

Subsea Workshop 26th November 2012

Welcome and Introduction

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Visiting Professor, NUS

Date/Time	Activity
0830 – 0900	Registration
0900 – 0905	Opening Remarks
0905 – 1005	Segment 1: Subsea Production Systems – Current and Future Trends <ol style="list-style-type: none"> 1. NUS –Subsea Systems Evolution & Influences 2. FMC – Advances in Subsea Processing Systems 3. NUS – Trends in Subsea Water Management 4. INTECSEA, WorleyParsons Group
1005 – 1045	Panel Discussion (40 min)
1045 – 1105	Coffee/Tea Break
1105 – 1150	Segment 2: Subsea Asset Management, Life Extension and Integrity <ol style="list-style-type: none"> 1. NUS – Mid-life Asset Transformation, Life Extension 2. Schlumberger – Reservoir Management 3. Lloyd’s Register, Global Technology Centre
1150 – 1230	Panel Discussion (40 min)
1230 - 1255	Aligning Education Curriculum to Meet Industry Needs
1255 – 1300	Closing Remarks
1300 – 1400	Lunch
1400 – 1500	(Optional) Tour of NUS Multi-phase Flow Loop Facility

Segment 1

Subsea Systems

Current and Future Trends



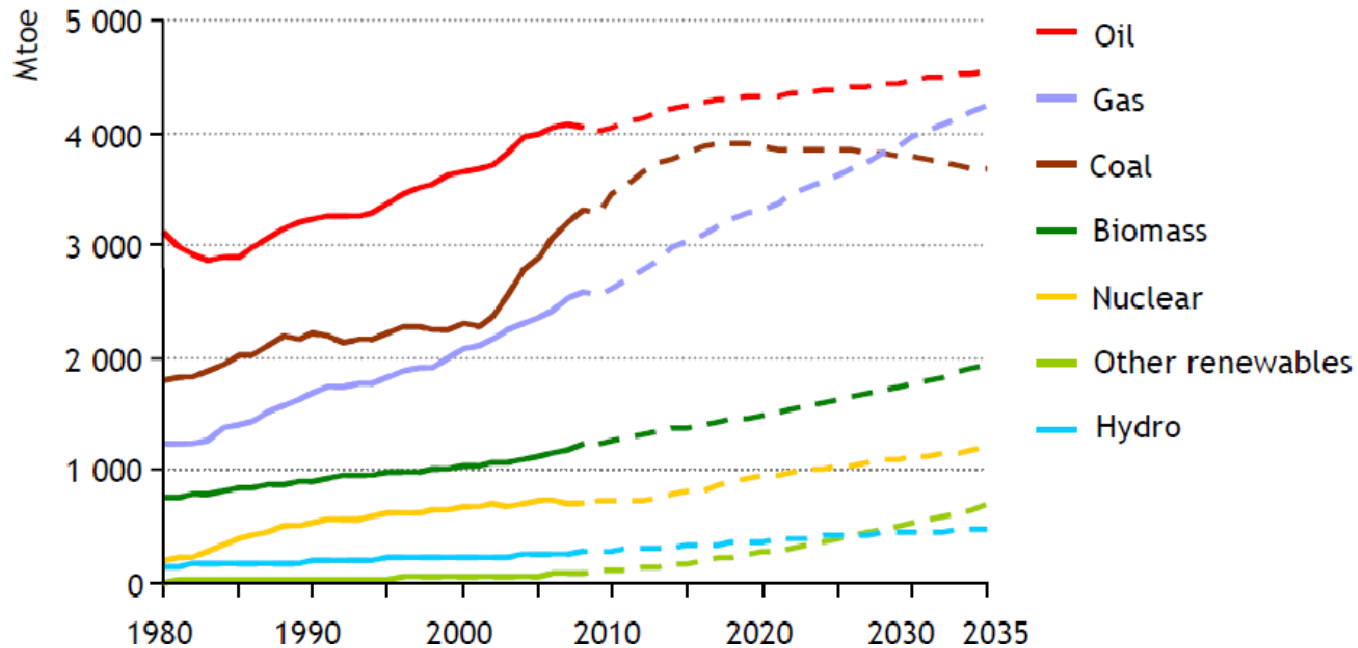
1979



2006

Main Avenue in Beijing

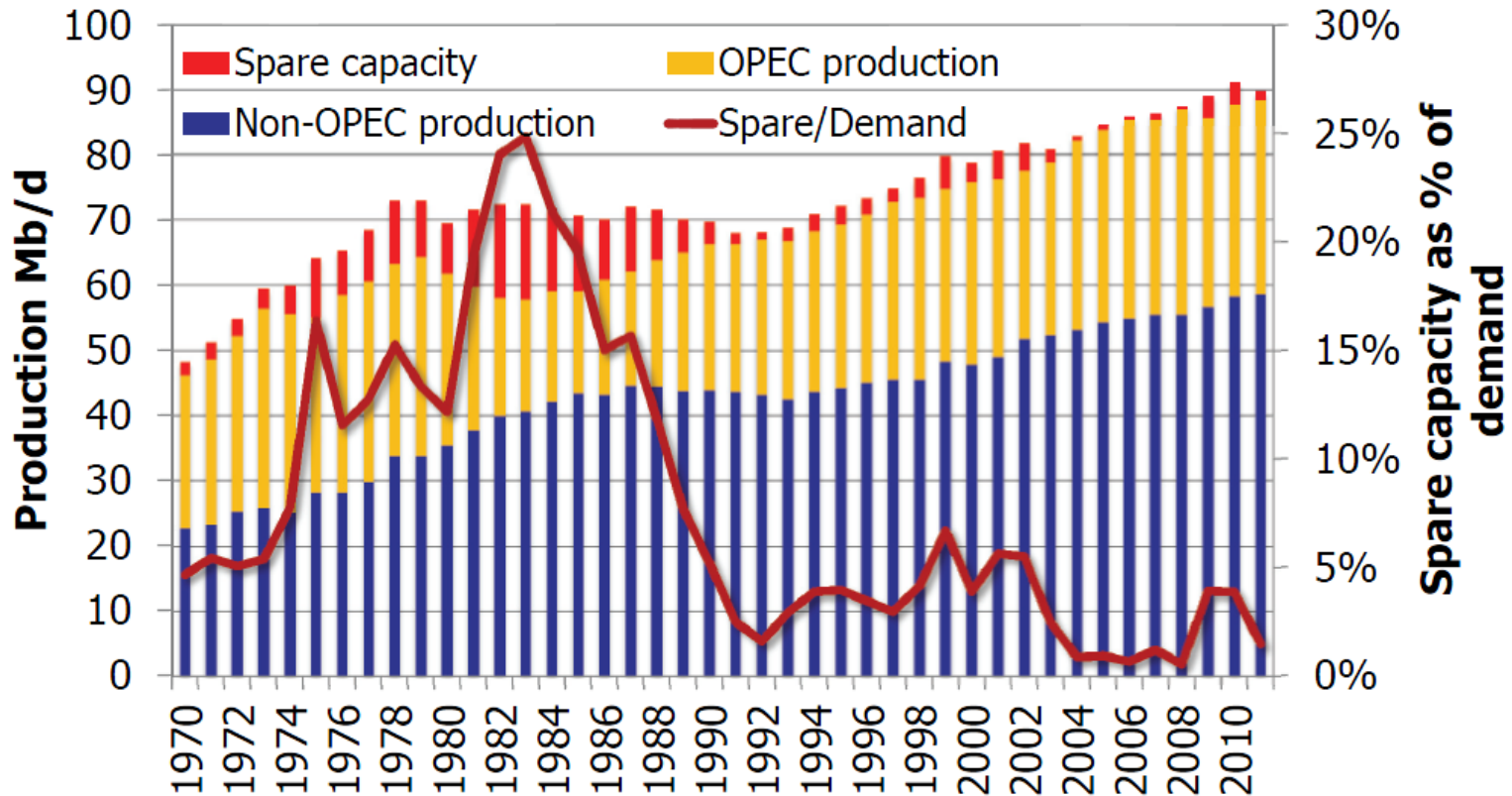
- The world has changed rapidly over the last 30 years and continues to evolve
- Growth requires (high grade) energy at an increasing level
- Security of energy supply has become a strategic consideration



Source: Douglas Westwood (2012)

Projected World Energy Demand to 2035

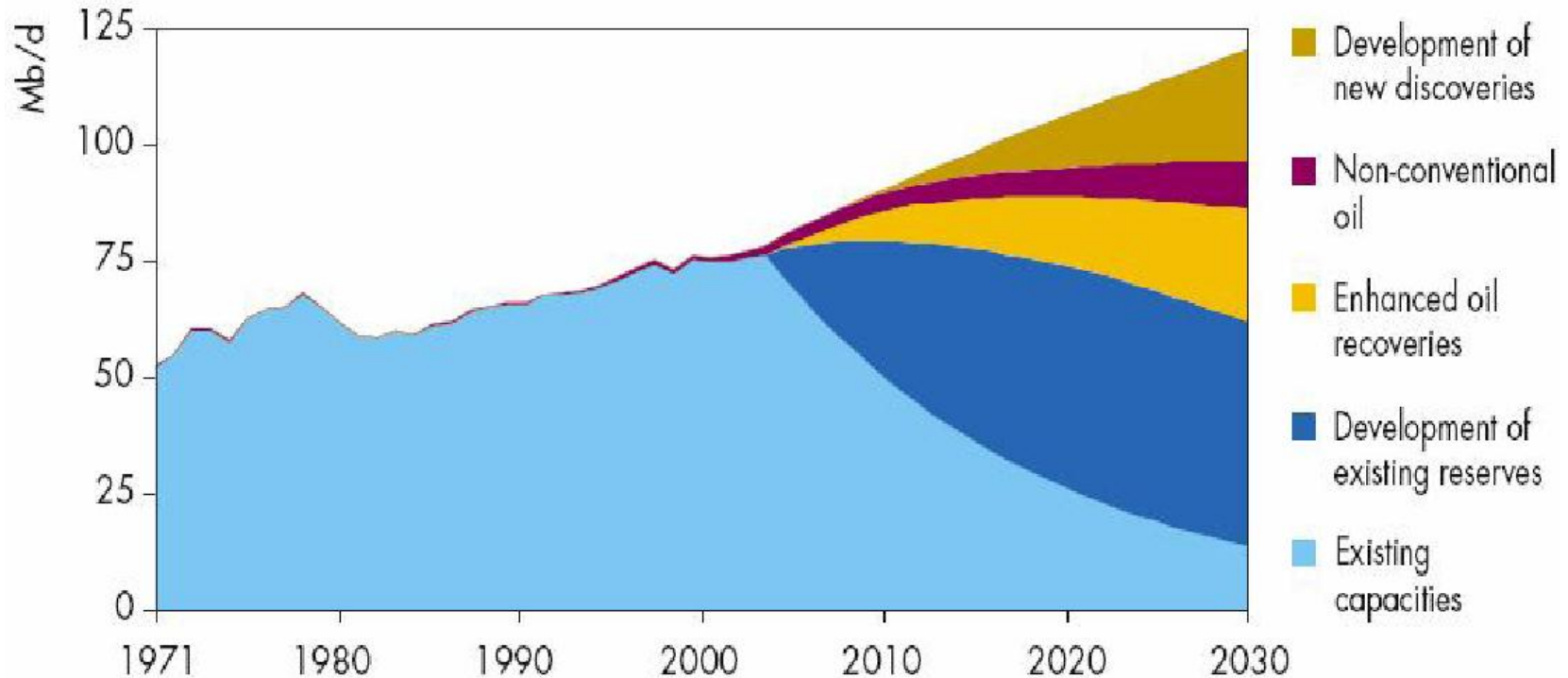
Demand growth forecast to continue with both oil and gas continuing to be a highly sought after resource.



Source: Strategic offshore Research

Global Oil Supply and Demand Data

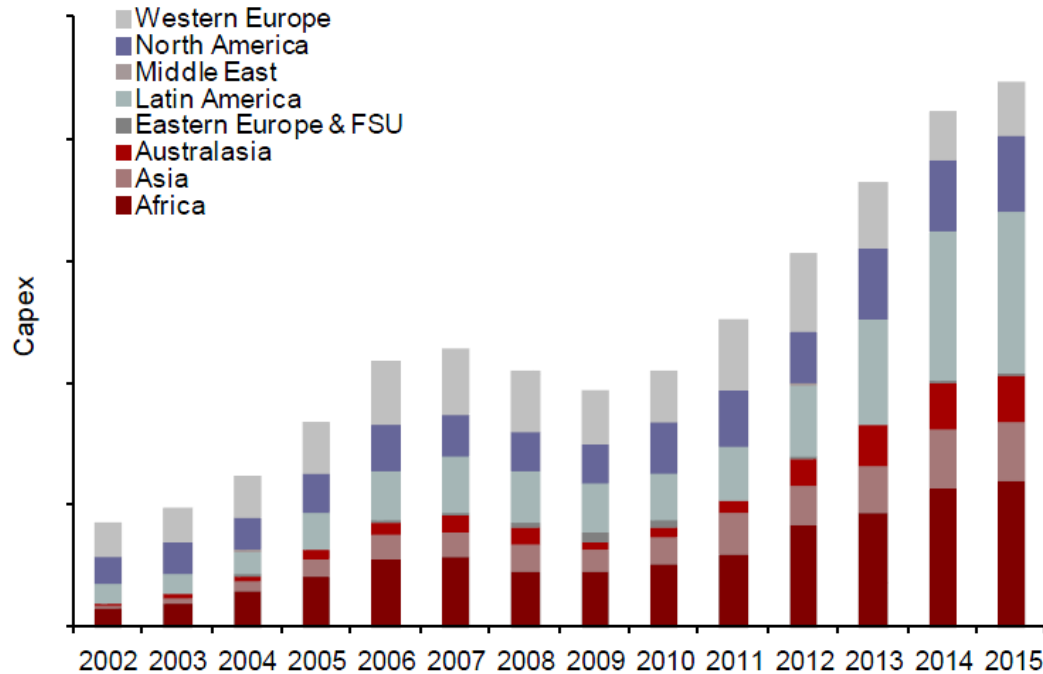
Supply and demand of oil has been very tight and is heading for an under-supply again. This will drive prices and will have an impact on field development and re-development.



Source: WEO-2004, IEA.

World Oil Production by Source (million barrels per day)

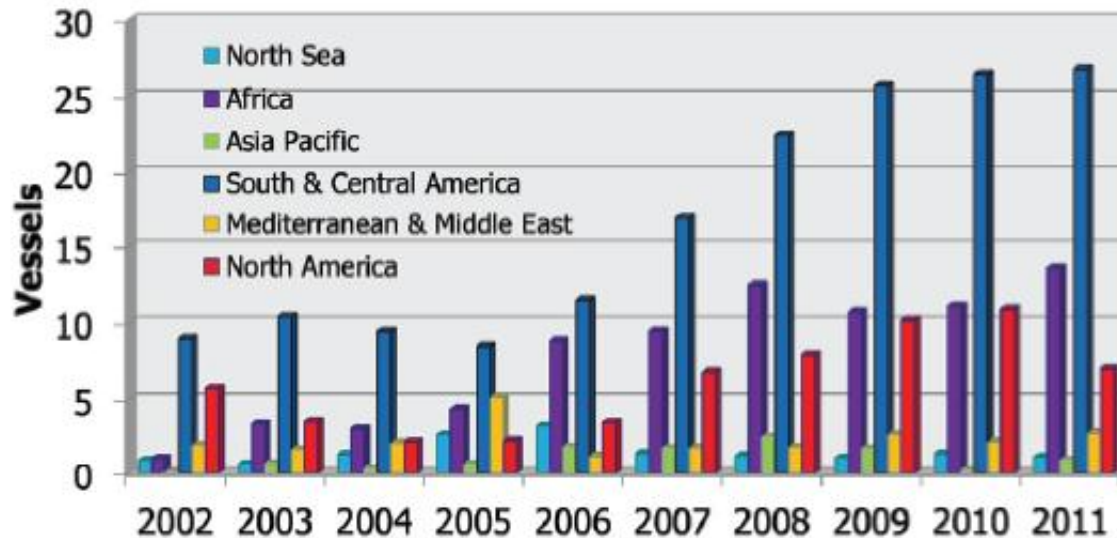
Supply mix for oil will change significantly, with emphasis on additional development, EOR, non conventional reserves and development of new discoveries which will probably be very different to those developed



Source: Douglas Westwood

Global Subsea Capital Expenditure Forecast (2012)

Subsea CAPEX set to grow at record rates, driven by Brazil, Africa but with significant growth also in Asia. However, will Brazil continue to under-perform against expectations as has historically been the case?



Source: Strategic offshore Research

World Subsea Vessel Activity

Statistically Brazil has seen a very significant increase in subsea construction (and IRM) activity since 2006. Note also Africa activity level has been sustained since 2006. Market projections indicate this trend is set to continue to 2015 and beyond. Note downturn in N. America – this is now reversing with deep-water drilling under way again.

Characteristics of the “first half”

- Massive “elephant” field developments
- Relatively straightforward economics but dogged by uncertain oil price and tax issues
- Main issue of reservoir access has been working at water and reservoir depth
- Generally simple systems using either natural reservoir pressure or water/gas injection to stimulate production
- Design life generally of the order of 15-20 years
- Tertiary recovery not really considered during early development phases



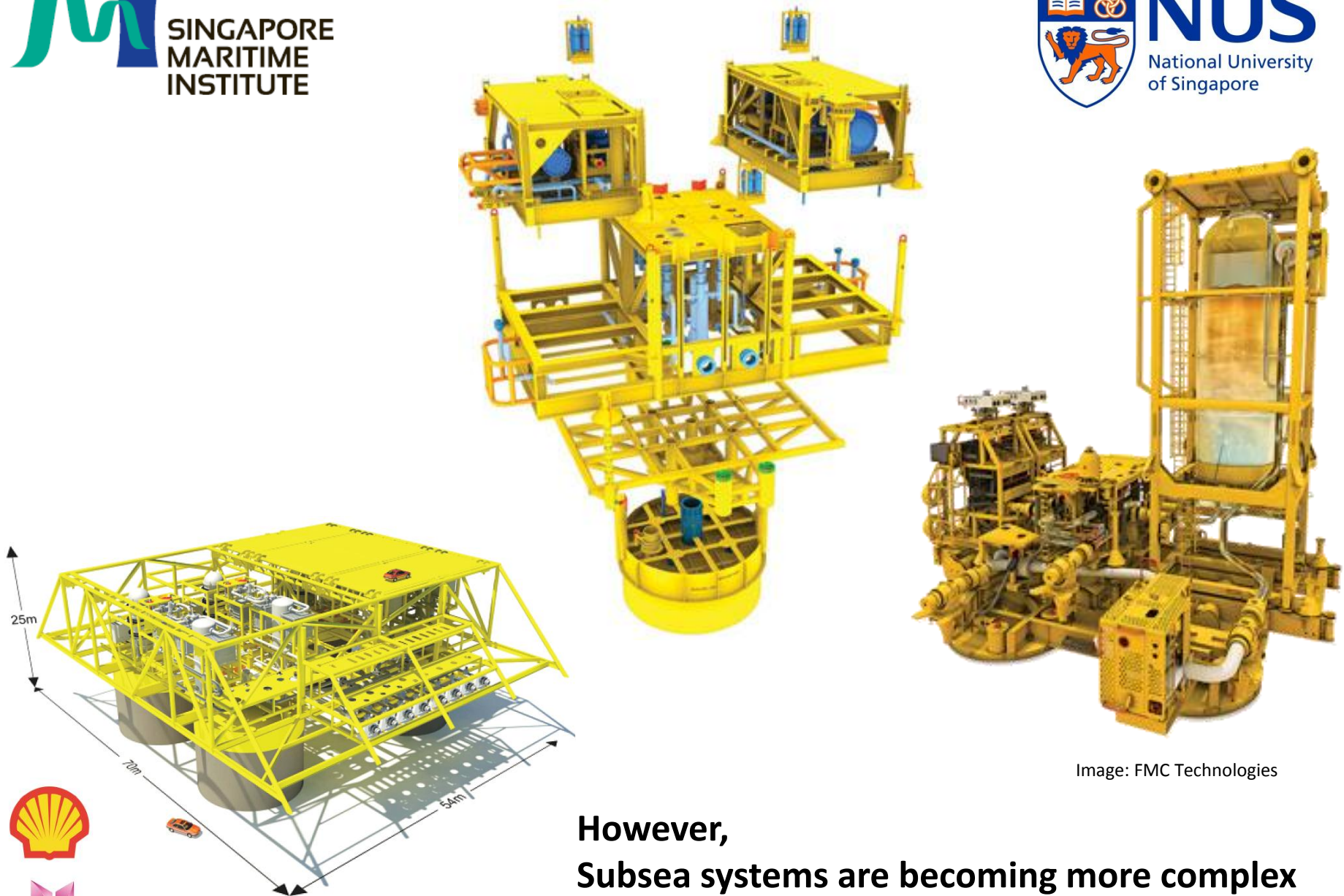


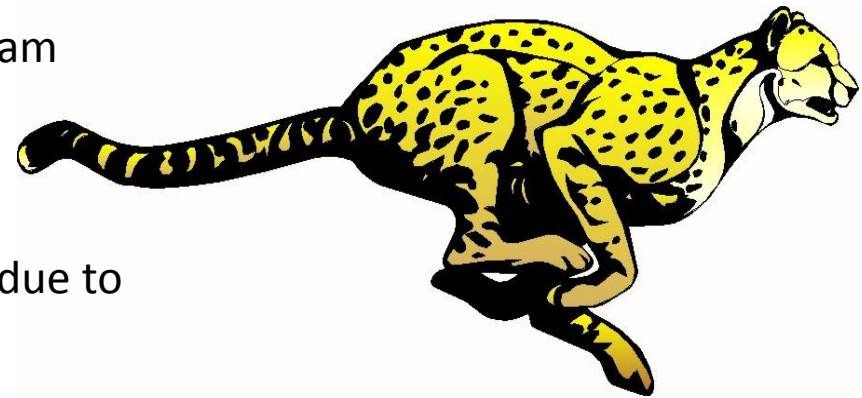
Image: FMC Technologies

**However,
Subsea systems are becoming more complex**



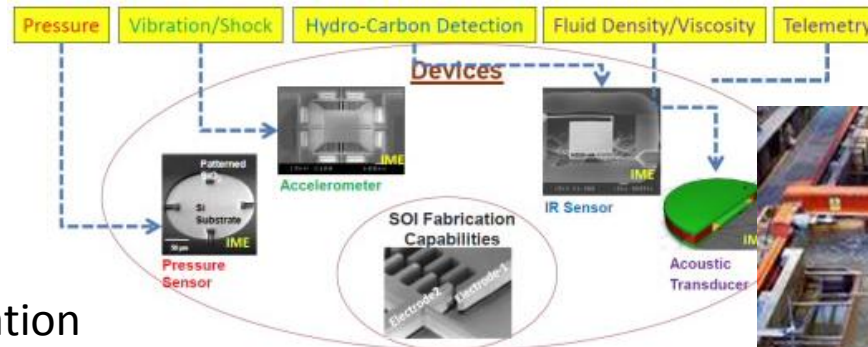
My predictions for the “second half”

- Much greater mix in size of field developments and maturity
- More difficult reservoirs being taken on-stream
- Lean and mean field operating practices
- CAPEX and OPEX reduction will be essential due to impact of smaller reservoirs
- Main issue is increasing production rate and recovery factor with higher water loading
- More complex reservoir flow composition – higher water and gas content
- Seabed processing becoming increasingly essential



NUS Areas of Research

- Subsea processing
- Multi-phase flow
- Compact separation
- Produced water micro-filtration
- High temperature electronics
- Riser VIV and suppression modelling
- AUV intelligence
- Battery systems
- Arctic Subsea engineering
- Hydrates formation and effects
- Spud can design
- Pipe crack analysis
- Dynamic load compensation
- Mooring systems
- Power electronics and electrical systems
- etc.



Some Possible Areas to Explore:

- Advanced subsea processing and reduction of pipeline and facilities loading
- Longer step-outs, arctic conditions
- Hydrate management and reduction of chemicals
- Subsea power distribution and control
- Well intervention and work-over systems
- Reduction in operational cost and risk
- New concepts for SURF and subsea installation
- Subsea robotic technologies (AUV/AIV)
- Advances in ROV technologies
- High temperature components - HPHT reservoirs
- New concepts in subsea well intervention
- Nanotechnologies
- Composite materials
- Better utilization of materials
- Intelligent decision support and visualization
- Integrated environmental management
- Well containment/capping technologies

