China Auto and Manufacturing R&D

Professor Jun Ni
Shien-Ming (Sam) Wu Collegiate Professor of Manufacturing Science
Director, SM Wu Manufacturing Research Center
The University of Michigan, Ann Arbor
Email: junni@umich.edu

also
Dean, University of Michigan-Shanghai Jiao Tong University Joint Institute, China
Outline

1. Key Statistics and Chinese Auto Industry
2. Chinese Manufacturing R&D Strategies
3. Priority Areas
4. Sample Projects
5. Conclusion
Fun Facts about China

- Population: ~ 1.3 billion (a Big multiplier)
- More people in China study English than those in USA.
- Chinese lunar calendar - the oldest known calendar (This year is 4705)
- Archaeological evidence indicates Chinese grew rise as early as 5000 BC
- Greatest Ancient Inventions
  - Compass (1040-44 AD in Song dynasty)
  - Gun Powder (1040 AD in Song dynasty)
  - Paper-making (105 AD in Han dynasty)
  - Printing (220 AD in Han dynasty)
Key Statistics

- GDP (Nominal) - 2007, $3.42 trillion (ranked 4th)
- GDP (PPP) - 2006, $10.21 trillion (ranked 2nd)
- GDP per capita (Nominal) - 2006, $2,034 (ranked 107th)
- GDP per capita (PPP) - 2006, $7,800 (ranked 82nd)
- Labor force - 795.3 million
- Unemployment rate - 4.3% (official) vs 13% (unofficial)
Key Statistics

- Annual production of degreed engineers over 1.6 millions
  - 0.6 million from 4-yr programs and
  - 1 million from 3-yr programs

- Manufacturing accounts for 48% of China’s GDP (2007 data)

- Manufacturing employs 11% of total workforce and 90% of industrial workforce

- China became the third largest nation in total manufacturing output following US and Japan

- China became the second largest automotive market in the world
Annual GDP Growth in China
History of China’s Auto Industry

Inscription of Chairman Mao for FAW

Deng Xiaoping visits SVW

Jiang Zemin visits Dongfeng Motors

Hu Jingtao visits FAW-VW

China’s automotive industry has over 55 years history.
Four Major Development Stages

Auto market development

- Spent 40 years to reach 1,000,000
- Only 8 years to reach 2,000,000
- Just 2 years to reach 3,000,000
- 1 year to reach 4,000,000

YEARLY OUTPUT (thousand/year)


TIME
Forecasting of China’s Auto Market

Predicted Demand of Passenger Cars (2005–2014)

- Forecasting was made in 2003.
Prediction vs. Reality

Vehicle Sales (Million Units)

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<th>Actual</th>
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<td>2006</td>
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China’s Automotive Industry

- **123** auto enterprises, located in 27 provinces
- **23 provinces** have sedan car assembly line
- More than **5000** component enterprises
Major Auto OEMs in China

- **Daimler Chrysler-BJC**: Beijing
- **Hyundai-BAIC**: Beijing
- **FAW**: Changchun
- **FAW-VW**: Changchun
- **GM-Jinbei**: Shenyang
- **FAW-Toyota**: Tianjin
- **Fiat Nanya**: Nanjing
- **Shanghai-VW**: Shanghai
- **Shanghai-GM**: Shanghai
- **DFAC-Nissan**: Shiyan
- **Dongfeng-Citroen**: Wuhan
- **GM-Daewoo**: Yantai
- **Chang’an-Ford**: Chongqing
- **Chang’an Suzuki**: Chongqing
- **Liuzhou Wuling**: Liuzhou
- **Guangzhou-Honda**: Guangzhou

University of Michigan China Automotive Conference
Major Players

“3＋9” structure, market centralization rises

3 giant auto group——51%
9 independent carmakers——40%
others——9%

Three big giant groups

Nine independent carmakers
GZ Honda, CQ Chang’an, Anhui Chery, SY Brilliance, NJ Fiat, ZJ Geely
Hafei Auto, Changhe Auto, Jianglin Auto

“3+9” occupy 91% of total domestic yearly output
Several enterprises make efforts to develop local vehicle models

- Chang’an——Chongqing
- Hafei——Harbin
- Brilliance——Shenyang
- Chery——Anhui
- Geely——Zejiang

Chang’an CM8
Market Differentiation

More than 30 brands in the market, the sub-models have reached 90.

- luxury class, sales price more than 400,000 yuan
- top grade, sales price between 200,000 and 400,000 yuan
- middle grade, sales between 100,000 and 200,000 yuan
- economy class, sales below 100,000 yuan
- subcompact class, sales below 50,000 yuan

Audi A6 (luxury) Regal top grade BORA middle grade KIA economy class Q-Q subcompact
Recent Expansion and Export

- Mercedes are assembled in Beijing.
- Audi A6, A4 and MAZADA 6 are produced in FAW-VW.
- Cadillac is produced in Shanghai GM.
- SY Brilliance has launched BMW-3.
- 600 POLO of SVW have been exported to Australia.
- 500 GL10 MPV of Shanghai GM exported to Philippines.
SWOT Analysis of Chinese Auto & Manufacturing Industry
SWOT Analysis of Chinese Auto & Mfg Industry

(S-Strength):

- Large number of highly trained workforce
- Resources
- Market
- Dividend from old planned economy
- Large number of small-medium enterprises (SMEs)
- Entrepreneurship
SWOT Analysis of Chinese Auto and Mfg Industry

(W-Weakness):

- Lack of key process knowledge base and technical know-how & know-why
- Lack of key equipment design, manufacturing and integration capability
- Lack of system design and integration
- Lack of system-level thinking and integration of manufacturing with business strategy
- Behind in advanced process technology
- Most products are low value-added
- Weak in high-technical content product innovation and development
SWOT Analysis of Chinese Auto and Mfg Industry

(O-Opportunity):

- Entry into WTO
- Bonus of Globalization -> MNCs move production facilities to China
- Emergence of global R&D centers in China
- Significant market share in many products
- Competitive workforce
- Opportunity for global alliance
  - e.g., US-China relation (large trade deficit, political and diplomatic concern, access to up-scale market)
SWOT Analysis of Chinese Auto and Mfg Industry

(T-Threat):

• When trade barriers are taken down, business/investment environment could change like water falls.
• Without China’s own IP & key technical know-how and know-why, production facility could be moved easily to somewhere else.
• Complacency.
• Manufacturing rise and fall can occur relatively quickly (exchange rate, DFI, new technology invention, social instability, etc.).
Competitive Strength/Weakness

- **R&D Personnel (per 10,000 population)**
  - China (83)
  - US (476)
- **Total R&D Personnel**
  - China (10.5 million)
  - US (13 million)
- **R&D in China’s Manufacturing**
  - Mfg R&D accounts for 82.8% of total industrial R&D personnel
  - 50% of industrial R&D expenditure is in mfg (45.3 billion RMB)
- **Education**
  - On-campus students (1 million graduate students, 16 million 4-year college students, and 15 million 2~3 year technical college students)
  - 64% of college students are in science and engineering
China’s Auto and Manufacturing R&D Strategies
China’s Auto and Mfg R&D Strategies

- National R&D Roadmap through a national long and medium range (5 to 15 years) planning exercise
- Curiosity-driven research supported by National Natural Science Foundation of China
- State key development initiatives funded by Ministry of Science and Technology’s 863 programs
- Basic key research projects funded by Ministry of Science and Technology’s 973 programs
- More emphasis on self-owned original innovations
- Encouragement of industry and university collaborations
- Incentives for setting up multinational R&D centers (1,160)
National Priority Areas

- Aerospace industry
  - Large commercial aircraft
  - Space programs
- Automotive industry
  - Electrical vehicles
  - Hybrid technologies
- Energy systems
  - Wind turbines & Super power turbine systems
  - Nuclear power stations
- Transportation systems
  - High-speed trains
  - Ship building industry
- Key manufacturing equipment technologies
- Sustainable development technologies
Priority Areas of NSF China

- Basic research for resource minimization in manufacturing
- Resource saving designs for mechanical systems
- Bio-tribology and nano-tribology
- Meso/micro/nano manufacturing
- Digital manufacturing and equipment
- Manufacturing systems and operations
- Remanufacturing and green manufacturing
- Intelligent maintenance for mechanical systems
- Intelligent structures and systems
Sample New Technology Developments
Nano-Machining by AFM

c) 80µN 垂直载荷

d) 100µN 垂直载荷
Nano Coating with Diamond Powder

4—5um, Wear-resisting Increase 12 times
Micro Manufacturing
Micro/Meso-scale Material Forming
Micro-Machining with Laser Beam

(Sub-molecule)

直径 500μm
齿数: Z=108
齿根圆直径: D₀=480μm
齿顶圆直径: D₁=500 μm
齿高: h=10 μm

微孔阵列铝板
10齿直齿微齿轮
Extreme Manufacturing
Critical Infrastructure Manufacturing
Large Aircraft Design and Manufacturing
Large Power Generation Equipment
Remanufacturing
Wind Turbine Manufacturing Technology
Model-Based Design and Manufacturing
Forming Simulation and Modeling
Precision Magnesium Casting
New Process: Electromagnetic Control for Continuous Casting
New Process: UV Source Fast Curing for Rapid Mould Development
New Process: Ceramic Thermal Spray for Rapid Mould Development
Personalized Medical Device Manufacturing
Piston Machining Key Equipment and Technologies

- Precision boring of non-circular holes;
- Automated CNC machining in a single setup;
- In-process precision inspection of non-circular surfaces;
- Adaptive mould temperature control for automated casting and solidification.
Conclusions

• China has already become a major global manufacturing powerhouse and the second largest auto market.
• China has invested significantly in manufacturing R&D and will become a major player in global manufacturing R&D.
• China has shifted its R&D strategy from following western countries to coping with its own national needs.
• The expansion of multinational R&D centers in China will greatly increase China’s manufacturing R&D capability.