March 15, 2023

TO THE MEMBERS OF THE JOINT LEGISLATIVE EDUCATION OVERSIGHT COMMITTEE AND THE GENERAL ASSEMBLY:

Attached is the report pursuant to [Session Law 2022-74, Sec. 7.11](#) ("Interoperable and Interconnected Student Data Systems Study"). The legislation required myFutureNC to conduct a study of the requirements and challenges **to create an interconnected and interoperable real-time data system** to facilitate communication, collection, and transition of student data between our education institutions, as well as **to provide students access to their own data.** The purpose would be to improve students' abilities to pursue and complete postsecondary education—moving us closer to the state's educational attainment goal of 2 million North Carolinians ages 25-44 with an industry-valued credential or postsecondary degree by 2030. The report provides a path for the State of North Carolina to be a national leader through development and implementation of interoperable student data systems.

Included in the report are four actionable recommendations for North Carolina:
- Designate a guidance framework;
- Develop an operating model;
- Complete a Proof of Concept; and
- Develop legislation in support of interoperable data systems and appropriate necessary funding.

The cost to develop interoperable student data systems is approximately $20 million non-recurring over three years, including technology, human capital, process redesign, training, and organizational change management. Annual maintenance costs thereafter are estimated at $1-3 million.

As an initial step, the report focuses on a Proof of Concept around three resonant use-cases which prioritize helping students and parents more easily navigate the path to a postsecondary credential or degree: 1) a unified K-16 digital transcript; 2) real-time data for dual enrollment; and 3) student degree roadmaps. The estimated cost to implement this Proof of Concept is approximately $7 million over 12-15 months, with the remaining cost of implementing the full solutions described in the report at $13 million.

The success of interoperable data systems largely depends on people rather than technology. North Carolina should couple any new technology with dedicated, sustained leadership and guidance to support cross-sector data sharing along with investments in skilled human capital to implement and sustain interoperability. Modernizing our data infrastructure in this way may entail significant challenges, but the outcomes for our students and the state of North Carolina will pay dividends for years to come.

Respectfully submitted,

John A. Fraley

Hon. John A. Fraley
Board Chair, myFutureNC

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A Report for

myFUTURENC
2 million by 2030

Interoperable and Interconnected Student Data Systems: Findings for North Carolina

Commissioned by the North Carolina General Assembly
Prepared by Gartner Consulting, Inc. on behalf of myFutureNC

15 March 2023
Engagement: 330079497

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1.0 Executive Summary

Overview

myFutureNC engaged Gartner Consulting to study interoperable and interconnected student data systems for North Carolina, pursuant to Session Law 2022-74 §7.11. This study supports North Carolina's education leaders in determining how interoperable and interconnected student data systems can facilitate a more seamless exchange of data between and among institutions.[1]

Figure 1.   Stated Goals for Interconnectivity and Interoperability

Improve data-sharing	**Support students and families**	**Eliminate potential redundancies**
Share student-level data more efficiently between K-12 and post-secondary institutions, using existing student information systems	Provide students and families with access to their own data, in order to assist in their journey toward postsecondary education and careers	Re-evaluate processes used across the state, with an eye for eliminating any potentially-redundant efforts and expenses

Current State — Understanding the Need

Gartner heard that students and the frontline workers who support them are challenged by the lack of interoperability among student data systems.[2] They are currently expected to use data from various distinct and non-integrated systems to get a complete picture of a student's progress.

Gartner discovered recurring challenges that can be improved with interoperability:[3]

- Lack of visibility into the many pathways and options available to students and the staff who support them as they plan for postsecondary education[4]
- Inefficiencies when students apply to and enroll in postsecondary institutions (e.g., excessive time spent entering data, reconciling records, and interpreting transcripts)
- Challenges when students transfer between postsecondary institutions (e.g., loss of credits or time, lack of clear articulation agreements)[5]

North Carolina can address these challenges by providing access to more current and streamlined data and by standardizing how data is shared and used across institutions.

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[1] Per the National Institute of Standards and Technology (NIST) SP800-47, "interconnection" is defined as "the direct connection between two or more systems in different authorization boundaries for the purpose of exchanging information and/or allowing access to information, information services, and resources." In contrast, "interoperating systems" interact with a source system of interest for the purpose of jointly performing a function. Working definitions of these terms, as they are used throughout this study, are provided by Gartner in Section 2.2.

[2] Throughout this study, Gartner uses the term "frontline workers" to refer to those staff members at education institutions who work directly with students as part of their day-to-day responsibilities. This includes roles like guidance counselors, advisors, admissions staff members, and other administrators who work with students throughout the K-16 pipeline.

[3] These are illustrative only. More detailed information is provided throughout the report; please see Section 4.0 in particular.

[4] According to statistics provided by myFutureNC, approximately 32% of all high school graduates enrolled in at least one dual enrollment college-level course during their high school years, and this percentage is growing. These students need better insights into how these courses might be beneficial to them in their postsecondary educations.

[5] In the fall of 2021, approximately 17,000 students transferred to the UNC System from North Carolina Community Colleges, private, out-of-state, and other institutions. This data point was provided by myFutureNC.

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Findings

Gartner found that North Carolina already has many of the technology components that would be necessary to support interoperability and interconnectedness across its K–16 data ecosystem. North Carolina can begin by building upon this existing technology immediately, as part of a larger journey to develop interoperable and interconnected student data systems.

The findings in this report indicate that the state should move forward with developing and implementing better interoperability, given the potential for this work to contribute positively toward the state's educational attainment goal: to have two million North Carolinians ages 25–44 hold an industry-valued credential or postsecondary degree by 2030.[6] The state will also need to invest in maintaining the critical source systems and solutions that will ultimately become interconnected to enable interoperability.[7] If the source systems for interconnectivity are not adequately funded and maintained, the quality and availability of student data will be compromised, negatively affecting the state's ability to pursue interoperability.

Developing and sustaining interoperability and interconnectedness across K–16 student data systems is a *transformational journey*—one that requires dedicated, sustained leadership and sponsorship, proven technology solutions, and changes to education data standards and processes. While this study concludes that interoperability and interconnectedness will contribute to the state's educational attainment objectives, such a system will not, by itself, achieve these objectives. The state must couple any new technologies with the required governance structures and policies, changes to business processes, and investments in skilled human capital that will be necessary to sustain interoperability. The organizational and process challenges will be significant and require as much effort as the development of any new technology.

Key Stakeholder Requests

With support from key stakeholders, Gartner identified ten priority stakeholder requests, or "use cases," that support the interoperability and interconnectedness of student data.[8]

Table 1.   Key Use Cases

#	Description	High-Level Requirement
1	Unified K-16 Digital Transcript	As a student or guardian, I would like to be able to view a K–16 universal digital transcript that shows my courses, credits, exams, and credentials from all the schools I attended within North Carolina.[9] This would build upon my existing K–12 digital transcript and may include a competency-based view.[10] I must be able to manage access to this record and control how my data is shared with institutions or employers in the future.

6 In 2019, North Carolina established a statewide postsecondary attainment goal in House Bill 664. The goal is "to increase access to learning and improve the education of more North Carolinians so that, by 2030, two million North Carolinians between the ages of 25 and 44 will have completed a high-quality credential or postsecondary degree."
7 E.g., K–12 Student Information Systems (SIS) and higher education Enterprise Resource Planning (ERP) solutions. These terms are defined in the glossary.
8 This study uses the concept of use cases to identify specific ways in which interoperability can advance the state's educational attainment goals. These items are numbered for reference only and are not in a ranked priority. There are many more potential use cases that the state may wish to consider; these are the ten priorities identified by stakeholders during this study. The state should anticipate that, as systems become more interoperable, there will be additional use cases that support educational attainment.
9 While this is referred to as a K-16 transcript throughout this study, stakeholders noted that the actual grade bands and data elements are still to be determined. For example, it may ultimately be more helpful to produce a "secondary through college" view. In addition, as with all future use cases, this must comply with critical data privacy and security requirements.
10 Stakeholders noted there is also a desire to provide tools for a mastery-based or competency-based record. This use case should support a modernized education framework that would allow the state to create scalable, flexible, and portable learning records for students, along with competency-based records where appropriate.

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#	Description	High-Level Requirement
2	**Portable, Holistic Student Portfolio**	As a student, I would like a student portfolio that, in addition to courses and grades, would include information related to my extracurriculars, athletics, awards, and work-based learning. I would like to be able to control access to my data and share it with institutions or employers when appropriate.[11]
3	**Manage Privacy Settings**	As a student or guardian, I would like a tool to opt-in or opt-out of sharing data and manage who can access my records.
4	**Data Sharing Bidirectionally Across Sectors**	As a K–12 administrator, I would like to receive data on my students' subsequent enrollment and attainment in postsecondary institutions after they have left K–12, to help me understand how to improve my own schools' work.[12]
5	**Real-time Data for Dual Enrollment**	As a school administrator or advisor, I would like to view the attendance and grades of my students enrolled in another institution's programs in near real-time, so that I can provide better and more immediate support.[13]
6	**Student Degree Roadmap**	As a student, advisor, or college administrator, I would like to be able to view degree requirements through a single, searchable portal that incorporates information from the many articulation agreements, baccalaureate degree plans, and other policies that determine potential student degree pathways.
7	**Inter-institutional Higher Ed Course Map**	As a college administrator, I would like to leverage a consistent crosswalk that maps courses across higher education institutions and supports transcript evaluation.
8	**Automated Transcript Matching**	As a college administrator, I want a more efficient process to be implemented so that I can match applications to existing student materials.[14]
9	**Connected Postsecondary Systems**	As a college administrator, I would like a centralized student data system to be implemented within the NCCCS so that I can better track data for students moving from one postsecondary institution to another. This should support more consistent registration, enrollment, and grading.[15]
10	**Postsecondary Interest Survey**	As a college administrator, I would like a survey with questions of my choice implemented and deployed to high school students, so that I can later receive better data about their preferences and intentions, providing support for postsecondary enrollment where appropriate.

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[11] This use case was often compared to a myChart® for students that would allow graduates to export artifacts for use after graduation.
[12] This refers to data and tools beyond what is provided by a Longitudinal Data System (LDS).
[13] Stakeholders noted that there are important policy and legal distinctions that apply to students enrolled in high school vs. those enrolled in college courses. As an example, only, attendance for high school tends to be "face to face," whereas in virtual Career and College Promise (CCP) courses, attendance is demonstrated by participation and completion of assignments.
[14] This could include leveraging the North Carolina Department of Public Instruction's (NCDPI) existing Student Unique Statewide Identifier (UID) web service, the North Carlina Department of Information Technology's (NCDIT) entity resolution process, etc.
[15] As part of this item, stakeholders strongly support recurring funding to maintain and improve data systems and data use across the pipeline.

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Potential Outcomes

Interoperable and interconnected student data systems have the potential to assist students, families, and administrators as they work toward the shared goal of attaining postsecondary degrees and credentials. The table below provides a list of the interim outcomes that can be achieved if the above requests are met.

Table 2.   Potential Outcomes Aligned to the Above Use Cases

#	Outcome	Explanation
1	Complete View of Student Records	Students may have a single place to view important data from K–16, including potentially a more holistic view of not just transcript data but information on extracurriculars, awards, and work-based learning. Students would have control over, and access to, their data after they leave high school and could authorize others to view this information when appropriate. For example, students could use this view to demonstrate knowledge and skills to potential employers. This supports the legislative goals of improved data sharing and better support for students and families.
2	Data Shared for Improvement	School-based staff may have better bidirectional data flows, provided in near real-time, complementing other historical and aggregated data available in Longitudinal Data Systems and other tools. Any dashboards or reports would utilize predictive and prescriptive analytics and practical, student-level data (where permissible).[16] This supports the goal of improved data sharing.
3	Better Understanding of Postsecondary Options	Students and frontline staff who support them may have tools that describe a personalized roadmap or journey through postsecondary education, highlighting key steps and dates.[17] This could potentially mean that students have a single place to review the various requirements and course loads associated with specific degree programs so that they can make informed choices.[18] This supports the goal of improved data sharing and better support for students and families.
4	Support for Postsecondary Transfer Students	Students and frontline staff who support them may have a better understanding of the articulation processes and agreements that affect which credits are used and accepted at postsecondary institutions. Students might also potentially experience an easier process when enrolling in /transferring to higher education programs. There may even be a measurable impact in "lost credits" and associated costs, with the appropriate agreements and processes. This supports the goals of improved data sharing, better support for students and families, and eliminating potential redundancies.
5	More Efficient Application Process	The state may experience a more seamless process that is less manual and labor-intensive for staff. In theory, improvements to the process and experience of applying to postsecondary education might mean that more students enroll, and administrative resources can be redeployed to drive better student outcomes. This supports the goal of eliminating potential redundancies.

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[16] For example, a guidance counselor may be able to pull a list of former students who are actively enrolled in a community college as of the current date, in order to support them as appropriate.

[17] Counselors, advisors, tutors, and community partners play a critical role in supporting students directly and guiding them through decisions at key points in their educational journey (e.g., what types of programs to apply to, what funding is available, how to transfer credits, etc.). Stakeholders reported a need for more support and tools to better leverage data in support of their constituents.

[18] A large amount of information is already available, but it is sometimes hard to navigate or not contextualized.

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High-Level Cost Estimates

Gartner estimates the cost to develop the technology for student data interoperability to be approximately $16-$20 million over approximately three years, from inception to completion. This includes $5-$8 million for initial technology costs, plus the costs associated with human capital, process redesign, training, and organizational change management; all of these are critical components to successfully enable interoperability and interconnectivity. Gartner estimates that it will cost the state approximately $1-$3 million for annual technology maintenance fees.[19]

The state can also choose to begin with a Proof of Concept (POC) over approximately 12-15 months, as outlined in the recommendations below. Gartner estimates the cost to implement a POC would be approximately $6-7 million. If the POC is implemented first, the total cost to implement the full solution would be reduced by this amount, for a total remaining cost of $10-13 million.

Actionable Recommendations

Gartner recommends that the state execute the following steps in the next 6-12 months:

1. Designate an Executive Sponsor

Building interoperability is a major undertaking that must be sponsored at the highest echelons within government. Gartner recommends that the state select an Executive Sponsor who has the appropriate statewide authority to implement interoperability and interconnectedness.[20] The Executive Sponsor must be dually empowered and accountable for achieving the key requests and outcomes. This level of authority will be required to galvanize support and effectively drive K–12, community college, and university sector stakeholders toward a unified vision. The Executive Sponsor should collaborate with education leaders from across the state to ensure their input and recommendations are accounted for as the program evolves.

2. Develop an Operating Model

Gartner defines an "operating model" as "the blueprint for how value is created and delivered to target customer." The Executive Sponsor should designate a team of subject matter experts from key sector institutions who can develop an operating model for student data interoperability. This operating model must specify how organizations, processes, technology, and policy will all function to support interoperability. This includes defining roles and responsibilities, procedures, data standards, technical capabilities, and governance.[21]

The operating model will require extensive collaboration across sectors. As such, the Executive Sponsor may wish to designate an independent, non-profit or government entity that is separate and apart from any individual sector, to guide this operating model. [22]

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[19] High-level price details and potential vendor insights are provided in Section 8.4.
[20] This individual is also called the "Senior Responsible Officer" in Gartner research. As an example, this could include Governor's Education Cabinet or Board of Education.
[21] Later sections of this report describe proposed governance model(s) as well as existing structures that may be able to be leveraged in support of interoperability.
[22] Some existing organizations for the state to explore as options might include MCNC, NCDIT, and the College Foundation of North Carolina, provided they have the right teams with the technology expertise needed to guide interoperability.

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3. Complete a Proof-of-Concept

This study highlights specific use cases and a composable architecture to address them.[23] Before committing to a full solution (and after completing steps 1 and 2), Gartner recommends that the state consider a Proof-of-Concept (POC). The POC should include three specific use cases (i.e., Unified K-16 Digital Transcript, Real-time Data for Dual Enrollment, and Student Degree Roadmap). This POC can be used to validate that the operating model and supporting technology will work together to produce the intended outcomes.

The state should consider investing a total of $6-$7 million over the course of 12-15 months to conduct the POC. To efficiently run the POC, the Executive Sponsor will need to establish an ongoing program-level governance and discrete project-level teams with representation from key organizations. This then includes:

- Creating and releasing a Request for Proposals (RFP) that includes the vision, business case, and detailed functional/technical requirements[24]
- Select vendor(s) best capable of implementing the POC based on a review of proposals
- Develop a minimum viable product (MVP) with the functionality required to implement selected use cases; concurrently, perform the necessary business analysis/process design
- Evaluate if the outcomes of the POC merit additional investment from the state

Executing the POC will require dedicated resources from the North Carolina Department of Public Instruction (NCDPI), the North Carolina Community College System (NCCCS), and the University of North Carolina (UNC) system. Resources must have subject matter expertise in existing source systems and technologies, processes, and data. Gartner estimates that 12-14 resources should be dedicated to supporting the POC, consisting of:

- Two to three people from each of the education sectors
- A POC project manager
- Four to five resources dedicated to developing the RFP and MVP

The cost of resources to support the POC are factored into the $6-$7 million cost estimate.

4. Develop legislation to mandate interoperability and commit funding

Because any successful program requires support beyond the initial technology implementation, and beyond individual peoples' tenures, Gartner recommends that the state codify and enact legislation that embeds interoperability within the education ecosystem and requires its implementation. As part of this process, the state should commit to long-term funding for maintaining and sustaining this program, provided the goals of the POC have been appropriately met.

In addition to funding for this interoperability program, it is critical that the state continue to invest in high-quality student data source systems and the necessary analytical and technological capacity to appropriately use the data collected, in support of student educational attainment.

These steps will set the state on the path toward greater interoperability and interconnectedness and further support students as they seek to earn high quality degrees and credentials and build meaningful careers.

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[23] A composable architecture organizes technologies into modular application building blocks that deliver well-defined capabilities in support of specified business outcomes.
[24] This may require multiple RFPs, e.g., one for technology and one for systems integration/implementation.

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Background
& Context

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2.0 Background & Context

2.1 Introduction

North Carolina has experienced substantial population growth over the past decade. People and companies have relocated to the state due to its distinct advantages, including a robust economy, access to high-quality education and medical care, and a vibrant cultural arts scene. In fact, CNBC recently scored North Carolina as its Top State for Business in 2022. North Carolina is poised for continued growth and prosperity; however, it must take additional steps to improve educational attainment so that all North Carolinians can take advantage of the anticipated economic boom.

An increase in higher-skilled jobs in high-tech, finance, and healthcare industries requires an educated workforce. Increasingly, state residents need a postsecondary degree or credential to meet the labor market demands. Currently, less than 50% of North Carolinians ages 25-44 years old possess an industry-valued credential or postsecondary degree—but jobs that are being created require more than a high school diploma, and as a result employers within the state struggle to fill vacancies.[25]

myFutureNC and educational sector leaders across the state are working toward a common goal — ensuring that by 2030, two million North Carolinians ages 25-44 hold an industry-valued credential or postsecondary degree.[26] As of 2021, myFutureNC estimated that 1.55 million adults met these criteria.[27]

Figure 2.   Educational Attainment Goal
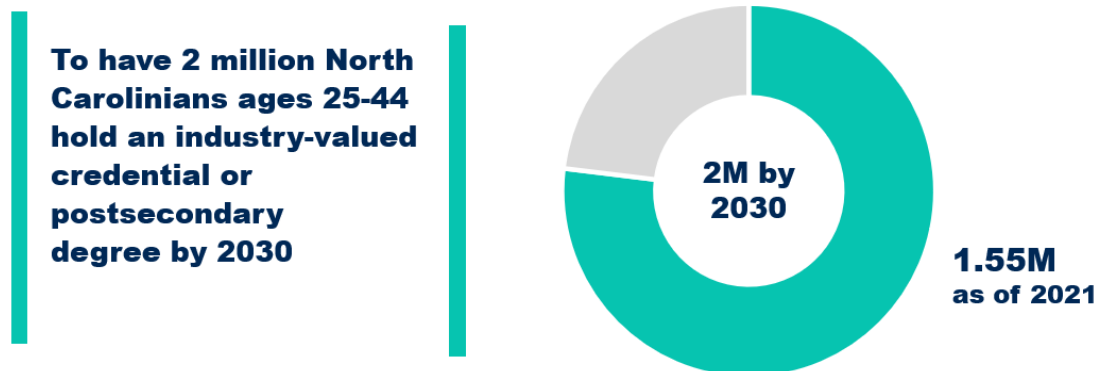
In 2022, the North Carolina General Assembly issued Session Law 2022-74 §7.11, which tasked myFutureNC with studying the requirements necessary to create interoperable and interconnected data systems "to facilitate communication, collection, and transition of student data between public school units, community colleges, and universities and to provide students access to their own data, including after they are no longer enrolled in an institution." This was driven in part by a theory that increasing interoperability would lead to an eventual increase in educational attainment.[28]

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[25] This information is provided by myFutureNC.

[26] In 2019, North Carolina established a statewide postsecondary educational attainment goal in House Bill 664.

[27] This is a key performance indicator (KPI) tracked and provided by myFutureNC as part of their dashboard.

[28] There are many factors that influence an individual's educational attainment decisions and status; it is important to remember that access to near real-time data to help decision-making and drive better outcomes is only one of many potential levers for improving against this goal. Gartner did not evaluate this against any other options. See Section 2.6 for more information on the Potential for Impact.

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About this Study

The state requested the development of a report that includes:

- Current instances of best practices regarding data warehouses, school district-community partnerships, and relationship management systems.

- Technology necessary to create such an interconnected and interoperable system and to create a working prototype.

- Legal considerations for sharing data across institutional systems that would conform with the Family Educational Rights and Privacy Act (FERPA), specifically focusing on student support services.

- Human capital and machine capabilities, such as artificial intelligence, needed to develop data and analytical capacity across institutions.

- Any issues that may arise with cultural views on data as an individually owned resource, as opposed to a collaborative tool.

- As applicable, the potential role of existing State longitudinal data systems.

Gartner submits this report on behalf of myFutureNC, pursuant to the requirements in its Scope of Work with myFutureNC and in response to Session Law 2022-74 §7.11. This report provides a summary of the state's current education data ecosystems, outlines key stakeholder requests (i.e., use cases) for interoperable and interconnected data systems, and offers recommendations and next steps for a more interoperable future state.

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2.2 Purpose of this Study

This study supports North Carolina's education sectors in determining how interoperable and interconnected student data systems can facilitate a more seamless exchange of data between and among institutions.

However, it is important to note that pursuing interoperability and interconnectedness does *not* mean replacing current source systems at the K–12, Community College, and UNC System levels; rather these systems become even more useful and necessary to maintain. Interconnectivity and interoperability allow information to be shared and used across these separate systems to support students as they move through primary, secondary, and postsecondary education (i.e., K-16). To that end, while this may lead to greater efficiency or even to long-term cost-savings, the immediate future will *not* include eliminating any of the existing source systems in place at this point in time.

> ## Working Definitions for this Study
>
> **Interconnectedness** is the ability to share data seamlessly and with limited manual effort across sources and systems. Common examples of interconnectedness in daily life include:
>
> - Travel websites that consolidate information from many airlines and hotel providers in a single place, allowing travelers to search and plan.
> - Electronic health records that collect data from multiple sources to provide practitioners with a comprehensive view of a patient's health and medical history.
>
> **Interoperability** occurs when business processes are designed to respond to the data shared via interconnectivity. In an interoperable environment, the interconnected data automatically enables coordination and collaboration across organizational boundaries. To be successful, interoperability requires not just a technical infrastructure but common terminology, common data and technical standards, common data structures, and aligned business processes. Examples of interoperability in daily life include:
>
> - Travelers using travel websites to reschedule or cancel a trip, automatically informing the relevant hotels and airlines.
> - Physicians writing electronic prescriptions that are (a) transmitted to the right pharmacy and automatically filled and (b) automatically applied to the patient's insurance.

Gartner did not presuppose a need for new technology in its approach to this study; and in fact, the state should carefully weigh the costs and benefits before making a long-term investment. Any future state technology that is ultimately implemented because of this study must be grounded in an understanding of real pain points and gaps that exist today. In addition, the state must also consider how those gaps can be addressed through other mechanisms (e.g., policy, governance models, additional resources). These "non-technology" factors are heavily interrelated with interoperability, and without them, no technology will be successful.

In fact, there are multiple ways to support better interconnectivity and interoperability that do not involve new technology. The technology components and architectural elements described in this study are secondary to the people and process-related components, which will likely prove more challenging and require significant time and effort.

The state has established an ambitious educational attainment goal. The ultimate success of any initiatives resulting from this study should support this goal, helping the state to remain economically competitive while improving student outcomes and placing more educated and skilled graduates in the workforce. These benefits will, over time, pay dividends, in the form of an increase in the number of students with specific skills needed in today's economy.

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A Note on Terminology

Throughout this study, Gartner uses the term "education sector" to define three distinct groups of stakeholders and organizations impacted.[29]

Table 3. Sectors Examined for this Study

Sector	K–12 education	2-year and 4-year postsecondary education	
Institution [30]	**North Carolina Department of Public Instruction (NCDPI)**	**North Carolina Community College System (NCCCS)**	**University of North Carolina (UNC) System**
Description	▪ For the purposes of this study, this refers to public schools that serve students in grades kindergarten through twelve, through the point of high school graduation, drop out, or the age of twenty-one; whichever comes first. Note that education is compulsory between the ages of seven and sixteen in North Carolina. ▪ Public schools are governed by the North Carolina Department of Public Instruction (NCDPI), which acts as the state education agency on their behalf.[31]	▪ For the purposes of this study, the term "postsecondary" refers to publicly funded institutions that offer credentials, certificates, and degree programs to students and adults, after the completion of a high school education. ▪ There are also other postsecondary programs and experiences in which North Carolinians participate in large numbers, and these include private and independent postsecondary schools, internships and apprenticeships, and the military.	
Size	▪ There are 2,500+ traditional public schools, 200+ independent public schools, and two education entities serving approximately 1.5 million students across North Carolina.[32]	▪ There are 58 public community colleges serving approximately 574,000+ students in North Carolina. ▪ There are 16 public universities under the UNC banner, serving approximately 272,000+ students in North Carolina.	

In addition to the above, other organizations play a valuable role in connecting these sectors and serving students in North Carolina; they are highlighted throughout this document.

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[29] These are by no means the only options available to North Carolinians. While this study often refers to a K-16 "pipeline", many individuals earn a high school diploma or high school equivalency (HSE) diploma and do not continue to postsecondary programs. They may instead seek industry-recognized credentials or certificates, participate in internships, join the military, or move directly into the workforce.

[30] There are other options for students and families as they complete their education, and these include schools and programs not depicted in this figure or addressed in detail in this study. At the primary and secondary level this includes homeschooling and nonpublic K–12 schools. At the postsecondary level this includes independent colleges and universities, private schools, internships, technical programs, and the military.

[31] SEA refers to a state board of education or other agency or officer primarily responsible for the state supervision of public elementary schools and secondary schools. In North Carolina, NCDPI is the SEA.

[32] The source for this information is NCDPI's Month 3 2022–2023 ADM data and 2022–2023 North Carolina Local Education Agencies.

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## 2.3 Challenges of Interoperability and Interconnectedness

Achieving interoperability is challenging because it requires organizations and people to operate and think differently. The road to implementing a program focused on interoperability and interconnectedness can be long and complex, but if done correctly can provide tremendous benefits for many years. Organizations that have successfully achieved interoperability approached the journey as a program and put their full weight and commitment into it to achieve the intended outcomes.[33] This too will be required of North Carolina—establishing a program for interoperable and interconnected educational data will be necessary to complete its journey for near real-time data sharing across education sectors.

The concept, practices, and technologies of interoperability are not new: they have been used in industries such as defense, financial services, healthcare, information technology (IT), and transportation for well over a decade and have delivered operational, financial, and customer benefits. However, the education sector has been slower to adopt interoperability because of the complex challenges that are often encountered with undertaking such a transformational program.[34]

Building interoperability spans well beyond technology and involves developing technical and data standards, establishing governance practices and processes, implementing data-sharing agreements, and instilling discipline to maintain data quality and accuracy. At first glance, a phrase like "interoperable data systems" might seem overtly technical. However, data interoperability is firmly grounded in the needs of organizations and requires a paradigm shift in institutional and system perspectives; from "my data" to "our data", in order to allow individuals to see "across" systems that were once separate from each other.[35] In the pursuit of interconnectedness and interoperability, the organizational, skill, and cultural challenges are at least as significant as the technological challenges.

Interoperability relies on established agreements between separate organizations about how data will be used and interpreted, and who can access it. It allows data to be securely transferred and *used* across organizations and systems—more frequently, and in near real-time. In this way, data is made available to people at the right time: in time for it to be meaningfully used in day-to-day work. This might mean that school-based staff and administrators spend less time searching for information, compiling data from disparate sources, merging files, and updating reports; or that students and families have contextualized and appropriate data at their fingertips to help them as they navigate the education pipeline. Optimistically, it could even help reduce the system-created barriers or breakage points that negatively impact the state's educational attainment goal.

Gartner's experience and research reveal that successfully implementing interoperable and interconnected data systems across multiple organizations is a journey that must be strategically planned, coordinated, and implemented from the top down. Therefore, as the state considers future programs

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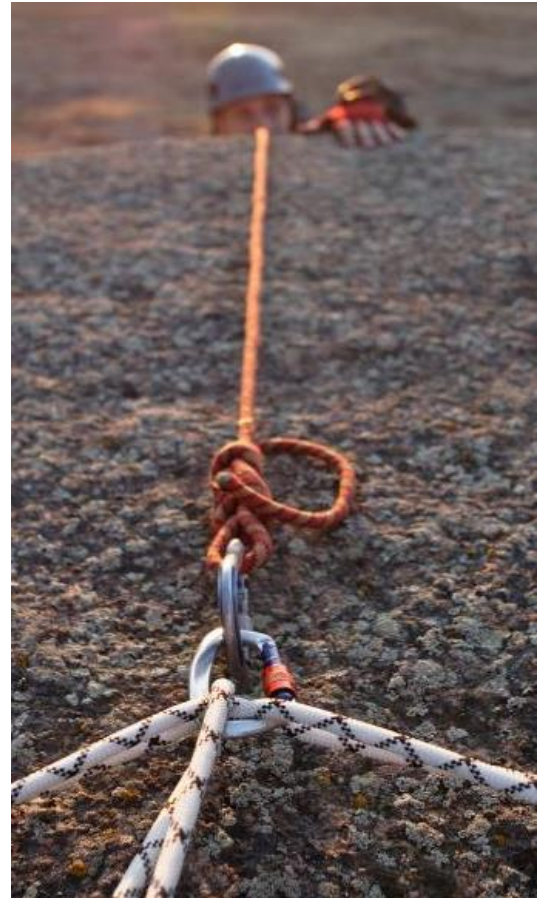
[33] In this context, program has a specific meaning, i.e., referring to multiple coordinated projects; please see the definition of program in the Glossary in the Appendix.
[34] There are also ways in which interoperability is unique in the education space; as an example, there are additional requirements for appropriate data use and governance given that education is compulsory (up to a point) and that it involves minors.
[35] Data sharing must always adhere to student privacy laws and cybersecurity requirements.

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Background & Context

Engagement Number: 330079497   Prepared on behalf of myFutureNC
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stemming from this study, it should consider all of the factors—technical, policy and legal, organizational, cybersecurity, and cost—necessary to develop and enable such a program, understanding that it will likely take multiple years to arrive at Gartner's proposed target state. Within Section 6.0 of this report, Gartner expounds upon the factors that may impact the state's journey toward interoperability; in section 7.0, Gartner proposes near-term next steps to advance the journey of interconnectedness and interoperability among and between the state's education data systems.

The solution envisioned by myFutureNC and the General Assembly is separate and distinct from efforts to better coordinate all of the state's existing historical longitudinal data systems, via a North Carolina statewide Longitudinal Data System (i.e., the NCLDS). As such, Gartner's recommendations in this report take into consideration the NCLDS and other education data systems currently in place and how these current state solutions can support interconnectivity and interoperability across education sectors and institutions.

Figure 3.   Statewide LDS Efforts

Complementing Statewide Longitudinal Data System Efforts

North Carolina is a national leader in the use of longitudinal data systems (LDS) to facilitate education policy decision-making. The state has benefited from decades of sustained efforts to build LDSs and data warehouses across the education ecosystem. LDSs have been used previously to collect data for compliance and accountability purposes; and now they are increasingly used to support evidence-based policymaking, continuous improvement, and performance management.

While there are several distinct, operational LDSs within the state, efforts are underway to better coordinate these systems to more efficiently and consistently link data from early childhood through the workforce.

Three of the initially participating systems (or "Partner Organizations") include:

- Early Childhood Integrated Data Systems (ECIDS)
- North Carolina Common Follow-Up System (NCCFS)
- North Carolina School Works (NCSW)

These systems provide government agencies and system offices access to key data for compliance, funding, program evaluation, and reporting. They also support researchers and policymakers, providing historical data that helps the state understand its challenges, opportunities, and outcomes.

Across the U.S., the benefits of most LDS efforts are realized for policymakers, researchers, and other leaders. Most LDSs provide comprehensive, vetted, linked, and access-restricted historical data for research, evaluation, and policy development. However, there are several key distinctions between the capabilities offered by an LDS and those supported by interconnected and interoperable student data systems, described in brief below:

- LDS efforts support primarily analytical data usage. In contrast, greater interoperability can support near real-time operations and decision-making by frontline staff, including guidance counselors, admissions officers, college advisors, principals—and importantly students and families as well, who have significant control over and stake in how their data is used.[36]
- LDSs restrict most users to de-identified or aggregated views of data. In contrast, this can support the potential for a wider array of users having access to student-level data.[37]
- Typically, an LDS provides thoroughly vetted and approved historical data, often taken in regular intervals as snapshots, so that leaders can understand trends and progress over

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[36] This requires a front-end and likely web-based access point that allows students or, in the case of minors, authorized adult guardians, to manage access to their data, and to establish conditions for how and with whom data is shared, based on privacy requirements.
[37] This includes Personal Identifiable Information (PII), but only if privacy requirements are fully met and students have significant control over what is shared via opt-out/opt-in procedures that comply with the law.

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time. In contrast, it is anticipated that interoperability would mean near real-time data flows that allow data to be used in daily operations
- The NCLDS efforts already undertaken by North Carolina include a broader scope of information and players (e.g., health and human services-related data, financial data, and early childhood records). In contrast, the current scope of this study is limited in nature to public education institutions. As described currently in this study, this means K–16 education

2.4 Gartner's Summarized Project Scope

The scope of Gartner's support was driven by the requirements of the established Scope of Work and with myFutureNC. At the request of myFutureNC, this project also included collaboration with two additional consultants for their expertise and relationships in North Carolina.[38]

Gartner's scope for this effort included the following:

- Project planning and project management support
- Collaboration with myFutureNC and its consulting partners to facilitate discovery sessions with stakeholders
- Defining and prioritizing use cases (e.g., unified digital transcript or similar form of individualized electronic educational record available to students and education institutions) with an exploration of the role of data interoperability among institutions and/or education systems
- Based on the discovery sessions, documenting ways that different student information systems can be connected
- Identifying current longitudinal data system capabilities, partnerships, practices, and systems
- Leveraging Gartner research to identify vendors with products available that would address priority use cases identified through the study[39]
- Conducting a national scan of promising practices related to inter-institutional collaborations on data sharing, including three to five institutions, and documenting key findings/lessons learned
- Reviewing and validating findings and recommendations with myFutureNC leadership
- Recommending potential technology needs and roles and developing a target state ecosystem and technical architecture, if appropriate
- Developing recommendations to address potential implementation barriers (e.g., people, process, technology)
- Estimating the high-level cost to acquire and maintain a solution
- Considering legalities for sharing student data across institutional data systems that would conform with the Family Educational Rights and Privacy Act (FERPA) and other applicable federal and North Carolina law[40]
- Recommending approaches to interoperable data system governance and measures to address cybersecurity risks[41]

Areas that were deemed outside the scope of Gartner's support for this study include the following:

- A thorough technical or functional assessment of current state technology
- Creating formal personas, user journey maps, and other user-centered design artifacts
- Developing a concept of operations or organizational change management strategy
- Developing a list of detailed functional and technical requirements that can inform procurement, development, and/or configuration of a new solution

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[38] myFutureNC and Gartner Consulting collaborated closely with Zach Ambrose, of Ambrose Strategy and Dan Cohen-Vogel, of DataWorks Partners. See the Appendix for additional details on this collaboration, including a list of myFutureNC's Steering Committee members.
[39] Because of its stance on independence and objectivity, Gartner cannot recommend specific vendors. Gartner Research and Consulting recommendations are produced independently by the Company's analysts and consultants, respectively, without the influence, review or approval of outside investors, shareholders, or directors.
[40] Gartner agreed to provide potential legal considerations; however, Gartner does not provide formal legal or regulatory advice. Detailed advice on how to comply with various legal and security requirements is not in scope.
[41] Gartner agreed to provide a list of challenges, recommendations, and considerations for implementation, governance, and staffing; however, a full Organizational Change Management Strategy was not in the scope of Gartner's proposed approach.

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- Creating a formal RFP
- Developing an overall program plan or roadmap
- Providing a comprehensive Total Cost of Ownership (TCO) model
- Comparing the value of an investment in an interconnected and interoperable data system to the value of alternative investments
- Recommending specific software/technology vendor(s) or system integrator to design, develop, and implement the interconnected and interoperable student data system
- Determining any systems or technologies that could be decommissioned by implementing an interconnected and interoperable student data system
- Resolving differences in perspectives and requirements across participating agencies and obtaining stakeholder support and buy-in for an interconnected and interoperable system
- Reengineering and redesigning business processes
- Creating case studies highlighting other state's interoperability efforts and identifying interviewees
- Identifying specific student information data elements or categories
- Creating a prototype of a potential solution

The table below provides traceability between the study requirements provided in the legislation and the applicable sections of this report.

Figure 4.   Traceability Matrix

Legislative Requirement

Related Section(s) of this Report

1 Current Best Practices

Section 3.0: Current State Assessment
Section 3.2: Practices to Build Upon
Section 5.1 : Strategies for Leveraging Existing Data System Partnerships

2 State-of-the-Art Technology

Section 5.0: Future State Design and Development
Section 6.4: Technology Factors

3 Legal Considerations

Section 6.6: Legal and Privacy Factors
Section 6.5: Cybersecurity Factors

4 Human & Technology Resources

Section 6.2: Human Capital Factors
Section 6.4: Technology Factors

5 Potential Barriers

Section 6.1: Governance Factors
Section 6.3:   Trust and Culture Factors
Section 8.5 : National Best Practices

6 Existing Systems

Section 3.1: Current State Architecture
Section 3.2: Practices to Build Upon

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2.5 Study Approach and Methodology

Gartner followed a framework that has been used on projects of comparable size, scope, and complexity with other states and school districts to design and implement student data systems. This was supported by two major phases of work, described in the figure below.

Figure 5.   Study Approach

Understand the Current State

- Interview a wide group of stakeholders from across North Carolina to understand current systems and student data
- Identify existing partnerships, practices, and systems through interviews and discussion
- Determine gaps and improvement opportunities
- Conduct national scan to identify systems and applicable best practices in other states that can be used by North Carolina
- Define possible outcomes and needs to establish functional requirements

Envision the Future State

- Scan the market to identify solutions capable of meeting stakeholder requirements
- Summarize potential challenges to this effort, in particular resourcing, governance, security, and legal risks
- Assess specific root causes for the challenges
- Provide recommendations – technology, governance, security, and legal
- Validate vision and recommendations with Steering Committee

From November 2022 through January 2023, Gartner met with stakeholders from across the state to conduct discovery interviews and gather documentation, to understand the current systems in use, gather information about how data is used to support workflows and processes, and collect perspectives on the challenges experienced today. Together with these partners, Gartner participated in 100+ hours of stakeholder interviews and follow-up conversations, with representatives from 41 schools, agencies, and other entities, including teachers, administrators, and students. The work included three convenings (one each in December, January, and February) of a project Steering Committee established by myFutureNC to ensure that stakeholder perspectives were captured accurately, and that results provided in this study support the outcomes desired by the North Carolina education community. The appendix provides lists of stakeholders consulted.

Figure 6.   Summary of Stakeholders Engaged During this Study

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Gartner's future state is not limited to the conceptual architecture design, which focuses largely on potential technology—instead, Gartner followed a framework that considers People, Processes, and Technology. Once the conceptual design was created, Gartner focused further on the specific non-technology needs that can enable better interconnectivity and interoperability.

Results captured in this report are inclusive of best practices from the national scan and market research of potential technologies that may be used to meet stakeholder functional requirements.

Figure 7.   Description of Methodology

Identify Stakeholder Requests

The team identified and interviewed key stakeholders across education institutions in North Carolina. These stakeholders articulated challenges and requests based on their own perspectives and experience. There were over 30 discrete requests raised and catalogued.

Agree on Key User Groups

The team agreed upon the end-users who would potentially benefit most, prioritizing three groups of users:
- Students and families/caretakers/guardians
- K–12 school administrators, guidance counselors, and other frontline staff
- College administrators, admissions staff members, and advisors

Validate against Current State

Utilizing the identified end-users and needs, the team assessed if or how the current systems could address end-user and stakeholder needs sufficiently. This involved leveraging the Steering Committee members and other key leaders to review and validate requests and check for accuracy.

Design a Potential Future State Conceptual Architecture

Using the information collected, the team designed a conceptual and high-level architecture that could be used to improve interconnectivity and interoperability amongst education sectors and existing student data systems within North Carolina.
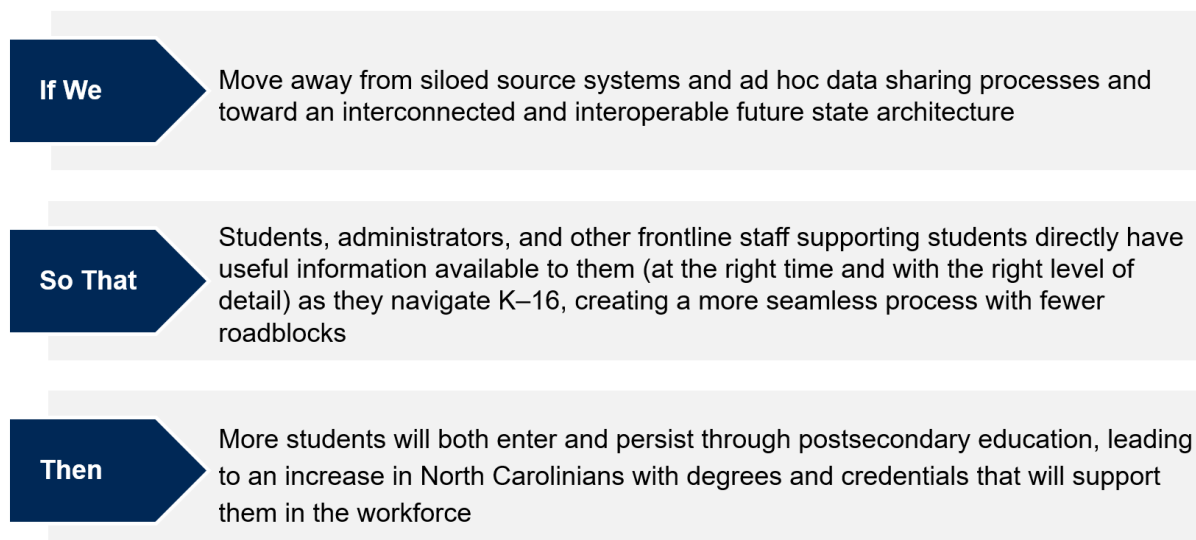
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2.6 Potential for Impact

Any results or new interoperable solutions coming out of this study have the potential for broad impact. All individuals who attend a North Carolina public education institution at any point in time could benefit from having better access to their data. Administrators across sectors could also benefit from more efficient processes and workflows that make the data they need available to them in near real-time both for operational work and for program improvement, such as with certification exams, classes with other institutions, and more. Finally, residents and businesses in the state could benefit in the long term, provided that the goals of this study come to fruition and the state moves the needle on educational attainment. Consider the following statistics:

- High School Graduation: In 2022 North Carolina's high school graduation rate was 86%, per the myFutureNC dashboard
- Postsecondary Planning: In 2022, 58% of North Carolina high school seniors completed the Free Applications for Federal Student Aid (FAFSA), per the myFutureNC dashboard[42]
- Postsecondary Enrollment: In 2021, 55% of North Carolina high school graduates enrolled in a postsecondary institution within 12 months, per myFutureNC
- Postsecondary Persistence: In 2021, 79% of students who began postsecondary at a North Carolina institution continued to a second year of enrollment at any postsecondary institution, per the myFutureNC dashboard
- Postsecondary Attainment: In 2022, 77% of students who began postsecondary at a North Carolina 4-year public institution completed a degree or credential within 6 years, per the myFutureNC dashboard. 75% of students who began postsecondary at a North Carolina 4-year private institution completed a degree or credential within 6 years, per the myFutureNC dashboard. 48% of students who began postsecondary at a North Carolina 2-year public institution completed a degree or credential within 6 years, per the myFutureNC dashboard.

This study is supported by a theory of action, positing that interoperability and interconnectedness will support improvement across the K-16 pipeline and lead to demonstratable impacts on the statistics above.

Figure 8.   Theory of Action

If We	Move away from siloed source systems and ad hoc data sharing processes and toward an interconnected and interoperable future state architecture
So That	Students, administrators, and other frontline staff supporting students directly have useful information available to them (at the right time and with the right level of detail) as they navigate K–16, creating a more seamless process with fewer roadblocks
Then	More students will both enter and persist through postsecondary education, leading to an increase in North Carolinians with degrees and credentials that will support them in the workforce

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[42] It is important to note that there are many reasons why families may choose not to complete the FAFSA; these may include individuals being uncomfortable with sharing detailed personal information (e.g., income, taxes, and financial data). They are not simply systems related.

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Future efforts or programs supporting interconnectedness and interoperability will benefit the state as a whole; however, the stakeholder groups in the following figure have the most potential for impact.

Table 4.   Benefits by User Group

User Group	Potential Benefits
Students & families	- A more complete picture of their academic data, spanning K–16, via a universal K–16 digital transcript and/or portable, holistic student portfolio[43] - The ability for students to authorize and share their data more easily (e.g., as part of a "digital wallet" or profile that they control) could better enable planning, enrollment, transfer, and transition to the workforce, and could provide a clear picture of the various qualifications, skills, credentials, credits, and certificates they have earned that contribute to career readiness - A better understanding of postsecondary options, degree requirements, and policies that will impact their educational attainment, via a student degree roadmap[44] - Better support from guidance counselors, K–12 school administrators, college administrators, admissions staff members, advisors, and other "front line workers" at key points in their educational journeys (e.g., during dual enrollment, at the point of applying to college, at the point of transferring between programs)
K–12 school administrators & guidance counselors	- More timely information that can support dual enrollees - Improved ability to advise high school students as they plan for postsecondary education, by leveraging a student degree roadmap
College administrators, admissions staff members & advisors	- Timely collaboration and collection of data related students' postsecondary interests via a survey implemented in high school - A more efficient process for matching applicant records[45] - A consistent crosswalk mapping courses and other key data across higher education institutions, supporting transcript evaluation, via an inter-institutional higher education course map

Please note that a detailed, quantitative Return on Investment (ROI) is not in scope. As no systems are expected to be eliminated, there will be no initial cost savings, however the potential for positive impact on the state is described above.

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[43] Students do not have one place where they can view their own data from K–16 (e.g., a "myChart" or "unified digital transcript") regardless of the program or school or their enrollment status. Should the state pursue this, students (and their trusted adults) must have the ability to control access.
[44] CFNC provides a wide range of tools that support students in this planning. However, stakeholders reported that students, families, and advisors do not have an easy way to make decisions about what is ahead using data that is specific to them. They may not fully understand the range of educational or career options that are available, and they can miss steps they need to take to access those options.
[45] While transcript data is transferred between institutions, there are manual entry steps and reviews that stakeholders reported.

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Current State Assessment

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3.0 Current State Assessment

Gartner interviewed key leaders and reviewed documentation to develop a baseline understanding of the student data source systems and data flows currently in use across the K–16 continuum. This approach supported the legislative directive to avoid duplication, redundancy, or added and unnecessary complexity in an already robust data ecosystem.

Today, education organizations across the state utilize a collection of systems to consolidate and manage student-related data for operational use.[46] These include a primary Student Information System (SIS) for K–12 schools and Enterprise Resource Planning solutions (ERPs), both of which contain Student Information-related modules.

The most critical source systems in scope for this study exist within three major institutions:

- The North Carolina Department of Public Instruction (NCDPI)
- The North Carolina Community College System (NCCCS)
- The University of North Carolina (UNC) System[47]

The following sections examine how the state collects and uses student information *within* each of these institutions.[48]

3.1 Current State Architecture

3.1.1 K–12 Public Education, as governed by The North Carolina Department of Public Instruction (NCDPI)

As a strong, centralized State Education Agency (SEA) with considerable in-house technical expertise, NCDPI has implemented a single SIS solution that all public-school districts, independent school districts, and educational entities in the state currently utilize. The North Carolina SIS organizes K–12 student data centrally and connects to sources for other administrative data such as financial information, teacher licensure records, human resources information, and other domains.[49]

NCDPI follows data management best practices by utilizing a mature ecosystem of connected sources, data management tools, warehouses, and reporting systems. Gartner found evidence of interoperability and standardization across the K–12 public education system. NCDPI connects source systems from its K–12 schools to a central data repository. This repository is managed with quality data transformation and security services, and information flows between local instances and the Central instance in real-time or near real-time. Student information data is consumable to a wide variety of users, from state policymakers to individual students and their family members, with appropriate privacy and security controls.

NCDPI has also implemented consistent data definitions, frameworks, and schema that underpin the interconnectedness and interoperability of its system(s). Stakeholder from NCDPI pointed out that they are currently working to upgrade and update legacy systems, to support modern technologies and

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[46] Student Information Systems (SIS) typically provide administrator functionality, as well as student-, parent- and teacher-facing functionality to manage key organizational information across a wide-range of business capabilities (e.g., student biographic and demographic data; application and enrollment; school set up and calendaring; scheduling; attendance; gradebooks; transcripts, etc.). Enterprise Resource Planning systems (ERPs) are common in higher education, and they typically provide an enterprisewide solution to manage finance, human resources, and student information.

[47] See Figure 11 for details on these institutions.

[48] This does not consider planned efforts or technology not currently in place. There are efforts underway to modernize and or replace current SIS and ERP solutions, as well as to improve systems and the quality of data they house. Gartner anticipates that these changes will add functionality and support interconnectivity and interoperability.

[49] Currently the state utilizes a PowerSchool SIS product. The Department has an open Request for Proposals (RFP) eliciting potential new solutions. Throughout this report, Gartner refers to this as the Department's SIS or the "NC SIS." This study attempts to remain vendor-agnostic in its recommendations, with the understanding that the specific vendors and products used today may change over time.

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standards, improved data sharing, and cross-organizational collaboration. These efforts rely on consistent funding and resourcing.

Notable Strengths of the K–12 Data Ecosystem

- A single NC SIS that all public schools utilize, with consistent data standards, policies, governance, and security
- Implementation of a UID service for staff and students, which could be further leveraged in higher education to support entity resolution
- An official digital transcript that shows individual student progress
- Data privacy practices aligned to FERPA and other key requirements
- Strong collaboration with other major education institutions, with the technical ability to enhance integrations

A key component of this success is the use of a universal ID solution. NCDPI uses a Unique Statewide Identifier for students ("Student UID") along with a similar "Staff UID."[50] Staff with access can use this service to manage the creation, reconciliation, and deduplication of students. The Student UID solution in place in K–12 can be considered a crucial building block for interoperability because it allows data to follow students as they move across school districts, avoiding duplication and the loss of data. Importantly, the UID remains valid even when families move out of state and return to another North Carolina school.[51]

NCDPI supports integration with CFNC, in near real-time, utilizing a web service. In addition, NCDPI has developed a custom, automated file exchange solution (i.e., the electronic managed file transfer system, eMFTS) to provide critical data to external systems that do not yet have other established connections to its data warehouse.[52] This is a key connection for many postsecondary and third-party systems and is relied upon when extracting data out of the K–12 data ecosystem.

Overall, the data ecosystem for K–12, as depicted at a high-level in the figure below, utilizes industry best practices and provides a well-defined set of data for users across the state.

Other systems that are not yet connected to NCDPI's databases still rely on flat files rather than a direct connection. There have been alternatives proposed by NCDPI to connect to other systems, and it appears that the necessary technology is in place, but these alternatives have not yet been implemented.

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[50] The Student UID service is currently implemented using the eScholar Uniq-ID® product.
[51] Differences exist in the way students are uniquely identified at various points in their education. NCDPI's UID solution is one of several similar efforts supporting entity resolution across the state.
[52] "CFNC" refers to the College Foundation of North Carolina. The College Foundation, Inc. described further in Section 3.2, provides the infrastructure, maintenance, and content updates for the CFNC.org website. Throughout this document these terms may be used interchangeably.
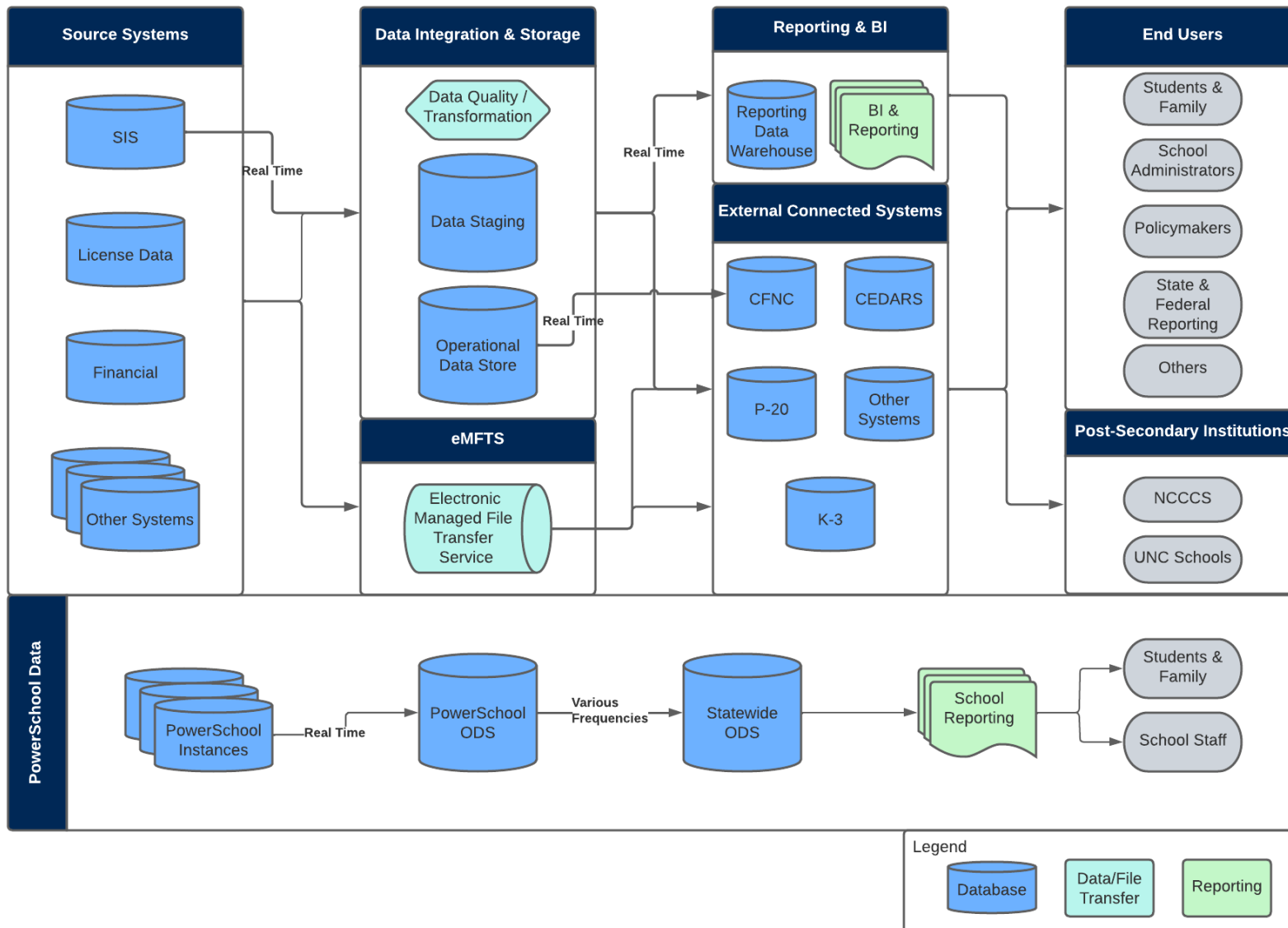
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Figure 9.   K–12 NCDPI Data Ecosystem

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3.1.2 Postsecondary Education, as governed by the North Carolina Community College System & UNC System

Postsecondary education institutions are not as centralized as K–12, and thus they rely more on local data sources and have less control over statewide student information.[53] Gartner found that most student-related data is stored in local databases at individual campuses and is collected and managed via each institution's ERP solution. These ERP solutions include student-data-related modules and other operational information (e.g., HR, finance). There is less interoperability than what exists today in the K–12 sector.

The North Carolina Community College System (NCCCS)

North Carolina's community colleges all use the same ERP vendor today; however, each college manages its instance and defines its data.[54] There is a significant lack of standardization. Each college's local database contains the operational data necessary for its community of students and administrators. The System office receives and consolidates a subset of this information for the purposes of state and Federal reporting, providing insights to policymakers and agencies. The data is pulled from all fifty-eight local ERP instances, at scheduled intervals, to meet reporting requirements. Therefore, the data is typically retrospective in nature; it provides a subset of information in the form of a static "snapshot."

In addition, at the community college level, student data is segregated; the data of degree-seeking students ("curriculum" students) is managed separately from the information of students participating in adult and continuing education ("continuing education" students). This is important to note because community colleges provide a wide variety of educational services to their communities, including not just formal postsecondary degree programs but also short-term workforce training and retraining in basic education skills, English language acquisition programs, distance learning, high school equivalency classes, and transition services. There is no single source system for student information: while Ellucian instances act as the source system for this data, technology and workflows have been customized by each campus, and distributed governance makes it challenging to use and share this data.

NCCCS leaders are engaged in discussions around a potential new ERP system that will better centralize student information across the state. Stakeholders reported that these initiatives are partially approved and beginning to move forward. Gartner identified these as critical pre-steps for interoperability; investing further in these efforts could help speed up any program of interoperability. Importantly, they will require sustained funding and resourcing, and will not be completed for several years.

The University of North Carolina System

The UNC System function similarly to NCCCS, with each school operating its own ERP instance and database for its students and administrators. The UNC System is also connected to each instance and provides insights for state and national use. The System office conducts separate data analysis to provide insights into the system, with strategic plans and operational improvements.

UNC's student data mart collects data at varying frequencies. Snapshots are pulled and then validated, at four main intervals (i.e., fall, spring, summer I, and summer II). At any given point, these intervals may be open at the same time based on varying term dates at local colleges. Within each interval, there are multiple snapshots taken (e.g., the beginning of term, census, end of term, post-grade finalization).

Gartner could not identify any direct connections between the UNC System and NCDPI, CFI or K–12 organizations. Each individual campus has its direct connection (via API) to pull residency data and application information from CFI. (The system office does consume that data later, via web services, at the point when other data snapshots are completed). In addition, the system office receives cyclical and

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[53] This is typical in postsecondary education and is true across the country.
[54] Currently community colleges use Ellucian's Colleague solution. The North Carolina Community College System office described efforts to modernize and/or replace current solutions, with a goal of better interconnectivity. These efforts will be heavily reliant on funding and resourcing.

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ad hoc files from NCDPI and NCCCS. These files are transferred and loaded via a data upload program, such as registration and completion data that is sent each term.

The data ecosystems for both postsecondary systems are naturally focused locally, but still have a useful central database of student and operational data. While additional centralization, data management, and security would be beneficial, the system is functioning and provides utilization to both the state level and individuals.

Notable Strengths of the Postsecondary Data Ecosystem

- System offices have established connections with all individual campus ERP instances
- Data insights and analysis are currently being used to optimize processes within the system
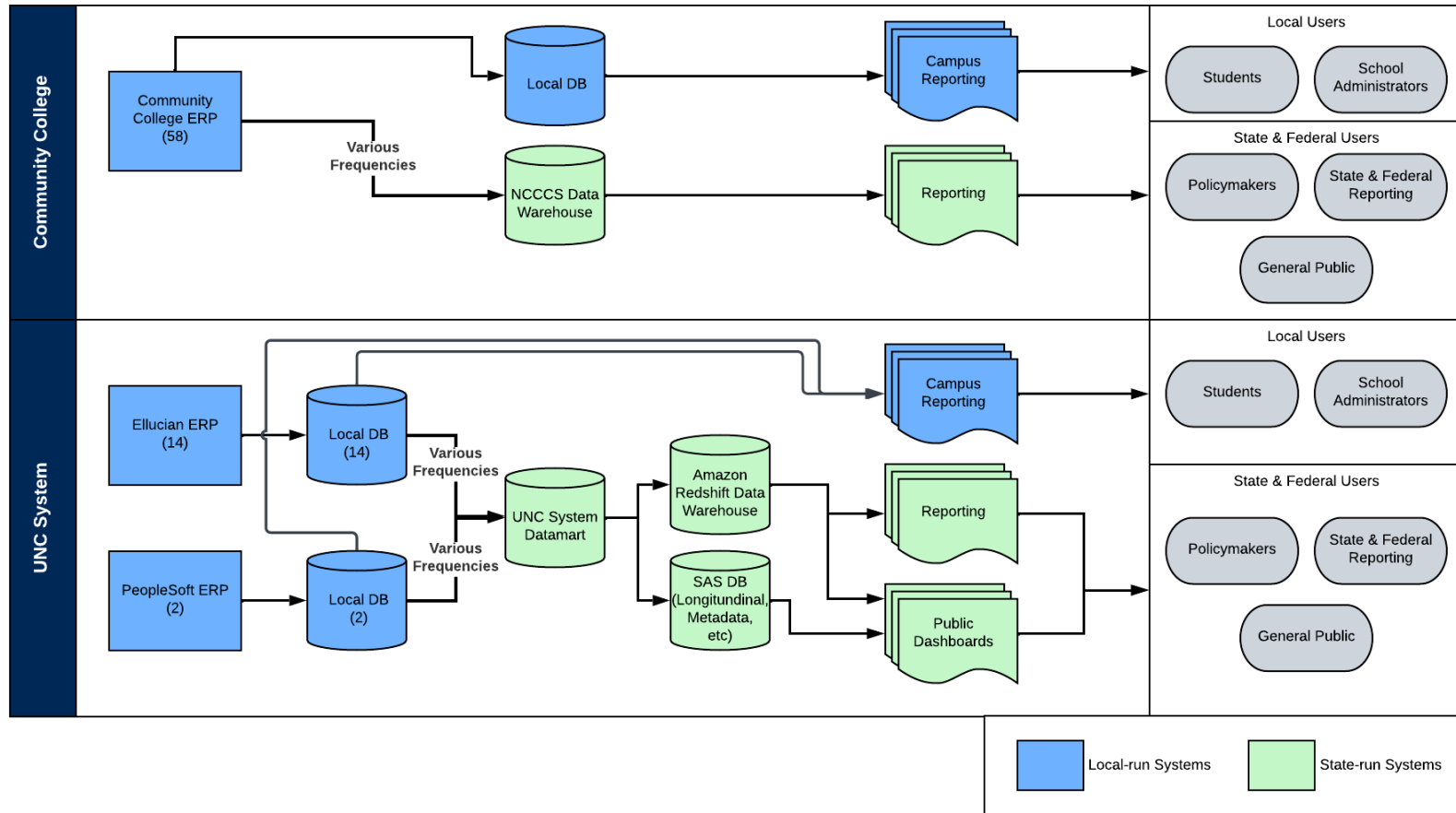- Many efforts underway to improve and centralize data systems

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Figure 10. Postsecondary Education Data Systems

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3.1.3   Current Interconnected & Interoperable Capabilities

The high-level diagrams above describe ways in which student-related information is collected, managed, and stored. While, *within each individual sector*, there is a wealth of valuable information, this data is not as useful as it potentially could be, because there is limited interoperability.[55] Each state system currently functions individually, providing its students, administrators, and other users valuable information; but the larger picture is obscured.

That said, considerable efforts have been made to partner and share data already, across K–12, community college, and four-year institutions. Gartner identified several ways in which sectors collaborate in support of students' success, and these are depicted in the figure below. Gartner found that the collaboration efforts primarily focus on processes and workflows, with limited cases that could be described as supporting "interoperability." Most points of interconnectedness involve isolated partnerships utilizing flat file transfers rather than a direct connection, which often is very resource intensive.

Figure 11.   Current Examples of Interconnectivity
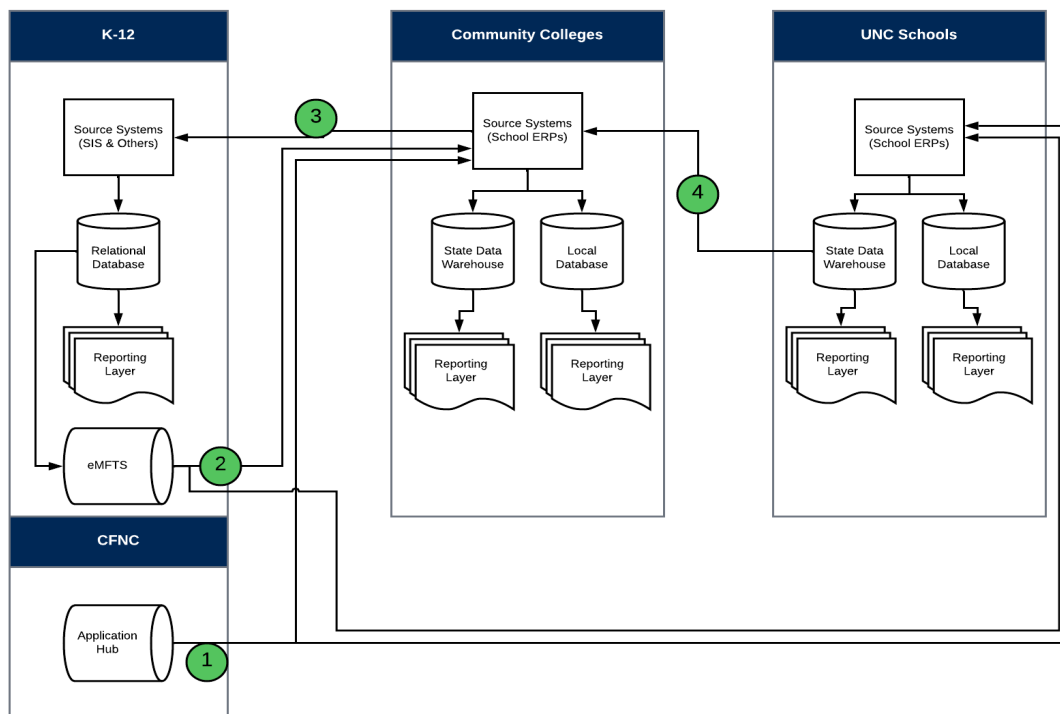
1.   **CFNC Application Hub and related tools**: Students can send applications to postsecondary institutions; they can also request K–12 transcripts and request a North Carolina Residency Determination. When students complete the FAFSA this data is also shared back with NCDPI.[56]
2.   **NCDPI eMFTS**: NCDPI sends files securely to systems not currently integrated with their own.
3.   **Local Partnerships**: Individual institutions have developed working partnerships to share data in ad hoc ways, usually using flat files. As an example, individual relationships exist to support students participating in dual enrollment programs at public high schools and community colleges.
4.   **Reverse Transfer**: The UNC System provides records to a student's prior community college when preconditions are met.[57] The processes highlighted above were built to solve individual needs and to mend gaps between K–12 and postsecondary sectors. They often rely heavily on

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[55]The State's LDS efforts compile data snapshots of important information, but they do not represent interconnectedness or interoperability. For more information on these efforts, see Section 3.2.
[56] Note the integration between NCDPI and CFNC is in near real-time via a webservice. Only FAFSA data is sent via a file.
[57] See the UNC website for more information on reverse transfer.

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Current State Assessment

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relationships and agreements around limited data use. Stakeholders identified cases where technology is available to help automate these tasks, but this technology has not yet been implemented (likely due to budget or human resource constraints.) There are opportunities to enhance system connections so that data can be more easily used and transferred across sectors. In short, current integrations are good to build on, but by themselves are not comprehensive enough to enable interoperability.

Technology alone will not address these needs; the success of the state's interconnectedness and interoperability efforts will be contingent on collaboration between these sectors, in the form of policy, process, standardization, and governance.

3.2 Practices To Build Upon

In addition to the systems identified above, the state of North Carolina has organizations, shared governance efforts, and articulation supports in place that assists student data sharing. These are described briefly in the sections below.[58]

3.2.1 Additional Organizations and Collaborative Efforts

These additional organizations play a critical role in the K–16 education landscape. These are examples only; this list is not all-inclusive.

The North Carolina State Education Assistance Authority (NCSEAA)

NCSEAA is the state agency responsible for helping students pay and save for education. NCSEAA administers financial aid and savings programs and provides information to students and teachers about financial aid. NCSEAA contracts with the College Foundation, Inc. for the administration and support of specific services in support of NCSEAA's mission.

College Foundation, Inc. (CFI) and College Foundation of North Carolina (CFNC)

CFI administers a portfolio of education loans, state and private grants, and scholarship programs for students attending schools in North Carolina. It also manages the North Carolina 529 college savings program.

CFI provides infrastructure, maintenance, and content updates for the CFNC.org website. They employ regional representatives to deliver information to North Carolinians about planning, applying, and paying for college. Financial aid services and other tools and supports are available at the College Foundation of North Carolina (CFNC) college and career planning website.

CFI maintains:

- *The Residency Determination System*: a portal that allows postsecondary applicants to request a North Carolina Residency Determination in support of in-state tuition and state-funded aid

- *The Application Hub*: allows prospective students to apply to all fifty-eight community colleges, a subset of North Carolina private institutions, and many of the UNC institutions.[59] Application information is delivered to these colleges and universities via a custom API.[60] The Application Hub also provides a transcript service through which students may request their K–12 digital transcripts

- *Finishing the FAFSA:* allows NCSEAA to match high school student enrollment data from NCDPI to the U.S. Department of Education FAFSA completion data. This helps to show schools which

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[58] Gartner did not evaluate the technology solutions associated with each of these organizations. This is intended not to endorse any solution or organization. Rather this provides a brief list of the collaborative efforts and agencies that support key education services outside of NCDPI, NCCCS, and the UNC System.
[59] This is offered via collaboration between the UNC System, NCCCS, NCICU, NCDPI, NCSEAA, and CFI.
[60] This data is not shared directly with system offices, but rather with each individual campus location.

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of their seniors have completed or partially completed the FAFSA. Information on FAFSA completion is shared with high school counselors to monitor students' progress using the CFNC interface

The North Carolina Department of Information Technology (NCDIT)

NCDIT and its Government Data Analytics Center (GDAC) provide solutions tailored to critical business needs, including the following, non-education-specific examples of interconnectivity and interoperability:

- *NC Health Connex* is a tool created to link Health Information Exchange (HIE) networks together, enabling organizations to securely access, use, and exchange sensitive patient information for approved uses. This is a prime example of interoperability. It allows records to be linked by a Master Person Index (MPI) for entity resolution. The utility offers bidirectional data sharing, analytical reporting, and a patient portal for healthcare professionals
- *Criminal Justice Law Enforcement Automated Data Services (CJLEADS)* integrates criminal offender data found in multiple state and local systems, in another example of interconnectedness. This system matches person records, creating a "person index" to support the compilation of criminal justice offender records. Most of the data is updated nightly, however, in certain cases where business need requires real-time information, APIs support the sharing of the most current information
- *NC eLink* is a state utility that enables individual records and people to be linked across administrative systems. Data within this utility is classified and highly governed to ensure data links are limited by need and use case and restricted to data that is approved to be shared. This system also creates a "person index." Most of the data is updated nightly, based on the data contributor's ability to share information. This utility supports both batch and APIs queries

MCNC

MFNC is the not-for-profit operator of the North Carolina Research and Education Network (NCREN) that provides network connectivity, Internet access, cybersecurity, and related infrastructure services for the public education enterprise K-20. NCREN also serves most private colleges and universities, rural healthcare facilities, NCDIT (and thus all state agencies), and research institutions. MCNC's Board comprises leadership from NCDPI, the UNC System, individual UNC campuses, NCCCS, and NCICU.

> **Extensive collaboration among K–12, postsecondary institutions, and other data providers across the state is required — these groups need to agree on a shared vision and mission, governance structures, standardized data definitions, and timelines.**

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3.2.2   Shared Governance Efforts

The following illustrate existing examples of shared governance in the K–16 education landscape. These are examples only; this list is not all-inclusive.

NCCareers.org

NCCareers.org is led by North Carolina education, health, workforce development, and business institutions. The goal of this website and its suite of user-friendly tools is to help individuals make informed career decisions. Its collaborative development and governance are an example of inter-agency cooperative efforts to bring together multiple data sources and surface value-added information through user-centered products.

North Carolina Longitudinal Data System (NCLDS) Governance Board

This board, established by executive order in 2022, provides consultation to the North Carolina Longitudinal Data System (NCLDS). The board members are senior leaders from each entity that contributes data to NCLDS. The board also includes a non-voting member from the North Carolina Department of Information Technology (NCDIT) and the Governor's Office.

Each of these efforts involves cross-agency or cross-organization collaboration, and as such, they have governance models that have the potential to be leveraged to support interconnectedness and interoperability.

3.2.3   Support for Articulation and Transfers in Postsecondary Education

Below are examples of existing efforts to standardize data and offer support for students when they move from school to school. These are examples only; this list is not all-inclusive.

Articulation Agreements

The UNC-NCCCS Comprehensive Articulation Agreement (CAA) and associated Transfer Advisory Committee (TAC) include local and bilateral articulation agreements. This information could be leveraged to support students in understanding degree pathways available, as part of an education roadmap.

Catalysing Transfer Initiative

Representatives of the higher education sectors in North Carolina collaborated to evaluate the transfer policy. The goals were to identify where inequities exist in transfer processes, understand how those inequities negatively affect students and identify opportunities to improve student outcomes. This effort is supported by the ECMC Foundation, with the engagement of the State Higher Education Executive Officers Association (SHEEO) and the Gardner Institute.

Common Numbering and Standardization of Course Data

The UNC Common Numbering System (UNC CNS) improves students' ability to transfer courses between UNC institutions, which include the state's public universities and the North Carolina School of Science and Mathematics. It includes a subset of undergraduate courses that are frequently transferred between UNC institutions.

The NCCCS leverages a common course numbering system, viewable through the Combined Course Library.

In addition, the UNC System collaborated with the NCCCS to build the rules and technology to allow students who opt into the Reverse Transfer program to have their post-transfer UNC-earned credit hours reported back to the previously attended community college, where the college registrar can evaluate the student for a post-transfer associate degree award. The program requires cooperation around

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governance and policy as well as complex data-sharing arrangements across institutions. This supports the system office's proposed plans to further centralize student data.

3.2.4   Local Data-Sharing Partnerships

Below are examples of existing partnerships highlighted in stakeholder interviews. These are examples only; this list is not all-inclusive.

Wilkes Community College and Area School Districts

The college and area school districts have partnered through data sharing and advising efforts, providing integrated cross-sector data from current source systems. As part of the Career and College Promise program, Wilkes Community College "career coaches" use this information to advise students participating in their dual enrollment programs. The behind-the-scenes data integration is currently largely manual and homegrown.

Appalachian State University College Access Partnerships

The suite of student success programs (e.g., GEAR UP) at App State are supported by inter-institutional data sharing, and leverage data sharing agreements made with partner school districts.

The Forsyth Promise Data Sharing Project

Forsyth Tech, Winston-Salem-Forsyth County Schools, and various community non-governmental organizations (NGOs) collaborate using a web platform that provides a way for partners to access student and program data. This platform is a valuable tool for partner agencies, allowing them a secure way to access information and collaborate to support children who are enrolled in their programs.

Career Coaches

The Career Coach Program, administered by the North Carolina Community College System, places community college Career Coaches in high schools to assist students with determining career goals and identifying educational pathways that enable students to achieve these goals.

Career and College Promise Partnership Agreements

Based on observations from North Carolina Dual Enrollment Opportunity Study from UNCG SERVE, and staff experience, the State Board of Education (SBE) has directed LEAs to create partnership agreements with their IHE Partner that will address student academic support systems, including advising and sharing student progress. This could lead to data-sharing agreements to support advising dual-enrolled students.

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Understanding
the Need

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4.0 Understanding the Need

This study's stated goals require us to consider how students and families might be better empowered with access to their own data. A key point in the journey of a student where this might occur is the transition *from secondary to postsecondary education*.[61]This is a place where many students "drop off" in the pipeline— or in other words, where this pipeline fails to be seamless for students. To increase educational attainment, the state must ensure that more students are both *entering* postsecondary programs and *persisting* through them. In support of this, Gartner focused on three points, highlighted below, and described further in the subsequent tables.

1. Participation in Dual Enrollment Programs
2. Application to Postsecondary Programs
3. Transferring Between Postsecondary Programs

Figure 12. Three Key Points in a Student's K–16 Journey

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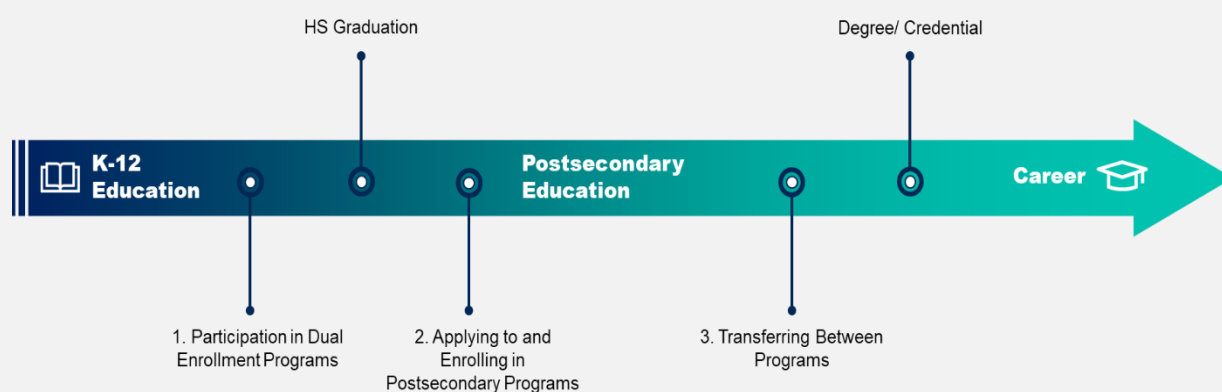
[61] In primary and secondary school, education is largely compulsory. All students between the ages of seven and sixteen are required to receive an education, whether via public school, a charter school, a nonpublic school (e.g., private, parochial), or some form of home schooling. Most young people in North Carolina participate in the public education system governed by NCDPI.

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The tables below provide details on each of these three key points in the student's journey.

1. Participation in Dual Enrollment Programs	
Current State	▪ North Carolina's Career and College Promise initiative (CCP) allows eligible students to participate in college-level course work at community colleges while still enrolled in high school. Students can earn college credit to take with them after high school graduation; and in some cases, courses serve as "dual credit," fulfilling requirements in both high school and community college programs ▪ This is an important way for students to be exposed to college-level course work while earning credits that can save them time and money later in their postsecondary degree programs ▪ The program is successful and growing; in fact, 32% of all high school graduates in 2021–2022 participated in Career and College Promise or Dual Enrollment[62]

Potential Opportunities	▪ Students in the CCP program are being supported by both their high school and college. These two groups lack near real-time access to information, like attendance and performance data, for the students they serve. While data is already shared at the middle or end of the term, parties would benefit from more bidirectional data in order to:
	    ▪ Develop student, instructor and course schedules that facilitate participation in the program
	    ▪ Enable advisors to see student performance and attendance in near real-time and provide needed support to students who are struggling

2. Application to Postsecondary Programs	
Current State	▪ Currently, 75% of high school seniors indicate that they intend to enroll in a postsecondary institution. However only 58% of these students complete the Free Application for Federal Student Aid (FAFSA), and only 55% of all graduates enrolled in a postsecondary institution within 12 months[63] ▪ The College Foundation of North Carolina (CFNC) provides a website with publicly available tools that support the application process. This includes numerous resources to help plan, apply, and pay for college, including an "Application Hub," a "Request Your Transcript" tool, a North Carolina "Residency Determination System," along with supporting resources ▪ In addition, NCDPI and CFI collaborate in a program to support students with complete the FAFSA. This includes matching student-level data from high school with information from the U.S. Education Department (USED) to provide greater visibility into which students have already completed this crucial step, and which need more support
Potential Opportunities	▪ Administrators report that challenges are matching student-level data and that the process is not as simple as it could be. Better adoption of North Carolina's Unique Student ID (UID) system could ease this burden. This would ensure students' data elements are accurately matched across institutions[64] ▪ In addition, while a wealth of information is available to students and their families via CFNC's Planning Tools, it is not always personalized or easily used. Stakeholders have requested a more specific and personal view of student's data that serves as a "roadmap" with steps to take to move forward in their education journeys

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[62] This statistic was provided by NCDPI.
[63] This statistic was provided by myFutureNC.
[64] This solution is already in place and could be helpful as a tool to support interconnectedness, however stakeholders noted that additional funding for upgrades may be required.

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3. Transfer between Postsecondary Institutions	
Current State	Students may transfer from one institution to another during their postsecondary education for multiple reasons — cost/financial hardship, program fit, or other personal factors. In the fall of 2021 alone, 10,000 students transferred *from an NC community college to a UNC institution.*[65] Another 2,100 students transferred *between UNC institutions.*[66] The transfer process is far from seamless and can be difficult to navigate. It is unfortunately common for students to lose credits as a result of transferring from one institution to another. Students are also sometimes unsure when navigating course selection and choosing the right institutions that align to their sought-after degree.
Potential Opportunities	Stakeholders recommend that a digital, unified transcript and inter-institutional higher education course mapping can help make the transfer between postsecondary institution easier to navigate. A universal transcript can serve as an official record of the courses completed and credits received at all the institutions a student attended. This coupled with the mapping of inter-institutional courses can help ensure credits are not lost and students are placed in the appropriate course to complete their degree requirements

4.1 Key Use Cases and Requests

It was Gartner's goal throughout this study to understand the current needs of stakeholders across the education space in North Carolina, and to ensure that any requests or use cases were grounded in an accurate understanding of the current state and not only "perceived" need. Over many interviews, 30+ discrete requests were raised and cataloged.

To properly address these requests in a future state solution, each request was evaluated against the affected end-users or beneficiaries.[67] Gartner also considered if each request could be resolved with current state technology, or even *without* a technology solution. To focus further and guide a potential future state architecture, the requests were prioritized based on the goals and potential outcomes of this study.

Technology alone cannot address these requests. Many are dependent on people and processes (e.g., policy, governance, resourcing). The items described below are referred to as "use cases," but could also be labeled as "prioritized requests."

Table 5. Stakeholder Use Cases

#	Description	High-Level Requirement
1	**Unified K-16 Digital Transcript**	As a student or guardian, I would like to be able to view a K-16 universal digital transcript that shows my courses, credits, exams, and credentials from all the schools I attended within North Carolina. This would build upon my existing K–12 digital transcript and may include a competency-based view. I must be able to manage access to this record and control how my data is shared with institutions or employers in the future.

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[65] This statistic was provided by UNC.
[66] This statistic was provided by UNC.
[67] Different user groups have different data needs to consider, so defining the key individuals who stand to benefit from interoperability was an important pre-step to any "solutioning." It is also important to note that this study did not allow for significant direct engagement with end-users, nor research on their needs. Evidence provided in this report is largely anecdotal without further engagement.

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#	Description	High-Level Requirement
2	**Portable, Holistic Student Portfolio**	As a student, I would like a student portfolio that, in addition to courses and grades, would include information related to my extracurriculars, athletics, awards, and work-based learning. I would like to be able to control access to my data and share it with institutions or employers when appropriate.
3	**Manage Privacy Settings**	As a student or guardian, I would like a tool to opt-in or opt-out of sharing data and manage who can access my records.
4	**Data Sharing Bidirectionally Across Sectors**	As a K–12 administrator, I would like to receive data on my students' subsequent enrollment and attainment in postsecondary institutions after they have left K–12, to help me understand how to improve my own schools' work.
5	**Real-time Data for Dual Enrollment**	As a school administrator or advisor, I would like to view the attendance and grades of my students enrolled in another institution's programs in near real-time, so that I can provide better and more immediate support.
6	**Student Degree Roadmap**	As a student, advisor, or college administrator, I would like to be able to view degree requirements through a single, searchable portal that incorporates information from the many articulation agreements, baccalaureate degree plans, and other policies that determine potential student degree pathways.
7	**Inter-institutional Higher Ed Course Map**	As a college administrator, I would like to leverage a consistent crosswalk that maps courses across higher education institutions and supports transcript evaluation.
8	**Automated Transcript Matching**	As a college administrator, I want a more efficient process to be implemented so that I can match applications to existing student materials.
9	**Connected Postsecondary Systems**	As a college administrator, I would like a centralized student data system to be implemented within the NCCCS so that I can better track data for students moving from one postsecondary institution to another. This should support more consistent registration, enrollment, and grading.
10	**Postsecondary Interest Survey**	As a college administrator, I would like a survey with questions of my choice implemented and deployed to high school students, so that I can later receive better data about their preferences and intentions, providing support for postsecondary enrollment where appropriate.

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4.2 Potential Outcomes Supported

After developing an understanding of the requests above, Gartner sought to describe the potential "interim outcomes" that would result if these requests were met, described below.

Table 6.   Potential Outcomes Aligned to the Above Use Cases

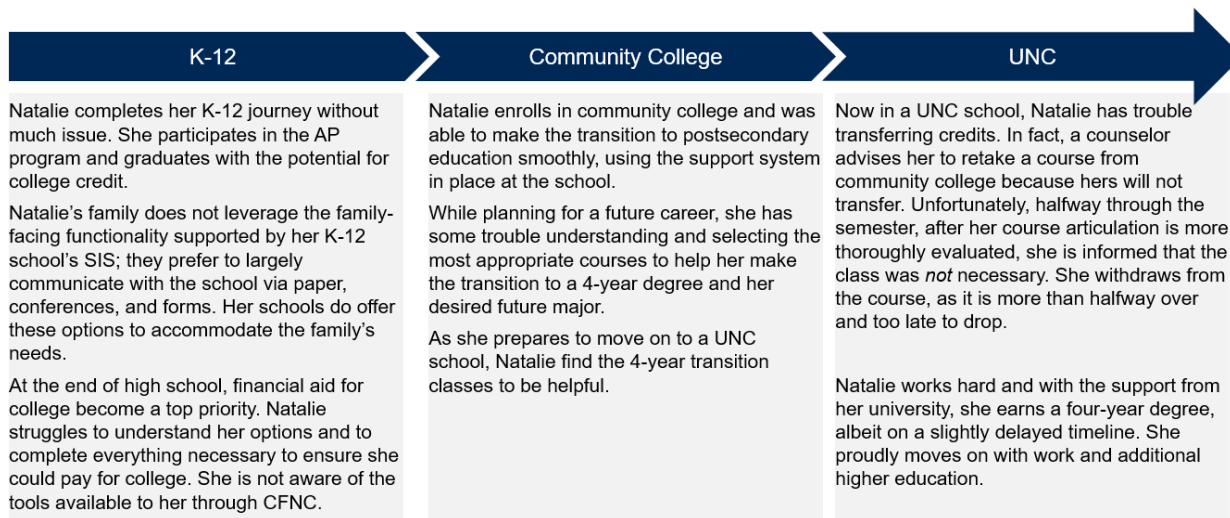| #	Outcome	Explanation
1	**Complete View of Student Records**	If requests are met, students may have a single place to view important data from K-16, including potentially a more holistic view of not just transcript data but information on extracurriculars, awards, and work-based learning. Students would have control over, and access to, their data after they leave high school and could authorize others to view this information when appropriate. For example, students could use this view to demonstrate knowledge and skills to potential employers. This supports the legislative goals of improved data sharing and better support for students and families.
2	**Data Shared for Improvement**	School-based staff may have better bidirectional data flows, which are provided in near real-time, complementing other historical and aggregated data available in LDSs and other tools. Any dashboards or reports would utilize predictive and prescriptive analytics and practical, student-level data (where permissible). This supports the goal of improved data sharing.
3	**Better Understanding of Postsecondary Options**	Students and frontline staff who support them may have tools that describe a personalized roadmap or journey through postsecondary education, highlighting key steps and dates. This could potentially mean that students have a single place to review the various requirements and course loads associated with specific degree programs so that they can make informed choices. This supports the goal of improved data sharing and better support for students and families.
4	**Support for Postsecondary Transfer Students**	Students and frontline staff who support them may have a better understanding of the articulation processes and agreements that affect which credits are used and accepted at postsecondary institutions. Students might also potentially experience an easier process when enrolling in /transferring to higher education programs. There may even be a measurable impact in "lost credits" and associated costs, with the appropriate agreements and processes. This supports the goals of improved data sharing, better support for students and families, and eliminating potential redundancies.
5	**More Efficient Application Process**	The state may experience a more seamless process that is less manual and labor-intensive for staff. In theory, improvements to the process and experience of applying to postsecondary education might mean that more students enroll, and administrative resources can be redeployed to drive better student outcomes. This supports the goal of eliminating potential redundancies.

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4.3 Select Student Case Studies

The overall goal for myFutureNC and this study is to help North Carolinians attain more credentials, with a focus on helping the end user, students, better utilize their data. Understanding the needs of stakeholders across the major educational systems is critical; however, the value of hearing directly from students and potential students impacted by the topics discussed in this study cannot be understated.

Below are two case studies, based on real and personal experiences. These describe the journeys that these students took through the K–16 system within North Carolina. [68] Gartner recommends that any future programs related to interoperability, which may result from the findings in this study, be grounded in more thorough engagement with students, families, and direct-end users.[69]

Figure 13. Natalie A.'s Story

K-12	Community College	UNC
Natalie completes her K-12 journey without much issue. She participates in the AP program and graduates with the potential for college credit.	Natalie enrolls in community college and was able to make the transition to postsecondary education smoothly, using the support system in place at the school.	Now in a UNC school, Natalie has trouble transferring credits. In fact, a counselor advises her to retake a course from community college because hers will not transfer. Unfortunately, halfway through the semester, after her course articulation is more thoroughly evaluated, she is informed that the class was *not* necessary. She withdraws from the course, as it is more than halfway over and too late to drop.
Natalie's family does not leverage the family-facing functionality supported by her K-12 school's SIS; they prefer to largely communicate with the school via paper, conferences, and forms. Her schools do offer these options to accommodate the family's needs.	While planning for a future career, she has some trouble understanding and selecting the most appropriate courses to help her make the transition to a 4-year degree and her desired future major.	
At the end of high school, financial aid for college become a top priority. Natalie struggles to understand her options and to complete everything necessary to ensure she could pay for college. She is not aware of the tools available to her through CFNC.	As she prepares to move on to a UNC school, Natalie find the 4-year transition classes to be helpful.	Natalie works hard and with the support from her university, she earns a four-year degree, albeit on a slightly delayed timeline. She proudly moves on with work and additional higher education.

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[68] Names and experiences described are anonymized to ensure privacy.
[69] It is important to note that the experiences documented below may not be representative of the experiences of the broader population, so any takeaways from these examples should not be applied generally without further discussion or surveying. This may include surveys or focus groups (leveraging both new and previously conducted outreach).

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Figure 14. Carlos G.'s Story

K-12	Community College	UNC
Carlos is enrolled in public schools within the State. As a first-generation immigrant, his parents are not fluent in English; in addition, they are concerned about any potential negative impacts that would occur based on Carlos's immigration status.	To help with his financial situation, Carlos chooses to attend community college for a few years, with the goal of transferring credits to a 4-year school later.	Carlos eventually transfers to a UNC school. This is a bumpy process. When articulating and signing up for classes, he misses a key sign-up deadline for a mandatory, pre-requisite summer course, because he enrolled in late spring. Carlos pushes hard for other options (e.g., a different class to take, some flexibility) and speaks to many people, but is unable to enroll in the necessary course. As a direct result, he is informed that he will need to wait and delay other subsequent courses. This ultimately delays his degree attainment significantly.
Overall, Carlos navigates and is very successful in school, with support from the school community and his family.	Carlos is successful in community college and appreciates the support he receives. He does wish he has more information on the process of transferring (e.g., when key decisions must be made, when certain deadlines apply).	
His parents do not utilize the family-facing functionality supported by the school's SIS; they primarily interact with schools in person.		While Carlos graduates later than anticipated, he is ultimately successful in earning his degree.
As Carlos considers postsecondary options, he has trouble getting sound advice, in part because support staff working with him do not understand the intricacies of how his enrollment and financial aid could be impacted by his immigration status. Carlos advocates for himself, and ultimately works with a lawyer for support.		

Our selected stories highlight several challenges within otherwise quite successful journeys through the state's K–16 pipeline:

- Students may have benefited from a better and/or more personalized understanding of postsecondary choices.[70]

- Students found the transfer process challenging, and this may be a place where improved interconnectivity and interoperability could help.

- While these two students had technology supports to use, language barriers or lack of comfort with technology and data collection may have kept them away.[71]

While these two experiences cannot paint a complete picture, they support the idea that the path through a K–16 education is personal and specific. Further engagement with end users (including students, families, and school-based staff at both the K–12 and postsecondary levels) will provide the context necessary for any future solution, so that specific students and families impacted can find real value and support.

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[70] While a use-case related to an "education roadmap" may support this, it is important to note that this also might be addressed through policy, process, or training.
[71] This may be real or perceived; Gartner did not evaluate current systems' business capabilities. For example, NCDPI may provide various translation services and in-application language support that the student and/or parent was not aware of.

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Future State Design and Development

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5.0 Future State Design and Development

Based on use cases and desired outcomes identified from stakeholders, Gartner developed a conceptual design for a future state solution that addresses the expressed functional requirements. Gartner looked for possibilities to leverage current data systems to address as many needs as possible as well as define a future state architecture that if implemented provides a holistic solution.

5.1 Strategies for Leveraging Existing Data System Partnerships

The foundations for any data solution should utilize the existing systems and the current connection capabilities. There are systems already in place which exhibit an ideal foundation for interconnections within certain organizations. NCDPI along with the College Foundation of North Carolina (CFNC) already have some level of interconnected processes and data sharing, with the system offices (UNC, NCCCS) best suited for enhancing integrations.

The data ecosystem currently in use by NCDPI is capable and ready to incorporate additional connections to other systems and has processes in place for sending files to other institutions. This is further expanded by the partnership with CFNC which handles applications and transcripts for NC institutions. The CFNC application hub can be utilized in conjunction with the future state solution to facilitate transcript requests and data sharing. CFNC also already has direct connections to each postsecondary college/school which could be expanded upon. The current application of this service is limited with postsecondary institutions not yet fully capable of interpreting the data sent (e.g., transcript matching) but further efforts can be utilized to improve and optimize.

The postsecondary system offices are structurally in the best position to provide data for an interconnected system but are not currently in a state where additional connections would be readily impactful. This is due to the fact that most of the student-affected operations at postsecondary institutions are primarily conducted through individual schools rather than a centralized system and data warehouse. However, the system offices already have connections with each individual school for collecting data. If these connections are enhanced, the communication between institutions would be improved and simplify a possible future state solution.

The first step toward any future state solution should be leveraging the current data systems, processes, and structures in place, while also enhancing them as this can create a faster impact for lowering cost than creating an entirely new solution.

5.2 Future State Architecture

This study requested Gartner to design a complete interconnected and interoperable data system between all major education systems. An interconnected and interoperable student data system would essentially function similarly to a middleware tool which integrates and connects all major education systems across the state. To do this, a mature, comprehensive technology solution will be required to be implemented "on top of" the current systems. Due to the many requirements and confidential nature of student data, the future system must satisfy not only business requirements but also data quality, privacy, security, and governance needs.

Based on the understanding of the current state of data systems across North Carolina, Gartner designed the conceptual interconnected and interoperable architecture, Figure 17, to specifically fulfill requests made by education stakeholders. The conceptual data system architecture follows best-in-class data practices with additional applications to satisfy the identified use cases (i.e., "requests") detailed in Section 4.1.

Gartner recommends an interconnected and interoperable student data system composed of the following components:

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- **Source Systems:** The key to interconnectedness is to establish a network between places where student information lives. This will require connecting to NCDPI's integration hub databases, CFNC for application data, and each individual community college and UNC institution. The state system offices do not yet collect enough data to be a single connection point; however, if a single ERP or SIS is implemented consistently this would be improved

- **Data Management & Store:** The data collected will be ingested through a robust data governance process, then managed and matched such that relational databases will be able to administer data to an analysis layer. There will be multiple databases (e.g., data lakes, data warehouses, data marts, etc.) used to store a staging version of the data, with another data mart to provide cleaned data (with privacy options, de-identified if appropriate) for data analysis and consumption

- **Data Governance:** Throughout the entire system, data governance will be critical to maintaining the trust, privacy, and security of data. These processes will include identity access and metadata management, along with data security and quality checks. The primary application of these processes will be located when data is being ingested from the source system

- **Master Data Management:** The primary factor for this system to be consumable and successful is to utilize master data management to ensure uniformity, accuracy, accountability, and semantic consistency across data in all source systems. Master data will need to be implemented with a uniform set of identifiers and attributes to describe all the data being ingested into the system

- **Data Analysis:** The primary method of data consumption will be through customized dashboards and self-service reports in a business intelligence and analysis suite. Individual reports will be created for specific purposes for end users. For example, a holistic profile or universal transcript can be created for a student, but a college administrator will have a different view for their purposes. These reports will be able to satisfy the majority of requirements and provide users with easy access to the available data in all source systems

- **Application Portal:** An application such as a web portal will need to be custom-developed and added to the platform to meet some of the requirements. For example, granularly determining privacy options for individual data points will require an additional web interface that users can opt-in or out of sharing data when appropriate

- **End Users:** The primary end users will be students and families accessing or authorizing access to their data as well as institutional administrators/frontline staff using the data to improve student success and institutional operations

This conceptual architecture solution will look to achieve greater interconnectivity between the major education institutions across the state, providing real-time and holistic views of student data from K–16. The system will be able to assist with technology-related stakeholder requests, with additional policy changes needed to complete a comprehensive solution.
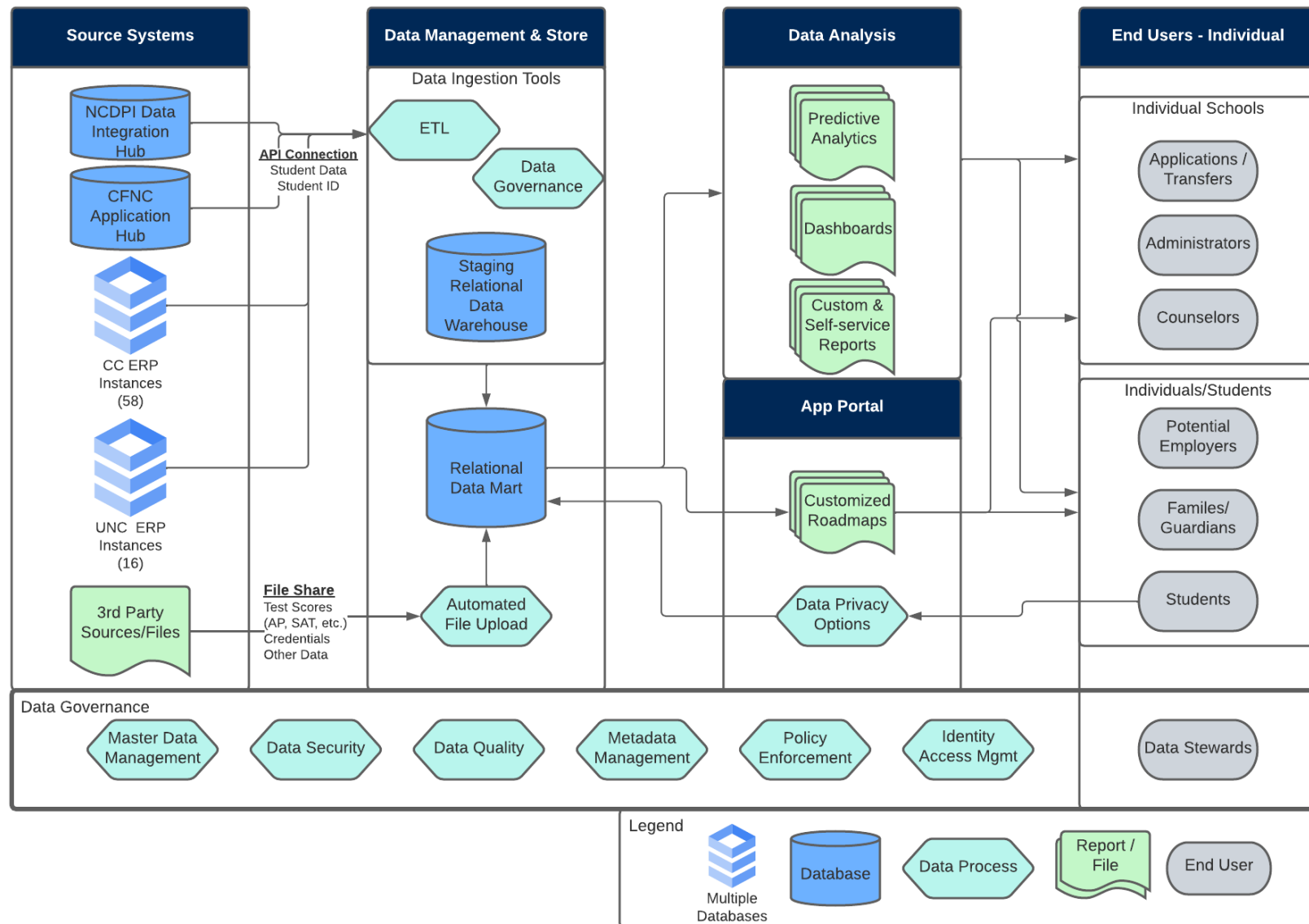
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Figure 15. Future State Interconnected and Interoperable Student Data System Architecture

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Considerations and Recommendations

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6.0 Considerations and Recommendations

6.1 Governance Factors

Before the state of North Carolina can move forward in pursuing an interoperable student data system, a governance structure must be put into place to *enable* this new interoperability. Interoperability requires interdependence—organizations that once made decisions independently will now need to collaborate with each other. This is because "interoperability" requires a high degree of standardization in order to work—data cannot be exchanged and used meaningfully across multiple organizations and systems without agreement on how it will be used.

The education industry as a whole has lagged behind other industries in pursuing interoperability, perhaps in part due to monolithic legacy data systems, silos across institutions, and a historical culture of institutional autonomy and distributed decision-making.

To understand the governance needs, Gartner has defined two categories, described further in the subsequent sections.

Program-level Governance

Gartner recommends that the effort to transform from the current state to a meaningful level of interoperability be managed as a *program*—that is as a *coordinated effort involving multiple projects*. This program will probably last for at least three years, perhaps longer.

To be successful, this K–16 interoperability program will require a strong governance model. Program-level governance is about making investment decisions well, and decision-making is rarely simple for any large enterprise, especially when it involves resolving conflicting or competing IT priorities and demands.

A critical part of governance is defining who can make decisions, what types of decisions they can make, and how these decisions will be communicated. Because of this, a program-level governance model includes clear roles and responsibilities to help organizations focus on cross-sector or cross-institutional programs of work so that together they achieve sustainable results.
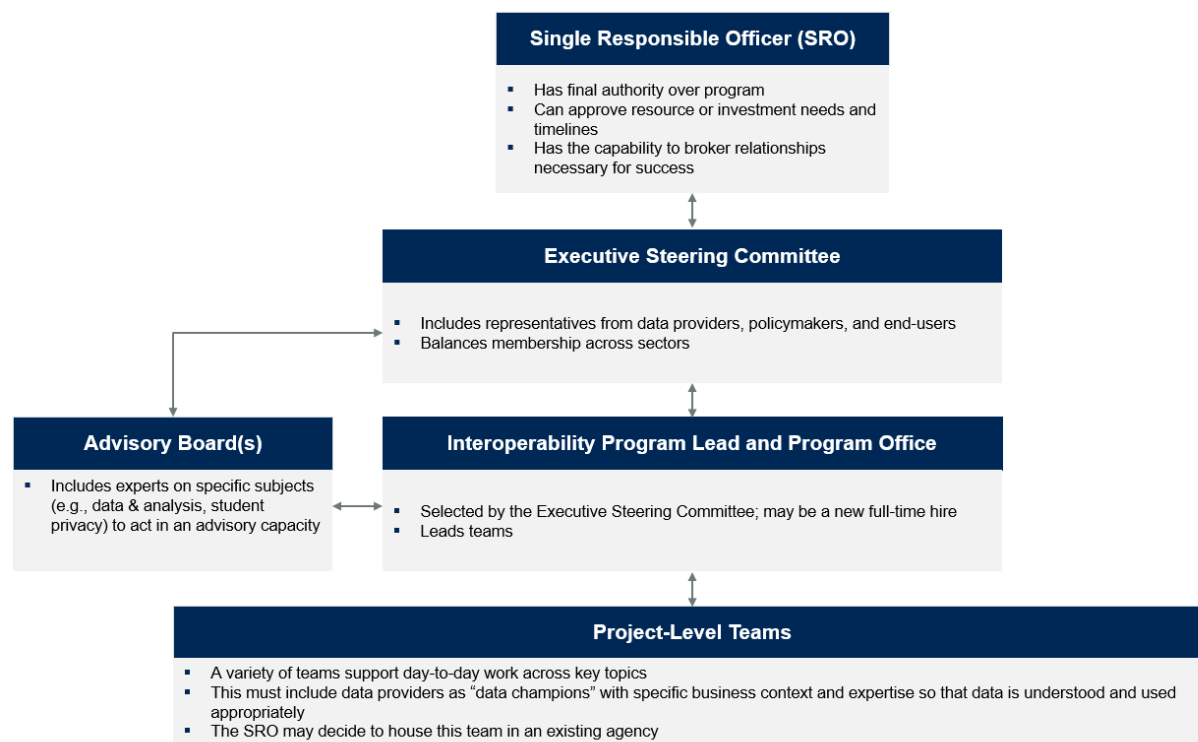
Guiding Principles for Program-Level Governance

Gartner research supports the following set of "guiding principles" for public sector program-level governance:
- Governance is a means of making decisions and ensuring the project's success, not the means of managing a program or project
- Information will be communicated to all members of the governance body at the same time and cadence
- Decision-making will be pushed down to the lowest possible organizational level and knowledgeable, experienced users will be empowered to make decisions
- Decision-making will be structured, transparent and engage relevant business, and technical staff throughout the process
- Decisions will be made by consensus, which means discussing items and reaching an agreement among decision-making members. This agreement does not necessarily mean that each member concurs with the decision itself, but rather supports the decision and will visibly demonstrate that support in the public arena within the organization
- Members will strive to make decisions regarding schedule, scope, budget, and risk mitigation actions within the scheduled meetings
- Members will participate on a regular basis as defined in the governance structure
- Members will respect and listen to each other
- Members will recognize and celebrate successes as well as recognizing and learning from challenges
- Members will welcome and give helpful feedback to support continuous improvement

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Typically, Gartner recommends an "Executive Steering Committee" or "Governing Board" to lead cross-functional programs, with accountability rolling up to a single office or official.[72] A high-level generalized example in depicted in the figure below.[73]

Figure 16. Potential Governance Structure

Single Responsible Officer (SRO)
- Has final authority over program
- Can approve resource or investment needs and timelines
- Has the capability to broker relationships necessary for success

Executive Steering Committee
- Includes representatives from data providers, policymakers, and end-users
- Balances membership across sectors

Advisory Board(s)
- Includes experts on specific subjects (e.g., data & analysis, student privacy) to act in an advisory capacity

Interoperability Program Lead and Program Office
- Selected by the Executive Steering Committee; may be a new full-time hire
- Leads teams

Project-Level Teams
- A variety of teams support day-to-day work across key topics
- This must include data providers as "data champions" with specific business context and expertise so that data is understood and used appropriately
- The SRO may decide to house this team in an existing agency

An Executive Steering Committee can support a future North Carolina interoperability program by:

- Helping executive leadership oversee the program
- Creating a transparent decision-making and reporting authority
- Providing leadership, accountability, and direction for the program
- Ensuring effective and balanced decision-making between key stakeholders
- Giving executive leadership a mechanism to set and monitor monitoring policies and principles related to the program
- Supporting delivery against strategy by monitoring risk and elevating specific program-level decisions to the appropriate level

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[72] For a significant program that involves multiple institutions and sectors, it may be appropriate to secure state executive-level support.
[73] As part of the National Scan, Gartner spoke with a small group of leaders involved in similar statewide efforts. For more information on their recommendations regarding governance, see Section 8.6.

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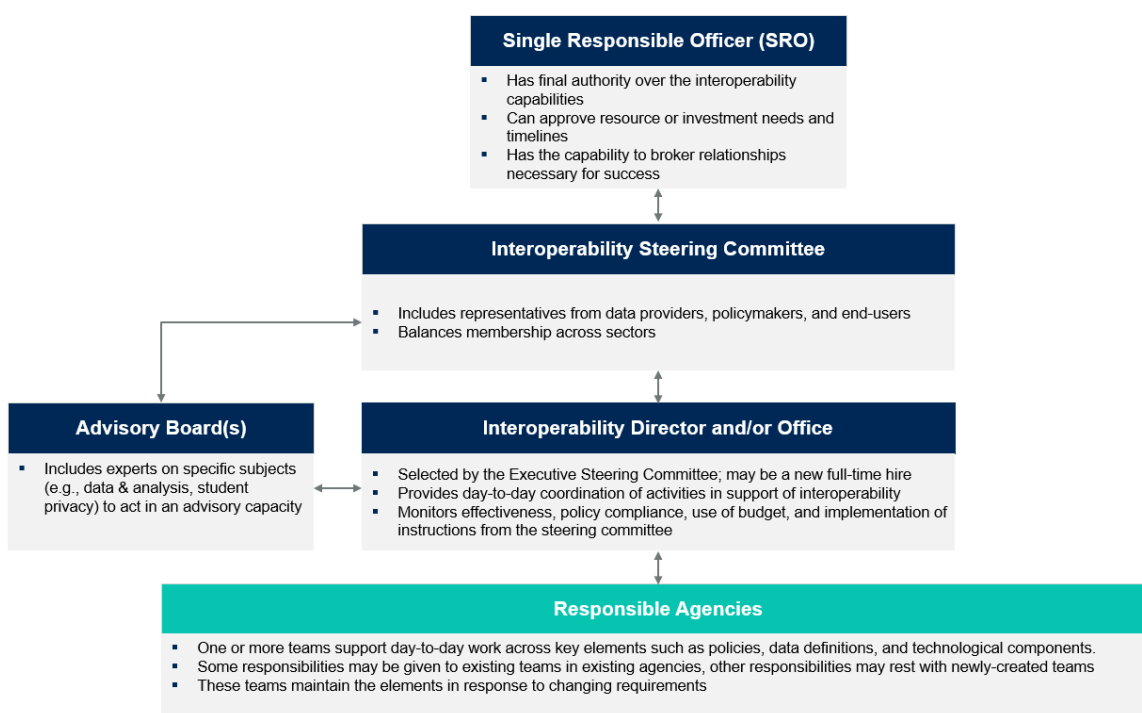## Ongoing Governance & Operating Model

Once the initial transformation program is complete, North Carolina's new interoperable student data system will become part of the regular, ongoing business of the state. The state will need to determine the *operating model* for this system—who will be responsible for managing the various elements of the system and how will these efforts be funded, coordinated, and governed?

One or more organizations will be given responsibility for managing the various elements of the interoperable student data system (such as policies, data definitions, and system components). These organizations will be responsible for maintaining these elements, modifying them in response to changing requirements, and pursuing continuous improvement.

Regardless of which organizations are responsible for maintaining the various elements of the system, they need to be managed for the benefit of a broad group of providers and users of information and other stakeholders. To ensure that this happens, these stakeholders need to participate in collaborative governance of the overall interoperability capability.

This governance structure will be similar to the governance for the original program, and some elements of program governance will likely transition into elements of ongoing governance. The following figure illustrates a high-level example of the ongoing governance structure:

Figure 17. Potential Governance Structure—*Updated for Ongoing Governance & Operations*

The participants in this governance structure will have multiple responsibilities. Gartner defines seven components that are key for governance of data and analytics (D&A) operating models, listed in the table below. The detailed design of the ongoing governance will need to determine how that governance addresses each of these components and artifacts.

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Table 7.   Components and Artifacts that Support The D&A Operating Model

Component	Brief Description	Major Artifacts
Institutional	Articulates the strategic direction	▪ Vision and Strategy ▪ Terms of Reference
Program Leadership	Monitors Program progress toward strategic goals	▪ Program Metrics ▪ Roadmap ▪ Communications Plan
Demand	Enables the prioritization and selection of initiatives	▪ Backlog and Prioritization
Architecture/Solution Components	Describes required architectures and Technology/Architecture selections, governs technical solution design, development, and deployment	▪ Physical and Logical Models ▪ Tool Portfolio ▪ Tool Policies ▪ Technical Data Dictionary ▪ Conceptual Architecture ▪ Collaboration Platform Requirements ▪ Data Solution Requirements ▪ D&A Architecture Imperatives
Data and Analytics Standards	Captures outcomes of decisions about data definitions, structures, and relationships	▪ D&A Information Models ▪ Metadata Standards ▪ Data Quality Standards and Rules ▪ Data Quality Dashboards ▪ Reporting Standards ▪ Analytics Standards
Data and Analytics Policy/Management	Governs how data should be managed, maintained, accessed, shared, etc. across D&A	▪ User Classifications and Personas ▪ Stewardship Playbook ▪ Data and Report Glossary ▪ Analytics Product Inventory ▪ Data Access Policy ▪ Data Literacy/Training Program Design
Program Management	Enables daily D&A operation and execution	▪ D&A Program Plan ▪ D&A Service catalog ▪ SLAs

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6.1.1   Key Findings on Governance and Standardization

A governance model will support data quality and data management and provide trust in the usefulness of the data. While some pieces of the puzzle are in place, much of the data across the education landscape is not standardized in a way that sufficiently prepares the state education sectors for interoperability.

Gartner found that:

- North Carolina has existing partnerships that ensure data can be meaningfully leveraged across institutions and sectors. Many of these efforts are still scaling up and are already making positive impacts on the lives of students and families. These may provide the building blocks that support the governance of any future interoperability initiatives[74]
- In most cases, strong executive sponsorship is critical for the success of a cross-agency interoperability effort.
- Differences exist in the way students are identified at various points in their education. This creates challenges when data is transferred between institutions. Stakeholders reported significant time and labor is being spent to consolidate and match data for reporting purposes
- The state's plan to create its longitudinal data system may lead to data governance and stewardship structures as well as entity resolution that will be useful for any interoperability efforts to come[75]
- Existing efforts to standardize data will support future interoperability. System offices play an important role in standardization but do not always use their authority fully. With collaboration, consensus-building, and better resourcing, they may be able to better advance initiatives like common SIS, shared application processes, universal course registration, and credit exchange policies. Technology-related initiatives at NCCCS and the UNC System will help these institutions modernize and centralize systems while providing the services and solutions that support each individual campus with operations and student information. [76] The current system offices already play an important role, one that only needs to be strengthened to improve upon data governance
- Across sectors and institutions, only limited information is standardized. There are leaders in this area, with K–12 (NCDPI) providing a single SIS solution that captures key information with a common set of schemas, but this type of standardization is not fully in place across postsecondary institutions[77]

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[74] See Section 3.2 for more information.

[75] As an example, an Executive Committee or similar structure supporting the state's LDS could be leveraged to also guide further interoperability efforts. Similarly, current entity resolution strategies (e.g., NC eLink) and unique identifiers (e.g., NCDPI's student UID service) can be used to match individuals across source systems and agencies with reasonable precision. These include partial and exact matching algorithms (i.e., on values like name, social security number, date of birth, driver's license, and "sounds like" tools).

[76] A key example of this is provided in the NCCCS Strategic Plan for 2022–2026, which includes "the adoption of an ERP strategy for an effective IT system that drives positive student outcomes and meets college requirements". It also includes plans to "develop a data management and integration plan for the North Carolina Community College System."

[77] As an example, K–12 schools in the state utilize common transcript formats and course coding schema. Schools across the state collect and send common data elements to NCDPI nightly. Data is also normalized to improve data integrity and reduce redundancy.

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6.1.2   Related Considerations & Recommendations

As the state considers how to improve educational attainment outcomes, and whether to invest further in a program supporting interoperability, Gartner recommends the following:

1. Involve the right experts

Bring in data and subject-matter experts from within the major education systems to guide any future initiatives. A successful governance model will include "data champions" or "data stewards" for each major domain.[78]

2. Build consensus

Governance should begin with defining the business goals it can help achieve, and then designing specific governance mechanisms from there. Before proceeding with any new statewide efforts to improve interoperability, education leaders must first decide if this is a priority and how much time, effort, and funding to invest. To do this, the state will need to build consensus around the "business case" for this effort. Similar statewide efforts have involved much lengthier and more formal "planning periods," with regular legislative reports and multiple advisory committees focused on specific topics (e.g., security, legal frameworks, data definitions, community engagement, user feedback).

3. Implement using education data standards that support critical use cases

There are many important education-related efforts toward standardization, and while nationally the education industry has not yet coalesced around specific solutions, there are a wealth of possibilities. There are different use cases, data domains, and standards used to address these separate domains. This might include student "roster" data, technical frameworks for student data privacy & security, common course data schemes and definition, and more. Below are just a few limited examples of organizations and standards specific to education.[79]

- Common Education Data Standards (CEDS)
- Ed-Fi
- Postsecondary Electronic Standards Council (PESC)
- Schools Interoperability Framework (SIF)
- 1EdTech Consortium

North Carolina leaders should anticipate using many different data standards within any potential future state architecture, depending on use cases and design.

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[78] The State has already collaborated on an LDS to link early childhood, K–12, postsecondary, and workforce-related data. This represents progress toward reducing silos that exist between education sectors. Many of the data domains implicated in the LDS are the same ones that will require deep collaboration and standardization to support interoperability—an LDS should help to reduce siloed data and should involve many (perhaps not all) of the same stakeholders. While governance of any new program supporting interoperability will need to be different, there are already relationships and people that could be leveraged.

[79] This list is illustrative only. Project Unicorn, a national initiative that includes a coalition of education organizations focused on standardization and interoperability, publishes publicly available lists and resources. There are many other sources and organizations supporting interoperability in education, and the list is growing.

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6.2 Human Capital and Organizational Change Factors

In Section 2.6, Gartner identifies the potential value of an interconnected and interoperable student data system. Section 4.2 further details the benefits that would justify the state's investment in interoperability. Achieving these benefits will require much more than the implementation of new technology. Agencies across the state, and the people within those agencies, will need to:

- Adopt new data definitions, and in some cases new processes, for correctly collecting data
- Establish new processes for putting the data to work to achieve the desired outcomes
- Develop new skills
- Collaborate in new ways
- Given the variety of agencies and other organizations involved, implementing the necessary procedural and organizational changes will be particularly challenging. These groups have varying objectives, constraints, cultures, and requirements. A successful interoperability program will require dedicated efforts directed at business analysis and process change, communications, training, and organizational change management.

6.2.1 Key Findings on Human Capital and Organizational Change

Gartner found that:

- Counselors, advisors, tutors, and community partners play a critical role in supporting students directly and guiding them through decisions at key points in their educational journey (e.g., what types of programs to apply to, what funding is available, how to transfer credits, etc.). These "frontline workers" will need increased support and improved tools to better leverage data in support of their constituents
- Strong expertise will be needed at each system office. Multiple interview participants identified the need for more analytical skills in their organizations; these positions will need to be authorized and funded
- Community colleges are an essential component of their communities and serve as a valuable link between the K–12 and 4-year systems. They also serve adults with continuing education opportunities. However, they reported being under-resourced and lacking in technology, staff, and data systems to support their work. Investments specifically targeted at the community college level will be required for them to effectively use an interoperable student data system
- The program plan and budget must include business analysis, business process reengineering, communications, training, and organizational change management activities[80]
- In some cases, the speed at which people can change may be a greater constraint than the speed at which technology can be implemented: this will need to be considered during the prioritization of use cases and the development of program plans and schedules, should the state proceed
- Better ongoing communication across these stakeholder groups (i.e., K–12, community colleges, and 4-year institutions) is needed to prevent/mitigate duplicate efforts

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[80] Note that there is strong stakeholder support for recurring funding for staff to lead research and data analysis. These individuals can provide data-driven and research-based policy recommendations and respond to data-driven questions from state and local leaders.

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6.2.2   Related Considerations & Recommendations

As the state considers how to improve educational attainment outcomes, and whether to invest further in a program supporting interoperability, Gartner recommends the following:

4. Craft a change management strategy

As mentioned above, implementing the necessary organizational and procedural changes will require significant effort. Early program efforts should include the development of an explicit, proactive strategy for educating participants and overcoming barriers to change. A comprehensive organizational change management (OCM) strategy would include:

- Definition of the different populations (audience segments) that need to be addressed.
- Identification of the potential barriers to change overall and for each population.
- Development of messages that articulate the benefits to each population (e.g., "What's in it for me?") of supporting the requested changes.
- A high-level plan for monitoring population attitudes, refining messages, selecting communication channels, and working with affected agencies to promote and enable the desired organizational changes.
- A high-level plan for training and user support.[81]

5. Build analytical capacity

As the interoperable student data system is rolled out, increasing numbers of individuals will start to rely on the information provided. To understand the data and correctly apply it, people will require more analytical skills and training. Participating agencies will have to look for ways to increase the analytical capabilities of their staff.

Options for investing in people to build analytical capabilities include (but are not limited to):

- Including requirements for analytical skills during the hiring process for a broad range of positions.
- Creating new positions for analysts and data scientists.
- Investing in existing staff through training, tuition reimbursement, and incentives.

6.3 Trust, Culture, and Ownership Factors

Trust, collaboration, and working across silos are commonly documented issues arising in cross-organizational, and large-scale technology. This is true almost without exception, regardless of the type of technology effort implemented. However, it is even more true with efforts to increase interconnectedness and interoperability.

Despite considerable and even exemplary collaboration across education sectors in North Carolina, this is still a challenge. The government (and the public sector in general) is notoriously siloed. Agencies and institutions have their own leaders, styles, terminology, budgets, reporting structures, and systems. In addition, they may also have their own views on how data should be collected, used, and shared. "Cultural differences" often negatively impact cross-functional efforts.

Below, Gartner offers a summary of information gleaned during the process of creating this study. Silos, lack of effective communication, understaffed resources, and duplication make this work particularly challenging (and even more necessary)—and the state can overcome these challenges with continued collaboration and consensus-building.

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[81] During Gartner's national scan, one individual engaged in a similar Statewide effort described her biggest single concern as follows: "We built the thing, but then didn't have the capacity to use it."

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6.3.1   Key Findings on Trust, Culture, and Ownership

Gartner found that:

- K–12, community college, and 4-year institutions have worked hard to partner in support of students. Relationships exist between individual organizations in K–12 and higher education to support career readiness and college matriculation as well as college affordability. Just some of these efforts are described in Section 3.2 of this report, including those that support connectivity, funding for college, state residency determination, transcript and college application programs, and tracking FAFSA completion.
- Most individual institutions report that they generally have access to the data required to support accountability, funding, compliance, reporting, and day-to-day operations for the students enrolled in their schools. Some stakeholders shared that they would like greater access to data from other sectors, as well as more frequently updated or near real-time data. However, there did not appear to be a complete consensus on the need for interoperability between K–12 and postsecondary systems.
- In addition, stakeholders shared examples of local and regional partnerships (e.g., between high schools and community colleges, universities, and between institutions across a geographic area) that are growing and are making positive impacts on the lives of students and families.
- Based on stakeholder interviews, there are gaps in perspective between K–12 leaders, community college leaders, and 4-year institution leaders. In addition, there is a perceived lack of alignment between state level organizations and local voices—including differences in opinion on where there are challenges for students and families.
- Stakeholders are concerned about duplicative efforts and a lack of resources. Given competing priorities and initiatives, there is not yet a clear consensus about the practicality of pursuing interoperability and interconnectedness. Stakeholders expressed a concern that new solutions would be implemented that might duplicate existing capabilities and put a strain on current resources. The rate of change across education and workforce organizations and the amount of funding used to support similar initiatives means that some degree of duplication is likely stakeholders report it is already hard to keep up with upstream changes that impact their work.
- Better and more frequent communication across major institutions would support future work.
- Students, their families/caregivers, and school-based staff members who stand to most directly benefit from interoperability must have a voice in this work if it is to ultimately support them and meet their needs. Without this, any solutions could end up being implemented without the end-user—and their level of data literacy and familiarity with technology—in mind.

6.3.2   Related Considerations & Recommendations

As the state considers how to improve educational attainment outcomes, and whether to invest further in a program supporting interoperability, Gartner recommends the following:

6. Develop a structure for student, family, community, and frontline staff to advise on interoperability

The education leaders engaged in this study have an incredible wealth of information, context, and direct experience in education, including at the "ground-level" (e.g., in classrooms, as faculty, as coaches) given their careers and relationships. However, this is not a substitute for direct engagement with the users who stand to benefit most from interoperability. Any future program must include communication with potential end-users. This could take the form of an "advisory group," multiple focus group sessions, a survey, or standing representatives who join the steering committee.

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6.4 Technology Factors

While the conceptual architecture provided in this study solves many requirements and use cases that have been expressed, it still only touches the surface of a full-scale technology solution. There are many factors to consider when developing the data system further. As the state evaluates a path forward, these factors should also be considered to finalize the end solution.

- **Empowerment of End-Users**: The end goal of this study is to empower students and families such that more people within North Carolina can attain credentials. This focus on students and families should be at the forefront of any technical solution or enhancement. The conceptual solution provided attempts to provide students (and, where appropriate, other adults) the ability to control their data and utilize it in new, useful ways. This might include new self-service suites and tools.
- **Technology Enablement**: Before any conceptual solutions are explored further, the state should examine the "technical enablement" within the current systems. Technical enablement focuses on the strategic use of technology to empower users to improve results and understand where that can be focused with the current set of products.
- **Low/No Code & Self-Service Platforms**: One of the current movements in the technology space is the implementation of low or no-code platforms to give more power to users. These platforms are types of visual software development environments that allow citizen developers to drag and drop components to create their own web apps. This allows analysts and end-users be able to attain more control of their views and can help end-users develop their own views to fit their needs. For example, a student can customize their portfolio of educational achievements to help apply for a specific type of job or an employer's specific needs.
- **Predictive Analytics & AI**: With additional capabilities being added to a conceptual solution, there are many improvements that can be identified with predictive analytics. With the implementation of student roadmaps and a postsecondary crosswalk, additional datapoints will be made available for analysis and improvement for students. This capability can be realized if the state purchases and implements vendor software solutions with AI features.
- **Composability vs Interoperability**: As technology develops further, leading to more developed networks, the system can evolve to become more composable. A composable system allows developers to utilize existing systems or products to develop new solutions within the network. This builds upon interoperable solutions to generate additional innovation within the space and should be considered when developing the solution.
- **Chat Bots:** A future system will require a significant effort in knowledge transfer and awareness for users to widely adopt it, and to encourage usage, immediate support will be needed. An AI chatbot would help users to overcome initial challenges, provide immediate support, and help reduce the need for maintenance with fewer employees required to create new reports, assist users, and troubleshoot issues. This can also be utilized within current systems to increase adoption on current platforms and support users in other ways.

6.4.1 Key Findings on Technology

Gartner found that:

- Most use cases and requests captured in this study could be enabled, at least in some fashion, with currently available technology and solutions.
- Many of the pre-conditions for good data exchange are in place, due to the foundational technology services that the state has supported.
- With the amount of information spread across disparate tools, the end-user experience can be confusing. Tools are not always built with their user perspective in mind.
- Various systems use separate log-on and authentication methods. Individuals keep track of a variety of sources, tools, accounts, and passwords, including some they create themselves and some that are created in school. They use a web of separate systems, websites, applications, tools, informational reports, and logins that, pieced together, show many of the pieces; but navigating it is not easy and could improve with interoperability.

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- Most of the use-cases still require policy and governance discussions—they cannot move forward without agreement. The technology will be secondary.

6.4.2 Related Considerations & Recommendations

As the state considers how to improve educational attainment outcomes, and whether to invest further in a program supporting interoperability, Gartner recommends the following.

7. Focus on personalization

Today's students are rethinking their educational trajectories and what they would like to do after college. In light of this, tools should be more customized to meet their needs and should offer additional capabilities like predictive analytics, AI, and technology-enablement factors. This could be realized if the state moves forward with a program supporting interoperability, based on the vendors and products selected.

8. Prioritize further among use cases in a phased approach

The state should consider a phased approach, focusing first on items that have the highest potential to positively impact attainment. Not all of the use cases rise to the same level of importance; nor do they have equal support across stakeholders. The state may wish to narrow the scope to a specific use-case with clear data domain(s) and then develop a small pilot as outlined in Section 7.0.

6.5 Cybersecurity Factors

Education and student information systems are rich with personally identifiable information (PII) that must be closely safeguarded. National Institute of Standards and Technology (NIST) Special Publication 800-122 defines PII as "any information about an individual maintained by an agency, including (1) any information that can be used to distinguish or trace an individual's identity, such as name, social security number, date and place of birth, mother's maiden name, or biometric records; and (2) any other information that is linked or linkable to an individual, such as medical, educational, financial, and employment information." Given the attempted cybersecurity hacking incident on state systems in October 2022, increased vigilance is being placed on current and future systems to ensure they are not vulnerable to cybersecurity incidents and that best practices are embedded within them.

Education institutions and leaders are entrusted to safeguard student information, and the organizations interviewed for this study take this responsibility very seriously. The news is filled with stories of data breaches and ransomware attacks, and bad actors are increasingly targeting public sector infrastructure. Recent Gartner research indicates that education has become a favorite target of cyber criminals. K–12 and postsecondary education sectors have, for many years, lacked sufficient cybersecurity resources to effectively thwart attacks. Many organizations have not kept up with investments in cybersecurity — and as such become an ideal "soft target" for criminals. Defenses have been easy to penetrate, and organizations have been slow to address this problem.

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In addition, criminals know that education organizations in both K–12 and higher ed manage sensitive data that they can use to for ransom. These organizations are also under significant time pressure. This puts a lot of pressure on administrators to pay ransoms as expeditiously as possible to avoid data being sold to other criminal enterprises. Attacks themselves, which target both information and critical infrastructure, are also becoming far more sophisticated.

What are Cyber Attacks?

There are many types of "attacks." Gartner's research provides this list of common and notable types of "attacks," where the term is used broadly to define related risks:

- **Phishing and social-engineering-based attacks.** Attackers fool users with links and other methods that open the door for unauthorized use, allowing them to transfer information and data out (data exfiltration) of the organization.
- **Internet-facing service risks (including cloud services).** Individuals fail to adequately secure cloud services or other internet-facing services from known threats.
- **Password-related account compromises.** Unauthorized users deploy techniques to identify passwords they can exploit to gain access to confidential data.
- **Misuse of information.** Authorized users inadvertently or deliberately share or misuse information.
- **Network-related and man-in-the-middle attacks.** Attackers eavesdrop on unsecured network traffic or redirect or interrupt traffic due to a lack of encryption within and outside an organization's firewall.
- **Supply chain attacks.** Partners, vendors, or other third-party assets or systems (or code) become compromised, creating a way into enterprise systems.
- **Denial-of-service attacks (DoS).** Attackers attempt to overwhelm and cause a temporary shutdown or slowdown.
- **Ransomware.** Malicious software infects an organization's systems and restricts access to encrypted information until a ransom is paid to the perpetrator.

6.5.1 Key Findings

As part of engagement with stakeholders and current state analysis efforts, Gartner found that:

- Adherence to key cybersecurity standards is currently practiced, particularly in the K–12 space. Gartner found that education organizations in the state already follow standard policies and procedures related to encryption, storage, and transmission. In most cases, access to educational data appears to be based on role and need-to-know status. The most sensitive types of data (e.g., health-related information, special education indicators, data on social services) are treated with extra care.[82]
- A range of cybersecurity supports exist and can be built upon (e.g., multi-factor authentication (MFA), and identity access management (IAM)).
- With ever more incidents related to data breaches and cybersecurity, organizations are making significant investments and efforts, particularly in the K–12 space. However, with systems that are not as centralized, it is difficult to understand and adopt best practices evenly across the state. As such, some key systems have not yet implemented industry-standard security practices and lack the technical resources to fully support this.
- Because North Carolina utilizes a single SIS across K–12 public schools and has a strong policy authority in the form of NCDPI, there is more security and adherence to best practices than what is typically found in less centralized systems.
- Because each organization within the educational ecosystem is tasked with safeguarding sensitive student information, they can be reluctant to share data across sectors (or externally)

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[82] Gartner did not perform a thorough assessment of current state technology, as it was not in scope. This is based on publicly available information and interviews.

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> without appropriate clearances and agreements, especially considering recent malicious attacks and inadvertent disclosures.

- Some practices are not evenly adopted. Organizations have discretion when it comes to their budgets and the third-party solutions they purchase and utilize, so their level of security compliance is not known.
- Organizations expressed deep concern about cybersecurity, but in some cases, they may lack the technical resources and budgets to fully support the need.
- Some key systems have not yet implemented industry-standard security practices (e.g., multi-factor authentication).
- Families want to know where their data goes. As students live more of their lives online, they are becoming increasingly aware of the fact that their data is used and shared widely. Students do not, however, have a clear way to know exactly how their data is used. In some cases, there is no designated place for students and families to learn more about how their data is used and to have their questions addressed. This impacts trust—families may be unsure that their data is being used in ethical and supportive manners, which may impact their willingness to participate in programs and services, particularly among undocumented populations and already marginalized communities. Families would like tools that allow them greater ownership over their data, and the ability to share it when they would like at various stages in their educational journeys.

6.5.2   Related Considerations & Recommendations

As the state considers how to improve educational attainment outcomes, and whether to invest further in a program supporting interoperability, Gartner recommends the following:

9. Comply with North Carolina statewide security policies

Through NCDIT, a manual of Statewide Information Security Policies supports the privacy and security of statewide systems and infrastructure. The manual provides a baseline for managing information security and making risk-based decisions. Any form of interconnected and interoperable student information system that may be developed in the future should comply fully with the statewide information security policies and procedures. Additionally, the state's Chief Information Security Officer (CISO) and Chief Risk Officer (CRO) should be consulted in an effort to develop and implement a new interconnected and interoperable student data system.

10. Align around Federal and National standards

Any future (and current) efforts at interconnectedness should also comply with the NIST Risk Special Publication (SP) 800. SP 800 provides a comprehensive set of best practices for implementing cybersecurity control measures and how to respond to cybersecurity incidents. By adhering to and implementing the policies, guidelines, and technology recommended within NIST SP800, the interconnected and interoperable system should be properly safeguarded. Moreover, the state's information security policies originated from NIST SP800.

Other industry cybersecurity standards can be used and/or referenced to provide additional security. These standards include, but are not limited to, the following:

- ISO/IEC270001 — specifies the requirements for establishing, implementing, maintaining, and continually improving an information security management system within the context of the organization
- Federal Risk and Authorization Management Program (FedRAMP) — a standardized approach to security assessment, authorization, and continuous monitoring for cloud products and services

Each of the aforementioned cybersecurity standards provides a means for vital student, PII to be protected and security from potential cybersecurity incidents.

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6.6 Legal and Privacy Factors

Data privacy laws and regulations help to protect information from being collected, used, or shared inappropriately. This includes, but is not limited to, information that can be used to identify, locate, or contact an individual.

Everyone, from the frontline staff members who collect and interact with data to the policymakers and system leaders later reviewing the data, must understand the legal requirements that help protect this information.

Confidential information about students is governed by strong privacy protection laws; these are often considered to be more stringent than similar requirements in other industries. Because the education system serves students who are minors, there is additional scrutiny—unlike in other industries where data collected belongs primarily to consenting adults, education leaders bear additional responsibility to safeguard student data when the students cannot protect themselves. Consider the example of a student with a parent who has an "order of protection" against another member of the family due to domestic violence: aside from the obvious right to privacy, if the student's location and real-time schedule is released to the wrong adult and the court order is violated, the student's safety may be at risk.

In the state of North Carolina, education organizations are subject to regulations that provide guardrails dictating how student information can be used. Key laws are described in brief below.[83] [84]

The Family Educational Rights and Privacy Act ("FERPA")	
Type	Federal Law (and associated amendments) [85]
Purpose in Brief	FERPA is a federal law that protects the privacy of student education records.[86] First enacted in 1975, it gives legal guardians the explicit right to review and confirm the accuracy of all data collected about their child. It also heavily restricts the ways this information can be shared, and outlines specific cases (i.e., "exceptions") where data sharing is permissible. FERPA allows students and parents to file a complaint with the U.S. Department of Education if they believe that their rights under FERPA have been violated.
Applicability	FERPA applies to all education agencies and institutions that receive funding from ED

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[83] Gartner offers these potential legal considerations; this does not constitute legal advice. Instead, all information contained here is for general information purposes only.

[84] Note that these are not the only laws that may apply; different types of data are governed by other laws, including but not limited to the Health Insurance Portability and Accountability Act of 1996 (HIPAA), The Confidential information Protection and Statistical Efficiency Act of 2022 (CPSEA), the Children's Online Privacy Protection Act of 1998 (COPPA). Because this study is primarily focused on student educational data, requirements regarding HR and Finance data are not in scope.

[85] In general, when people refer to "FERPA" they are also including reference to the Protection of Pupil Rights Amendment (PPRA) of 2020.

[86] The term "Education records" is quite expansive. Generally, it refers to any digital or physical records (e.g., handwritten information, print materials, data stored digitally) that directly relate to a student and are maintained by an education agency or institution, or a party acting for or on behalf of the agency or institution. This includes biographical information about the student and associated adults (e.g., date and place of birth, addresses, emergency contacts); academic information (e.g., grades, test scores); special education records; health information; attendance records; and other personal information (e.g., pictures, unique identification codes, birth certificates).

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Individuals with Disabilities Education Act (IDEA)	
Type	Federal Law[87]
Purpose in Brief	IDEA is a federal law that establishes a right to a "free appropriate public education" for eligible students with disabilities. It governs how special education services and related services are provided and ensures the rights of students with disabilities are protected. It also authorizes formula and discretionary funds to states, institutions of higher education, and other organizations.
	Minors who are classified as "students with disabilities" are protected under IDEA. There are important distinctions in terminology (e.g., the definition of a "participating agency" is different in IDEA than in FERPA). ED provides a cross walk between FERPA and IDEA along with supporting materials to help districts navigate the intersection of these policies.
Applicability	IDEA is generally aligned to FERPA; however, it includes early intervention service provides and any individuals or entities that provide service coordination, evaluations, assessments, and other services.

North Carolina State Student Privacy Law, General Statute Chapter 115C Article 29	
Type	State Law
Purpose in Brief	Article 29 of this State Law covers "Protective provisions and Maintenance of Student Records. Among many important topics, it outlines when individuals are required to report suspected child abuse or neglect, prohibits unlawful disclosure of information about students (including by third parties), and specifies protections for student privacy while online. It also sets the state's requirements for record maintenance and confidentiality. Parents must be notified annually of their rights related to student record keeping and must be given opportunities to opt-out of certain data sharing activities.
Applicability	This statute applies expansively across the state of North Carolina

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[87] There are two somewhat related laws, both of which are enforced by the Office of Civil Rights under USED: the Rehabilitation Act of 1973, Section 504 and Americans with Disabilities Act of 1990, Title II.

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In general, these and related laws serve to protect student-related data. The following are considered core areas of protection:

- **Data Collection and Sharing** — The right to see what has been collected as part of your own record and request changes; the right to restrict how your data is shared in specific cases.
- **Opt-in Policies** — The option to indicate which specific cases your data may be shared. Note that with education data, there are specific valid "exceptions" which allow education providers with a legitimate interest to access student data without opt-in (e.g., directory information). In those cases, families must opt-out. There are also cases where families *cannot* opt-out.
- **Nondiscrimination** — The right not to be discriminated against based on privacy decisions.
- Personally Identifiable Data — The requirement that organizations severely limit access to data that reveals your location or characteristics at an individual level.
- **Breach Notification Policies** — The requirement that you must be notified when breaches or inadvertent disclosures occur with your data.

6.6.1   Key Legal and Privacy Findings

Students, families, and educational administrators across the state care deeply about privacy and security, and they work hard to protect sensitive student information. In fact, this was one of the most common risks raised during discussions about interconnectedness and interoperability. Stakeholders remain concerned that any future efforts will not fully comply with legal requirements. To address this concern in part, Gartner prioritized gathering information from several leaders and organizations with detailed knowledge of student data privacy.

Gartner found that:

- North Carolina's education-related data systems contain highly sensitive data.
- Even among the relatively small subset of stakeholders interviewed, there were inconsistent interpretations of key privacy laws and policies.[88]
- Student privacy policies vary significantly based on the age of the student. This makes it challenging for sectors to work together as students move across the education pipeline.[89]
- While there are sources for standardized legal and policy guidance, institutions still reported that they have different interpretations of what is permissible or advisable. This was described by one interviewee as "chaotic"—one where each organization's General Counsel and Chief Information Security Officer had to produce their own take (some more lenient and some more strict).[90]
- A key part of this study is empowering students with their own data; however, in the case of minor students, this is highly complex. Most students have a primary guardian, but other adults and family members participate in their education and need the authorization to view their data at various points in time. These contacts can change frequently (e.g., in the case of divorce, marriage, or court orders). Primary guardians need a mechanism for authorizing and managing access to their children's data. While stakeholders generally commented on the risk of oversharing or incorrectly sharing sensitive data, there are also cases where not sharing critical information is a risk, particularly with regard to discipline, behavioral, and health data.[91]
- Privacy may seem "at odds" with the goal of better and more frequent student data sharing, but it is not. Instead, it is a prerequisite to interconnectedness and interoperability. The right data at the right time can transform education, and this requires a degree of personalization and student-level detail. However, none of these efforts can be implemented without trust that sensitive

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[88] While this study focuses primarily on student data, there are a wide range of data sources beyond education (e.g., salary data, etc.) that have their own unique data protection rules, which are also not broadly understood.

[89] FERPA grants rights to manage education records to parents; this includes both "custodial" and "noncustodial" parents alike, unless there is a court order, legally binding document, or State law that specifically provides to the contrary. At the point when a student reaches the age of 18 years—or when the student chooses to enroll in a postsecondary school, the rights transfer from the parent/guardian to the student themselves. Students who are "dually enrolled" in both college classes and high school course work must still be protected by the K–12 school per FERPA, because they have not yet graduated.

[90] NCDIT's Chief Data Privacy Officer may be able to advice on behalf of stakeholders to further address the significant and growing number of data privacy concerns and regulations.

[91] NCDPI's Request for Proposals for a new SIS does include functionality around opting in and out as part of its requirements, so this is likely to be addressed in a future iteration of the Department's SIS. Implementation of this solution is intended for the 2024–2025 school year.

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> student data is managed correctly, is dependable and accurate, and most importantly does not land in the hands of those who might do harm. Education leaders have a responsibility to help ensure that interconnectedness or interoperability does not come at the expense of privacy.
> - In a number of cases, educational organizations are sharing data via informal relationships and MOAs/MOUs, in an effort to support their students and absent other structures. There is not consistency in the data elements shared, and the agreements themselves vary widely in content.
> - Stakeholders report that they would like standardized data-sharing agreements and memoranda of understanding to leverage.

6.6.2   Related Considerations & Recommendations

As the state considers how to improve educational attainment outcomes, and whether to invest further in a program supporting interoperability, there are several important considerations.

11. Consult with privacy experts *across* sectors and age groups for the most informed answers

K–12 education leaders are best positioned to make decisions about student privacy while students are still enrolled in primary and secondary school. Likewise, postsecondary leaders are generally more informed on the requirements for privacy that apply to older students. Both K–12 and postsecondary sector leaders have public guidance on how to manage and protect sensitive student-related data.[92] Discussions need to occur across these organizations. As an example, an "advising body" could gather to focus on student privacy, with legal representatives from major institutions present.[93]

The state should make a concerted effort to better inform those who interact with students across the education continuum—not just in K–12 schools, but also in community colleges and four-year universities. In interviews with education leaders, Gartner heard the confusion and repeated requests for support. There are widespread misunderstandings about data sharing, including when it *is permissible without explicit consent* and when parents must be given *an option to opt-out* of this data sharing. This is particularly important as postsecondary institutions pursue "direct admissions" activities.[94] Further engagement would be required before the state could proceed with a "direct admissions" use case for interoperability.

12. Create example data-sharing agreements and additional guidance at the state level

Legal and security teams are acting in silos. The state's leadership has an opportunity to provide examples, templates, and other guidance that will support leaders with creating and structuring their own data-sharing agreements and memoranda of understanding.

There are many positive examples of organizations collaborating to share data in an ad hoc way, and in each case, the leaders have created local organization-to-organization agreements. However, rather than relying on each organization's legal team, the state has an opportunity to provide examples, templates, and other guidance that will support leaders with creating and structuring their own data-sharing agreements and memoranda of understanding. Similarly, as education institutions are increasingly experiencing inadvertent disclosures and breaches, the state can provide guidance on how to best notify families.

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[93] During Gartner's national scan, one organization referred to this critical step as "just getting the right legal experts in the room and letting them talk it out." There are few spaces where this can occur across organizations.

[94] Direct Admissions allows students to receive notice from a postsecondary institution that they have been qualified for or "preadmitted" to programs, even if they did not apply or contact the school directly. This "flipped system" is thought to help students better understand their postsecondary options and expand their pool of choices. Direct Admissions typically relies on student and parent contact information (i.e., "directory" information), coupled with academic data, which can be used by the postsecondary institution to identify those students who are a strong match.

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The Way Forward

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7.0 The Way Forward

As described throughout this report, achieving interoperability and interconnectivity in K–16 education is a multi-year programmatic journey that requires technology, data, operational, policy, and organizational changes. Based upon Gartner's findings, developing an interconnected and interoperable student data system is feasible from a technology perspective and a worthwhile investment.

Section 8.4 of the Appendix provides a rough-order-of-magnitude (ROM) estimate of how much the state would need to spend on new technology.[95]

While Gartner can confirm the feasibility of this project and the opportunity for benefits, this project has not compared the potential benefits of this investment to the potential benefits of other investments the state could make with its limited resources.

For interconnectedness and interoperability to serve as an enabler of the state's educational attainment goals, the state will need to determine who will ultimately be accountable and responsible for this effort. It will also need to make changes to existing policies and potentially develop new policies and convince people to adopt the changes that will be necessary. In order to decide to proceed, the state will also need to weigh the temporary disruption that will result against the expected benefits.

Gartner estimates the cost to develop the technology for student data interoperability to be approximately $16-$20 million over approximately three years, from inception to completion. This includes $5-$8 million for initial technology costs, plus the costs associated with human capital, process redesign, training, and organizational change management; all of these are critical components to successfully enable interoperability and interconnectivity. Based on Gartner estimates, it will cost the state approximately $1-$3 million for annual technology maintenance fees.[96]

The state can also choose to begin with a POC over approximately 12-15 months, as outlined in the recommendations below. The cost to implement a POC would be approximately $6-7 million. If the POC is implemented first, the total cost to implement the full solution would be reduced by this amount, for a total remaining cost of $10-$13 million.

As stated in the Executive Summary, Gartner recommends that the state prioritize the following next steps to advance a full program of student data interoperability and interconnectedness:

1. Designate an Executive Sponsor

Building interoperability is a major undertaking that must be sponsored at the highest echelons within government. Gartner recommends that the state select an Executive Sponsor who has the appropriate statewide authority to implement interoperability and interconnectedness.[97] The Executive Sponsor must be dually empowered and accountable for achieving the key requests and outcomes. This level of authority will be required to galvanize support and effectively drive K–12, community college, and university sector stakeholders toward a unified vision. The Executive Sponsor should collaborate with education leaders from across the state to ensure their input and recommendations are accounted for as the program evolves.

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[95] A detailed total cost of ownership was not in scope for Gartner.
[96] High-level price details and potential vendor insights are provided in Section 8.4.
[97] This individual is also called the "Senior Responsible Officer" in Gartner research. As an example, this could include Governor's Education Cabinet or Board of Education.

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2. Develop an Operating Model

Gartner defines an "operating model" as "the blueprint for how value is created and delivered to target customer." The Executive Sponsor should designate a team of subject matter experts from key sector institutions who can develop an operating model for student data interoperability. This operating model must specify how organizations, processes, technology, and policy will all function to support interoperability. This includes defining roles and responsibilities, procedures, data standards, technical capabilities, and governance.[98]

The operating model will require extensive collaboration across sectors. As such, the Executive Sponsor may wish to designate an independent, non-profit or government entity that is separate and apart from any individual sector, to guide this operating model. [99]

3. Complete a Proof-of-Concept

This study highlights specific use cases and a composable architecture to address them.[100] Before committing to a full solution (and after completing steps 1 and 2), Gartner recommends that the state consider a Proof-of-Concept (POC). The POC should include three specific use cases (i.e., Unified K-16 Digital Transcript, Real-time Data for Dual Enrollment, and Student Degree Roadmap). This POC can be used to validate that the operating model and supporting technology will work together to produce the intended outcomes.

The state should consider investing a total of $6-$7 million over the course of 12-15 months to conduct the POC. To efficiently run the POC, the Executive Sponsor will need to establish an ongoing program-level governance and discrete project-level teams with representation from key organizations. This then includes:

- Creating and releasing a Request for Proposals (RFP) that includes the vision, business case, and detailed functional/technical requirements101
- Select vendor(s) best capable of implementing the POC based on a review of proposals
- Develop a minimum viable product (MVP) with the functionality required to implement selected use cases; concurrently, perform the necessary business analysis/process design
- Evaluate if the outcomes of the POC merit additional investment from the state

Executing the POC will require dedicated resources from the North Carolina Department of Public Instruction (NCDPI), the North Carolina Community College System (NCCCS), and the University of North Carolina (UNC) system. Resources must have subject matter expertise in existing source systems and technologies, processes, and data. Gartner estimates that 12-14 resources should be dedicated to supporting the POC, consisting of:

- Two to three people from each of the education sectors
- A POC project manager
- Four to five resources dedicated to developing the RFP and MVP

The cost of resources to support the POC are factored into the $6-$7 million cost estimate.

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[98] Later sections of this report describe proposed governance model(s) as well as existing structures that may be able to be leveraged in support of interoperability.
[99] Some existing organizations for the state to explore as options might include MCNC, NCDIT, and the College Foundation of North Carolina, provided they have the right teams with the technology expertise needed to guide interoperability.
[100] A composable architecture organizes technologies into modular application building blocks that deliver well-defined capabilities in support of specified business outcomes.
[101] This may require multiple RFPs, e.g., one for technology and one for systems integration/implementation.

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4. Develop legislation to mandate interoperability and commit funding

Because any successful program requires support beyond the initial technology implementation, and beyond individual peoples' tenures, Gartner recommends that the state codify and enact legislation that embeds interoperability within the education ecosystem and requires its implementation. As part of this process, the state should commit to long-term funding for maintaining and sustaining this program, provided the goals of the POC have been appropriately met.

In addition to funding for this interoperability program, it is critical that the state continue to invest in high-quality student data source systems and the necessary analytical and technological capacity to appropriately use the data collected, in support of student educational attainment.

These steps will set the state on the path toward greater interoperability and interconnectedness and further support students as they seek to earn high quality degrees and credentials and build meaningful careers.

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Appendices

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8.0 Appendices

8.1 Steering Committee Membership

The following leaders comprise the myFutureNC Steering Committee and served in an advisory capacity for this study. The Steering Committee met monthly during this study period and provided invaluable feedback during the development of this report. We thank these leaders for their time and insights.

Organization	Name	Title
Ashe County Schools	Eisa Cox	Superintendent
Caldwell Community College and Technical Institute	Mark Poarch	President
Forsyth Technical Community College	Paula Dibley	Chief Officer for Student Success and Strategic Innovation
Governor's Office	Geoff Coltrane	Senior Education Advisor
North Carolina Community College System	Patrick Fleming	Senior Vice President & Chief Information Officer
North Carolina Community College System	Michelle Lair	Director of Academic Programs
North Carolina Department of Public Instruction	Amy Powell Moman	Section Chief Enterprise Data and Analytics
North Carolina Department of Public Instruction	Vanessa Wrenn	Chief Information Officer
North Carolina State Education Assistance Authority	Mary Shuping	Director of Governmental and External Affairs
Scotland County Schools	Takeda LeGrand	Superintendent
University of North Carolina System	Eric Fotheringham	Director of Community College Partnerships and Adult Learner Initiatives
University of North Carolina System	Allen Lakomiak	Associate VP IT & Deputy Chief Information Officer
University of North Carolina Charlotte	Claire Kirby	Associate Provost of Enrollment Management
Fayetteville State University	Monica Leach	Provost and Vice Chancellor for Academic Affairs
Wake County Public Schools	Marlo Gaddis	Chief Technology Officer

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8.2 Key Stakeholders Interviewed

The following list includes public school units, community colleges, universities, government and administrative organizations, and sector leaders from across North Carolina who were contacted and interviewed as part of this engagement.[102] These organizations freely provided information on their current state systems and discussed pain points and wishes for a new and more interoperable future. We thank these practitioners and leaders for their support. The views expressed in this document do not reflect the views of any one organization listed here.

- Appalachian State University
- Ashe County School System
- Bladen Community College
- Caldwell Community College and Technical Institute
- Central Piedmont Community College
- College Foundation, Inc./College Foundation of North Carolina
- Durham Technical Community College
- Elizabeth City State University
- Fayetteville State University
- Forsyth Data Sharing Project
- Forsyth Technical Community College and Skyfire
- Martin Center
- MCNC
- Mitchell Community College
- North Carolina Agricultural and Technical State University
- North Carolina Association of School Administrators
- North Carolina Community Colleges System
- North Carolina Department of Commerce Labor & Economic Analysis Division
- North Carolina Department of Commerce Workforce Solutions Division
- North Carolina Department of Information Technology
- North Carolina Department of Public Instruction
- North Carolina General Assembly (Legislative Analysis & Fiscal Research)
- North Carolina Governor's Office
- North Carolina Government Data Analytics Center
- North Carolina Independent Colleges and Universities
- North Carolina Office of State Budget and Management
- North Carolina School Superintendents Association
- North Carolina State Board of Education
- North Carolina State Educational Assistance Authority
- Piedmont Community College
- Pitt Community College
- Scotland County School System
- The Hunt Institute
- Transylvania County School System
- University of North Carolina Charlotte
- University of North Carolina Greensboro
- University of North Carolina -Chapel Hill School of Government/Center for Public Technology
- University of North Carolina System
- Wake County School System
- Wake Technical Community College
- William and Ida Friday Institute for Educational Innovation

Gartner also interviewed selected students to hear about their direct experiences. We thank these students for sharing their stories.

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[102] myFutureNC also previously interviewed the following organizations, prior to the start of Gartner's work: Caldwell County Schools, Cumberland County Schools, North Carolina State University - Belk Center for Community College Leadership and Research Wilkes Community College, Wilkes County Schools, and Winston-Salem-Forsyth County Schools.

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8.3 Organizations Participating in the National Scan

Gartner conducted interviews with select organizations as part of the National Scan. In addition, Gartner interviewed specific education-related vendors to understand the capabilities offered.[103] The views expressed in this document do not necessarily reflect the views of any one organization listed here. Not all organizations contacted gave permission to be listed, and not all organizations were able to participate upon request. Gartner included its own educational sector market research and experience with similar clients in findings related to this National Scan.

We thank these practitioners and leaders for their support and insights.

- Canvas/Instructure
- Cedar Labs
- Certree
- Data Quality Campaign
- EduNav
- Ellucian
- GreenLight Credentials
- Lumina Foundation
- Maryland Longitudinal Data System Center
- Minnesota Office of Higher Education
- National Student Clearinghouse
- PowerSchool
- ServiceNow
- State of California Cradle-to-Career System/Public Policy Institute of California
- The Policy Lab at Brown University

8.4 Market Scan & High-Level Cost Estimate

When considering the costs and return on investment in a new technology solution, an analysis of all possible systems and their costs is the first step to implementation. Gartner has utilized extensive market research and evaluations to identify the leaders in each of the necessary areas of the system. These leaders do not have a specific focus on education; they deliver platforms across a variety of use cases.

Based on the future architecture, there are seven key areas in which specific vendors and tools should be considered. When evaluating tools these tools, state leaders may wish to select a best-in-breed solution, where various tools interact with each other, or a single vendor that has specific synergies which can lower costs.

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[103] Due to Gartner's strict stance on impartiality and objectivity, no one solution or product is being recommended as part of this study. Gartner recommends that the state should release a formal Request for Proposals for any technology vendors and services being purchased as a result of this study.

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Key Areas to Consider When Selecting Vendors

- Data Integration Tools
- Cloud Database Management Systems
- Data Quality Tools
- Analytics and BI Platforms
- Metadata Management (optional)
- Master Data Management
- Implementation Service Providers

With each of these areas, Gartner's research evaluates all vendors by understanding their strengths relative to others in their market segment as a first step to understanding the benefits of investing further in their technology. In each area, Gartner has highlighted a few leaders, but is not recommending any single vendor or solution as focusing on the leaders' quadrant is not always the best course of action, however; there are good reasons to consider market challengers, and a niche player may support your needs better than a market leader. It all depends on how the provider aligns with your business goals.

In addition to vendors specifically in these key areas, there are additional options with education-specific vendors, which have developed solutions catered specifically to the education industry and would cover parts of this solution. Through Gartner's research and involvement with many different vendors, education technology solutions could be a good foundation for this solution with custom applications developed in conjunction with these technologies. However, an evaluation of the capabilities and integration of other solutions should be conducted prior to the selection of any vendor strategy.

8.4.1   Data Integration Tools

The ability to deliver data seamlessly from many different sources is critical in the interconnected nature of this solution. There are a few vendors that focus on this area of data analytics by evaluating the vendor's relative strengths to assist in selecting the best tool.


- Informatica and IBM have the highest scores for most of the prioritized capabilities for Data Integration Tools with Data Movement Topology and Complex Data Transformation being the highest-rated relevant Capabilities.

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- IBM scores the highest for Data ops support and Data governance capabilities, which are also among the highest weighted relevant capabilities.
- Talend provides the Talend Data Preparation tool as part of the Talend Data Fabric platform to support data preparation requirements which are rated well for its data preparation and ease of use capabilities.
- Among the required capabilities Oracle scores the highest for Data Movement Topology and Complex Data Transformation. Oracle Data Integration products are perceived to be of higher price as compared to competitors.
- Denodo scores high for specific API services capabilities and least for one of the relatively top priority Active Metadata Support Capabilities.
- Denodo's built-in capabilities, such as data source abstraction, connection management, source parsing, execution tracing, streaming listeners, version control, and embedded ML notebooks, make it most suitable for the data engineering use case.

8.4.2 Cloud Database Management Systems

The data ingested through the various source systems will require storage and management capabilities, with a database management system (DMBS). With more users moving toward the cloud to host their databases, a Cloud DBMS would be optimal. Here data is stored in a cloud storage tier and managed data is through these storage providers.
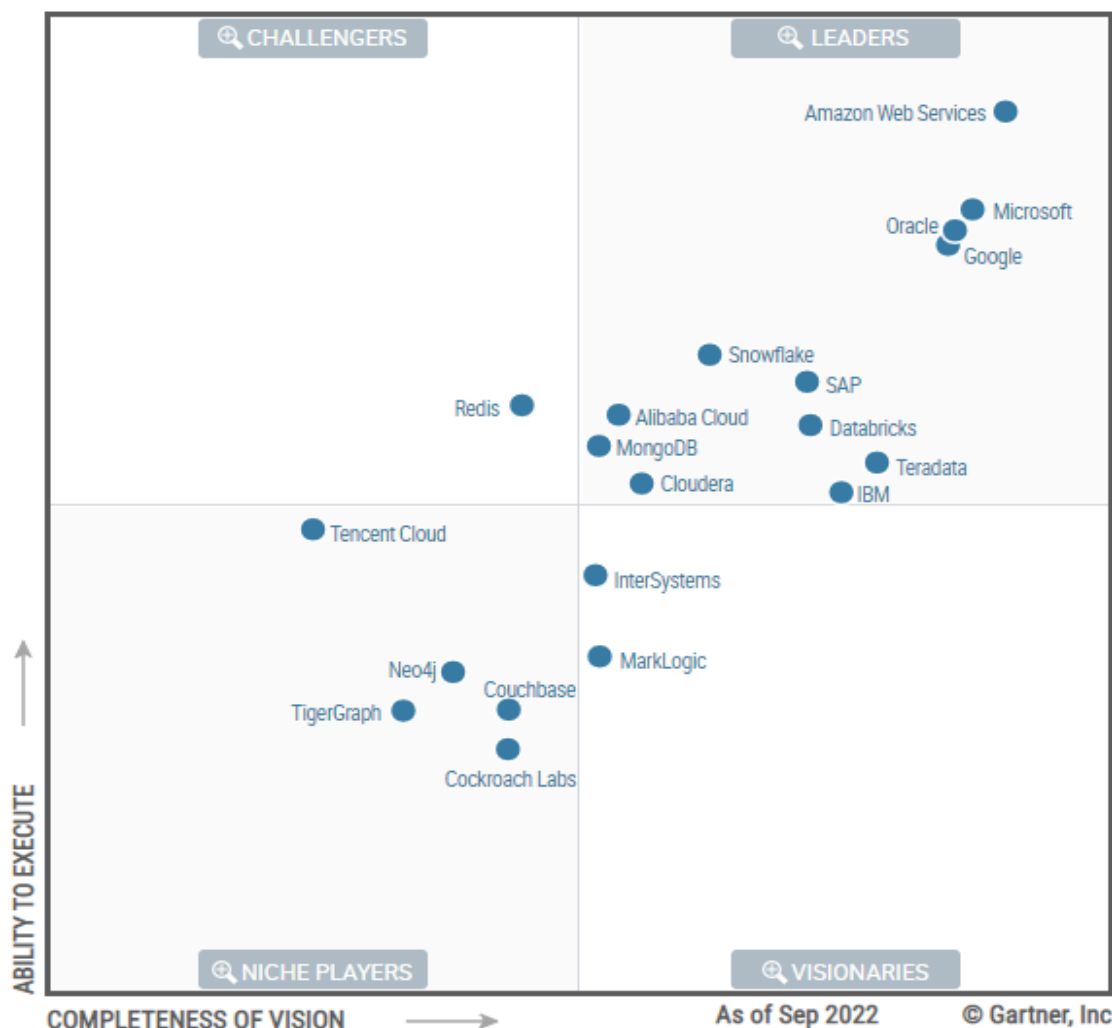
- Teradata and Oracle have the highest score for most of the prioritized capabilities for Cloud Database Management Systems.

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- Oracle has a strong presence in the market due to its hybrid cloud offerings and autonomous DBMS Technology. Oracle scores well above average for automated performance tuning and optimization which is one of the top priority capability requirements.
- IBM Db2 Warehouse on Cloud should be evaluated in the context of the broader ecosystems provided in Cloud Pak for Data. Db2 Warehouse on Cloud scored a 4 or above in six out of nine evaluated criteria and did not score below a 3.6 in any of them. Of particular note were high scores for distributed access, automated performance tuning and optimization, and multi-cloud, intercloud, and hybrid-cloud deployment.
- For the conceptual architecture SAP Data Warehouse Cloud is rated well across a range of different data science capabilities with the highest score in Workload Management Capabilities.
- For Snowflake (Data Cloud) Automated Perf Tuning/Optimization, Performance Monitoring and Admin, and Dynamic Elasticity are the only three capabilities scoring well above market average scores. It ranks as one of the top five vendors due to its highest score in prioritized Dynamic Elasticity capabilities.

8.4.3 Data Quality Tools

Various vendors provide additional processes and technology to identify understand and correct flaws in data that support effective information governance across different business processes and decision-making. This is another critical area that will require evaluation since there are many different source systems and data types. These tools include a range of functions such as profiling, parsing, standardization, cleansing, matching, enrichment, and monitoring.

- Informatica and IBM lead the space for supporting data quality systems with integrated systems and a depth of market understanding and responsiveness.

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- IBM offers a comprehensive and tightly integrated platform for managing data quality and collaborating with other parts of the system with an end-to-end solution.
- Informatica provides additional automated features and support for migrating data to the cloud and intelligent automation.
- SAP is the market share leader, especially when connect with ERP systems and an extensive partnership network.

8.4.4   Analytics and Business Intelligence Platforms

The goal of any data system is to allow data to be consumed in an organized and intelligent manner that will satisfy functional requests and requirements. To do this an analytics and business intelligent layer must be implemented in a customer-focused way to allow for easy and simple access.

- Salesforce (Tableau) and Microsoft have the highest score for most of the prioritized capabilities for Analytics and Business Intelligence Platforms.
- Tableau scored well above average on both the Data Preparation and Data Visualization capabilities. Tableau's license cost is higher compared to other vendors.
- Enterprise Analytics is Microsoft's strongest use case with reporting being its strong relevant capability score. Microsoft is one of the key vendors for customers that want all the security, manageability, and scale development using agile and waterfall methodologies.
- Domo's data preparation capability, branded as Magic ETL, offers a simple, visual way to build data pipelines with automatic inferencing and impact analysis and is one of the highest-rated capabilities. Domo is particularly gaining traction from organizations that have chosen a non-Microsoft cloud ecosystem but want a strong native cloud ABI platform.
- With strong scores in manageability and security, Enterprise Analytics is TIBCO Spotfire's strongest use case.

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- Sisense Fusion is cloud-agnostic and multi-cloud-capable. However, it lacks market momentum outside its core business use cases.

8.4.5 Master Data Management

Perhaps the most critical factor in developing a successful system with many different data points and end users is standardization and creating a consistent data model. Master data will require a specific management tool to organize and manage the millions of data points for students across the state.

- Informatica is a leader in the master data management space by providing prominent multiplatform and domain solutions and can be focused on domain-specific use cases. The provider has many clients across many verticals and would likely be able to provide customized solutions.
- Other leaders such as Semarchy, TIBCO, and Riversand provide focused expertise with robust MDM solutions combined with deep market understanding. They are positioned to be competitive in the longer-term strategy with solid MDM core capabilities.
- IBM and SAP are unique challengers with an established client base and domain expertise, as well as market awareness with synergy with other aspects of the data system. However, their pace of innovation is currently lagging compared to other competitors.
- Other challengers are focused on niche areas such as perfecting partnerships with various vendors like Microsoft or unique intuitive user interfaces.

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8.4.6   Implementation Service Providers

There are many options for implementation, from utilizing specific service vendors to internal teams or hiring third parties. The most common option is to employ the expertise of specialized vendors that are aware of any pitfalls of service and can evaluate your business needs as well. These vendors are typically third parties with established programs to integrate business and technology capabilities.

- The clear leaders in implementation support remain well-known names such as Deloitte and Accenture by leveraging integrated business, data analytics, and technology capabilities with end-to-end delivery services
- IBM has a relative strength by being the strongest vendor that also offers the leading technology in many areas of a data analytics solution. Having synergy with technology that few other firms offer with leading business analysis capabilities
- The leaders in data analytics implementation are primarily selected based on the talent available as the right people and skills develop the best measurable outcomes.
- Many of the leading vendors are very large firms, and it has been found that there are inconsistencies with the quality of resources and project management. Each leading vendor includes best-in-class resources; however, it is not guaranteed that these teams will be assigned to this project.

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8.4.7   High-Level Technology Costs

The conceptual solution that has been developed at this stage does not have vendors or business requirements identified, which would inhibit an accurate evaluation of the technology implementation and maintenance costs. With this limited understanding of the technology available in the market, relationships with market leaders, and a history of past implementation support, Gartner is able to generate a rough estimate to provide an understanding of effort. The cost breakdown follows each of the key areas and is based on estimating the total cost of licensing, installation, nodes, and data elements.[104]

Table 8.   Estimated Technology Costs

Technology Area	Low Estimate	High Estimate
Data Integration	$540,000	$787,000
Database Platforms	$705,000	$1,000,000
Master Data Management	$1,125,000	$2,635,000
Metadata Management	$131,000	$185,000
Data Quality	$360,000	$420,000
Analytics & BI	$200,000	$328,000
Custom web Applications (per single application)	$2,000,000	$3,000,000
Total	**$5,061,000**	**$8,355,000**

Table 9.   Estimated Annual Maintenance Costs

Technology Area	Low Estimate	High Estimate
Data Integration	$212,000	$531,000
Database Platforms	$265,000	$820,000
Master Data Management	$440,000	$1,020,000
Metadata Management	$88,000	$115,000
Data Quality	$141,000	$280,000
Analytics & BI	$60,000	$120,000
Custom web Applications (per single application)	$225,000	$565,000
Total	**$1,431,000**	**$3,451,000**

These estimates are primarily focused on technology costs, with basic service implementation included. Costs and time for process redesign, training, communications, and organizational change management are not included. There are always risks that implementation does not go as planned with increased costs and duration.

As summarized in the Executive Summary, Gartner estimates the cost for student data interoperability to be approximately $16-$20 million over approximately three years, from inception to completion. This includes $5-$8 million for initial technology costs, plus the estimated costs of $11-$12 million that is associated with human capital, process redesign, training, and organizational change management. Gartner estimates that it will cost the state approximately $1-$3 million for annual technology maintenance fees.

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[104] Specific data elements would need to be specified as part of requirements gathering efforts. While outlining the data elements necessary for this work was not in scope for Gartner, it is worth pointing out that the use cases described in this study point to only limited data elements and data domains; this is a subset of all student information typically collected.

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8.4.8 Cost Breakdown Assumptions

Data Integration:

- Licensing model: Assume pay per use licensing model for cloud environment and a perpetual licensing model for on-premises
- Pricing Rationale: Each environment needs a license to run the tool. Assumed no enterprise licensing and/or discounts.
- Licensing costs are driven by number of instances on-premises and instances of data integration tools on cloud; used annual reserved instances for cloud environment
- Assume only one instance of data integration is required based on conceptual architecture
- Run costs for AWS glue environment; assumed to be the same for each environment
- One-time installation costs, as a function of total spend

Data Management:

- Licensing model: In Gartner's models, data warehouse on-prem uses core-based licensing model and data warehouse instances on cloud have usage-based pricing model
- Pricing Rationale: Assumed a maximum of four environments on cloud
- Assumed an average cost/core for on-prem instances
- Volume of data across all groups between 25 TB and 50 TB.
- Costs in cloud environment factor in other services such as object storage, virtual compute instances, serverless compute, etc.
- One node will be required to run big data environment
- One-time installation costs, as a function of total spend

Analytics and BI:

- Licensing model: Driven by number of end-users accessing reports
- Pricing Rationale: For any on-prem instances there will be a need to install Reporting Server costs assuming there is no Enterprise Licensing agreement
- Assume average license cost to access reports for each user (IT, admin, business, etc.)/month
- The number on-prem instances that will be stood up (across groups/subgroups) will be from 1-2 instances
- Report server costs (assumes no Enterprise licensing agreement)
- One-time installation costs, as a function of total spend

Master Data Management

- Licensing model: Enterprise licensing model driven by Master Records
- Pricing Rationale: A minimum of 2.5M customer records will need to be mastered within Business Group. Other groups might have similar number of records to be mastered. In the high scenario, assumed three additional domains with similar record set to be mastered
- Master data licenses are driven by number of master records which is estimated to be between 2.5M and 5M
- Depending on vendor chosen the cost per element is representative of what will be spent and must be used as a guideline
- One-time installation costs, as a function of total spend

Metadata Management:

- Licensing model: Enterprise licensing model driven by number of modules chosen
- Pricing Rationale: Choose at least Data Catalog and Business Glossary modules at a minimum but could potentially choose all modules eventually
- Licensing costs vary by the number of modules chosen and not by number of instances
- Range of costs per module driven by vendor
- Costs are independent on instances and medium but driven by modules
- One-time installation costs, a function of total spend

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Data Quality:

- Licensing model: Data Quality software prices are driven by number of cores licensed and number of instances
- Pricing Rationale: This estimates that two groups choose to implement data quality solutions and potentially all four groups can have solutions implemented
- License costs are driven by number of cores
- Typical Data Quality server with number of cores purchased
- One-time installation costs, a function of total spend

Application Portals:

- Assume that custom development will be required for this application
- Application will be developed on a web portal
- Cost estimates are very high level and utilize common web app development costs
- Custom web app development for this specific use case is not included in this estimate

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8.5 National Best Practices

Gartner identified organizations from across the United States—including those directly involved in similar largescale efforts and those considered thought leaders in this space.[105] Gartner used subsequent interviews to gather their perspectives on interoperable and interconnected student data systems, with a goal of understanding *specific best practices and steps taken to ensure success*. These interviews and supporting documents provided industry advice on how to successfully engage in statewide, cross-sector data-sharing initiatives, particularly those spanning K–16.

Gartner heard that many states and localities are working on similar initiatives, to complement their longitudinal data system efforts with interoperability. As statewide longitudinal data systems mature (and policymakers, practitioners, and elected officials can glean the information they need), the education industry's focus is gradually shifting away from static reports and data snapshots, and toward opportunities for interoperable systems that allow school-based staff to *use* the same types of data "on the ground" and in near real-time.

National organizations compared this to a similar groundswell around interoperability in the health sector—one that has led to standardized data schema and consolidated health records for patients (e.g., tools like MyChart that allow individuals to download and share their records and communicate across health organizations and providers).[106]

The team heard stories and firsthand experiences about work that has failed or has been limited in success. Gartner asked these participants to identify patterns, themes, and recommendations that can help support success in North Carolina.

National organizations consistently raised considerations around ownership, accountability, governance, funding, data standardization, and data sharing agreements, summarized in the sections below. Importantly these same concerns were echoed by leaders across North Carolina as well.[107]

8.5.1 Cross-Sector Governance

Interoperability initiatives should be run by an entity that is not dedicated to (or housed within) any one agency or sector. In some cases, this means creating a new state level agency or organization; in others, it means an independent organization or office with a governing board made up of representatives from various sectors who can steer the initiative and mitigate disputes between agencies and organizations. This study envisions a future where data from key student information systems is shared not just *within* agencies, but *across* agencies. To find a suitable "home", North Carolina leaders should look first to an entity that can act impartially and in all three groups' best interests. There must be an agreement about which organizations are required to share data for the effort, along with executed data-sharing

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[105] A list of participating organizations is provided in the Appendix. Note that not all organizations elected to be named.
[106] Note that a shift toward more frequent data can in some cases mean a loss of data cleanliness. Traditionally, LDSs have relied on carefully validated and finalized data for this purpose. Data received in near real-time has the likelihood of containing more errors.
[107] While Gartner spoke with multiple individuals and organizations, "Case Studies" on these organizations were out of scope for this study. It should be noted, however, that multiple states have pursued or are pursuing similar efforts, and it may be fruitful for North Carolina to further engage with them around interoperability should the state proceed.

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agreements. "Top-down" strategies have proven effective; in some cases, similar initiatives are run out of the Governor's Office in other states.[108]

8.5.2 Direct Involvement from Data Stewards

It is important that each organization, agency, or sector have a champion who participates in the initiative. Each agency or organization contributing data should designate one dedicated representative to the larger collective. This individual represents their needs, champions the appropriate use of their data, and helps interpret and understand the information in the context of their users and business processes. This also ensures that each participant is seeing value from the initiative furthering ownership and involvement from all groups.

8.5.3 Dedicated Dollars

Stakeholders consistently recommended that initiatives like this one should be funded via appropriation and codified in state law so that they can endure inevitable changes in state elected leadership. States are seeing success by braiding together disparate funding sources from both the federal and state levels. While pandemic stimulus dollars provided short-term support, they will not be stable enough to fund large multi-year initiatives that play out over years, not months.

8.5.4 Bi-Partisan Support

States recognizing that this can be a powerful bi-partisan issue that unites political parties. To ensure that data interoperability initiatives receive broad support, states should identify a set of core principles and vision statements that are meaningful and valuable across parties and sectors.

8.5.5 Exemplar Data Sharing Agreements

Successful initiatives establish data-sharing agreements and parameters at the state level and effectively provide the framework for local institutions to copy. This means data-sharing agreements between agencies, standardized/templatized MOUs, or guidance on the "presumption of use" to describe how the initiative will meet legal requirements. Independent attorneys (e.g., within the North Carolina Department of Justice) can advise and prepare materials to ensure objectivity. When these parameters are set at the top, they provide effective "cover" for local organizations to act.

8.5.6 Standardized Data Schema

States and localities need to define and agree upon standardized data schema to support interoperability. As noted elsewhere in this report, this is a critical component of interoperability. There are many existing models to leverage; the hard part is agreeing on and implementing any set of standards.

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[108] As noted elsewhere in this study, Gartner recommends that an Executive Sponsor be identified. This individual should have the authority to act and accountability to all sectors and institutions involved.

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8.6 Key Success Factors

1 Consider how K–16 initiatives are funded and who owns them. The solution or system will bear the stamp of the agency that manages the resources. If the initiative is to be truly cross-sector, it must sit in a place that does not favor one agency or sector. The organization should be independent and objective. It will also be necessary to have active representation (i.e., delegates) from each organization that is required to contribute data so that their data can be interpreted and understood. In addition, the desired capabilities will require initial funding to establish, and then ongoing dollars to operate, mature, and expand—obtain/establish a reliable source of funding that is not subject to the varying interests of the participating entities or changing economic and political circumstances.

2 Carefully define your vision and goals. This will support clear communication and ensure that all data contributors and participating institutions understand the "why" behind the initiative. It will also help descope when there are too many ideas or competing priorities. In addition, establishing a clear vision will help enforce data sharing across organizations.

3 Understand who your end-user is, in detail. It is not enough to say you are supporting "students and families;" rather you should define the types of students or families you are trying to support and these groups' specific needs. Many initiatives skew toward middle and upper-middle-class families while undervaluing the needs of traditionally under-underserved users. As an example, these families tend to want distinct types of data and different ways of engaging with that data (e.g., preference for paper/manual vs. online systems, etc.). While there are efforts to directly engage with communities, it is rare that the needs of marginalized populations, criminally involved youth and adults, and first-generation college students are fully heard or addressed. Many solutions favor the tech-savvy student who is self-motivated and has considerable adult support.

4 Prioritize outcomes that will have a direct, positive impact on educational attainment, rather than on what supports better data collection for researchers or policymakers. Hundreds of millions of dollars have been spent on similar efforts across the country, but they have not significantly increased educational attainment due to insufficient planning, stakeholder buy-in, and governance.

5 Establish technical pre-conditions for success. Factors like universal ID and common course numbering/coding schemas/data standards must be in place to support interconnectivity across institutions.

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8.7 Glossary

Gartner provides the following terms and their definitions to assist the reader with the understanding of this study. While many definitions exist, the ones provided below indicate our best definition for the purposes of this report.

Articulation

In education, articulation refers to the process of transferring from one school or institution to another. For example, students go through the "articulation process" when they move from high school to higher ed. "Course articulation" is a term is used to describe the process of transferring specific courses or credits from one institution to another, which requires agreement on content and matching of data, to help ensure students can transfer work completed at one school into another. Articulation between schools and degree programs is challenging because there may be different subject requirements, pre-requisites, grading scales, credit values, or term models.

Composable Architecture

A composable architecture organizes technologies into modular application building blocks that deliver well-defined capabilities in support of specified business outcomes. To enable composability, enterprise architects and IT leaders must identify functionality with strong potential for reuse, and then package that functionality as shared services. Composability stands in contrast to monolithic approaches, where a single solution meets all needs. Composable architecture satisfies the need for flexibility, scalability, and support for incremental change. For North Carolina's goals, this could mean that individual solutions can be combined to complement each other and to create a web of services that together meet all of the interoperable and interconnectedness requirements.

Conceptual Architecture

A model that depicts a layered architectural style, showing the interplay between business and technology; this type of diagram provides a high-level map of how the system will work.

Data Governance

Data governance is the specification of decision rights and an accountability framework to ensure the appropriate behavior in the valuation, creation, consumption and control of data and analytics.

Data Lake

A data lake is a concept consisting of a collection of storage instances of various data assets. These assets are unstructured and stored in a raw or near exact, copy of the source format and are in addition to the originating data stores.

Data Mart

A data mart is a data warehouse that serves a specific need, with a reduced amount of data that has been organized for this need. This can be data specific to an organization's financials, user information etc.

Data Management

Data management (DM) consists of the practices, architectural techniques, and tools for achieving consistent access to and delivery of data across the spectrum of data subject areas and data structure types in the enterprise, to meet the data consumption requirements of all applications and business processes.

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Data Stewardship

Management of an organization's data assets to help provide business users with high-quality data that is consistently available and used. Stewardship is most effective when it is positioned closest to the point of capture and maintenance of the data. Stewards are in an ideal position to help with an effective governance strategy for data quality, since governance must cascade across the entire organization to ensure that appropriate accountability is enacted and enforced.

Data Warehouse

A data warehouse is a similar data storage concept that consists of data assets that are structured and somewhat organized. It typically serves as the central repository of preprocessed data for analytics and business intelligence

End-User

For the purposes of this study, this refers to the person who actually uses a product or service. It can also be more broadly interpreted to mean the individuals who most directly benefit from the use of that specific product or service.

Enterprise Resource Planning (ERP)

Enterprise resource planning (ERP) is defined as the ability to deliver an integrated suite of business applications. ERP tools share a common process and data model, covering broad and deep operational end-to-end processes, such as those found in finance, HR, distribution, manufacturing, service, and the supply chain.

ERP applications automate and support a range of administrative and operational business processes across multiple industries, including line of business, customer-facing, administrative and the asset management aspects of an enterprise. ERP deployments are complex and expensive endeavors, and some organizations struggle to define the business benefits.

Entity Resolution and Analysis (ER&A)

This is the capability to resolve multiple labels for individuals, products, or other noun classes of data into a single resolved entity and analyze relationships among such resolved entities. Multiple references may result from data entry errors, inconsistency due to multiple systems for entering data, intentional falsification of information, or the creation of false identities. Entity resolution and analysis (ER&A) leverages many aspects of data integration, master data management (MDM) and data quality management, and eventually becomes instrumental in the success of each of these practices. Additionally, all four of these disciplines (that is, data integration, MDM, data quality management and ER&A) make up a significant portion of the implementation which takes place under enterprise information management.

Longitudinal Data System (LDS)

This is a system that collects and maintains information from a variety of sources. The LDS links data across entities and systems, over time, so that individuals can monitor long term trends. Typically, an LDS makes data available to analysts, researchers, and policymakers using simple reporting and analysis tools. A data warehouse is not an LDS in and of itself; typically, the warehouse simply stores historical snapshots of information. An LDS must connect individual records to provide insights on progress. Annual snapshots may, on their own, be ineffective.

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Predictive Analytics

Predictive analytics is a form of advanced analytics that examines data or content to answer the question, "What is likely to happen?" It is characterized by techniques such as regression analysis, multivariate statistics, pattern matching, predictive modeling, and forecasting. Predictive models score the propensity for customers to respond to a marketing campaign by analyzing historical patterns, relationships, and behaviors.

Program

A "program" is a coordinated effort involving multiple projects. While each project has its own plan and its own management structure, the program also has an overall, higher-level plan and a program management capability that focuses on coordinating the various projects within the program. (For example: building a new classroom building would be a project; building a new campus consisting of multiple classroom, residential and other buildings would be a program.) Programs require strong governance, particularly when they involve multiple institutions, sectors, government agencies, or systems.

Ransomware

Ransomware is a type of cyber extortion where a malicious actor infiltrates an environment and encrypts and exfiltrates files, denying access and threating disclosure, unless the victim pays a ransom. Ransomware is often designed to spread across a network and target database and file servers and can thus quickly paralyze an entire organization.

Relational Database

A collection of data that is organized in predefined relationships into tables. The data is then structured across multiple tables with unique identifiers to provide complex relationships and ready for consumption with an analytics or business intelligence tool.

Standardization

Specifications or styles that are widely accepted by users and adopted by multiple organizations or vendors. Standards are critical to the compatibility of hardware, software, and everything in between. Industry standards enable the essential elements of a computer and related infrastructure to work together. Standards provide specifications to hardware manufacturers and software developers that allow them to create products that will work together. Deviation from standards could result in the following example problems (which are not specific to education, and are illustrative only):

- A plug on a keyboard does not fit into the related outlet on a computer.

- A piece of software does not work with a particular operating system.

- An internet browser cannot read a certain page on the web because the page is not formatted according to the browser requirements.

- Proprietary software does not work on the internet.

Student Information Systems (SIS) in K–12

The student information system (SIS) of the typical K–12 organization continues to sit at the center of nearly all its data management. It provides back-office administrator functionality, as well as student-, parent- and faculty-facing functionality to manage key organizational information assets. Such assets include not only demographic data, enrollment, grades, and transcripts, but also State or other governmental agency reporting capabilities. Systems vary widely in size; scope; state, regional or national markets; and functional capability — and they range from individual components to enterprisewide

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integrated solutions. They also function as the system of record for several other critical applications, including the LMS, demanding interoperability.

Student Information Systems (SIS) in Higher Education

The SIS serves as the core system of record for institutions of higher education. It supports and delivers services for a variety of routine administrative and academic activities on a daily basis. Overall, it supports a broad spectrum of back-office administrator and student-/faculty-facing functionality to manage key institutional information assets, such as student prospects, applicants and matriculates, courses offered, student course registrations, and grades and transcripts throughout the student life cycle. The current market offerings vary in size, scope, country localizations, functional capability, and delivery options (SaaS/cloud, hosted or on-premises). They range from individual components to enterprisewide integrated solutions or sometimes are part of a larger administrative ERP application suite. "ERP" is defined above.

Webservices

A software concept and infrastructure — supported by several major computing vendors (notably Microsoft and IBM) — for program-to-program communication and application component delivery. The web services concept treats software as a set of services accessible over ubiquitous networks using web-based standards and protocols.

Specifically, a web service is a software component can be accessed by another application (such as a client, a server, or another web service) through the use of generally available, ubiquitous protocols and transports, such as Hypertext Transport Protocol (HTTP). Joint efforts between IBM and Microsoft, with the support of other vendors such as Ariba and Iona Technologies, have produced agreement on a basic set of XML-based standards for web service interface definition, discovery, and remote calling. They include:

- Web Services Description Language (WSDL) for describing Web service interfaces
- Universal Description, Discovery, and Integration (UDDI) as the means for users to publish and locate available Web services, their characteristics, and interfaces
- Simple Object Access Protocol (SOAP), which enables an application to call a Web service

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