

Mathematics (Departments) in a Changing Landscape

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& ICMS
Talk @ HoDoMS 13/04/15

Background

- Asked by HoDoMS Committee to speak about EPSRC and its funding strategy/mechanisms
- Why?
- Because I have just served as Chair of the Strategic Advisory Team for EPSRC's Mathematical Sciences Theme (April 2014-April 2015)
- New Chair is Ken Brown (Glasgow)

Remit

- However, rather than sticking to EPSRC alone I want to broaden the scope of my talk
- EPSRC's funding strategy may be seen to be favouring a few over the many

AND

- this may also be said to be the consequence of REF, as well as tuition fees etc

SO

- how do we maintain health of discipline at the same time as recognising and supporting the highest quality research and teaching?

About me

To see where/how my prejudices arise:

- I served as Deputy Chair for REF2014 UoA sub-panel B10 (mathematics) and sat on RAE 2008 sub-panel 21 (applied mathematics)
- I am an applied mathematician with strong links to industry (currently 5 CASE PhDs + other research grants; chaired European Study Group with Industry (ESGI 107) 3 weeks ago)
- Extensive involvement with IMA, LMS and other learned societies – mainly because I believe in the mathematics community working together
- New Scientific Director of ICMS

Talk structure

- The SAT and its role; EPSRC structure
- EPSRC funding mechanisms and (un)intended consequences
- REF – results and (un)intended consequences
- Broadening mathematics and looking for other funding opportunities
- Challenges and opportunities: collaborative approaches (inter and intra, working in consortia), subject specific shortages, embracing change ...

What does Mathematics want from EPSRC, and what does EPSRC need from Mathematics?

- EPSRC provides financial support (from Government) to the Mathematics Community; *why?*
- Our perspective: to provide ‘core funding’ and maintain health of discipline
- Their perspective:
 - Delivering Impact
 - Developing Leaders
 - Shaping Capability

EPSRC Themes

‘Capability Themes’ (£1.8bn)

- Engineering
- Information & Communication Technologies (ICT)
- Mathematics Sciences
- Physical Sciences

‘Challenge Themes’ (£1.7bn distributed through above themes):

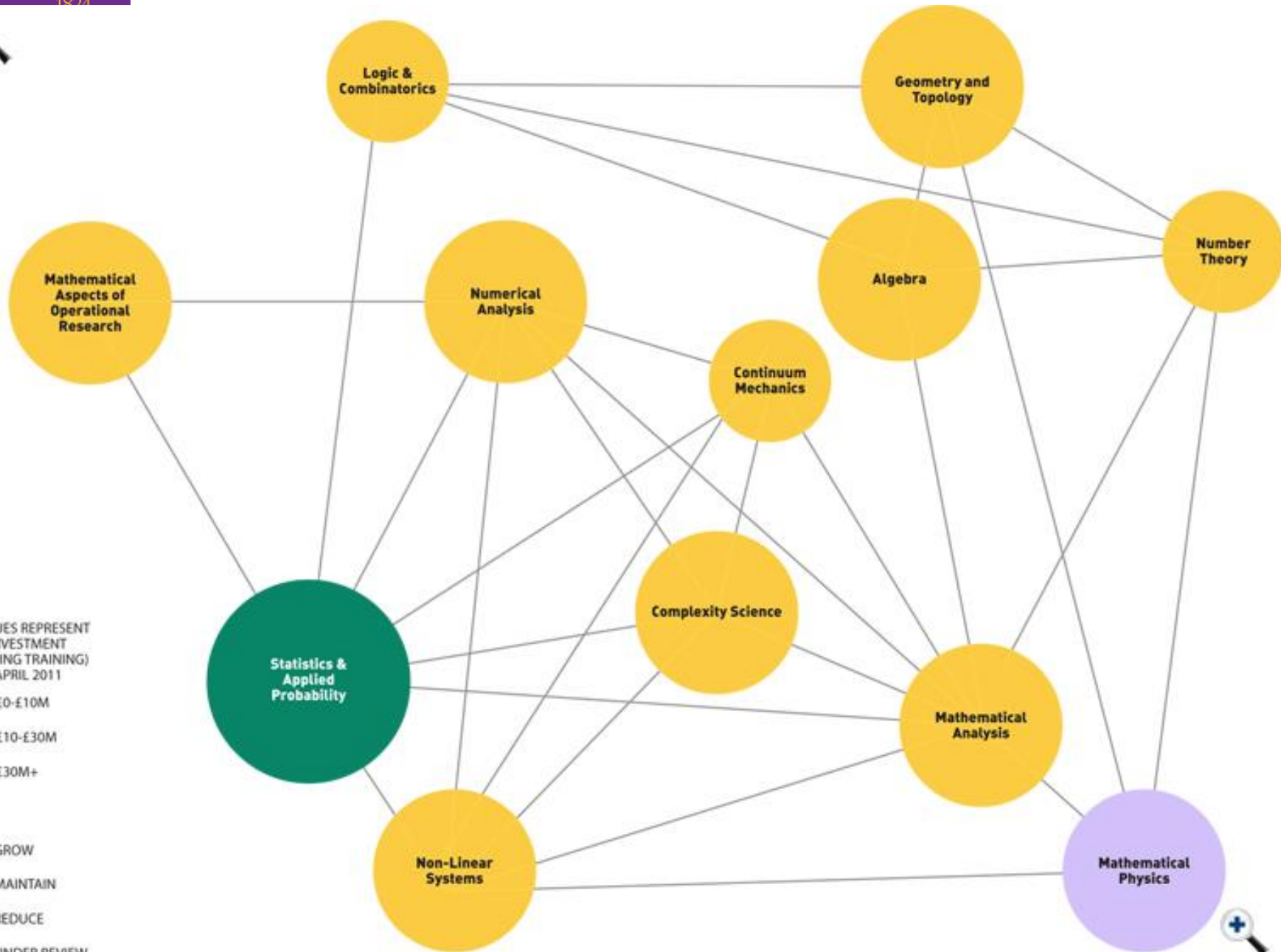
- Digital Economy
- Energy
- Global Uncertainties
- Healthcare Technologies
- Living with Environmental Change
- Manufacturing the Future



ALL VALUES REPRESENT
EPSRC INVESTMENT
(EXCLUDING TRAINING)
ON 1ST APRIL 2011

- E0-E10M
- E10-E30M
- E30M+

- GROW
- MAINTAIN
- REDUCE
- UNDER REVIEW



EPSRC Structure

- Staff

- Executive (CE: Nelson, Chair: Golby, etc)
- Capability and Challenge Theme Managers etc

- Governance

- Council (13 or so of the great and good!)
- Strategic Advisory Network (30 members, including Chris Linton and Alison Etheridge)
- Strategic Advisory Teams (numerous)

Strategic Advisory Team (SAT)

- Each “Capability Theme” has a Strategic Advisory Team (SAT); Mathematical Sciences is a Theme
- SATs exist to provide **Theme Leaders with strategic advice that will assist them to develop, implement and modify plans**
- SATs are devised as a flexible resource, providing **EPSRC advice in a timely manner, drawing on a range of perspectives from across the key “stakeholder groups”**
- Post of Chair is to offer the SAT independence

Principles

- An important principle governs the function of SATs: the separation of the provision of strategic advice from delivery and decision-making by the Executive
- SAT members are individually and collectively responsible for the advice offered
- SAT has to be independent of peer review

Role of SATs

- Act as a body of advisors to EPSRC, helping to ensure that the skills and research base are there to support the advancement of knowledge and the future needs of business and society
- Provide an early alert to the EPSRC on priority and emerging issues
- Alert EPSRC to new and emerging research and training opportunities
- Act as a sounding board for the early development of relevant policy and priorities
- Help with two-way communication between EPSRC and the research community

Membership of SAT

- Members are drawn from EPSRC's stakeholder groupings: researchers and users of research (eg business, third sector and Government)
- Expected to bring a broad strategic view to bear and to act as '**generous generalists**'
- Members are not required to act as representatives of their own organisation, research area or sector
- New SAT membership:

Professor Kenneth Brown, Glasgow (Chair)

Professor Alan Champneys, Bristol

Dr Ben Dias, Tesco Stores Ltd

Professor Mark Girolami, Warwick

Professor Kevin Glazebrook, Lancaster

Professor Arie Iserles, Cambridge

Professor Anne Juel, Manchester

Professor Paul Milewski, Bath

Professor Graham Niblo, Southampton

Professor Beatrice Pelloni, Reading

Dr Richard Pinch, GCHQ

Professor Lasse Rempe-Gillen, Liverpool

Professor Ian Strachan, Glasgow

Recent Concerns/Issues on SAT

- People pipeline
- CDT versus DTG/DTP
- Shaping Capability and Monitoring Portfolio Evolution
- Taxonomy of Mathematical Sciences Theme
- Fellowships
- Peer Review
- Community engagement with EPSRC priority areas and Government's Grand Challenges
- Responsive Mode versus themed calls
- Maths Infrastructure investment
- Programme Grants
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Effectiveness

- Maths SAT has not been very effective in the communication process between community and EPSRC to-date
- As Chair I tried to put items of concern to the community up for discussion at SAT – **how do we develop an effective two-way process?**
- CMS & EPSRC
- HoDoMS & EPSRC
- **How can our community better engage with EPSRC?** We can and should let EPSRC know what would be useful to us.

EPSRC perspective

- To satisfy societal needs as defined by Government
- Help the science community deliver impact of their research
- Help the community produce well trained scientists for UK plc.
- Need to balance national need, cutting-edge mathematical research and health of discipline – is this balance presently OK?

National need – Willett's Eight Great Technologies

- The big data revolution and energy-efficient computing
- satellites and commercial applications of space
- robotics and autonomous systems
- life sciences, genomics and synthetic biology
- regenerative medicine
- agri-science
- advanced materials and nano-technology
- energy and its storage

Portfolio of funding

- Training: TCCs, DTP, CDT, CASE
- Research:
 - Responsive Mode
 - Themed calls, e.g. ‘Healthcare Technologies Challenge’
 - Platform Grants
 - Programme Grants
- People: Fellowships
- Examples of possible ‘issues’:

DTP – divergence of funding

UCL	1.55%	1.53%	1.53%	2.66%	2.4%
Bath	3.48%	3.70%	3.70%	3.66%	2.4%
Birmingham	1.49%	1.52%	1.52%	2.14%	1.7%
Bristol	6.29%	5.87%	5.87%	5.82%	5.4%
Cambridge	8.16%	8.32%	8.32%	6.92%	4.5%
UEA	1.32%	1.25%	1.25%	0.96%	1.6%
Edinburgh	3.64%	2.65%	2.65%	2.59%	3.3%
Exeter	0.92%	0.86%	0.86%	0.92%	1.8%
Glasgow	2.29%	2.23%	2.23%	2.48%	1.7%
Kent	0.83%	0.79%	0.79%	1.40%	1.9%
Leeds	2.86%	2.72%	2.72%	3.61%	3.0%
Leicester	1.21%	1.13%	1.13%	1.25%	1.4%
Liverpool	1.30%	1.33%	1.33%	2.05%	1.7%
Nottingham	3.94%	4.47%	4.47%	4.56%	3.6%
Oxford	11.01%	11.17%	11.17%	9.93%	7.8%
Reading	0.00%	0.59%	0.59%	1.13%	1.7%
Sheffield	1.56%	1.52%	1.52%	2.24%	1.4%
Southampton	3.03%	2.11%	2.11%	2.59%	3.9%
St Andrews	1.13%	1.14%	1.14%	2.24%	2.3%
Strathclyde	1.54%	1.46%	1.46%	1.64%	1.8%
Surrey	1.00%	0.95%	0.95%	0.88%	1.8%
Sussex	0.73%	0.66%	0.66%	0.00%	2.0%
Warwick	8.57%	8.11%	8.11%	7.17%	10.3%
York	1.64%	1.53%	1.53%	1.56%	3.0%

Centres for Doctoral Training

Mathematics successful – 12 funded in theme plus other related CDTs, eg Fluid Dynamics. [What about balance?](#)

- Bath – Statistical Applied Mathematics
- Cambridge – Analysis
- Edinburgh – Analysis
- Imperial – Climate (.5)
- Lancaster – Statistics & OR
- Liverpool – Risk
- Oxford – Analysis, Industry, Statistics (.5), System Bio
- Reading – Climate (.5)
- UCL – Geometry & Number Theory
- Warwick – Complexity, Statistics (.5)

Fellowships

Postdoctoral	Early Career	Established
Statistics & Applied Probability	Statistics & Applied Probability	Statistics & Applied Probability
Intradisciplinary Research	Intradisciplinary Research	Intradisciplinary Research
	New Connections between Mathematical Sciences & ICT	
Mathematical Aspects of Operational Research	Mathematical Aspects of Operational Research	
New Connections from Mathematical Sciences	New Connections from Mathematical Sciences	
Complexity Science		

Priority Area	Postdoctoral	Early	Established	Total
Statistics and Applied Probability	4	7	5	15
Intradisciplinary	10	10	5	16
New Connections MS and ICT		-		0
New Connections from MS	2	1		3
Math. Aspects of Op. Research*	1	-		1
Complexity Science	1			1

Research Area	Total	CAF	LF	EPSRC Fellowship		
				Postdoc	Early	Established
Algebra		3		4	7	13
Geometry & Topology		6		2	7	2
Number Theory		2	1	1	2	
Logic & Combinatorics				1	1	
Mathematical Analysis		4		4	4	1
Mathematical Physics				2		4
Numerical Analysis			1	2		1
Non-linear Systems		1	1	4		
Continuum Mechanics		1		2		1
Complexity				1		
Operational Research				1		
Statistics and Applied Probability			1	5	9	6

Programme Grants

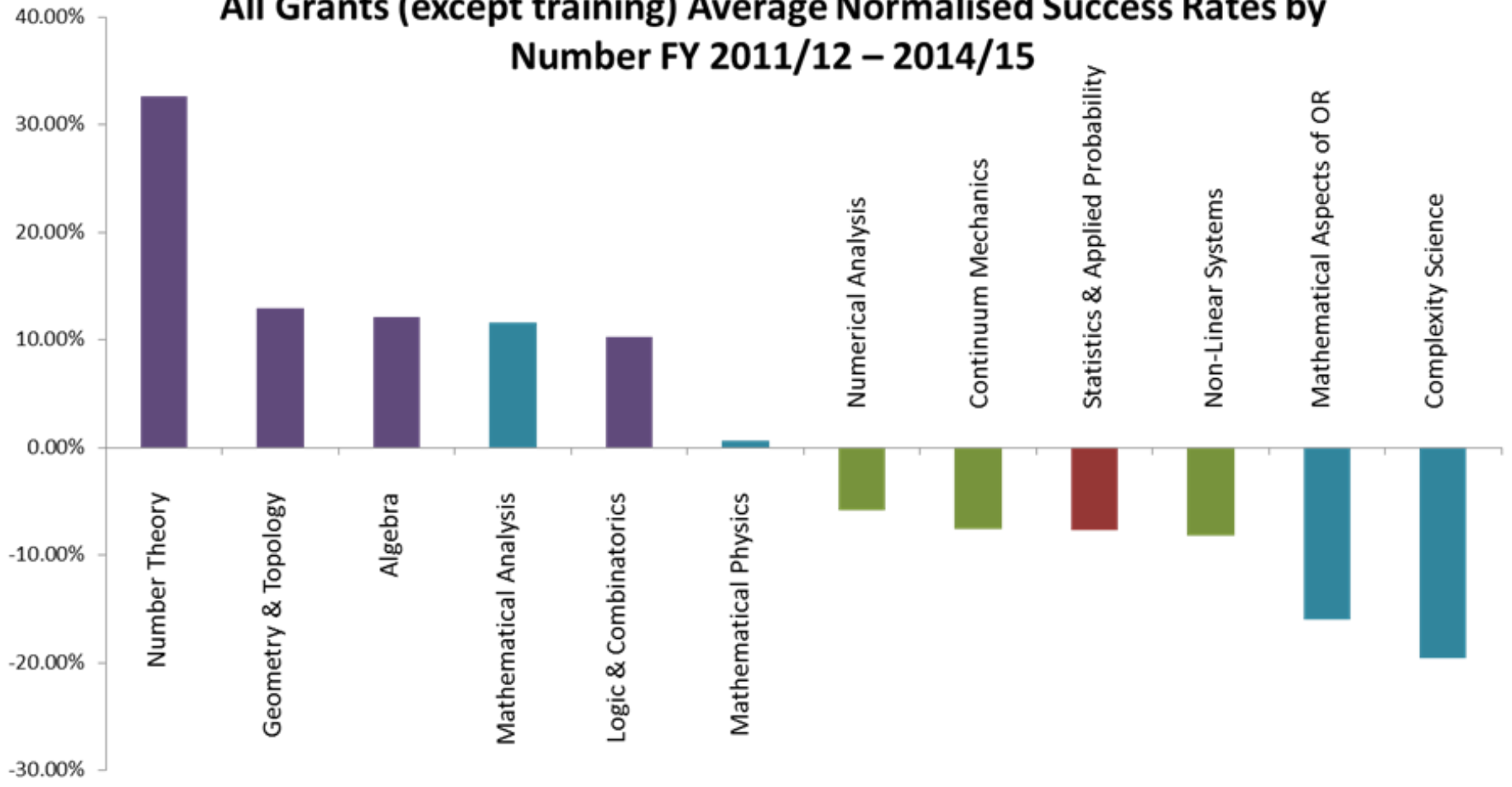
- 9 currently funded
 - 3 IC (Continuum/PDEs, 2 Algebra & Geometry)
 - 2 Warwick (Stats/Applied, A,G & Number Theory)
 - 2 Cambridge (Applied, Probability & AG)
 - 1 Oxford (AG & Math Physics)
 - 1 York (Number Theory)
- 2 funded in latest round (3 unfunded)
 - 1 Lancaster (OR)
 - 1 Nottingham (Number Theory)
- Three grants in # theory (on top of substantial extra funding from Heilbronn/GCHQ). **Balance?**

Funding success (Feb 2015)

- 1st: Oxford £36.5M (includes stats)
- 2nd: Warwick £35.0M
- 3rd: Imperial £21.8M
- 4th: Cambridge £17.5M (INI £6M omitted)
- 5th: Bristol £16.3M (includes eng maths)
- 6th: Lancaster £9.3M
- 7th: UCL £8.3M
- 8th: Edinburgh £7.5M
- 9th: Bath £7.2M
- 10th: Manchester £7.1M
- 11th: Heriot-Watt £5.8M

Funding distribution by area

All Grants (except training) Average Normalised Success Rates by Number FY 2011/12 – 2014/15



EPSRC discussion points

- Should there be routes to informing EPSRC other than via SAT?
- Are we ensuring that we provide EPSRC with sufficient ammunition for CSR discussions ?
- Despite fears, Impact not seemingly skewing portfolio – but does this mean we are not diversifying/engaging enough?
- Are we looking irrelevant on the Impact stage?
- Are the present funding mechanisms suitable/relevant?
- Is the people pipeline broken?
- How well is peer review doing at giving us a balanced portfolio? Is strategy ‘killing’ small institution?
- Are we missing lots of new opportunities?

REF 2014 – some personal thoughts

- Is RAE/REF the best way to judge quality and support research in the mathematical sciences?
- How to get a balanced panel that averages out unconscious bias?
- How can we do an ‘honest job’ without damaging institutions by unintended consequences of the process or funding formulae?

UOA 10: Mathematical Sciences

Submission information

Number of submissions	53
Category A FTE staff submitted	1,930
Headcounts of category A and C staff submitted	2,005
Headcounts of early career researchers (REF1a)	418
Number of outputs submitted	6,995
Number of case studies submitted	236

Doctoral research degrees awarded

2008-09	2009-10	2010-11	2011-12	2012-13
398	498	520	499	600

Total external research income, including income-in-kind (£M)

2008-09	2009-10	2010-11	2011-12	2012-13
57.84	65.54	69.06	72.75	76.85

Average overall quality profile and average sub-profiles for all submissions in the UOA (FTE weighted) ¹

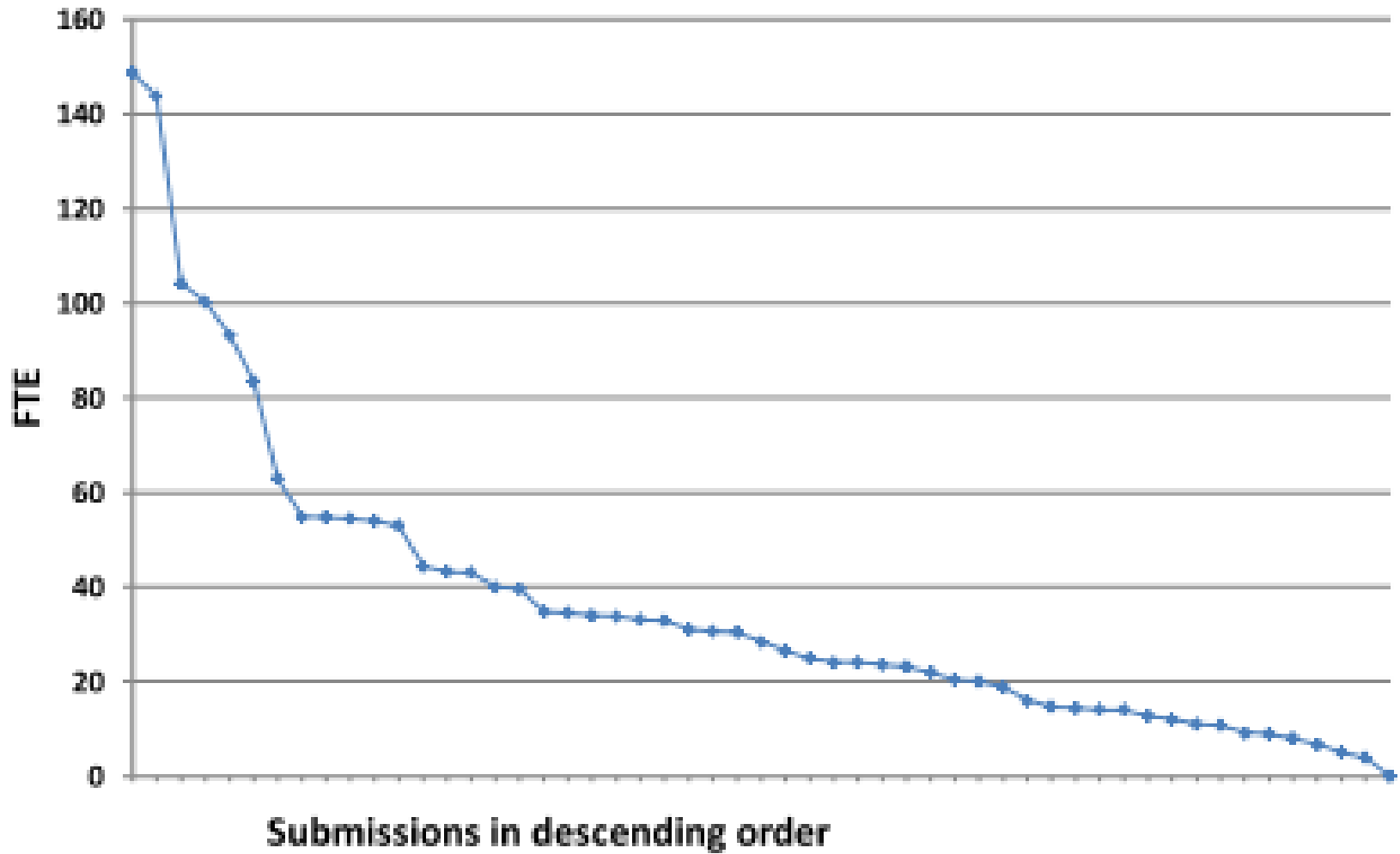
	4*	3*	2*	1*	U/C
Overall	29	55	15	1	0
Outputs	22.7	59.7	16.8	0.6	0.2
Impact	35.9	46.6	14.1	2.3	1.1
Environment	44.2	47.4	8.1	0.3	0

- Looks very healthy – almost 30% world leading!
- Look at a few specific individual UoA results (by size)

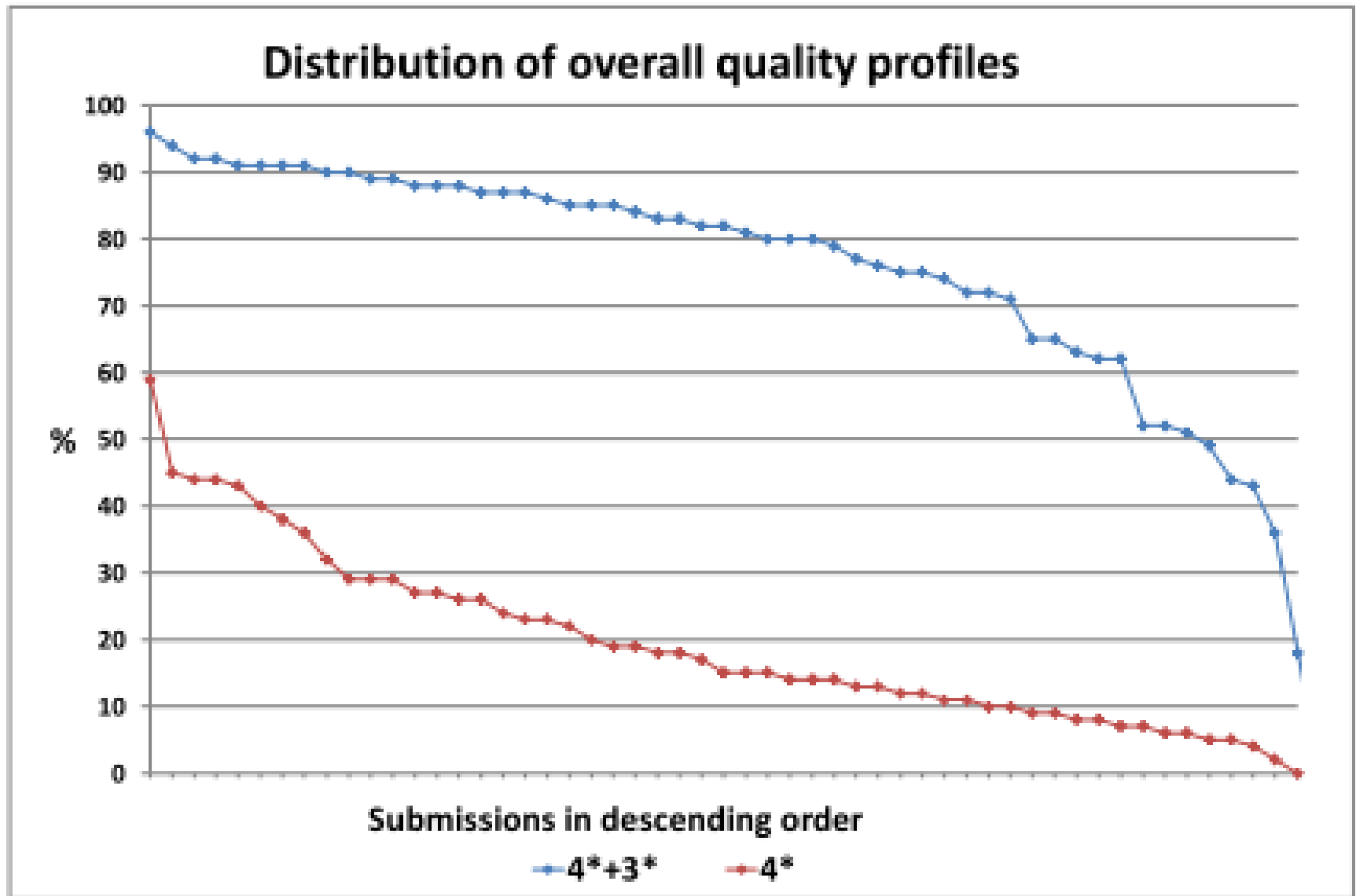
Oxford	4*	3*	2*	1*	U/C	(FTE 148.6)
Overall	59	37	4	0	0	
Outputs	41.1	52.6	6.3	0.0	0.0	
Impact	87.5	12.5	0.0	0.0	0.0	
Environment	100.0	0.0	0.0	0.0	0.0	
Cambridge	4*	3*	2*	1*	U/C	(FTE 143.77)
Overall	45	47	7	1	0	
Outputs	35.4	56.1	7.4	1.1	0.0	
Impact	44.7	44.6	10.7	0.0	0.0	
Environment	90.0	10.0	0.0	0.0	0.0	
Warwick	4*	3*	2*	1*	U/C	(FTE 104.1)
Overall	44	48	7	1	0	
Outputs	31.4	56.0	11.2	1.1	0.3	
Impact	42.7	57.3	0.0	0.0	0.0	
Environment	100.0	0.0	0.0	0.0	0.0	

Imperial	4*	3*	2*	1*	U/C	(100.31)
Overall	44	47	8	1	0	
Outputs	27.7	59.7	11.5	0.8	0.3	
Impact	56.4	40.0	3.6	0.0	0.0	
Environment	100.0	0.0	0.0	0.0	0.0	
Bristol	4*	3*	2*	1*	U/C	(FTE 83.5)
Overall	43	44	12	1	0	
Outputs	28.4	52.8	17.3	0.8	0.7	
Impact	68.9	26.7	4.4	0.0	0.0	
Environment	70.0	30.0	0.0	0.0	0.0	
Manchester	4*	3*	2*	1*	U/C	(54.4)
Overall	38	52	9	1	0	
Outputs	24.0	61.0	13.0	2.0	0.0	
Impact	53.3	46.7	0.0	0.0	0.0	
Environment	80.0	20.0	0.0	0.0	0.0	
Leeds	4*	3*	2*	1*	U/C	(53.0)
Overall	36	49	15	0	0	
Outputs	20.7	60.6	18.7	0.0	0.0	
Impact	56.7	30.0	13.3	0.0	0.0	
Environment	75.0	25.0	0.0	0.0	0.0	

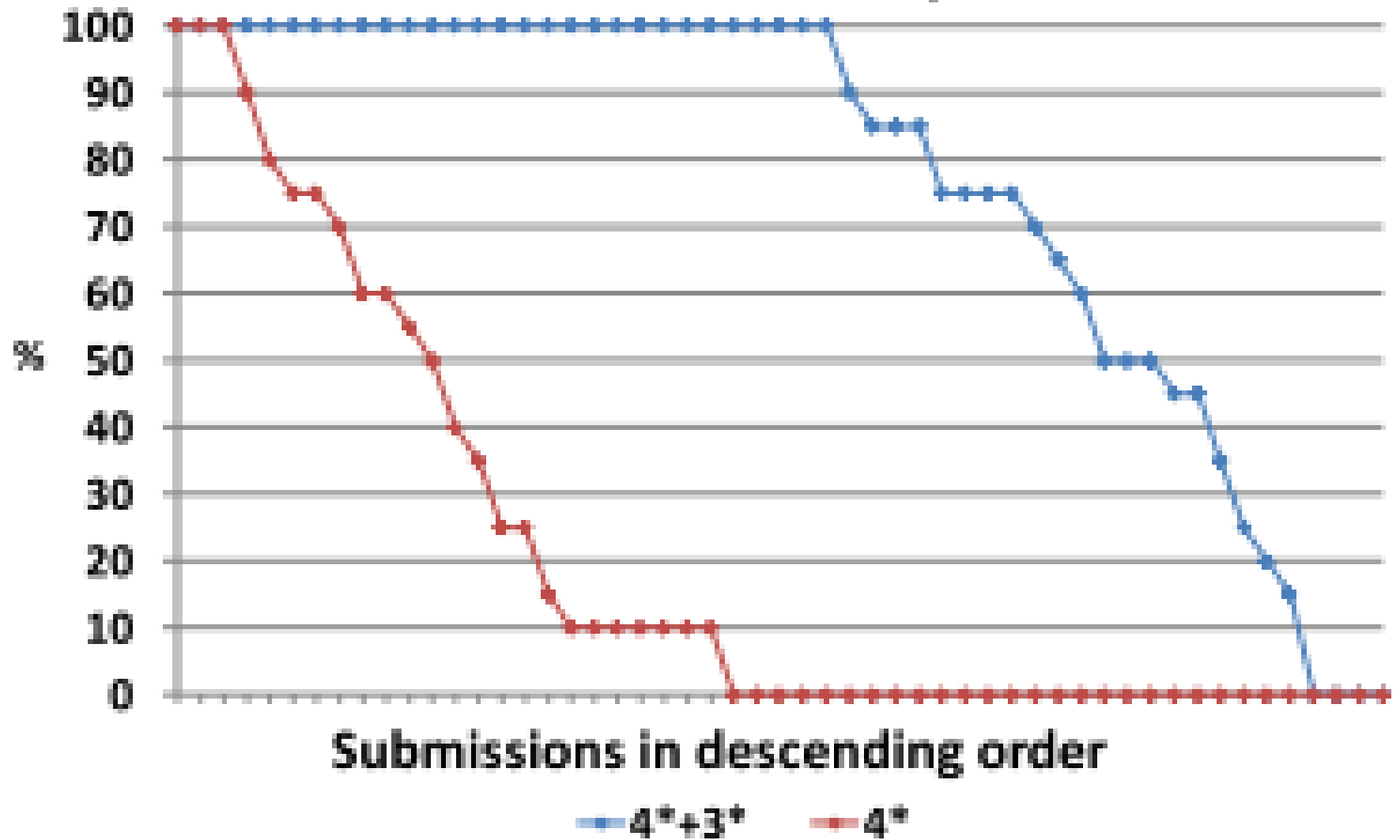
Distribution of Category A staff FTE



Size Matters!



Distribution of environment sub-profiles



Some REF observations

- Top 4 in size accounted for over 25% of all FTE staff in UoA
- But 17 places have fewer than 20 FTEs (& 38 UoAs < 41)!
- Headline conclusion is that **size matters**. Of the top places, between RAE and REF:
 - Oxford grew from: 133.9FTE to 148.6FTE; Warwick: 85.25 to 104.1; Imperial: 72.9 to 100.3; Bristol: 95.53 to 83.5 (BUT latter = maths only excluding engineering mathematics)
- Only Cambridge had shrunk a little (to 143.8) and was demoted from 1st to 2nd place!
- Only a couple of places bucked the trend: Lancaster, who went from 31.65 to 24.9, played an effective strategic game!

How to be successful?

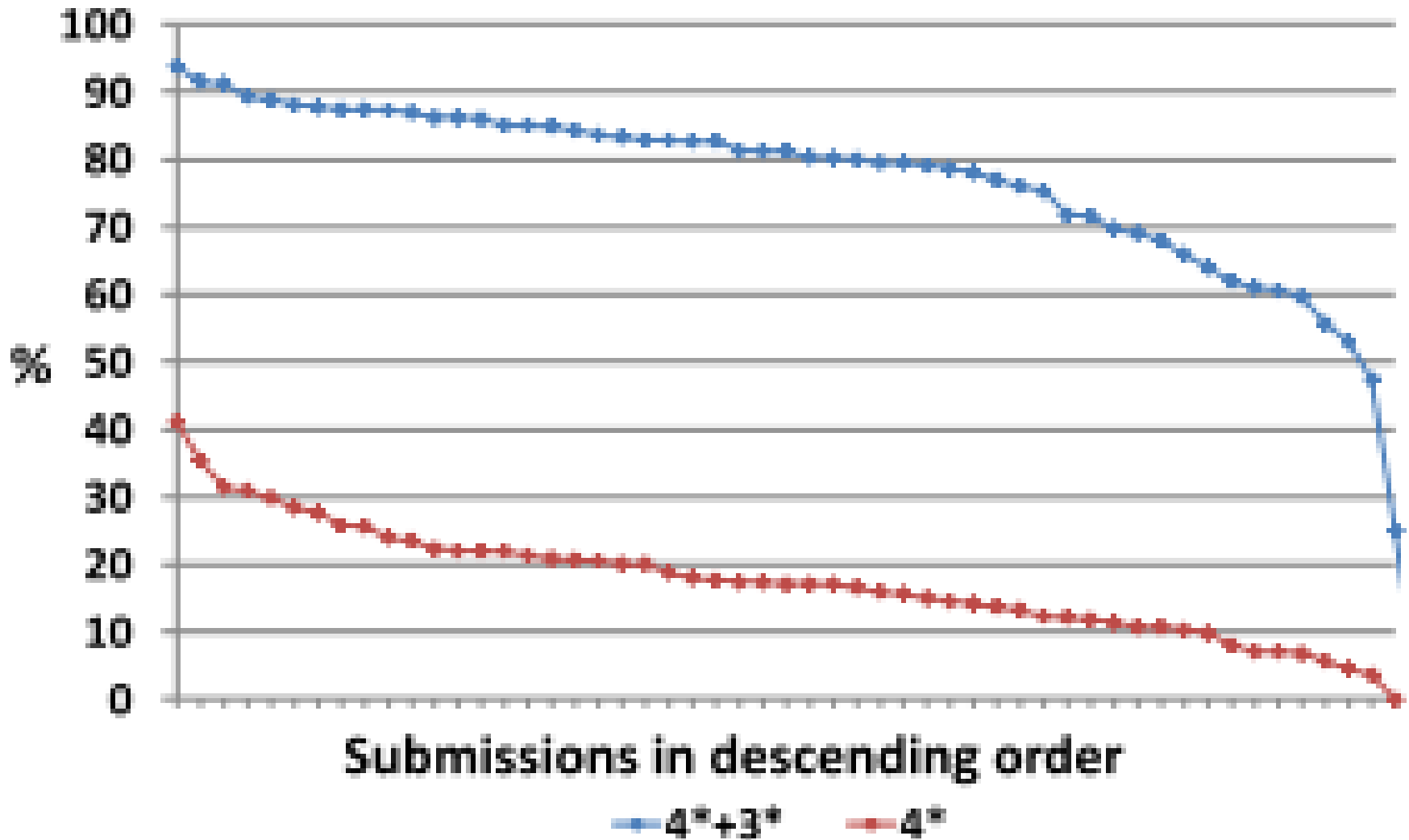
Do you need to be

- as big as possible?
- highly valued ('jewels in your University's crown') and so treated exceptionally?
- more successful at grant getting from ALL sources (CDTs, ERC, EU, Programme Grants, specific calls, ...)?
- more aggressive at seizing opportunities for investment/growth (eg Alan Turing Institute)?
- developing a/several unique angles to your activity (eg complexity, OR, cryptography)?

What about the community as a whole?

- How many UoAs will submit to REF2020?
- ‘perfect storm’ affecting many UoAs – even middle/large size departments
 - ‘disappointing’ REF scores and QR income
 - withered DTP, no CDTs or Programme Grants
 - pressure on UG and PG cohort numbers/quality
- Desertification of maths departments
- But, REF recognised quality across the whole community:

Distribution of output sub-profiles



My thoughts

- Over 50% of research is recognised as international excellent or world leading in 51 out of the 53 UoAs in B10!
- Yet these ‘scores’ are seen as poor by many universities – mainly due to the funding formula used
- So, we need to work together, don't we?

Routes to collaboration

- Can we encourage EPSRC to do more to support multi-site bids? EU?
- How can we ensure that the maths infrastructure actually works for everyone in the community?
 - ICMS – short workshops, KT & PE activity, research visits
 - INI – long-term thematic programmes & TGM
- How do we promote interdisciplinary & KT work?
- How do we access the KTN, Innovate UK & Catapults – possibly via the Smith Institute?

Smith Institute

- Ran a Faraday Partnership in early 2000s, which stimulated at least 10 new maths/ industry collaborations
- Ran a highly successful Knowledge Transfer Network for Industrial Mathematics
- The Smith Institute provides mathematical consultancy for industry, business, and government, and also
- supports and encourages mathematicians to play a full role in the knowledge transfer, research, and innovation agendas (EPSRC IRMS 2010)
- To bring this about SI works closely not only with industry but also with government and academia.

European Study Groups with Industry & other activities

- Smith Institute plays a crucial role in facilitating study groups with industry
 - Helps to seek funding (from KTN, NERC)
 - Helps to find industrial partners
 - Provides technology translation and assistance in organisation of study group
- Four EPSRC CASE awards to distribute p.a.
- Two workshops p.a. in emerging areas (KTN)
- (other activities: internships, network,...)

Other opportunities

- Heilbronn – currently funding a huge slice of the pure PhD and Postdoc community in Bristol and London. **Why not elsewhere?**
- Industrial support – close working partnerships
- Other research councils beyond EPSRC
- Sponsorship & benefaction
-