# - Innovation Mapping - White space Analysis for Biomaterials in Complex Patent Landscapes

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ICIC – 2007

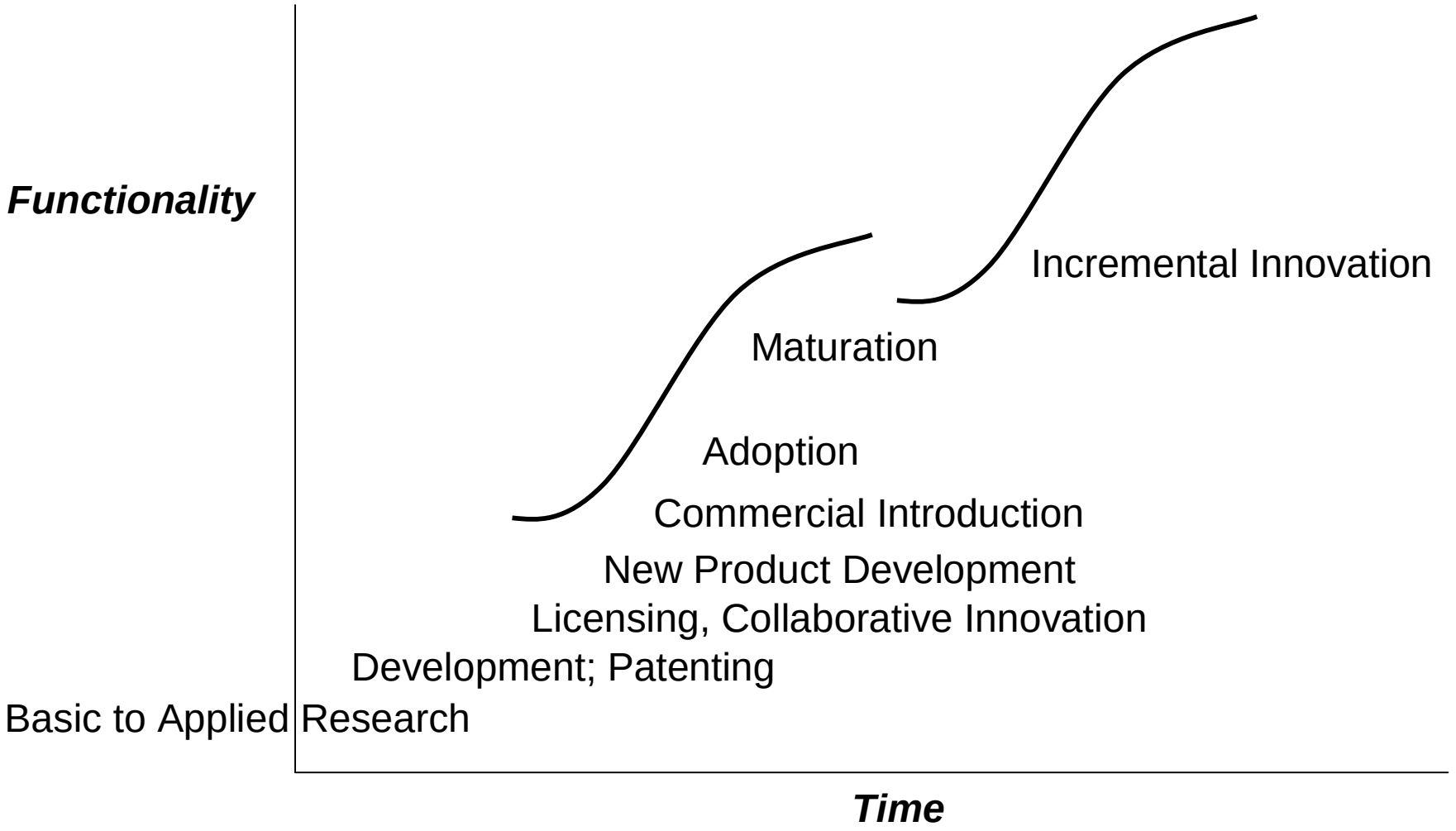
# Premise

- The Challenge: Expedite Innovation
- The Foundation:  Innovation Process Modeling
- The Tools: Tech Mining
- The Result: Innovation Mapping for intelligence & foresight
  - illustrated for Biomaterials Opportunities

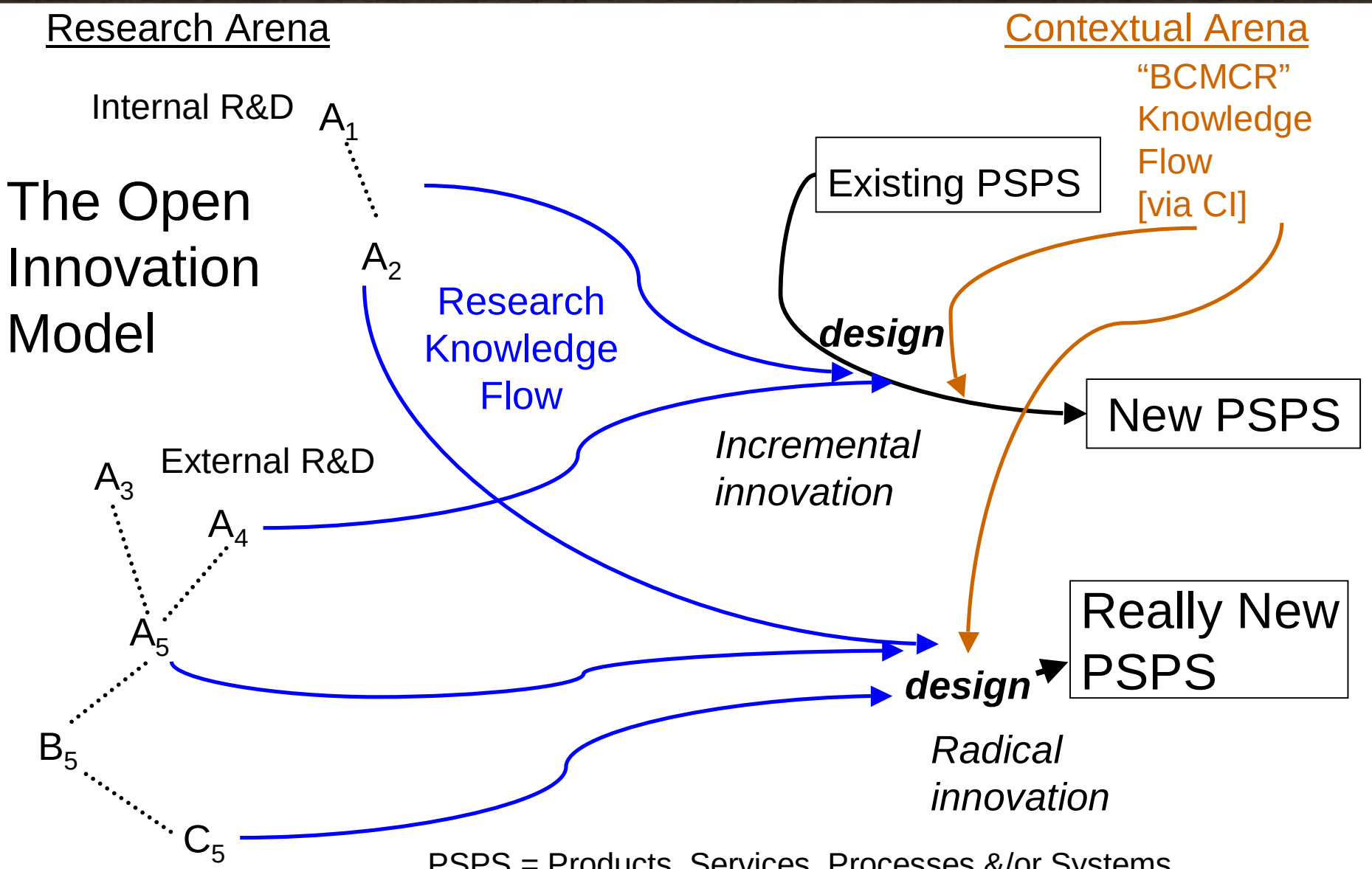
# Technological Innovation: The Conceptual Bases

- Recognize Technological Capabilities
- Focus on changes in function – of products, processes, or services
- Draw upon models of technological change
  - Innovation (life cycle) processes
  - Technology substitution, transfer & diffusion
- Promote “OI” – Open Innovation

# A “Linear” view of Innovation Processes



# The Open Innovation Model



# Innovation Mapping Elements I

## Technological Landscape

- Technological Advance
  - Capabilities
  - Applications
- Competitive/Collaborative Milieu
  - Key players
  - Profile their strengths & orientation
- Contextual Influences?
  - Stakeholders & Concerns
  - Regulations, standards, funding
- Future prospects

# Innovation Mapping II: Market Prospects

(not the emphasis in today's presentation)

- Market Opportunities
  - Sectors & Locations
  - Forecast
- Customer Needs
  - Currently identified & extrapolated
  - Lead users
- Innovation Implementation
  - External obstacles
  - Internal obstacles

# “White Space” Analysis – Misnomer?

- Complex, multidimensional milieu [ → ]
- Reduction to 2-D or 3-D is precarious
- Finding what’s missing (“not there”) is dicey
- Better to focus on “what is” along selected dimensions
- “What is” is much like Competitive Technical Intelligence
- Provide derived empirical knowledge to a diverse expert body with requisite domain knowledge to stimulate discourse

# Multi-Dimensional Space to Explore for Opportunities

- Technology
  - Capabilities
  - Functionality
  - Platform or Specialized
  - Modes (treatment types)
  - Complementary / competitive technologies
- Context
  - Targets (organ systems, tissue types)
  - Target ailments (or enhancements)
  - Attributes of concern
  - Market (opportunities)
  - Our strengths & weaknesses
  - Competitor / collaborator strengths & weaknesses

# “White Space” Analysis – Misnomer?

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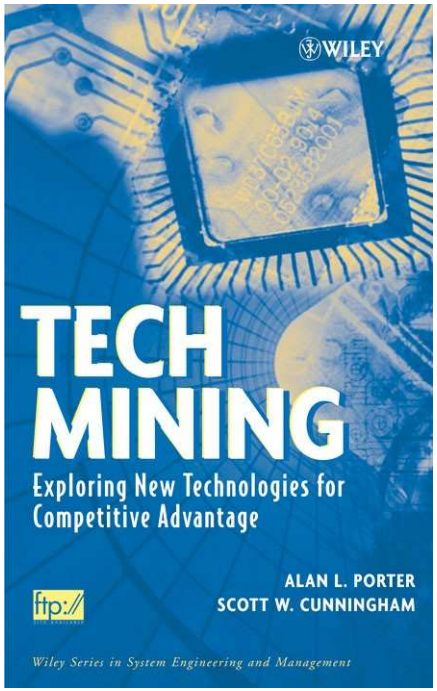
# Technology Opportunities Analysis

- No one way
  - Technology Policy & Assessment Center (TPAC) at Georgia Tech has been at it since 1990
- In an “Information Economy,” exploiting information resources is key to gain competitive advantage
- Data and tools enable and facilitate Technology Opportunities Analysis
- People find the opportunities

Tools: How do you build useful Knowledge Products that provide effective decision support?

# Tech Mining




Alan L. Porter and Scott W. Cunningham
John Wiley & Sons Inc., 2005

# The Tech Mining Process

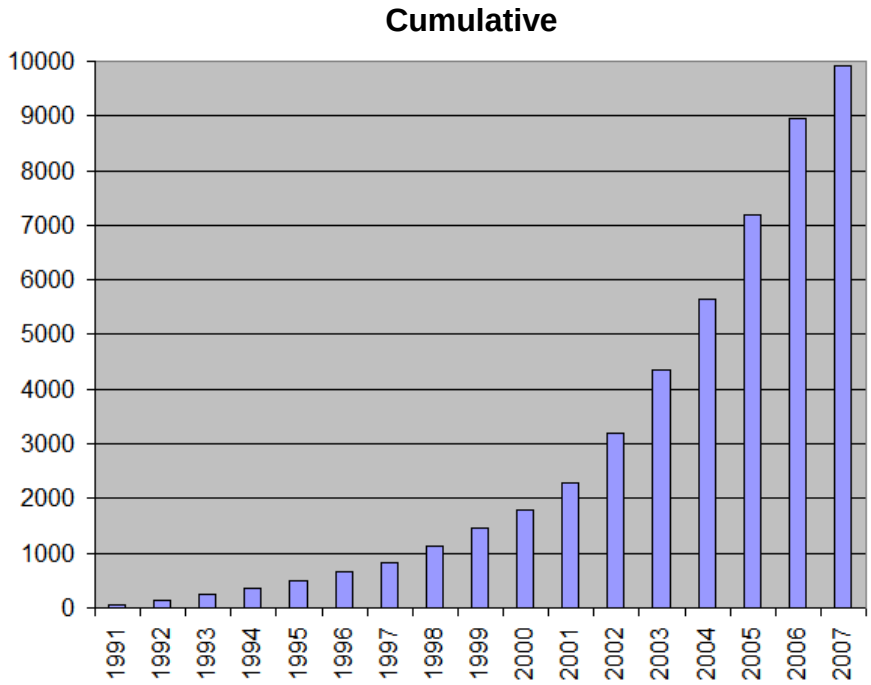
1. Understand & scope the question, set in an Innovation Process context
2. Identify suitable databases (especially R&D publication or patent abstracts)
3. Search & download topical records [iteration likely]
4. Clean the data
5. Analyze & interpret – Who? What? When? Where?
6. Represent the information effectively – interactive “one-pagers”
7. Communicate [interactively]

# Example: Polymer Biomaterials

- "Are there any new market spaces for [*your idea here*] which look relatively free of existing IP?"
- Market Prospects: A Quick Glance
  - Implants: global spending nearly $120 billion/year
  - Biocompatible materials market projected to $12 billion in 2008
  - Biomaterial polymers reached $7 billion in 2003

# Example: Polymer Biomaterials

- Micropatents search yielded ~10,000 patents (not comprehensive)
- This constitutes the broad picture
- Could extend via research funding, research publications, business activity, etc. searches & analyses (not today!)



# Application Domains

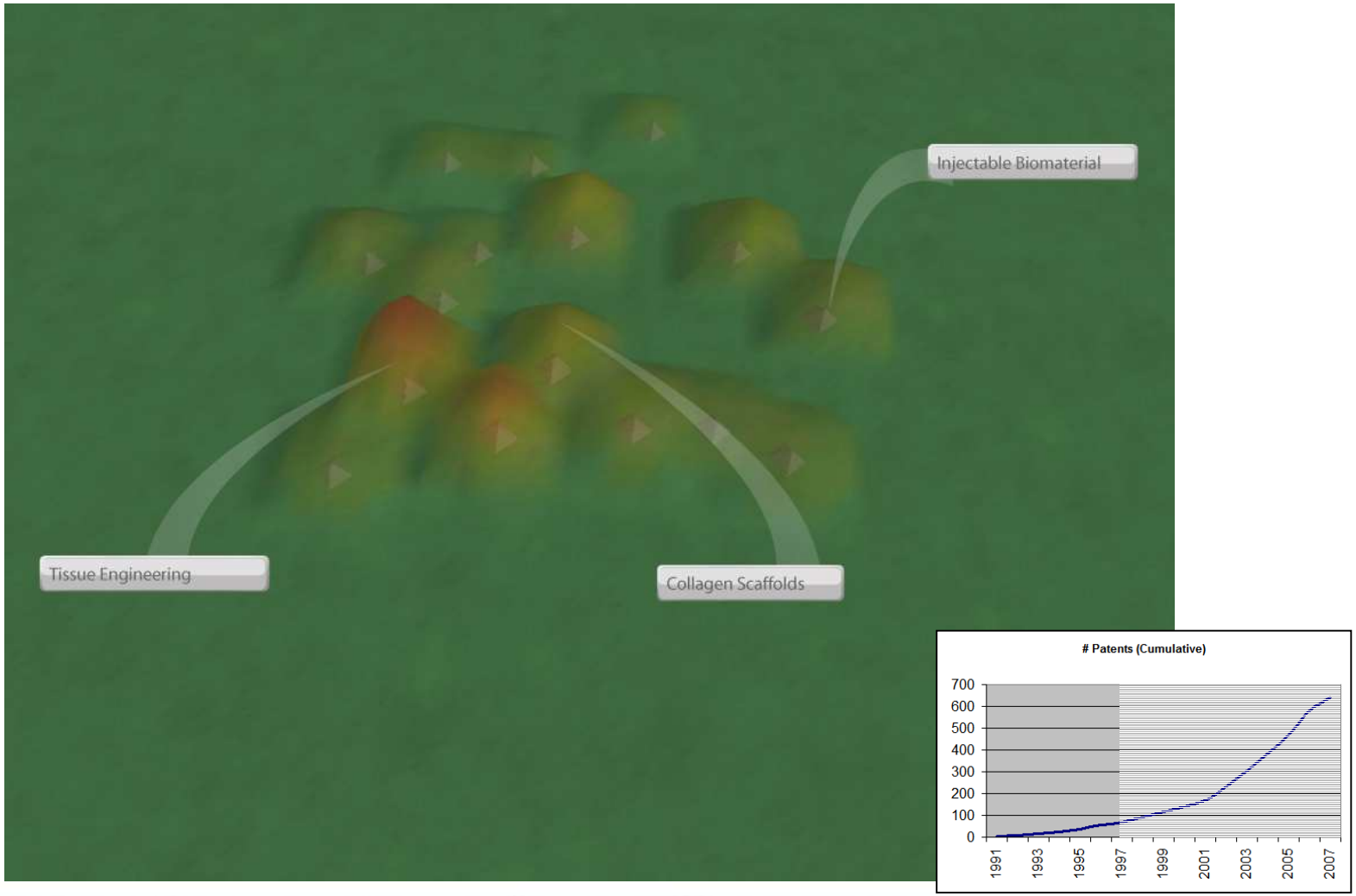
## Leading International Patent Classes (IPC codes)

| **IPC Classes** | # |
|---|---|
| A61K-Preparations For Medical, Dental, Or Toilet Purposes | 4148 |
| A61L-Methods Or Apparatus For Sterilising Materials Or Objects In General; Disinfection, Sterilisation, etc. | 4043 |
| A61F-Filters Implantable Into Blood Vessels; Prostheses; Orthopaedic, Nursing Or Contraceptive Devices; etc. | 2782 |
| C12N-Micro-Organisms Or Enzymes; Compositions Thereof; etc. | 1477 |
| A61B-Diagnosis; Surgery; Identification | 1214 |

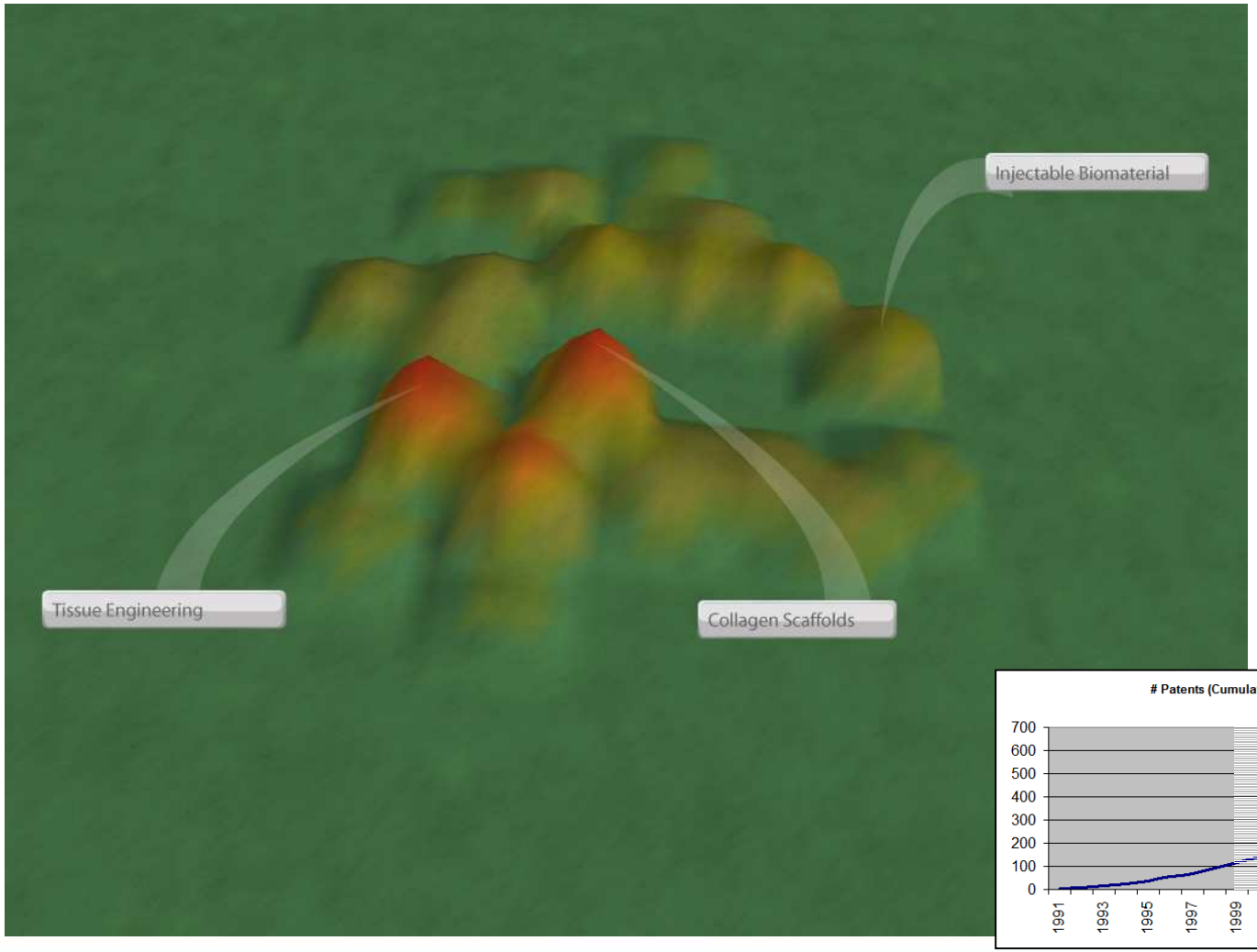
# Focusing: For this illustration

- Multidimensional – various ways to cut 10,000 Biomaterials Patent set
- We selected on 2 dimensions:
  - Technology Type: Fibrous structural proteins [searched these patent records for collagen, fibrillin, laminin, proteoglycan, elastin, ECM, …]
    - ~2200 patents
  - Target Application Biosystem: skin [or derm] in claims
    - ~640 patents

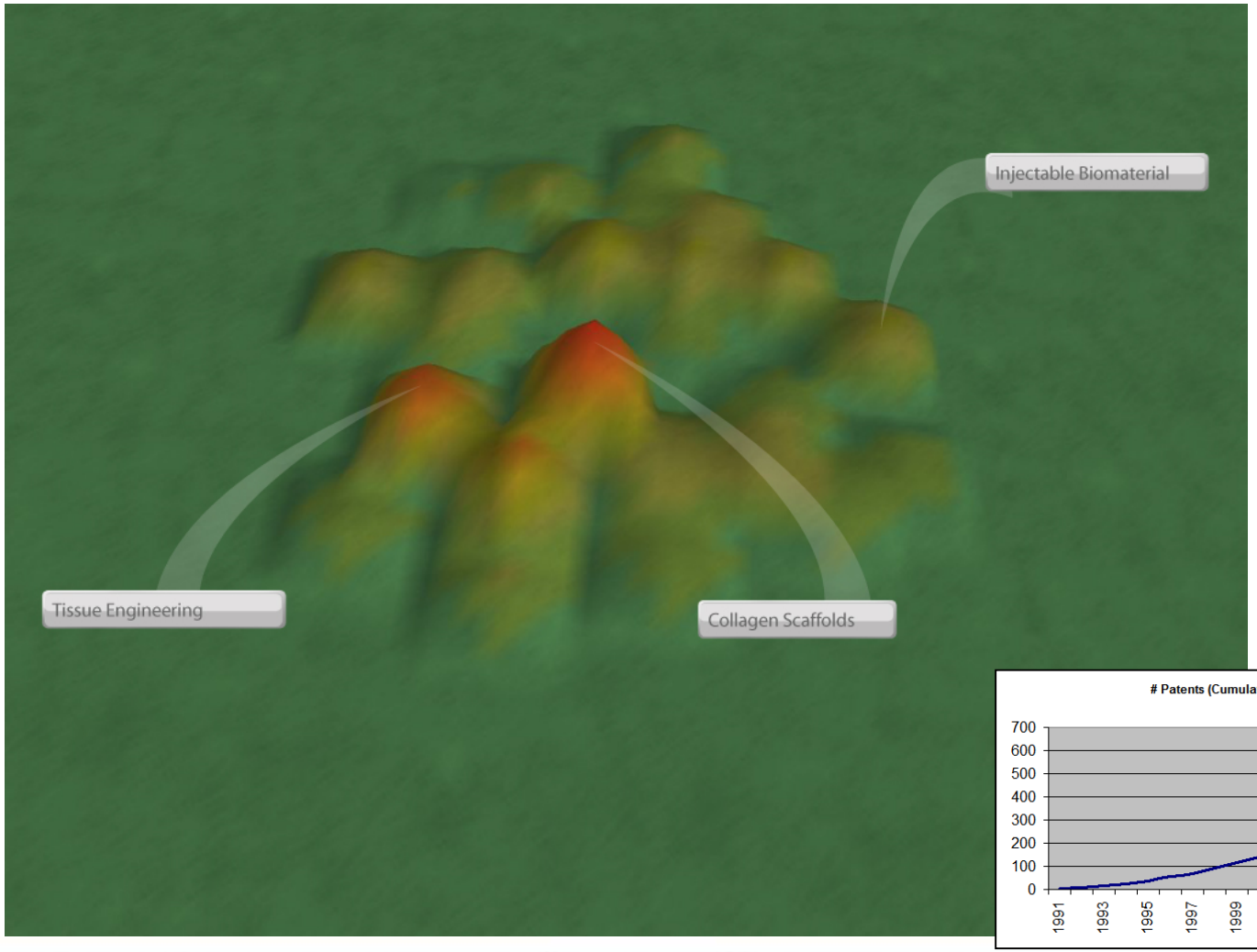
# Polymer Biomaterials : fibrous structural proteins : skin 1991-1997 (68 records)



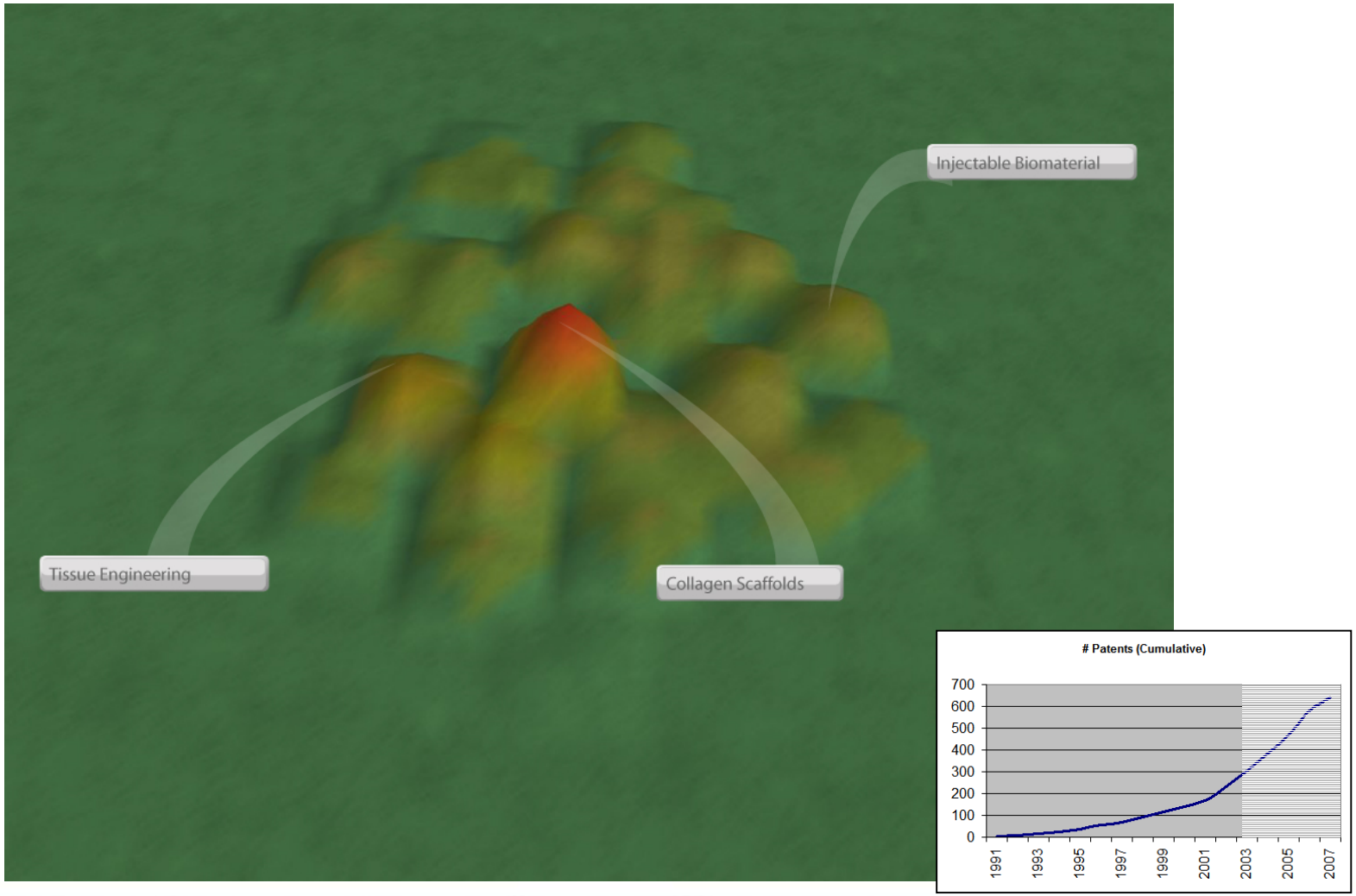
# Polymer Biomaterials : fibrous structural proteins : skin 1991-1999 (117 records)



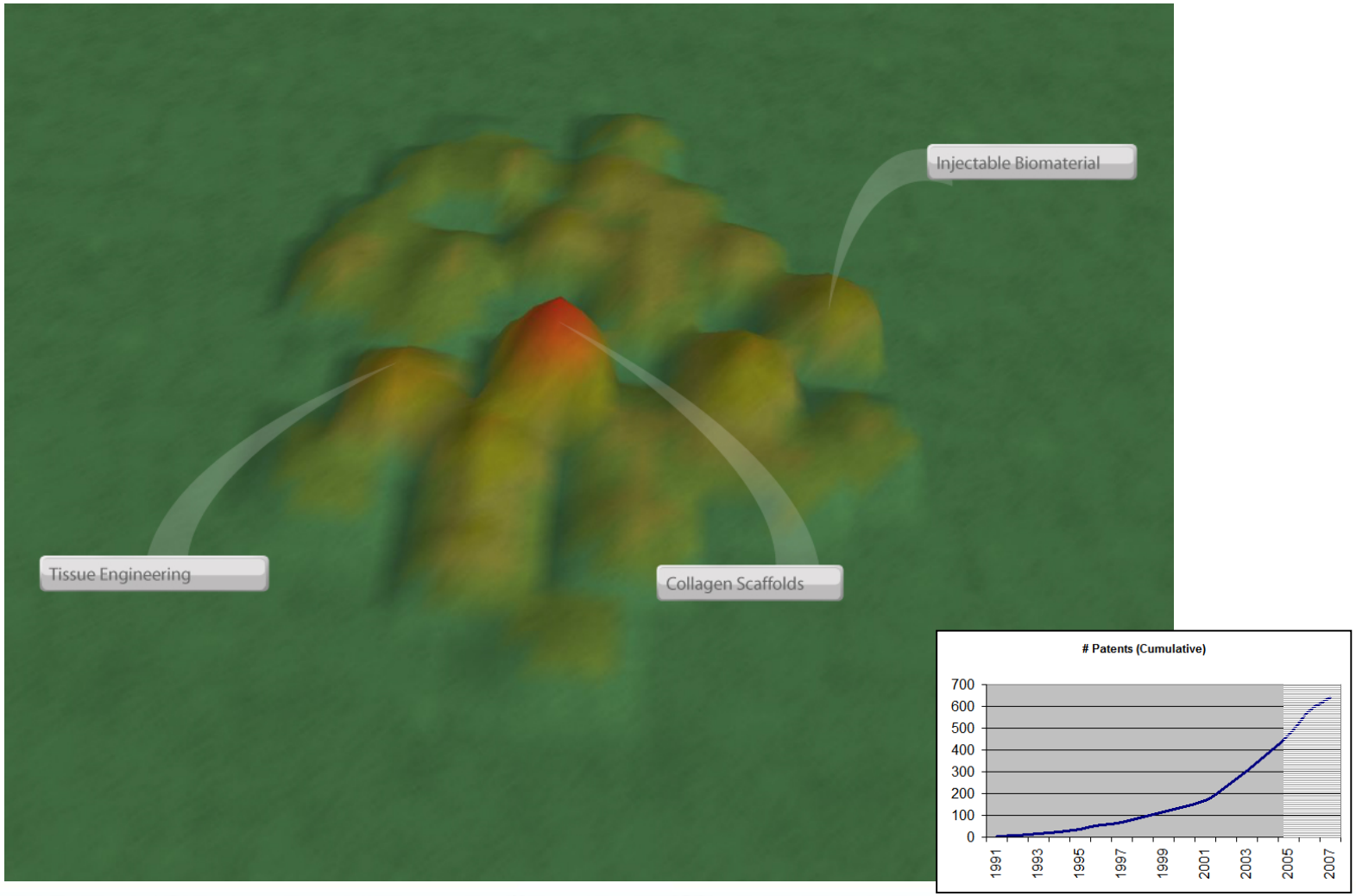
# Polymer Biomaterials : fibrous structural proteins : skin 1991-2001 (168 records)



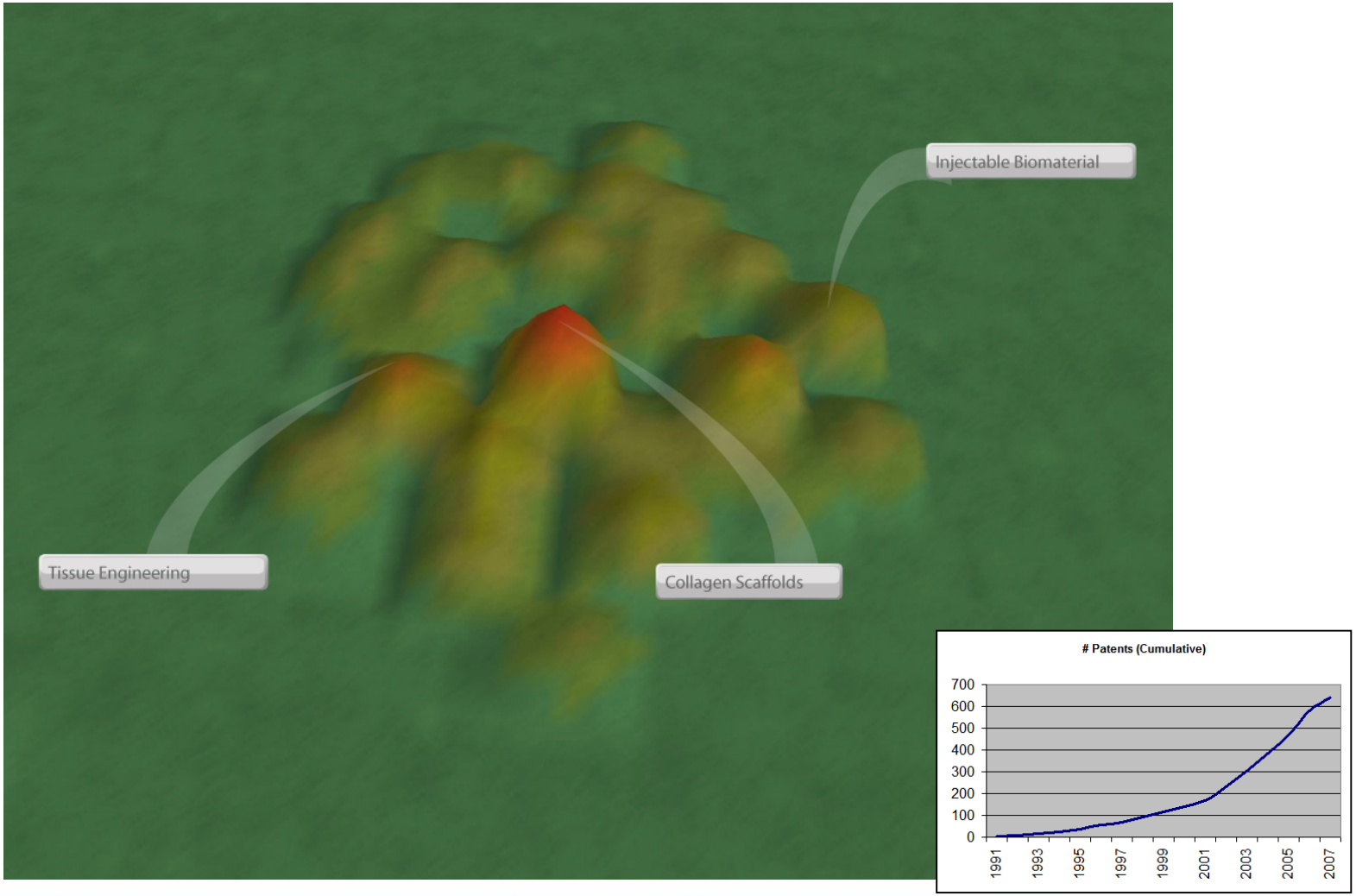
# Polymer Biomaterials : fibrous structural proteins : skin 1991-2003 (306 records)



# Polymer Biomaterials : fibrous structural proteins : skin 1991-2005 (470 records)



# Polymer Biomaterials : fibrous structural proteins : skin 1991-2007 (640 records)

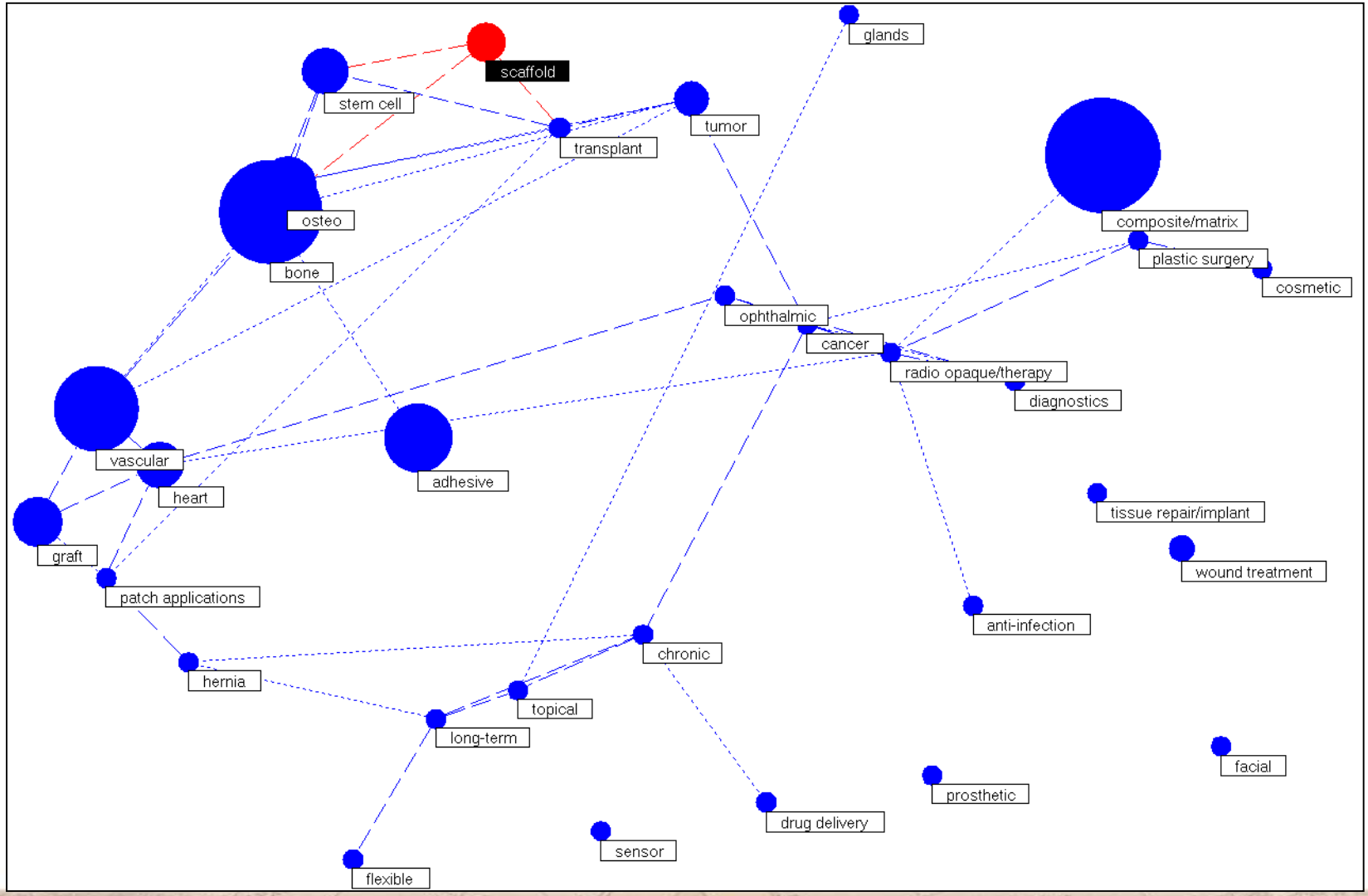


# Topic Detection

- Patent records lack keywords
- Class codes are very helpful, but not highly specific
- One approach: "entity extraction" – apply a dictionary or rule-set to get at key phrases
  - Used in this example to extract Extracellular matrix (ECM) classes of biomolecules [chondroitin, hyaluronic, collagen, elastin, fibrillin, fibronectin, glycosaminoglycans, …]
- Another: apply a general-purpose natural language processor to extract terms (noisy); browse and classify large collections interactively.
  - Used in this example to select application/property terms in Claims [graft, scaffold, tumor, wound treatment, ophthalmic, cancer, cosmetic, tissue repair/implant, …]

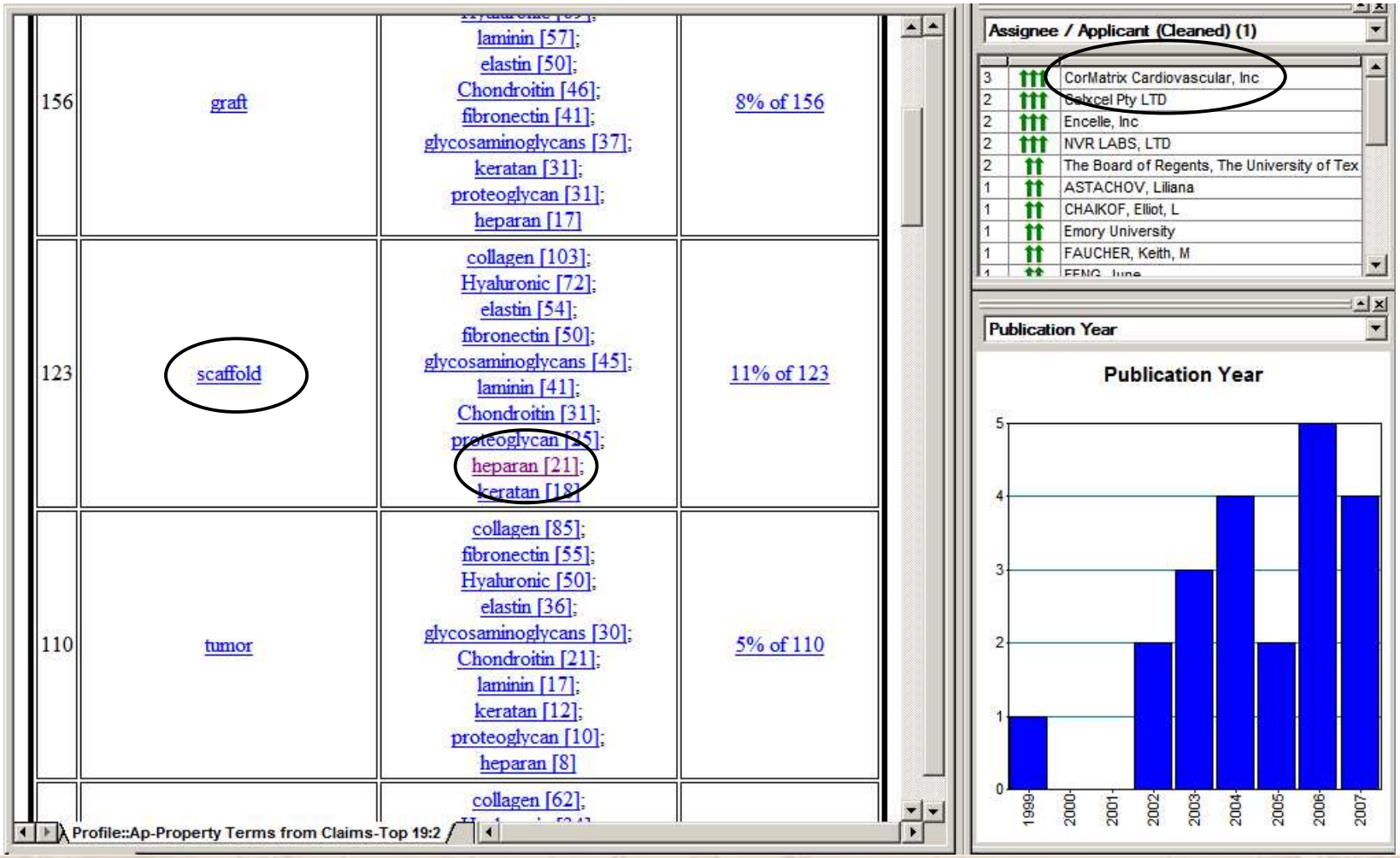
# Application/Property Term Associations

## – What is and what is not related –



# Multi-dimensional Views

## What is (application/property vs. material)



| | | | |
|---|---|---|---|
| | | laminin [57]; elastin [50]; Chondroitin [46]; fibronectin [41]; glycosaminoglycans [37]; keratan [31]; proteoglycan [31]; heparan [17] | |
| 156 | graft | | 8% of 156 |
| 123 | scaffold | collagen [103]; Hyaluronic [72]; elastin [54]; fibronectin [50]; glycosaminoglycans [45]; laminin [41]; Chondroitin [31]; proteoglycan [25]; heparan [21]; keratan [18] | 11% of 123 |
| 110 | tumor | collagen [85]; fibronectin [55]; Hyaluronic [50]; elastin [36]; glycosaminoglycans [30]; Chondroitin [21]; laminin [17]; keratan [12]; proteoglycan [10]; heparan [8] | 5% of 110 |
| | | collagen [62]; | |

Profile::Ap-Property Terms from Claims-Top 19:2

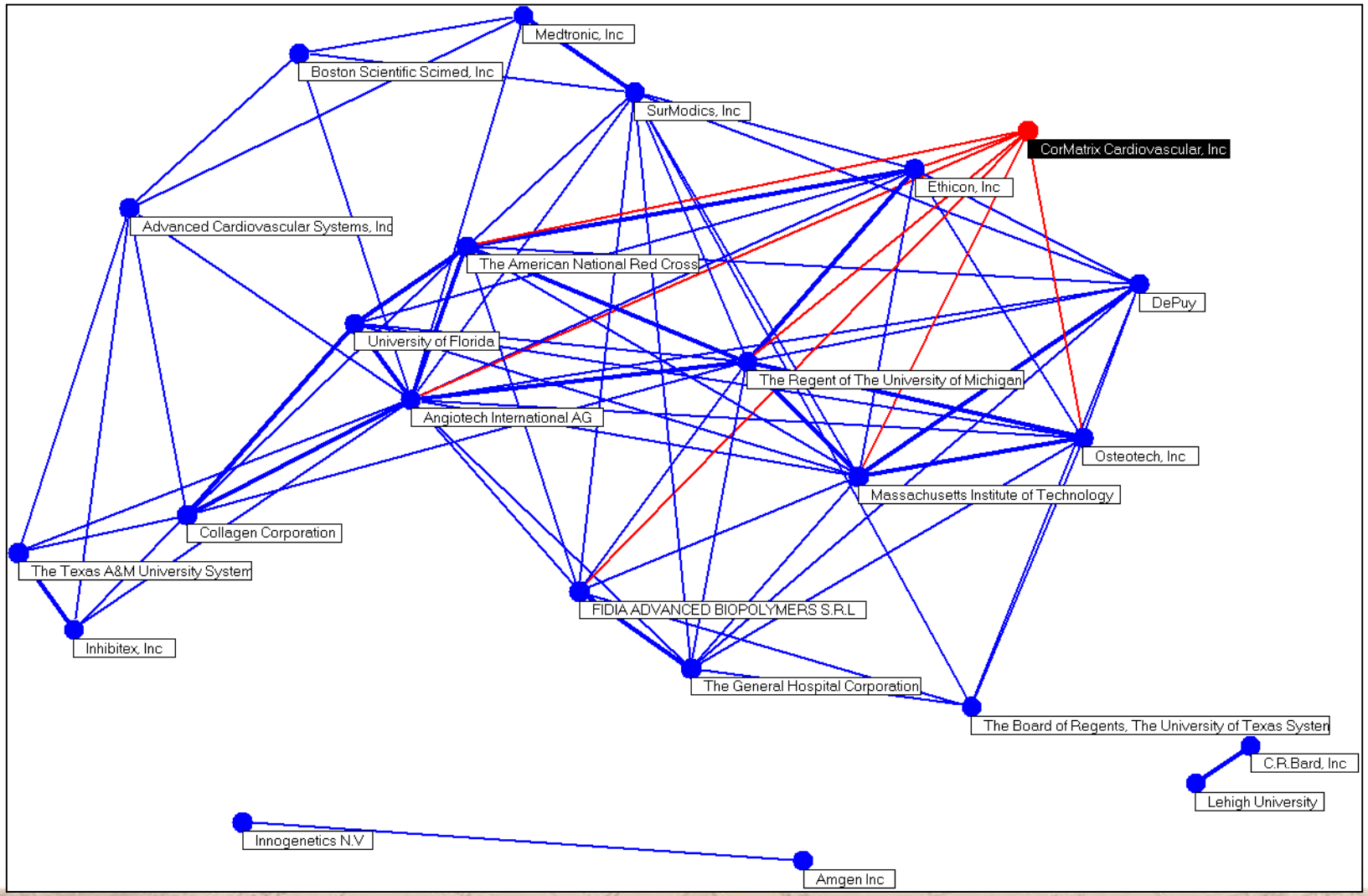
Assignee / Applicant (Cleaned) (1)

| | | |
|---|---|---|
| 3 | ↑↑↑ | CorMatrix Cardiovascular, Inc |
| 2 | ↑↑↑ | Calxcel Pty LTD |
| 2 | ↑↑↑ | Encelle, Inc |
| 2 | ↑↑↑ | NVR LABS, LTD |
| 2 | ↑↑ | The Board of Regents, The University of Tex |
| 1 | ↑↑ | ASTACHOV, Liliana |
| 1 | ↑↑ | CHAIKOF, Elliot, L |
| 1 | ↑↑ | Emory University |
| 1 | ↑↑ | FAUCHER, Keith, M |
| 1 | ↑↑ | FENG, June |

Publication Year

# Assignees based on Shared Topical Claims

## – Who is doing similar work? –



# Who – What – When

## What else are they doing?

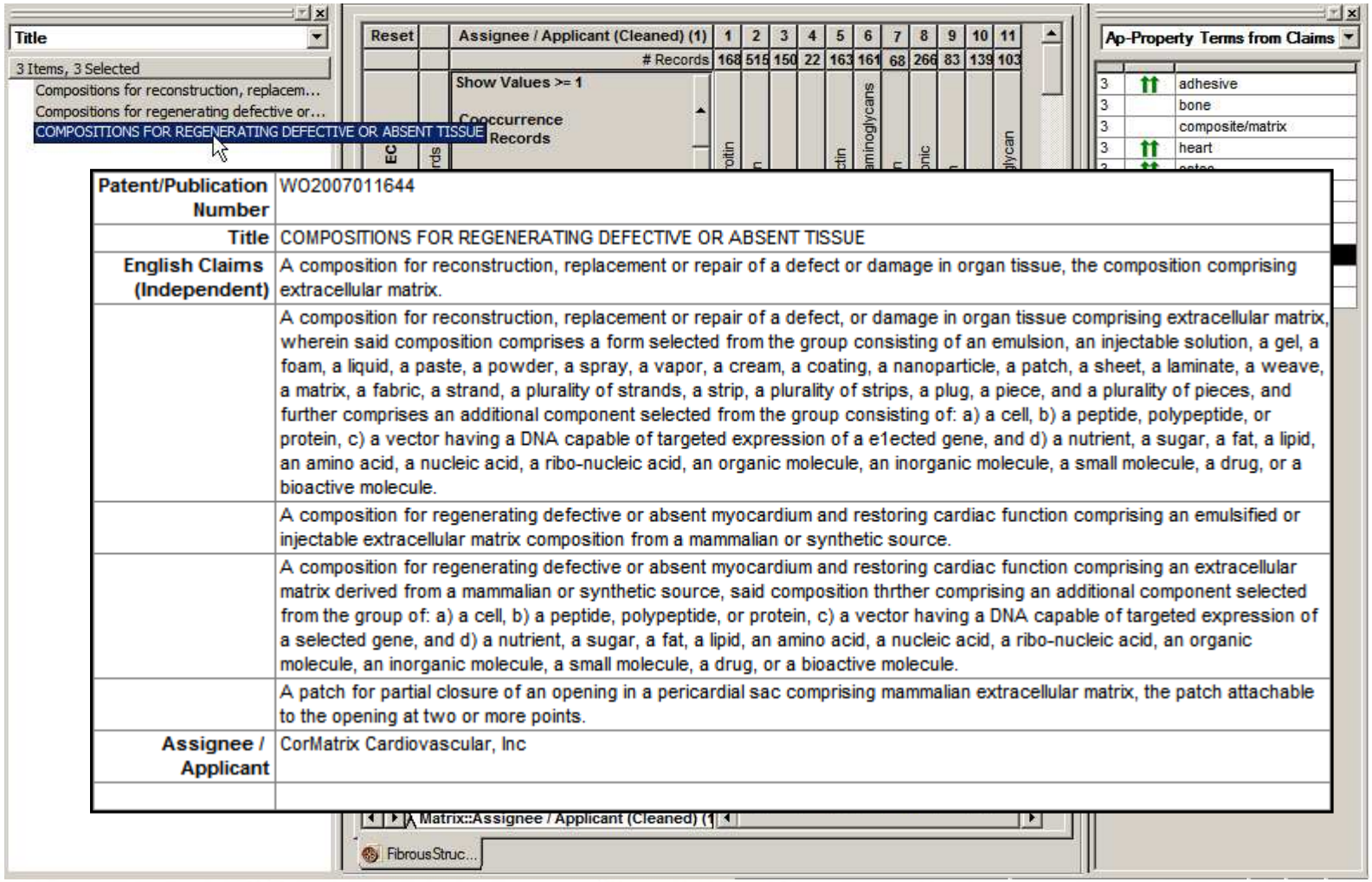
| | Assignee / Applicant | Property Terms in Claims | Publication Year |
|---|---|---|---|
| | scaffold | Top 5 Items | % since 2006 |
| 7 | CorMatrix Cardiovascular, Inc | scaffold [7];<br>patch applications [6];<br>heart [6];<br>composite/matrix [5];<br>stem cell [5] | 100% of 7 |
| 6 | Osteotech, Inc | tumor [6];<br>adhesive [6];<br>scaffold [6];<br>transplant [6];<br>bone [6];<br>osteo [6];<br>stem cell [6] | 17% of 6 |
| 6 | FIDIA ADVANCED BIOPOLYMERS S.R.L | tumor [6];<br>adhesive [6];<br>wound treatment [6];<br>composite/matrix [6];<br>scaffold [6];<br>heart [6];<br>vascular [6];<br>radio opaque/therapy [6];<br>diagnostics [6];<br>cosmetic [6];<br>bone [6];<br>ophthalmic [6] | 0% of 6 |
| 6 | The Regent of The University of Michigan | tumor [6];<br>adhesive [6];<br>anti-infection [6];<br>scaffold [6]; | 0% of 6 |

# Who – Who – When

## Are they collaborating with anyone?

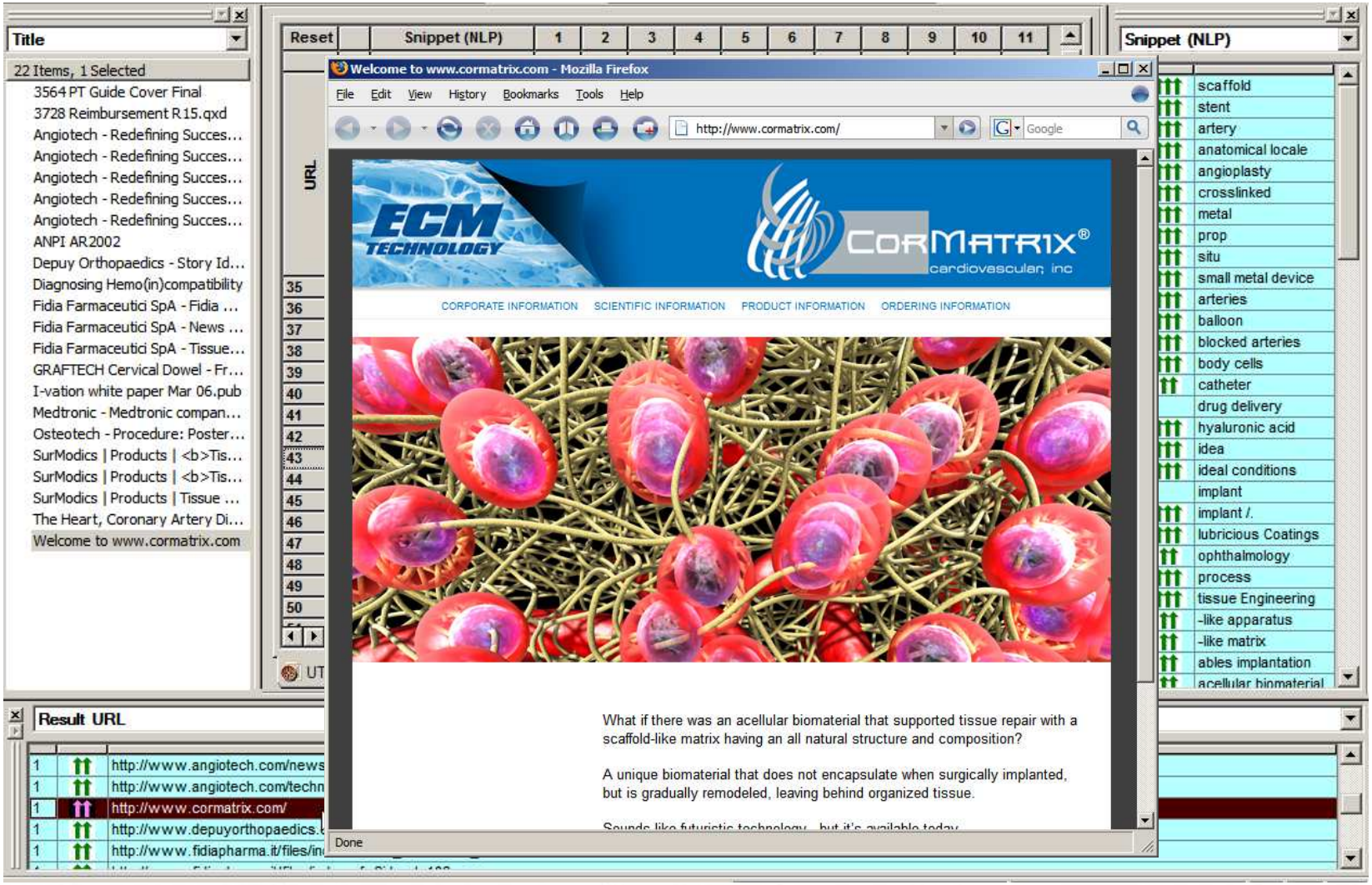
| | Assignee / Applicant | Assignee / Applicant | Publication Year |
|---|---|---|---|
| | | Top Terms (minimum 1 records) | % from 2006 to 2007 |
| 9 | The Board of Regents, The University of Texas System | The Board of Regents, The University of Texas System [9];<br>RIVERS, Tyrell, J [1];<br>SCHMIDT, Christine, E [1] | 0% of 9 |
| 8 | SurModics, Inc | SurModics, Inc [8] | 0% of 8 |
| 8 | The Texas A&M University System | The Texas A&M University System [8];<br>Inhibitex, Inc [7];<br>The Provost Fellows and Scholars of the College of the Holy and Undivided Trinity of Queen Elizabeth Near Dublin [3];<br>Universita Degli Studi di Pavia [2];<br>The UAB Research Foundation [1] | 12% of 8 |
| 7 | CorMatrix Cardiovascular, Inc | CorMatrix Cardiovascular, Inc [7] | 100% of 7 |
| 6 | Osteotech, Inc | Osteotech, Inc [6] | 0% of 6 |
| 6 | The General Hospital Corporation | The General Hospital Corporation [6];<br>Massachusetts Institute of Technology [2];<br>The Charles Stark Draper Laboratory [1];<br>WEINBERG, Eli [1];<br>BORENSTEIN, Jeffrey [1];<br>VACANTI, Joseph, P [1] | 0% of 6 |
| 6 | C.R.Bard, Inc | C.R.Bard, Inc [6];<br>Lehigh University [6] | 0% of 6 |
| 6 | Lehigh University | C.R.Bard, Inc [6];<br>Lehigh University [6] | 0% of 6 |
| 5 | Amgen Inc | Amgen Inc [5] | 0% of 5 |
| 5 | University of Florida | University of Florida [5];<br>Regeneration Technologies, Inc [1];<br>University of London [1] | 0% of 5 |

# And Eventually…
## You need to read



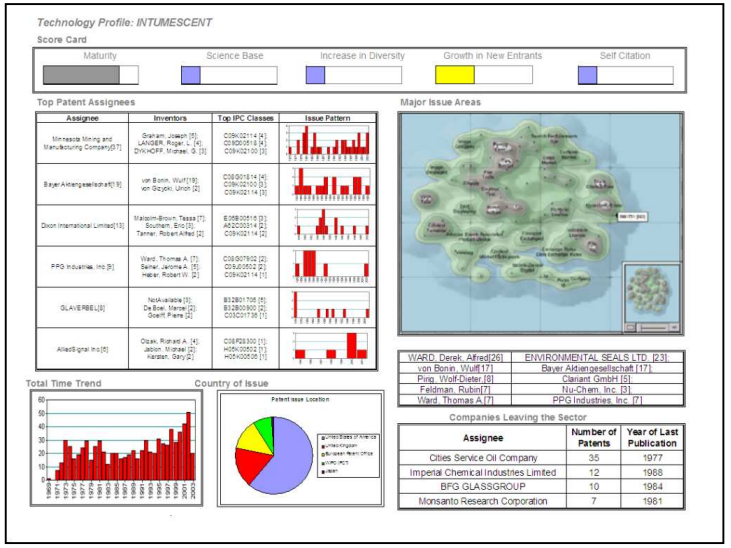

| | |
|---|---|
| **Patent/Publication Number** | WO2007011644 |
| **Title** | COMPOSITIONS FOR REGENERATING DEFECTIVE OR ABSENT TISSUE |
| **English Claims (Independent)** | A composition for reconstruction, replacement or repair of a defect or damage in organ tissue, the composition comprising extracellular matrix. |
| | A composition for reconstruction, replacement or repair of a defect, or damage in organ tissue comprising extracellular matrix, wherein said composition comprises a form selected from the group consisting of an emulsion, an injectable solution, a gel, a foam, a liquid, a paste, a powder, a spray, a vapor, a cream, a coating, a nanoparticle, a patch, a sheet, a laminate, a weave, a matrix, a fabric, a strand, a plurality of strands, a strip, a plurality of strips, a plug, a piece, and a plurality of pieces, and further comprises an additional component selected from the group consisting of: a) a cell, b) a peptide, polypeptide, or protein, c) a vector having a DNA capable of targeted expression of a e1ected gene, and d) a nutrient, a sugar, a fat, a lipid, an amino acid, a nucleic acid, a ribo-nucleic acid, an organic molecule, an inorganic molecule, a small molecule, a drug, or a bioactive molecule. |
| | A composition for regenerating defective or absent myocardium and restoring cardiac function comprising an emulsified or injectable extracellular matrix composition from a mammalian or synthetic source. |
| | A composition for regenerating defective or absent myocardium and restoring cardiac function comprising an extracellular matrix derived from a mammalian or synthetic source, said composition thrther comprising an additional component selected from the group of: a) a cell, b) a peptide, polypeptide, or protein, c) a vector having a DNA capable of targeted expression of a selected gene, and d) a nutrient, a sugar, a fat, a lipid, an amino acid, a nucleic acid, a ribo-nucleic acid, an organic molecule, an inorganic molecule, a small molecule, a drug, or a bioactive molecule. |
| | A patch for partial closure of an opening in a pericardial sac comprising mammalian extracellular matrix, the patch attachable to the opening at two or more points. |
| **Assignee / Applicant** | CorMatrix Cardiovascular, Inc |
| | |

# And do current research…



# Engage Experts

- Interactively
  - Expert ←→ Analyst
  - Expert ←→ Data
- In/out licensing opportunities
- Goal: How to fit in to/differentiate from "what is"



# Summary

- View “white space” analysis in the context of innovation mapping
  - Build on a model of innovation processes
  - Incremental vs. Radical innovation
- Use a variety of data sources and tools to understand “what is”
- Develop a rich set of interactive information products
- Use these information products with experts to explore white spaces (what might be) and evaluate connecting points (e.g., Open Innovation)

# Thank you

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