You Won't Believe How Easy it is To Build an AI!

Rebuilding Inspec for the 21st Century

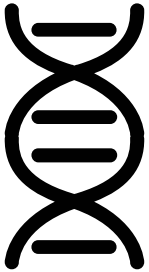
David Smith, Head of Technology Strategy & Product Solutions
The IET

About the IET

- The IET is one of the world's largest engineering institutions with over 175,000 members in 150 countries. It is also the most multidisciplinary – to reflect the increasingly diverse nature of engineering in the 21st century.
- The IET is working to engineer a better world by inspiring, informing and influencing our members, engineers and technicians, and all those who are touched by, or touch, the work of engineers.

INSPEC: A Bluffers Guide

- A highly curated A&I database covering Engineering, Computing and Physics (etc etc)
- For over 40 Years
- ~18 million abstracts
- So Much Metadata WOW!
- Several hundred years worth of Human Expertise keeps a very close eye on the metadata quality

Physics	Electrical and electronic engineering	Computing and control engineering	Information technology	Production, manufacturing & mech. engineering
				
9.84 million	**7.1 million**	**5.3 million**	**113K**	**2.1 million**

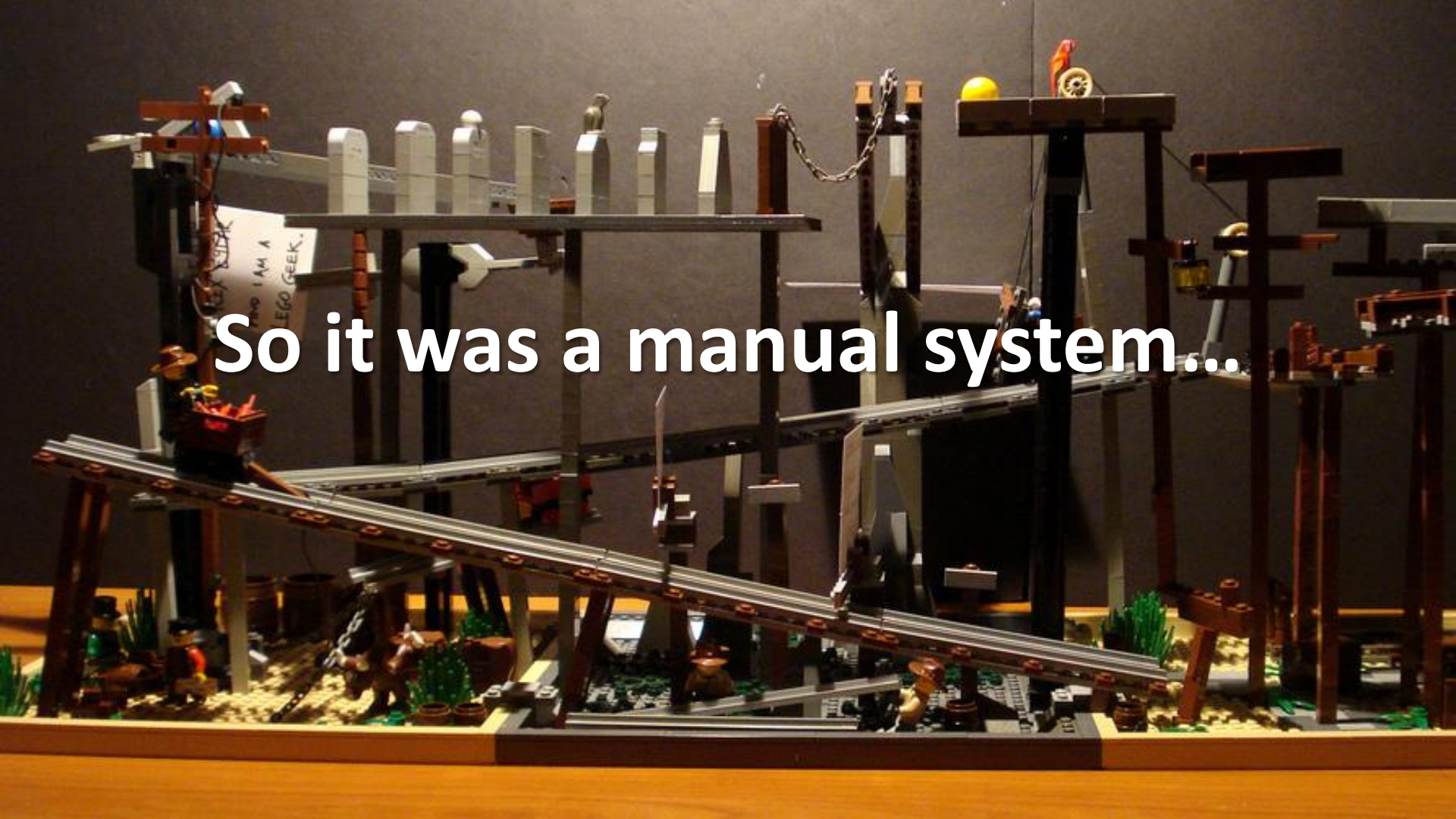
17.2M

records (Oct 2017)

- **870,000** records added in 2016
- Optional Archive adds another **873,699**
- Over **4,200** journals, and **3,000** other publications from 700 publishers

1969 — To date

- Or **1898** with the Archive


So it was a manual system…

And here’s how it worked…

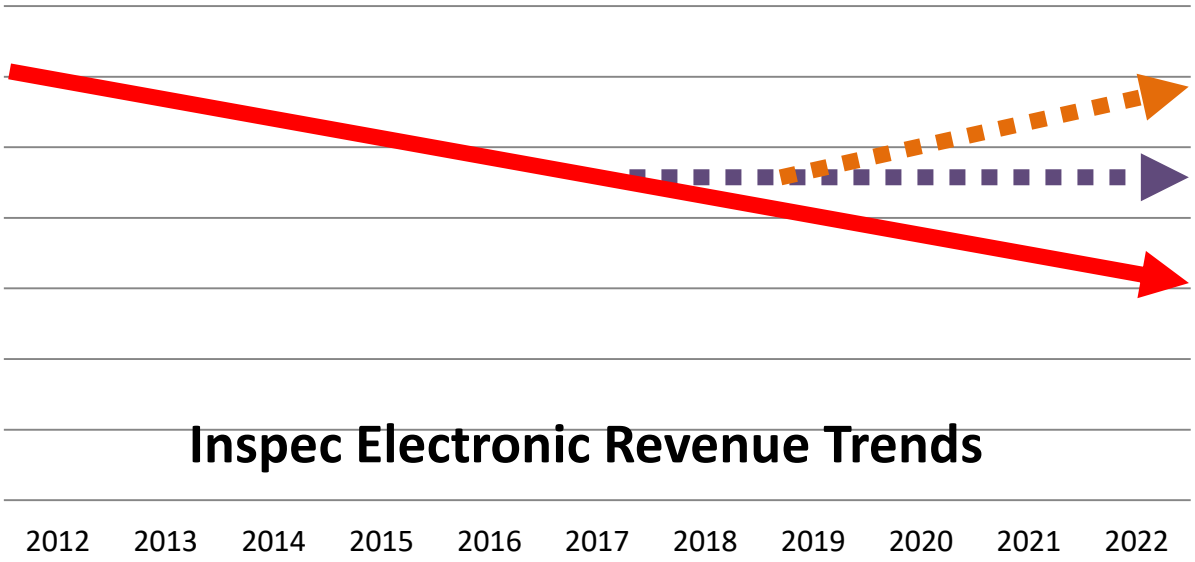
We needed to change this…

- The Tech was E.O.L
- The Manual methods were restrictive & expensive (but V High Quality)
- We had reached an upper limit on coverage and volume
- **There were clear opportunities to rethink what we were doing and why…**
- **Rebooting INSPEC production could open up new business avenues – if we got it right.**

Goals…

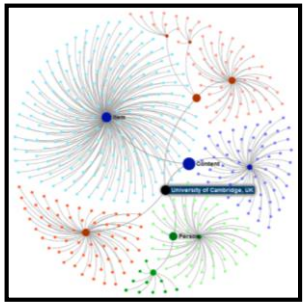
- **Deliver cost savings (ROI argument used)**
- **Move the human effort further up the value chain**
- Be able to extend coverage capabilities
- Be able to extend volume capabilities
- Reconfigure the data in INSPEC to allow new ways of asking questions of it.
- **Build a new IET IP asset**
- Focus on automation with human QA (‘Ground Truthing’)

Historic decline in A&I revenues



AI & Knowledge Graph Powered Inspec Production System

Humans	Machine	Machine & Human QA	Machine	Machine / Human QA
Acquisition	Normalisation	Metadata Application	**Product Generation**	Output
• Ingest Content • 3rd Party • IET	• Render to standard Inspec schema for onward processing	• The AI lives here…	• There are many flavours of Inspec	• Various outputs as needed



The Inspec Knowledge Graph covers all of the Inspec subject areas

The Inspec project has given the IET …

- A 21st C production process
  - Scalable
  - Extensible
  - Flexible

- A new POWERFUL and valuable asset: The Knowledge Graph – the IET's USP
  - The Inspec artificial intelligence (AI)
  - The Inspec domain models (& ontologies)
  - The reconfigured organisation of Inspec data

How does it work?

- It uses a mixture of
  - Heuristics
  - Natural Language Processors
  - Statistical analysis tools
  - And a selection of AI algorithms.
- We built a detailed domain model & Ontology for it to use
- It's been trained via directed learning of a golden corpus (circa 600K documents across INSPEC)

How does it work?

- And a selection of AI algorithms…
  - We looked at adaboost (go see wikipedia…)
  - Also word2vec (likewise)
  - And Tensorflow – the deep learning algo from Google. Interesting results… It did some rather odd things TBH so we abandoned that approach.

Inspec USP 1: What does the Inspec AI Do?

Title: Branching fraction measurements of $B \to \eta_c K$ decays

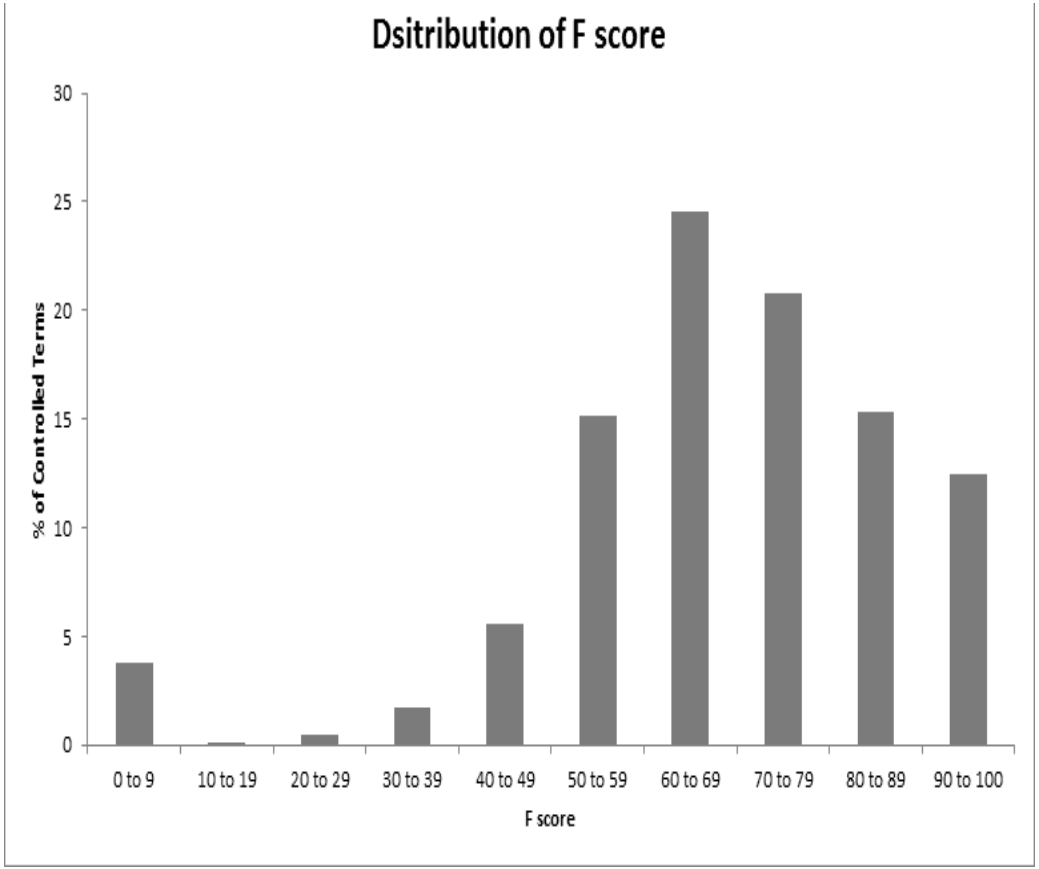
Abstract: We study the decays $B^+ \to \eta_c K^+$ and $B^0 \to \eta_c K^0$, where the η_c is reconstructed in the $K_S^0 K^\pm \pi^\mp$ and $K^+K^-\pi^0$ decay modes. Results are based on a sample of 86 million $B\bar{B}$ pairs collected with the BABAR detector at the SLAC e^+e^- B Factory. We measure the product of branching fractions $B(B^+ \to \eta_c K^+) \times B(\eta_c \to K\bar{K}\pi) = (7.40 \pm 0.50 \pm 0.70) \times 10^{-5}$ and $B(B^0 \to \eta_c K^0) \times B(\eta_c \to K\bar{K}\pi) = (6.48 \pm 0.85 \pm 0.71) \times 10^{-5}$, where the first error is statistical and the second is systematic. In addition, we search for $B \to \eta_c K$ events with $\eta_c \to 2(K^+K^-)$ and $\eta_c \to \phi\phi$ and determine the η_c decay branching fraction ratios $B(\eta_c \to 2(K^+K^-))/B(\eta_c \to K\bar{K}\pi) = (2.3 \pm 0.7 \pm 0.6) \times 10^{-2}$ and $B(\eta_c \to \phi\phi)/B(\eta_c \to K\bar{K}\pi) = (5.5 \pm 1.4 \pm 0.5) \times 10^{-2}$. (20 refs.)

Free Indexing: B^+ decay into etac+kaon+; B0 decay into etac+kaon0; B-antiB pairs; etac decay into kaon+antikaon+pion; B decay into etac+kaon; etac decay into kaon++kaon-; etac decay into phi+phi; branching fraction

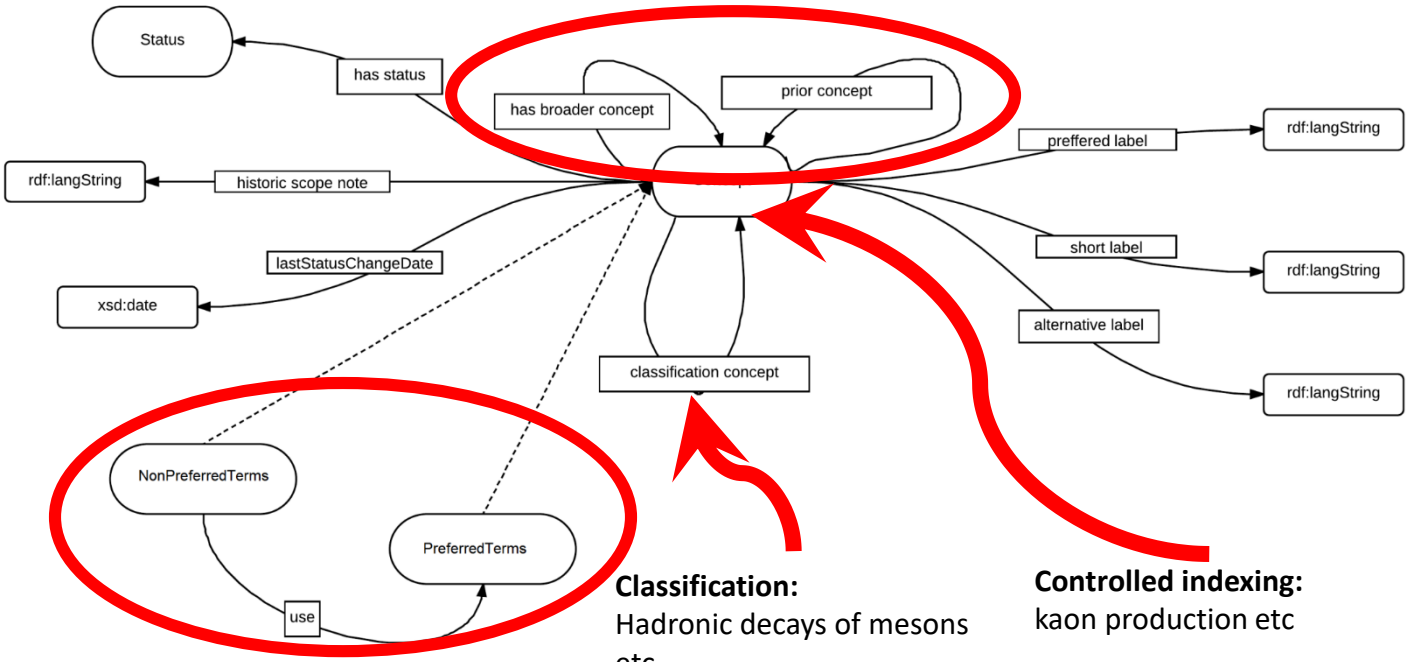
Controlled indexing: B mesons; eta mesons; kaon production; meson hadronic decay; phi mesons; pion production.

Classification: A1325 Hadronic decays of mesons; A1440M a and B mesons; A1440K rho, omega, and eta mesons; A1440N psi/J, upsilon, phi mesons

Is it any good?

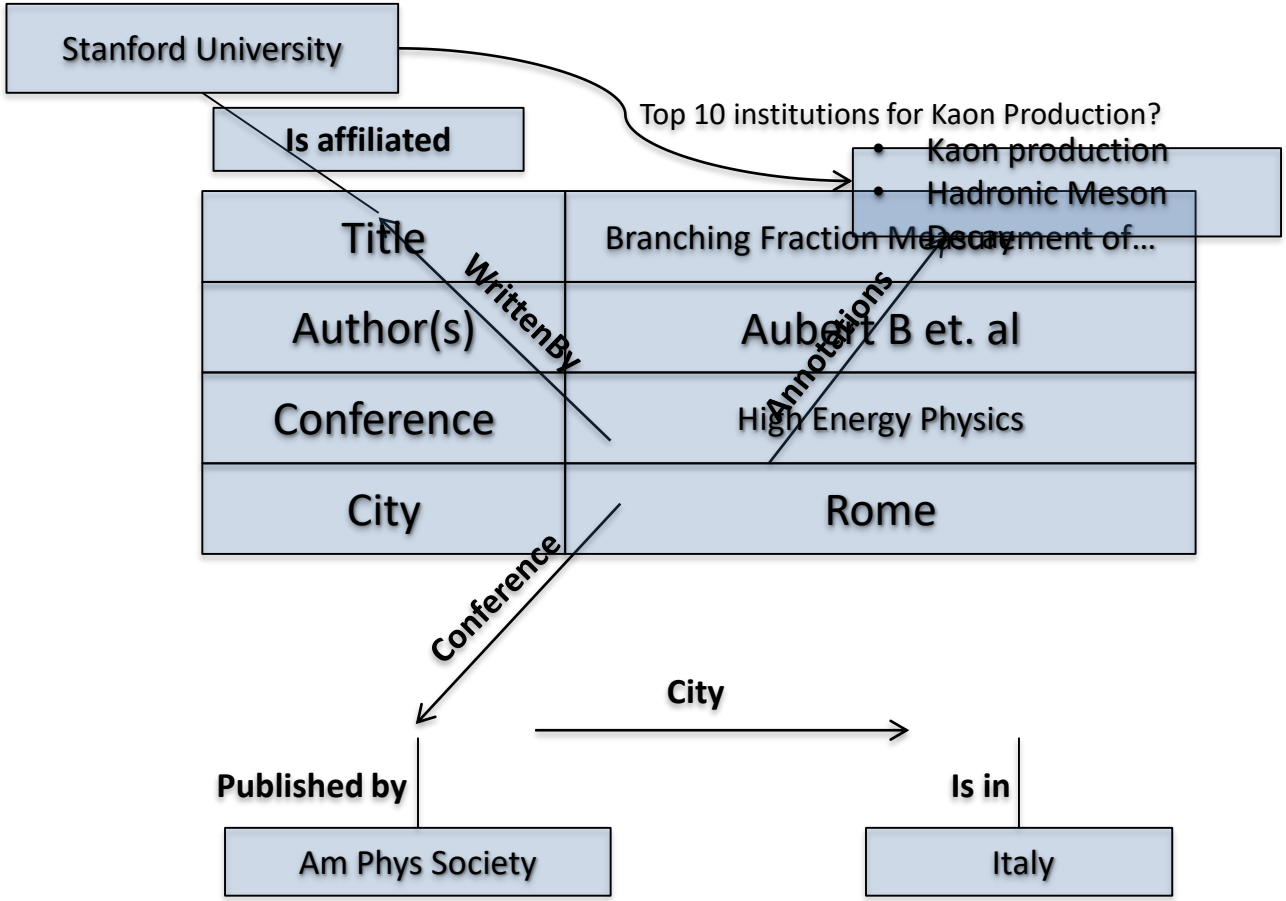


Inspec USP 2: Inspec Domain Models



Classification:
Hadronic decays of mesons etc

Controlled indexing:
kaon production etc


Stanford University
Is affiliated
Top 10 institutions for Kaon Production?
Kaon production
Hadronic Meson
Decayment of…
Title
Branching Fraction Measurement of…
Author(s)
Aubert B et. al
Conference
High Energy Physics
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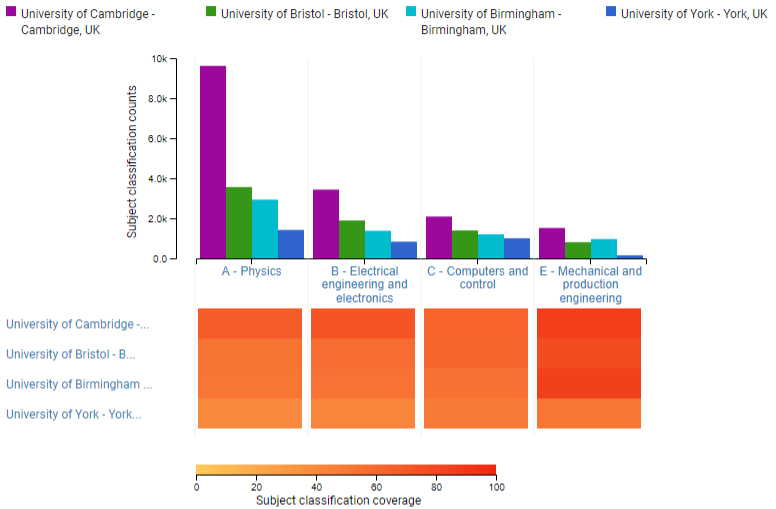
Subject Classification



Organisation	Articles	Inspec Classification Counts							
		A - Physics		B - Electrical engineering and electroni...		C - Computers and control		E - Mechanical and production engineerin...	
		Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage
University of Cambridge Cambridge, UK	12914	9613	67.9%	3433	72%	2088	63.2%	1518	86.1%
University of Bristol Bristol, UK	5778	3560	52.9%	1892	57.5%	1393	62.1%	808	77.2%
University of Birmingham Birmingham, UK	4882	2932	52.2%	1377	53.2%	1198	53.7%	963	84.8%
University of York York, UK	2678	1419	39.9%	833	42.3%	1003	49.3%	152	51.9%

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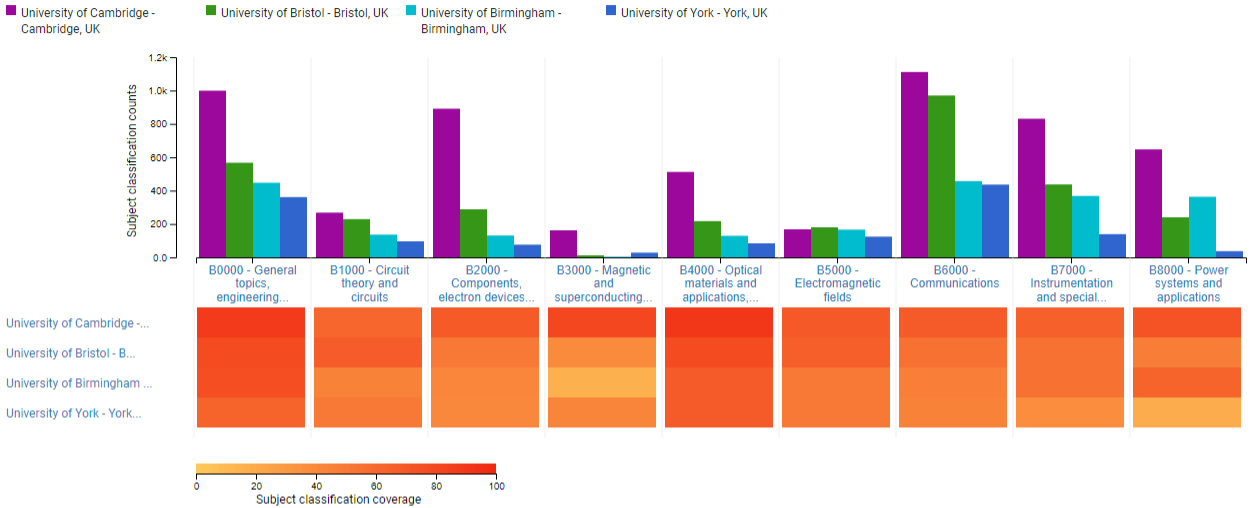
Subject Classification ▸ B - Electrical engineering and electronics



Organisation	Articles	Inspec Classification Counts																	
		B0000 - General topics, engineering mathematics ...		B1000 - Circuit theory and circuits		B2000 - Components, electron devices and materia...		B3000 - Magnetic and superconducting materials a...		B4000 - Optical materials and applications, elec...		B5000 - Electromagnetic fields		B6000 - Communications		B7000 - Instrumentation and special applications		B8000 - Power systems and applications	
		Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage
University of Cambridge Cambridge, UK	12914	999	88.1%	268	61.5%	891	68.9%	162	80.8%	512	90%	168	69.2%	1111	68.4%	831	65%	647	72.7%
University of Bristol Bristol, UK	5778	567	78%	229	67.3%	288	49.5%	12	38.5%	217	78%	180	65.4%	970	54.7%	437	54.7%	240	46.5%
University of Birmingham Birmingham, UK	4882	447	76.3%	136	44.2%	131	41.7%	4	15.4%	129	68%	166	50%	457	46.3%	368	54.7%	363	62.6%
University of York York, UK	2678	361	62.7%	96	50%	76	40.8%	28	42.3%	84	68%	124	50%	436	44.2%	139	37.2%	37	18.2%

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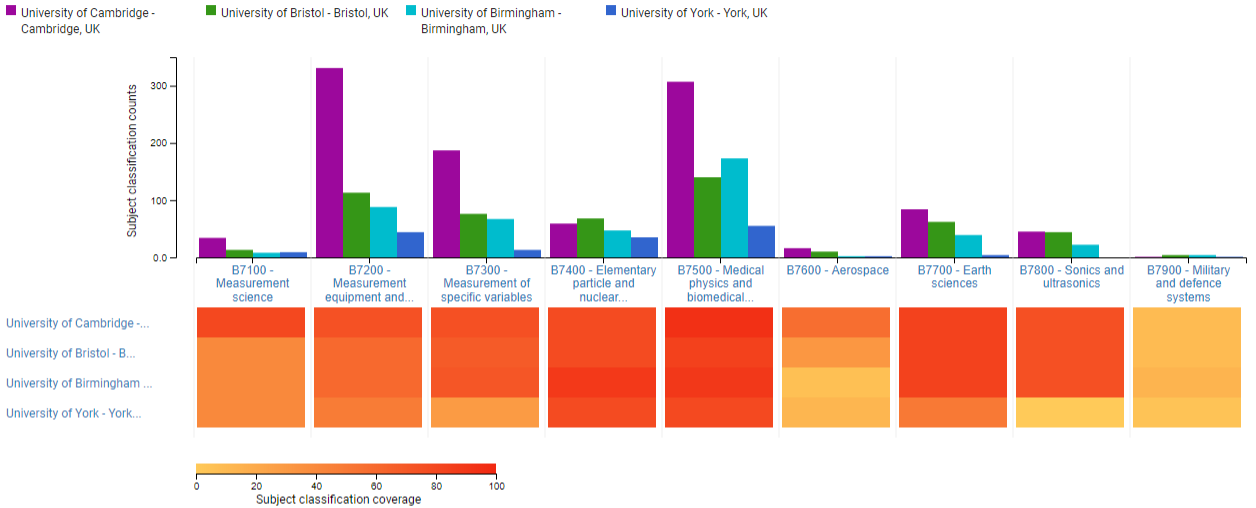
Subject Classification ▸ B - Electrical engineering and electronics ▸ Instrumentation and special applications



Organisation	Articles	Inspec Classification Counts																	
		B7100 - Measurement science		B7200 - Measurement equipment and instrumentatio...		B7300 - Measurement of specific variables		B7400 - Elementary particle and nuclear instrume...		B7500 - Medical physics and biomedical engineeri...		B7600 - Aerospace		B7700 - Earth sciences		B7800 - Sonics and ultrasonics		B7900 - Military and defence systems	
		Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage
University of Cambridge Cambridge, UK	12914	34	80%	331	74.1%	187	75%	59	77.8%	307	94.7%	16	56.3%	84	83.3%	45	75%	1	9.1%
University of Bristol Bristol, UK	5778	13	40%	113	59.3%	76	67.9%	68	77.8%	140	84.2%	10	31.3%	62	83.3%	44	75%	4	9.1%
University of Birmingham Birmingham, UK	4882	8	40%	88	59.3%	67	71.4%	47	88.9%	173	89.5%	2	6.3%	39	83.3%	22	75%	4	13.6%
University of York York, UK	2678	9	40%	44	48.1%	13	28.6%	35	77.8%	55	78.9%	2	12.5%	4	50%	0	0%	1	4.5%

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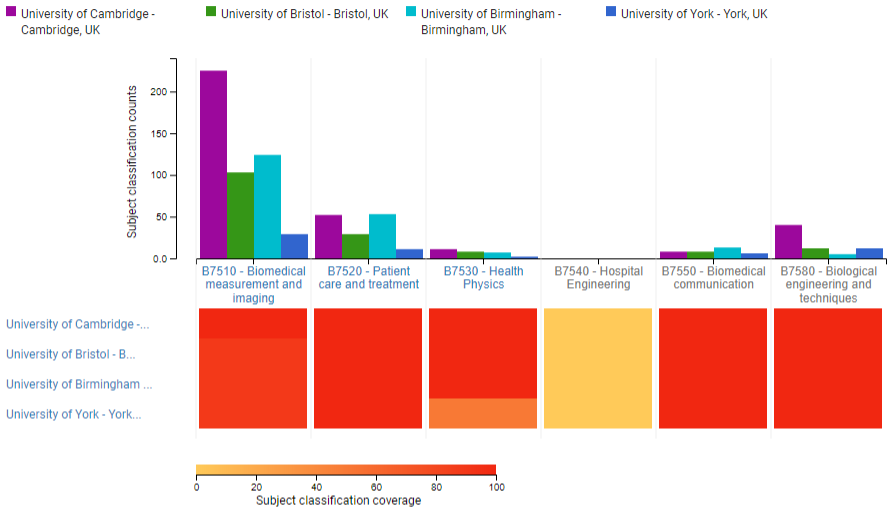

Organisation	Articles	Inspec Classification Counts											
		B7510 - Biomedical measurement and imaging		B7520 - Patient care and treatment		B7530 - Health Physics		B7540 - Hospital Engineering		B7550 - Biomedical communication		B7580 - Biological engineering and techniques	
		Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage
University of Cambridge Cambridge, UK	12914	225	100%	52	100%	11	100%	0	0%	8	100%	40	100%
University of Bristol Bristol, UK	5778	103	88.9%	29	100%	8	100%	0	0%	8	100%	12	100%
University of Birmingham Birmingham, UK	4882	124	88.9%	53	100%	7	100%	0	0%	13	100%	5	100%
University of York York, UK	2678	29	88.9%	11	100%	2	50%	0	0%	6	100%	12	100%

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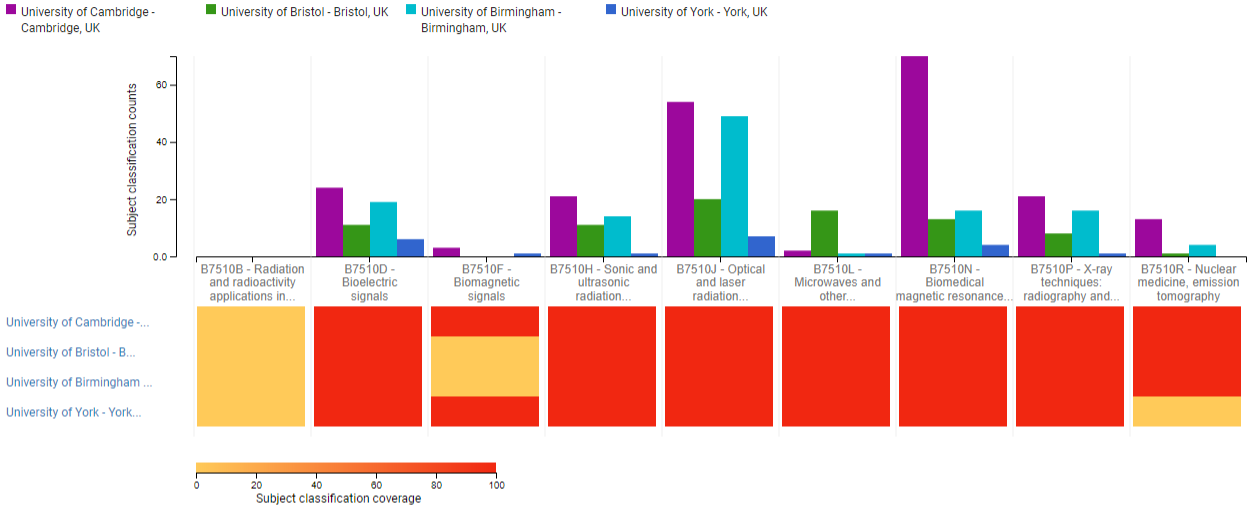
Subject Classification ▸ B - Electrical engineering and electronics ▸ Instrumentation and special applications ▸ Medical physics and biomedical engineering ▸ Biomedical measurement and imaging



Organisation	Articles	Inspec Classification Counts																	
		B7510B - Radiation and radioactivity applications...		B7510D - Bioelectric signals		B7510F - Biomagnetic signals		B7510H - Sonic and ultrasonic radiation (biomedic...		B7510J - Optical and laser radiation (biomedical ...		B7510L - Microwaves and other electromagnetic wav...		B7510N - Biomedical magnetic resonance imaging an...		B7510P - X-ray techniques: radiography and comput...		B7510R - Nuclear medicine, emission tomography	
		Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage	Count	Coverage
University of Cambridge Cambridge, UK	12914	0	0%	24	100%	3	100%	21	100%	54	100%	2	100%	70	100%	21	100%	13	100%
University of Bristol Bristol, UK	5778	0	0%	11	100%	0	0%	11	100%	20	100%	16	100%	13	100%	8	100%	1	100%
University of Birmingham Birmingham, UK	4882	0	0%	19	100%	0	0%	14	100%	49	100%	1	100%	16	100%	16	100%	4	100%
University of York York, UK	2678	0	0%	6	100%	1	100%	1	100%	7	100%	1	100%	4	100%	1	100%	0	0%

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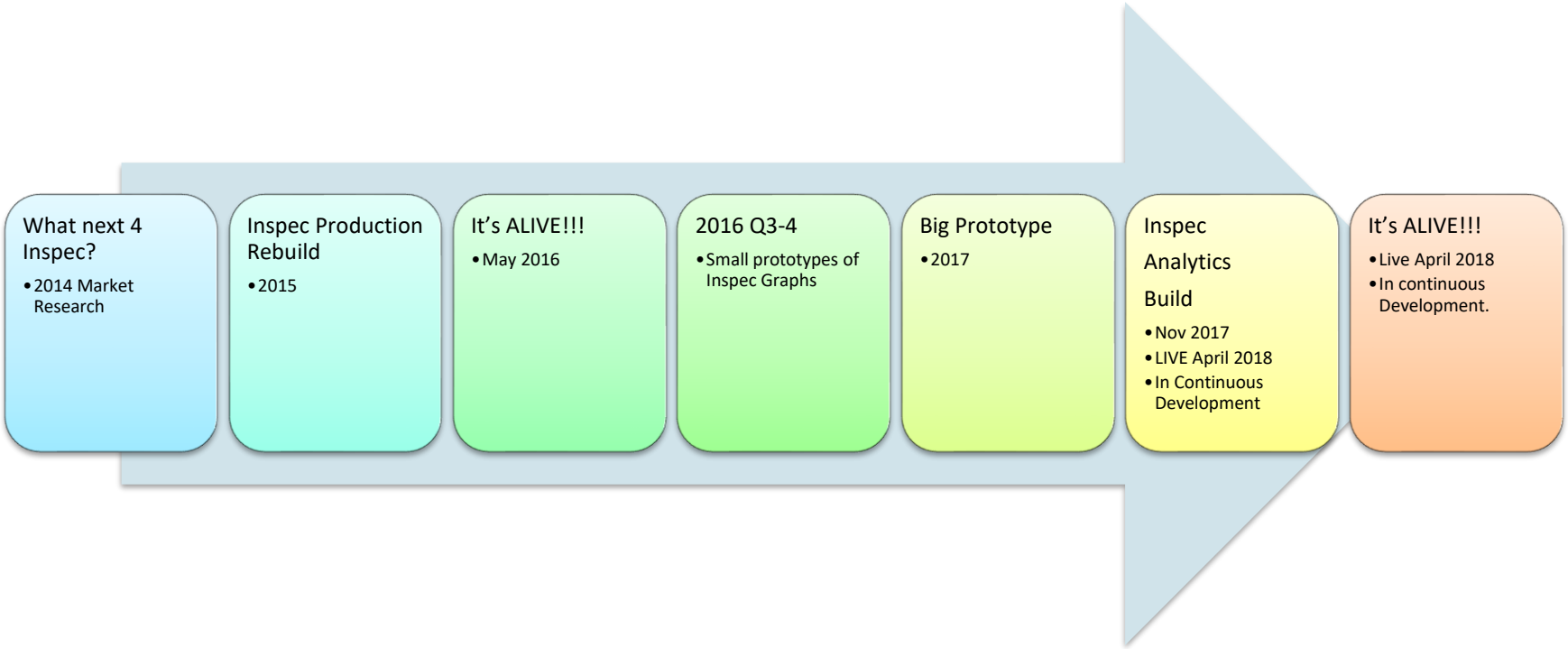
Trend Chart Galaxy Chart

Update graph 0 ✖ Reset

From 2013 To 2017

#	Subject classification	Articles
1	B7510-Biomedical measurement and imaging	225
2	B7520-Patient care and treatment	52
3	B7580-Biological engineering and techniques	40
4	B7530-Health Physics	11
5	B7550-Biomedical communication	8

The Inspec Journey




Thanks!
Q’s?