



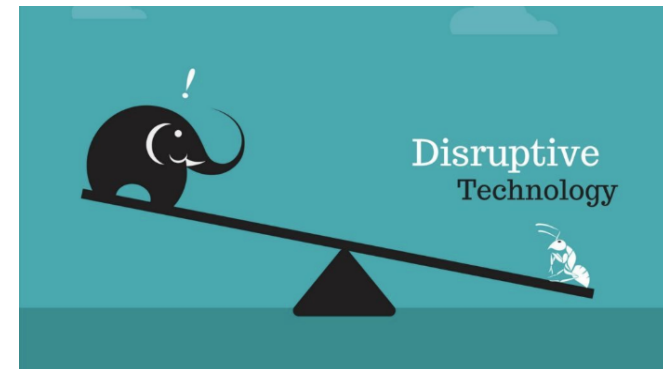
National University of Singapore

Strategic Technology Management for Future Growth

Instructor: Professor LAU Hon-Chung



Technological Progress & Potential Disruptive Innovations





Video link

https://www.youtube.com/watch?time_continue=25&v=mbPiAzzGap0





OUTLINE

- Definition and examples of disruptive innovations
- What type of innovations makes the most impact?
- Sourcing disruptive technologies
- Questions and answers





Disruptive Innovation	Market disrupted
Wikipedia	Encyclopedia
Digital camera	Film camera
High Definition TV	Analog TV
Hand phone	Wired phone
Smart phone	non-smart hand phone
LCD LED	CRT
USB flash drive	Floppy disks, zip drive
Streaming video	Video rental
Computer printer	Offset printing
Word processor	Typewriter
Plastic	Metal, wood, glass





Potential disruptive technologies in oil & gas

Disruptive Innovation	Market disrupted
Cloud computing	Data storage & mining
Machine learning	Reservoir simulation, well completion, drilling
Additive manufacturing	Tool manufacturing & transportation
Nano-steel composites	Conventional steel
Fiber optics	Smart well
New proppants	Hydraulic fracturing
New enhanced oil recovery	Chemical EOR



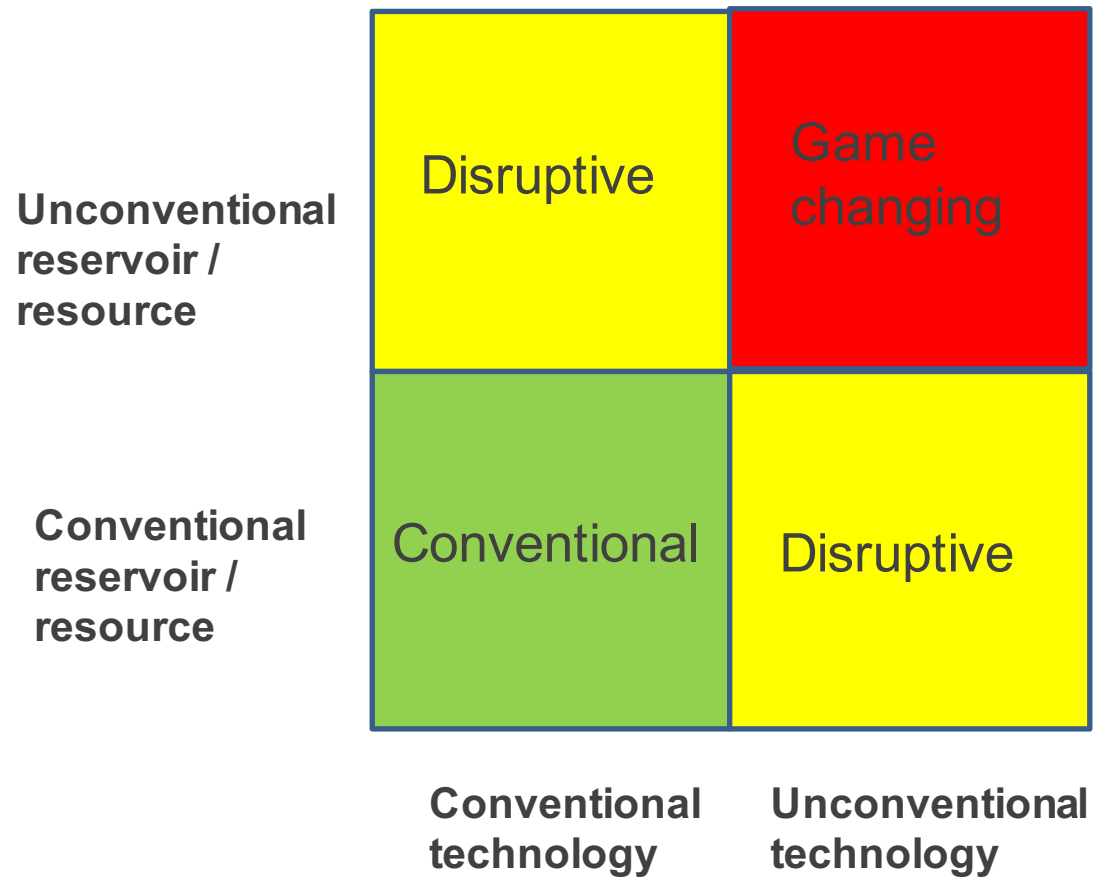


Which type of innovation makes the most impact in your sector?





What type of innovation makes the most impact?





What type of innovation makes the most impact?



Conventional reservoirs / resources

- Conventional oil and gas
- Deepwater oil and gas

Unconventional reservoirs / resources

- CBM
- Tight oil
- Tight gas
- Gas shale
- Oil shale
- Gas hydrate





What type of innovation makes the most impact?



Conventional technology

- Enhanced oil recovery
- Smart wells
- Artificial lift
- Stimulation
- Horizontal well
- Hydraulic fracturing

Unconventional technology

- Horizontal wells and hydraulic fracturing
- Nanotechnology
- Artificial intelligence
- Additive manufacturing
- Cloud computing





How do you source disruptive technologies?



- **Short-term solutions**

- Borrow mature technologies from other industries
- Shell's models (Shell Techworks, Shell Technology Ventures)

- **Long-term solutions**

- Support game-changing innovations
- New technology sourcing models
 - Crowdsourcing (video)
 - Government-industry cooperation (video)





Crowdsourcing





Government-industry partnership



LEADING FROM ASIA





Implications for Petroleum Engineers



- What type of research will be gamechanging?
- What type of research will be disruptive?
- How should petroleum engineers position themselves for the future?

From petroleum engineering to energy engineering

Understand how energy production and usage impact the environment.

Think energy affordability, security and sustainability.

