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Developments within the UK Wave Energy Sector

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Presentation Overview:

-The Research Problem(s)
-This Research
-Overview of Methodology
-Findings
-Discussion Section/Policy Implications

Research Problem- The Sector

40 Years of research…5.6MW Operational (wave and tidal)
It's just not happening…

-Clear technical challenges still exist but…
-IP concerns can make developers reluctant to collaborate, limiting knowledge transfer and collaborative engagement (LCICG, 2012, POST, 2009, Winskel, M., 2006)
-Interaction between universities and industry could be stronger (EPSRC, 2009 Renewables Advisory Board, 2008)

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Research Problem- Theory

We just don't know if It's just not happening…

-We know that networks are important to the innovation process but these relationships are hard to assess (non-codified) and difficult to map out. (Hekkert and Negro, 2009, OECD, 2005)
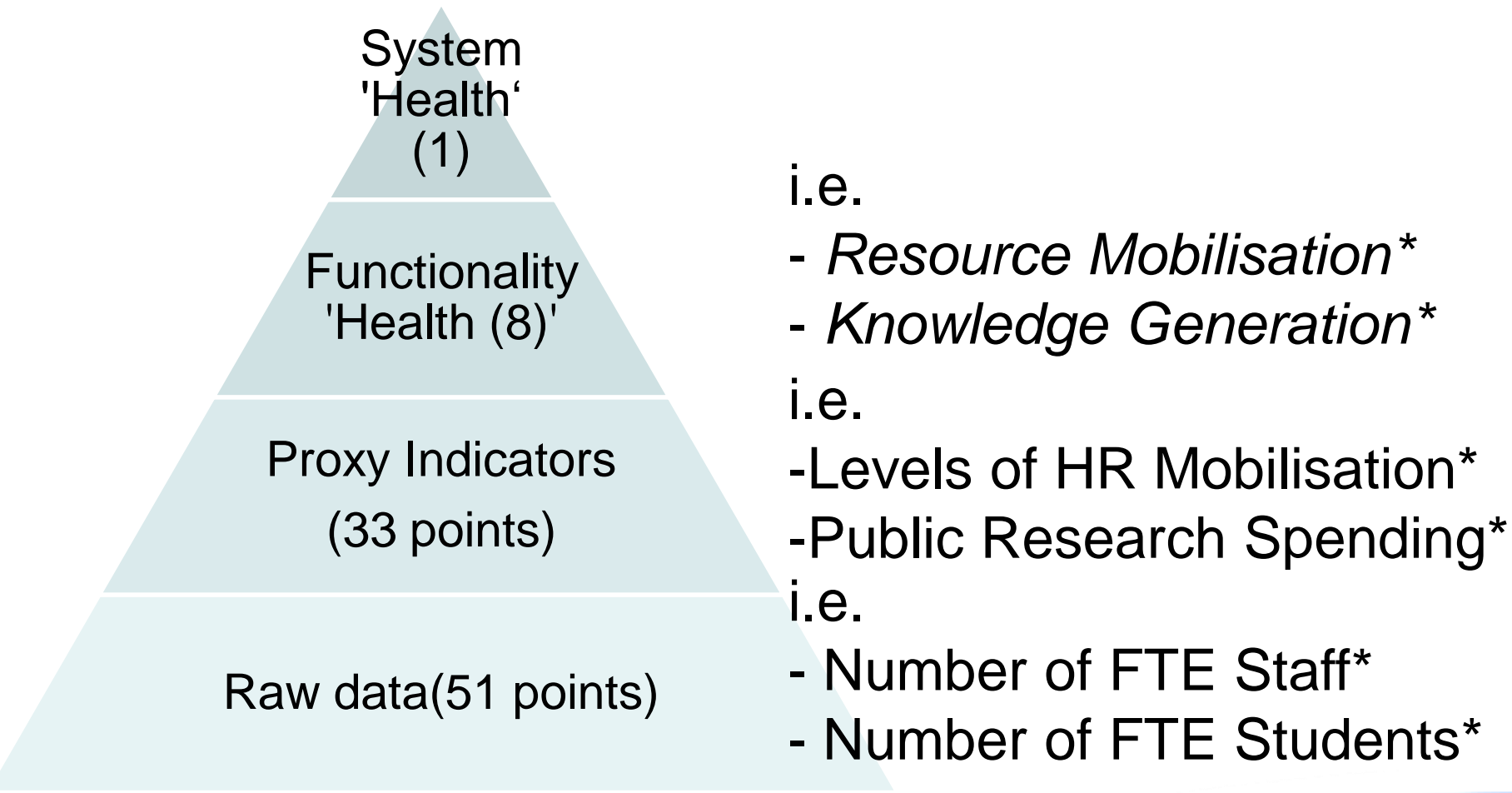
- There is a failure to recognise the importance of networks, especially in emerging industries where on average 2/3 of relationships are non-formal (Dosi *et al.*, 2002, Low and Abrahamson, 1997, Håkansson, 1990, Coleman, 1988)

Research Goal:

Gain a stronger understanding of activities occurring within the sector using:

-Framework of Bergek et al's Technological Innovation System (TIS)

-Application of network analysis, to create a 'map' of all interactions

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Methodology: Hierarchy of TIS Indicators

System 'Health' (1)

Functionality 'Health (8)'

Proxy Indicators (33 points)

Raw data(51 points)

i.e.
- *Resource Mobilisation**
- *Knowledge Generation**

i.e.
-Levels of HR Mobilisation*
-Public Research Spending*

i.e.
- Number of FTE Staff*
- Number of FTE Students*

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* within the wave energy sector

Methodology: Network Analysis

Identify Initial Actors & System Boundaries

Device Developers & Utilities (26)	**Public Sector: (7)**	**Universities: (14)**	**Test Facilities: (3)**
Aquamarine Power	DECC	University of Exeter	Wave Hub
Pelamis Wave Power Ltd	Scottish Government	University of Plymouth	EMEC
Checkmate Sea Energy	Marine Scotland	University of Edinburgh	NaREC
Ocean Power Technology	Marine Management Organisation	University of Manchester	
EDF Energy	Crown Estates*	Queens University Belfast	
RWE NPower	Carbon Trust*	University of Strathclyde	

* Non-public body working in public interest

Methodology: Network Analysis

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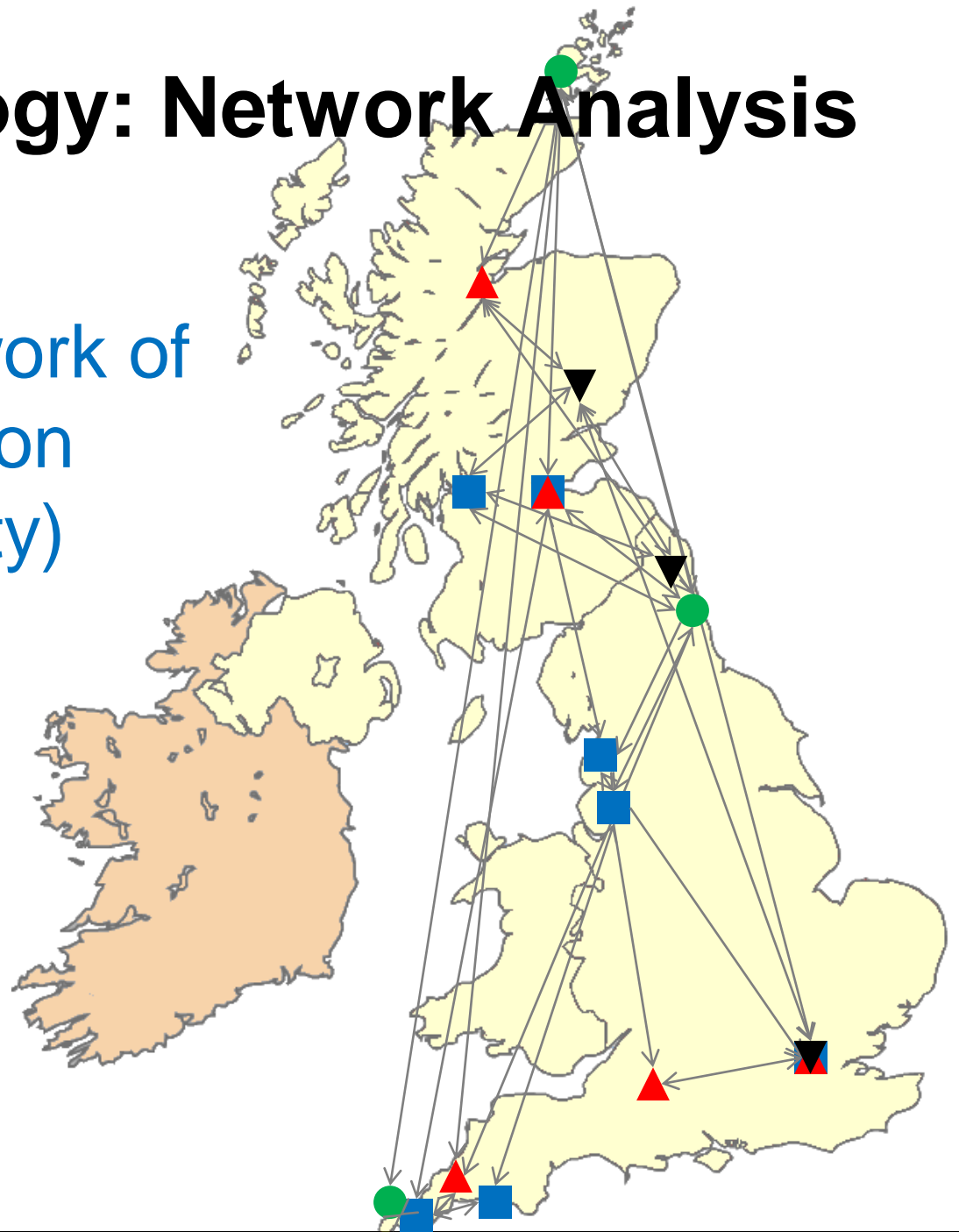
University of Strathclyde

Test Facilities: (3)

Wave Hub

EMEC

NaREC

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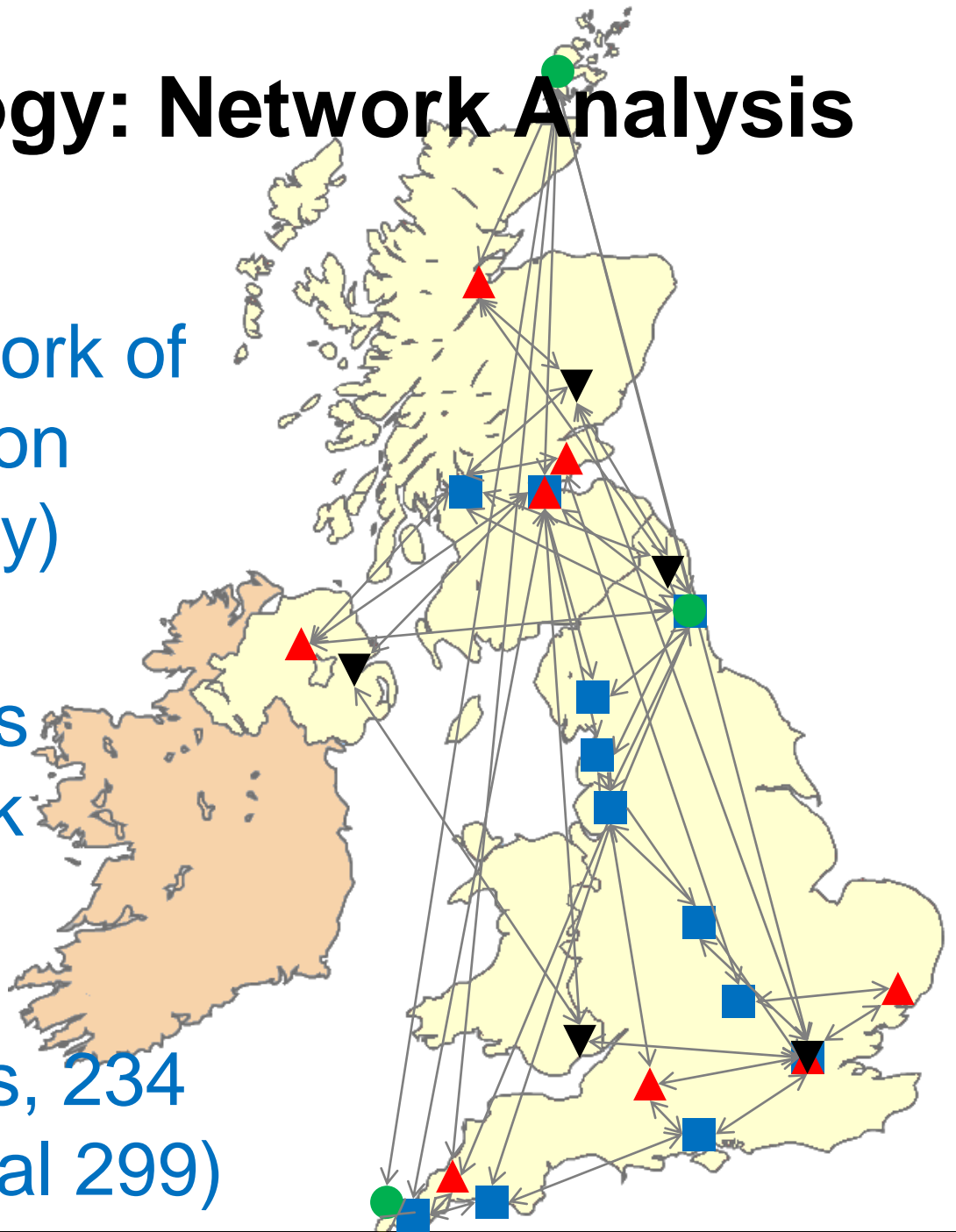
Methodology: Network Analysis

Build Weighted Asymmetric Network of Different Interaction Types (Multiplexity)
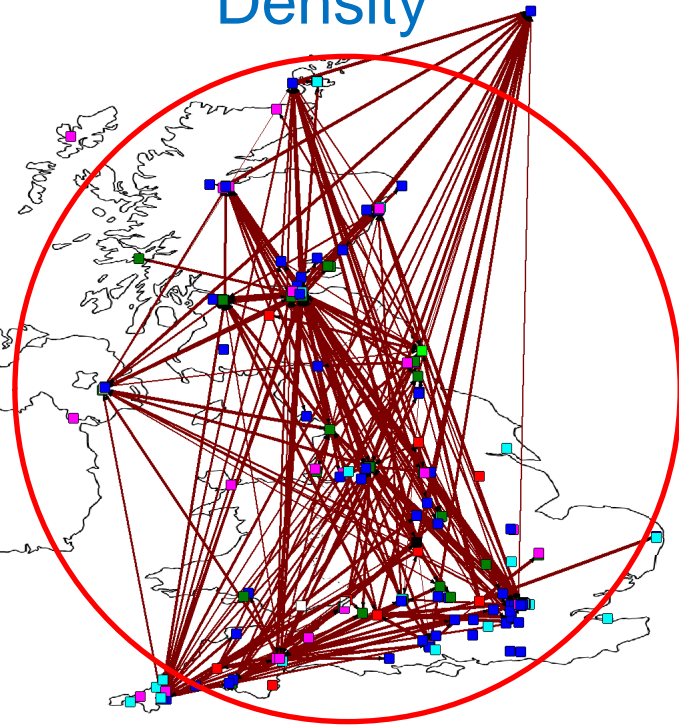
Methodology: Network Analysis

Build Weighted Asymmetric Network of Different Interaction Types (Multiplexity)

'Snowballing' the Interview Process Until Full Network Saturation
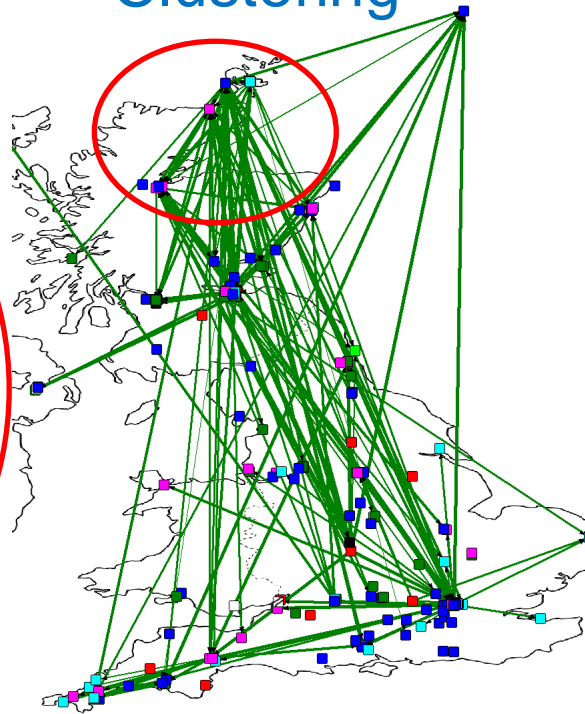
65 System Actors, 234 Non-System (Total 299)

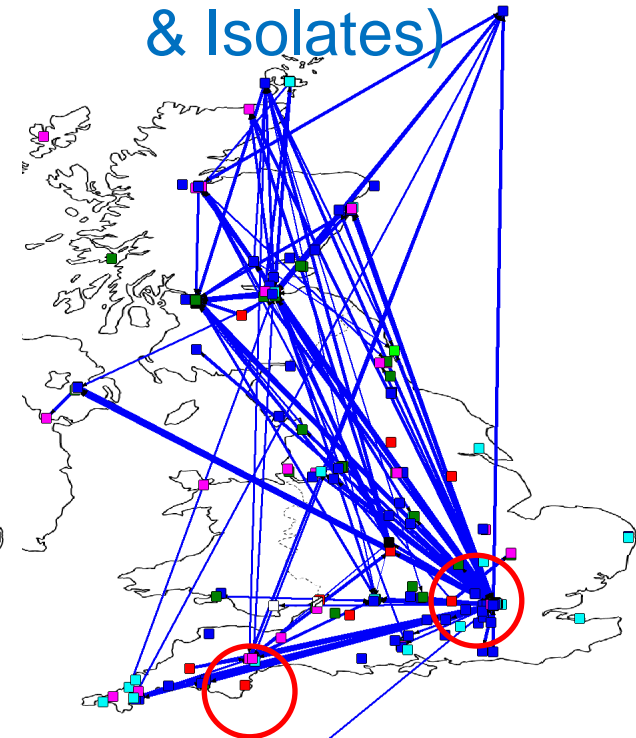# Findings: Network Analysis

Overall Network Density

Clustering

'Key Actors' (Prime Movers & Isolates)

Macro Scale (Technical)

Meso Scale (Environmental)

Micro Scale (Market /Fiscal)

Findings: Groups

Normalised for prominence.

(i.e. each receiver gets on average:)

	Summated Knowledge Average Provision (Influence)					
Summated Knowledge Average Reception (Prominence)	Test Centre	Utility Company	University	Public Sector Body	Device Developer	Other Company
Test Centre	8	5	46	56.33	19.7	38
Utility Company	10.4	4.6	17.4	26.8	11.8	8.8
University	4.71	4.43	55.9	13.07	12.1	21.6
Public Sector Body	6.4	13.6	5.2	43.8	21.2	9.2
Device Developer	6.64	3.57	19.2	25.43	0.43	22.4

Findings: Networks

	Network Knowledge Types			
	Sum.	Environmental	Market	Technical
Primary Influential Actors	Mixed	Public Sector (Regulators)	Public Sector (Funders)	Universities
Secondary Influential Actors		Environmental Consultancies	Mixed	Device Developers

Findings: Device Developers
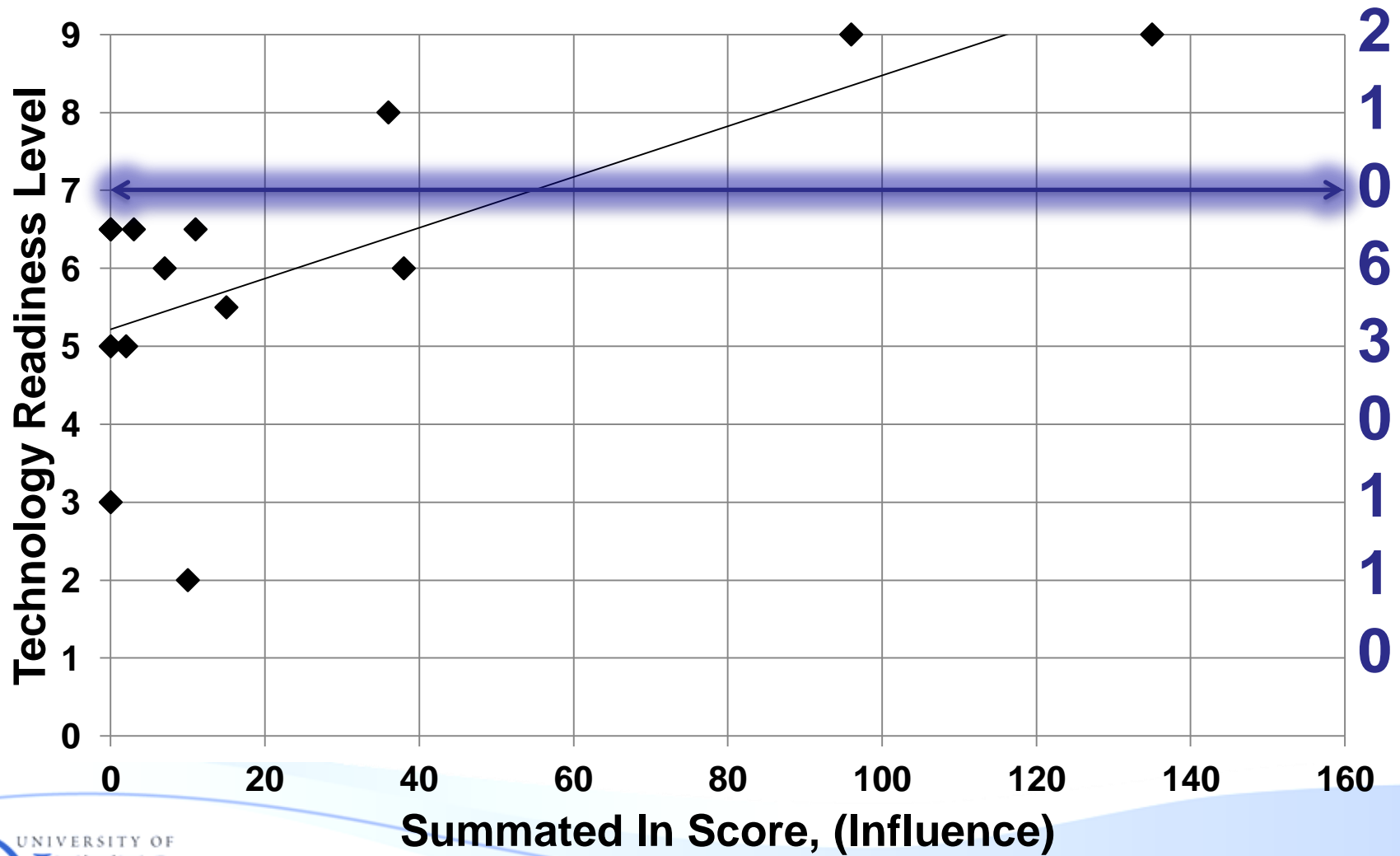
Findings: Device Developers

TRL	YR	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
8>9	GB									MEAD		
	Scot									MRCF		
7>8	GB		MRDF									
	GB	CCL Exemption Cert.										
	Scot	1 ROC/MWh		RO Scot. MSO		RO Scot. 5 ROC/MWh						
	Eng	1 ROC/MWh				2 ROC/MWh				5 ROC/MWh		
	Scot								The Saltire Prize			
6>7	GB					MRPF						
	Scot		WATES				WATERS		WATERS 2			
5>6	GB			TSB Funding								
	GB					ETI Tech. Prog. (<5 + Non Device)						
	GB		MEA (<5)									
3<4	GB	EU FP(6-8) Funding (<4 + Non Device)										
	GB	Research Council Funding (<4 + Non Device)										

Discussion Section: Findings

-Levels of Interaction
- University↔university technical network is strongest
- University↔device developer interaction is moderate
- Device developer↔device developer interaction is low however there is wide disparity between them

-'Gating' of technology/location support
-Two UK devices have been supported to full scale.
- WATES, WATERS (1 & 2) for Scottish deployment
- This is creating a 'Matthew' Effect' for developers

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Discussion Section: Problems

-Technology 'Bundling' of wave/tidal
  -Tidal is some years ahead and has strong advantages (design convergence, 20-30% cheaper, potentially higher UK resource, predictability)
  -Collective support beneficial for communalised goods/problems)

-A disaggregated UK funding community
  -10+ funding agencies for marine renewables
  -Varying motivations, (tech./employment/ infrastructure/carbon abatement...)
  -Lack of co-ordinated approach

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Thank You For Listening

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