

# Harnessing State Longitudinal Data Systems to Assess Career and Technical Education Outcomes

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## Background

States are at varying stages in deploying statewide longitudinal data systems (SLDS) that contain individual record-level data on public school students.<sup>1</sup> These data can be used to assess students' progress and outcomes in and across education levels, with information encompassing their preschool, kindergarten through grade 12 (K–12), and postsecondary education experiences. Moreover, when student-level identifiers can be linked to national data clearinghouses and state unemployment insurance wage record systems, relationships can be established among students' K–12 educational preparation, postsecondary enrollment, in-state labor market outcomes, and attainment of industry-recognized credentials, transforming SLDS into comprehensive, cross-sector P20/workforce data systems (P20W).

Career and technical educators have long understood the importance of connecting students' in-school experiences with their post-program outcomes. Since passage of the *Carl D. Perkins Vocational and Technical Education Act of 1998*, states have assessed high school students' performance on a set of core indicators specified in federal legislation. Statewide data are available for all students achieving a threshold level of career and technical education (CTE) coursework, with disaggregates for different student groups, dating back to 1999–2000.<sup>2</sup> At the secondary level, federal indicators include academic proficiency, high school graduation, and—beginning in 2020–21—at least one indicator of CTE program quality. At the postsecondary level, data encompass students' receipt of a recognized postsecondary credential<sup>3</sup> or retention at a postsecondary institution. Indicators common across both education levels include placement into employment, apprenticeship, or the military and participation in a program that leads to employment in a nontraditional occupation.

Although some states are working to incorporate CTE data into their SLDS, most maintain separate CTE databases to facilitate compliance with federal and/or state reporting requirements.<sup>4</sup>

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<sup>1</sup> According to the Education Commission of the States, although all states connect data between systems, all but 10 states have an operational SLDS. States lacking such a system include Alabama, California, Colorado, Montana, New Hampshire, New Mexico, Oklahoma, South Carolina, South Dakota, and Wyoming. See <https://c0arw235.caspio.com/dp/b7f9300060022a2299054bc6b35a>.

<sup>2</sup> These historical data are available at <https://cte.ed.gov/accountability/reports-to-congress>.

<sup>3</sup> As defined in the *Workforce Innovation and Opportunity Act*, a “recognized postsecondary credential” includes an industry-recognized certificate or certification, certification of apprenticeship completion, a license recognized by the state or federal government, or an associate or baccalaureate degree.

<sup>4</sup> Many states maintain separate CTE databases that include data not incorporated into a single, centralized SLDS. Some states, such as Florida, Louisiana, and Texas, have incorporated CTE-related elements into their existing K–12 and postsecondary data systems. These data continue to be collected in conduits separate from the SLDS, but the data are integrated into the SLDS from those conduits.

Although these data are accessible by state agency personnel and often may be linked to information in their larger SLDS, they are largely invisible to those outside the state agency.

Unfortunately, transferring existing CTE data elements into states' larger SLDS is not a simple task. Since states' CTE data systems were not designed with SLDS in mind, linking records without adequate documentation and controls can create problems, particularly if state CTE agency data are not well documented, are stored in ways that prohibit longitudinal records from being readily constructed and extracted, or are not subjected to regular quality checks for accuracy and missing information.<sup>5</sup> Consequently, until CTE elements are fully integrated into SLDS, education researchers will need to merge education data from multiple sources. This paper examines the elements that are critical to conducting CTE research, as well as national data sources and clearinghouses that will need to be accessed, for a more complete picture of education and workforce development.

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<sup>5</sup> Moreover, accessing trend data for a given CTE student does not mean annual data can simply be aggregated to produce a longitudinal record. Data must be collected across years using similar methods and coded in similar ways, and all data must be checked for accuracy and consistency before they can be aggregated to produce historical information. In practice, state data quality likely depends on the existence of state agency protocols and long-standing staff commitments to collecting accurate data over time. Given that state reporting requirements have been primarily cross-sectional, the quality of SLDS data may be determined only by analyzing system components element by element.

## Essential Data Elements

Much of the information needed to assess CTE students' experiences in a given education level is incorporated in SLDS (e.g., attendance, disciplinary records, academic performance, and completion data elements). These data can be extracted to infer levels of student participation in CTE and performance in academic and technical coursework. Other data—such as student receipt of an industry-recognized certificate, credential, or license; participation in work-based learning; or attainment of postsecondary technical credits—may be unique to CTE. Accordingly, researchers will need to cross-reference the elements collected at the state CTE agency level with those contained in SLDS to ensure they are able to access robust, longitudinal data on CTE students' experiences and outcomes.

Researchers and other CTE stakeholders<sup>6</sup> who wish to access CTE data in SLDS, or in combination with a state's stand-alone CTE data system, will need to be specific about the data elements they require and the purposes for which they will be used. Although state data dictionaries describe the elements that make up the SLDS, they may not shed enough light on how the information was acquired and coded. Metadata tools are generally available to describe business rules associated with acquisition, data cleansing, and other conversions that may have been adopted to integrate the data sources into SLDS.<sup>7</sup> Consequently, it is important that researchers consult with state data system managers (and if necessary, educators contributing data to the system) when accessing SLDS or state CTE agency data.

When research efforts involve more than one state, the Common Education Data Standards (CEDs) website and attendant tool sets are good starting places.<sup>8</sup> With the support of field representatives, CEDs project managers have identified a common vocabulary and criteria that states may use to record data across education levels and sectors. Intended to promote the interoperability, portability, and comparability of data across states, districts, and higher education institutions, data element descriptions and analytic tools can provide information that may help identify the information needed to address particular research questions. However, the use of CEDs is voluntary—states are under no obligation to use the tools

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<sup>6</sup> Requests for access to individual data often come from researchers. However, they also come from state auditors, administrative staff members charged with performance measurement and monitoring, and legislative committee staff members conducting program reviews, among others.

<sup>7</sup> See the *Forum Guide to Metadata: The Meaning Behind Education Data* (NFES, 2009). Metadata tools build on the data dictionaries of shared data inherent in SLDS to describe how and why elements are included. Many states maintain updated data dictionaries and metadata tools on their websites.

<sup>8</sup> See <https://ceds.ed.gov/elements.aspx> for a current listing and explanation of version data elements that include adult education, CTE, and workforce elements.

developed—so researchers will need to exercise care when accessing state data to ensure a full understanding of CTE data variables and the information they represent.

CTE programs are primarily designed to support students in achieving a basic set of goals that include attainment of academic knowledge and technical skills, preparation for postsecondary education and careers, and transition into the workforce. The remainder of this section focuses on four categories of data elements suggested by these basic goals—student participation, student characteristics, student success, and student identification—and the data elements that should be included in an SLDS to allow for informed research.

### **Student Participation**

The identification of a CTE student is a critical element of SLDS. Students' participation status is typically assigned based on the number of CTE credits they have earned. This may range from those with low levels of engagement in CTE (i.e., participants who earn a fractional credit or several credits in unrelated fields) to those achieving a higher threshold level of related coursework (i.e., students who have concentrated in CTE by earning multiple credits in a single program area).

Changes in federal definitions of a CTE concentrator have significant implications for CTE researchers. Before the 2018 reauthorization of the *Strengthening Career and Technical Education for the 21st Century Act (Perkins V)*, a CTE concentrator at the secondary level was identified as a student who earned three or more credits in a single program sequence, and at the postsecondary level, one who earned 12 or more credits in a single program area. Under new *Perkins V* requirements, the threshold for concentration status at the secondary level has declined to two or more courses in a single program area, but the postsecondary threshold remains unchanged. The definition of a completer (a CTE concentrator who has finished all coursework in a given state-approved CTE program sequence<sup>9</sup>) also remains unchanged across legislation.

The new concentrator definition has the potential to expand the pool of secondary students who are considered concentrators, which may have implications for the use of SLDS data. For this reason, researchers will need to retrospectively analyze state data if they wish to make comparisons of concentrator status over time. Federal language has also changed, with the criteria for concentrator identification changing from “CTE credit attainment” in previous legislation to “course completion” in *Perkins V*. If course completion does not equate to credit attainment (i.e., completion of a half-year course may confer less than one credit), then skill holdings of concentrators may differ over time.

An individual's classification as a participant, concentrator, or completer may be specified in a local student information system's processes and procedures. Such determinations may be

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<sup>9</sup> Some states are establishing a minimum threshold for completion (for example, complete three or more credits in a single program area). Since states are not required to report on CTE program completers for federal accountability purposes, there is considerable variability across states in this term.

made by management information system personnel at the school or institution level or at a district office by analysts preparing data for submission to a centralized state-level system. In these cases, personnel should make assignments based on guidance state officials provide. In other cases, state CTE management information system personnel may guide determinations through the use of course-level information embedded in the system reporting process or through separate transcript systems. Although moving this determination to SLDS operations through programs, algorithms, or business rules integral to longitudinal processes may improve data reliability, it does require that SLDS personnel charged with making these assignments fully understand the CTE landscape.

Where transcript-level data are limited or unavailable, states frequently rely on local personnel to assign CTE course-taking status to students. In some places, a district reporting unit may have these “local personnel” responsibilities. In others, it may be a school or institutional responsibility. This practice has implications for data reliability and consistency in and across sites, particularly if status assignments are based on cross-sectional analyses of course taking rather than a longitudinal review of student records. For example, CTE concentrator status could be assigned to any student completing a capstone course in a CTE program sequence, irrespective of whether they completed the preceding coursework. States also may use differing approaches for conferring CTE concentrator status to students who complete multiple programs, such as by assigning students to the CTE program they most recently completed. Although the U.S. Department of Education has promulgated nonregulatory guidance regarding the classification of CTE students in the past, each state has its own sets of decision rules. For this reason, analysts must exercise care when accessing SLDS data to identify students.<sup>10</sup>

*Perkins V* continues the requirement that all secondary and postsecondary grant recipients offer at least one CTE program of study (POS), although states are not mandated to report data on students participating or concentrating in these programs.<sup>11</sup> Consequently, states’ classification of CTE concentrators and completers is based on student course taking in a single program area or designated POS. Ideally, states would assign CTE status using student transcript data; status would be conferred by analyzing students’ technical course taking to identify those completing a threshold number of credits in a state-established or -approved, locally developed CTE program sequence. Use of transcript data is critical for assigning CTE POS concentrator status

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<sup>10</sup> Reauthorization of *Perkins V* has introduced new indicators and some changes both in terminology and expectation for CTE program rigor. Given the dynamic nature of the field, state SLDS will likely need to be updated over time to stay current. Moreover, the absence of federal regulatory or nonregulatory guidance for *Perkins V* may lead to greater variability in state CTE terminology and indicator construction.

<sup>11</sup> A CTE POS describes a rigorous sequence of CTE coursework that incorporates challenging academic standards; addresses academic knowledge, as well as technical and employability skills; is aligned to industry needs; progresses in specificity, from basic to occupationally specific instruction; has multiple entry and exit points that incorporate the credential; and culminates in the attainment of a recognized postsecondary credential. See Sec. 3(41) of *Perkins V*.

because programs are often associated with a specific set of courses that receive state approval. To ensure CTE students are correctly identified, researchers should look for the following types of data in SLDS, and they should consider conducting their own analyses to confirm state CTE status flags (Exhibit 1).

*Exhibit 1: CTE student participation elements*

CTE course credits
CTE course completion
CTE participant
CTE concentrator
CTE completer
CTE POS participant
CTE POS concentrator
CTE POS completer

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### **Student Characteristics**

Postsecondary institutions and school districts receiving *Perkins V* funds must provide equal access to CTE programs for students who may encounter challenges to their educational success. Student characteristics provide a basis for determining program accessibility. Demographic characteristics, such as gender, age, and race/ethnicity, apply to all students. Additional special populations in CTE are specifically targeted. These include individuals with disabilities; individuals from economically disadvantaged families, including low-income youth and adults; individuals preparing for employment in nontraditional fields;<sup>12</sup> single parents, including single pregnant women; out-of-workforce individuals; English learners; homeless individuals; youth who are in or have aged out of the foster care system; and youth with a parent in the armed forces on active duty. Consequently, there is a need to access unique sets of characteristics and demographic elements within SLDS to allow for meaningful analyses and reporting on CTE.

New student populations introduced in the *Perkins V* reauthorization include out-of-workforce individuals (formerly identified as displaced homemakers), homeless individuals, youth who are in or have aged out of the foster care system, and youth with a parent who is a member of the armed forces on active duty. These revised and new definitions will have ramifications for who is considered part of a special population for retrospective analyses. Moreover, states may have some difficulty scaling up the collection of data. Consequently, researchers will need to pay special attention to population disaggregates across years.

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<sup>12</sup> Nontraditional fields are occupational areas in which employment is underrepresented by gender, defined as comprising 25 percent or less of the workers in the field. *Perkins IV* included the requirement that the proportion of students participating in and completing nontraditional fields be regularly reported. *Perkins V* drops these expectations in favor of reporting on the percentage of CTE concentrators in programs or POS that lead to nontraditional fields. Nontraditional fields are identified through occupational data provided by the U.S. Bureau of Labor Statistics.

The elements in Exhibit 2 must be included in SLDS to both meet federal *Perkins V* reporting requirements and support analyses for characteristics of importance in the legislation. Some, such as gender, date of birth, and race, are typically incorporated into most state SLDS for secondary and postsecondary data. Others, such as information on individuals preparing for nontraditional fields, are unique to CTE.

**Exhibit 2: Student characteristics elements**

Gender
Date of birth
Race/ethnicity
Individuals with disabilities
Economically disadvantaged individuals
Foster children, including those in or who have aged out of the system
Homeless individuals
Individuals preparing for nontraditional fields
Individuals who are single parents
Individuals who are single pregnant women
Individuals who are out of the workforce
Individuals with limited English proficiency
Individuals with a parent in the armed forces on active duty

How elements are specified affects their accuracy and usefulness. In some instances, such as the identification of secondary CTE students with a disability, status assignments are clear. This is because federal guidelines integral to the *Individuals with Disabilities Act* and provisions in the *Every Student Succeeds Act* provide the necessary guidance. States or local agencies may use proxies to assign status when guidelines are not stipulated, such as for self-reported disability characteristics in postsecondary education or the identification of students from economically disadvantaged families. At the secondary level, this could include a student’s eligibility for free or reduced-price lunch. At the postsecondary level, this could include receipt of financial aid (e.g., Pell Grant).<sup>13</sup> As long as states use consistent criteria to assign disability and/or economic disadvantage status and do so for all students—not just those in CTE programming—SLDS can be used to control for student characteristics and comparisons of engagement and outcomes across populations.

Status assignments may be more complicated when criteria are unique to CTE programming or are based on subjective criteria. For example, states are required to report information on students who are single parents, including single pregnant women. In the absence of clear criteria for identifying these students, local program personnel are left to make their own status assignments. This can undercut the validity and reliability of data in states and even across

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<sup>13</sup> The use of proxies is not without challenges. For example, studies suggest that secondary students may be more likely to underreport eligibility for free or reduced-price lunch due to concerns of social stigma, which may undermine the validity of the measure. Disentangling measurement issues associated with assigning special population status is beyond the scope of this report.

schools or institutions in a given school district or community college.<sup>14</sup> Therefore, controls on data collection and reporting must be built into the CTE data system and incorporated into SLDS to ensure data elements are consistently and accurately reported.

## **Student Success**

Education success is traditionally measured in terms of program completion. With respect to the core indicators described in *Perkins V*, at the secondary level, students are considered to have completed their studies when they attain a high school diploma or industry-recognized certification, credential, or license, and at the postsecondary level, an industry-recognized certification, occupational license, or education certificate. Accordingly, these data elements are obvious and important candidates for SLDS inclusion. Experiences that indicate continuing progress, such as completion of a CTE POS, also can be considered indicators of future success.<sup>15</sup>

Providing information on CTE students' experiences after they exit their programs is the game-changing contribution of SLDS. These systems provide information on students' experiences as they transition across education levels—and where connections can be established, into postsecondary education and advanced training and/or employment. Accordingly, a functional SLDS should include the elements listed in Exhibit 3, which can be used to examine CTE student success.

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<sup>14</sup> In some cases, metrics that have long been thought to provide valid data may have drawbacks. For example, states' use of free or reduced-price lunch eligibility criteria to identify individuals who are economically disadvantaged may lack reliability over years due to changes in student eligibility over time. Other approaches for identifying such students are being advanced. See, for example, [http://blogs.edweek.org/edweek/inside-school-research/2015/06/ies\\_offers\\_alternatives\\_to\\_fre.html?utm\\_source=feedblitz&utm\\_medium=FeedBlitzRss&utm\\_campaign=insideschoolresearch](http://blogs.edweek.org/edweek/inside-school-research/2015/06/ies_offers_alternatives_to_fre.html?utm_source=feedblitz&utm_medium=FeedBlitzRss&utm_campaign=insideschoolresearch). Also see National Forum on Education Statistics (NFES) (2015). Consequently, individuals will need to use care when accessing SLDS data to ensure data are both valid and reliable. In some instances, other approaches to identifying students using existing SLDS variables may be warranted.

<sup>15</sup> Although tipping/transition points may represent major milestones in students' education pathways, such as the attainment of a high school diploma or an associate degree, they also may encompass lesser accomplishments, such as the point at which a student completes the technical courses in a CTE POS, because they can be used to predict future outcomes. It is beyond the purpose of this paper to attempt to identify tipping/transition point metrics that should be incorporated into SLDS. Paradoxically, it may be impossible to accurately identify these points until functional SLDS are brought online.

### Exhibit 3: Student success elements

<b>Secondary</b>
Postsecondary credit awarded in high school (e.g., Advanced Placement, dual or concurrent enrollment)
Industry certifications, credentials, or license
Standard high school diploma
Special diplomas and awards
<b>Postsecondary</b>
Continuation of secondary POS
Eligibility for and enrollment in developmental education coursework
Successful completion of developmental education coursework
Enrollment in credit-bearing coursework upon completion of developmental education
Application of secondary dual or concurrent enrollment credit toward a postsecondary certificate or degree
Industry-recognized certification, occupational license, or education certificate*
<b>Employment and earnings</b>
Employment by North American Industry Classification System code
Wages and earnings
Employment retention

\*Working definitions of nondegree credentials provided by the Interagency Working Group on Expanded Measures of Enrollment and Attainment can be found at <https://s3.amazonaws.com/PCRN/uploads/studentdef.pdf>.

Assessing transitional outcomes will take on increasing importance, given the introduction of new program quality indicators in *Perkins V*. For example, one expectation is that high school students have the option to earn postsecondary credit through dual or concurrent enrollment before graduating. Information on whether high school students earning such credits subsequently apply them toward their college degree program may be obtainable only in a holistic SLDS environment.

As SLDS mature, longitudinal data will increasingly become available on CTE students' post-program outcomes and trajectories. These data will include information on high school students' enrollment in in-state public workforce training programs and/or two-year and four-year colleges and universities, as well as transfer from two-year to four-year baccalaureate degree-granting institutions. Data on post-program employment and earnings are also expected to improve with time and expand to cover reporting options from other state and national data sources.<sup>16</sup> For example, it may be possible to assess CTE students' participation in other federal or state social service systems, such as participation in the federal Supplemental Nutrition Assistance Program, enrollment in federally funded or state-funded job training programs, receipt of state unemployment benefits, or incarceration in a state jail or prison.

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<sup>16</sup> According to a 2019 Education Commission of the States survey, 16 states and the District of Columbia maintain a P20W SLDS system that can be used to access information on students from early learning through the workforce. See <https://www.ecs.org/state-longitudinal-data-systems/>.

## Student Identification

In states with fully integrated SLDS, there is likely no need for researchers to have access to individually identifiable data because states have developed anonymous identifiers to mask personal identity elements.<sup>17</sup> The anonymous identifier replaces potentially sensitive personal information, such as name, Social Security number (SSN), and birthdate, with a random number that retains important characteristic details. However, there may be studies in which a researcher will need to collect or incorporate additional individually identifiable data from a source that is not part of the SLDS. If matches between SLDS data and the additional sources may provide important insight, the state SLDS team should do the necessary matching before removing or masking identifiable fields. There may be limited cases in which the state may allow the researcher to access identifiable information to achieve a match.

Researchers who are interested in answering questions about CTE students may need to find new approaches for linking student records across datasets where CTE data are not fully integrated in an SLDS. In these cases, the elements listed in Exhibit 4 will be important to consider.

### *Exhibit 4: Student identity elements*

Individual student anonymous identifier

First, middle, and last name

Date of birth

Gender

SSN

Location

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Note: "Location" may take several forms: a home address, a school location, a recent school attended, or other.

Connecting education and workforce information introduces an added challenge because of the need to include SSNs in SLDS. This is because an SSN is the primary personal identifier in quarterly unemployment insurance wage records in most states.<sup>18</sup> In its study of higher education data systems, the State Higher Education Executive Officers Association reported that the majority of postsecondary student-level information data systems included the collection of SSNs as part of their student identity data elements (Whitfield, Armstrong, & Weeden 2019). Although the collection of SSNs for K–12 students is a more sensitive issue than in postsecondary systems, at least half of the states capture (or at least allow for the local collection of) SSNs as a part of their K–12 data collection systems.<sup>19</sup> At least 30 states had general laws

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<sup>17</sup> See, for example, NFES (2012).

<sup>18</sup> Florida has introduced wage record reporting that includes full names, as well as SSNs. The Florida Department of Education has begun exploring the value of using the name information in its matching routines. As of October 2016, the results were inconclusive.

<sup>19</sup> In some cases, particularly the K–12 data collections that were operating before the SLDS program started, the SSN is embedded in a student identification number. In others, it is sought as a demographic data element.

limiting the use of SSNs in their state administrative data systems in 2007.<sup>20</sup> Eight states, by policy or law, restrict or prohibit the collection of SSNs specifically from K–12 students.<sup>21</sup> Limitations on the collection of SSNs restrict states’ capacity to link secondary education and employment data via quarterly wage reports. Several states have worked through these restrictions by including SSNs for secondary students after they appear in state postsecondary records (GAO, 2014).<sup>22</sup> At least two states link K–12 records to state driver’s license or ID records to obtain SSNs for K–12 students who are in high school.

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<sup>20</sup> See footnote 1 in <https://www.mofo.com/resources/publications/state-statutes-restricting-or-prohibiting-the-use-of-social-security-numbers.html>.

<sup>21</sup> See the “state limits” section on page 5 of <https://oig.ssa.gov/sites/default/files/audit/full/pdf/A-08-10-11057.pdf>.

<sup>22</sup> According to the GAO report (p. 76), the 2013 DQC survey reported that out of the grantee recipient states, 31 could match data across P–12, postsecondary education, and the workforce.

## Areas for Future Consideration

Fully operational SLDS offer researchers access to a range of education data for the universe of students in a state. The systems can support statistically based research on CTE programming and the contribution of applied learning on individuals' college preparation and career success. However, SLDS development is at a crossroads. Continued federal funding for the expansion of SLDS will eventually be more narrowly focused or end. States will increasingly need to depend on their own investments, philanthropic giving, or some combination thereof for system expansion and maintenance. State-level or any organizational interest in providing support will require that the systems produce useful information that responds to current issues and policy interests likely to garner high levels of interest among states and educational providers.

Complicating state-level support questions are myriad concerns from elected officials and others about “cradle-to-grave” data systems containing personally identifiable data. There is an urgent need for researchers, especially those with a CTE focus, to produce compelling and usable reports, research results, proposed policy actions, and evaluation findings that would not otherwise be available from a traditional administrative information resource. Simply put, the short-term emphasis needs to be on data uses that maximize the unique characteristics of SLDS, such as their cross-sector coverage and their longitudinal aspect.<sup>23</sup> Emphasis also must be placed on converting the data into information that is accurate, easy to understand, and actionable. Data visualizations and infographics may improve how data are conveyed to decision-makers. As this occurs, the benefits of SLDS should become clear and the path forward more easily justified.

As important as compelling data uses are to sustaining systems, state database administrators and agency personnel must address additional issues related to SLDS development. The issues include providing assurances of thorough, continuous governance and stakeholder engagement processes; deploying strong data security and privacy protection policies; improving data timeliness and accuracy; and filling gaps in data coverage. Inclusion of secondary and postsecondary CTE state organizational entities is crucial to addressing these issues. Unfortunately, the capacity of state agency personnel to undertake improvements, expand services, and address new content—while continuing to maintain basic operations—is limited. However, these are areas in which contractors with expertise in longitudinal data analyses and education researchers (CTE researchers in particular) can guide the form that improvements take and offer strategies to facilitate the effective use of SLDS. Suggested areas of work are discussed below.

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<sup>23</sup> Most public reporting efforts in states have been geared toward complying with federal and state laws rather than addressing questions of interest to education stakeholders (DQC, 2014). To be useful, SLDS must provide actionable information that gives insight into student experiences and outcomes, not all of which have been incorporated into data systems.

## Supplying Use Cases

Although SLDS contain a wealth of information, not all potential users have the research knowledge or statistical skills to use the longitudinal information they contain. To promote appropriate access and use of study findings, at the national and state level, there is a need for guidance and assistance on how SLDS can be harnessed to produce useful information. The Institute of Education Sciences at the U.S. Department of Education is helping spearhead such efforts through its funding of the CTE Research Network, which is promoting studies to strengthen the rigor of CTE research and learning across researchers.<sup>24</sup> Although not all studies make use of SLDS data, findings from network-sponsored studies and cross-researcher discussions will help promote causal studies of CTE and offer new opportunities to harness SLDS in conducting this work.

The U.S. Department of Education's Office of Career, Technical, and Adult Education has also undertaken efforts to promote responsible data collection and use through national activities, such as communicating information through its Perkins Collaborative Resource Network.<sup>25</sup> Such collaborative activities foster state information sharing on the uses of data and the challenges of working in SLDS environments. Finally, the National Center for Education Statistics has initiated efforts to provide this guidance, although more work is needed.<sup>26</sup>

Technical information on CTE must be provided to education data administrators at all levels. Researchers and state administrators working to extract datasets or conduct analyses using SLDS are often unfamiliar with CTE programs and the nuances of locally reported data. This can cause problems if those charged with providing data lack the insight into why information is being collected or how CTE data differ from other types of information included in SLDS. Efforts have been made to provide such guidance. For example, before the 2008 Great Recession, several large states convened a series of meetings focused on education reporting and state data systems. These meetings alerted data system administrators about forthcoming changes to data systems due to congressional, legislative, executive, or administrative actions. The meetings also included panels about data reporting issues and best practices. Frequently, the meetings included training sessions about SLDS and their importance and limitations. Research projects and their results were also highlighted. These types of convenings were important for fostering a sense of partnership between state officials and local counterparts.

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<sup>24</sup> See <https://cteresearchnetwork.org/research>.

<sup>25</sup> See <http://cte.ed.gov/>.

<sup>26</sup> See <http://ies.ed.gov/ncee/pubs/20154013/pdf/20154013.pdf>. See also GAO (2014) and NFES (2012). The Institute of Education Sciences has also reorganized the Regional Educational Laboratories based on research on and researcher use of SLDS data. See <http://ies.ed.gov/ncee/edlabs/>. Further, the National Center for Education Research and the Institute of Education Sciences encourage the use of SLDS data in several of their grant programs. See <http://www.ies.ed.gov/ncer/projects/program.asp?ProgID=76> and <http://www.ies.ed.gov/ncer/projects/program.asp?ProgID=90>.

When the Great Recession hit, face-to-face conferences were largely canceled. Although there have since been efforts to continue such dialogues through video and other forms of electronic conferencing, the levels of statewide communication and collaboration have been reduced.<sup>27</sup>

Methodological guidance is also needed to ensure that those accessing SLDS make effective use of their capabilities regarding CTE data. This could be accomplished in states by the development of state-level handbooks that lay out the issues underlying the use of CTE data contained in SLDS. Examples in the guide could include descriptions of the types of analyses that may be conducted and the appropriate use of rigorous statistical techniques (for example, the application of quasi-experimental designs to create matched comparison groups when more rigorous evaluations, such as randomized control trials, are not feasible). Guidance on how gaps in data element availability may lead to misinterpretations of observed findings are also necessary.<sup>28</sup>

Ultimately, if SLDS are to be used to improve CTE programming, local education practitioners must be engaged in the data analysis to produce actionable information. One way might be for education researchers to work with CTE instructors and faculty members to identify a critical set of research and policy questions that SLDS can help answer. Models of how data can be used to answer these questions could then be provided. These use cases might include lists of data elements that should be included, options for generating comparison populations, statistical methods for analyzing data, and strategies for translating findings into actionable information.

Many states are establishing or recasting processes for reviewing research proposals, sharing data with researchers, and helping researchers understand the data in their systems. As projects are approved by state authorities, data provided, and research plans finalized, it is important that researchers provide structured feedback to state SLDS and CTE administrators. This feedback could include possible improvements to SLDS support services and request

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<sup>27</sup> Annual and more frequent meetings become a huge cost issue for state and local administrators when financial resources are stressed. It is challenging to simply maintain day-to-day operations. Such things as database conferences, problem-solving work groups, and stakeholder engagement efforts are not seen as critical. When such efforts are curtailed or canceled, it becomes more difficult to reestablish them. One solution is to replace them with webinars or teleconferences.

<sup>28</sup> The National Center for Analysis of Longitudinal Data in Education Research (CALDER), which is funded by the Institute of Education Sciences, has also been established to publish research articles and monographs illustrating the sophisticated use of SLDS data to address and demonstrate K–12, postsecondary, and workforce research issues. See <http://www.caldercenter.org/>. Similarly, the Institute of Education Sciences has established the Center for Analysis of Postsecondary Education and Employment (CAPSEE) at Columbia University. See <http://capseeecenter.org>. Both CALDER and CAPSEE maintain inventories of projects and publications on their respective websites and share research findings and methods through annual conferences. At this point, neither organization has provided sets of “lessons learned” in their efforts to work through state SLDS operations.

procedures. The most important feedback should focus on technicalities about data elements, the processes by which records are conjoined over time and across sectors, and data accuracy.<sup>29</sup>

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<sup>29</sup> [https://nces.ed.gov/forum/pub\\_2012809.asp](https://nces.ed.gov/forum/pub_2012809.asp).

## Ensuring Data Governance and Continuous Stakeholder Engagement

The advent of SLDS has focused attention on data governance processes that go beyond what has typically been applicable to state education agencies at the secondary and postsecondary levels.<sup>30</sup> This has led to moving data systems away from a compliance mindset to one that is intended to inform policy development, model education progress, and track outcomes. Continuing data governance is also critically important because SLDS include data from different agencies that often have diverse missions and data conventions. Joining the systems longitudinally requires hundreds of so-called “business rules.”<sup>31</sup>

An SLDS governance process must include representatives of the various agency data owners, information technology staff members, state and local business practitioners, legal counsel, and data customers. These representatives must also be agents of the major data contributors, such as early childhood educators, K–12 and postsecondary program administrators, and workforce agency staff members. They must be engaged to supply critical information and feedback for data collection and use in these areas of education. Providing for continuous stakeholder feedback is an important function in these data governance processes.

The CTE research community plays an important role. Researchers have a responsibility to work through agency access processes, observe protocols on data agreements, and navigate the business rules that underpin the longitudinal data. All these functions can be improved. Researchers are in an ideal position to observe the effects of applying business rules and recommending improvements, and their experiences should be shared with SLDS managers to improve system access and confidentiality.

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<sup>30</sup> See NFES (2011). Page 7 discusses the advent of governance requirements brought about by SLDS.

<sup>31</sup> Florida deployed the first P20W SLDS in 2003. Personnel identified more than 800 data business rules to conjoin secondary and postsecondary data elements from their separate data systems. These business rules dealt with common reporting anomalies, changes in collected items and definitions, and other factors that became the basis of their SLDS metadata approach.

## Protecting Privacy While Preserving Access

Federal and state policymakers continue to establish and refine interpretations of laws and policies intended to balance student privacy, data security, and data use. The Data Quality Campaign (DQC) reported that in the 2017 legislative session, state lawmakers introduced 93 bills focused on protecting the privacy of individual student records.<sup>32</sup> These bills and the deliberations regarding their passage included efforts to establish guidelines on how states collect, use, and report student data, in addition to safeguards to protect who may access data and for what purposes, improvements in transparency, and technical issues associated with data transfer and storage) (DQC, 2017).<sup>33</sup> In attempting to improve data security, care must be taken to ensure researchers and other user communities are not prohibited from accessing information or faced with significant delays between initial requests and the provision of extract files.

Most states have clearly defined policies regarding record storage and retention for individually identifiable records compiled for administrative data systems. Generally, these policies are based on the premise that datasets should remain available and accessible so long as there are legitimate uses of the data for administrative purposes, including audits and the resolution of audits. When these policies were originally promulgated, “administrative purposes” were originally thought to be in the general range of three years, with provision for exceptions. A three-year period seems limited for the vision of an SLDS, in which a functional configuration could logically mean the continuous collection of data on individuals throughout their early childhood, K–12, postsecondary, and graduate education. This could potentially create record series spanning 22 years or more. Additional time also may be needed to assess longer-term employment outcomes, with no clear timeline yet identified for accurately capturing the return on education investment. Without clearly defined purposes and demonstrable uses of the data, it is difficult to define reasonable time periods that would govern the retention of longitudinal data series.

All existing SLDS, even relatively mature ones (such as those in Texas and Florida) are in varying stages of continuous implementation. Because they are relatively new, the period defined as “longitudinal” is limited to a few years. However, as more and more data are compiled, the maintenance of the longitudinal integrity of the student-level data will be challenged. As an initial foray into longitudinal reporting and analysis, a palatable course of action (at least with respect to CTE programming) might be to work within an appropriately

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<sup>32</sup> See <https://dataqualitycampaign.org/wp-content/uploads/2017/09/DQC-Legislative-summary-0926017.pdf>.

<sup>33</sup> See [https://iapp.org/media/pdf/resource\\_center/DQC-Leg-summary-2016.pdf](https://iapp.org/media/pdf/resource_center/DQC-Leg-summary-2016.pdf). According to the DQC report, since 2013, 49 state legislatures have introduced 419 related bills. Of these, 36 states have enacted 73 laws related to student data and privacy protection.

restricted length of time centered on key education and/or workforce transitional events.<sup>34</sup> For example, one of the more important policy pieces in assessing CTE programs relates to students' successful transition into further education and training—and at the postsecondary level, into work. To give policymakers access to these data, states might create a limited extract file for a cohort of graduating high school students who achieved a threshold level of CTE coursework. This file could contain and retain longitudinal data for up to three years on students' high school educational experiences.<sup>35</sup> Records would be merged with state postsecondary data supplemented by the National Student Clearinghouse (NSC)<sup>36</sup> and augmented, when feasible, with information contained in state unemployment insurance wage records and national datasets.

This three-year period would provide sufficient time to assess immediate transitions for students while accounting for delays in student matriculation in postsecondary education or training (e.g., for students who delay enrollment for personal reasons). Results could be used to track students' attainment of short-term certificates or credentials and to assess students' completion of an associate degree.<sup>37</sup> At the end of this three-year period, the file would be destroyed. This would simplify state data request responses, as well as request management by SLDS staff members, although it would compromise states' and researchers' capacity to assess the long-term outcomes of students. Over time, as privacy and other security concerns are addressed with new technologies, the potential for maintaining data for longer periods of time could be explored.

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<sup>34</sup> DQC reported that, based on its annual survey of state SLDS actions, at least 11 states had high school feedback reports in 2013 that dealt with transitions to postsecondary education, and in some cases, employment across the high school-to-postsecondary transition time periods, generally covering the year following high school graduation.

<sup>35</sup> One possible drawback of such an approach is that it presumes a student's enrollment or employment outcome is associated with only their most brick-and-mortar education affiliation. Although it is likely that outcome snapshots reflect a cumulative and complex set of factors, including formal and informal education and training experiences, researchers' abilities to control for all these experiences may not be feasible, given existing privacy constraints.

<sup>36</sup> Founded in 1993, NSC provides comprehensive information on student enrollment outside of a state's boundaries and in private institutions. Containing longitudinal data for over 98 percent of postsecondary students attending degree-granting, *Title IV*-eligible institutions, as defined in the *Higher Education Opportunity Act* (P.L. 110-315), for a negotiated fee, NSC enables state personnel and researchers to track whether students enrolled in a postsecondary education institution; their institutional location, affiliation, and type; and their enrollment status and attendance dates. NSC has plans to include information on graduation date, degree title, and major. Costs associated with accessing NSC must be weighed against the value it provides.

<sup>37</sup> Three years is one standard used for assessing the award of an associate degree, which corresponds to 1.5 normative time to degree. This is consistent with Integrated Postsecondary Education Data System reporting, as well as such initiatives as Achieving the Dream.

## Strengthening SLDS Capacity to Assess Student Transitions

Ideally, SLDS would include information for all postsecondary education institutions operating in a state. Comprehensive data can provide the basis for shared analysis and shared policy development among agencies. In addition, comprehensive data are preferable because course, performance, and completion rates differ among state education systems. However, there are drawbacks—even if these connections can be made. For example, many of the states that connect to postsecondary education do so only for public institutions.<sup>38</sup> This coverage is often uneven because postsecondary data reporting capacity differs across states, with some lacking centralized data systems. Assessing the outcomes of high school students or adults participating in CTE will require strengthening the collection of post-program data, improving the quality and completeness of postsecondary placement data, and introducing elements to gauge the scope of student transitions.

Although combining states' in-state enrollment data with NSC enrollment data can produce high match rates, these data are not without their limitations. Gaps in institutional coverage — in particular, among private trade schools offering technical training—may adversely affect match rates for some types of students. To avoid presenting an incomplete story on CTE students, researchers will need to consider how gaps in NSC coverage may affect their observed outcomes. This can be accomplished, in part, by paying attention to the mix of CTE programs offered in high schools, the relative number of students enrolling in different programs, and the type of individuals for whom data are missing.

To fill gaps inherent in state-level data systems, the Western Interstate Commission for Higher Education (WICHE) has developed a multistate longitudinal data exchange among member states. This exchange is being expanded to include at least 10 states. There are already significant lessons learned from WICHE's use of shared datasets with respect to the transitions across education sectors and into the labor force.<sup>39</sup>

Students enrolling in a POS in high school may also have the option of earning postsecondary credit while in high school through dual or concurrent enrollment programs. Unlike Advanced Placement credits in academic subjects, which typically transfer readily across institutions and state lines, technical credits may be limited to a specific institution for which an agreement has been negotiated or to a subset of institutions in a region. Technical credits are rarely recognized statewide and even less rarely recognized across state lines. Processes must be built into SLDS not only to allow for assessing whether credits were awarded at the high school level but also to determine whether students who earned them subsequently enrolled in an institution that recognized and accepted those credits. It must also be assessed whether the students were able to apply the credits toward their postsecondary program and ultimate completion.

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<sup>38</sup> See <https://www.wiche.edu/files/info/Fostering%20State-to-State%20Data%20Exchanges.pdf>.

<sup>39</sup> See <http://www.wiche.edu/longitudinaldataexchange>.

If the aims of CTE programming are to be realized, educational coursework must be aligned so that high school students have the necessary skills to succeed in postsecondary academic programs. Additional data elements may be needed in some SLDS to improve states' ability to assess whether high school students are adequately prepared for college-level studies. Among other things, this will entail collecting information on whether CTE students who enrolled at a postsecondary institution were either identified as having educational needs and/or were enrolled in developmental coursework.

### **Education to Employment**

States have encountered difficulty linking education and workforce data, and these challenges are most pronounced at the K–12 level, where only 19 states have reported the capacity to link their in-state records (DQC, 2014). A few states have accessed national datasets, such as the Wage Record Interchange System (WRIS) and before its demise, the Federal Employment Data Exchange System (FEDES), to complement what is collected via state wage records.

Unfortunately, the January 2018 termination of the federal grant to support FEDES has made matching of state education data with federal employment records impossible.

Two WRIS are maintained through contracts with the U.S. Department of Labor.<sup>40</sup> WRIS facilitates the exchange of information from state unemployment insurance wage reports so that states may assess out-of-state employment outcomes for participants in Department of Labor-funded programs. WRIS supports the exchange of individually identifiable data from states and back to states that voluntarily participate, and all states participate in WRIS. WRIS 2 is designed to support non-Department of Labor programs in meeting required federal reporting requirements (such as *Perkins V*). WRIS 2 receives identifiable data from states and provides aggregate statistics regarding individuals found to be employed in other states. The data are generally limited to whether someone was employed, the industry of employment, and quarterly wages. Few states collect information about full- or part-time employment status or job industry classifications. As of October 2019, 45 states, the District of Columbia, and Puerto Rico participated in WRIS 2. WRIS 2 can provide useful data to CTE researchers and state administrative operations, but the aggregation of results limits the data's value for SLDS because they cannot be incorporated into SLDS on a longitudinal basis. Further, the limited participation of states has a differential impact among the states with respect to the data's usefulness.

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<sup>40</sup> See <http://www.doleta.gov/performance/wris.cfm> for a general description of the operation of WRIS and WRIS 2. See [http://www.doleta.gov/performance/wris\\_2.cfm](http://www.doleta.gov/performance/wris_2.cfm) for differences between WRIS and WRIS 2.

To comply with *Perkins IV* reporting requirements, some states conducted annual surveys of all high school graduates who completed a CTE program.<sup>41</sup> In lieu of conducting universal surveys, CTE researchers may consider contacting a representative random sample of students in a state who were identified as not having enrolled in postsecondary education. Identified students would then be followed using traditional survey methods to ascertain their post-program employment outcomes, with information contained in SLDS used to assess the effects of their program preparation.

The use of SLDS to assess the employment outcomes of CTE program graduates is limited by several issues. There are technical issues related to the use of unemployment insurance wage records, which have been well documented since they were first used in the 1980s. Among the more difficult technical issues are the lack of complete individual worker personal identifiers, such as names and limited employer coverage.<sup>42</sup> Unemployment insurance wage reports are limited to state-level data, and their content is specific to a given state. Efforts to develop data-sharing agreements across states, such as those afforded by WRIS 2, may provide options for improving reporting. However, prohibitions in WRIS 2 regarding the sharing of individually identifiable wage-record data limit the value added by these systems, for example, by preventing researchers from applying statistical methods that allow for the identification of causal relationships. Researchers may contribute to improving SLDS development by drawing attention to the statistical limitations of using aggregate-level data, possibly by illustrating the benefits of national clearinghouses.

Researchers also may seek to harness the power of SLDS—used in conjunction with employment data—by assessing the impact of different combinations and sequences of education and training investments on the subsequent employment and earnings trajectories of CTE participants. Longitudinal data on educational coursework may help show whether certain combinations of academic and technical coursework or coursework cutting across career cluster areas afford students some type of relative advantage in the labor market. Similarly, information on interrupted work patterns, in which individuals intersperse their educational training and workforce experiences, may shed light on how CTE programs contribute to individuals' advancement through their careers.

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<sup>41</sup> In total, 38 states used surveys to collect follow-up placement data for secondary students to respond to federal *Perkins IV* reporting requirements compared with 24 states at the postsecondary level (GAO, 2009). A 2009 survey of states' approaches to tracking student placement found that just 17 states accessed their unemployment insurance database for secondary students compared with 33 states for postsecondary students (U.S. Department of Education, 2014).

<sup>42</sup> Stevens (2007) covers this topic. This document was used as part of the background information for CEDS version 3 development efforts in which data elements were proposed regarding employment and earnings.

<sup>42</sup> See <http://www.workforcesecurity.doleta.gov/unemploy/uitaxtopic.asp> for the applicable tax rates.

## Conclusion

SLDS contain student-level records, including demographic characteristics, transcript information, assessment scores and grades, and awards (diplomas, degrees, and certificates). Because they contain detailed student data across the spectrum of education and the workforce, SLDS can be used to support complex, cross-cutting statistical analyses of students' educational performance. Building states' individual educational data systems to capture information on early childhood education through professional/graduate school and workforce entry is challenging. SLDS initiatives do not necessarily represent a set of consistent, common definitions and technical conventions, and their status with respect to CTE content is not well documented. Therefore, further development is needed to ensure SLDS support CTE educators in responding to federal accountability requirements and improving educational programming.

CTE is primarily intended to support students in achieving a basic set of goals, including the attainment of academic knowledge, technical skills, and employability skills; preparation for postsecondary education and careers; and successful transition into the workforce. Accordingly, SLDS should include the following categories of data elements to support researchers in the assessment of student outcomes related to these educational goals.

- *Student participation:* The identification of a CTE student is a critical element of SLDS. Therefore, states must incorporate elements that allow for key CTE populations to be identified, including those participating in, concentrating in, and completing CTE programs—and potentially POS. Ideally, student course taking (transcript-type) data will be used to assign this participation status.
- *Student characteristics:* Although SLDS contain detailed student demographic data, additional information is needed to control for the characteristics of students participating in CTE programs. These additional designations are necessary to comply with the federal reporting requirements in *Perkins V*.<sup>43</sup>
- *Student success:* To comply with federal *Perkins V* reporting requirements, students participating in CTE programs must achieve an additional set of performance results that transcend those earned by non-CTE students. Consequently, SLDS must account for CTE student outcomes that include technical skill attainment; industry certification, credentialing, or licensing; and post-program workforce outcomes—which require access to longitudinal data outside the education agency.

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<sup>43</sup> Demographic characteristics, such as gender, age, and race/ethnicity, are important elements that apply to all students. Additional student populations specifically targeted in *Perkins V* include individuals with disabilities; individuals from economically disadvantaged families, including foster children; individuals preparing for employment in nontraditional fields; single parents, including single pregnant women; displaced homemakers; and individuals with limited English proficiency.

- *Student identification:* Accessing CTE data in SLDS will require the use of a student identifier that can bridge the education and workforce systems. Where SLDS are sufficiently mature to link across education sectors and the workforce, these identifiers will often be provided as anonymized numbers. In other cases, states will need to develop strategies for using SSNs or matching algorithms that use combinations of elements to join data across education sectors and over time.<sup>44</sup>

State SLDS are in continuing development, and relatively little has been published about their current reporting capacities. CTE researchers and stakeholders who use these systems will be able to provide feedback to SLDS administrators about the content and utility of their systems and future development needs. The following areas will require focus.

- *Supplying use cases:* Guidance must be provided to assist users in understanding how SLDS data elements can be applied, using rigorous statistical analysis approaches, to answer key research questions related to the benefits of CTE instruction.
- *Ensuring data governance and continuous stakeholder engagement:* Conventions underlying the formation of SLDS must be regularly reviewed and refined. Researchers are in an ideal position to provide feedback to SLDS managers on the functioning of these complex systems.
- *Protecting privacy while preserving access:* Individuals' right to privacy must be respected while ensuring data can be accessed in a comprehensive and timely manner to address various research and reporting purposes.
- *Focusing longitudinal data collection on student transitions:* The key contribution of SLDS is their capacity to provide information on the post-program experiences of students via linkages between K–12 and postsecondary and workforce data, which can help identify whether students are being adequately prepared.
- *Strengthening SLDS capacity to assess student transitions:* Improving measurement will require that SLDS be designed to have “sticky edges,” meaning that records contained in SLDS must be capable of being linked to data maintained by other state agencies, as well as with national databases, such as NSC and WRIS 2.
- *Recognizing that SLDS can serve many purposes and uses:* Data can and should serve a variety of statewide administrative, management, public information, and reporting purposes, as well as research purposes. From the standpoint of sustainability, these

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<sup>44</sup> Matching routines can be complex and often are the basis for the regular assignment of statewide student identifiers in SLDS. Several white papers from private companies offer detailed explanations of the use of master data management tool suites. See, for example, Informatica (2013), Russom (2014), and Wainwright (2013).

myriad uses may have a visible effect on policy development, program improvement, and student success.

If SLDS are to prove worthy of continued investment, they must be engineered to produce useful and actionable information. CTE research is ideally suited to serve as a laboratory for this purpose, as well as a testing ground to improve data content and utility. This will require that these systems incorporate key elements in a manner that facilitates useful research on successful CTE programming and policies that affect student success.

## References

- Data Quality Campaign (DQC). 2014. *Paving the Path to Success: Data for Action 2014*. Washington, DC: Author.
- Data Quality Campaign (DQC). September 2017. *Education Data Legislation Review*. Washington, DC: Author.
- Education Commission of the States. August 2019. *50-State Comparison: Statewide Longitudinal Data Systems*. Retrieved November 1, 2019 from <https://www.ecs.org/state-longitudinal-data-systems/>
- Informatica. 2013, October. *The Requirements of Universal Master Data Management (MDM)*. Redwood City, CA: Author. Retrieved November 1, 2019, from [http://now.informatica.com/en\\_requirements-of-universal-master-data-management\\_whitepaper\\_02560.html?uid=12-24408#fbid=ZLIIMY7BD7U](http://now.informatica.com/en_requirements-of-universal-master-data-management_whitepaper_02560.html?uid=12-24408#fbid=ZLIIMY7BD7U). [registration required].
- National Forum on Education Statistics (NFES). 2009. *Forum Guide to Metadata: The Meaning Behind Education Data* (NFES 2009–805). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. Retrieved November 1, 2019, from [https://nces.ed.gov/forum/pub\\_2009805.asp](https://nces.ed.gov/forum/pub_2009805.asp).
- National Forum on Education Statistics (NFES). 2011. *Traveling through Time: The Forum Guide to Longitudinal Data Systems. Effectively Managing LDS Systems* (NFES 2011-805). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. Retrieved November 1, 2019, from <http://nces.ed.gov/pubs2011/2011805.pdf>.
- National Forum on Education Statistics (NFES). 2012. *Forum Guide to Supporting Data Access for Researchers: A State Education Agency Perspective* (NFES 2012-809). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. Retrieved November 1, 2019, from <http://nces.ed.gov/pubs2012/2012809.pdf>.
- National Forum on Education Statistics (NFES). 2015. *Forum Guide to Alternative Measures of Socioeconomic Status in Education Data Systems* (NFES 2015-158). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. Retrieved November 1, 2019, from <http://nces.ed.gov/pubs2015/2015158.pdf>.
- Russom, Philip. 2014. *Seven Tips for Unified Master Data Management: Integrated with Data Quality and Data Governance*. Renton, WA: TDWI. Retrieved November 1, 2019, [http://www.sas.com/en\\_us/insights/articles/data-management/unifying-master-data-management-with-existing-data-practices.html](http://www.sas.com/en_us/insights/articles/data-management/unifying-master-data-management-with-existing-data-practices.html). [registration required].

Stevens, David. 2007. *Employment That Is Not Covered by State Unemployment Insurance Laws*, Technical Paper No. TP-2007-04. Suitland, MD: U.S. Census Bureau.

U.S. Department of Education, Office of Planning, Evaluation and Policy Development, Policy and Program Studies Service. 2014. *National Assessment of Career and Technical Education: Final Report to Congress*. Washington, DC. Retrieved November 1, 2019, from [https://s3.amazonaws.com/PCRN/uploads/NACTE\\_FinalReport2014.pdf](https://s3.amazonaws.com/PCRN/uploads/NACTE_FinalReport2014.pdf).

U.S. Government Accountability Office (GAO). 2009. *Career and Technical Education: States Have Broad Flexibility in Implementing Perkins IV* (GAO-09-683). Washington, DC: Author. Retrieved November 1, 2019, from <http://www.gao.gov/new.items/d09683.pdf>.

U.S. Government Accountability Office (GAO). 2014. *Education and Workforce Data: Challenges in Matching Student and Worker Information Raise Concerns About Longitudinal Data Systems* (GAO-15-27). Washington, DC: Author. Retrieved November 1, 2019, from <https://www.gao.gov/assets/670/667071.pdf>.

Wainwright, Phil. 2013. *Right Data, Right Place, Real-Time: How Master Data Management Supercharges Fast-Moving Businesses*. Procullux Limited. Retrieved November 1, 2019, from <http://marketing.boomi.com/MDMRightDataRightPlaceReal-time.html>. [registration required].

Whitfield, Christina; Armstrong, John; and Weeden, Dustin. 2019. *The State of Postsecondary Data Systems: Strong Foundations 2018 pub 2019 Appendix C*. State Higher Education Executive Officers Association.