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Research Article

Research Platforms: Two Diverse Sites-Similarities and Differences

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Abstract

Research platforms-efforts providing data and tools to support a number of interrelated, typically longitudinal projects-generate economies of scale for policy research and intellectual synergies. The data science underlying these platforms represents a fascinating combination of political, organizational, "big data", and design factors. Two highly regarded place-based research platforms-one focused on understanding health and human development (the Manitoba Centre for Health Policy, MCHP) and the other facilitating ecology and environmental studies (the Experimental Lakes Area, IISD-ELA) deal with dissimilar scientific and policy problems yet share a number of common elements.

Comparisons demonstrate the wide-ranging opportunities for policy research which such place-based platforms create.

These platforms enable both experiments and quasi-experiments, make more covariates available, and allow longer follow-up and larger case counts. They generate collaboration and facilitate improving data quality. Regardless of disciplinary roots, platforms expand research opportunities.

Keywords: Place-based; Research platforms; Human development; Environmental studies; Expanding opportunities for policy research

1. Introduction

A research platform can be defined as an organization focussed on accessible/shareable data, research goals, and collaboration. Usually one location or physical center is involved. A successful platform typically begins with a unique situation having one or more special advantages that become more obvious over time. Then another project builds on the first set of developments, then another, and so on. A platform grows by storing and organizing information key for advancing a body of research. Such activity is typically operationalized by storing and linking records, constructing "wide" data files, providing follow up as years pass, and collecting data on a regular basis. As new projects build on available information, the research topics are likely to expand and the potential of the platform becomes clearer. Staff take on responsibilities as data stewards yet must also generate funding to support a range of activities. A number of features influence platform construction: geography, modes of networking among researchers and organizations, perceptions of the value of the work, and financial support.

Platforms have substantially changed the potential and conduct of research (Tash [1], Westfall [2]). Monitoring of key measures, as well as design and management of experiments and quasi-experiments, are key functions facilitated by these platforms. This paper traces the history, processes, outputs, and effects of two very different place-based research platforms, highlighting their strengths and responses to various challenges. Because the principles of organization and design remain relevant across different types of data, comparing seemingly disparate platforms is illuminating.

2. Organizing Information

2.1 Background

This paper highlights research platforms at two ends of a spectrum relevant to health and bioscience-one (the Manitoba Centre for Health Policy-MCHP) concentrates on human health and social research and the other (the Experimental Lakes Area-IISD-ELA) on ecology and environmental sciences. The potential for creating new research platforms certainly exists. Over the last decade an International Population Data Linkage Network has enlisted well over a hundred centres/members working with health data. Many of these are place-based, focusing on a single geographic site. Experienced investigators have stressed the desirability of constructing platforms for long-term work in ecology and environmental studies (Lindenmayer et al. [3], Lindenmayer and Likens [4]). Information on life histories, spatial mapping, and a variety of plants and animals has proved important, particularly in the context of climate change. For example, the Grants' work on Galapagos [5] used "a vast and unparalleled range of ecological, behavioral, and genetic data" to uncover the causes and consequences of events leading to evolutionary change in finch species.

Both MCHP and IISD-ELA are place-based, producing detailed, long-term data from a defined geographic area. A key factor in the success of such single-site research is incorporating a "comparative advantage"-relevant information and design features not available elsewhere. For example, special characteristics of the Manitoba data set (including a population registry going back to 1970) have proven invaluable in producing detailed parent-offspring data and a large number of cases for analysis (Wall-Wieler et al. [6]). Findings cannot be automatically

generalized elsewhere; comparisons with other sites almost always involve shorter time series, redefinition of variables, fewer measures, and so forth. However, examining even one or two other locations can help in establishing the external validity of more "in depth" findings from the single site (Fee and Hecky [7], Roos et al. [8]).

2.2 Broad potential

MCHP and IISD-ELA have organized vast amounts of data, with key features enhancing multi-disciplinary research. Information on a wide variety of parameters gets the attention of policy makers and potential collaborators and makes their studies more broadly applicable. Unusually comprehensive data files (a characteristic of both platforms) help recruit and retain scholars from other disciplines.

3. Centres and Platforms

3.1 Manitoba Centre for Health Policy (MCHP)

The Manitoba Centre for Health Policy (MCHP) is a research unit in the Department of Community Health Sciences in the University of Manitoba's Rady Faculty of Health Sciences. Established in 1991, the Centre built on early work using population-based administrative data routinely collected by government agencies (Marchessault [9], Smith et al. [10]).

MCHP hosts the Manitoba Population Research Data Repository, which is impressively comprehensive, well integrated, and oriented around an anonymized population registry (Enns and Roos [11]). Essentially all Manitoba residents (over a million persons at any one time) going back to 1970 are included. Repository data are de-identified; research is subject to a rigorous approval process to ensure compliance with applicable legislation.

The Repository include registry, survey, and other databases (at last count over 90 active files) focussed on Manitoba residents. The health database, for example, holds records for virtually all contacts which provincial residents have with the health care system (the Manitoba Health Services Insurance Plan), including physicians, hospitals, personal care homes, home care, and pharmaceutical prescriptions. Linkage to both educational (enrollment, grades, graduation) and social data (income assistance, child and family services, justice data) for all provincial residents has facilitated inter-sectoral policy research (Guttmann [12]).

The MCHP platform has supported a wide range of studies in health services, education, data quality, aging, clinical epidemiology, and pharmaco-epidemiology. Longitudinal and cohort research has been particularly popular, often leading to multi-disciplinary studies of child development. Examining the relationships among parent-child characteristics and behaviors is a new topic of increasing interest (Wall-Wieler et al.[6]). MCHP also integrates knowledge translation to increase the impact of its work on policy and practice and to encourage public engagement. This research generates a great deal of "extra value" from information originally collected in the course of managing various government systems.

Manitoba data are typically administratively relevant (for paying physicians, analyzing hospital usage, tracking who is enrolled in school), legally mandated (i.e. by Statistics Canada as part of a Community Health Survey), associated with a provincial program, or clinically relevant (in depth data collected by a clinician). The various files can be linked for each provincial resident. Because a de-identified number

for each individual has been added to each record on each file at an earlier stage (carried out at Manitoba Health, Seniors and Active Living), linkage is straightforward.

The Manitoba data support comparisons among areas or individuals in usage of health care. One deliverable highlighted the gap between the health of First Nations Peoples and all other Manitobans, pointing to inequities in service provision (Table 1: Katz et al. 2019). The diagnostic prevalence of mental illness among adults and subgroups provided important input for government reports directed toward planning services to diagnose and treat mental illness (Table 1: Chartier et al. 2018). The potential advantages of a guaranteed annual income have been among the most topical policy problems studied (Table 1: Forget 2011). Another body of work has used a large cohort of children, siblings, and twins to analyze the effects of infant health on subsequent health, education, and labor force attachment (Table 1: Oreopoulos et al. 2008). Several papers explain or contribute to important methodological developments (Table 1: Jutte et al. 2011, Romano et al. 1993). Among quasi-experiments evaluated, the prenatal income supplement was of particular interest (Table 1: Brownell et al. 2018). Other longitudinal studies utilize several Canadian pharmaceutical databases to examine a variety of outcomes (Table 1: Dormuth et al. 2014).

Brownell M, Nickel NC, Chartier M, Enns JE, Chateau D, Sarkar J, Burland E, Jutte DP, Taylor C, Katz A. 2018. An Unconditional Prenatal Income Supplement Reduces Population Inequities In Birth Outcomes. Health Aff (Millwood) 37: 447-455. doi: 10.1377/hlthaff.2017.1290.

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Table 1: A Sample of Studies using the Manitoba Database.

The Manitoba Centre for Health Policy is supported by contracts with the government and peer reviewed grants. MCHP has approximately 50 full-time researchers, data managers, analysts, research coordinators, and support staff. Researchers benefit from collaboration with peers across Canada, the United States, Europe, and Australia. There is considerable engagement with First Nations, Metis, and Inuit communities. High-profile representatives from research, health care, business, and government serve on an advisory board.

3.2 IISD-Experimental Lakes Area

The IISD-Experimental Lakes Area (IISD-ELA) is a research facility located in northwestern Ontario and operated from offices in Winnipeg, Manitoba. Officially opened in 1968 as a Canadian government facility, the Experimental Lakes Area (initially including 46 separate lakes) was founded on the idea of experimenting on whole lakes and their watersheds to understand environmental stressors and inform policy and regulation. The IISD-ELA has been noted as a premier ecological research institution, as an exceptional natural laboratory free of human impacts, allowing scientists to study how all aspects of the ecosystem (from atmosphere to biosphere) respond to manipulation (Blanchfield et al. [13]). Long-term data from 'reference sites'—five lakes left in their pristine state-have proved increasingly valuable in providing information on climate change and other ecosystem stressors.

Responsibility for the Experimental Lakes Area was moved out of the federal government in 2014 and a privately funded organization, the International Institute for Sustainable Development, took over the operation (now known as IISD-ELA). Provincial governments and later the federal government have provided baseline support. The longest running controlled experiment at IISD-ELA has continued since 1968. This study and others identified phosphorous as a key contributor to the development of excessive algal blooms (a process called eutrophication) that has degraded water quality worldwide. This research led the way to policy changes in the use of phosphorous in agriculture and other industries (IISD [14]). Other important work has examined the effects of acid rain, reservoir development, climate change, synthetic estrogen, mercury, silver nanoparticles, and aquaculture, among others (Kelly et al. [15], Kidd et al. [16], Martin et al. [17], Schindler [18, 19], Schindler et al. [20]). Most recently, the IISD-ELA is involved in projects examining the impacts of crude oil and diluted bitumen, microplastics, metals, and pharmaceuticals on freshwater systems.

IISD-ELA has fruitfully combined its large, multi-year body of data with a capacity to conduct whole lake experiments. Whole-lake experiments typically mimic human activities; examples include nutrient inputs from sewage and agriculture, acid rain and mercury deposition from coal burning, flooding to create hydroelectric reservoirs, etc. Long-term data have provided crucial insights into the impacts of climate change or natural events such as forest fires.

New bodies of inquiry may build on existing ELA information. For example, new methods for using environmental DNA (eDNA) are currently being validated (Table 2: Littlefair et al. 2020). With eDNA, a water sample is collected and analysed for DNA. Results are then compared with existing libraries linking DNA profiles to known taxa abundances and

habitat preferences. Hopefully, this approach will ultimately be able to determine what species live in a body of water and what their abundance is. Observations may lead to whole-lake experiments. Thus, monitoring of Lake 239, a reference lake at ELA, showed changes in precipitation to decrease inputs of dissolved organic carbon (DOC), which increased lake clarity (Table 2: Schindler et al. 1996). This led to a whole-lake experiment where water inputs were reduced to affect DOC (Table 2: Spence et al. 2018). Many experiments have also resulted in new observations pointing to follow-up work. As an example, whole-lake additions of sulfuric acid to mimic acid rain found that pH did not decrease as much as expected; this led to new research on the role of sulphate reducing bacteria as a buffer against acidification. Secondly, the development of harmful algal blooms was affected not only by phosphorus alone but also by the balance of nitrogen and phosphorus (Table 2: Schindler et al. 2008). This spurred several follow-up manipulations in whole lakes and enclosures.

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Table 2: A Sample of Studies from IISD-ELA.

4. Comparisons

Operating a platform involves investment in material resources and social capital. Although platforms (including the two we focus on) tend to evolve over time, considerable planning and organization, as well as securing funding and political support for the maintenance of material and intellectual resources, are necessary.

5. Funding

Changing governmental priorities, coupled with the possibilities of funding cuts, represent real dangers to long-term research platforms. The "latest front page topic" pressure on agencies leads to undervaluing the benefits accruing from such platforms (Duncan [21]). Thus, Statistics Canada never restored the Survey of Labour and Income Dynamics after abolition in 2011 because of data collection expenses.

Funding for the two platforms described here has been precarious through much of the time the authors have been professionally active. The long-running saga threatening closure of the Experimental Lakes Area represented a major setback to ongoing research (Hoag [22]). A 2017 inventory of long-term ecological and environmental studies highlighted shrinking allocations of funds to such work (Hughes et al. [23]). Several factors seem helpful in maintaining funding: a) provision of high-quality studies with practical management applications, b) attracting endorsement from other investigators and provinces, c) raising external funds from non-governmental sources, and d) conducting highly recognized academic research. The use of administrative data-collected at short intervals in response to issues such as the ongoing COVID-19 crisis-may make it easier for centres using such data to obtain baseline funding if their capabilities prove useful to governments trying to provide a quick response to serious ongoing issues.

6. Strengths and Advantages of Platforms

Given the opportunities to use rich observational data in multiple studies, researchers benefit from skill sets and infrastructure created by others. A good place-based platform facilitates access to and explanation of how data has been and can be used. A Concept Dictionary describing important MCHP concepts was accessed more than two million times in 2018; some concepts described by ICD codes have been directly translated into SAS variables (Smith et al. [10]). ICES, based in Ontario and initially building on MCHP, has adopted a data dictionary to help with its organization. In addition, the Manitoba Centre for Health Policy has developed a framework and software for assessing the quality of administrative data (Smith et al. [24]); this is most useful when importing a new data set. IISD-ELA also widely shares its data through its web site, dealing with about 75 external requests a year. Being based in (and now partially funded by) a large Canadian province—Ontario-help generate student and faculty interest. The Experimental Lakes Area is working to improve data accessibility and documentation by putting its information into a formal repository.

Applying record linkage to administrative data facilitates building a diverse set of covariates and outcomes not available from simpler data collection efforts. MCHP researchers are able to build cohorts using a variety of sources; some of these include: registry data, hospital discharge abstracts, an Educational Development Index (to measure developmental vulnerability), a Baby First/Family

First Screen (to measure a number of maternal characteristics), and data from Child Protection Services (Wall-Wieler et al. [6]). The titles of the papers based on research from the Experimental Lakes Area show the variety of themes and designs generated from such a place-based approach.

Gathering enough data over sufficient periods to consider different research designs has typically been assumed to be time consuming and expensive. Big data organized with the help of platforms are increasingly free of constraints based on small numbers of cases and relatively few years of follow-up. Improving on the 'collecting data to fit a single design' perspective which characterizes and limits much research may be increasingly possible (Feely et al. [25]).

7. Access and Ownership of Information

Research platforms based on administrative data and those oriented toward ecology and environmental studies typically differ in access to and ownership of information. Even with de-identification of individual information, legislation poses barriers to pooling health data across Canadian provinces (Guttmann [12]). Special, more complicated statistical techniques have been necessary for data analysis (Suissa et al. [26]). Despite efforts by the SPOR Canadian Data Platform to build on existing investments and infrastructure (such as that at MCHP) to conduct multi-jurisdiction research, administrative data are unlikely to be freely distributed for widespread use.

Fewer ethical concerns arise about sharing environmental data like those collected at the IISD-ELA. However, environmental science is increasingly adopting "big-data" approaches and sharing may become more of a concern.

8. Differences between Platforms

Research platforms, including the two compared here, vary in terms of how their data are collected. MCHP first developed around acquiring and linking various files from government operating agencies. Centres like MCHP use record linkage to build on studies typically designed for different purposes by combining the details on each linked individual (de-identified for confidentiality purposes). Such additional information allows stronger, often quasi-experimental research designs (Oreopoulos et al. 2008).

The IISD-ELA, given the five uniquely untouched reference lakes, has been able to set up and support an environment conducive to true experimentation. This dramatic "design advantage" has been critical to the ELA's success. Moreover, some projections are confidently made; data from one lake may be used to predict what's probably happening in another. For example, chemistry data vis-a-vis runoff from one lake (Lake 239) is often scaled to parallel information from other water sheds at ELA (correcting for size).

With their regular program of primary data collection from the lakes under study, ELA researchers control data quality in gathering this information; they have had less need for MCHP's data quality software. This data quality software is oriented towards identifying and correcting possible problems in unfamiliar fields supplied by outside agencies. Any platform accepting data from outside agencies confronts potential problems with validity and reliability. Increasingly, IISD-ELA data are being incorporated in larger

national and international datasets where data quality and comparability create new concerns. Data quality software may eventually prove helpful in coordinating information gathered by various investigators using somewhat different methodologies (Lindenmayer and Likens [4]).

Agencies change over time regarding access to already collected information and in data collection decisions. Such issues would seem to be more likely with "human oriented" administrative data, but the Canadian Department of Fisheries and Oceans did terminate invaluable long-term (up to 45 years) records of Sockeye salmon population dynamics in British Columbia several years ago (Hughes et al. [22]). Such decisions have major implications for research!

9. Conclusion

Comparisons between the place-oriented platforms underlying the MCHP and the IISD-ELA highlight the many similarities in opportunities generated for research and in the problems faced. Constructing platforms for research enhances the potential of the "data rich" environments developing across fields. Building on existing information and concepts enables leveraging and testing existing knowledge. A wealth of data and specialized skills have developed as platforms have grown.

Researchers can look for existing platforms to connect to or might consider expanding their own work to develop new platforms. The policy and academic research potential resulting from a platform is definitely worth the effort!

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Conflicts of Interest

The authors confirm that there are no conflicts of interest.

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