Materials Science and Corporate Research-
Differentiation *via* Innovation

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Science drives differentiated materials businesses

3 characteristics needed to enable profitable materials science

Uncertainty Management

Balanced portfolio

Absorption of failure

Knowledge Acquisition

Sensing

Absorb/Learn/Create

Integrated Development

Across divisions

Throughout stages

Derived from Pisano, Industry and Corporate Change, 19, pp 465-482 (2010)

Research → Invent → Prototype → Market → Scale → Manufacture → Sell → Support

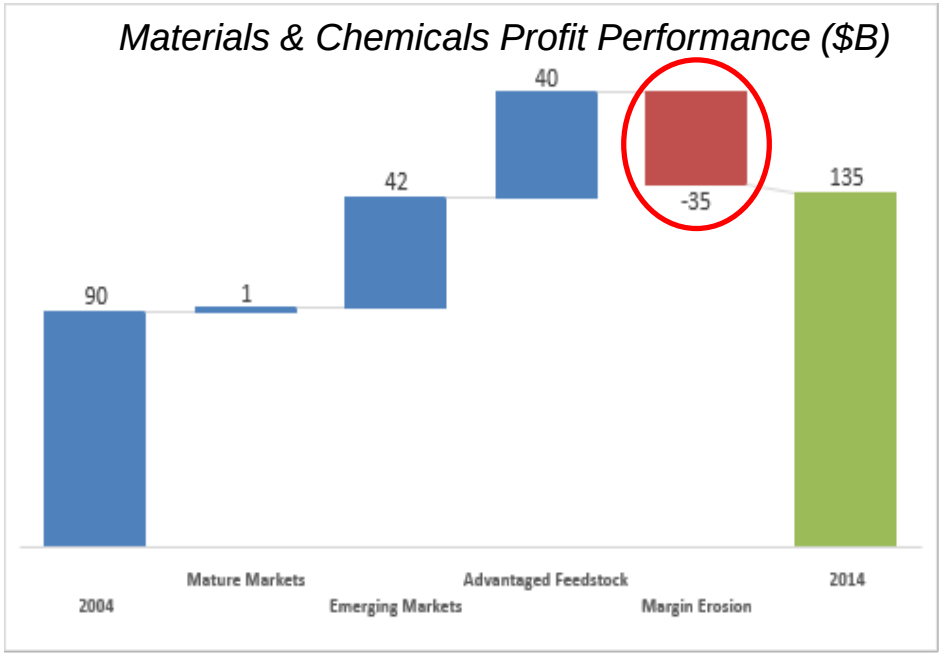
The global market challenges materials companies

Markets rapidly commoditized

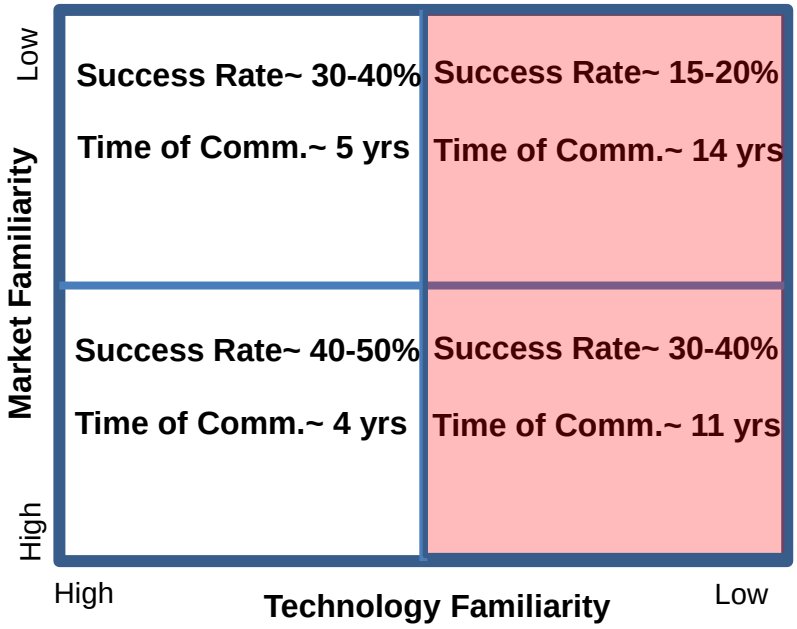
- Margins squeezed; R&D becomes cost
- Stock buy-back for short-term "growth"

Long innovation delivery times

- Requires funding by cash businesses
- Hard to absorb research investment



J. Boringer, T.J. Simons, McKinsey, Commoditization in chemicals 12/16



C. Musso *et al*, McKinsey Chemical Innovation 5/13

Materials businesses react to investor pressure

- Companies become “focused”- *i.e.* short-term focus on existing products
- Shift spending from research to application development
- Eliminate functions not required for short-term strategy and sales
- Violates characteristics of science-based business
  - Harder to move from discovery to commercialization
  - Reduces the ability to attract new talent and ideas
  - Reduces the ability to sense and incorporate new opportunities

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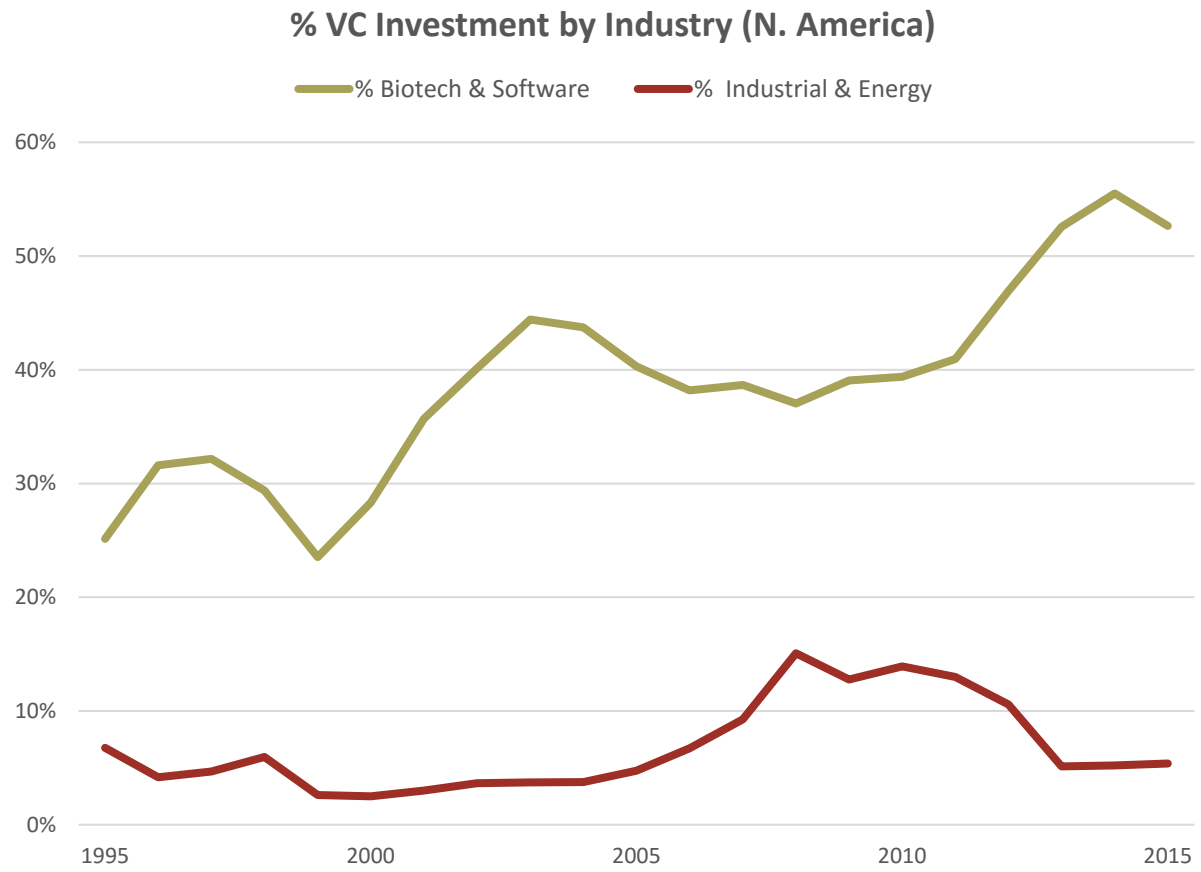
Depending on starts-up not the perfect answer

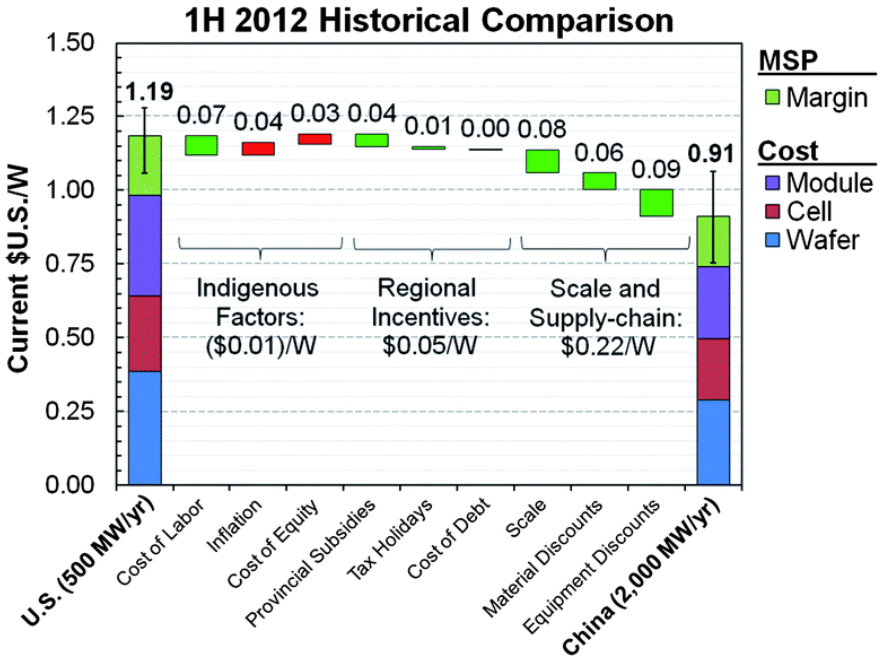
- Large materials companies lack the sensing capability and risk tolerance
- Venture money prefers 3-5 years to exit & minimal invested capital
  - Shy away from investment in materials companies
- No one to bridge the Valley of Death

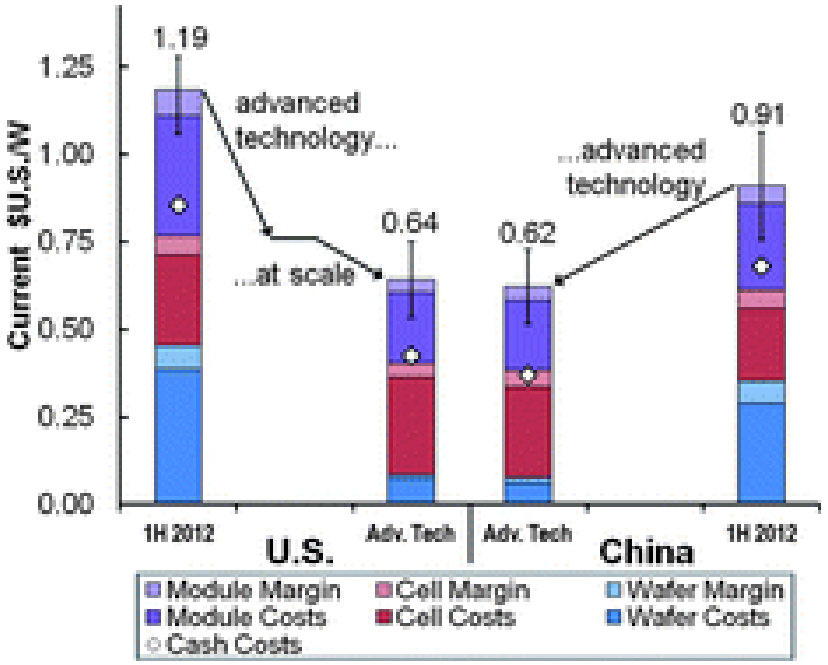


National Venture Capital Association, 2016 Yearbook

Changing the competitive equation- a solar example

Government support is critical to reduce private sector risk
Public/private partnerships can impact the entire supply chain





- US vs. China cost: scale & supply chain, not labor
- Can be reproduced but installed base challenges

- Advanced technology can level the playing field
- Performance transformation leads to:
  - Lower costs
  - Larger scale
  - Discontinuity in the experience curve

AC Goodrich, *et.al.*, *Energy and Environmental Science,* 2013, **6,** 2811-2821

Conclusions

- Short-term focus breaks the connection to science-based model
  - Separates invention from manufacture
  - Reduces fundamental ability to convert invention to innovation
- Cripples corporate front-end sensing capability
  - Increases the depth & width of the Valley of Death for external inventions
- Underscores the importance of the historic role of government to reduce private industry risk
  - Government not doing what "the private sector does better," or trying to "pick winners" and instead is investing in those things that private sector cannot/will not do
  - Drive science that is the foundation for innovation (*e.g.* ARPA-E, NSF, DARPA)
- Purposeful public-private partnerships can drive innovation and restore US manufacturing in key industries