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Longitudinal Data Systems to Support Data-Informed Decision Making: A Tri-State Partnership Between Michigan, Minnesota, and Wisconsin

Christopher A. Thorn and Robert H. Meyer

Many states are ill equipped to manage and effectively use the data that they are now required to collect as a result of the No Child Left Behind Act (NCLB; 2002) and other state and federal policy initiatives. Michigan, Minnesota, and Wisconsin, in partnership with the Wisconsin Center for Education Research (WCER), recently submitted a collaborative proposal (Wilmot & Meyer, 2005) to the U.S. Department of Education, Institute of Education Sciences, to create a multistate longitudinal data system (LDS) that will enable education stakeholders to conduct value-added and other diagnostic and policy-relevant evaluation research and engage in data-informed decision making, with the ultimate goal of strengthening teaching and improving student achievement for all students and all schools. All three states received awards, creating a joint initiative called the Tri-State Partnership.

To achieve its goals, the Tri-State Partnership is structured to ensure that all LDS design decisions will be fully informed by a thorough understanding of end-use requirements and, more generally, by the needs of all education stakeholders: parents and students; teachers; school, district, and state leaders and program staff; and policy makers (Hamalainen, 2001). By reaching out to a wide range of stakeholders, we expect to foster a sense of shared purpose and ownership in the LDS, resulting in stakeholder buy-in to the strategy of using data to drive student achievement.

Leveraging a Partnership to Do System Design

One of the distinctive aspects of the Tri-State Partnership is that it reflects genuine collaboration among three states and WCER. Working together will permit each state to share responsibility for at least 50% of all project tasks—in effect more than doubling the impact of the resources allocated. Moreover, by structuring work products so that they can be shared across the partnership, we expect to create products that will be of value to states outside the partnership (Alter, 2002). Project results and products, including overview papers that describe the concepts and strategies used in the project, will also be disseminated via conferences and workshops, including the Management Information Systems conferences sponsored by the U.S. Department of Education, National Center for Education Statistics.

The LDS developed by the partnership will include data on all students enrolled in PK–12 education. Collaborating with state partners in the PK–16+ Initiative, we expect to extend the LDS to include students enrolled in higher education.[1] This work will be a critical component of efforts focused on identifying the relative of success of high school graduates in the transition to postsecondary education. This partnership will also explore the data and collaborative infrastructure needed to evaluate teacher education programs. This would include linking to the

[1] The PK–16 Initiative was created to support collaboration between PK–12 and postsecondary education institutions. The goals of the group include improving the quality of PK–12 teacher preparation and professional development and aligning high academic standards for PK–12 students with postsecondary education.

student outcome data from new teachers in the PK–12 system in order gauge the effectiveness of teacher preparation programs.

The project is divided into distinct task areas—(a) data analysis and research requirements; (b) data access; (c) data dictionary; (d) data warehouse; and (e) secure data transport—as illustrated in Figure 1. Specific research methods for each task area are presented in detail in the proposal (Wilmot & Meyer, 2005). Each of the partners has been assigned a specific level of responsibility for each task and subtask: (a) primary responsibility; (b) secondary responsibility; or (c) review and implementation. The partners are also committed to using computer-supported collaborative work (CSCW) tools—that is, collaborative tools that will support distributed work and address many of the challenges of multisite development (Grudin, 1990, 1994). CSCW tools were used in the writing of the proposal as well as in the development of management plans. This early use of CSCW tools by both leadership and project team members created a shared understanding of the work practices involved.

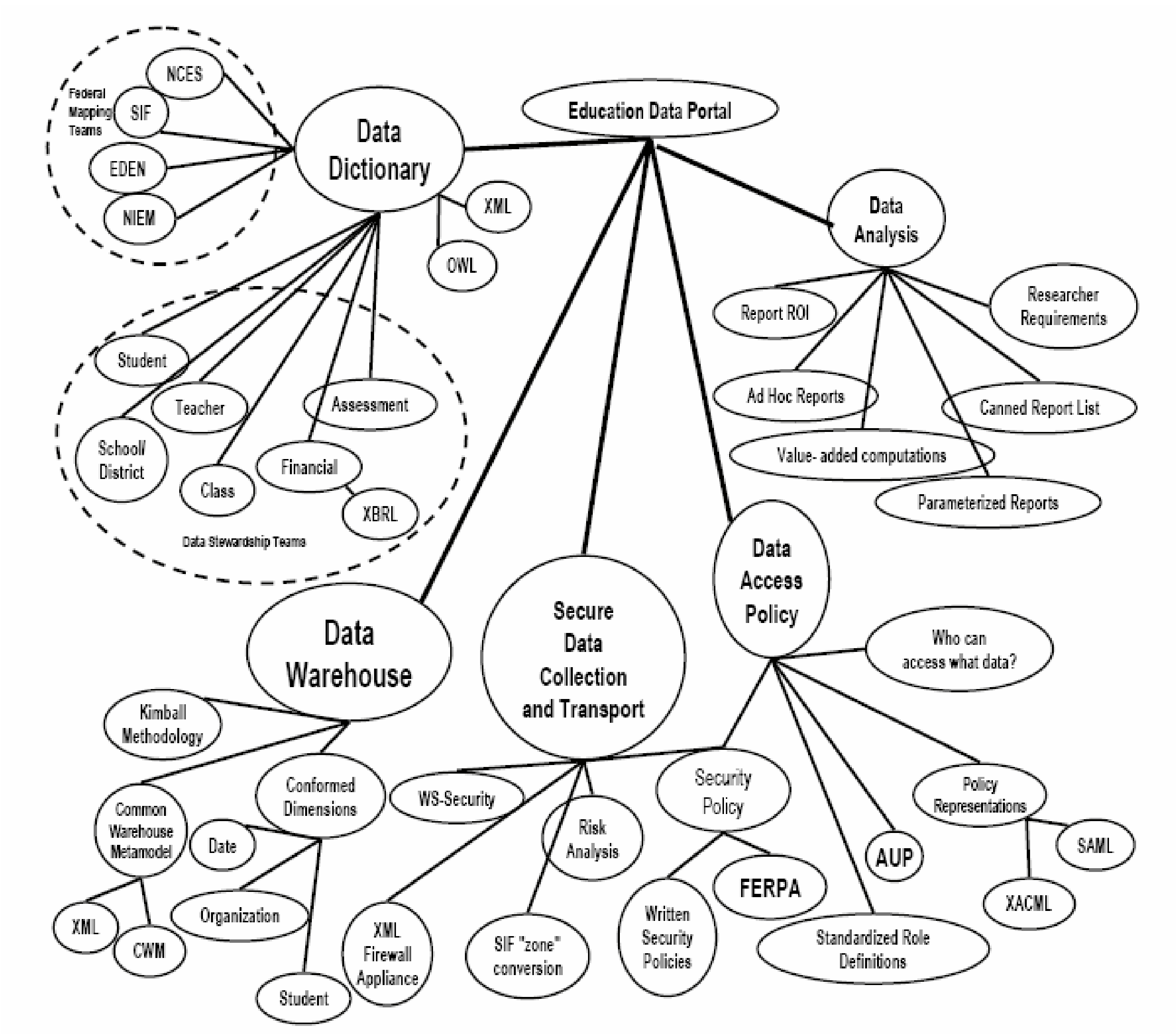

Figure 1. Longitudinal data system mind map (Wilmot & Meyer, 2005, p. 7).

Laying out the Details of Development

Tasks and subtasks of the partnership are broken down into discrete parts that can be designed and implemented in phases. This incremental approach to implementation will help us launch end-use applications and build local support for the overall project more quickly and effectively. Three types of activities will be subject to this phased-in implementation:

1. Shared cross-state activities (such as development and adoption of data dictionary specifications);

2. State-specific implementation of products (such as the data portal to support data access by various stakeholders); and

3. End-use applications (such as piloting a state value-added system).

Figure 1 is a concrete example of the initial development work done as part of the proposal preparation process and the collaborative process the partnership will engender. The graphical LDS "mind map" in Figure 1 was a contribution of one of the partners (Minnesota) to the others. Minnesota had already done substantial work with an external contractor on the major dimensions of an LDS. They generously allowed staff from the other states to take advantage of this investment and leverage it for the development of lines of work for the partnership. The collaborative technologies supported by WCER made this sharing easy and secure (Thorn, 2005). The availability of collaborative solutions coupled with the human support needed to scaffold their adoption allowed the partnership to engage in extensive knowledge accumulation and sharing.

Adopting Complex Tools and Evaluation Models

In developing longitudinal data systems to support data-informed decision making, the Tri-State Partnership is taking on a number of challenging tasks, made all the more difficult by the need for effective communication and collaboration among the partner states. This burden will have at least two dimensions. One will be to identify the decision support needs of the many stakeholder groups and to align storage and representation models with those needs. The other will be to foster understanding of new value-added models of program evaluation. Each of these challenges is discussed below.

Payoffs to Developing New Storage and Representation Models

The achievement of the partnership goals will require increasing understanding by the partners of the return on investment in knowledge infrastructure. One key payoff of such investment is the ability to develop new storage and representation models designed to support the decision support needs of partners' many stakeholder groups (Ross & Kimball, 2006).

The difficulty of developing new ways of representing data to inform decision making should not be underestimated. Muthukumar and Hedberg (2005) identify two important products of data warehouse design and construction: (a) the *knowledge repository* and (b) the *knowledge refinery*. The repository is "an electronic model that stores and manages explicit knowledge resources" (p. 384). The refinery is "a representation of the activities involved in the electronic creation and distribution of the explicit digital knowledge resources contained in the repository" (p. 384). These are important distinctions that are not transparent to someone who has not previously grappled with longitudinal data warehouse design.

The repository is a departure from traditional models in which data management is organized around operations. Early state-level education systems were designed to manage and track licensing for adult professionals (teachers, counselors, superintendents, etc.). Other systems were built around particular funding streams and were designed to ensure that services delivered to designated populations—special education students, English language learners, vocational education students, or other student groups—complied with funding agency requirements. Early state-level testing systems were designed to collect the results of statewide testing. Typically, testing was done in a handful of grades, and results were reported to the federal government for compliance purposes. Over the past 5–10 years, many states have also used test data to publish (in paper and on the Web) the year-by-year percentage of students' achieving proficient or average test scores to inform the public about the average performance of schools and districts by subgroup (gender, race, ethnicity, language status, etc.).

It is in the area of student outcome data—test results as well as behavioral indicators such as attendance and discipline statistics—that the first repositories began to emerge. Even then, most states did not link student performance over time in order to show growth in individual student learning. A repository, in contrast, is designed to link data from different operational sources into relational models that allow new meaning to be made of the data.

A refinery may transform data for a new audience or impose operational rules that differ from those defined for reporting systems. The following examples illustrate two such differences and the way in which they might be used to support decision making in particular circumstances.

First, consider the often-used proxy for household income—eligibility for free and reduced-price lunch. Some evidence suggests that students experience social stigma when they participate in free lunch (and breakfast) programs (California Project Lean, 2005). This phenomenon is associated with age: the older children are, the more likely they are to perceive this stigma. If children do not avail themselves of free or reduced-price meals in order to avoid the associated stigma, it follows that free and reduced-price lunch eligibility codes would underrepresent the number of poor students. Further, it is likely that this underreporting would increase with age. In the decision support system (aka refinery), it might be more appropriate to look at historical data to see if a child has ever been coded as receiving free or reduced-price lunch. This approach might yield a better indicator of household income and address both the issue of underreporting and concerns about the long-lasting impact of poverty. What would be a misrepresentation for an operational data system associated with food services would be totally appropriate for research on program effectiveness in which it was important to control for household income.

A second example comes from another area of household data. During the annual registration process, some districts and states request—but do not require—data on parental education. Because the data is not required, parents often decline to provide it. Given that most student systems are able to handle basic geographical data—zip plus four or census tract and block—it would be possible to use average education data from census records to fill in missing values. The appropriateness of using such a substitution technique depends on its purpose. If large consequences are associated with a decision made with this data, concerns about misrepresentation would be large. However, if the consequences are small, the inclusion of household education might provide vital information for redrawing attendance boundaries or other grouping activity intended to address some equity or access issue.

For state agencies whose primary information technology activity has focused on compliance, shifting to a model that allows for exploration and evaluation will not be a simple task. However, the payoffs of this increased flexibility are likely to be quite large.

Payoffs to Adopting New Value-Added Models of Program Evaluation

One of the challenges of the Tri-State Partnership—aside from the daunting task of building a complex student data system able to link students to teachers, schools, and courses—will be to encourage the partner states to explore new models of program evaluation. The Value-Added Research Center (VARC) at WCER is the project home for this effort. The VARC leadership team (the authors of this paper) will work with the three state partners to foster new ways of thinking about student outcomes and program effectiveness (Meyer, 2000; Meyer, 2002).

$$Y_{2i} = \mu + \delta Y_{1i} + \kappa' X_i + \sum_{l(\text{district})} \sum_{k(\text{school})} \sum_{j(\text{class})} \left\{ \alpha_{jkl}^{\text{class*}} I_{Cijkl} + \beta_{kl}^{\text{school*}} I_{Sikl} + \chi_{l}^{\text{district*}} I_{Dil} \right\} + \varepsilon_i$$

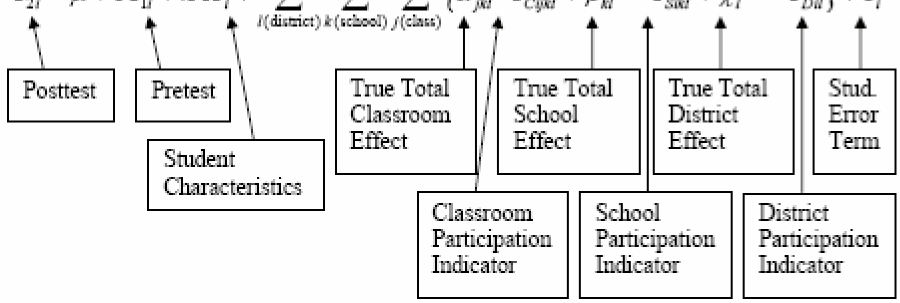

Figure 2. General value-added model for a given subject, grade, and year (Wilmot & Meyer, 2005, p. 113).

Figure 2 represents what we refer to as a *general* value-added model. It does not specify the particular value-added technique used to address a specific testing and accountability regime. Rather, it is our attempt to make explicit our understanding of a robust model of growth in student learning. The notational system is intended for technical audiences, but the model can also be explained using the boxes below the figure equation. What we are arguing is that models of performance should explicitly address the impact of student characteristics and the effect of classroom, school, and district inputs. This differentiates the VARC model from other value-added analysis frameworks that relegate many of these factors to a *black box* or fail to address them at all.

The VARC approach to school and district data analysis does not abandon the NCLB mantra of high expectations. Rather, the VARC model supports high expectations by examining the value added by programs and materials, professional development and teacher training, and a variety of models for school and classroom organization to determine which children learn more under which settings. High expectations by themselves provide a motivator but not guidance on how best to achieve challenging learning goals. As explained in the partnership proposal (Meyer & Wilmot, 2005), VARC's general value-added/longitudinal model can be used to estimate both value-added indicators and the effects of educational programs and other inputs. Thus, a single model can be used both to achieve educational accountability and to evaluate program effectiveness. One of the end-use applications that the partnership will explore is combining these tasks so that it is possible to provide concrete guidance to educators about available program options that will improve the performance of classrooms and schools. Each state in the Tri-State Partnership will examine different value-added models that are appropriate to its own testing schemes, resource allocation models, and governance structures.

As with the introduction of a refinery model of system design, the introduction of large-scale evaluation to the partnership will pose a number of technical and social challenges. Gaps in conceptual knowledge of study design and the appropriate use of student outcome data to fairly evaluate programs, schools, and materials are likely to engender concern across the entire range of stakeholders. It will be the responsibility of the partnership members to anticipate these concerns and focus on the shared values of rigor, transparency, and organizational improvement that brought the teams together.

The LDS proposal is an ambitious effort to address technical, social, and political challenges in supporting educational improvement. The Tri-State Partnership has been designed to address these challenges and create a collaborative environment that focuses on the shared needs and interests of the partners – maximizing the opportunity for collective action. The policy environment created by NCLB provides the impetus for change. It is our plan to exploit this pressure to *race to the top* rather than fight a rear guard action.

References

Alter, S. (2002). Whiteboard: The collaboration triangle. *CIO Insight, 9*, 21–27. Retrieved December 22, 2005, from http://www.cioinsight.com/article2/0,1540,16484,00.asp

California Project Lean. (2005). *Student wellness: A healthy food and physical activity policy resource guide.* West Sacramento: California School Boards Association. Retrieved December 21, 2005, from http://www.csba.org/ps/hf.htm

Grudin, J. (1990). Groupware and cooperative work: Problems and prospects. In B. Laurel (Ed.), *The art of human-computer interface design* (pp. 171–185). Reading, MA: Addison-Wesley.

Grudin, J. (1994). Groupware and social dynamics: Eight challenges for developers. *Communications of the ACM, 37*(1), 92–105.

Hamalainen, R. (2001). Evaluating a framework for multi-stakeholder decision support in water resource management. *Group Decision and Negotiation, 10*(4), 331–353.

Meyer, R. H. (2000). Value-added indicators: A powerful tool for evaluating science and mathematics programs and policies. *NISE Brief, 3*(3), 1–7. Retrieved December 22, 2005, from http://www.wcer.wisc.edu/archive/nise/Publications/Briefs/Vol_3_No_3/Vol%203,%20No%203.pdf

Meyer, R. H. (2003). *Value-added indicators: Do they make an important difference? Evidence from the Milwaukee Public Schools* (WCER Working Paper No. 2003-5). Madison: University of Wisconsin–Madison, Wisconsin Center for Education Research. Retrieved December 21, 2005, from http://www.wcer.wisc.edu/publications/workingPapers/Working_Paper_No_2003_5.php

Muthukumar, S. L., & Hedberg, J. G. (2005). A knowledge management technology architecture for educational research organisations: Scaffolding research projects and workflow processing. *British Journal of Educational Technology, 36*(3), 379–395.

No Child Left Behind Act of 2001, Pub. L. No. 107-110, 115 Stat. 1425 (2002).

Ross, M. & Kimball R. (2004, March 6). Differences of opinion: Comparing the dominant approaches to enterprise data warehousing. *Intelligent Enterprise.* Retrieved March 3, 2006, from http://intelligententerprise.com/showArticle.jhtml?articleID=17800088

Thorn, C. (2005). Systemic reform efforts in the U.S.: Role of information technology in fostering collaboration within new partnerships. In A. Visscher, J. Osorio, & Arthur Tatnall (Eds.,) *Information technology in educational management*. Dordrecht, Netherlands: Kluwer Academic Publishers.

Wilmot, B., & Meyer, R. H. (2005). *Longitudinal data systems to support data-driven decision-making: A proposal from Wisconsin* (proposal submitted to the Institute of Education Sciences Statewide Longitudinal Data System Grants Program). Madison: University of

Wisconsin–Madison, Wisconsin Center for Education Research, Value-Added Research Center. Retrieved December 23, 2005, from http://www.wcer.wisc.edu/varc/pubs/DPI_WCER_LDS_Proposal.pdf