

Innovations Creator Networks: Blind, Quantitative, Longitudinal Databases for Comparison of Pharmaceuticals and Film

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Abstract

Analysis of social networks has added a new useful dimension to developing actionable understanding of innovation processes, particularly for creating policy that effectively supports innovativeness. However, progress is constrained. For instance, reliance on data from sources that reflect properties other than innovation, such as invention, knowledge dissemination, or geographic clustering is faulty. Also, methodologically, reliance on questionnaires, interviews, or case-study observations lack authenticity, comprehensive applicability, or both. Finally, it is constrained by lack of data sources that are authentic to innovation processes, comprehensive industry overviews, sufficiently longitudinal to bridge policy- and economic-impact events, and blind to researcher-subject bias. This report suggests two industries' databases that overcome the aforementioned constraints and are, therefore, offered as subjects for the founding of future blind, comprehensive databases for quantitative social network analysis of innovation processes. It includes how the two databases would best be constructed and suggests several methodological considerations for future research using them, particularly for comparative analysis. Doing so would harden the soft science characteristics and misappraisals presently commonplace in this area of scholarly research. Subsequent research utilizing this approach and material would enable policy metrics that would enhance policies aiming to build better overall national innovation systems.

Introduction

When policy is changed to improve innovation, the metrics make the conclusions, so maximally blind, quantitative, and longitudinal data that tracks the impact of policy change is optimal. Further, the novelties founding innovative products often arise within an interpersonal collective—a social network—that can show policy changes' impacts on potential inventors' interest in inventive networking. Dr. Bart Nooteboom's research mates network analysis to cognitive distance initiated this research area through deduction of firms' managers' perceptions of inter-firm linkages (Nooteboom, 1998) (Nooteboom, 2006), so greater reliance on massive amounts of blind, quantitative, and longitudinal data to develop conclusions without reliance on managers' perceptions would advance this study to nearer optimal. This study introduces the contents of two sets of data that may be amassed for the purposes of blind, quantitative, and longitudinal social network analysis of innovations' creators and discusses what those contents may effectively assess.

Constraints on data availability

2.1 Introduction to Data Availability Constraints

Securing valid and valuable data-sources to assess creative individuals' patterns in networking is constrained by factors limiting the depth and breadth of generalizability. Research into the social networking nodalities of the people who create innovations (inventors, artists) suffers under the twin tyrannies of the questionnaire and invention. Survey respondents represent themselves differently due to interpretation of questions. Invention, lacking corollary of market entry, ignores policy's purpose. Also, firms' innovation management values secrecy, so intellectual property ascribed to products is hidden, inaccessible to researchers, or lacking, and respondents' self-reporting threatens authenticity of ascriptions reported. Thus, to those data that can be compiled into databases that are useful for social network analysis on innovation's inventors and artists are limited to a very few by the above-mentioned tyrannies and varying veracity of subjects' reporting constraining appropriability of findings. Therefore, the comprehensiveness and authenticity of databases of creative persons' characteristics compiled from marketed novel pharmaceutical and film products contents is discussed.

2.2 Depth Constraints from Validity and Value

Generating responses, versus retrieving them, and defining usefulness limit availability of acceptable options for network analysis on innovators.

Questionnaires, which, in interrogators' quest for testable proofs, ascribe quantitative allusions to data that is actually qualitative, influence responses. Respondents intuitively construe questions' interests and modify responses accordingly (Murray, 1999)(Oppenheim, 2000), so allusions in questions beget illusions of independence. To overcome this deficiency, limiting source data to those where the authors' self-characterizations bear as little value to interested parties as is possible and that are made with complete ignorance of researchers' interest is the optimal research instrument.

Invention asks no proof-by-market while a narrow definition of innovation, which is not synonymous with invention, does. Invention that does not go anywhere is not

innovation. Dissemination defines innovation. By innovation's narrow definition, it implies *ad sparsis (at dissemination)* viability, not empty creativity, so recognizably being of social benefit and, consequently, worthy for providing valuable new knowledge for aiding policy management. Notwithstanding valuable case-based tests, which also ask for sources without the capriciousness of subjective underpinnings for source data and without content that is short of to-market validation, the grailacious search for quantitatively derived understanding of creator networking with real-world value adds to that understanding the need be applicable across contrasting industries' creator-networks. The issue here is that research on innovation almost universally counts patents or research and development budgets and expenditures and, so, is focused away from real-world application and the validity that it implies. Measuring marketed innovation, rather than invention, validates research conclusions maximally.

In conclusion to the issue of depth of research as shown by value and validity, overcoming constraints against using social network analysis to penetrate into the social nature of the innovation process extends from two foundations. First, retrieval of uncompromised content, whereby research questions are blind to reported information, assures authenticity of the reported source data. Second, creations are independently proven to be meaningful, wherefore products' entrance into the market after an industry-appropriate measure of attribution has occurred, validates the exclusive technological inventions on which they are founded. Thus, invention- and questionnaire-derived results' limitations are mitigated for social networking analysis with subjects' reportage occurring without their knowledge of research interest and by selecting only those subjects whose knowledge creation has been market-validated. Essentially, to progress, social network analysis needs absolutely quantitative data with the right content target.

2.3 Breadth Constraints against Emergence of Data

Invention and questionnaires limit potential sources by hurting analysis, but two other constraints reduce the availability of useful innovation source material to the public and researchers in the first place. Secrecy and organizational culture discontinuities are one. Another is that people responsible for inventions typically go unnamed. The qualitative failings of reliance on patents (inventions) and questionnaires asks for new sources, while both innovation management's either hiding or not volunteering information curtails opportunities to find useable quantitative data sources for effective statistical analysis.

Publicly available source data is exceptionally rare in the business of innovation. Secrecy, or, at least, opacity, makes possible monopoly rent, the most efficient variety of profit-taking in markets. However, more typical than outright secrecy is where connections between inventions and the resulting products are not labeled, either intentionally, as is concretely demonstrated when "patent pending" is entered on products without identifying the patents' themselves, or through neglect, as when no market value is generated by adding the information, so no notice of specifics of novelty's capital is applied. To demonstrate this aspect of business culture, consider that, for instance, computer hardware designers typically do not offer any list of the patents that exist on the multitude of parts that constitute their finished products. "Intel Inside", the trademarked logo of Intel Corporation, does not explicitly indicate anything about patents from which research can then generate the names of patentees

or assignees, or application and granting dates, priority intellectual property, and geography. Viewing patents from the firm rather than from the product, a search of patents' assignees does not assert that each patent actually found its way into a marketed product. A gap exists that confounds the availability of source data.

Given this, the only way to access a firm's innovation history data would be to contact it directly and be provided access to its internal information that chronicles which patents were utilized in marketed products—effectively, a firm-level case study approach. With patents identified, their content data would be assimilated to complete the innovation information package. This means tracking marketed patents through the United States Patent and Trademark Office (USPTO) database. However, examining different firms' cases of invention and innovation augers a compounding, confounding issue: discontinuities between corporate cultures related to innovation management must result in faulty comparability. This is a fundamental drawback of case studies. They provide exacting accuracy of results that cannot be extrapolated to other organizations. The lessons of Silicon Valley's and Route 128's successes have not proven easily transportable despite intense efforts to borrow from them and despite their networks being far more visible than the inner workings of individual firms' secrecy-shrouded innovation management operations. Whatever meaningful results may be gained by researchers accessing firms' otherwise private contents is lost by the very privacy and resulting uniqueness of individual firms' conditions undermining comparability. Firms effectively compartmentalize based on tacit knowledge informed by business culture and history. Barriers against corporate espionage and those that arise from firms' desire to flex competitive and comparative advantage are intentionally instituted barriers against generalization, standardization, and the comparability that allows judgment of best practices. Just as the reason that “best practices” transport poorly between organizations is that those practices tend to be embedded in an organizational culture that is not present in the firm receiving the transplant, innovation management's firm-specific peculiarities engender a case-by-case expression of research and development results. Forced standardization is the only way around this compartmentalization of results.

Thus, business practices inhibit social network data availability in the two ways outlined above. For one, protecting information asymmetries that arise from their research and development activities adds value by causing and maintaining monopoly positions. Secrecy aids revenue generation. However, even where inventions are intentionally or unintentionally made anonymous, inter-firm comparisons are jeopardized by contrasting corporate operational norms and cultures. For another, innovators are often anonymous, because firms guard their identity and often fail to even identify which patents among their portfolios' accrue in a given product. Consequently, failure of emergence of information on innovations' foundations results from firms' secrecy and peculiarities and their not publicly specifying their marketed products' creative inputs.

2.4 Conclusion to Data Availability Constraints

To conclude this report's examination of data availability for social network analysis of innovation processes for the purpose of aiding assessment of policies' impacts, constraints limit opportunities to find useful information sources upon which social network analysis data can be built. For research to progress in understanding innovators' networking in their creative processes, comparability among the

remaining narrow band of available data is necessary. The purpose of this examination is to expose comparability factors between two examples of innovation that breach the above-mentioned constraints and achieve a level of comparability by force of law and force of market. Those examples are, broadly, drug therapies and film and television productions.

Two applicable and available data sources

3.1 Introduction to Applicable, Available Data Sources

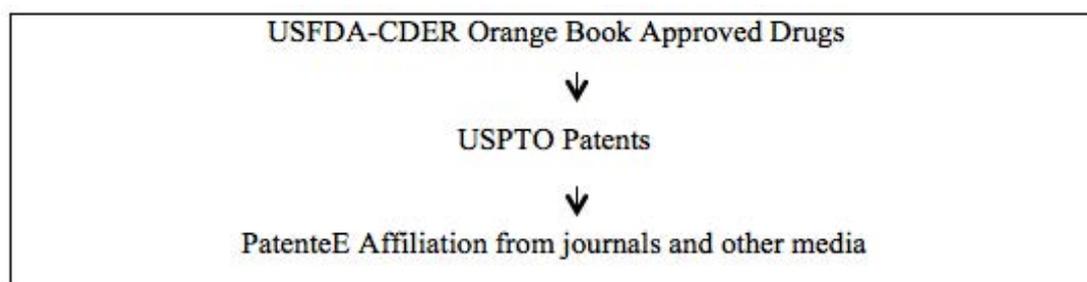
Given the constraints outlined above, the optimal location for sourcing meaningful data on innovators' creators' networks is limited to those that are forced, as by being demanded by law, or custom, as by being demanded by market participants. This paper compares the characteristics of one largely legally enforced source with another that is principally market-driven for disclosure of participants (creative and other). In the United States of America (US), as in other developed economies, bureaucratic transparency in the relatively highly regulated and government subsidized healthcare industry ensures both corruption-inhibiting accountability and a measure of informed consent for full disclosure. This is partially legislated, partly a disclaimer against civil lawsuits, and part corporate constraint against inflated pricing for outsourced, sponsored, or collaborative research through the increasing of fear of litigation, which has been shown to reduce pricing disproportionately heavily among smaller and academic drug researchers (Azoulay, Michigan, and Sampat, 2007)(National Institute for Health Care Management Research and Educational Foundation, 2002). All have legal underpinnings, even if the last mentioned aspect is fundamentally economic in nature. In the entertainment industry, recognition of contributors is customary, but a custom built on commercial considerations. Fame is a marketing tool, so gives studios and distributors a reason to advertise some contributors to their projects, but fame does not explain the extensive lists that follow movies and television programs, though the latter typically offers lists more curtailed than the former. Copyright protections require that copyright holders identify themselves, but copyright law does not ask for the extensive lists either. What does explain the extensiveness of the lists is the nature of employment marketing within the entertainment industry as people and organizations demand to have their names attached to projects for public disclosure. Thus, everyone from stars, directors, and executive-level production staff to walk-on actors, gophers, and caterers demand identification. Furthermore, naming names acts as a payment-in-kind, in lieu of cash, that reduces labor costs. Therefore, law and market provide incentives for identification of contributors to the innovative products of each of the pharmaceuticals and the movie and television entertainment industries.

Force of law and incentives of and for marketing generate exposure of creative individuals in the pharmaceutical and film industries respectively, but other areas deserve discussion of the consideration for entry into this research. In the case of law's sanction, transparency and diffusion of novel content tend to be the determining factors for ensuring public disclosure. In that of visual media, there is a branding effect that augments legal considerations. In effect, the latter is about star-power in the making, where the attachment of famous names to projects generates income. However, legal and contractual considerations provide a foundation of legitimacy for disclosure. Substantially, since both have legal underpinnings, it is noteworthy that the force of law is represented in intellectual property law and the force of custom is

represented in intellectual property's less legally constituted (but generally more important and better reflecting of the reality of the social environment of innovation generation) concept—intellectual capital. Within that context, pharmaceutical therapies offer one legally induced data source and, broadly, copyrighted publications, which includes a variety of entertainment, educational, and even functional (as with software and printed circuit topographies) authorship. Though a level of legal responsibility exists, not all such sources are made accessible to the public and not all meet a complementary level of diligence and inclusiveness of participants in the creative process, particularly since some clearly name more names than can result from legal demands for transparency or tendering of rights. Wholly beyond the realm of legal constraints are a few industries where naming of the people whose creativity is on display is nonetheless publicized. For them, publicity of identifying innovations' creators appears market-induced for purposes of branding, quality-control by assumption of responsibility, and as an instrument for making contact with potential patrons. This group includes, among others, the fashion industry (branding by star-making), entrepreneurship and SME (Small and Medium Enterprise) and, particularly, non-growth professional businesses (mom-and-pop shops, professional service providers, and skilled workers). Thus, other industries are appropriate considerations for inclusion into future social network analysis, though this paper selected only relatively robust sources of data.

3.2 Constructing a Pharmaceutical Innovations' Inventors' Social Networking Database

Table 1: Stepped Construction of the Drugs Database



3.3 Introduction to Pharma Innovations' Creator Database Construction

To complete the innovations' inventors' network database introduced here, it is constructed using two source databases and one broad realm of source information to complete innovators database's contents. The first data source identifies pharmaceutical innovations and their inventions. Those inventions bridge to the second source, which identifies inventors, locations, and timelines. Background on inventors, sourced through academic and professional publications, characterizes inventors' employment. Thus, after constituting the applicable list of inventions from those used in drugs that have been approved for sale in the American market, the location and affiliation of each of the industry's creative personnel forms this full database.

By way of introducing this database compilation for social network analysis of an innovation process, this paper determines that US data on drug development sets the highest standard for comprehensiveness and authenticity. Due diligence suggests

that any effort to develop conclusions using social network analysis of innovators will be aided by accounting for the pharmaceutical industry, owing to its diversity and blind, quantitative, and longitudinal character of its data. Consequently, combining US drug innovations' constituents and timeframe with intellectual property disclosures pertinent to the patenting process, and identification of the inventors' and assignees' geography and population, and determining how prolific and how they are employed builds a real and full database. The following subsections explore expression of those steps toward building a useful database on the innovation process related to drug development.

3.3.1 Approved Drugs

3.3.1.1 Introduction to Approved Drugs Approximating Innovations

Optimally, it is innovations that originate the database. Several considerations connected with authenticity and comprehensiveness of data contents rationalize the use of American listed drugs. The United States Food and Drug Administration's division, the Center for Drug Evaluation and Research, publishes its Orange Book: Approved Drug Products with Therapeutic Equivalence Evaluations: Patent and Exclusivity Information Addendum—Patent and Exclusivity Lists, which catalogues all approved drugs, and the patents upon which each is built, back through those from 1984. Since patents span of enforceability extends over 17 years, this database indicates patents fully from 1984 to present and in numbers that diminish from then to extinction in 1967. Comprehensiveness and authenticity make it optimal.

3.3.1.2 Orange Book

The Orange Book offers comprehensiveness and authenticity. Every drug approved for public consumption is listed, so it offers an opportunity for study of a full population, not just a sample. Its contents truly represent (a) American law, which compels transparency, (b) in excess of 60 percent of university technology transfer office revenues (Cockburn, 2009), and (c) the American drug market, being the largest in the world, attracting all drugs created abroad that pass the US health code. It is the optimal source for comparison of innovation.

3.3.1.3 Alternative Drug Innovation Data Sources

Drug approval sources that are comparably comprehensive and authentic to the USFDA-CDER Orange Book include the European Union's (EU) European Medicines Agency's Committee for Medicinal Products for Human Use/Committee for Medicinal Products for Veterinary Use (EMA-CHMP/CHVP) database and Japan's Ministry of Health, Labor, and Welfare's (MHLW) Pharmaceutical and Medical Devices Agency (PMDA) database. Nevertheless, for reasons of comprehensive scope and several levels of authenticity, given the analytical benefit of contiguity within each national innovation system, though the drug approval for marketing process in each of the three markets is highly similar, the underlying legal frameworks identifying patentees deprives Japan and the EU equal authenticity with American data. Also, since their markets are smaller and, in the case of the EU, more fragmented, any deficiencies of tripartite patent families that exist in the United States of America will only be greater elsewhere. For purposes of comparison between the systems, however, any corner within that triad would be good, given that, collectively, they represent the overwhelming majority of pharmaceutical research and revenues and, when adding in the partners within each of the three domains' trade-group relationships, the North American Free Trade Agreement's zone and the

EU's European Economic Area (EEA) and European Free Trade Association (EFTA) states, the remainder of the worldwide market becomes increasingly discountable. With the rise of economic power in BRIICS countries, the Asian Tiger economies within and without ASEAN, and Mercosur, that discount is declining, but, for the medium-term future, three is most reasonable for purposes of direct comparison of the most important markets that focus on market as opposed to developing markets. Moreover, sampling of triadic patent families in pharmaceuticals by descriptive statistics has shown that practically all pharmaceutical patents are found in at least two of the three patenting indexes and the vast majority are found in all three (Levirs, 2013). For an internally coherent comparison, the USFDA-CDER Orange Book's approvals are optimal for naming innovating inventions.

3.3.1.4 Conclusion to Approved Drugs Approximating Innovations

The Orange Book, then, names each drug by its trade name, designates its active ingredient, indicates dates of application and approval, and lists applicable patents (by USPTO number) and the exclusivity date (which, in the case of drugs affected by additional regulations, such as drugs for pediatric use or other specific medical conditions for which special extensions are provided, the exclusivity deadline is lengthened—6 months in the case of pediatric drugs). Thus, except for comparisons between the three drug approval systems, use of the USFDA-CDER's Orange Book of Approved Drug Products with Therapeutic Equivalence Evaluations offers the most authentic and comprehensive source linking drug innovations with patents for which inventors and assignees may be determined.

3.3.2 Patents

3.3.2.1 Introduction to Patents Approximating Creation

Patents' inventors originate innovations inventions. To formulate a fulsome network analysis of the people whose intellectual capital invents the foundations for the previously outlined innovations requires augmentation of innovations' patent data to discern those inventors' backgrounds. US patents most authentically and comprehensively divulge US-market pharmaceutical innovations' invention and their inventors.

3.3.2.2 Pharmaceutical Patents as Drug Inventions

Within the pharmaceutical industry, patents are effective proxies for inventive activity for several reasons. At the investment end, the costs and risks in research and the approval process are high, while reverse-engineering of new molecular entities (NME) is relatively easier and less serendipitous than is the initial research and development both for scientifically and for the investors, since the initial market entrant develops a new market that the reverse-engineered product can usurp. Regarding markets, that for generic drugs (as of approved drugs lacking exclusivity protections) both conveys a significant erosion of pricing and is often supported by government regulatory authorities and government-affiliated insurance providers in this restrictively regulated industry. Patents provide limited-time protections against erosion of returns on investment. Patenting is critically important to recouping costs and earning returns under the conditions of risk that drug developers face and is effectively universally undertaken in order to safeguard monopoly rents.

3.3.2.3 USPTO Primacy

While the USFDA's being the optimal source for networking data relative to its EU and Japanese counterparts is a nigglingly small advantage, since the three are highly comparable and represent invention within their innovations almost perfectly alike, the underlying patent systems make using US data qualitatively superior. While EU and Japanese patents identify patentees based on the applicants' introduction of the novel idea to each of their jurisdiction, the US Patent and Trademark Office's legal framework demands that all the inventors be included and that their rights over the intellectual property are joint, so an inventor who is not named on a patent, but who can prove his or her inventive involvement, has equal right to market the intellectual property without remittance to the other participants or assignee. Thus, the strength of the US data is that it has legal sanction (and a resultant costly market risk) for the inclusion of all actual inventors. In reality, this would result in an insignificant change in the constitution of patents' inventors, given that drugs typically result from advanced medical research that occurs within a corporate, university, or government-sponsored research organization that has extensive and redundant protocols for documenting the inventive processes in their laboratories, but the actuality does not deny that the underlying legal structure validates American reporting more definitively.

3.3.2.4 Conclusion to Patents Approximating Creation

Patenting, then, is a high value undertaking in the drug development industry and US patents embody specific legal accountability that ensures all inventors are named.

Information on creative activity included in the US Patent and Trademark Office's patents specifies inventors, assignees, and dates. These allow the comparison of entries in the various ways mentioned above and in the discussion below. USPTO patent data, then, names drugs' inventor(s) and assignee(s) and locates them by city and state within the United States of America or by city and region for some European countries, and by city and country for the remainder of the world's people. Additionally, dates are provided for filing and grant of patents. From USPTO database information, geographic distributions, longitudinal or cross-sectional analysis, patentee group size, patentee group composition (as of sex or locality/nationality), and assignee group size, and assignee group composition (as academic or corporate) are available for analysis. Nevertheless, though patentee names are available for assessment, their usefulness requires additional investigation described below.

3.3.3 Affiliations

3.3.3.1 Introduction to Creators' Professional Character

Inventors' natures (type of academic, and academic versus non-academic) and inventive prolificacy are available for examination each through a subsequent further step from original research. In this case, given the stipulations of American patent law, designating people as patentees defines them synonymously as inventors. Cross-referencing of inventors names among patents, scholarly articles, and other forms of publication and publicity provide insights that can result in meaningful conclusions on the relationships between those activities and the author(s)' inventing for innovations. While the results would not ascribe statistical causality, they would provide strong indications by correlation.

Regarding how prolific is the inventor and how great is that person's economic impact, much current and legacy scholarly research utilizing patents has developed conclusions based on these features. To a greater or lesser extent, depending on the nature of the research question being asked, the inventors' natures can be discerned from other source material, such as professional networking sites, like LinkedIn and Facebook, or, more confidently, through academic and professional journal and book publications, scholarly and professional presentations, and employment histories. Depending on the research question and the source material, confidence in the accuracy of the representational value of the data will vary, but that confidence can be accounted, statistically, to ensure robust results. Tracking patents' inventors' published histories adds two potentially meaningful layers to the analysis, that of the patentees' characters and that of how prolific they are in inventing and in publishing and practicing their research.

3.3.3.2 Journals, Academic and Professional

Whether published by professional associations or academia, journals and trade magazines offer the most trustworthy statements of contributors' employment affiliations. These include the date of publication, the authors' names and, usually, workplace, and articles' topics and categories. Such scholarly and professional literature corroborates authors' affiliation with confidence. Through specialized search engines Google Scholar Advanced™ and Microsoft Academic Search™, patentees' names are tracked to articles whose authors' names match. Commonplace names risk false-positive misidentifications, so search parameters utilize helpful cues for verification. Firstly, searches are restricted to only medical, chemical, and biological articles. Second, matching USPTO-provided dates, locations, co-patentees, and assignees with comparable assignments in articles' (co-patentees = co-authors, assignees = employer). Where conflicts occur, that with the maximum number and proximity of identifiers shared by the patentees and articles' authors designates the highest parallel and, so, acceptance as the same individual.

How prolific are inventors is also possible to identify by surveying literature. This approach has been well-utilized in testing how inventing correlates with publishing in academic journals and with regional or national economic development. Numerous authors, assessing the impact of the commercialization of academia, show how the new culture of academic entrepreneurship, which includes any potentially commercial activity by academics, including mere patenting, focus on correlations between journal publishing and patenting. Some have focused on academia's impacts (Abrams, Leung, and Stevens, 2009)(Sampat, 2006)(Mowery, Nelson, Sampat, and Ziedonis, 2004)(Mowery, 2005 and 2001)(Owen-Smith, and Powell, 2003)(Pechter, and Kakinuma, 1999) and others on how academia has been affected (Azoulay, Graf Zivin, and Manso, 2011)(Colyvas and Powell, 2007)(Azoulay, Ding, and Stuart, 2006)(Leaf, 2005)(Owen-Smith and Powell, 2001)(Thursby, J, and Thursby M, 2000)(Cockburn, Henderson, and Stern, 1999). Thus, by starting with only patents that led to innovations, rather than all patents, the focused nature of the resulting database that assesses inventor-scholars' academic publishing would be more relevant to real-world applications and impacts than broader studies that do not apply *lex parsimoniae* (Ockham's razor) to innovation.

3.3.3.3 Professional Linking Networks and News Articles

In order to confirm employment-affiliation where no journal article is ascribed to a patentee, professional linking forums and news stories fill the gaps. News reports lack the verifying certitude of journals, but supersede ascribing affiliation-type based on non-publication. News sources include everything from print and digital versions of newspapers and magazines, news releases and disclosures, legal or other, to firms and government agencies, and even to obituaries. Self-reported information sources, like professional networking sites and resumes or curricula vitae, also help make identifications. For example, Linked-In™ provides professional detail and history. Misrepresentation is unlikely to affect content from these sources, since only basic elements, like name and residency are drawn. However, the potential for false-positives, as with like names causing misattribution, asks for secondary corroboration by date, place, and assignee-employer alignment. When academic and professional journals are lacking, then networking and news offer an acceptable fall back source to help identify affiliations.

3.3.3.4 Inventive and Authoring Prolificity

Similar to professional networks and news articles in that the added content comes from outside the core innovations, the USPTO patent database also offers network information. Specifically, though the present research focuses on inventions that induce innovations, many other patents never ultimately contribute to a marketed product. They do not fit the definition of innovation applied herein, but they do offer indications about another facet of the inventors' activities that are at least on par with the importance of the inventors' professional and scholarly research and authorship. This approach has been well-utilized in testing how inventing correlates with publishing in academic journals and with regional or national economic development. The eminent researcher-writer in this research area is Bronwyn Hall in her reporting and calculation of patenting prolificity (Hall, 2013). Certainly, though the present research article has condemned reliance on patents over innovations, to identify relevant creativity, looking across the spectrum of patenting and publishing proclivities does indicate much about the overall innovative environment as it aligns with other trends and considerations that are important to inventors.

3.3.3.5 Absence from Published Literature

Relevant only in attributing inventors to non-academic employment is the lack of any publications. Of course, particularly regarding older or foreign data and, to a lesser extent, people very new to the research field, publications of scholarly researchers employed at government-funded research institutes, universities, or polytechnics or institutes of science and technology, may be unavailable, so extra diligence is needed in tracking such individuals. However, as a rule, publication of scholarly research is the currency of academia. Consequently, no publishing by a given inventor indicates that the person is not an academic, so is near definitively employed for a commercial firm's research and product development. Notwithstanding false positives of (a) age, (b) newness, and (c) non-English decent deserve note.

3.3.3.6 Conclusion to Creators' Professional Character

Thus, the nature of inventors' employment affiliation and how prolific is their inventiveness is available through diligent fact-gathering. A hierarchy of trustworthiness and cross-referencing for information sources that elicit less

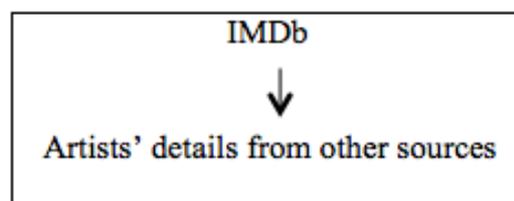
confidence secure the most accurate results possible. Analytical results posit indications by correlation, not ascription of causality.

3.3.4 Conclusion to Pharma Innovations' Creator Database Construction

In summary, by amalgamating quantitative data from the USFDA, USPTO, and published narratives and articles, a wide range of network analysis on innovations' inventors can be garnered. In terms of generating conclusions on the workings of innovator networks, this amalgamated data-source defines one critically important business area, pharmaceuticals, with diverse, quantitative data for statistical analysis. Thus, building this database for social network analysis of inventors that result in innovations is analytically valuable and the more limited exposures of other potential sources of product creator information is most likely to find comparability herein.

3.4 CONSTRUCTING THE MOVIE DATABASE

Table 2: Stepped Construction of the Movie Database



3.4.1 Introduction to Constructing a Movie Database

At the nexus of innovative creativity and well-documented social networks, the amount of work necessary to compile the above-defined drug innovation inventors' database demonstrates how demanding is the process to formulate workable datasets that are capable of generating usefully meaningful conclusions, even when they are available. That few are available in the first place owes to the lack of motivation to disclose that information as when required by law or sought by the marketplace. Publishing is an exception. Publications list authors, artists, and publishers for both reasons, but within the recording subset of publishing, near full disclosure of participants is descriptively detailed for the purpose of marketing. Publishing's subset of well-described innovations' creative population is that of scripted cinematography, scripted television, and lyricized music. An additional, comparable, but unpublished, adherent to this subset's model includes scripted professional theatrical productions, as they tend to be well-documented. However, though databases of scripted entertainment abound and are readily and freely available or can be accessed for relatively nominal fees, few are sufficiently comprehensive as to function effectively for social network analysis. The Internet Movie Database (IMDb), together with its for-pay service IMDbPro™, by contrast, is broadly, deeply, and diversely informed. In some aspects, it is better informed than even the fully compiled drug database chronicled previously. In it, creative individuals' roles are designated and projects' revenues are reported. Drug inventors' roles and contributions are indistinguishable in its data sources and revenue generated by individual drug products is not publicly disclosed. Further, any that could be stated would not be comparable across firm boundaries due to inconsistencies in corporate cultures and accounting. In other ways, IMDb is less fulfilling, like its lack of geographic location of the individuals and the distracting effect of talent agency

locations. Further, the nature of creativity occurring in film, television, theatre, and music production makes illusive determining which tasks are definitively creative. However, a massive amount of categorized and standardized background information is aggregated, if not in a uniform structure. IMDb offers deep, broad, and robust information on movie, television, and music innovations' creators in ways that allow for comparison with drug innovations' creators.

The Internet Movie Database is a comprehensive listing of cinematographic and television productions with sufficient designation and description of the creative people involved in each that sophisticated quantitative social network analysis is feasible, authentic, and valuable. While nominally a movie database, it also includes a non-cinema entertainment format—television. Furthermore, almost all innovation data is self-contained within IMDb, whereas USFDA-CDER and USPTO data sources were needed to furnish its preliminary contents, so little augmentation with additional sources' data is needed to bring the new database's compiled content in line with that provided for drug innovations. Adding information about professional-geographical base, which, given film's global production, is more important than people's choice of abode, is an example of an additional point that needs be sourced externally. Identity and location of agents is a significant additional factor, too, which needs to be sourced from other media. However, where academic research is relevant to drug research and development, it is not for film. Also, IMDb provides some types of information that are unavailable through pharmaceutical sources, such as revenue generated in release and from ancillary sources. Unlike drugs, however, for film and television, the type of intellectual property protection employed, which is copyrighting, does not designate the intellectual property's core inventive contributors. Finally, both databases register products protected by intellectual property legislation: patents for drugs and copyright for film and television products. Consequently, by sourcing the bulk of innovations' social networking from the Internet Movie Database and augmenting it with publicly available components to add peripherals significant to social network analysis (such as a proxy for the inventive phase, such as the start or end date of principal photography), creative artists and the producer-owners of their projects' geography, population within projects, networking societies across successive projects, prolificity, and professional capacity in which individuals are employed are all present for independent assessment and comparison. The following paragraphs itemize expression of those steps toward building a useful social networking database to assess the innovation process associated with film and television productions with a view toward discerning parallels with social network analysis of databases on other industries, such as the pharmaceuticals one outlined above.

3.4.2 Artists and Innovation Designated by IMDb

The content and format of the Internet Movie Database is a variety of professional networking site, somewhat comparable to LinkedIn, but with a view to raising public awareness in the film and television industries, which rely on publicity. Resulting from this, in production and distribution, the inclusion of information as self-reported by the personalities and professionals themselves, making IMDb akin to a résumé. Indeed, the site was introduced as a subscription service for résumés (Wikipedia, retrieved 2014). As such, credibility and accuracy are implicitly questionable (more so than is the case for patent documents, wherein the individuals are equally free to misrepresent themselves, though there may be less of an economic impetus

driving misrepresentations). Misrepresentation is reduced for this research by its sourcing from movies, which are self-reported by the movies' production studios, not the artists, so content portrays the firms' interests, which are not advanced by misrepresentation of artists. Structurally, the data is compartmentalized as a lattice between the people and organizations/firms and films or television programs, but is provided in linear fashion in each, so requires transcription, much as is needed with USFDA and USPTO contents. It is incumbent upon the researcher to define creativity such that the strongest statistical effect possible forms. Optimally, once the statistical test is determined, testing a variety of data inputs by the statistical parameters of invention will indicate the strength of that relationship, thereby enabling a quantitative determiner of novelty. With patents, the novelty determination is implicit in the review and granting process. This is because law designates that an inventor had some role in the inventive process that lead to the invention in question. With copyrights, no direct identification of all the critical creative individuals associated with the project is given, so the names provided in IMDb mix explicitly and implicitly creative personalities with mere laboring professionals and workers. No designation is provided to differentiate the two and, perhaps, none is possible.

3.4.2.1 Defining Creativity

In determining categories of creativity on order with patenting, consider a thought experiment that stipulates to the difficulty in determining whether an individual is creative or not. This question is jejune, since, arguably, most tasks involve some level of creativity, but few are germinal of innovations on order with intellectual capital, let alone intellectual property.

3.4.2.2 Screenwriters

Writers are paid to create and are highly likely to be released from service and have their reputations besmirched if they fail to provide creative content to their projects, regardless of whether their element of the writing is eventually edited out of the final product. The writer writes and writing is definitively creative.

3.4.2.3 Actors and Actresses

Actors, in contrast to screenwriters, are less clearly artistic. Surely, actors bring their own takes on a particular script, but that does not necessarily differentiate the actor from a factory worker or farmer whose job is similarly defined and structured with tasks that effectively are scripted, but demand some creative problem-solving and nuance. Furthermore, different grades of actor occur in scripts whereby headliners' roles typically enjoy dynamic character arcs. At the opposite extreme, "extras" are props. Broadly, supporting actors' roles tend to be purposefully non-creative so that the main characters' arcs display in vivid relief. Thus, actors' creativity is defined separately from the title of actor, yet the separation between main and supporting actors is not consistently defined or recorded in IMDb.

Discerning a method to determine their separation is at researchers' discretion, but that choice inevitably impacts the results of statistical analysis considerably. Other professional tasks also lay between the creativity of the writer and the least dynamic of actors, but simple placement within a creative continuum is problematic, since qualitative dissimilarities and discontinuities are commonplace.

3.4.2.4 Editors

Editing requires a keen and artistic vision (and one can draw parallels to a drug researcher who adds to the realization of a new molecular entity by subtracting problematic input rather than actually adding insights), but that role may only be deemed creative by clarifying that subtracting and selecting from among content provided is a creative act. By that definition, workers watching production lines to remove faulty product, like inspectors examining eggs to remove those that are damaged, deformed, or otherwise unmarketable, would be creators. Certainly, film editing and egg inspection have distinctly different creative input, but that difference is quantitative, not qualitative, so researchers' characterizations and specifications become critical.

Optimally, again, researchers would be able to remove definitional determination from subjectivity by utilizing statistical assessment of correlation to see which professional definitions most significantly correlate with innovation. That effort would be required to retain the objectivity of conclusions.

3.4.2.5 Professional Roles for Testing for Innovativeness

Though the Internet Movie Database, and industry as a whole, lacks a standardized format and definition of roles, professional differentiation makes for a fairly high order of comparability across product entries. Furthermore, it is only at the extremities of film and television production that job characteristics grow diverse. Directors are almost universally common throughout the medium. IMDb lists of professions include, but are not exclusive to, the following nearly thirty categories: Director(s), Writer(s), Cast (often subdivided into classes), Producer(s), Composer(s)/Music, Cinematographer(s), Film Editor(s), Casting, Production Design, Art Direction, Set Decoration, Costume Design, Make-up, Production Management, Second Unit Director or Assistant Director, Art Department, Sound Department, Special Effects, Visual Effects, Stunts, Camera and Electrical Department, Animation Department, Casting Department, Costume and Wardrobe Department, Editorial Department, Music Department, and Other crew. Which of them are essential to the creative content of the production is determined by researchers' definitions—a circumstance that contradicts objective blindness. Clearly, parameters for defining creativity require some rationalization. Notwithstanding what was previously suggested as an objective way to determine that definition (using statistical tools), another valid method is to extrapolate from other successful social network databases' analyses. The danger in that approach is that it may result in one industry's characteristics imposing invalid constraints on another. The task of defining creative roles is paramount, but fraught with challenges that largely result from blind quantitative social networking analysis being new.

3.4.3 Globalization

International data on IMDb is incongruous with that in the drug database, because, while the world's pharmaceuticals are patented throughout the tripartite family of intellectual property systems and has long accessed markets globally, films and television programs are much less broadly applied. Films produced outside of English-speaking countries, owing to language constraints, tend to find market acceptance beyond their language group problematic. Any drug that can enter the United States' market will do so, due to the scale of the American market and because human bodies' are sufficiently common for pharmaceuticals to translate universally.

Only safety concerns restrain some by their not being approved for sale in the US. Foreign films have a different order of constraint to entering the American market and their budgets are more marginal and the entertainment market is much more unpredictable than is the pharmaceutical market. Thus, drug innovation for the US market is tantamount to the world market while, for film and television, foreign-language, subtitled, and dubbed viewing is restrictive. This is partly because the market for entertainment products produced and delivered within the particular country or countries within like-language groups are well-represented. The English-language markets are highly saturated with English-language programming. Meanwhile, due to the adaptability of Anglo-American film and television in particular (an adaptability that is largely augered by their respective scales, scopes, and quality), English-language sourced film and television is the world's most profitably global. This incompatibility of comparison between drugs and film constrains comparative analysis between the two and suggests limiting comparison to English-language countries' source data.

3.4.4 Conclusion to Constructing a Movie Database

To conclude on the Internet Movie Database as a source for film and television production innovations, it is well-positioned by its comprehensive and authentic enumerations to provide inputs for network analysis of its creative personalities for comparison with innovation processes in other industries. While its overall detail is an advantage over alternative industries as sources of data, one deficit is that creative roles are not distinguished from non-creative ones. Doing one's job does not necessarily make a person creative, even when the industry's aim is to repeatedly create novel content. Thus, by one of arbitrary judgment, adapting the definitions of another creative industry to this one, or utilizing statistical tools to evaluate relative capability to generate novelty, the researcher provides a definitive framework for selecting those roles that are to be deemed creative must precede and inform comparison.

3.4.5 Artists' Details from Other Sources

3.4.5.1 Introduction on Other Sources' Details

While the details included in the Internet Movie Database are extensive and those within IMBdPro are more so, two critical points of information that are found within the tripartite drug innovation data and are important dimensions for understanding innovations' inventors' social networking patterns are only possible to source outside IMBd. These are the critical dates in films' innovation process and the locations of filming and of the people and organizations involved in movie production.

3.4.5.2 Sources

Deriving dates and learning locations must be earned by diligence, since no single source readily provides that data across the range of movies included for analysis. Thus, due to their wide-ranging and efficient gleaning of content relevant to key-word parameters, internet search engines function optimally for finding the desired information. This is done by inserting films' titles, institutions' names, or creators' professional names into online searches and augmenting those identities with key indicator-words to indicate date or industry-specific terminology for the desired time-reference, like "pre-production", "principal photography", "post-production", "soundstage" or "on location". Sleuthing across the resultant range of hits will divulge locations and dates associated with the specific filmmaking processes.

However, given the above-stated problems with location, particularly the potential for plurality, double-indemnification to verify accuracy ensures maximal validity of results. Academic-quality research surely demands on a high order of verification. Plurality of locations must be given appropriate attribution, also, as by economic logic or standard accepted practice. Where drugs' verifications offered a range of trustworthiness from academic journals down to news stories, film's verifications lack consistency or pervasiveness in the top order of verifying media, so must rely on professional, self-reporting options. The moral hazard inherent in this reliance on lower-quality information sources must be endured and is a good reason for demanding an increase in the quantity of data included in the research to ensure that aberrations are minimized by increased numbers. As for location, a hierarchy of trustworthiness is absent. The only sources available are self-reporting and news stories, which typically result from press releases, so are tantamount to self-reporting, too. Nevertheless, there is little to be gained from misrepresentation of date and location, so any problems tend to come from the differing interpretations the reporter has of location and, particularly, timing. Looseness of definitions, and the lack of commonality in resulting responses, are addressed by increasing the sample size, which is not a problem due to the enormous number of films available. Further, where multiple different responses may be available, it is incumbent on the researcher to validate the location and dates across several reports. Therefore, the internet provides the desired locational and temporal background information from a diverse range of sources, but the vagaries of imprecise and contradicting reports is overcome through expanding the scope (different types) and scale (number) of those sources.

3.4.5.3 Principal Photography

Just as with drug discovery, many alternatives present themselves as potential representations of the innovation process' beginning. Consistency and rationalization to real-world decision-making by the creative protagonists of innovation are the two principal determiners of which start is the optimal proxy for dating that process.

To explain the analytical framework in relation to the industry against which to measure film, for drug innovation, patent application, patent granting, drug application, drug approval, and approval's publication date are all options. However, in consideration of the speed of the innovation process, the duration between patents' application and grant and between either of those patent events and a drug's approval are the optimal options for affixing dates and durations. Of patents' application and granting, the latter option is most consistent choice given that it is the definitive end of the inventive process, since, at that endpoint, all patents are equal. At the application point, all inventions are not necessarily at the same point and, indeed, are unlikely to be as comparable among the various creative ideas that enter the process. However, the endpoint is one of legal acceptance of completeness. Any further additions or revisions are attributed to subsequent patenting events for separate, new patents. To compare benefits from this knowledge on how the comparable industry's contents are determined.

Film offers a similarly diverse range of start and end dates. Purchase of story rights, pre-production, scriptwriting, principal photography, post-production, marketing, and release are all parts of the process of innovation that produces individual motion picture products. Most of these also have start and end dates, though some of them,

such as marketing and release, typically have staggered beginning and end dates to undertake worldwide rollouts in manageable stages. Among these, only release dates are available through IMDb. Many of the remainder are plagued with inconsistency that arises from many forms of unpredictability. One example is that many projects do not rely on the purchase of story rights. Another inconsistency is that marketing is highly diverse in scale, scope, and nature. A further juxtaposition comes from reporting by standards and definitions that differ widely. Date of purchase of a story often goes unreported, for instance. Finally, the reality of some elements is that the onset and conclusion of a portion of the innovative process occurs slowly and often overlap with previous and subsequent stages, which leads to erratic and subjective representations of when one stage begins and when it concludes. Among these, then, owing to the precision of its definition and its widespread disclosure, principal photography offers the most common measures, the initiation and completion of principal photography is most consistent and logical. It is the time period when the core creative process is realized. Owing to costs, timeframes exist under a common rationality (that time is money), which accommodates comparison well. Owing to demands for marketing and for insurance and capital-servicing reasons, the timing and duration of principal photography is typically publicized and its length minimized under budgetary constraints. Unlike patents' application dates' inconsistency, principal photography's start and finish are equally trustworthy and indicative of consistent time references. Thus, for its availability, logical rationality, and consistency of and among reports, the time of principal photography is the optimal selection among films' innovation process stages.

3.4.5.4 Location

As with dating, locating a production, institution, or person is a complex act and not often divulged within the Internet Movie Database. Additionally, the placement of any of those three appears to be rather irrelevant to the innovative process as the following thought experiments indicate. Though Hollywood remains the iconic center of English-language film production, placement there or elsewhere offers no contest about the innovativeness of the film project, particularly when contrasted with "on location" shoots. Neither is expressly differently innovative than the other based on its location. Similarly, where a creative individual comes from does not carry significance in an industry where relocation for work is as ordinary as following the films' placement. Different, though, is the location of institutions, such as talent agencies, production and marketing firms, and professional organizations. These do tend to cluster in film-making centers, but tend to cope with abbreviated scope by expanding scale. Agencies will have offices in many cities with active film production and send their representatives elsewhere expediently. However, in the interest of discerning national innovation system policies' impact and other geographic effects and to discern what is not understood or misunderstood, location is worthy of full consideration and examination.

3.4.5.5 Conclusion on Other Sources' Details

Summarizing, then, accessing content that informs on the location and timeframe of films, their firms and professions, and their creative personalities, requires casting a wide net, diligently searching through the options, and verifying input through multiple and varied sources.

3.4.6 Conclusion

Finally, the Internet Movie Database is a data source that, for the scripted visual recordings industries of film and television, accepts blind, comprehensive, and longitudinal analysis by including both innovative creativity and well-documented social networks. Though a singular database, parsing relevant data from its individual sources is time-consuming because of the compounding effects of the large number of individual characteristics requiring inclusion and the number of people to be characterized, which is, in total, 4.2 million professionals (IMDbPro, retrieved 2014). By contrast, drug data allots only near 14,000 person-patents (Levirs, 2013). That is to say that, even when people with multiple patents are represented multiple times, the total number of discrete entries is less than twenty percent that of the number of individuals (not multiplied by multiple roles) in IMDb. Many multiples of the effort needed to compile the drug database as a population is required for visual and performing artists in film and television. Certainly for explorative statistical analysis, such as determining which professions are inventive, statistical analysis by sampling is highly appropriate. Efforts to formulate a database of the whole population would be cumbersome and unnecessary, given that the statistically significant number of entries is easily accessible and conclusions from that analysis hold a proven rate of confidence. To summarize and conclude, IMDb offers deep, broad, and robust information on movie, television, and music innovations' creators in ways that allow for comparison with drug innovations' creators.

3.5 COMPARISON OF DATABASES' CONTENTS

3.5.1 Introduction on Comparing Data Content

While the two industries are resoundingly different in structure and product, both are innovative and the reporting of their innovations offer many similarities from which comparison gains its traction. The table below outlines points where comparability can be deduced or induced for blind, quantitative data extrapolation. Induction is needed where no direct reportage of the given content-point is directly provided by a single source, so requires being developed across multiple sources. From these parallel descriptions of available content, the reader is provided a list of possible tractable points for comparison for future research, though any future research will need to verify that comparable features and parameters suggested herein are verified, statistically or logically, to ensure that whatever comparisons follow represent real commonalities. At its bottom, numerous features that are present and are sources of blind, quantitative data within the IMDb data source, but which lack a parallel disclosure in patent-related data, are offered. Partly this is done to satisfy comprehensive disclosure herein, but also to notify the reader of other potential points of contact for future research that either finds additional comparable data features in pharmaceutical innovation data or finds and develops a data source other than pharmaceuticals. As such, the following is as comprehensive a list of blind, quantitative innovation data for the two industries as was available at the time of this report's writing.

3.5.2 Comparable Content

Table 1: Identifiers and Quantifiable Data

From 3 Sources on Drugs:

Drug's Commercial Name;
Drug's Active Ingredient's Name
Patentee's Name

Assignee's Name

Inventor's Name as Found in
Verification Data

Assignee's Name as Found in
Verification Data

Patentee's Verification Source
Reference

Assignee's Verification Source
Reference

Patent Number

Date: Patent Granting

Date: Patent Application

Date: Patent Expiration

From IMDb on Film:

Film/Program's Name (by country or region)

Full Cast and Crew* (likely candidates: director(s), writer(s), cast, composer(s), cinematographer(s), film editor(s), production design, art direction, costume design, make-up, second unit director or assistant director, art department, sound department, special effects, visual effects, animation department, editorial department, and music department)

Company Credits (production companies, distributors, special effects subcontractors, other)

Full Cast and Crew* (likely candidates: director(s), writer(s), cast, composer(s), cinematographer(s), film editor(s), production design, art direction, costume design, make-up, second unit director or assistant director, art department, sound department, special effects, visual effects, animation department, editorial department, and music department)

Copyright Holder*

IMDb Self-reference

IMDb Self-reference

Title, Working Title(s)

Online Search (key words to determine end of principal photography (between pre-production and post-production)): film's/program's title + "principal photography" or "filmography" or both

Online Search (key words to find start of principal photography (between pre-production and post-production)): film's/program's title + "principal photography" or "filmography" or both, or (key words to find end of principal photography (between pre-production and post-production)): film's/program's title + "principal photography" or "filmography" or both

Date: Drug Approval	Festival*, Limited*, and/or General Release*
Patentee's City and Residence	IMDb: Artist's Page
Assignee's City and Residence	Country, Copyright Holder*, Filming Locations
Patentee's Sex (suggested by name, confirmed by non-USFDA/USPTO search)	Artist's Sex (suggested by name, confirmed by IMDb & other searches)
Number of Patentees	Number of Creative Cast & Crew* (likely candidates/segmented by job title): director(s), writer(s), cast, composer(s), cinematographer(s), film editor(s), production design, art direction, costume design, make-up, second unit director or assistant director, art department, sound department, special effects, visual effects, animation department, editorial department, and music department
Number of Academic Patentees	
Number of Assignees	Copyright Holder*
Number of Academic Assignees	
	Festival Release
	Limited Release (by country or region)
	General Release (by country)
	Technical Specifications (runtime, sound mix, color/bw, aspect ratio, camera, laboratory, negative format, cinematographic process, printed film format)
	Full Cast and Crew (Director(s), Writer(s), Cast (often subdivided into classes), Producer(s), Composer(s)/Music, Cinematographer(s), Film Editor(s), Casting, Production Design, Art Direction, Set Decoration, Costume Design, Make-up, Production Management, Second Unit Director or Assistant Director, Art Department, Sound Department, Special Effects, Visual Effects, Stunts, Camera and Electrical Department, Animation Department, Casting Department, Costume and Wardrobe Department, Editorial Department, Music Department, and Other crew)
	Box Office Receipts (budget, gross revenues, weekend gross revenues, admissions, rentals, copyright holder)
	Ratings (demographic, and age/sex/top/US-nonUS voters)
	Awards
	IMDb Charts
	Soundtracks

Genre

Motion Pictures Association Classification, Certification

Motion Pictures Association of America Number

Runtime

Language

* Subset within larger category or combines several categories

* Discard non-English source data (because non-English film is not comparable—language constraint)

* Discard television source data (because its creative process is not comparable—ongoing and short)

(Levirs, 2013)(IMDb, retrieved 2014)

3.5.3 Conclusion on Comparing Data Content

Thus, as the above table of comparable features between drug and film innovations' inventions' creators, commonalities are numerous. In total, eighteen comparable features that satisfy the demand for the data being blind and being quantitative are present. Film contents are more diverse when representing professions and specializations among the members of potential groups, but these categorizations of the people do not automatically disqualify any one group from contention as representatives of creativity that results in innovative products and without which the innovative product would not be possible. While the two industries are resoundingly different in structure and product, both are innovative and the reporting of their innovations offer many similarities from which comparison gains its traction. The table below outlines points where comparability can be deduced or induced for blind, quantitative data extrapolation. Induction is needed where no direct reportage of the given content-point is directly provided by a single source, so requires being developed across multiple sources. From these parallel descriptions of available content, the reader is provided a list of possible tractable points for comparison useful in future research into social networking's role throughout the innovation process, though any future research will need to determine that comparability of features and parameters suggested herein are statistically or logically verified as innovation processes and, subsequently, the strength of the commonalities. All elements included in the table represent blind, quantitatively derived content, but, at points in the table and especially at its end, categories are shown where no corollary appears present between available data. IMDb provides most of these categories that lack any parallel in the USFDA-USPTO-affiliations dataset. Partly, these are included to satisfy comprehensive disclosure, but they also to notify the reader of other potential points of contact for future research that either finds additional comparable data

features in pharmaceutical innovation data or finds and develops a data source other than pharmaceuticals. As such, the above table comprehensively lists for comparison between the blind and quantitative social networking content of innovation processes in drug development and film production.

3.6 Conclusion to Applicable, Available Data Sources

Building a useful database is benefitted by law or custom forcing full disclosure. American drug development and English-language countries' film offer data content for those reasons. Nevertheless, the terms of the transparency fit their needs, so require some interpretation and interpolation to ensure accuracy of results. Further, owing to the overwhelming mass of data available in the film industry by the large volume of movies and the compounding divisions of labor and individuals within those divisions, the near prohibitive scale and scope of entries from that industry legitimize both limiting the scope to only those few professions with the proven highest connection to creativity and scale to approximately the number offered in the compared database, in this case that of pharmaceuticals' discovery and development.

Discussion

4.1 Introduction to Questions for Discussion

Substantially, comparative analysis of the patterns of social networks in drug development's and in scripted film and television production's creative communities tests their groups' constitution to find correlations among variables. Since drugs and film and television can be assumed to be independent of each other, given that the nature of the professions, institutions, and markets are radically distinct, correlated results suggest that external factors are impacting both. Identifying these externalities is beyond the scope of this report, so would be the subject of the further research for which this report is introducing these databases. Mainly, this is tested longitudinally to determine patterns' evolutionary trajectory. Synchronous change is explored as shown in the following questions:

- a) Group Size Developments: has the number of members in creative groups changed?
- b) Group and Institution Diversity Developments: has the composition of membership by sex or geography changed?
- c) New Diversity: has sources of geographic diversity changed for inventors and artists?
- d) Duration of Innovation Process: has the length of production time changed?

- e) Pluralization of Institutions in the Innovation Process: has the number of production companies or assignees changed?
- f) Gross Innovations: has the number of drugs or films/television programs changed?

Thus, patterns in the constitution of innovations' social network among inventors are available for assessing correlations among reported characteristics in the pharmaceuticals and the film and television industries over time.

4.2 Group Size Developments

Positively or negatively correlated change in the quantity of people grouped for inventive or creative activities indicates presence of a common impacting factor. Examples of possible causes include generalized temporal effects (time) and specific macro-economic events (economic or financial crisis or exuberance, new technology, altered law or policy). From the demand side, enlargement of creative groups suggests that inventive work demands more varied intellectual capital inputs or occurs under greater time pressure. From the supply side, efficiencies and scarcities scale back group size, reduce time pressure, and encourage investment in research tools. Given that some supply and demand features of creativity impact across creative industries, positive correlations deserve investigation to determine whether they accrue from features of the novelty-generating environment, such as policy. Internalities, like that the consumer-demand market for drugs tends to be less discretionary than is that for new entertainment, produce so lack of correlation that is most likely to express itself as vacillations between the markets. Negative correlations arise from contrasting traction in sales, as can be expected to result from factors like the demography of aging and changes in the prevalence of non-communicable diseases. Combining results of these three outcomes has the potential to develop, by deductive statistical analysis, generalizable conclusions from innovations' creators' social networking. Thus, the similarities of changes among inventors and creators over time or across the line of specific events show that at least one development parameter coincides with or causes the observed evolution.

4.3 Group and Institution Diversity Developments

This assessment encompasses several possible factors to be tested, like members' sex and location, possibly age, employment role (such as manager versus other, and academic versus commercial creator, and entrepreneurial inventor versus funded inventor), if employment can be derived. However, comparable changes in the characteristics of participants in innovations' inventive social groups over time or in

response to singular events demonstrate influence on social networks composition. Note that the change may not have an effect on innovative or inventive products, but may only reconstitute group structure. Whether more of one or other sex or if greater dispersion of contributing researchers is beneficial is debatable, but certainly is not within the assessment parameters of this report. This report only outlines databases that are worthwhile to construct for purposes of comparing the results of social network formation. Hypothesis testing would occur subsequently, using these databases. Furthermore, preliminary research would simply aim to determine if there is a common effect.

Detectable macro-developments include, but are not restricted to, time, events, economics (such as improved communications and institutions), finances, or markets). Time is a loose category encompassing a great variety of chaotic factors that may, nonetheless, result in some overarching trend that may or may not be possible to parse into its constituent elements. It may influence drug development and entertainment together by the progressive development of tastes and fashionable interests, but may also arise within the two industries simply as a product of their maturing, which is a continuous macro-effect where tastes and interests may vacillate, cycle, or wander aimlessly. Events, as with group size, have a peculiar role, owing to its one-time impact, but comparing between drugs and entertainment may be more treacherous. Given the large role that men are seen as playing in both industries, the rise of a high profile woman may result in women entering the field. This could be tested by difference of means before and after the profiled woman's popularity augers some margin of public attention plus some length of lag-time to account for the time required to educate the next generation of women. The same may be found for geography. Other event changes may result from the institution of new laws or policies, even those not directly involved in either of the industries, as would policy changes that encouraged universities to train more female or foreign students. Economic issues may appear to be temporal issues, but the true source lies in the economy, such as entrance of revolutionary technology, communications, education, data management and computing, demographics, and fracturing or consolidation of the institutional environment. For instance, as manufacturing moves to cheap-labor countries, increased focus on services and on precision manufacturing may reduce costs of the tools of both the drug research and the film and television production trades in unison, thereby allowing increased involvement by relatively cash-poor, non-traditional people. Diversification would be the result of this wider inclusiveness. Finances may appear micro-economic in nature, so should not be uniform and distinguishable from economic impacts, but its effects can be separate.

Change in the availability of investment capital for creative industries would have a broad and disproportional effect as reductions in funding would exponentially heighten risk such that only far safer projects from creative teams with the best track record receiving the remaining funding. Entrance of new talent would decline and the status quo would uniformly curtail the changes in the social network that this facet would test. Consumer markets also portend significant related impacts, such as in the face of the demographic shift, increased wealth of non-traditional buyers, and rival products siphoning away potential market scale. Thus, as these many examples suggest, groups' locational and male-versus-female composition alters under the effects of time, events, or other longitudinal, but definable, factors'.

4.4 New Diversity

In addition to simple increases in the balance of proportions of men to women and people from varied localities rather than single clusters, there is matter of changes in pluralities prevalence and the complexities of those mixes, the relationship between the location of projects and the proportion of mixed nationality and complex-mix projects, and the rate of change in each location (national innovation system). Since males and females are the only two established sexes, only the differing proportion of each sex and the proportion of projects including each or both sexes are relevant. To more clearly understand the content of this point with relation to geography, it addresses the following questions:

- (a) Has the ratio of the drug invention and film or television projects with people from more than one nation changed?
- (b) Has the number of nationalities represented in individual projects changed?
- (c) What are different nations' results on the previous two parameters?
- Finally, (d) what are different nations' trajectories in the rates of change?

These are related to change in composition, but of overall diversity's change under external effects, which, if contrastable between industries, suggests that those industries are insular and, if comparable, suggests of general factors initiating evolution across industrial sectors. Here, too, changes in diversity may have a positive, negative, or no effect on innovation, so supplementary research is needed to answer that question. Similarly, sources of said factors may be any of many, particularly by time, events, economic, financial, or market conditions, or by-products of immigration. Such factors may be specific to each industry or may show common or contrary impacts. Outcomes that are specific to each industry deny comparability, so designate insularity with regard to the tested factor. Where difference of means statistical analysis shows positive or negative correlations, the nature of each

industry's innovation process is either similarly or differentially affected by the factor's imposition, but a relationship is definitely asserted. Changes in diversity among inventors and artists may occur in ways that are specific to each industry or may be compared and, so, be generalizable.

4.5 Duration of Innovation Process

Innovation is a process both based on inspiration, as expressed by inventiveness, and on perspiration, as expressed by the number of people and time expended to achieve the final product. Hence, speed of the creative process may indicate an impact of other factors or that progress into new areas requires increasingly sophisticated solutions, whether those new areas are more complex molecules or a more demanding viewership. Though audience and chemistry suggest that analytical similarities are derived from unrelated industry characteristics, that appraisal may be simplistically generous. Shifts in pervasiveness of media and information technologies are likely to have wide-ranging impacts on the nature of public perception and of research. For drugs, the separation in time between patent-granting and drug approval is an effective proxy for estimating the overall speed of the innovative process in that industry. For films and television programs, the corollary would be the length of time between principal photography and movie release. Unfortunately, no database specifically lists films' dates of principal photography, so, as mentioned above, this point of evidence requires supplementary research. While not universally available, diligence allows a large contingent of major films' dates of start and end of principal photography to be found. However, establishing a workable corollary for television is problematic, since the structure of television programs tends to involve ongoing creativity rather than a fairly clear two-point ((a) invention date/(b) innovation date) process. It is further complicated by the lack of case-specific information on television programs' principal photography dates. For this reason, avoidance of television source data for research that asks for comparison of the rate of innovation processing is merited. Therefore, indications of duration of the innovation process may accrue in consort with other factors or independently to show that underlying features in the innovation environment are creating uniform change across the sphere of innovation in many industries.

4.6 Pluralization of Institutions in the Innovation Process

Part of the interrelationships among creative individuals is their relationship to their common institutional infrastructure. As a result, change in the number, location, and type of institutions that constitute invention's material and administrative environment indicates possible evolution in the demands of innovation, invention, and external

characteristics affecting the process. These externalities include such considerations as the financial market's appraisal of and appetite for risk and that different types of institutions may seek different results from being named at the institutional level. The increase or reduction in the number of institutions involved suggests that the costly risk of research and development of drugs and production and marketing for films are being diffused across multiple firms. Of these, films' marketing institutions are excluded from this assessment, because any creativity that occurs there is not within the realm of intellectual property development and has no data-driven corollary in the pharmaceuticals. Drug marketing occurs absent public disclosure. Institutions' locational dispersion may occur for political, market, or practical reasons, such as financial supports from government provided to attract projects, diversity of imagery or content whereby specific vicinities may offer access to attractive filming locations or clusters of vanguard technologies and knowhow. As an example of this, New Zealand's disproportionate involvement in film development can be traced to Peter Jackson and Fran Walsh's Weta Workshop. This is true of drug development, too, where biotechnology clusters, particularly near leading universities, see the sharing of research results with little regard for location-based constraints to sharing, and the same is substantially true of the type of institution (public versus private), as collaborative and sponsored research brings tertiary education institutions together with corporations to usher potential products through various stages in future products' development. For film, the collusion of different firms in the production process is more typically seen where firms from one category of the industry spill over into others, such as talent agencies, or actors themselves, entering into production tasks and distributors becoming involved in production, too. Forward and backward integration is an ongoing consideration in film and television. The past divide between television and film production is an area of lateral spill over. Multiple institutions becoming involved may also indicate the presence of multiple, exclusive interests. This is apparent when universities ask that their names be included as assignees, but claim no financial rights or risks for doing so. In such an instance, the corporate partner is motivated by cash while the university seeks recognition. The great variety of reasons for forward or backward integration and spill over in film is so multiplicitous as to be daunting to research, since it may be anything from part of the deal to win a film's casting contract for talent agents or it may be an effort for distributors to control content in order to assure a profitable end-product. While the expression of many of these factors may outwardly appear distinct between drugs' and motion pictures' development processes, statistical assessment may illuminate unexpected and even counter-intuitive correlations related to the innovation process' commonalities. To conclude, though the specific causes require subsequent study,

first, finding similar evolution in these two industries suggests that some underlying effect is impinging on their outcomes, so subsequent study is worthwhile in order to determine what is causing those impingements.

4.6 Gross Innovations

The last parameter noted here is change in the total quantity of innovations: actual movies being released and drugs being marketed. Change in the population of innovations indicates altered trajectory of scale or scope. Scale (size) includes growth or shrinkage in the market. Scope (density) includes the parsing or consolidating of products as separate from scale. Increasing the number of products in a given market tends to both grow that market and reduce profits through competition. Decreases tend to have the opposite market impact. Relating changes of scale across both the film and the drug industries' innovation processes seems unlikely, but cannot be discounted without testing. Of scale and scope, backwards anticipation of marketing capabilities or forward results from increased funding of projects, as with governments' competition to attract industry relocation, and changes in productivity, as from introduction of new technologies, business practices, or markets, alters interest in and, so, amount of creative work dedicated to projects in both industries. Likewise, budgetary constraints could diminish infrastructural development and raise taxation and other near-tax expenditures as would raise costs and, worse, increase unpredictability's risk. Differentiation between scalar and scope effects is critical to analysis, but somewhat problematic, given that environmental changes have both effects simultaneously. This differentiation problem compromises the integrity of any resultant conclusions. Alterations in scale or scope show themselves in the population of innovations and indicate underlying pressures, particularly directly to investment in innovation and indirectly and backwards from changes in the profitability of consumer markets.

4.7 Conclusion to Points of Discussion

This discussion began with the idea that assessing commonalities in the patterns in the constitution of creative people's social networks while they undertake their innovative processes would be helped by comparing drug inventors with film and television creative personalities. Suggested axes of comparison included were: (a) group size developments, (b) group and institution diversity developments, (c) new diversity, (d) duration of innovation process, (e) pluralization of institutions in the innovation process, and (f) gross innovations. During this discussion, the rationales for discarding television production and non-English movies were entered. Owing to the ongoing nature of its production rather than the distinct stepped approach of both film

production and drug development, television production lacks the others: two-step invention-to-innovation process. Non-English film lacks global market penetration that is in balance with and fulfilling for comparison with pharmaceuticals. Thus, details of the patterns in the constitution of innovations' social networking among inventors are discussed and considered as to their availability for testing in any research that compares the social network structures among pharmaceutical industries' innovations' inventors and the film industry's movie productions' creative personalities during the innovative process for the purpose of identifying correlations among reported characteristics in the ultimate search for expressions of factors affecting both industries in common.

Conclusions

Returning to this report's greater theme as presented in its introduction, the search for policies that are effective in managing the innovative process in industries would benefit from including assessment of maximally blind, quantitative, and longitudinal data. This report suggests how that could be done using a database of pharmaceuticals' innovations and another of films'. First, derived from Nootboom's composited analysis for determining speed of innovation from social networking data and founding that analytical technique on the micro-economic logic of cognitive distance within a Transaction-Cost framework, this report introduces a composited pharmaceutical industry database and a nearly single-source database of the film industry. Second, both databases count features that may or may not ultimately prove to be innovative, but for which diligence demands statistical testing to verify whether or not they are, rather than summarily dismissing them. Since the purpose of this report is to suggest and outline how innovation processes in these two innovative, but otherwise highly distinct, industries may be undertaken and offer new perspectives and understanding of innovation processes generally by using a research framework that compares their features in search of commonalities and correlations in the face of similar developments in each one's operating environment. Thus, revising Nootboom's analytical approach to deductive testing is the first major step toward formulating effective quantitative social network analysis and finding and developing data-sources into comparable databases is the second. Securing valid and valuable data-sources to assess creative individuals' patterns in networking is shown to be constrained by factors limiting the depth and breadth of generalizability. Research into the social networking nodalities of the people who found innovations suffers from use of questionnaires, which risk respondents articulating their interrogators, rather than their own, expectations and apprehensions, and invention,

which is not validated for usefulness and relevance by market entry. Survey respondents represent themselves differently due to interpretation of questions. Invention, lacking corollary of market entry, ignores policy's purpose, in addition to the non-market expression of firms' innovation management, which values secrecy over disclosure and standardization. Thus, to those data that can be compiled into databases that are comprehensive in their reporting, are authentic to the creative efforts that lead to innovation, and useful for social network analysis on innovation's inventors and authors are herein limited to that of the pharmaceutical industry's drug development processes and the film industry's writing and principal photography elements that lead to distribution. The structure of comparative research of these two industries' innovation processes is vetted and discussed as to their effectiveness in providing reliable research results into a generalizable understanding of innovation.

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