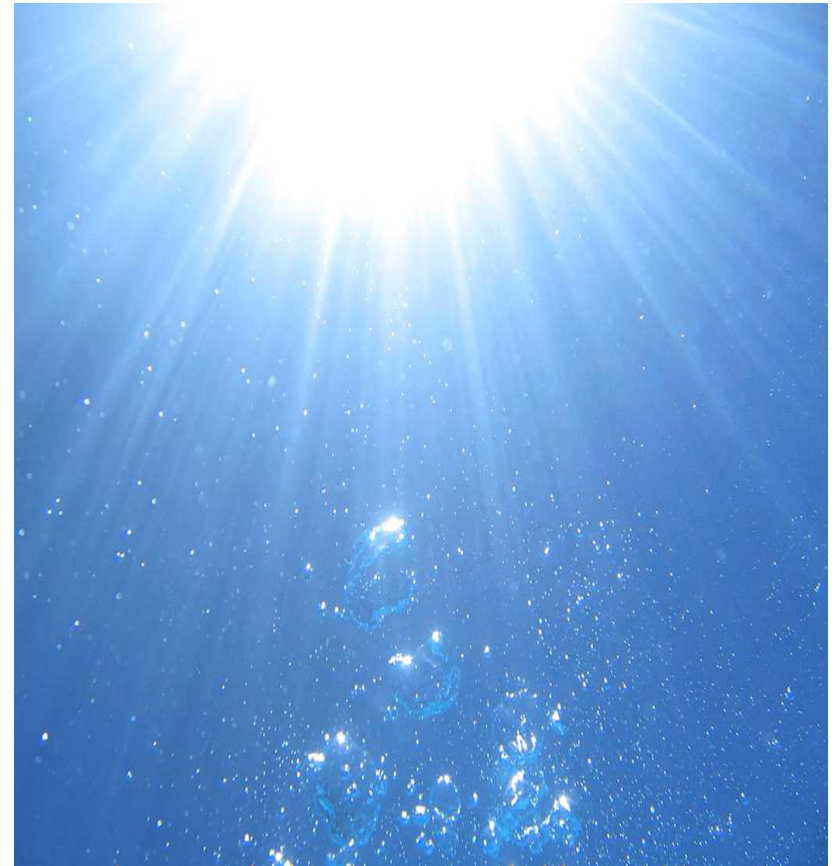


CREATE Technology Watch Workshop

Purpose and Value of Technology Watch



create

Add title in Header & Footer

Technology Watch in Generic Terms

- Assemblage of methodologies, both human and computer based, required to understand the status of science and technology
- A way for the
 - detection,
 - exploration,
 - assessment and
 - communication of promising technologies
- Define, facilitate and drive innovation management process
- Extract useful information from large volumes of structured and unstructured S&T text
- Statement on potential impact of new technologies



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Technology Watch in Generic Terms (2)

...but:

- Technology watch is non-predictive!
- No prediction of future characteristics and timing of new technologies
- Technology watch does not provide technology forecasts



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Technology Watch - Types of Technologies

- Emerging technologies
 - Technologically immature or mature
 - Have not yet achieved potential level of acceptance and market penetration
 - Part of a new technology path
- Sustaining technologies
 - improve performance of established product through current technology paradigms



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Technology Watch - Types of Technologies (2)

- Disruptive technologies
 - Scientific discoveries that break through usual product/technology capabilities
 - Introduce a package of attributes very different from the mainstream customers' historical set
 - May provide inferior product features wrt. some parameters measured by mainstream market, at least in the short run
 - Provide dramatic improvements in the long run
- Enabling technologies
 - Prerequisite for other technologies, products and processes



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Technology Watch in the CREATE Context

Purpose:

- Early detection of emerging technologies
- Early perception of potential impact

Value:

- Providing advice to long term strategic decisions in the aeronautics sector
 - Research policies
 - Funding policies
 - Product line management
 - New business development
 - Highlight new opportunities and threats



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Technology Watch in the CREATE Context (2)

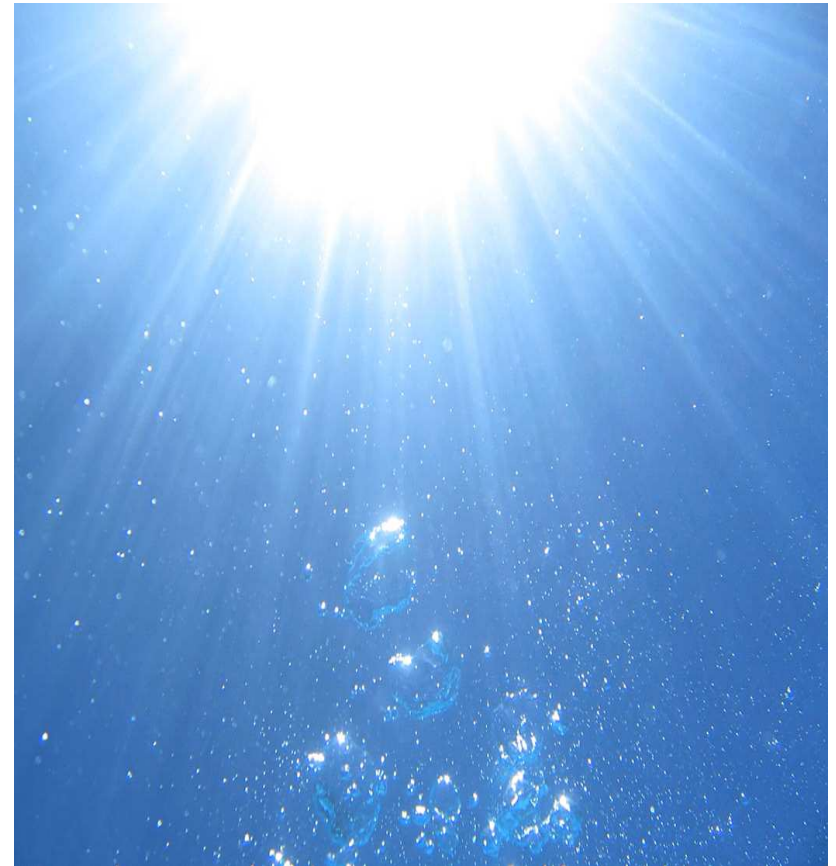
Additional aims

- Identification of experts and research hubs
- Technology signatures regarding readiness and capability
- Collaboration and social network analysis
- Targeting of R&D resources
- Patent opportunity and technology gap identification
- Feed for technology prediction models



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CREATE
Technology Watch Workshop
The Technology Watch Case Study



create

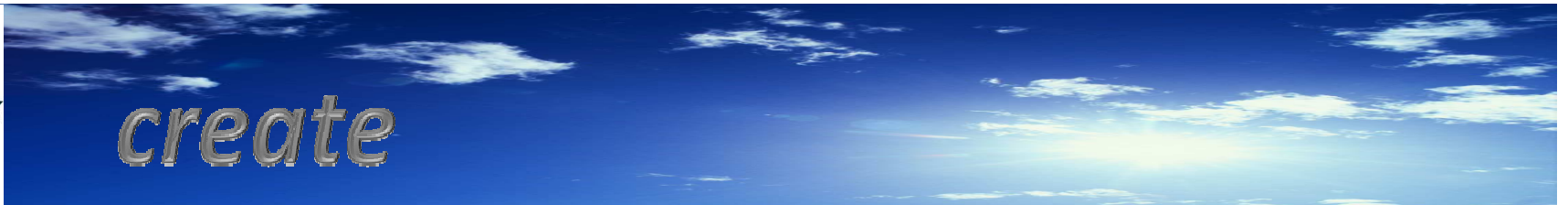
Add title in Header & Footer

Technology Watch Case Study

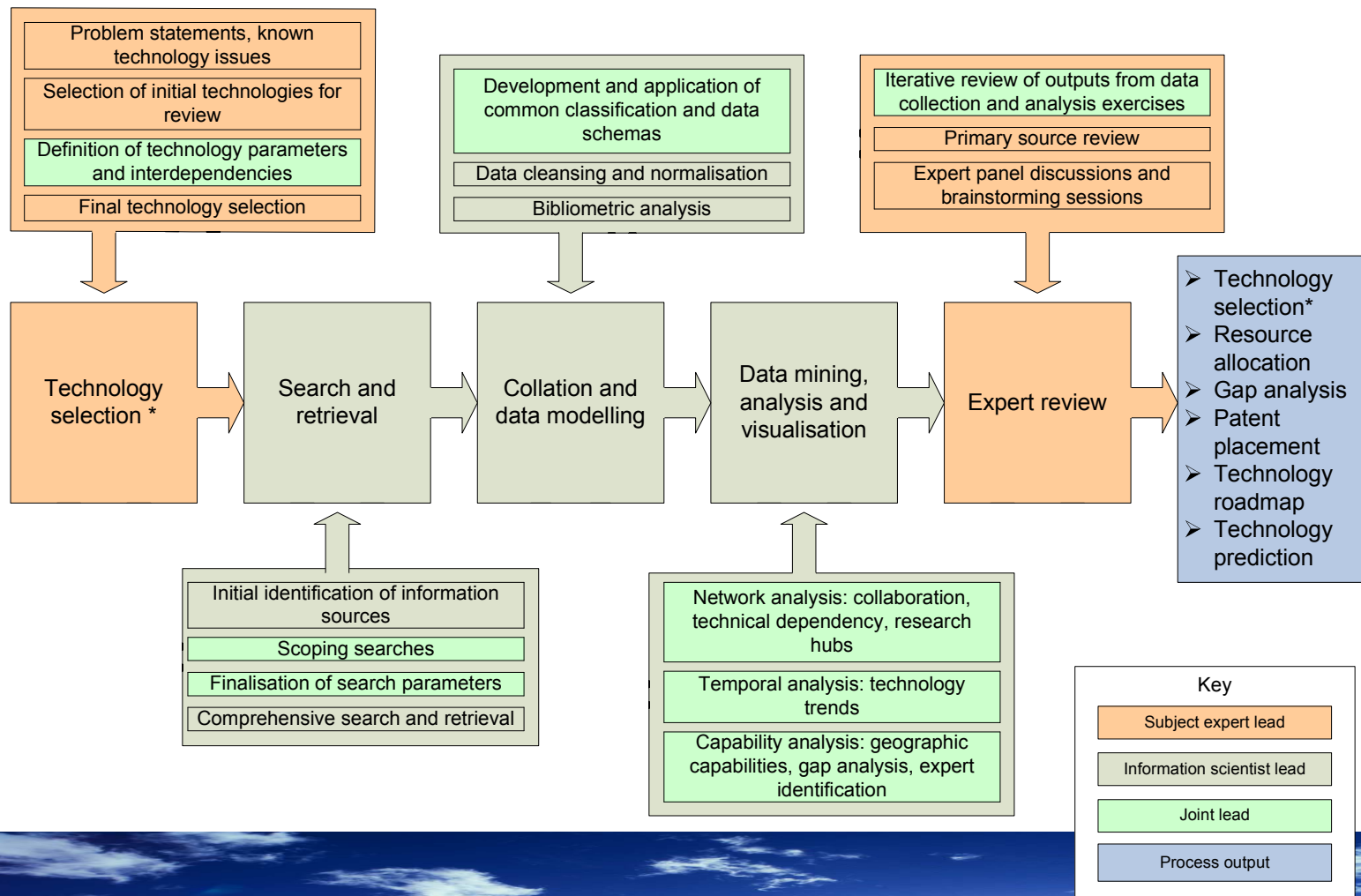
- Illustrative process
- Actual case study – high temperature polymers



create



Illustrative process - iterative



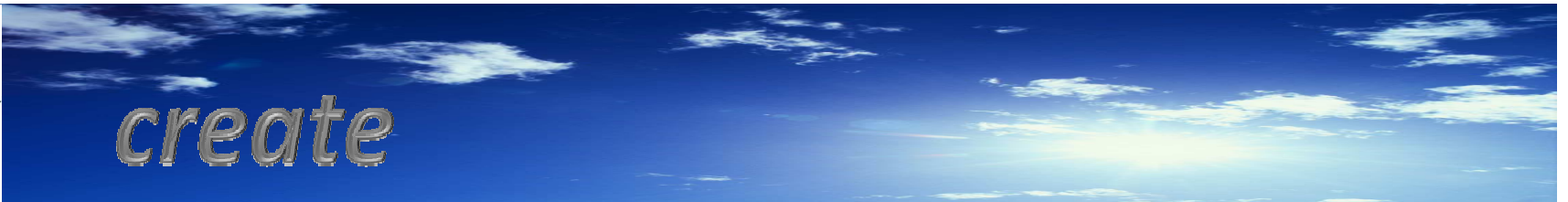
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Requirements overview

- Comprehensive retrieval of relevant, validated information
- Effective collaboration between technical subject and information science experts
- The development and application of bespoke classification schemes
- Development and use of a flexible analysis toolset:
 - Large scale access to key scientific, technical and patent literature databases
 - Database tools
 - Text analysis tools
 - Visualisation tools
- Collaboration with internal and external stakeholders
- Process must be iterative



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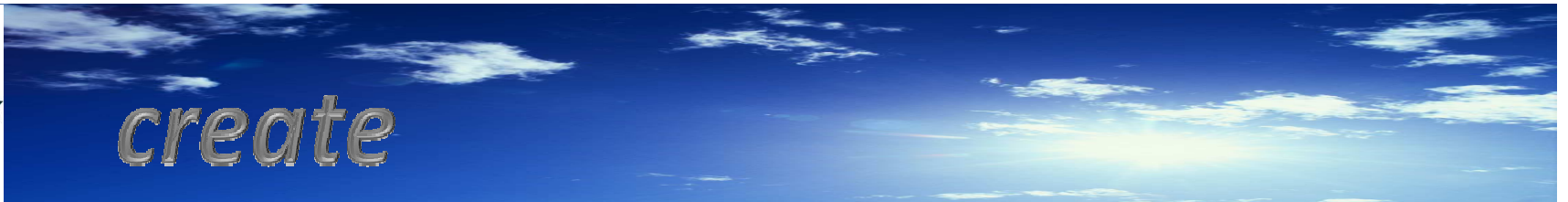


Overview 2

- Definition of search terms and sources
- Information retrieval
 - Patents
 - Scientific and technical literature
- Text processing and data cleansing
- Expert review and application of classification scheme
- Identification and visualisation of emergent links
- Identification of trends



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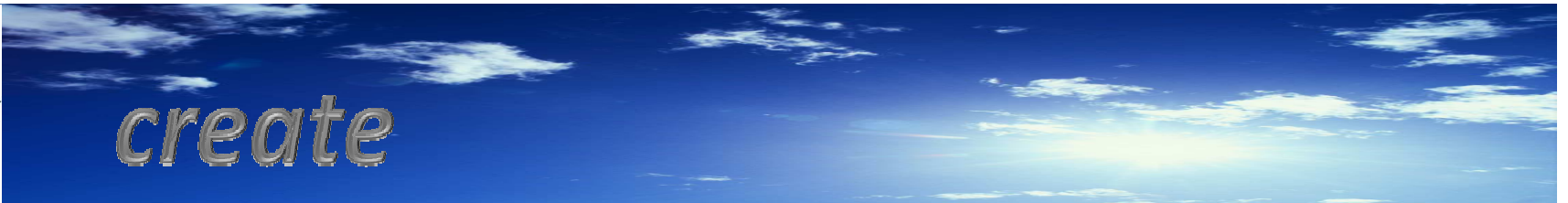


Key capabilities required

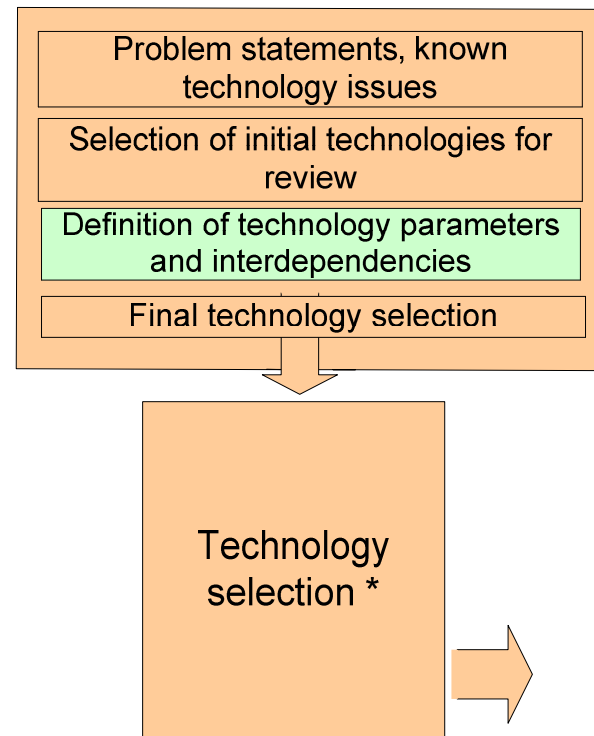
- Information Science and Architectures
 - Retrieval and analysis of scientific, technical and patent literature; creation and application of data architectures, concept-based and inferential taxonomies; visualisation; and applied text analysis
- Data mining and text analysis
 - Data mining, algorithm creation, automatic classification, text extraction, software development
- Subject matter experts
 - Unparalleled access to internal subject matter experts across key technology areas
 - Access to wide network of experts from academia, industry and government



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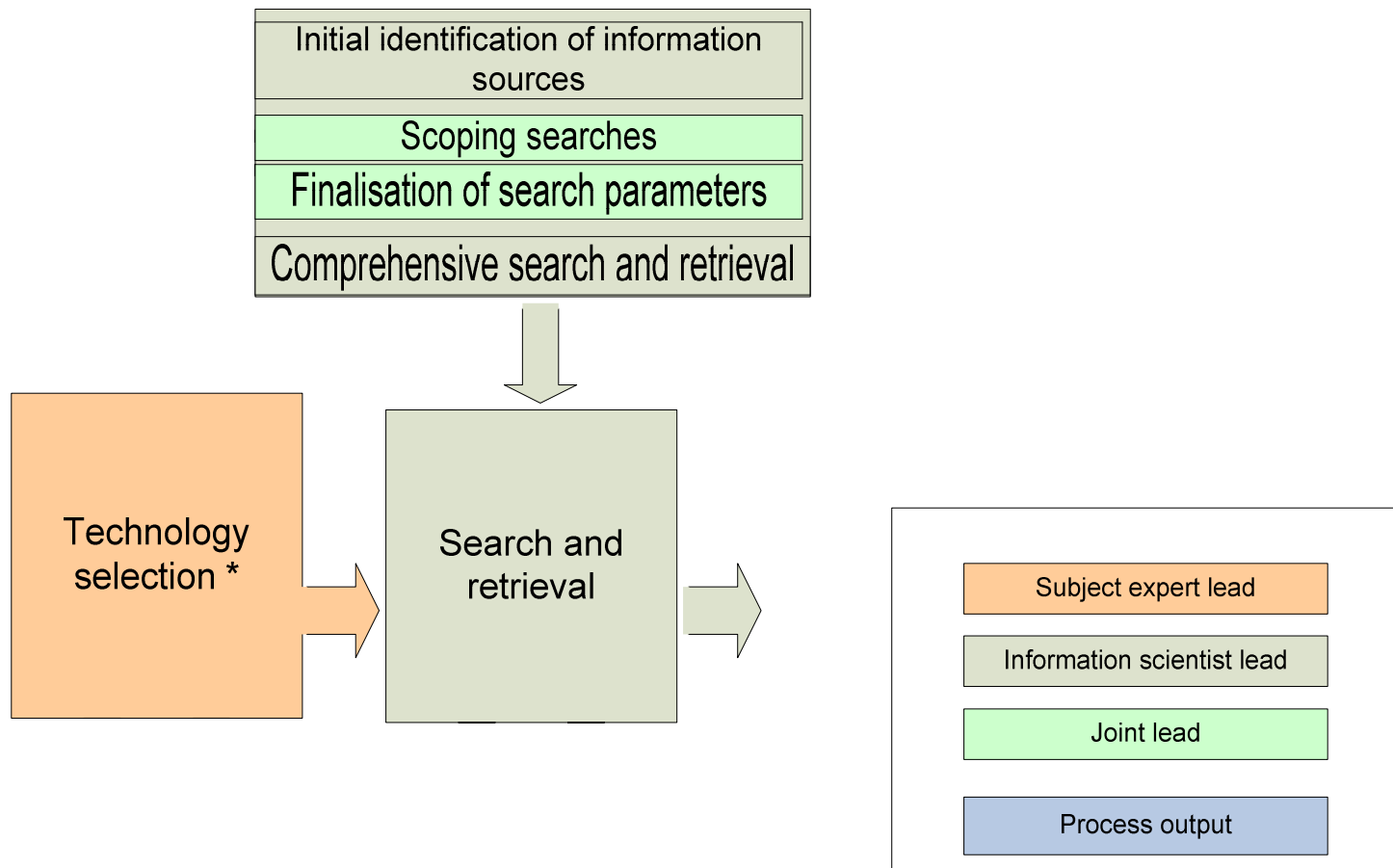


Technology selection



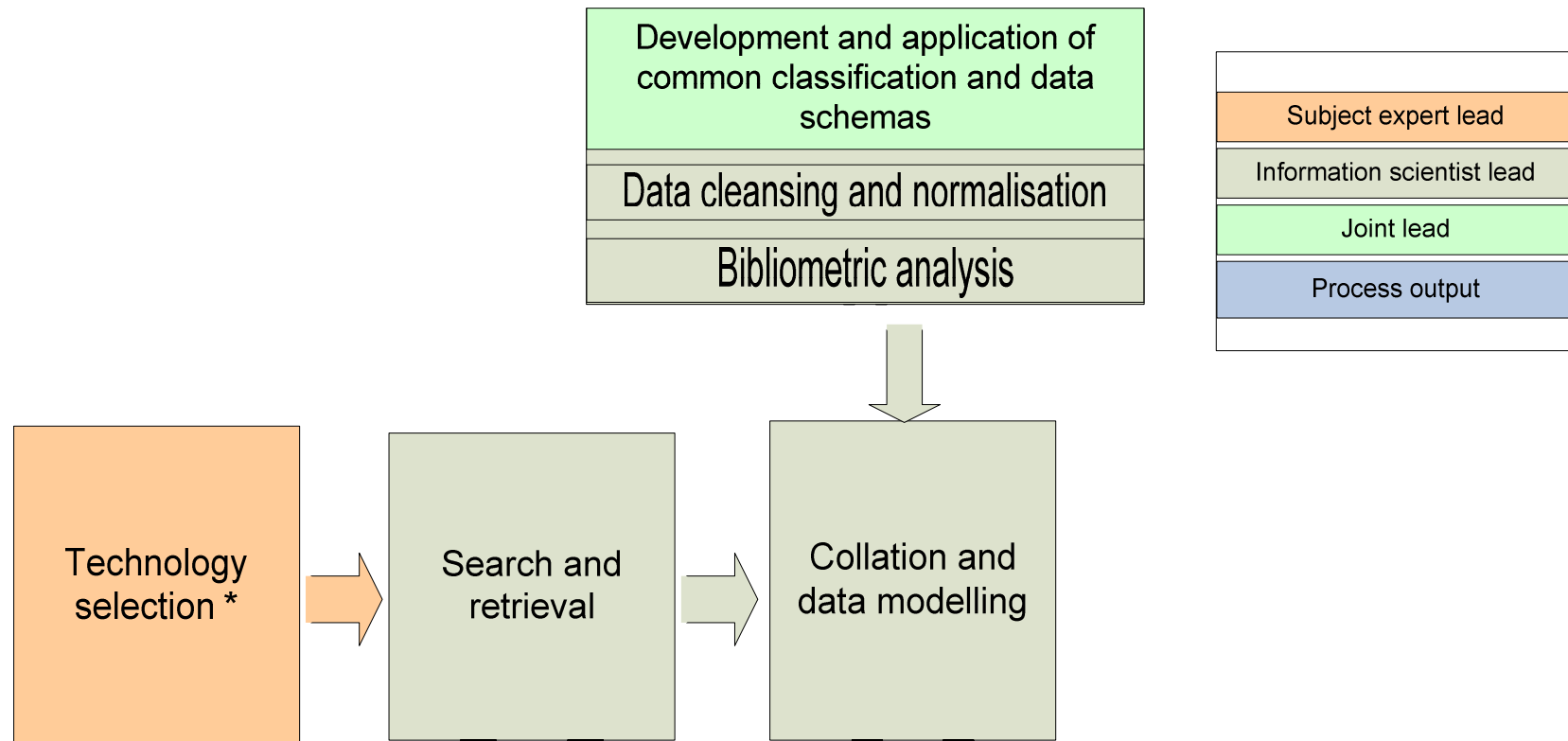
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Search and retrieval



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Data modelling



create

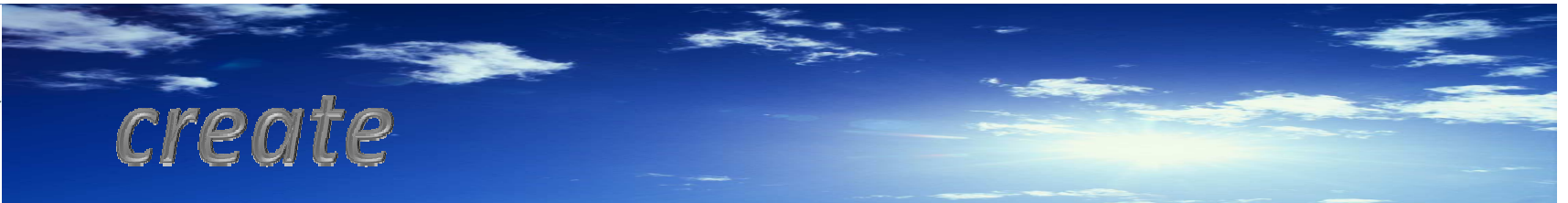
Data modelling techniques

Fundamental techniques:

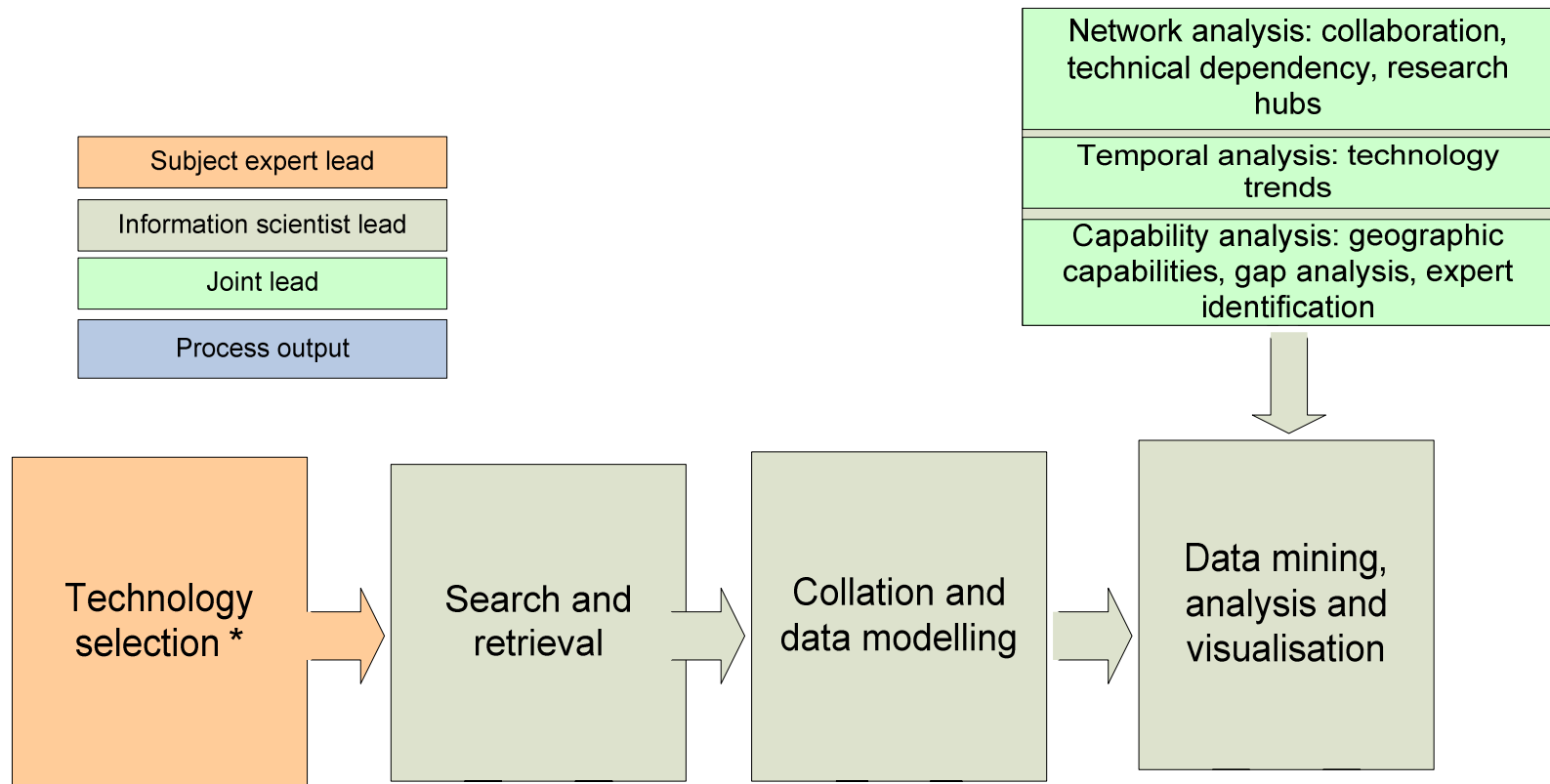
- Definition of concepts
 - Entity identification
 - Person, Institution, Material, Application, Year
 - Entity relationships
 - Institution-Institution links, Material-Application links
 - Entity description
 - Construction of concept taxonomies
 - Dependencies between taxonomies



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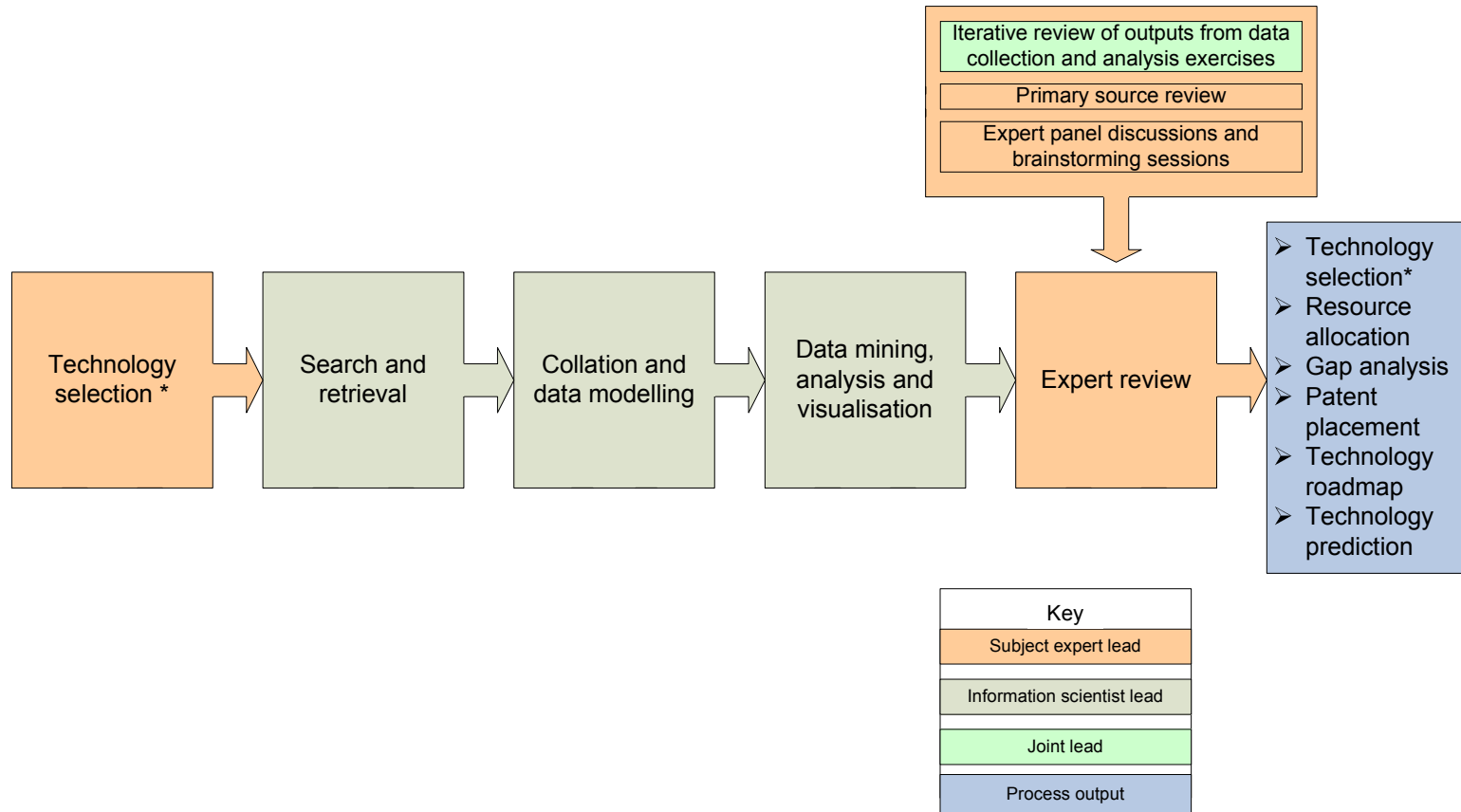


Analysis



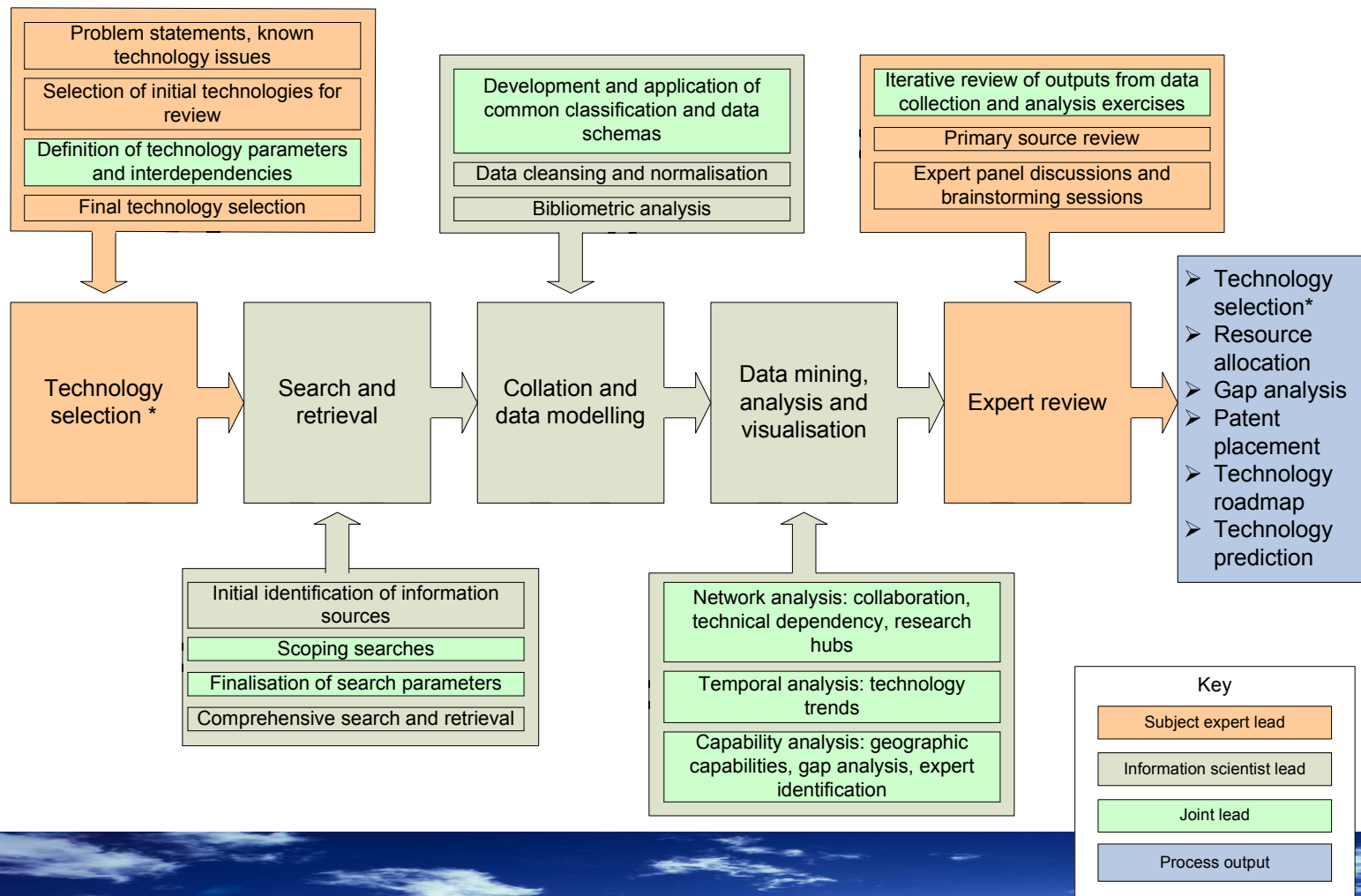
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Expert review



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Illustrative process - iterative



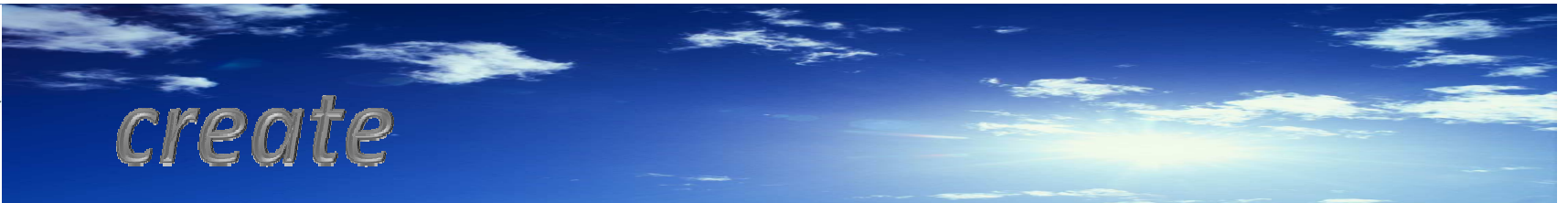
create

High Temperature Polymers Case Study

- Choice of technical area to study
- Sources:
 - INSPEC
 - Compendex
 - Aerospace
 - Scopus
 - ISI
 - Patent databases
- Iterative search string development with subject matter experts
 - Alternative terms
 - Time period to be covered



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Key word review

- **General**
- Search for “plastics” as well as “polymers”
- Search for polymer* (this covers polymer, polymers, polymeric and polymerization)
- **Ceramic-polymer composites (for structural applications as composite matrices)**
- Ceramers
- Organic-inorganic hybrid
- Polyimide / silicates
- Clay
- **High temperature matrix polymers (for structural applications as composite matrices)**
- Polyimide (these have processing problems) also referred to as PMR
- Imide oligomers (i.e. modified polyimides)
- Cyanate esters
- Cyclic phosphazenes
- Perfluoroether (a toughening agent that has advantages in high-temperature hybrid polymers)
- Cyanate ester resin modified with a phosphazene group that has been reacted with a phenol compound
- **Fuel cell materials**
- proton exchange membrane fuel cells (PEMFCs)
- polymer electrolyte fuel cell (PEFC)
- direct methanol fuel cells (DMFCs)
- Organic/inorganic composite membranes
- inorganic heteropolyacid (HPA) additives (added to membrane material for better high temp. operation)
- silica - poly (vinyl alcohol) hybrid polymer (electrolyte membrane material)
- organic/inorganic nanohybrids (polymer electrolyte)
- polybenzimidazole (PBI)
- perfluorosulfonylfluoride copolymer resin (Nafion resin)
- 1,8-bis(triethoxysilyl)octane (TES-Oct) and 3-(trihydroxysilyl)-1-propanesulfonic acid ((THS)Pro-SO₃H) via sol-gel process
- H₃PO₄-doped polybenzimidazole (PBI)
- **Flame retardant / Fire resistant materials**
- Flame retardant
- Fire resistant
- Intumescent
- Nan-composites
- Bisphenol
- cyclotriphosphazene-containing polyimide
- bisphthalonitriles



create

Records returned

Number of records	Source
546	INSPEC
259	Compendex
228	Patents
411	ISI Science Citation Index



create

Primary Analysis

- Key Institutions

	Affiliation (Cleaned)	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
n		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
32	IBM Res. Div., Almaden Res. Center, San Jose, CA, USA		10	6	5	2	2	2	2	1						4	
14	NASA, LANGLEY RES CTR, HAMPTON, VA 23681			2	2				2			1	1	1	5		
11	TOKYO INST TECHNOL, DEPT ORGAN & POLYMER MAT, MEGURO KU, TOKYO 152, JAPAN		1	4	3	1	1							1			
12	NASA-Lewis Research Cent, Cleveland, OH, USA	1	1	1		3	2		1			1		2			
5	Dept. of Chem. Eng., Case Western Reserve Univ., Cleveland, OH, USA			1					1							3	
5	IBM, Thomas J. Watson Res. Center, Yorktown Heights, NY, USA		4													1	
5	UNIV CINCINNATI, POLYMER RES CTR, CINCINNATI, OH 45221							1	1		1		2				



create

Primary Analysis

- Key Authors

	Authors/Inventors (Cleaned)	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
n		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
50	Yoon, D.Y		50														
50	Mita, I		50														
13	Hergenrother, PM	1	1	3	2				1			1	1	1	2		
12	Imai, Yoshio	1	1	4	3	1	1							1			
11	Kakimoto, MA		2	4	3	1								1			
11	Hedrick, JL			1	2		2	1	2	1						2	
9	Connell, JW			2	2				1			1		1	2		
9	Volksen, W		2		1	1	2					1				2	
8	Sutter, James K				1	2					2		1		2		
7	Smith, JG				2				1			1		1	2		
7	Russell, TP			1	2		2		1	1							
7	Culham, J.R											2	1			4	
7	Morgan, Roger J	1					2	2			2						
7	Zuo, Sun													3	4		
6	Labadie, JW			1	2		2	1									
6	Luo, JJ													3	3		



create

Results database

Results	
ID	244
Title	POLYIMIDE-POLYSILOXANE-SEGMENTED COPOLYMERS AS HIGH-TEMPERATURE POLYMER ELECTROLYTES
Author(s)	TIAN, SB; PAK, YS; XU, G
Source	JOURNAL OF POLYMER SCIENCE PART B-POLYMER PHYSICS
Abstract	Based on the fact that the flexibility of the polymer backbone will affect the ion transport and sometimes enhance the ionic conductivity, copolymer electrolytes of 1,2,4,5-benzene-tetracarboxylic dianhydride (PMDA), 4-aminophenyl ether (ODA), and aminopropylmethyl-terminated polydimethylsiloxane (PSX), with or without doping of
Descriptors	ELECTRICAL CONDUCTIVITY; COPOLYMER ELECTROLYTES; LITHIUM DOPING
Identifiers	-
Application	Fuel Cells/Batteries
Materials	Electrolyte/membrane
Process	-
Chemical	- Edit Chemicals attached to this record
Notes	ISI
Comments	

Request Marked Items

Clear Marked Items

Mark All Items

Download Marked Results

Print Current Item

Update Marked Items

Back

Delete Record

Mark ☒ Held ☐

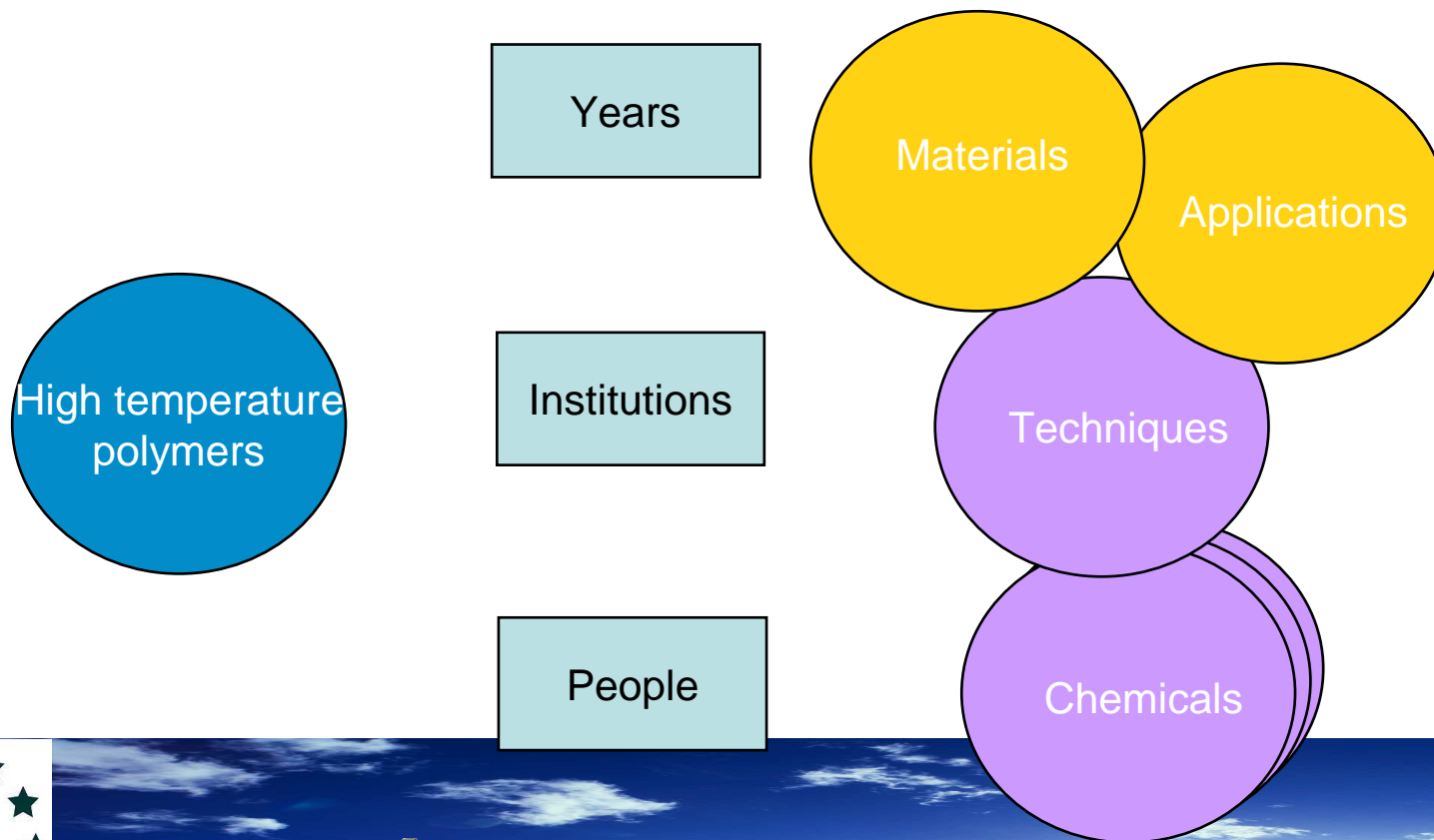
Link

Record: 4 of 727



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Concept areas for high temperature polymer research



create

Toolset examples: Taxonomy creation

Taxonomy editor

Chemical

ChemTerm
▶

Process

ProcessTerm
▶

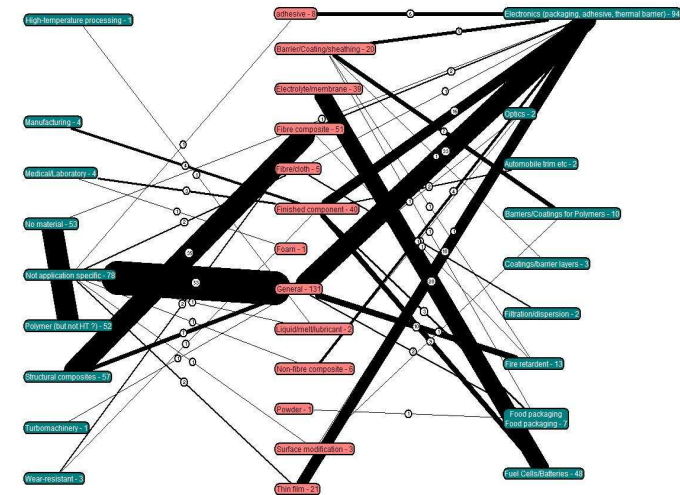
Material

MaterialTerm
▶ Adhesive
Barrier/Coating/sheathing
Electrolyte/membrane
Fibre composite
Fibre/cloth
Finished component
Foam

Application

ApplicationTerm
Electronics (packaging, adhesive,
Fire retardant
Food packaging
Structural composites
Not relevant
Not application specific
High temperature processing

Done



create

Toolset examples : Taxonomy application

Results

ID: 244

Title: POLYIMIDE-POLYSILOXANE-SEGMENTED COPOLYMERS AS HIGH-TEMPERATURE POLYMER ELECTROLYTES

Author(s): TIAN, SB; PAK, YS; XU, G

Source: JOURNAL OF POLYMER SCIENCE PART B-POLYMER PHYSICS

Abstract: Based on the fact that the flexibility of the polymer backbone will affect the ion transport and sometimes enhance the ionic conductivity, copolymer electrolytes of 1,2,4,5-benzene-tetracarboxylic dianhydride (PMDA), 4-aminophenyl ether (ODA), and aminopropyl-dimethyl-terminated polydimethylsiloxane (PSX), with or without doping of

Descriptors: ELECTRICAL CONDUCTIVITY; COPOLYMER ELECTROLYTES; LITHIUM DOPING

Identifiers: -

Application: Fuel Cells/Batteries

Materials: Electrolyte/membrane

Process: -

Chemical: - [Edit Chemicals attached to this record](#)

Notes: ISI

Comments:

Request Marked Items

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Update Marked Items

Back

Delete Record

Mark ☒ Held ☐

Link: -

Record: 14 of 727

Update

Update all marked records

Application	Process	Material	Chemical
<div>Wear-resistant Optics Lubricants Barriers/Coatings for P Manufacturing Turbomachinery Automobile trim etc Filtration/dispersion Medical/Laboratory Fuel Cells/Batteries Polymer (but not HT ?) Constituents Electronic packaging</div>		<div>Adhesive Barrier/Coating/sheathing Electrolyte/membrane Fibre composite Fibre/cloth Finished component Foam General Liquid/melt/lubricant Non-fibre composite Surface modification Thin film</div>	
<div>Update Application</div> <div>[Single value field]</div>	<div>Update Process</div> <div>[Single value field]</div>	<div>Update Material</div> <div>[Single value field]</div>	<div>Add Chemical</div> <div>[Multiple value field]</div>

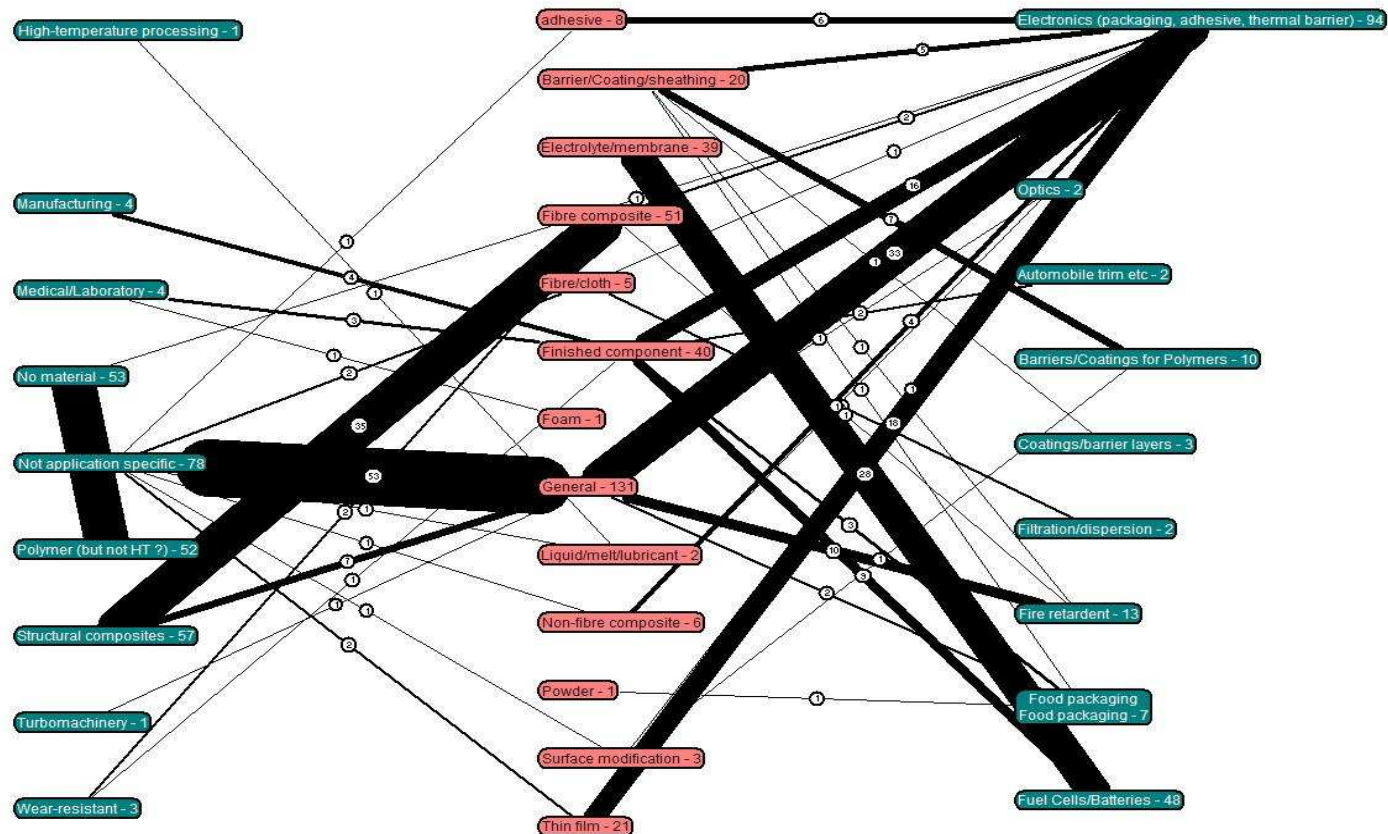
Delete Marked Items

Done



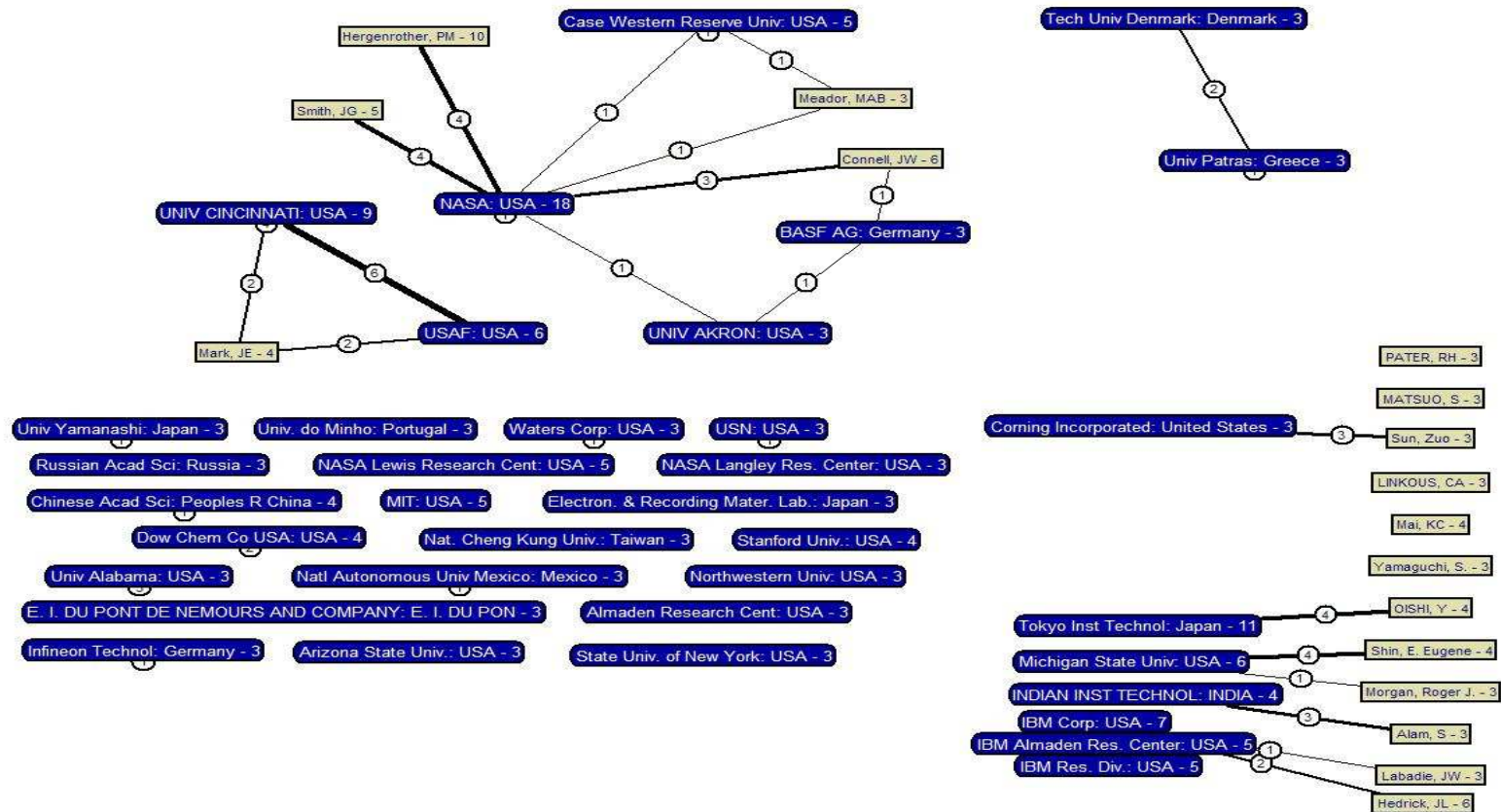
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Materials Applications mapping



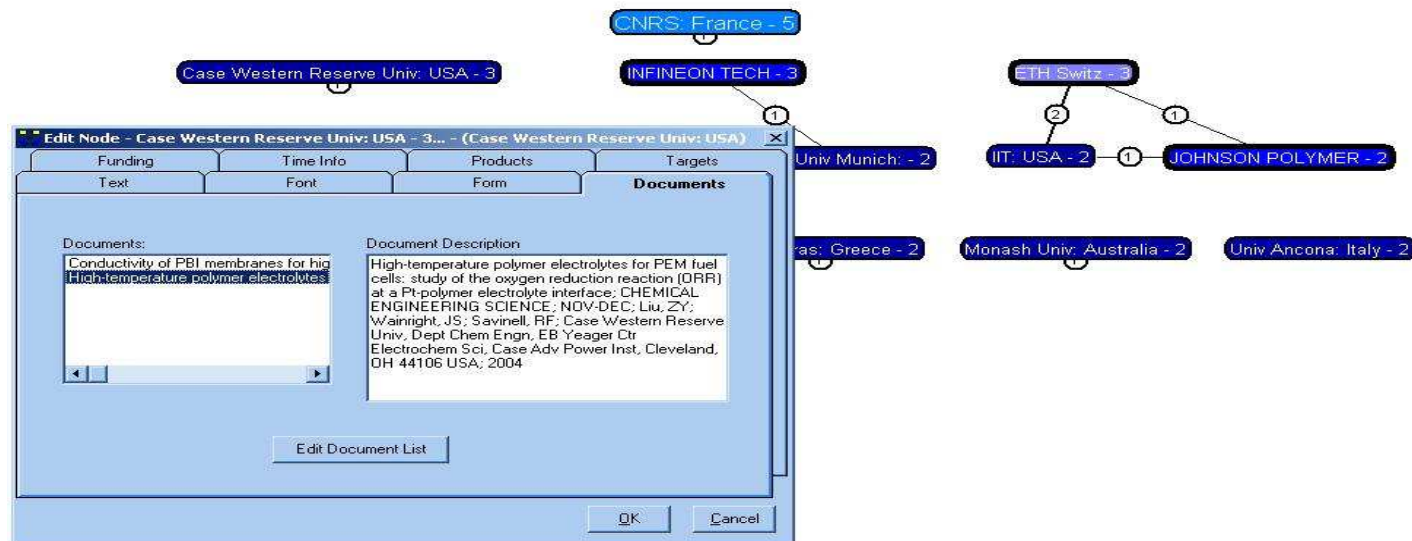
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Collaboration map



create

Hub analysis



create

Examples – single year technology matrix

		Materials	1	2	4	5	6	7	8	9	10	11	12	13	15	16	17
		# Records	2	8	87	2	12	7	37	1	4	4	59	2	42	1	3
Application	# Records	All years	Automobile trim etc	Barriers/Coatings for Polymers	Electronics (packaging, adhesive, thermal barrier)	Filtration/dispersion	Fire retardant	Food packaging	Fuel Cells/Batteries	High-temperature processing	Manufacturing	Medical/Laboratory	Not application specific	Optics	Structural composites	Turbomachinery	Wear-resistant
1	7	Adhesive			26								1		1		
2	14	Barrier/Coating/sheathing		17	16		3						1		1		
3	28	Electrolyte/membrane				2			40								
4	40	Fibre composite			6		1								88		4
5	5	Fibre/cloth	1		3	2					1		4	1			
6	35	Finished component	6		27				11		4	7	1	3			1
7	1	Foam			2							1	9		1		
8	103	General	1		61		18			5		4	152	7	14	1	
9	2	Liquid/melt/lubricant			1	2				5	5		1				
10	6	Non-fibre composite			16								2	2	1		
11	0	Powder											1				
12	3	Surface modification		1	7								4				
13	20	Thin film			83								4	4			

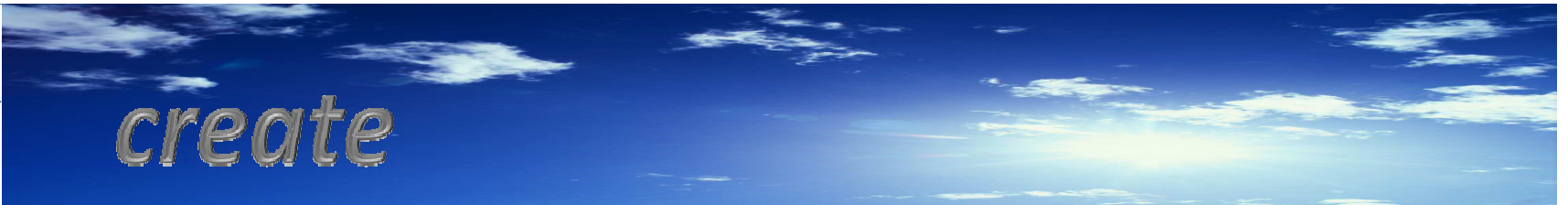


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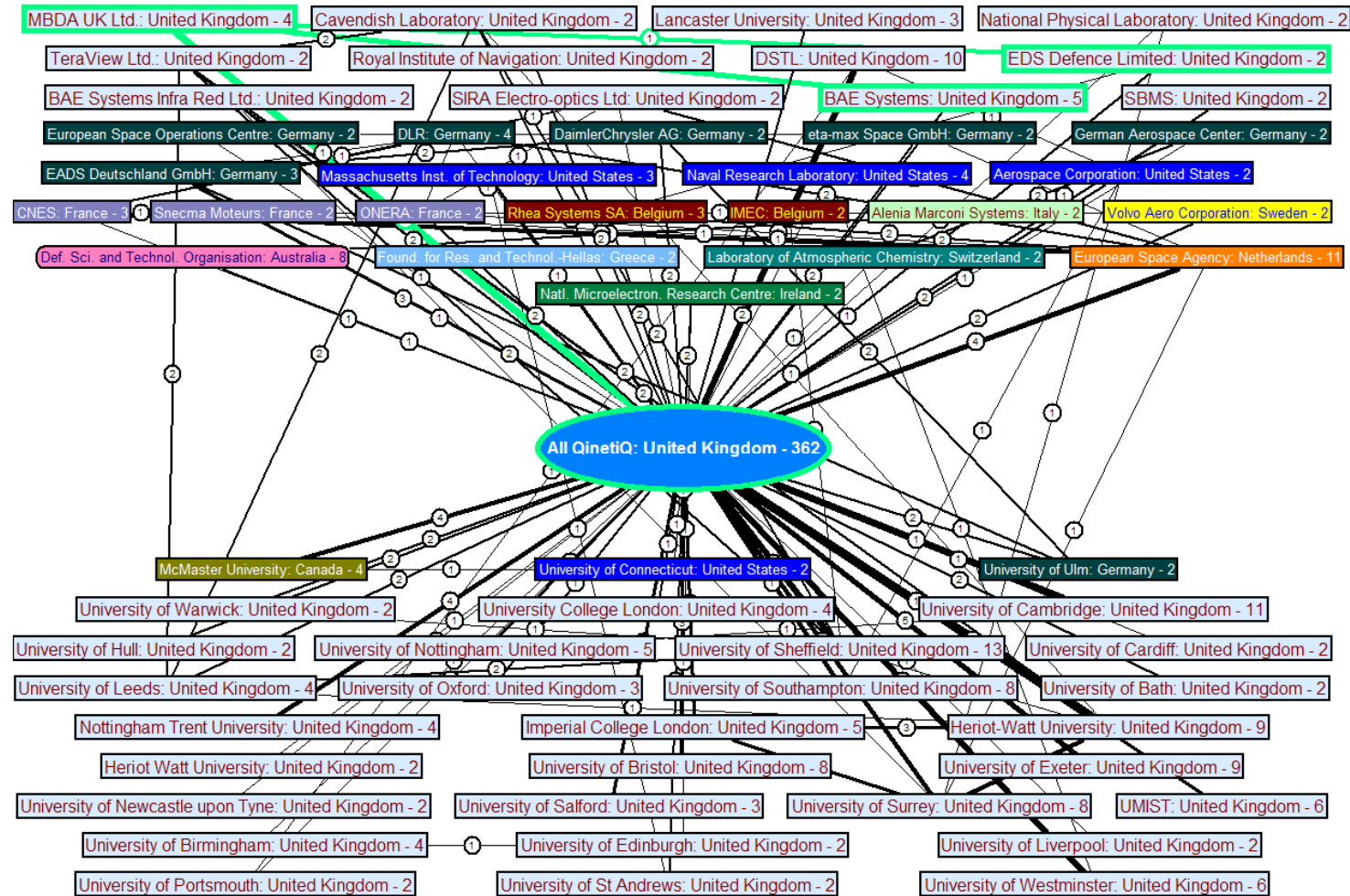
Further examples of visualisation and analysis



create

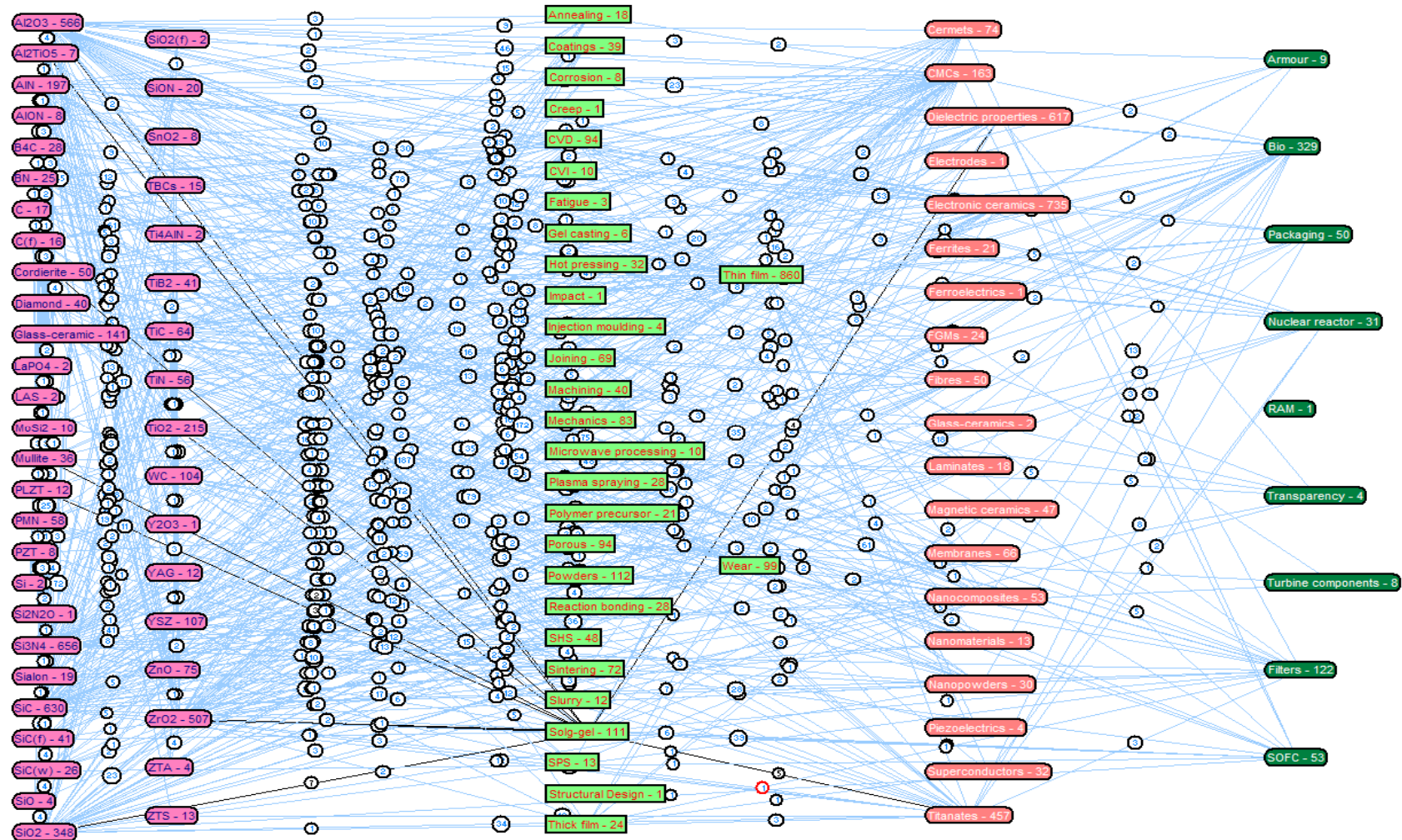


Examples – QinetiQ collaboration network



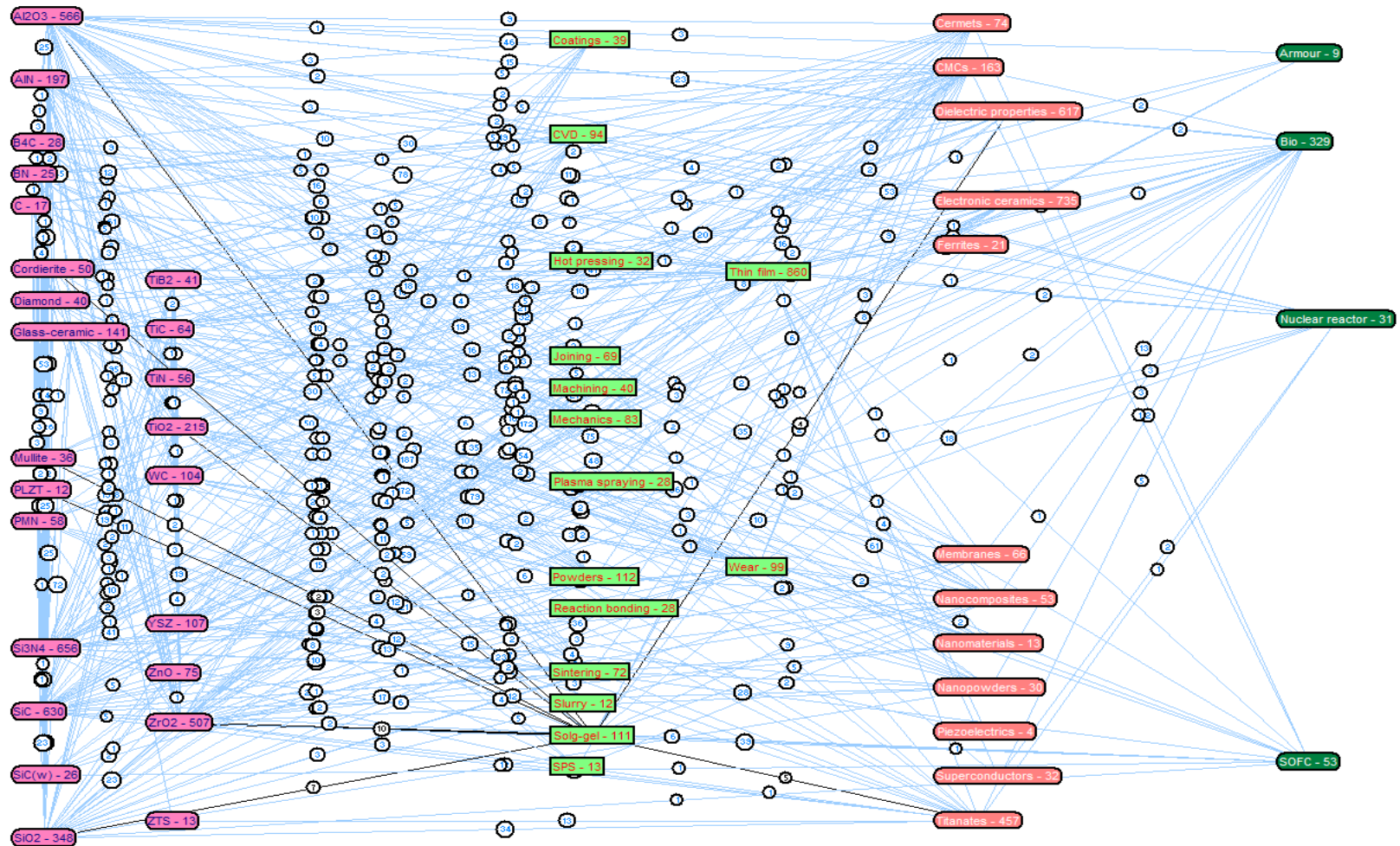
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Example: Technology Signature Country A



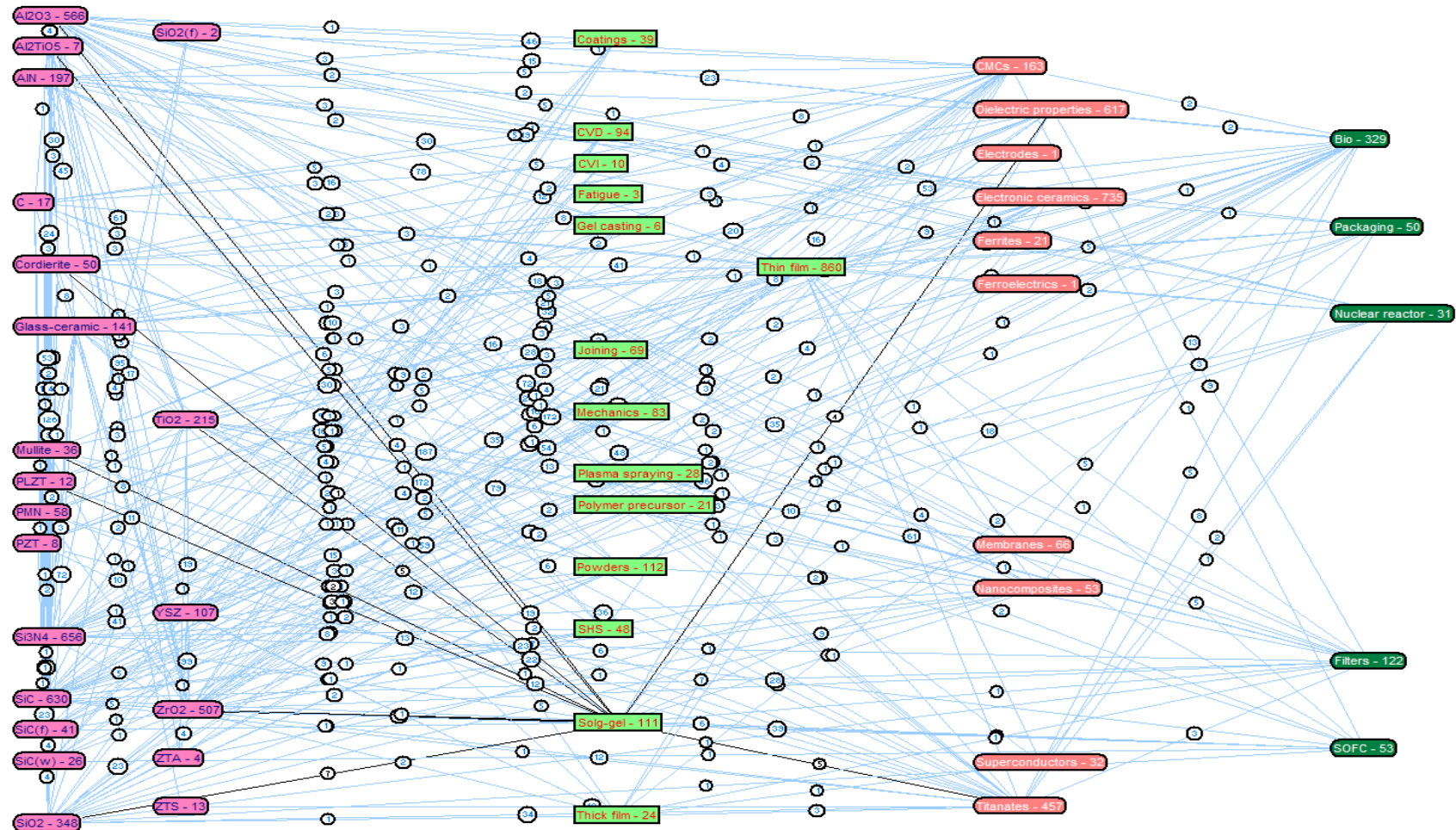
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Example: Technology Signature Organisation A



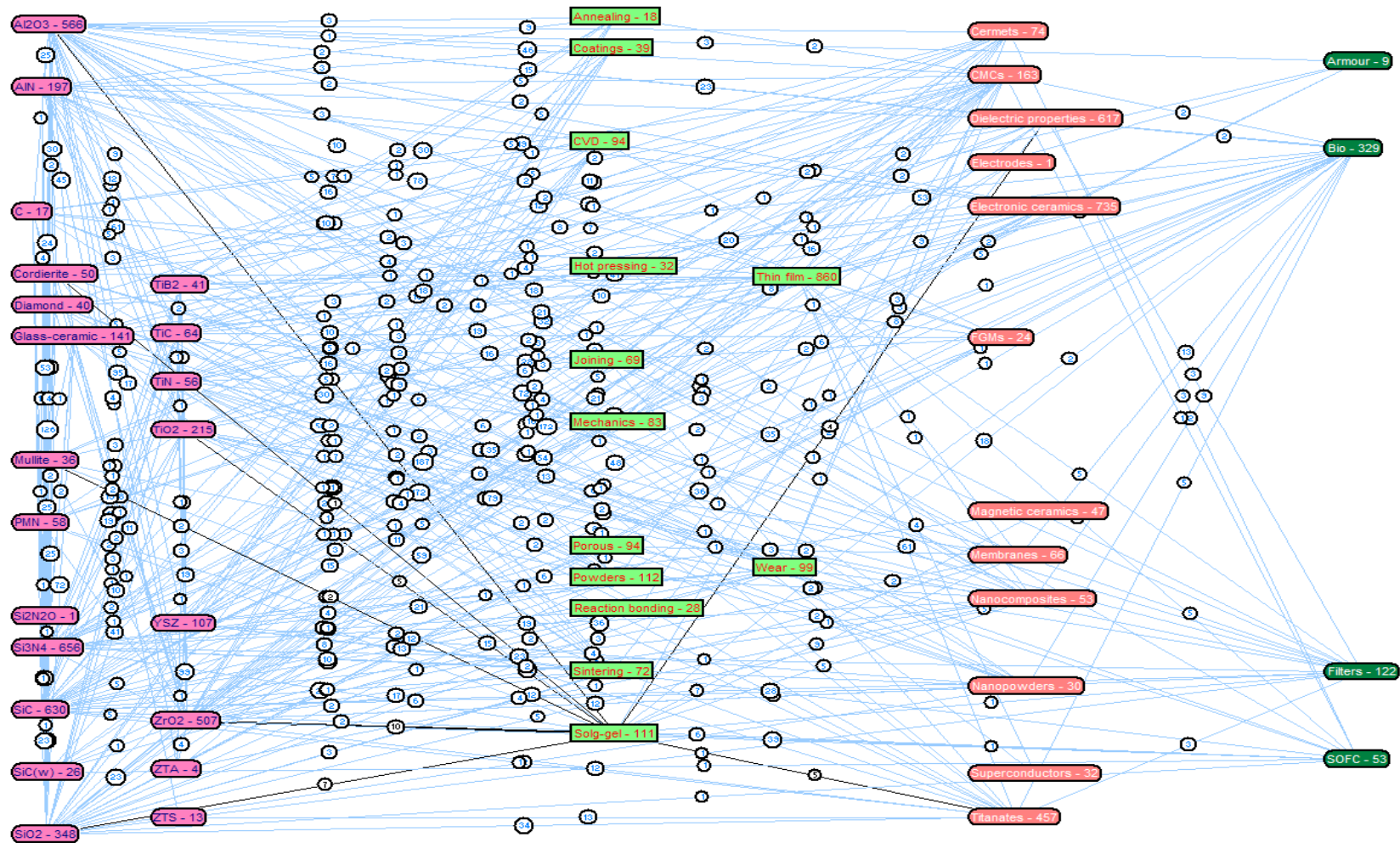
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Example: Technology Signature Organisation B



create

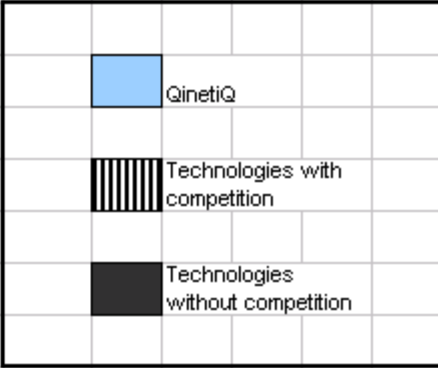
Example: Technology signature Organisation C



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Examples – competitive patent analysis

1		C07C Acyclic or carbocyclic compounds .				
2	Totals		110	14	13	13
3	153	C07C Acyclic or carbocyclic compounds .	110	14	13	13
4	46	e.g. catalysis, colloid chemistry; Their relevant apparatus.	40	5	1	
5	14	obtained otherwisethan by reactions only involving carbon-to-carbonunsaturated	12	1	1	
6	13	C07D Heterocyclic compounds	2		7	2
7	8	heterocyclic compoundscontaining elements other than carbon,	1		4	2
8	8	C09K Materials for miscellaneous applications, notprovided for elsewhere .			8	
9	7	C07B General methods of organic chemistry; Apparatustherefor .	2	1	4	
10	5	obtained by reactionsonly involving carbon-to-carbon unsaturatedbonds .			3	1
11	3	A61K Preparations for medical, dental, or toilet purposes			2	1
12	3	optical operation ofwhich is modified by changing the opticalproperties of the			3	
13	3	B01D Separation	3			
14	2	general;Adhesive processes not provided for elsewhere;Use of materials	1		1	
15	2	C01B Non-metallic elements; Compounds thereof .		1		1
16	2	Production of liquidhydrocarbon mixtures, e.g. by		2		



QinetiQ

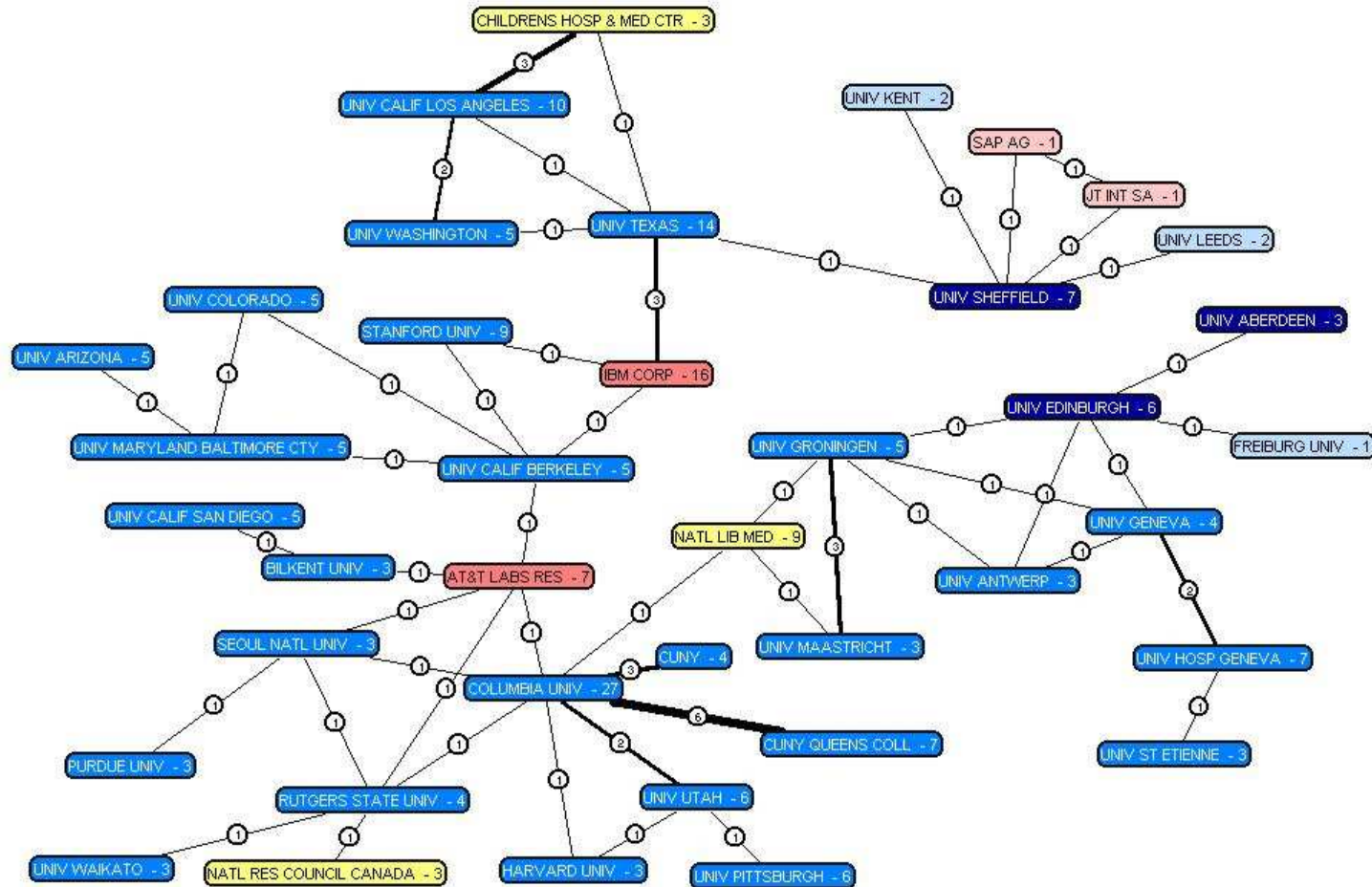
Technologies with competition

Technologies without competition



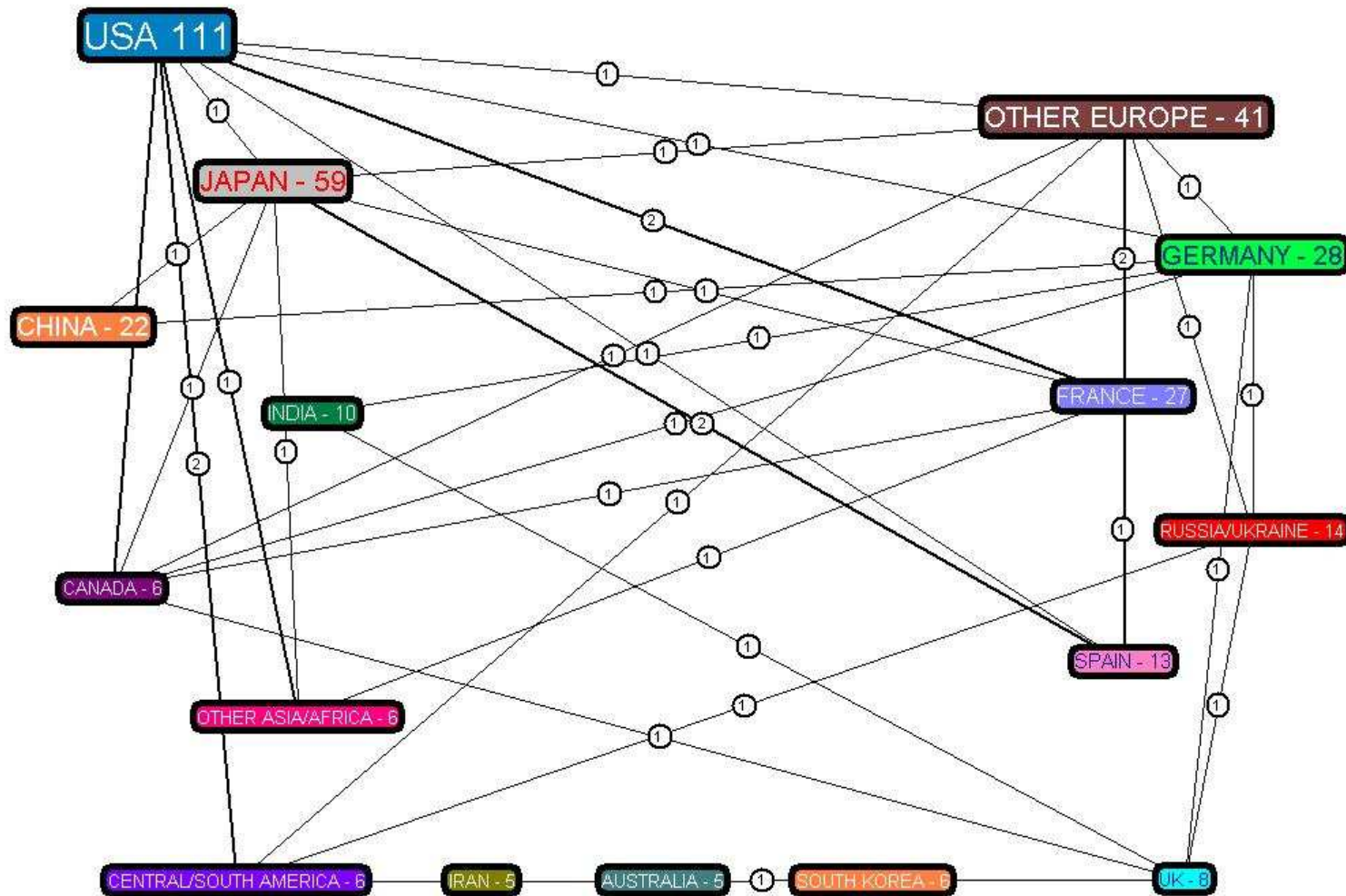
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Examples – international research hubs



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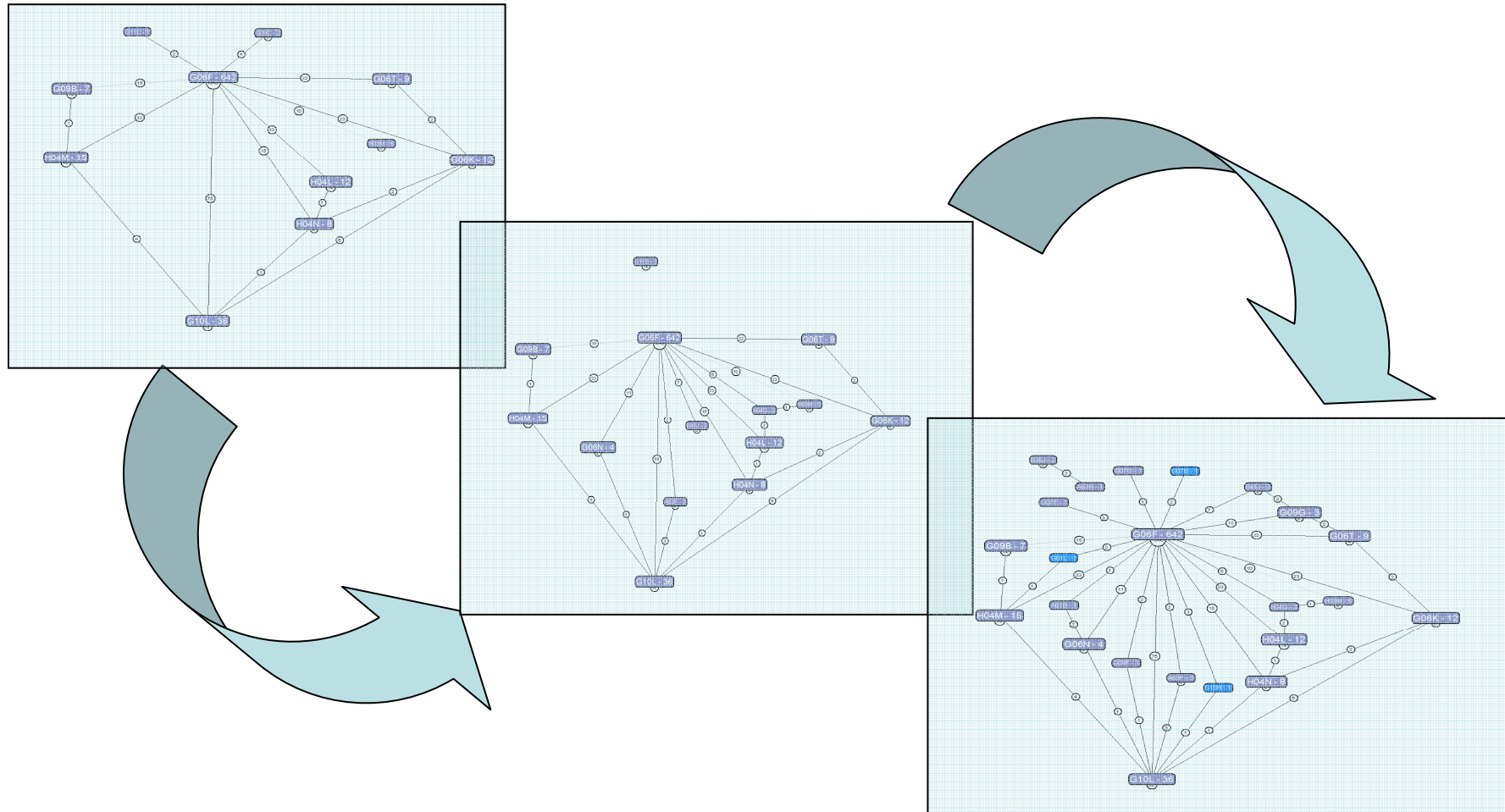
Examples – international collaboration



create



Examples – technology trends



create