SUPERGEN Wind
2011 General Assembly

Phase 2 Prospect

Peter Tavner

20th March 2011, Durham University

Durham University
School of Engineering and Computing Sciences

SUPERGEN Wind Phase 2

- 23rd March 2010 – 22nd March 2014
- £5.8M
- Aim: *"To undertake research to achieve an integrated, cost-effective, reliable & available Offshore Wind Power Station"*
- Research areas:
  - Reliability
  - Resource estimation
  - Scaling up of Turbine size
  - Lifetime Costs
  - Connection

Durham University
School of Engineering and Computing Sciences

Industrial partners

SUPERGEN WIND

e·on UK

GARRAD HASSAN

Romax TECHNOLOGY

Vestas

AREVA

Cefas

Clipper

nationalgrid THE POWER OF ACTION

Mott MacDonald

narec

QinetiQ

SIEMENS

3M

Rolls-Royce

SCOTTISHPOWER

tnei enterprise with energy

Durham University
School of Engineering and Computing Sciences

Academic partners

University of Strathclyde Glasgow

Research Hub

Durham University

Finance Hub

Loughborough University

MANCHESTER 1824

Manchester Metropolitan University

Science & Technology Facilities Council
Rutherford Appleton Laboratory

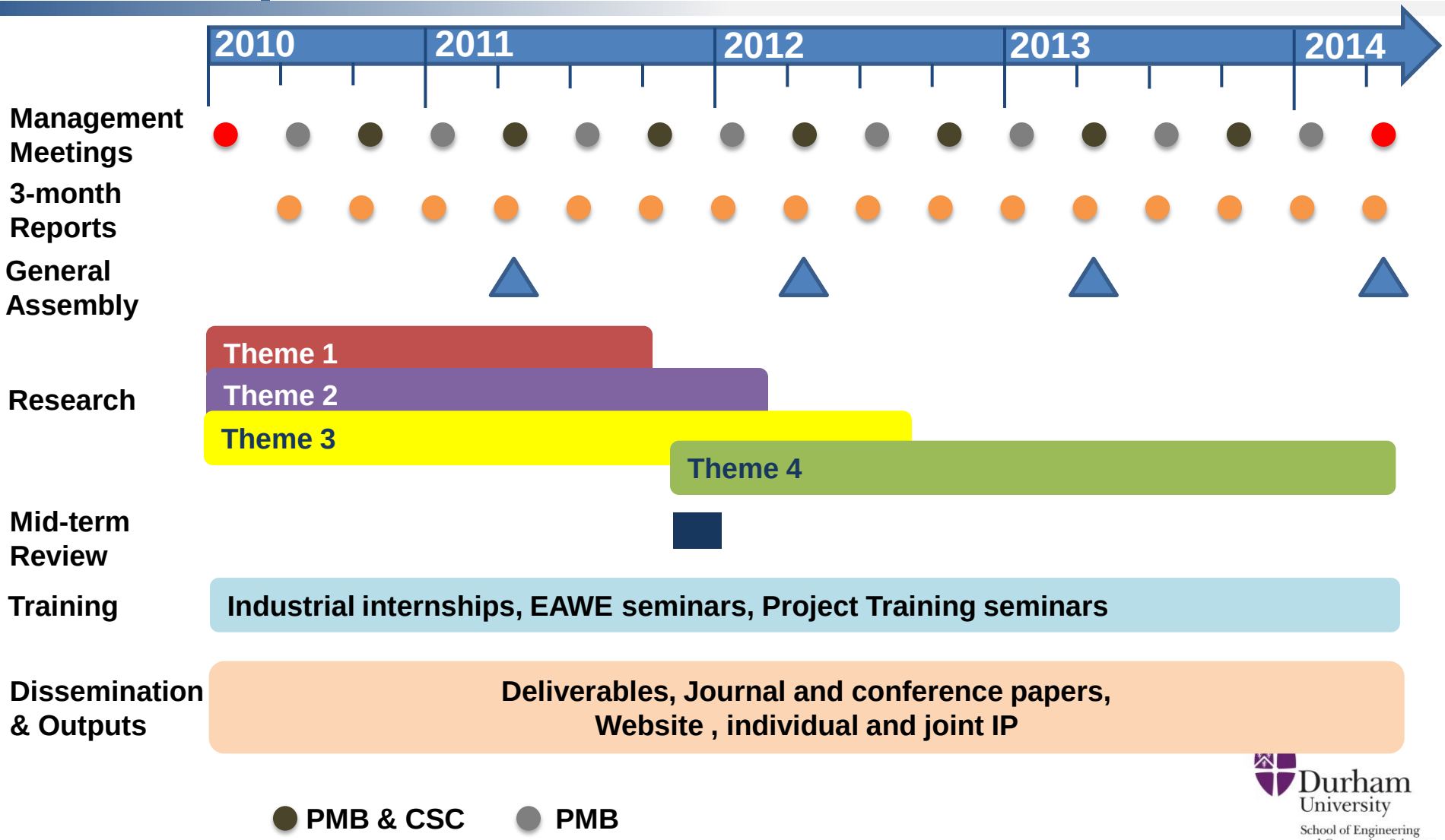
UNIVERSITY OF SURREY

Imperial College London

LANCASTER UNIVERSITY

UNIVERSITY OF Hull

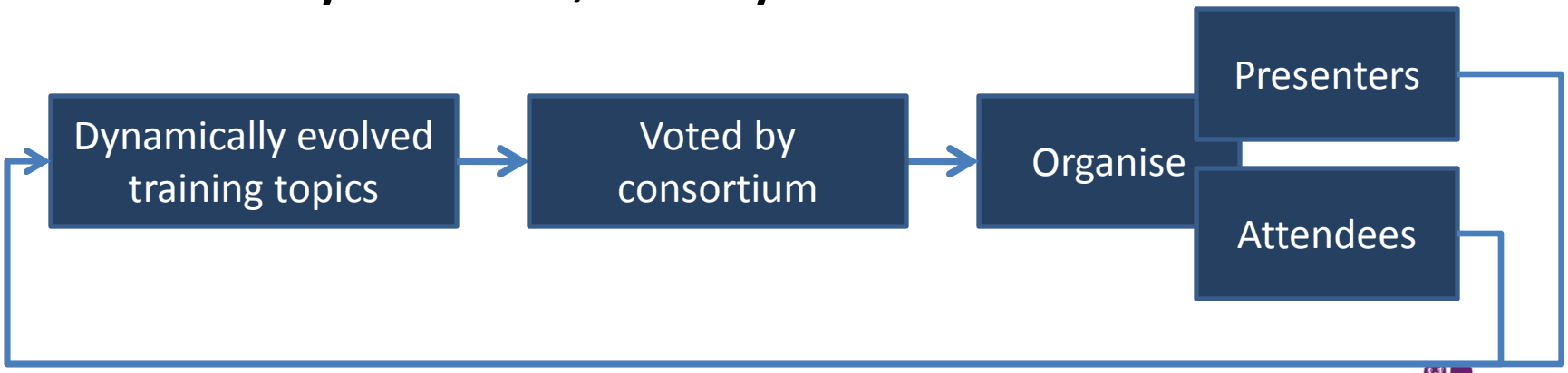
Project management



Durham University
School of Engineering and Computing Sciences

Phase 2 training scheme

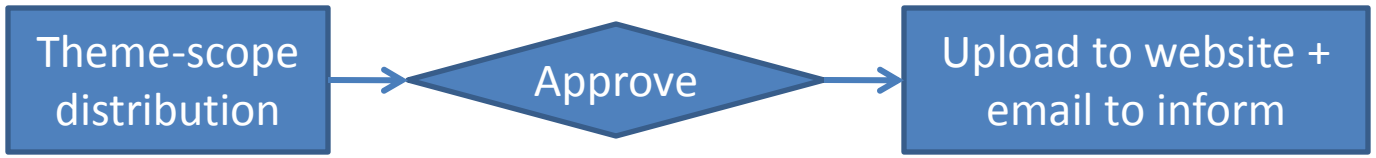
- The training will function not only as a training, but also a forum for RAs and students to communicate and develop.
- Requirements based.
- Two days event, every six months.



Durham University
School of Engineering and Computing Sciences

Deliverable and Publications

- Deliverables
  - Template: available online
  - Distribution procedure



- Publication acknowledgement

"This work was funded by Research Councils UK Energy Programme, SUPERGEN Wind Energy Technologies Consortium, EP/H018662/1"

Durham University
School of Engineering and Computing Sciences

Deliverables

THEME	SUB-THEME	WORK PACKAGE	DELIVERABLES	RESPONSIBLE
1 The farm	1.1 Offshore wind resource		D1.1 Report on offshore wind resource	LU
	1.2 Wakes and aerodynamics	1.2.1 Numerical modelling	D1.2.1 Numeric modelling multiple wind turbine wakes	LU
		1.2.2 Wind tunnel simulation	D1.2.2 Report on wind tunnel simulation	SU
	1.3 Radar and the invironment		D1.3 Report on radar and the environment	MU 1
	1.4 Optimisation of farm performance	1.4.1 Radar	D1.4.1 Guidelines of considering radar effects in windfarm sitting	MU 1
		1.4.2 Operation and maintenance for offshore wind farms	D1.4.2 Reliability analysis of UK offshore wind farms	DU
	1.5 Multiple wake impacts on machines		D1.5 Report on multipe wake impacts on machines	SU
2 The turbine	2.1 Drive train dynamics	2.1.1 Improving controllers	D2.1.1 Improved holistic controllers for large size wind turbines	StrathU
		2.1.2 Flexibility of operation	D2.1.2 Improved controllers respond to wind turbine conditions	StrathU
		2.1.3 Control of novel blade devices	D2.1.3 Integrated blade controller for alleviation of blades fatigue	StrathU
	2.2 Rotor-wid field interaction		D2.2 Report on rotor-wind interaction	STFC
	2.3 Turbine blade and tower materials		D2.3 Cost-effective manufacturing wind turbines with novel materials	MU 3
	2.4 Fault detection	2.4.1 Application of monitoring techniques	D2.4.1 Application of monitoring techniques towards predictive and predictive maintenance	DU
		2.4.2 Monitoring key subassemblies	D2.4.2 Fault monitoring of generators, gearboexes, and converters	MU 2
	2.5 Subsea turbine foundations	2.5.1 Extend hydrodynamic solver to simulate waves	D2.5.1 Extended hydrodynamic model with breaking waves	MMU
		2.5.2 Collection of historical data and experimental setup	D2.5.2 Report on historic data analysis and experimental setup	MMU
		2.5.3 Experimental sudy of wave loading and run-up	D2.5.3 Report on experimental study of wave loading and run-up	MMU
		2.5.4 Solver optimisation	D2.5.4 Validation and optimisation of solver	MMU
		2.5.5 Numerical experiments	D2.5.5 Report on numerical experiments	MMU
3. The Connection	3.1 System Performance Evaluation	3.1.1 Static & dynamic characteristics, turbines & farms	D3.1.1 Report on Static & Dynamic Characteristics of Offshore Turbines & Farms	DU
		3.1.2 Reduced order state-space models	D3.1.2 Report on Reduced order state-space models	DU
	3.2 Offshore Control Schemes	3.2.1 Electrical arrays for offshore wind farms	D3.2.1 Report on Electrical arrays for offshore wind farms	StrathU
		3.2.2 Control strategies design & verification	D3.2.2 Report on Control strategies design & verification	StrathU
	3.3 Connection to Shore	3.3.1 Assessment of HVDC converter technology	D3.3.1 Report on Assessment of HVDC converter technology	MU2
		3.3.2 Investigation of HVDC multi-terminal protection	D3.3.2 Report on Investigation of HVDC multi-terminal protection	MU2
	3.4 Integration of Storage	3.4.1 Assessment of applicable storage technologies	D3.4.1 Report on Assessment of applicable storage technologies	STFC
		3.4.2 Performance characteristics of storage technologies	D3.4.2 Report on Performance characteristics of storage technologies	STFC
		3.4.3 Simulation of power systems	D3.4.3 Report on Simulation of power systems	STFC

Publications

Journal papers

Parker, M A., Ng, C, Ran, L, Fault-tolerant control for a modular generator–converter scheme for direct-drive wind turbines, *IEEE Transactions on Industrial Electronics*, 58(1), January 2011, pp 305-315

Conference papers

Djurovic, S., Crabtree, C. J. , Smith, A. C., Tavner, P. J., Influence of DFIG Rotor Fault Severity on Stator Current and Power Spectral Content, European Wind Energy Association, Brussels, March 2011.

Dutton, G., Blade modelling, lifetime assessment, and health monitoring, Institute of Physics (IOP) meeting on *Wind Energy - challenges for materials, mechanics and surface science*, 28 October 2010

Feng, Y., Qiu, Y., Crabtree, C., Long, H., and Tavner, P., *Use of SCADA and CMS signals for failure detection and diagnosis of a wind turbine gearbox*, EWEA2011, Scientific Track, Oral Presentaion, Brussels, Belgium, Mar 2011.

Faulstich, S., Lyding, P., Tavner, P. J., Effects of wind speed on wind turbine availability. EWEA2011, Brussels, March 2011

Long, H., Wu, J., Matthew, F., Tavner, P. J., Fatigue analysis of wind turbine gearbox bearings using SCADA data and Miner's rule, EWEA2011, Brussels, March 2011

Peter Tavner, Yingning Qiu, Athanasios Korogiannos and Yanhui Feng, The correlation between wind turbine turbulence and pitch failure, EWEA2011, Scientific Track, Oral Presentaion, Brussels, Belgium, Mar 2011

Qiu, Y, Richardson, P, Feng, Y, Tavner, P. J., Erdos, G, SCADA alarm analysis for improving wind turbine reliability, EWEA2011, Brussels, March 2011

Watson S., Kennedy I., andGray C., The Application of Physics of Failure Modelling to Wind Turbine Condition Monitoring, EWEA2011, Brussels, March 2011

Thank you!

Durham University
School of Engineering and Computing Sciences