Techno-Historical Regional Economic Analysis Database (vTHREAD): Massachusetts Applications

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The Database

To get inside the faceless and ahistorical companies that feature in official US data, we constructed vTHREAD (Techno-Historical Regional Economic Analysis Database) to devise a set of research tools to interrogate a dataset of approximately 55,000 public and private, high-tech business units.

The database houses a longitudinal file covering 1990 to 2005, based on CorpTech data. The CorpTech raw data includes 147 fields of company information for each business unit.[1] The companies and their products are classified with a unique, finely granulated, technology-based taxonomy which make it possible to indicate regional concentrations of technology-defined companies and, as well, change over time. The unique application of the same taxonomy to each company's major product lines means the dataset captures multi-product firms which are highly valuable in examining the contribution of market repositioning companies in rapidly growing clusters. But including product codes greatly increases the database requirements. Eighteen sectors explode out to 280 major product codes and 3000 extended product codes which generate 4 million product entries in the longitudinal dataset.

Although the dataset was not constructed for scholarly purposes, CorpTech established sophisticated data collection and research methodology, including quality control systems and consistency checks.[2] However, considerable effort was required to convert the quarterly and annual data dumps into a historical file. For example, data had to be retrieved from previous generation IT systems, collated, integrated, and cleaned. This involved input from both CorpTech staff and computer science graduate research assistants directed by Georges Grinstein, professor of bio-informatics.[3]

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[1] Data for all of the fields is not always available.

[2] Until 2005, CorpTech's data collection methodology had 8 phases: company identification using a variety of sources, telephone interview after which the company's products are coded, editing by senior researcher, data entry, internal proofing, machine check which applies numerous tests to each record, external proofing, and written verification of the record from the listed company.

[3] Grinstein of the University of Massachusetts Lowell was in charge of the annual Information Visualization Symposia for the IEEE at the time and saw the opportunity to make the dataset the basis for the annual global competition in visualization techniques for the year 2005. For that latter purpose company names were replaced by an encrypted numerical identifier. The stunning visualization results can be observed at http://hcil.cs.umd.edu/trs/2004-30/2004-30.pdf Because of its size, it is still used for research and teaching purposes.

An outline of the construction characteristics, automatic queries, and research tool capabilities follows.

vTHREAD Construction:

- Embedded in MySQL open-source database

- Proprietary user interface and Java programming language

- Integrated with a data exploration and visualization program

- 55,000 annual company profiles and 4 million product entries

- Longitudinal series is created by linking the year-to-year records from 1990 to 2005.

vTHREAD Research Tools: (slides 1-8)

- Location technology audit (major categories)

- Fast growing firm query

- Cluster query and mapping

- Enterprise location quotient

- Cluster analysis by location and product profile.

- Cluster dynamics: industry churn analysis

- Regional Competitive Advantage indicators: inward FDI (foreign direct investment)

- Visualization and discovery tools

vTHREAD Report Capabilities:

- Historic audit of high tech companies by region and industry

- Audit of fast growing high tech companies

- Industry churn measured by enterprise entries and exits

- Changing sectoral composition of high tech by region

- Maps of high tech clusters illustrating size and growth

- Regional sectoral location quotients

- Operating units of foreign headquartered companies by region

- Indicators of regional technology and production capabilities

- Characterization of technology mini-clusters by location

- Evidence of company and technology genealogies by region

Applications

1. Locational technology audit for the Lowell area (slides 9-15). vTHREAD was itself shaped for the purpose of a strategic planning exercise at the University of Massachusetts Lowell. As a third-mission, technology-oriented university, the challenge was to get find a data-driven method for characterizing the demand side from the region's growing business enterprises for science and engineering graduates by discipline. Consequently the first application was a 'technology audit' of the three townships in the University's immediate catchment area.

 "Lowell's Industrial Regeneration: Dynamic Technological Capabilities". On-line publication of the Business History Association, http://www.thebhc.org/sites/default/files/Best_0.pdf

2. Cluster growth audit: medical devices (slides 16-23). The emergence and rapid growth of the Massachusetts medical device is decomposed into fast growing companies that leveraged the region's knowledge base and skills; companies repositioning into higher growth markets; and technology-related companies entering the region from elsewhere in the United States and from foreign countries.

"Massachusetts Medical Devices: Leveraging the Region's Capabilities". In in *Mass*Benchmarks, Vol. 8, No. 1, 2006: 14-25. On-line at http://www.massbenchmarks.org/publications/issues/vol8i1/06v8i1.htm

"Regional Specialization and Cluster Drivers: Medical Devices in Massachusetts". On-line publication of the Business History Association, http://www.thebhc.org/sites/default/files/best.pdf

3. Inter-regional Competition: Route 128 versus Silicon Valley (slide 24). Route 128 is shown to specialize in industrial products (complex product systems, instruments, equipment, machines and tooling) with little presence in consumer products. This reflects the region's historic lack of mass production capability.

"Discovering Regional Competitive Advantage: Massachusetts High Tech" (with Albert Paquin and Hao Xie). On-line publication of the Business History Association, http://www.thebhc.org/sites/default/files/BestPaquinXie_0.pdf

4. Cluster-dynamics Comparisons: Greater Boston versus Greater Washington DC. Greater Boston is shown to have an open-system business model with a vastly superior innovation performance than the closed-system business model surrounding the nation's capitol. The openness of the Boston business model is attributed to triangular relations amongst the federal government, academia and industry; in contrast, the evolution of northern Virginia's tightly linked industry-government inter-relations was not

under pressure for open research by the pivotal role of a major research intensive university. The result has been a closed business system with deleterious consequences on technological diversity and innovation.

Review Essay. *Internet Alley: High Tech in Tysons Corner, 1945-2005*, Cambridge: MIT Press, by Paul Ceruzzi in *Business History*, Vol. 53, No. 6, October 2011, 976–980.

http://www.michaelhbest.com/files/NV_vs_Greater_Boston_Business_Systems.pdf

5. Dynamics of Regional Industrial Innovation: Massachusetts as a case study in successful sectoral transitions.

The extraordinary adaptability of the greater Boston economy is not a Chandlerian story of the creation of the M-form, multidivisional enterprise as the region has remarkably few Fortune 500 enterprises. But it is a story of innovation, particularly as represented by sectoral transitions driven by growth amongst subsets of technologically related companies within an evolving co-located population of mutually adjusting firms. I have explored these dynamics in papers including the following:

"Massachusetts High Tech: A 'Manufactory of Species'". In Becattini, Giacomo; Bellandi, Marco; and De Prisa, Lisa (eds.) *The Handbook of Industrial Districts*, Cheltenham UK: Edward Elgar Publishers, 2009: 648-665.

"Vannevar Bush: The Accidental Architect of Greater Boston's High Tech 'Mittelstand'", working paper, to be presented at the 2012 Association of Business History Conference, Birmingham University, July 7, 2012.

These papers contribute to a theoretical treatment of the sources of industrial innovation, new sector creation and sector transition capabilities that is empirically informed. The greater Boston area is a good place to study sector transitions. Few firms can integrate the full innovation process of system of activities from basic research to manufacture, thus the need to form networks and thereby the critical importance of external relationships (see slide 27). The second is the triple helix which demands judicious coordination of government, education, and industry without all three spheres the system of regional innovation will suffer like a stool with only 2 legs. The system of diverse and specialized enterprises in turn creates feedback effects in the form of new opportunities to form new combinations that leverage a region's legacy skills, capabilities, and infrastructures.

Post vTHREAD: Comments on data availability, research methodology, and projects in Europe.

Unfortunately, in 2005 CorpTech's parent company, One Source, was acquired by InfoUSA an Omaha, Nebraska headquartered company. Thereafter, the CorpTech team was disbanded, the rigorous information collection methodology was no longer followed, and the comprehensive population data were no longer available.

Since constructing vTHREAD I have been and continue to be involved in two similar company-based, regional analysis projects in Ireland and currently in another involving 7 countries in central and eastern Europe.

1. The first Irish project was funded by European Union Framework Programme Six under the Marie Curie Action Fellowship Programme for Transfer of Knowledge hosted by the Center for Innovation and Structural Change at the National University of Ireland at Galway. The grant was awarded to develop a vTHREAD type database for Ireland. Applications can be found in:

Capability Transformation and Competitiveness (with Satyasiba Das, Majella Giblin, Paul A. Ryan, and Oner Tulum), Center for Innovation and Structural Change, National University of Ireland, Galway, November 2009, 80 pages.

2. The second Ireland project was commissioned by the the Centre for Cross Border Studies and funded under the INTERREG IVA programme by the Special EU Programmes Body is titled (*Normal Business restored: Reviving the border region economy in a new era of devolved government*). This project developed a research methodology that used both official and commercial datasets combined with company visits. The final report is titled *Cross Border Economic Renewal: Rethinking Irish Regional Policy* (with John Bradley), March 30, 2012: 284 pages. http://www.crossborder.ie/pubs/2012-economic-report.pdf

Two journal publications and a working paper resulted from the research:

"Bypassed Places? The post-Belfast Agreement Border Economy" (with John Bradley). *The Journal of Cross Border Studies in Ireland*, No. 6, Spring 2011: 25-44.
http://www.crossborder.ie/publications/journal-6/

"Rethinking Regional Renewal: Towards a Cross-Border Economic Development Zone" (with John Bradley). *The Journal of Cross Border Studies in Ireland*, No. 7, Spring 2012: 37-58.
http://www.crossborder.ie/pubs/journal7.pdf

"Rethinking Regional Development Strategy in the Context of Structural Funds: Lessons from the Irish Cross Border Region" (with John Bradley). Presentation made at the Directorate-General Regional Policy-Evaluation Network Meeting, June 21-22, 2012, Hermin Working Paper 3-2012, 32 pages,
http://www.herminonline.net/index.php/publications

3. The third involves participation in a EU/ERDF funded research project titled: ClusterCOOP - *Enhancing Framework Conditions for an effective Transnational Cluster Cooperation in Central European Countries* with Tea Petrin and Patricia Kotkin. It involves 10 partnering research groups in 7 countries in central and eastern Europe. It includes developing a mix of quantitative and qualitative methods with official and commercial datasets (combined with company visits) for the identification of emerging industry sectors. The technology taxonomy applied in vTHREAD is unique in its power to drill down to finely granulated, technology-based criteria and does not exist within the European context. However, in some countries, such as Slovenia, official data at the enterprise level is available and longitudinal files can be

created. Proprietary datasets that include all registered business units are available but, as always, the datasets are incomplete and not longitudinal (although the founding date can be a useful field). The challenges and methods are described in

 "Quantitative and qualitative research methods for the identification of emerging industry sectors in Central Europe" working paper, 20 pages, March 2012.