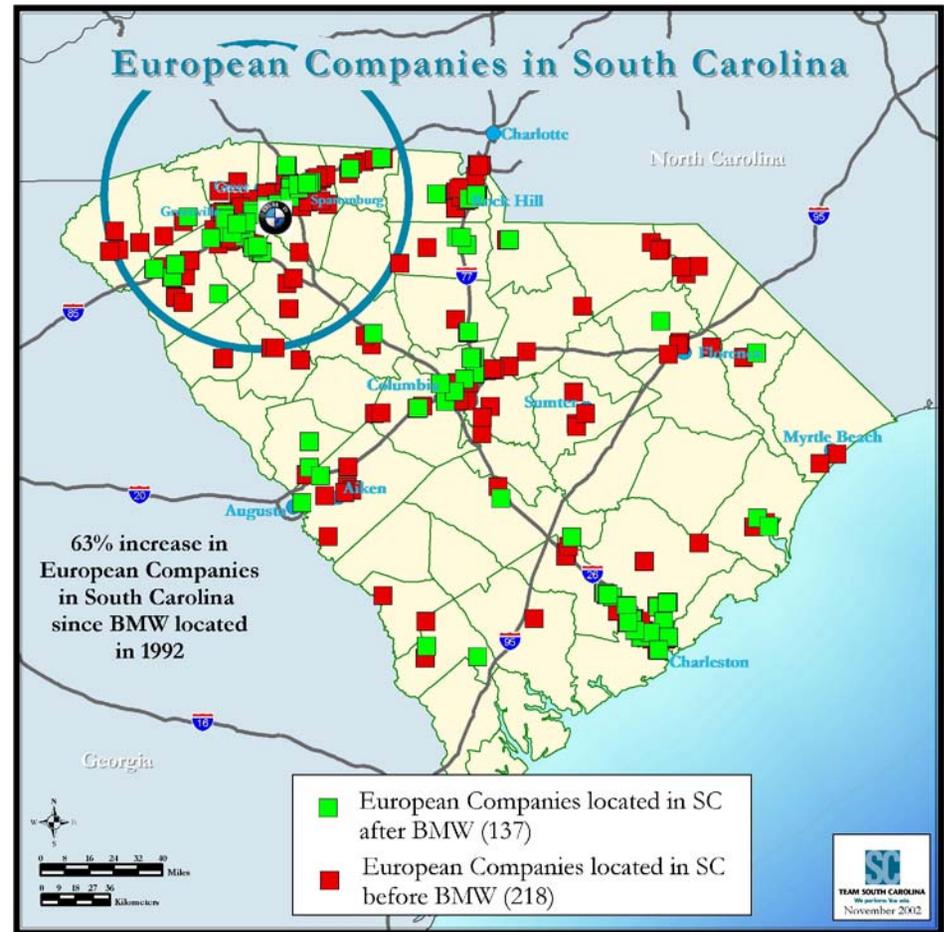
The Impact

- ❖ Emissions
- ❖ Safety
- ❖ Energy
- ❖ Manufacturing



SC and European Economic Impact

- ❖ Between 1992 and 2002
- ❖ Created 37,800 jobs
- ❖ Invested almost \$13 billion
- ❖ 37 companies located in SC



The Market

- ❖ World Population 6.6 Billion (July 2007)
- ❖ 265 Nations
- ❖ 82% Literacy Rate
- ❖ Gross World Product (GDP): \$46.77 Trillion
- ❖ GDP per capita: \$10,200
- ❖ Labor Force 3 Billion
 - Agriculture 40%
 - Industry 21%
 - Services 39%
- ❖ Unemployment Rate 30%
- ❖ Cars Sold
 - World Wide 43 million
 - Cars Sold in US 7.7 million
 - Cars Sold in China 3.83 million
- ❖ New Car Market \$1.5 Trillion.

<https://www.cia.gov/library/publications/the-world-factbook/geos/xx.html>

Education and Research for Next Generation Manufacturing

- ❖ Vision of innovation
- ❖ Building relationships between academia, government and industry
- ❖ Future directions for IMS in manufacturing research and education

Vision of Innovation

- ❖ Innovation
 - Incremental / small technological steps
 - Scientific Innovation – Large Scale
- ❖ Product and Process Innovation
- ❖ Academics must become more engaged in industry to better understand the requirements of next generation
 - Manufacturing
 - Technology
 - Management
 - Policy
- ❖ Academia gets some good experience / advice from industry
- ❖ Industry gets a fresh view from academia

Vision of Innovation

- ❖ Role of universities – cannot be parochial
 - Centers of excellence (focused but not too focused)
 - Increase in value of product (research and education)
 - Increase in collaboration between universities (research and education)
- ❖ Empirical nature of manufacturing
 - Progression of physics based modeling
- ❖ Education must go beyond hard science and engineering
 - Experience
 - Skill
- ❖ Sharing the wealth (or at least the IP)

Building Relationships Between Academia, Government and Industry

- ❖ Social responsibility
 - Academia and government
 - Industry and government
- ❖ Internships
 - Faculty
 - Students
 - Industry
 - Government
- ❖ Learning
 - Technology
 - Management (HR and Technology)
 - Policy issues

Building Relationships Between Academia, Government and Industry

- ❖ Students gain access to most latest
 - Equipment
 - Software tools
- ❖ Industry gains access to most latest
 - Equipment
 - Software tools
- ❖ Pragmatic knowledge for the students
- ❖ A fresh look at tradition for industry
- ❖ Thesis work vs. Project Work
 - Undergraduate and graduate
 - Critical issues for industry
- ❖ Multiple partners with university as focal point

Future Directions of Research and Education

❖ Collaboration

- Industry
- University
- Government

❖ Leverage

- Capital
- Intellectual capital

❖ Accessibility by SME's

❖ Pre-Competitive vs. competitive

Future Directions of Research and Education

- ❖ Education requiring multiple disciplines.
- ❖ Globalization is critical
 - Close proximity is gone
 - We can take advantage of this
 - We must teach students to take advantage of this
- ❖ Systems
 - Integration (mating technology)
 - To be integrated (modular design).
- ❖ Making a factory a black box, is an impediment,
Relates to IP

Future Directions of Research and Education

- ❖ Curriculum revision
 - Content
 - Tools used
 - Tools taught
- ❖ Education should be innovative
 - Model
 - Content
 - Delivery
 - Methodology
- ❖ Tightly linked to industry's needs
- ❖ Hands-on (Project Based Learning – PBL)
- ❖ Multi-disciplinary
- ❖ Systems engineering

Future Directions of Research and Education

- ❖ Communication
- ❖ Program / Project management
- ❖ Entrepreneurship
- ❖ Management
 - People
 - Projects
 - Technology (MOT)
- ❖ Policy
 - Understanding
 - Setting
 - Reacting

Future Directions of Research and Education

- ❖ Manufacturing is a post graduate degree
 - Undergraduate students get good fundamentals
 - Post graduate students receive additional training
 - Practicum
 - First year training at large companies
- ❖ Integration of engineering education into supply chain for manufacturers
 - Getting students in the pipeline
- ❖ Recruiting manufacturing engineers
- ❖ Retention of manufacturing engineers

Moving in the Right Direction: Global Education in Manufacturing (GEM)

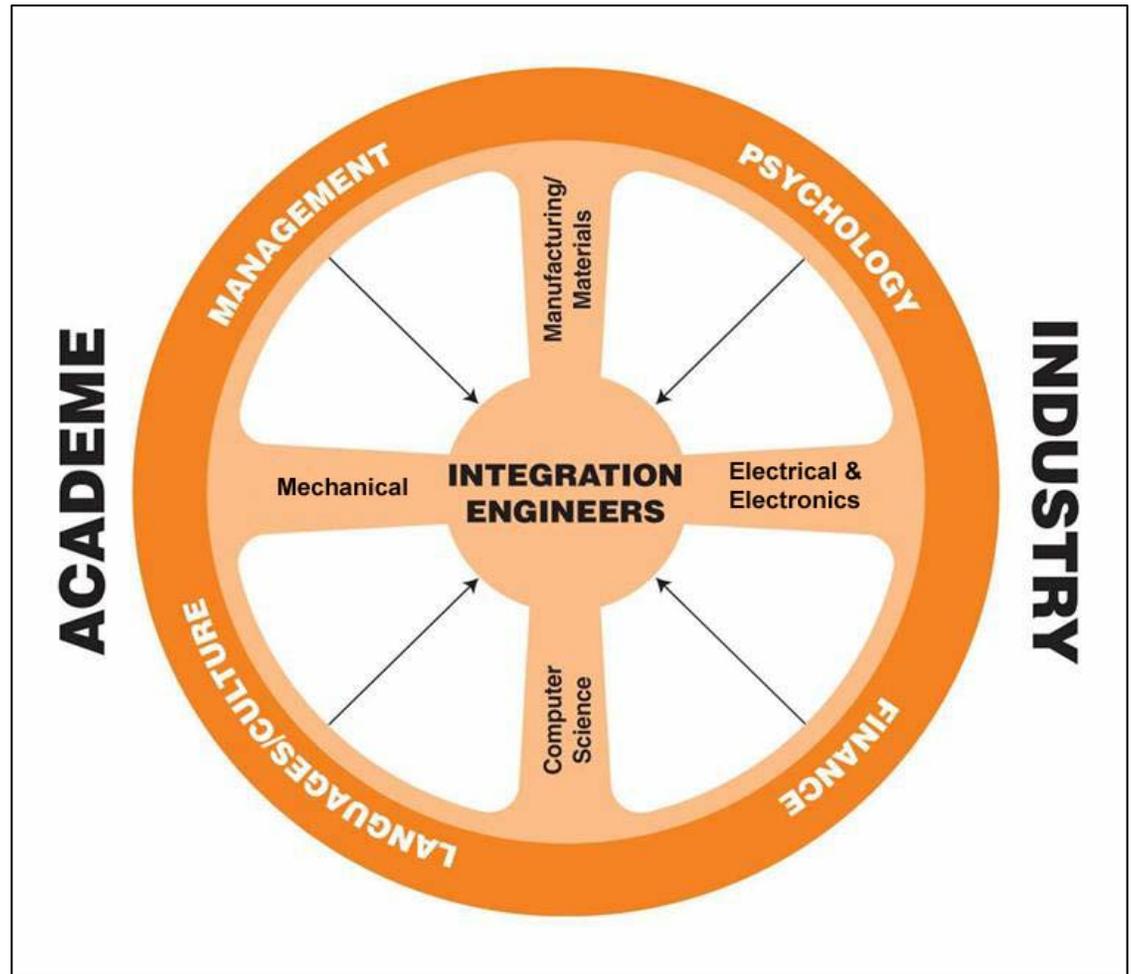
- ❖ Curriculum for Manufacturing Strategy
- ❖ 7 Modules - Outcomes
 - Development of extended products
 - Digital business along supply chain
 - End of life planning and operation
 - Business Operations and competitive strategy
 - Intelligent manufacturing processes
 - Intelligent manufacturing systems design
 - Enterprise and product modeling and simulation
- ❖ Industry focused education
 - Needs
 - Projects
 - Ongoing involvement
- ❖ Distributed education
- ❖ Multiple exit points for students
- ❖ IMS accreditation of degree

Challenges

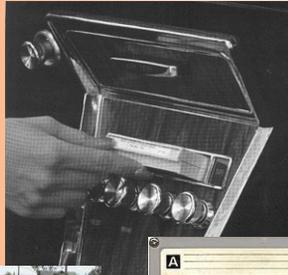
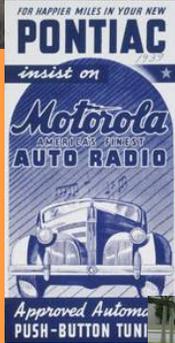
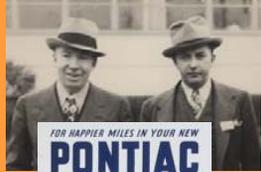
- ❖ Language
- ❖ Distance
 - Interaction
 - Laboratory
- ❖ Culture
- ❖ \$\$\$\$\$
 - Tuition
 - Profit

Partners

- ❖ Academe
- ❖ Industry
- ❖ Government
- ❖ Societies



History of Car Media – It is Accelerating!



1930s

commercial introduction of the fitted car radio came in from the Galvin Manuf. Corporation.

1965

Ford Motor Company introduced dealer-installed 8-track players as an option on most models

1952

Blaupunkt became the first maker to offer FM receivers

1970's

Compact Cassette Wins the war with 8 track for automobiles

1990's

Compact Disk Wins the war with tapes for automobiles

1996

GM offers Emergency services and system monitoring

1997

Mercedes offers GPS

2002

Honda Odyssey factory installed DVD player

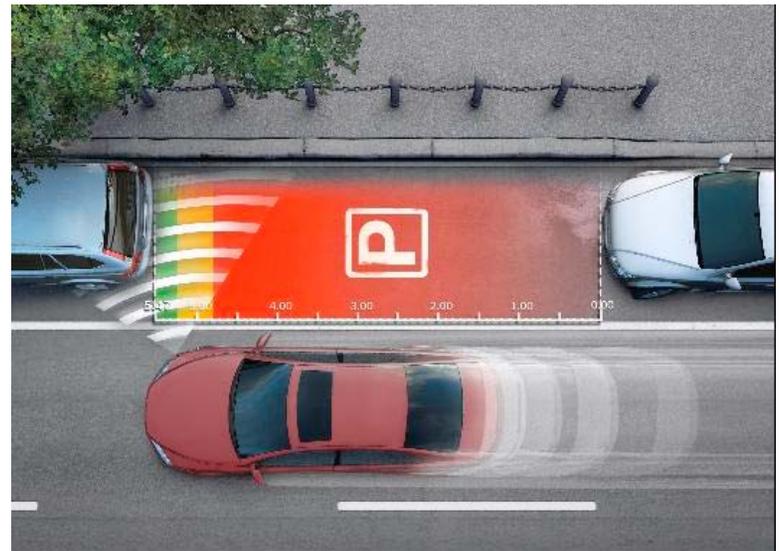
2003

Manufacturers offer a car radio capable of CD, MP3, XM satellite radio and AM/FM playback

What Next?

Automated Parallel Parking

- ❖ Available on Lexus LS460
- ❖ Optional on Toyota Prius
- ❖ Similar system by Bosch available in 2008



Lexus Automatic Parking



The Future for the United States

- ❖ Education at all levels
- ❖ South Carolina
 - Jobs – too many?
- ❖ The Southeastern U.S.
- ❖ The United States of America
 - Automotive
 - Manufacturing
- ❖ The World



Conclusions

- ❖ Many opportunities for innovation
 - Manufacturing research
 - Manufacturing education
- ❖ Relationship are our responsibility
 - Industry
 - Government
 - Academe
- ❖ Future directions must yield
 - New global leaders (CEO / CTO / CIO / Government Officials)
 - Flexible engineers
 - Systems integration personnel
 - Global thinkers
- ❖ There are challenges
- ❖ IMS is a good start in the right direction

Do Not Underestimate the Human Factor

