

2023 Global Forum on Mechanical Engineering

Global Trends in Manufacturing

Jung-Hoon Chun

Professor, Department of Mechanical Engineering
Faculty Director, MISTI MIT-Korea Program
Massachusetts Institute of Technology
Cambridge, MA 02139

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Manufacturing

“Value-added activity”

“Enrich the lives of people”

Objective

Review status of manufacturing and chart future courses for Korea.

The Industrial Revolutions

- Industry 1.0 (~1750): Mechanization
- Industry 2.0 (~1850): Mass production
- Industry 3.0 (~1970): Automation
- Industry 4.0 (2011): Cyber physical systems
- Industry 5.0 (?): ??????

Driving Forces for Changes

- Rapid advances in sciences and radical new technology developments, particularly the information, communications and transportation technologies.
- Global competition
- New trade frictions/barriers
- Unforeseen threats

Manufacturing in the US

(2022 Bureau of Economic Analysis + Bureau of Labor Statistics)

- Output: 2.5 trillion dollars
- 16.8% of the world output
- 10.7% of the US GDP
- 13 million employees
- Slow growth rate and declining economic sector
- Weak in consumer goods such as textiles and apparel
- Strong in “durable/high value goods” such as computer and electronic products, machinery, motor vehicles and aerospace manufacturing
- Higher-technology industries are the only sector still expanding

Manufacturing in Germany

(2021 World Bank + German Government Ministries)

- Output: 0.8 trillion dollars
- 5.0% of the world output
- 18.9% of the national GDP
- 7.8 million employees
- Moderate growth rate and high relevance for economic welfare
- Strengths in a diverse range of industries, including the automotive, mechanical, chemical and electrical industries driven by large companies combined with strong SMEs
- High relevance of new technologies, including AI, Industry 4.0 and advanced manufacturing processes for future growth

Manufacturing in Korea

- Output: 457 billion dollars (2021)
- 3.0% of the world output (2020)
- 28.0% of Korean GDP (2022)
- 3.7M employees (2022)
- Slow growth rate and leveling-off economic sector
- Weak in high-end equipment and advanced materials such as semiconductor equipment, aerospace, pharmaceutical and biomedical industries
- Strong in consumer goods and heavy industries such as electronic products, automotive, shipbuilding and steel
- Digital transformation is a major issue

Value-Added in the Semiconductor Industry (Market size: \$620B in 2022)*

■ Design:	53%
■ Foundry:	24%
■ Packaging:	6%
■ Equipment:	11%
■ Other:	6%

Equipment Market Share

- Semiconductor: 20%
- Machine tools: 65%

Enabling Technological Areas for the Competitive Manufacturing Industry

- High **purity** materials
- High **precision** components
- High **value-added** equipment

Suggested Public Policies

- Effective STEM education to build up the human resources for the future manufacturing industry
- Strong research, innovation and development infrastructure/cluster

MIT Education and Research Enterprise

- Education: Discipline-based hands-on approach
- Research: Broad-based, ground-breaking applications
- Development: Innovation clusters

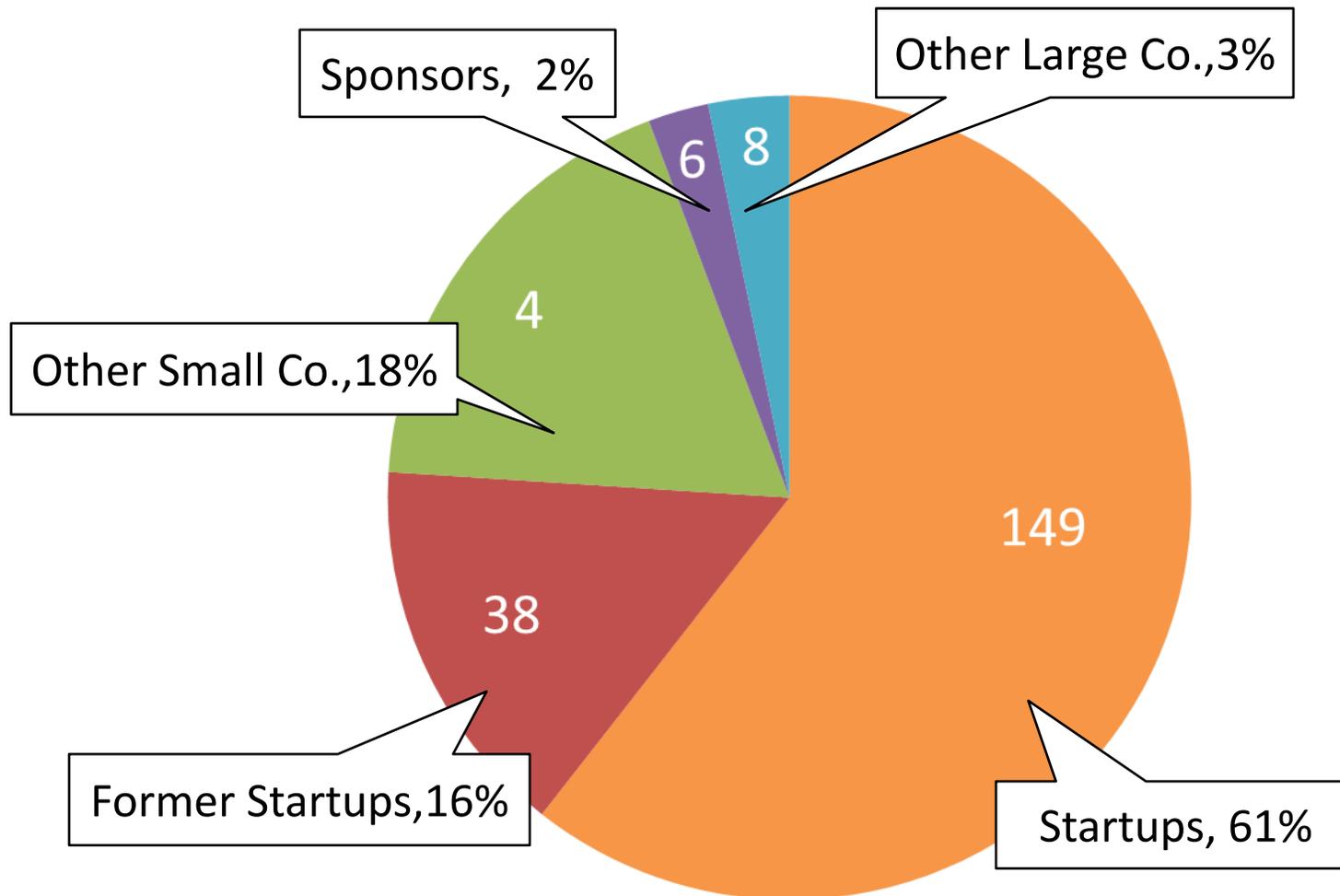
Myths

- Royalties are a significant source of revenue for the University
- Expect a quick return of technology transfer investment
- Companies are eager to accept new technology from universities
- You should broadcast availability of technology for licensing
- The technology transfer office finds the licensee

Reality

- With the exception of the rare “blockbuster”, licensing revenue is small
- Don’t expect product royalties for 8-10 years
- Most companies want quick time-to-market
- Publishing lists of available technology is not very effective
- The inventor is the best source for leads

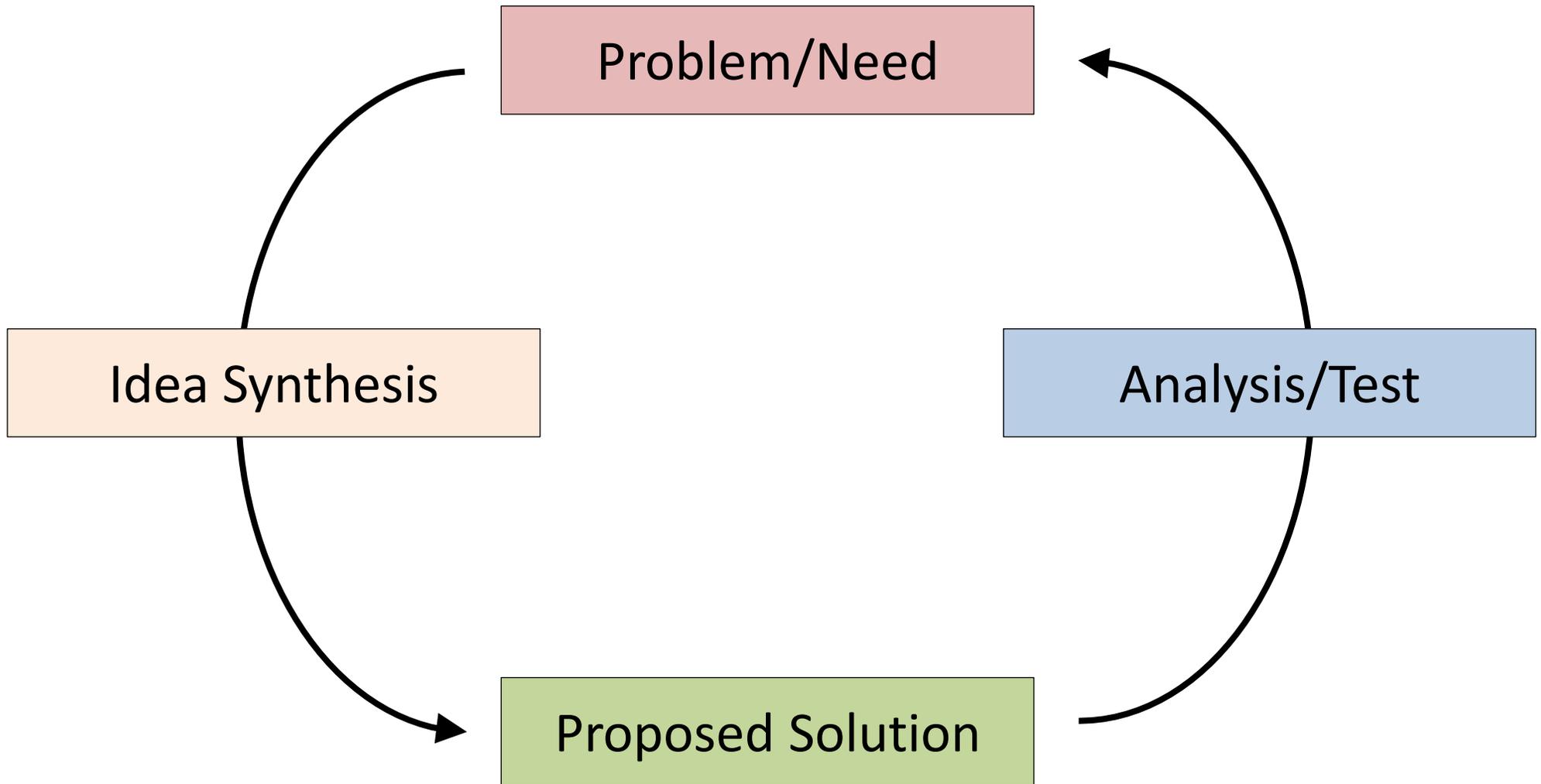
Exclusive Licenses 2010-2017



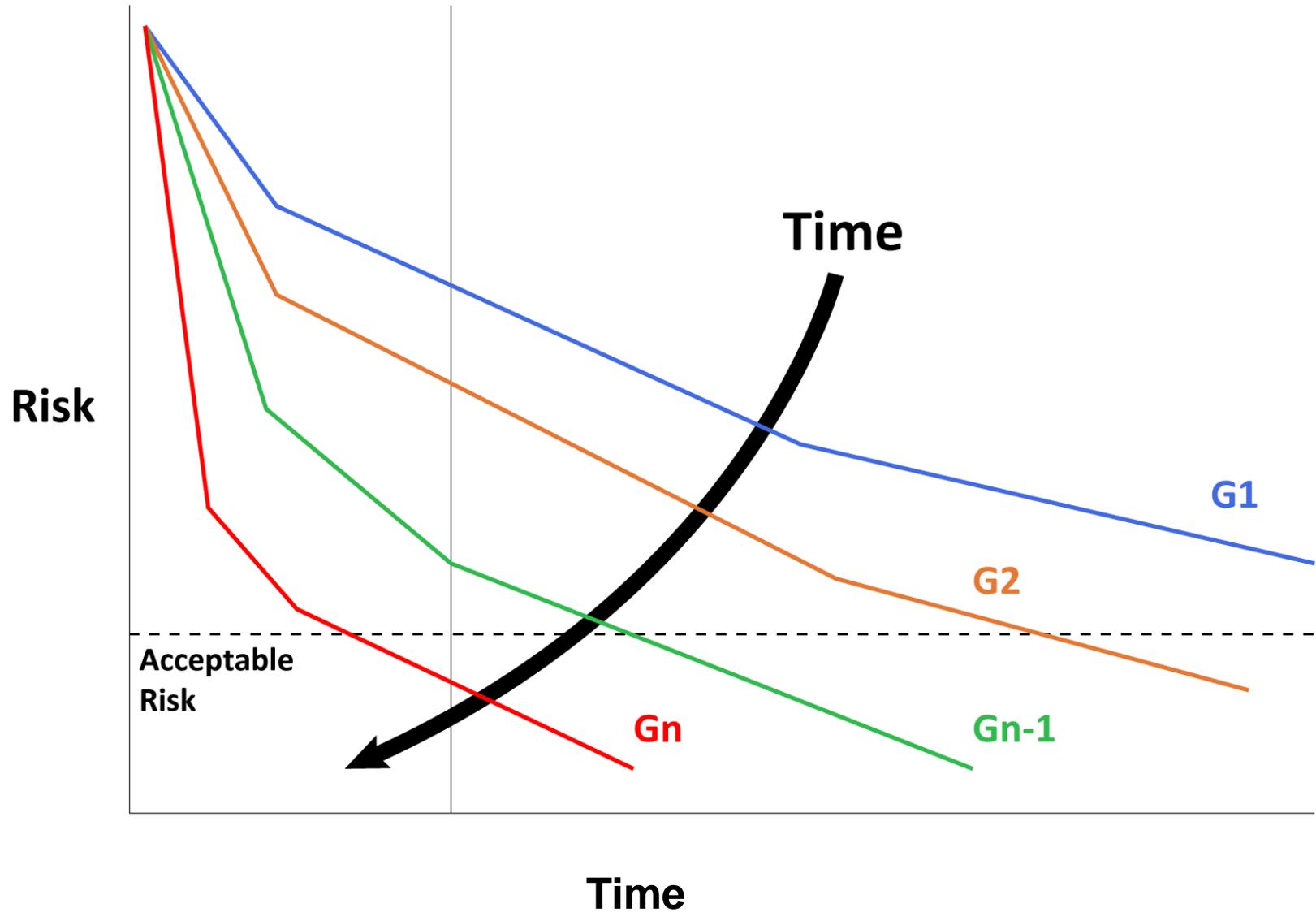
Observations on Successful Innovations

- Fundamentally grounded individual ideas
- Development by teams
- Synchronized R&D pipeline for continuous innovation and risk management
- Rapid innovation cycle for long-term success

Innovation/R&D Process

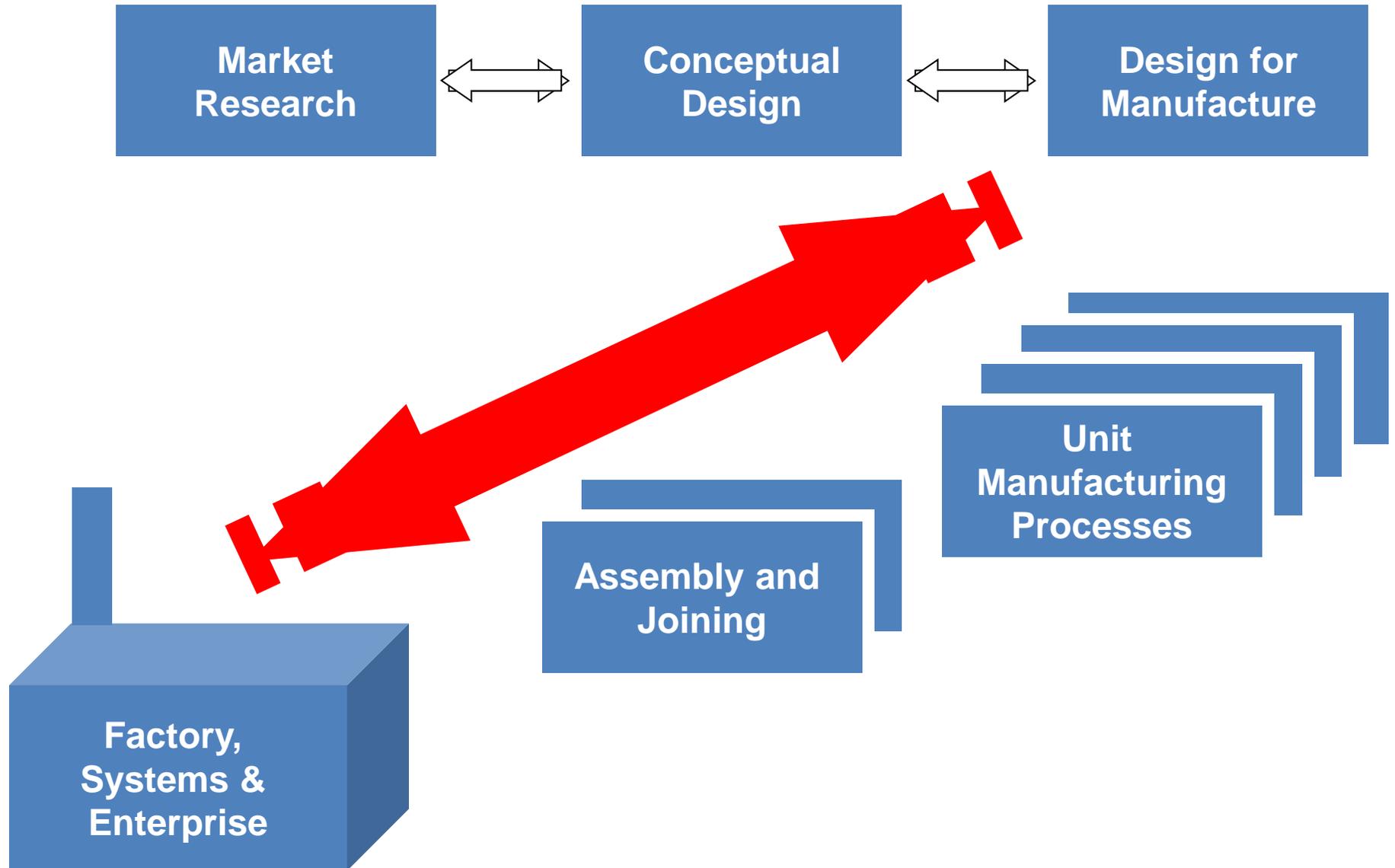


Innovation Cycle Time



Source:
Sunlin Chow

Role of Manufacturing in Innovation: Technology Multiplier



Technology Multiplier

Enable to

- Learn faster
- Innovate faster
- Shorten the time to market
- Produce complex products

$$F_{\text{success}} = F_{\text{hard}} \times F_{\text{smart}} \times F_{\text{passionate}}$$

Thank You!

Jung-Hoon Chun

jchun@mit.edu