# Executive Summary Report on Consulting Services for Diagnostic Assessment of Education Management Information System (EMIS), Data Integration and Analytic Systems

for

**Contract No.: GE-MESCS-193021-CS-QBS**

for

**Consulting Services for Diagnostic Assessment of Education Management Information System (EMIS), Data Integration and Analytic Systems**

Project Name: World Bank financed Georgia I2Q - Innovation, Inclusion and Quality Project

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Loan No: 8955-GE
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The Ministry of Education and Science of Georgia (MES)

and

JV EdTech Ventures Ltd (Leading Partner) Conscience IT (Partner) and H2 Learning (Partner)

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# Executive Summary

The consulting team carried out a diagnostic assessment of the EMIS organization; its capacity and skills, the systems it manages, and its context in the education system of Georgia between June 2021 and July 2022. From the multiple stakeholder interviews carried out there is a clear consensus that the EMIS team and the set of systems and data services it supports are extremely valuable to the management of the national education system in Georgia. There is also a consensus that many elements of the system need to be modernized, made more sustainable, and need to be updated to provide faster and more efficient data collection and analysis. EMIS provides a very broad range of IT support systems and services to Georgia's national education system in addition to the core education data systems. It is therefore like a very large back-office Corporate IT organization. As such, it is principally a technical support organization. It is not, and we believe should not be, the type of cross functional education transformation team that would lead the organizational, human capacity, training and organization activities required to 'unlock the true potential' of digital technologies in Georgia's education system. We recommend that a strong cross-MES team is required to lead this transformation and the education system is currently suffering from the absence of this focus.

## EMIS Systems and Organization

In our analysis of the EMIS data systems we have identified significant technical debt in the older systems, together with a lack of a consistent information architecture, and a lack of use of the international education data standards. There is a need for improved database management processes together with a database integration and streamlining before any advanced data analytics or data science processes can be planned. Our primary recommendation is therefore to establish a modern scalable, modular and extensible Enterprise Architecture (EA), Data Model and Domain Model for all EMIS systems, subsystems, and databases as the first development priority. This includes the application of the international education data standards and the distributed architecture model outlined in this document and the other supporting documents from the diagnostic assessment consultancy project.

We recommend this enterprise architecture should be included as a significant part of the planned eSchool upgrade project, and become the architecture and data model for all future projects including the higher education data systems upgrade project we recommended . The architectecture, data and domain models for these systems should be developed as a close collaboration between the EMIS technology team and the contractors selected for the eSchool (and subsequent) system development projects.

A significant series of system upgrades are proposed to modernize the EMIS systems, architecture and data management practices including:

1. The Enterprise Architecture, Domain and Data Models outlined above.
2. The upgrade of the eSchool General Education data system, including development of the preschool data system required by MoES.

3. A data upgrade and integration plan for the Higher Education data systems, including replacement of the RegAdmin system, data integration with the QMS system, and consideration of data flows required for the Performance-based Funding system.
4. Database integration and streamlining with improved data management and analysis processes.

To support this challenging roadmap significant organization improvement and skill development activities are essential at EMIS.

Other proposed initiatives, including the LMS for general education should be considered carefully before proceeding. The human and infrastructure capacity in General Education needs to develop significantly before this will be of value, and there is a lack of evidence of success from initiatives of this type around the world, particularly in environments where readiness and capabilities are lower. A more staged development plan for digital technologies for learning and teaching is proposed below.

We recommend the Distributed Architecture Model outlined together with the adoption of the international education data standards for efficient data feeds from external education institutions including universities and private schools. This would be implemented by working with the private schools, universities and other education institutions who are operating SIS systems to develop a data flow based on SIF and/or OneRoster for data interoperability. The capability to integrate this data flow to the EMIS data systems would be developed. A model for working with education institutions with high maturity software infrastructure and systems is proposed together with approaches for institutions with medium and lower maturity to support improvement and innovations in education data systems over time by all. A national conference is proposed with the universities and schools involved to define this methodology and agree on the application of the international data standards for these data exchanges.

The application of BPM (business process model) and Low-Code development methodologies are recommended for improved development quality and efficiency, and to support more efficient upgrade and maintenance of development systems. We recommend that EMIS begin the adoption of these systems for in-house development, and that contractors for outsourced systems are required to apply these systems initially for lower-risk module development, data entry and reporting modules. The use of these methodologies should be included in the Enterprise Architecture model for EMIS systems. Upskilling for EMIS in BPM and Low-Code methodologies has been included in the TOR document for EMIS Upskilling. A hybrid development approach is proposed for eSchool using traditional Java based development methodologies for the main modules and applying low-code tools initially for lower-risk modules and for future enhancements and maintenance.

## Governance and Priorities

EMIS operates in a unique and rapidly changing field of technology, data systems and development methodologies. The skills and expertise required to lead this activity are quite

different to the skills and expertise required to lead and administer other key activities of the MoES. Due to this, a different governance and steering approach is recommended, to support EMIS in good decision making and prioritization with skills and expertise in the technical environment in which EMIS operates. An Independent Expert Steering Group needs to be set up to help guide the EMIS organization through the very significant Strategic Roadmap, Priorities and Investments. This steering team should be constituted with a balance of independent external experts, qualified MES representatives and EMIS senior management. Greater flexibility should also be considered in the interpretation and application of some legal requirements and constraints applied to EMIS processes. At times this appears to obstruct EMIS in achieving its primary objective of effective data management and support to the national education system.

## EMIS Organization and Skills

EMIS is unable to maintain a large enough software development team to meet all the requirements for the multiple systems and support desired by MES and other stakeholders. This is due to intense competition from, and higher wages offered in private and international sectors, and to government budget, salary level and headcount restrictions. Against this background technical leadership and management at EMIS needs to be strengthened. An emerging and declining skills analysis has been done and a set of critical technical skills have been identified. A set of recommended critical hires and upskilling priorities have been listed. In addition to the hiring and upskilling, improvements in HR systems, pay scales and work conditions are recommended to build a modern high performance workforce.

Several changes in approach are needed at EMIS to deliver the significant set of upgraded systems desired by stakeholders and the modernized and more efficient development methodologies recommended in this report, in a competitive environment with constant challenges maintaining the high level technical skills required for this. Strategic outsourcing of technology development is necessary to achieve more with the relatively small technology team and to access the donor funding available. The phased implementation of and training in scaled Agile development methodologies using the SAFe5 Agile methodology is recommended for improved software development quality, efficiency and improved sustainability of developed systems. An actively managed transition to composable containerised modular solution delivery is also recommended. Significant improvements in data management, data analysis, and data reporting is needed. Increased use of low-code development tool sets, and a transition to hybrid-cloud hosting model are recommended to put in place the set of modern efficient data systems needed.

An experienced outsourcing management capacity needs to be put in place, including a senior outsourcing programme manager at EMIS, and a clear separation of the roles in procurement and outsourcing. To ensure this separation we recommend that contracting and financial responsibilities for procurement should remain at the PMU while the tactical and strategic management of outsourcing performance is the responsibility of EMIS, with close collaboration maintained between both. Lasting strategic relationships should be made with high quality

contractors to deliver the ambitious and challenging projects proposed. Strategic relations should be developed so that there are clear medium and longer term incentives and opportunities for the contractors when high quality work is done.

## Data management and Data Analysis

Our analysis has shown quite significant deficiencies in the EMIS data management, requiring both short-term basic fixes, and medium term database integration and upgrade to meet the needs and requirements of the stakeholders. Meanwhile, extremely high expectations have been created worldwide about the potential of data analytics, data science and artificial intelligence to support decision making and develop insights. For this to succeed, highly efficient data management processes are required together with large volumes of accurate and authentic data that is highly relevant to the insights sought on the decisions being made. However, EMIS needs to begin by improving some basic data management practices and developing reporting and data visualization capabilities in the short and medium term, while carrying out the database integration and streamlining activities outlined in the eSchool upgrade project. Additionally many data input processes are unreliable, require significant data validation or re-entry by EMIS and create inefficient time consuming workflows. The application of the system design proposed with the use of international education data standards and the distributed architecture model will improve data entry efficiency and accuracy significantly.

These are all necessary prerequisites to the more advanced steps developing the data engineering and advanced data science capabilities. Exaggerated expectations have been created around the application of AI and data mining and these steps cannot be taken without well managed, authentic and accurate data sets. EMIS has significant administrative data on Georgia's education system, which with the improved data management and integration proposed can provide accurate information and insights on the national education system. There is, however, almost no accurate and authentic learning data available in Georgia. Long-term progress is required in the development of digital methodologies, teacher support, human capacity development, regional support, and regional infrastructure improvement before any advanced data analytics or data science processes can be applied to learning or assessment data. We therefore recommend that the short and medium term focus of EMIS is to strengthen the data administration, analysis and reporting skills as outlined above, while monitoring some of the leaders we have identified over time as they apply the smart education technology outlined. The implementation of a central Data Management Portal should also be considered in the medium to longer-term. Many governments have begun to put these in place to help gather, store, access, analyze, and share Internal and Public Data. The CKAN open source data management system (DMS) supports open data portals around the world for the Canadian, Australian and Singapore governments and many others[1]

[1] CKAN open source data management system (DMS)

Data Security and protecting the privacy of minors, employees and citizens is a critically important aspect of modern data systems. The analysis found a good understanding, processes and skills for the management of data security at EMIS. However this remains a high risk area for all data controllers and data processors worldwide. Continuous upskilling of the data security team should be applied and continuous high vigilance. Staff should be supported to achieve the relevant certifications. Georgia aims to align with EU standards and processes in society and in education. While not fully applied, the GDPR provides a model against which the data privacy models can be designed in conjunction with the local laws and regulations, and US regulations which are generally followed in Georgia to the use of social media/networks. A reconciliation of these should be done to plan the path forward, with constant vigilance applied to current and new threats.

## Agile Development Management

Agile Development Management best practice methodologies for efficient and high quality software development management have become very widely accepted in the international software industry. These include Agile Project management (APM), Enterprise Architecture (EA) and Technology Business Management (TBM)[2] using the SAFe5 Framework for Lean Enterprises[3] and DevSecOps[4]. We recommended that EMIS adopt this scaled Agile methodology in a phased manner and put in place a significant training program in the methodologies for all levels of the organization. For the eSchool and follow-on development projects we recommend that the contractor and EMIS follow Architecture-driven Software Development following Agile and Software Engineering best practices based on the SAFe5 scaled agile framework for lean enterprises. Agile supports better business stakeholder driven project planning together with a lean development management process for efficiency and flexibility. Tested software components are continuously delivered and updated based on feedback in relatively short time periods.

## Digital Technology for Teaching and Learning

There is growing evidence that technology led solutions[5][6] in and of themselves are not enough. While the provision of digital infrastructure (i.e. devices, platforms etc.) and digital content and services (i.e. resources online) are important ingredients, they are not enough to transform educational systems[7].The European Commission Digital Education Action Plan (2021-27)[8] supports a holistic approach in the application of digital education to support better education

[2] TBM Council
[3] SAFe and Technology Business Management (TBM)
[4] US Department of Defense Enterprise DevSecOps Reference Design, Sept 2021
[5] Creating the "Right" Enabling Environment for ICT
[6] Avoiding solutionism in the digital transformation of education | Unesco Futures of Education
[7] 'Technology doesn't always make education better' | Jisc
[8] European Commission Digital Education Action Plan (2021-2027), April 2021

processes and outcomes. It states that *'digital is now a horizontal policy consideration'* which has to be incorporated in every aspect of education planning and implementation.

Educational systems need to take a holistic approach to embed digital education practices effectively into the system. ICT infrastructure is undoubtedly a key component but planning needs to go well beyond the provision of digital technology or IT infrastructure. What has been missing in many applications of technology is a clear and effective focus on enhancing the competency of teachers and school leaders to engage in transformative educational practices. Georgian education requires significant investment in human capacity and in support infrastructures to underpin the introduction of transformative practices.[9]

Our assignment reports and our presentations to MoES have outlined that a Cross-MES National Digital Education Leadership Team, supported by all functions in the ministry, is essential to *'unlock this potential'*. We are proposing a network of innovation and support centers across Georgia to support capacity development for teaching and administrative staff. These centers should be staffed with pedagogical experts, digitally competent teachers, and technical support staff and should have access to a wide range of smart technologies that are suitable for use in schools[10].

## A Modern Twenty-First Century Education System

There is a widespread realization that education systems need to evolve to meet the ever-changing needs of today's globally connected digital society. It is now essential that education systems evolve to ensure learners are equipped with the knowledge and competences to thrive in the rapidly-changing, connected, and technology rich 21st Century society and economy. In this increasingly connected world key competences such as communication, collaboration, problem-solving and critical thinking are to the fore in the workplace and society. Schools are focusing more and more on equipping learners with these competences through activity-led pedagogies such as cooperative, project and inquiry-based learning approaches, underpinned by investigative questioning and supporting critical thinking. These approaches require teachers to perform a very different role as facilitator for learning where they take ownership for designing and activating learning in their own classrooms.

There is growing evidence that systems that embrace more active learning approaches are more successful in producing more independent lifelong learners and a more creative and collaborative workforce for the 21st Century. In the IIQP and other initiatives introduced by MoES, there is a clear aim to introduce more active teaching, learning and assessment practices in the future. Therefore the digital systems, infrastructure, teacher professional development and support provided to schools need to be fully consistent with this objective and support development of the key competencies outlined above to better prepare Georgia's workforce and society for the challenges of this rapidly changing world.

[9] Digital competence: the vital 21st-century skill for teachers and students European School Education Platform.
[10] Highlights - OECD Digital Education Outlook 2021 - OECD (oecd-ilibrary.org)

We are therefore proposing a steadily progressive approach to the development of digital technologies for teaching and learning in Georgia's General Education system. We propose that existing technologies and infrastructures are leveraged and improved, with a strong focus on teacher competencies and support, and the application of new activity-led pedagogies.

We therefore propose the following principal areas for investigation and progress:

1. Leverage the existing investment in the Microsoft365 and Teams for education tool sets.
2. Begin the development of formative assessment capacity, methodologies and toolsets.
3. Develop student Gradebooks/Journals through the implementation of School Information Systems (SIS) or similar functions in the eSchool platform.
4. Investigate the application and benefit of LMS technologies for general education, by means of a pilot initiative in the innovation centers.
5. Develop moderated and supported digital education experiences and distance learning support.
6. Establish the teaching and learning innovation center and regional network of technical support centers for schools as proposed.

The innovation and regional support centers should support a cost effective approach by focusing on the technologies that schools have available to them, and where teachers and support technicians already have experience. The overall plan should progress by steadily improving the skills, experience, support and infrastructure available to schools.

A stand-alone LMS implementation for General Education is not recommended by the consultant at this point. Solutions of this type have not succeeded in other general education systems with the exception of very advanced school districts with high levels of maturity in systems, infrastructure and teacher skills. We recommend that the terms of reference (TOR) for the support of learning management in general education should seek to put in place a service provider to support the General Education department in the development of a more holistic set of learning system capacity based on the tools and activities proposed above.

Internationally new practices with digital technologies in schools became normalized and embedded during the Covid-19 pandemic. The provision of digital tools helped schools to remain connected with their students and to meet them live online or share learning asynchronously. Countries are wondering how they can continue to use these tools to support teaching, learning and assessment practices using blended learning models and flipped classrooms and other models. However, some of these gains have been overstated and there is less evidence of their application in Georgia due to the lack of infrastructure, broadband and teacher skills. We recommend the focus on holistic planning and human capacity development outlined above, supported by innovation and support centers is necessary to make real and lasting change in Georgia.

## Summary Conclusion

In summary EMIS provides a very broad range of IT support systems and services to Georgia's national education system in a similar manner to a large back-office Corporate IT organization. There is a clear consensus that the EMIS team and the set of data systems and services it supports are essential to the management of the national education system in Georgia. However, EMIS is not the type of broad cross-functional multi-skilled education transformation

team that would lead the multi-factored organizational, human capacity, training and organization activities required for effective planning and implementation of digital learning capacity and technology systems in Georgia's education system. It is a key support function to that activity. We recommend that a strong cross-MES team is required to lead this transformation. Real progress in this is currently suffering from the absence of this cross-disciplinary focus in Georgia.

We have identified significant 'technical debt' in the older EMIS data systems, together with a lack of consistent and modern information architecture models, and a lack of use of the international education data standards. There is a need for improved database management processes together with database integration and streamlining before any advanced data analytics or data science processes can be planned. Our primary recommendation is therefore to establish a modern scalable, modular and extensible Enterprise Architecture, Data Model and Domain Model for all EMIS systems, subsystems, and databases as the first development priority.

A significant series of system upgrades are proposed to modernize the EMIS systems including:

- The Enterprise Architecture, Domain and Data Models outlined above.
- The upgrade of the eSchool General Education data system, including development of a preschool data system.
- A data upgrade and integration plan for Higher Education systems.
- Database integration and streamlining with improved data management and analysis processes.

EMIS operates in a unique and rapidly changing field of technology, data systems and development methodologies with multiple and varied stakeholder inputs for the MES departments, national centers, universities, schools and other bodies. For improved governance and to support good decision making and prioritization an Independent Expert Steering Group is strongly recommended to help guide EMIS through the very significant Strategic Roadmap, Priorities and Investments that need to be implemented. Due to intense competition in the labor market EMIS is unable to maintain a large enough technical leadership and software development team to meet all the requirements for the multiple systems and support desired by MES and other stakeholders. Several changes in approach are needed at EMIS to achieve more with the relatively small and highly focused technology team. A set of critical hires and upskilling priorities has been identified to build high level software architecture, management and leadership skills. Strategic outsourcing of technology development is necessary. The phased implementation of scaled Agile development methodologies is recommended for improved software development quality, efficiency, and improved sustainability of developed systems. The adoption of other modern development methodologies is also recommended in this report.

Digital learning offers all nations an opportunity to improve education processes and outcomes and to better prepare citizens for the 21st Century. There is growing evidence that systems that embrace more active learning approaches are more successful in producing more independent lifelong learners, and a more creative and collaborative workforce for the modern workforce and to better participate in society. Educational systems need to take a holistic approach to embed digital education practices effectively into the system. An important and well documented missing factor in many applications of technology for learning is a clear and effective focus on

enhancing the competency of teachers and school leaders to engage in transformative educational practices. Georgian education requires significant investment in human capacity and in support infrastructures to underpin the introduction of transformative practices.

We therefore propose a steadily progressive approach to the development of digital technologies for teaching and learning in Georgia's General Education system, learning from international experience and best-practice, with a clear focus on human capacity development and regional support. There is growing evidence that technology led solutions without the focus on teachers dn human capacity produce limited results. We propose that existing technologies and infrastructures are leveraged and improved, with a strong focus on teacher competencies and support, and the application of new activity-led pedagogies. To make this work we are proposing a network of innovation and regional support centers to support teachers and schools in the development of the new methods and the digital systems and infrastructure, led nationally by the cross-MES leadership team proposed.

The combination of a strengthened EMIS technical team enhanced by the hiring and upskilling proposed with modernized, efficient and accurate data systems supporting data-based decision making, and a cross-MES task force planning and leading the implementation of digital education throughout the national education system will provide Georgia a strong path forward to better prepare its large population of young people for the twenty-first century.[11]

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[11] Young People | UNICEF Georgia

## Summary of Recommendations and Roadmap

The following is a summary of our recommendations for organization development, technology and software architecture, platform development, data management and digital education support compiled from all aspects of the 12-month study carried out.

### Organization Development

1. Establish and empower a cross-MES body chartered with National Digital Education Leadership to plan and lead Georgia's strategy for Learning and Teaching with digital technologies.
2. Put in place an effective governance structure for the EMIS organization through the establishment of an Independent Expert Steering Group to oversee the very significant EMIS Strategic Roadmap, Priorities and Investments with a balance of external experts, MES representatives and EMIS senior management.
3. Develop a plan to address the twenty-one recommendations from the organization analysis report addressing; governance and prioritization, hiring, upskilling, data management, and the training in and implementation of modern agile development methodologies.
4. Strengthen Technical Leadership and Technical Management at EMIS including the appointment of a senior technical director to oversee all aspects of the technical platform development and operations.
5. Put in place a hiring and upskilling plan to strengthen EMIS capacity in each of the key technical roles including software architecture, business analysis, data management and analysis, data science and technical project and programme management. The plan should address measures to reduce competition from private sector recruiting including the payscale flexibility and HR practices proposed.
6. Put in place a senior outsourcing programme manager at EMIS with experience in the outsourcing of large-scale technical development. Apply a separation of the roles in procurement and outsourcing with the contracting and financial responsibilities for procurement remaining at the PMU while the tactical and strategic management of outsourcing performance is the responsibility of EMIS.
7. A significant investment in training for the EMIS team in the SAFe Agile model is recommended. This is included in the capacity building TOR document. Training in the Team Topology models referenced below is also recommended.
8. Improvement of HR systems, pay scales and work conditions are recommended to build a modern high performance workforce.

### Technology and Software Architecture

1. Establish a modern scalable, modular and extensible Enterprise Architecture, Data Model and Domain Model for all EMIS Systems and Subsystems.
2. Complete the EA design and definition as a collaboration between the EMIS technology team and the contractor selected for the eSchool system development to support ongoing ownership and management of the EA model.

3. Modernize the Development Framework used at EMIS - standardize on development tools and development models and move to low-code and no-code methodologies.
4. Implement a modular containerized development methodology and prepare a strategy for migration to a hybrid-cloud hosting model.
5. Apply the distributed architecture model proposed using the international education data standards to support efficient data sharing and continuous innovation in systems applied in Georgia's education institutions.
6. Apply the international Education Data Standards based on the CEDS, IMS Global and other applicable standards.
7. Apply DevSecOps with containerization and Infrastructure as Code (IaC) to help shorten systems development life cycle and provide continuous delivery with high software quality for more composable Application Infrastructure, and to automate software build processes and deploy dynamically from the code repositories using GitOps.
8. The application of Business Process Modeling (BPM) and Low-Code development methodologies are recommended for improved development quality and efficiency and to support more efficient upgrade and maintenance of development systems in a phased manner initially for lower-risk modules and enhancements with a skill development plan for the EMIS team in the application of these tools.

### Platform Development

1. Implement the priority roadmap items:
    - The upgrade of the eSchool General Education data system, including development of a preschool data system.
    - A data upgrade and integration plan for Higher Education systems.
    - Database integration and streamlining with improved data management and analysis processes.
2. Incorporate the Enterprise Architecture (EA) design, development and documentation and the beginning of the database streamlining in the planned eSchool upgrade project.and integration activities.
3. Begin the refactoring of the main EMIS applications (beginning with eSchool with the higher education systems as next priority) according to Domain Driven Design and Metadata Driven Design principles to provide composability, eliminate technical debt in the current systems, provide better data integration and produce more maintainable and sustainable modular containerized software elements.
4. A plan and sources of funding should be identified for the upgrade of the higher education data systems, to integrate the data flow between QMS and eUni, including replacement of the RegAdmin system and its incompatible architecture. This activity should include an understanding of the integration and data flows needed with the planned Performance-based Funding system.
5. The development of the planned higher education Performance-based Funding system . independent of the Enterprise Architecture and the eUi, RegAdmin and QMS architecture and upgrade needed creates a risk of creating a sub-optimum architecture. Connections need to be made between the definition of the EA outlined here and the planning for the performance-based funding system to reduce this risk.

6. Stronger documentation, training, and understanding of the applications of all systems developed is necessary to increase maintainability and sustainability of the systems.

### Data Management

1. Address the short-term issues with data management identified relating to unreliable backups, the overwriting of historic data, and database software licensing and version management.
2. Begin the database integration and streamlining recommended, starting with the eSchool development project and migrating all databases to an integrated data model using PostgreSQL.
3. Strengthen EMIS skills in data management and analysis in the short and medium-term, including hiring one new data analysis professional, and significant improvement of data reporting and data visualization capabilities.
4. Address existing data input processes that are unreliable, require significant data validation or re-entry by EMIS and create inefficient time consuming workflows. The application of the system design proposed with the use of international education data standards and the distributed architecture model will improve data entry efficiency and accuracy significantly.
5. Retain a strong focus on data security and privacy practices with continuous upskilling and certification of key personnel and carry out a reconciliation of the GDPR, local laws and regulations and US regulations to plan the path forward in this high risk area.
6. The implementation of a central Data Management Portal should be considered in the medium to longer-term to help gather, store, access, analyze, and share Internal and Public Data. This will help organize internal data and put all the public-centric data in open data portal form.
7. In the longer term build data engineering and data science capacity to apply advanced data analytics and insights. This investment is premature until well structured, accurate and relevant databases are in place and the more basic analysis and reporting capacity is in place and delivering results.

### Digital Education Support

1. A significant investment in human capacity and support infrastructures to support the introduction of effective digital technology together with activity and inquiry-based learning and formative assessment practices is required with a holistic approach to professional development (TPD) and support for teachers.
2. A network of innovation and regional support centers should be set-up across Georgia to support capacity development for teaching, administrative and technical staff. These centers should be staffed with a range of experts; ranging from pedagogical experts, to digitally competent teachers, and technical staff.
3. We propose a steadily progressive approach to the implementation of digital technologies in schools and regions, leveraging and further developing existing technologies and infrastructures, with a strong focus on teacher competencies, support to teachers and schools, and the application of new activity-led pedagogies.

4. A basic LMS system as planned for general education will achieve very little alone without the leadership proposed from MES and the support systems proposed is likely to be an unused or wasted resource. The development of a holistic set of learning system capacity and systems supported by the TPD and regional supports is recommended.
5. International experiences with moderated and mentored distance learning processes are studied and experiments are carried out in supporting remote teaching in small and regional schools where teachers are not available for more specialized or more advanced level subjects.

The Cross-MES national leadership and coordination body outlined in the organization section above is the most essential factor for the advancement of an effective digital education plan in Georgia.

## Summary of Roadmap and System Development Priorities

The set of development priorities for EMIS system development have been reviewed and agreed in this consultancy process and were presented at the Briefing with MES and Senior Stakeholders on May 25th 2022.

Based on these priorities the following outline roadmap has been proposed for EMIS. The roadmap process is further outlined in the section below on EMIS Roadmap and Governance.

| | | H2 2022 | H1 2023 | H2 2023 | H1 2024 | H2 2024 | H1 2025 |
|---|---|---|---|---|---|---|---|
| **Enterprise Architecture, Data and Domain Models** | ***(A)*** | | | | | | |
| **TOR & Procurement of eSchool Upgrade** | ***(A)*** | | | | | | |
| **Interim Upgrades and Priorities** | | | | | | | |
| **Database Streamlining and Integration** | **A** | | | | | | |
| **Training in new SW frameworks** | **A** | | | | | | |
| **Improved reporting and access to data** | **A** | | | | | | |
| **Textbook Authorisation System** | | | | | | | |
| **Containerization of Software Modules** | **A** | | | | | | |
| **eSchool Upgrade** | **A** | | | | | | *Volume Testing* |
| **eUni/QMS Data Upgrade - RegAdmin replacement** | **C** | | | | | | |
| **Learning Platform/LMS for General Education** | **B** | | | | | | |
| **Preschool Data System (eSchool module)** | **A** | | | | | | |
| **Teacher Professional Development system** | | | *No Resources Applied* | | | | |
| **Ongoing Operations Support/Sustaining** | | | | | | | |

**Figure:** Outline Roadmap for EMIS Systems

## Introduction and Objectives

The EMIS systems and the capacity of the EMIS organization to develop and manage these systems were studied. This included a focus on the data systems, databases and data analysis capabilities to provide the education system with accurate data, and to gain insights from data analytics.

The application of digital technologies to support teaching and learning in Georgia were also studied, including the human capacity and software infrastructure required to apply this successfully. Proposals for a direction in learning support and learning management systems were presented.

Based on these analyses the following reports and terms of reference documents (TOR) were developed.

1. This executive summary, plus the complete detailed report on the Consulting Services for Diagnostic Assessment of Education Management Information System (EMIS), Data Integration and Analytic Systems.
2. The initial business stakeholder analysis report and initial recommendations reports completed in December 2021 and March 2022 respectively.
3. The report on EMIS capacity building and data collection and analysis improvement.
4. TOR for the Design and Development of EMS (Education Information Management system) for Early Childhood and General Education.
5. TOR for the Design and development of Capacity Building of EMIS to Effectively Implement the Revised Charter, Structure, Scope, and Strategy Ensuring Relevant Data Collection, Generation, Analyses and Reporting.
6. TOR for the Design and Development of Learning Management System (LMS) for General Education.

The project began in June 2021 and is to be completed in August 2022. There were a number of delays and challenges presented by the Covid-19 pandemic during the project. These are outlined in the methodology section below. The project scope was also expanded in December 2022 to include an additional TOR for the learning support/LMS systems and the TOR to support organization capacity improvement at EMIS.

## Methodologies

An analysis process was agreed with the stakeholders comprising the five main steps outlined below to support **situation analysis and problem definition phases**:

**Situation Analysis**

1. Business Stakeholder Analysis.
2. Technical Current State Analysis.

**Problem Definition**

3. Recommendations Development Phase.

4. Additional scope/follow-up project.

**Direction and Recommendations**

5. Finalized Recommendations and TOR Development.

**The Situation Analysis Phase**

The situation analysis phase was designed to be free of bias and prejudice, avoiding prescriptive solution model assumptions or potential solutions focus. The **business stakeholder and technical current state analysis phases** were conducted with complete independence. Interviews with more than twelve stakeholder groups took place during the summer of 2021 with a focus on their objectives, business processes and challenges. These included the MES, the Project Management Unit (PMU) at the MES, and with each of the relevant MES departments and National Centers, and a World Bank group. Technical reviews and interviews began in August 2021 and an extensive set of business process diagrams and database schematics were collected. A study of Internet Connectivity and Technology Infrastructure in Georgia was also completed. The business stakeholder analysis report and initial recommendations reports were completed in December 2021, and the Technical Current State Analysis Report was completed in March 2022.

**The Problem Definition Phase**

From this analysis the **recommendations development phase** started at the beginning of December 2021 to develop a set of technical, business, organizational, and operational recommendations. An extensive series of Online Video Workshops took place during the first quarter of 2022 and the Initial Recommendations Report was published in March ‘22. The timeline of this stage was again impacted by the Omicron variant of Covid-19 which impacted the stakeholder groups, the PMU and the consulting team.

An **additional scope/follow-up project** was agreed at the end of 2021 to propose learning systems and learning platforms for General Education in Georgia, and to complete an EMIS Organization and Resource Analysis and recommend approaches and a terms of reference document for capacity building in the EMIS organization. Additional information was collected in the situation analysis phase to support these extra activities. The development of the recommendations and TOR documents for these extra scope activities was then fully integrated into the direction and recommendations phase.

To complete the organization analysis report the SWOT analysis, an emerging and declining skills analysis, and several rounds of headcount analysis and meetings with senior and HR management took place. Key skills needed for EMIS were agreed. A revised charter statement and outline set of objectives for EMIS was also agreed with the leadership team.The analysis and recommendations were completed by integrating this organization analysis together with the goals, objectives and recommendations for the full analysis process.

**Direction and Recommendations**

The study covered a broad range of issues related to the EMIS organizations, its systems, capacities and skills, data management and data analysis methodologies, the application of digital technologies to support teaching and learning in Georgia and the human capacity and software infrastructure required to apply this successfully. Significant information was therefore reviewed and distilled into the final project outputs and several problems and challenges were identified in the complete analysis.

**Face-Face Workshops May ‘22**

After the lifting of Covid-19 travel restrictions a series of face-to-face workshops took place in Tbilisi covering technical, organizational, administration and policy aspects of EMIS and the MES, in order to present the consultants’ draft recommendations, take direct feedback on the proposals, and gather any additional or updated information required. The following meetings took place between Friday May 20th and Wednesday May 25th:

- EMIS technical workshops - two full days
- EMIS organization design and capacity development workshops
- Meetings with the PMU and the General Education Department of the MES
- A seminar at the MES for department leaders, directors, and managers outlining proposed directions and recommendations

In the Final Recommendations stage the workshop and stakeholder feedback was addressed and final reports were produced for the following:

1. This Executive Summary of Final Recommendations.
2. The complete detailed final recommendations report.
3. A final updated EMIS Capacity Development Report.
4. Finalized eSchool Terms of Reference Document (TOR).
5. The final EMIS capacity development TOR.
6. The final Learning Systems TOR document.

**The Covid-19 pandemic** had several impacts on the project since June 2021. A contingency plan was agreed at the beginning to hold the workshops by video over a time period. This was effective with an extensive series of Video Workshops carried out with the EMIS management team and other key stakeholders between March and May 13th 2022. Travel restrictions were reduced after spring 2022 and a series of Face-to-Face Workshops took place in Tbilisi between May 20 and 25. Each team involved in the project were impacted by Covid infections and office shut-downs, including EMIS, the PMU and each of the companies in the JV consulting team, including many personal and family challenges. This impacted the project timeline several times through the project.

# Summary of the Main Findings

## EMIS Systems and Organization Development

The EMIS organization and the many data systems they support was the principal focus of this analysis. EMIS operates in a complex and political arena. The OECD 'Reviews of Evaluation and Assessment in Education: Georgia'[12] published in 2019 stated that "Georgia does not have a strong culture of using evidence to inform policy-making." EMIS has a very large circle of stakeholders with different requests and needs and sometimes conflicting visions. EMIS is also affected by international education projects implemented by MES that are supported by large International Donor Organizations such as World Bank, Asian development Bank, USAID which do not always have harmonious or integrated objectives or plans. The release of data and reports also has political dimensions which causes delays and extra workload. Stronger governance processes and a clear strategic roadmap management process will allow EMIS to create clear priority and resource-based decisions.

EMIS faces technical and operational challenges. There is significant technical debt and obsolescence and lack of data integration in systems supported. There are significant challenges hiring, retaining and training the key technical skills needed, including the top level technical directors and technical leadership team. Poor regional infrastructure and a lack of skilled personnel in regions, both in schools and in technical support also creates challenges for the redeployment of the EMIS data systems. Data input is unreliable and poor infrastructure makes it difficult for the personnel entering the data. There is a lack of coordinated and central planning for digital education, and for new more activity based learning and teaching methods using technology.

A SWOT analysis was carried out and this is included in the Annex to this document. An organization analysis has been completed as part of this consultancy project including a workforce analysis and emerging and declining skills analysis. The main issues identified are summarized below and in the organization analysis report[13].

## EMIS Roadmap and Governance

**EMIS Charter and Objectives**

Recognizing the objectives for the National Education System in Georgia and the key role of EMIS in this, the following revised charter and six high level objectives has been proposed and reviewed and agreed with the EMIS leadership team and to representatives of MoES.

[12] The OECD 'Reviews of Evaluation and Assessment in Education: Georgia, December 2019

[13] EMIS Organization Capacity and Staffing Analysis, July 2022

**Proposed Charter for EMIS:**

In order to support the National Education System in Georgia and support the development of digital technologies in Georgia's Schools the principal Charter of EMIS is to:

- Support e-Governance, Administration and Data-Driven Decision Making
- Support improvement in Inclusion and Access to Education across regions, socioeconomic, ethnic groups and for special needs
- Support more active forms of learning and reform in teaching and learning that helps build the digital skills and 21st Century skills that support the modern workforce

**Proposed EMIS Objectives:**

1. Efficient data management to support national education planning, evaluation and evidence-based decision-making.
2. Supporting skills and capacity development through the education system in the use of technology for administration, learning and teaching.
3. IT infrastructure planning and support for broadband, systems, and computing hardware direction and planning for general and vocational education in the regions.
4. Implementation of modern forward looking and secure software systems and distributed systems.
5. Support innovation in practices and system design, and in digital education support to the wider education system.
6. Work through collaboration with multi-sector organizations.

High level and measurable tasks would be set against these objectives using the Management by Planning (MBP) or Management by Objectives methodology widely used by international corporations. This method helps ensure the organization is addressing the objectives in totality, through regular reviews of these high level tasks.

The SAFe Agile methodology is recommended for the in-project management of development and upgrades. The use of agile methodologies within projects is completely compatible with the use of MBP or MBO methodologies for the higher level organization tasks and goals. Some examples of applying key tasks to the strategic objectives are suggested in the attachment. Targets and key metrics should be applied to each objective and task.

**Governance and Priorities**

EMIS operates in a unique and rapidly changing field of technology, data systems and development methodologies. Many of the skills and expertise required to lead this activity are quite different to the skills and expertise required to lead and administer other key activities of the MoES. Due to this a different governance and steering approach is recommended to support EMIS in good decision making and prioritization with skills and expertise in the environment in which EMIS operates.

An Independent Expert Steering Group needs to be set up to drive the very significant EMIS Strategic Roadmap, Priorities and Investments. This steering team should be constituted with a balance of independent external experts, qualified MES representatives and EMIS senior management. A key role for this group is to agree and manage **the strategic roadmap for EMIS** and to manage consistency of roadmap implementation. Requests for change in priority from external sources should be assessed by this group to allow EMIS make progress on the large and challenging strategic initiatives without unnecessary change in direction or distraction. It is essential that this group is small and sets high expectations for members for high levels of attendance and preparation. Seven members are recommended.

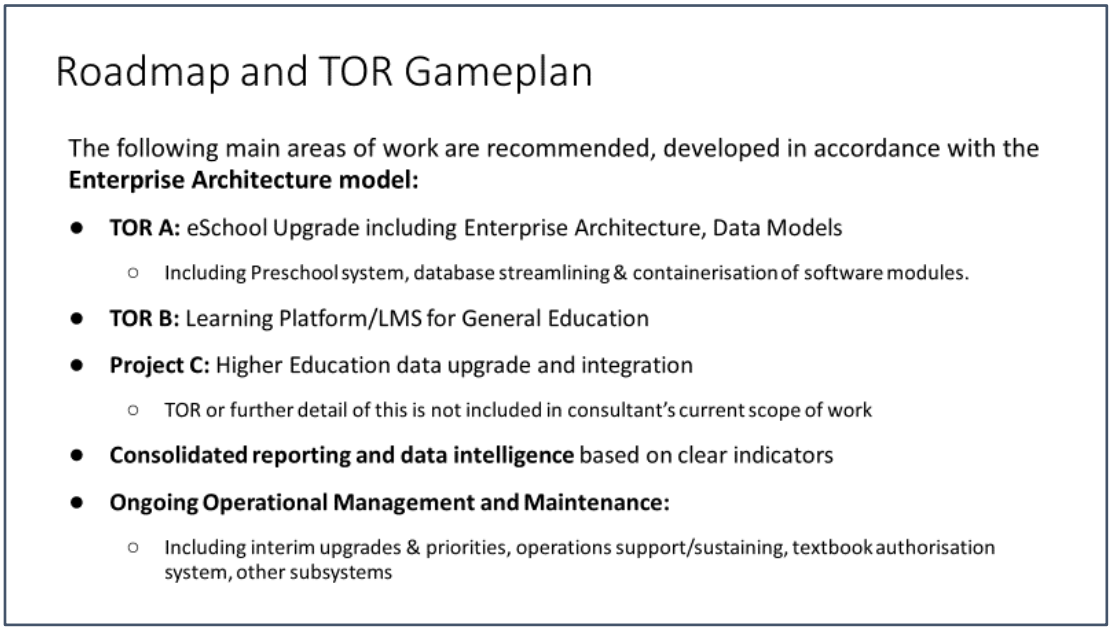


**Figure:** Strategic Roadmap Priorities for EMIS presented 25 May 2022

**Roadmap: System Development Priorities**

The set of development priorities for EMIS system development have been reviewed and agreed in this consultancy process and were presented at the Briefing with MES and Senior Stakeholders on May 25th 2022.

Based on these priorities the following outline roadmap has been proposed for EMIS.

| | | H2 2022 | H1 2023 | H2 2023 | H1 2024 | H2 2024 | H1 2025 |
|---|---|---|---|---|---|---|---|
| **Enterprise Architecture, Data and Domain Models** | ***(A)*** | | | | | | |
| **TOR & Procurement of eSchool Upgrade** | ***(A)*** | | | | | | |
| **Interim Upgrades and Priorities** | | | | | | | |
| **Database Streamlining and Integration** | **A** | | | | | | |
| **Training in new SW frameworks** | **A** | | | | | | |
| **Improved reporting and access to data** | **A** | | | | | | |
| **Textbook Authorisation System** | | | | | | | |
| **Containerization of Software Modules** | **A** | | | | | | |
| **eSchool Upgrade** | **A** | | | | | | *Volume Testing* |
| **eUni/QMS Data Upgrade - RegAdmin replacement** | **C** | | | | | | |
| **Learning Platform/LMS for General Education** | **B** | | | | | | |
| **Preschool Data System (eSchool module)** | **A** | | | | | | |
| **Teacher Professional Development system** | | | *No Resources Applied* | | | | |
| **Ongoing Operations Support/Sustaining** | | | | | | | |

**Figure:** Outline Roadmap for EMIS Systems

**TOR A** refers to the main Terms of Reference for the eSchool upgrade completed as part of this consultation. **TOR B** is the Learning Platform/LMS for General Education project. **Project C** is the proposal for a significant upgrade and data integration of the Higher Education Systems.

Activities marked in **blue** indicate those carried out by the EMIS team (activities in light blue are monitoring and review activities). Activities shown in **red** are outsourced to contractors funded in the current donor funding plans. The important higher education system upgrades proposed (Project C) are shown in **orange.** These are not currently funded or planned for (with the exception of the planned Performance-based Funding project for higher education). EMIS personnel play a key role in coordinating and managing this entire development roadmap, and in preparing for the operation and maintenance of these systems.

The capacity and skills analysis for EMIS outlined below has been completed based on this high level roadmap.

### Enterprise Architecture and EMIS Systems Refactoring

EMIS manages the operations, integration and interactions between four main systems plus several peripheral systems shown in the figure below. These are:

- The eSchool General Education System
- The new eVet system supporting Vocational Education
- The new eUni system, together with the legacy RegAdmin system for Higher Education
- Significant interactions with the Quality Management System (QMS) operated by the National Center for Education Quality Enhancement
- Satellite systems and subsystems - the information architecture and data integrations are not so critical for these
- A set of databases that need significant streamlining and integration
- Reporting systems which need to be fully implemented.

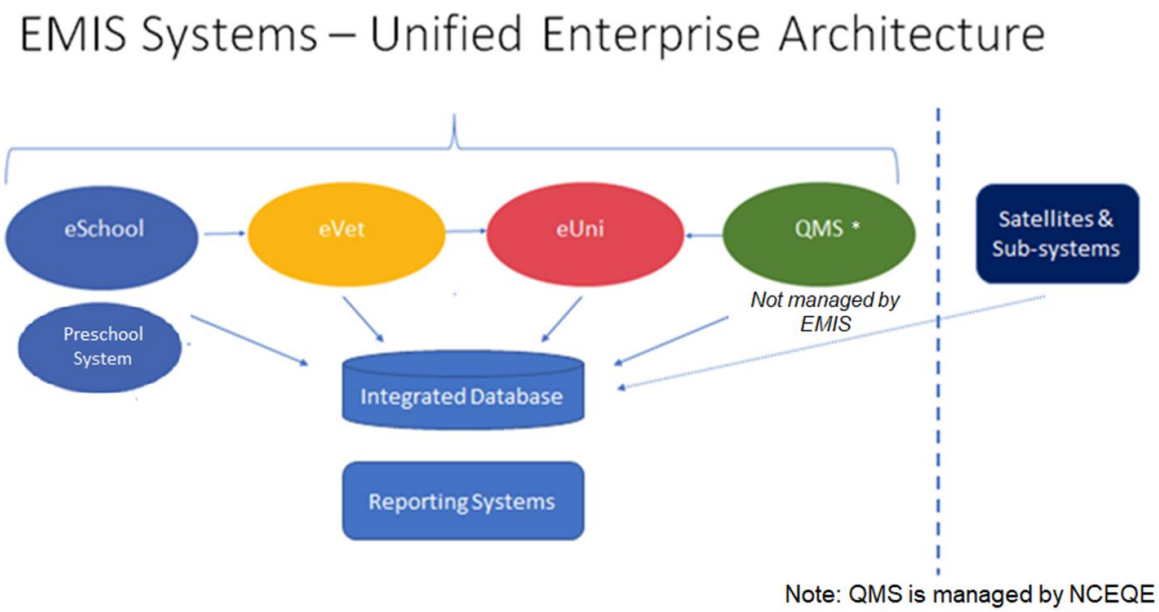


**Figure:** Main (Core) EMIS Systems

The multiple smaller subsystems require different levels to the core systems. Some may remain quite independent with little need for or benefit from greater integration or upgrade. The textbook approval subsystem is an example of this. Others enhance the core and will benefit from greater system or data integration. Further new learning support systems are planned which should use the International education data standards and learning management frameworks.

A significant series of system upgrades are proposed to modernize the systems, architecture and data management practices. The most significant are summarized below:

1. The Enterprise Architecture, Domain and Data Models.
2. The upgrade of the eSchool General Education data system, including development of a preschool data system.
3. A data upgrade and integration plan for Higher Education systems.
4. Database integration and streamlining with improved data management and analysis processes.

In addition there are some sub-system development and upgrades required and immediate database and data management improvements needed. There are also proposals for a Learning Platform/LMS for general education. We have expressed concerns relating to the human capacity and education system capacity and infrastructure required to make this successful which are addressed in the section on Digital Technology for Learning section below.

**Enterprise Architecture, Domain and Data Models**

Our primary recommendation is to establish a modern scalable, modular and extensible Enterprise Architecture (EA), Data Model and Domain Model for all EMIS systems, subsystems, and databases as the first priority, including the application of the international education data standards and the distributed architecture model proposed. **An Enterprise Architecture** ensures alignment of four main points of view; (1) the business perspective, (2) the application perspective, (3) the information perspective, and (4) the technology perspective. This ensures that the solutions designed and developed are always aligned to the goals for the system, organization and stakeholders.

Efficient and accurate EMIS management information systems, based on a scalable and extensible information architecture, and the data analysis and data reports developed (or made available) from these together are the critical success factors to enable **data driven decision making.** To achieve this it is essential that the big picture is defined in an Ubiquitous Language by means of the Domain Driven Design which drives the Data Model to create bounded contexts for modularizing the applications. This gives consumers of the data a clear understanding and a way to explain the requirements which can then be developed to identify the required data ingestion and sources to generate reports and data output.

We recommend refactoring the main EMIS applications (beginning with eSchool with the higher education systems as next priority) according to Domain Driven Design and Metadata Driven Design principles for composability. This will eliminate technical debt in the current systems, provide better data integration and produce more maintainable and sustainable modular containerized software elements. In addition stronger documentation, training, and understanding of the applications is necessary to increase maintainability and sustainability of the systems.

One of the primary tasks of this consulting engagement was to develop a terms of reference (TOR) for the upgrade of the eSchool General Education data system. Our analysis has revealed significant technical debt in the eSchool system, higher education systems and other older EMIS systems, as well as a lack of a consistent information architecture and lack of use of the international education data standards. We recommend that the enterprise architecture (EA) definition and the beginning of the database streamlining and integration activities are included as a significant part of the planned eSchool upgrade project. The EA, data and domain models should be done as a collaboration between the EMIS technology team and the contractor selected for the eSchool system development. It is essential that the EMIS team retain full ownership of and responsibility for the Enterprise Architecture, Data and Domain Models as they will apply across several systems and databases, to be developed or upgraded

potentially by several contractors and sub-contractors. The Enterprise Architecture, Data and Domain models then become the standard for all future projects including the Higher Education upgrade and data integration project.

Separation of roles will be required. EMIS should develop an outline Enterprise Architecture which the eSchool contractor improves in agreement with EMIS and implements in the eSchool development. Full documentation for this EA is then transferred to EMIS for ongoing maintenance and application to other systems. An outsourced project is recommended as the scope and scale of all the work required is too great for the current EMIS technology team and outsourcing is required to secure the donor funding that is available. The outsourcing management and capacity development is further described in the section on EMIS Organization Capacity Development below and in the separate report on Organization Capacity Development.

Some of **High Level Goals for the EMIS Enterprise Architecture** are outlined below:

- **Choose Single-Responsibility Systems:** Similar to the single-responsibility principle, this system-level design principle encourages creating or acquiring systems that interact with other systems through standard protocols.
- **Design for Emergent Reuse:** Emergent reuse is the ability to identify existing systems that can be used in implementing new systems. Utilizing existing systems in a new application is more effective than designing a new application.
- **Develop Homogeneous Systems:** Developing homogeneous systems is a prerequisite to emergent reuse. Systems that exchange information through standard protocols are easier to manage and enhance.
- **Demand-Driven Releases:** Demand-driven releases indicate that the contractor is in tune with the business demand. As a result, releases are in step with business changes.
- **Business Continuity:** Software systems being always available to support users. Including migration and phasing out of the existing eSchool application.
- **Low Cost for EMIS:** A principle where design and implementation designs will strive towards a low cost of ownership for EMIS, so that an EMIS can implement or adopt the new eSchool system with low upfront costs and low ongoing operational costs in a phased manner.
- **Open-Source Software:** Open-Source development tools are preferred for most needs to reduce lifetime costs and supplier lock-in risk. EMIS plans to use low-code and no-code solutions to develop future modules, enhancements and to maintain the platform. This will be considered and addressed by the Contractor in the Enterprise Architecture design and implementation. This includes review and integration of the international education data standards in accordance with the requirements in the TOR document.

**Composable Infrastructure: Build, Deploy, Operate - DevSecOps Tools and Automation**

Emerging best practices applying DevSecOps with containerization and Infrastructure as Code (IaC) are making Application Infrastructure more and more composable; automating build and deploy dynamically from the code repositories using GitOps.[14]

A highly **composable system** provides components that can be selected and assembled in various combinations to satisfy specific user requirements.[15] Composable systems are self-contained and modular. They can be deployed independently and cooperate with other independent components. Modules are stateless, treating each request as an independent transaction, unrelated to any previous request. This supports higher levels of software quality and robustness as individual parts of a composable system can be separately tested and evaluated.

**DevSecOps** is becoming standard practice in software development[16]. DevOps is a set of practices that combines software development (Dev) and IT operations (Ops) with the aim of shortening the systems development life cycle and providing continuous delivery with high software quality. DevOps is wholly complementary with Agile software development and several DevOps aspects came from the Agile methodology. DevSecOps is further augmentation of DevOps to allow for security practices to be integrated into the DevOps approach. Each software delivery team is empowered to factor in the correct security controls into their software delivery. In this way security practices and testing are performed earlier in the development lifecycle. The term "shift left" is applied to this practice of building quality and security into the earlier stages of the development process. In this way it is described as *'security shifting left'* and *'developers shifting right'* in the development process towards delivering secure, quality, tested software modules. Checking the code statically via static application security testing (SAST) is white-box software testing with special focus on security. As well as, Dynamic Application Security Testing (DAST) which is the process of analyzing a web application through the front-end to find vulnerabilities through simulated attacks. Depending on the programming language, different tools are needed to do such static and dynamic code analysis. This type of approach evaluates the application from the “outside in” by attacking an application like a malicious user would.The software composition is analyzed, especially libraries and their versions are checked against vulnerability lists published by CERT and other expert groups.

There are various tools available for DevSecOps both open source and commercial which can be explored. Testing and automated testing is essential to employ DevSecOps automation. Security is one of the most crucial aspects of DevSecOps and IaC and since EMIS uses open source tools it is important to use tools to detect dependencies and vulnerabilities. Containerization and Infrastructure as Code (IaC) make infrastructure composable according to the applications it needs to Build-Deploy-Operate. There are open source options available for implementing containerization on-premises.

**Potential Solutions**

[14] https://www.gitops.tech/
[15] Principled Assuredly Trustworthy Composable Architectures, Peter G. Neumann (2004).
[16] US Department of Defense Enterprise DevSecOps Reference Design, (Sept 2021)

Off-the shelf open-source and commercial EMIS systems were studied. The needs of the EMIS data systems; eSchool, the Higher Education, and the Vocational system, are complex and quite unique, with many business processes are well established. The Open-source systems available do not meet the full set of requirements, their software and data system architectures are becoming outdated, and their support and service systems are not very mature. There is a risk in a broad adoption of these systems as their architectures and data systems become more outdated. The service and support resources they offer should also be studied carefully before adopting in a significant way.

From our review of the market and environment for EMIS systems there is no open source EMIS or commercial solution which we believe can be customized to develop a national EMIS for general education, or higher education in an efficient, effective manner providing good value for money. There are some options which may provide some useful modules including the OpenEMIS modules for Data Warehouse, Analyzer and Dashboard[17], or the OpenSIS education analytics solution[18] both of which are not open source and would need customization. Commercial solutions like Microsoft's Azure-based low code development environment[19] which leverages Power Apps, Power BI, Dataverse, and Common Data Models (CDM) for education but this would require migrating to Azure, requiring an overhaul of the entire EMIS team and skills sets. Adopting any of the commercial systems would not reduce development time or need for the Enterprise Architecture & Domain and Data Models, and would not leverage anything from the current systems other than the lessons learnt. Similarly many commercial SIS systems such as market leader Powerschool do not meet the full set of needs, are not well serviced or supported outside the USA or Western markets, and have high licensing and service costs. For this reason the recommended path forward is based on a refactoring of the current eSchool based on the scalable and extensible Enterprise Architecture model proposed above.

However, some elements of the OpenEMIS solution or other open source or proprietary SIS systems should be considered to provide some modules of the overall solution. Any modules applied should fit the Enterprise Architecture model, support the international education data standards, and not bring technical debt to the overall solution planned. OpenEMIS should be considered for distributed systems, including the regional preschool data systems, and potentially some private school SIS solutions which will feed eSchool with relevant data. This task is included in the eSchol TOR to be considered by the contractor with the EMIS team.

**The eSchool and Preschool Data Systems**

The recommended scope of work for the eSchool upgrade project includes:

- The Enterprise Architecture, Data and Domain Models for the EMIS education systems and subsystems
- The upgrade of the eSchool software system supporting General Education

[17] Open EMIS: Manage & Analyze: https://www.openemis.org/product-suite/

[18] Open Source Student Information System | Education Analytics | Data Warehouse & Analytics for District, State and Corporate HQ

[19] EMIS - Developing modern Education Management Information Systems

- The design and implementation of new Preschool elements, database streamlining & containerisation of software modules.
- Additional new modules and capabilities outlined for the eSchool system reviewed with the client and documented in the TOR.

The TOR for the eSchool upgrade states that the enterprise architecture is to be defined as the initial step, comprehending the full set of EMIS systems, and working in collaboration with the EMIS technology team as described above. The first major task is to begin the database restructuring for eSchool, including migrating the data from the current Oracle database to PostgreSQL, and completing some data rebuilding from where necessary. Following the data restructuring and streamlining the restructuring and refactoring of the eSchool modules and the development of the additional eSchool modules outlined is carried out. This includes the development of the new system to support Early Childhood Education/Preschool. Containerised system modules should be put in place and preparation made for a transition to hybrid-cloud hosting. The transition from current on-premises hosting to hybrid-cloud hosting should take place when either additional or surge capacity is required or the existing hosting platforms approach end of life. There are significant security and user privacy risks to be managed, both in on-premises hosting and in a transition to cloud hosting which are addressed in the section on data security.

The international education data standards should be applied, primarily the School Interoperability Framework (SIF) standard for data interchange with information systems (SIS) at universities, private schools and other institutions. The OneRoster standard and the IMS LTI and QTI standards should also be considered where applicable. The section on the development of distributed systems provides further information. The eSchool solution design should be based on the IMS Student Learning Data Model[20] and with reference to the EdFi and CEDS models as further outlined in the eSchool TOR document to support robust system design, and to allow for greater system flexibility and interoperability with education data systems in the future. The eSchool upgrade project will include the development and implementation of a new preschool data system. Regional authorities will be responsible for maintaining this data. The application of the distributed system architecture outlined below is therefore proposed for this with regional SIS (school information systems) implemented based on the international data standards. These regional data systems feed data to the central EMIS data systems based on the standards. OpenEMIS should be considered as an option for these regional SIS data systems.

**Database Streamlining and Integration**

There are significant risks in the current database systems due to the use of different database software, the licensing of different database software versions and the manner in which the database upgrades are carried out. This short-term improvement work should be carried out immediately and detailed information on this has been provided to the EMIS team. Following this a complete database integration and streamlining activity is required to prepare a data

[20] Student Learning Data Model | IMS Global

system that can provide the level of data analysis and data-based insights that are desired by the MoES and other stakeholders. The many data metaphors in use such as ‘data warehouses’ or ‘data lakes’ are overstated and often represent hyperbole but this proposed integration will achieve the objective of bringing the existing data together in a way that makes it reliable, searchable, and support data mining for accurate and insightful reports.
The data analytics skills need to be built up so that progress can be made in providing the data analysis, data visualizations and data insights desired by many stakeholders. The path to sophisticated data analytics and ultimately the application of AI (artificial intelligence) is long and complex and will be built initially on strong well managed, accurate, representative and integrated data systems. Significant improvements in data systems management are required before this can be planned. Reporting systems have also been acquired by EMIS but have not yet been widely applied. The application and operation of these needs to be developed significantly so that reliable and accurate reports are provided to stakeholders from the data systems. Many existing data input processes are unreliable, require significant data validation or re-entry by EMIS and create inefficient time consuming workflows. The system design, use of international standards and distributed architecture model proposed will improve data entry efficiency significantly.

**Planning the System Upgrades**

A platform model based on the IMS Student Learning Data Model has been recommended above. This would include:

- A Database model
- A Domain model and metadata structures
- Application of the BPM methodology
- Modularisation of eSchool and modular design for eUni enhancements
- Application of the international education data standards for data exchange

The following development toolsets and databases are recommended:

- The use of **Java and PHP** is recommended as the main development toolsets. Java is recommended for larger modules and outsourced development, with PHP more often used for smaller subsystems making use of more available skills at EMIS.
- The migration of all databases **from Oracle to PostgreSQL** is recommended for integration, improved compatibility and to resolve versioning or licensing inconsistencies. The only exception to this would be licensed modules used which require another database (e.g. if OpenEMIS or Microsoft EMIS is considered as part of the solution).
- The **Angular web framework** for open-source web application framework is recommended for developing web applications.
- The Use **of Low-code and no-code development** is recommended in a progressive manner as experience is gained for increased development efficiency and improved quality. We recommend that the Camunda Business Process Modeling (BPM) open-source workflow and decision automation platform is used, and App development tools such as JHipster and Appsmith to build modules, forms and other functionality elements.

Any developments carried out without first considering the domain and data model proposed above will risk immediately creating more 'technical debt' or 'legacy' in the EMIS systems**.**The work required for replatforming and database streamlining will require time from the EMIS resources. Clear planning with the scarce resource base will be important for this, including agreement on the level of outsourcing for parts of the project. The governance and strategic roadmap methodology recommended will help the main stakeholders understand these priorities. Following completion of the Enterprise Architecture and development model, the start of replatforming the projects to upgrade eSchool and eUni should be planned as the next major steps.

For the very significant eSchool development project, including the Enterprise Architecture model and preschool system we recommend a **three stage project** which is summarized in the table below and defined in detail in the TOR for the eSchool project.

**eSchool Development - Three Stage Project**

**Stage 1:** Development of platform model with recommended toolkit + Domain & Data Modeling

Stage 1 involves the development of the **Enterprise Architecture, Domain and Data Models.** This applies to all the major EMIS systems and subsystems as a significant step towards a unified and modernized Enterprise Architecture. This will be applied in more detail to the eSchool system and be implemented in the development stage 2, but all EMIS systems should be comprehended in the design and documentation.

**Stage 2:** Development, Testing, Release of eSchool Modules

Stage2 is the more substantial stage of the project involving the Development, Testing, Verification and Release of eSchool Modules.

This stage involves **four major phases**:

**Phase 1:** Module Design: Phased design of the eSchool modules.

**Phase 2:** Module Development: Phased development of eSchool modules, including containerization, development, delivery, and testing. Phase includes use of DevSecOps best practices, Continuous Testing, Integration, and Deployment using Agile development methodologies.

**Phase 3:** Testing and Acceptance: Testing with real data and completion of all acceptance tests for eSchool modules.

**Phase 4:** Integration Testing and Release: integration testing and release and final acceptance of full eSchool system and modules.

**Stage 3: Support and maintenance**

The Contractor puts in place a long-term support and maintenance plan complementing the EMIS team with well-defined roles and responsibilities.

**Early Childhood Education System**

A new Early Childhood Education/Preschool data system is required as part of the eSchool system upgrade. Use of the distributed system model outlined below is recommended to allow regional authorities to take responsibility for the management and support of the system. Scheduled data updates would be provided by each regional system to the central eSchool system supported by EMIS based on the international SIS data standards defined to provide the aggregate data required for central data management and government reporting. This will use at a minimum the SIF (schools interoperability framework) data standards and ideally also support the OneRoster data standards.

OpenEMIS is recommended as a potential solution for the regional data systems. Other open source or proprietary school information systems may be considered. Each regional data system would provide data in the standard format to the central EMIS database in the same manner that private school data (and data from other higher maturity institutions operating and SIS) is to be provided by schools operating their own standards-based SIS. The existing Asia Development Bank preschool data project should be studied to assess the feasibility of upgrading this and applying the data standards recommended so that it could be upgraded to provide the same data feed required to EMIS. If this is not feasible the solution development in this project needs to be replaced by the new standards-based data system.

Data from the satellites (distributed systems) would then be provided automatically to an ECE/Preschool module in the eSchool system which collects, stores and reports preschool student, class, teacher and attainment data by means of CSV (or other agreed standard file structure) exchange. The same distributed model and protocols are to be applied for private school, boarding school and other remote institution data collection.

**Distributed Architecture Model**

A need for efficient data feeds from external education institutions universities and private schools has also been identified. We have recommended the Distributed Architecture Model shown below together with the adoption of the international education data standards. We suggest working with private schools, universities and other institutions who are operating SIS systems to develop a data flow based on SIF and/or OneRoster for data interoperability. The capability to integrate this data flow to the EMIS data systems would be developed. A national conference is proposed with the universities and schools involved to define this methodology

and agree on the application of the international data standards for these data exchanges. This conference may be required on a regular, possibly annual, basis to define the application of the standards and help the institutions ( schools, universities, etc) prepare to apply the agreed standards in their software systems.

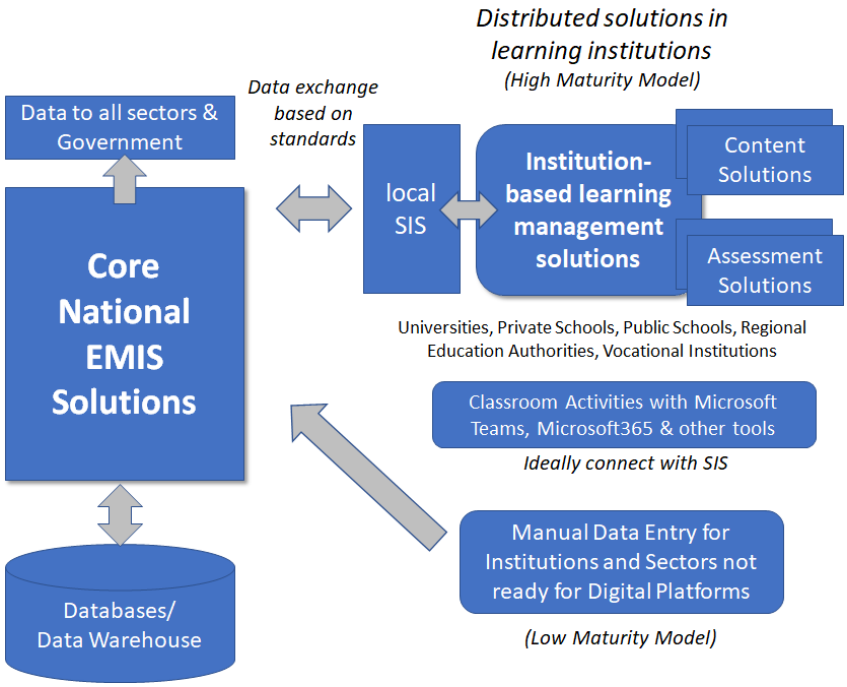


**Figure:** Proposed distributed system model to support low maturity and high maturity education institutions (schools, private schools, universities, vocational institutions)

**Supporting universities and schools high maturity and lower systems maturity.**
This distributed model is proposed to support efficient data flow to the EMIS systems, while supporting education institutions with higher maturity processes, IT solutions and human capacity to develop and innovate using the standards based digital education solutions. As well as supporting more efficient data transfer this allows independence for innovation in the technology applied in these higher maturity systems over time, reducing the risk of obsolescence that can be created by highly centralized monolithic data systems.

Education institutions with medium maturity and low maturity software systems initially enter their data directly into the EMIS systems (eSchool, eVet, eUni) and mature over time to manage their data using their own systems interfaced to EMIS using this model. The aim is to put in place a model for the system to mature over the next ten to fifteen years as the core EMIS systems, together with the capabilities and infrastructure in regions and in all of the education institutions increases.The figure above shows a very simple block diagram for a distributed set of systems communicating with the Core national services managed by EMIS. Education institutions such as universities, private and other leading public and private schools, vocational institutions and possibly regional authorities would develop a distributed set of systems to

manage their learning activities and communicate with the core national systems and databases. This model is also proposed for the implementation of the Preschool data systems, based on the regional model proposed by MES. Regions would operate their preschool data system (with OpenEMIS proposed as a potential solution) and use the data standards to provide this to the central preschool data system (to be developed as part of the eSchool upgrade). Implementation can begin with a national pilot with EMIS support to operate the first regional preschool system.

The first key step for the institutions or regional authorities to apply the distributed model is the implementation of a School Information System (SIS) to manage the institution or region's data and send information back to central authorities using the SIS standards and protocols referenced. The SIF data standards may be applied, but the extended version of OneRoster is recommended as the most forward looking SIS standard to adopt. Learning platforms such as LMS, assessment solutions and sources of content would then interconnect in these growing and innovative systems as they mature over time. The international education data standards are used to interconnect all systems. LTI (Learning Tools Interoperability) from IMS Global is recommended for these interconnections. It is the most versatile and complete set of standards. In Europe and the US universities, leading school districts, private schools and further education institutions show very high maturity examples of the application of this distributed model. A mini case-study at the University of Warwick in the UK shows how this distributed platform supports innovation and academic freedom.

**Higher Education Data Systems Upgrade and Integration**

The higher education data flows from QMS to and from eUni, and the incompatible RegAdmin architecture have also been identified as major issues. Once the recommended enterprise architecture model and development approach for EMIS systems has been prepared at a high level the plan for the upgrade of these functions should be prepared. We recommend the replacement of RegAdmin, building the functions into additional modules of the new eUni platform. This project may be outsourced or insourced. This needs to be prioritized in the roadmap process against the work to specify the new architecture models, and the eSchool platform upgrades required to decide which is addressed first and where the budget, external funding sources or internal resources should be applied. In the Strategic Roadmap outlined in the previous section the higher education systems upgrade has been identified as **Project C.** eUNI needs to be connected to the Quality Management System (QMS) to enable data exchange. We recommend that EMIS works together with NCEQE to clarify the process of program accreditation/authorization, and agree on the critical data fields that eUNI will use. Joint analysis of the legislative base is necessary so that data that is required is collected, and proposals for necessary legislation changes are developed where education program authorization and accreditation is concerned.

Planning is needed for the EMIS higher education data systems upgrade and integration as these are not currently funded or planned for. A separate tender has, however, been issued for a higher education performance-based funding system to be separately designed and developed. This creates a risk of creating a sub-optimum architecture if completed independent

of the Enterprise Architecture and this proposed higher education systems (eUni, RegAdmin and QMS) architecture and upgrade is not completed.

**BPM and Low-Code development methodologies**

Modern Business Process Modeling (BPM) and Low-Code development methodologies and tools are becoming widely accepted for improved development quality and efficiency and to support more efficient upgrade and maintenance of development systems. We recommend that EMIS begin the adoption of these systems for in-house development, and that contractors for outsourced systems are required to apply these systems. The use of these systems should be included in the Enterprise Architecture model for EMIS systems. Upskilling for EMIS in BPM and Low-Code methodologies has been included in the TOR document for EMIS upskilling and a hybrid development approach is proposed for eSchool using traditional Java based development methodologies for the main modules and applying low-code tools initially for lower-risk modules and for future enhancements and maintenance.

Software defined systems based on fixed data structures will need coding and software development to make changes and enhancements, making the systems brittle over time. Systems that are as little as 3 years old can become a risk. The metadata-driven development model for building Enterprise Applications is an architecture that primarily enables the creation of more *'Futureproofed'* business applications. In this approach the design elements of a web application, including the form interface, fields, tables, grids, tabs, controls, layout, business rules etc, are defined in metadata like XML or JSON. A runtime rendering engine or application browser engine processes this metadata and renders the applications' User Interface dynamically. These BPM based Metadata Driven Development and No Code/Low Code development platforms are therefore proposed for future development of EMIS platforms by boht contractors and the EMIS development team. Low-code/No-code doesn't mean no development or engineering, it means accelerated delivery with greater creativity and innovation. No-code eliminates the need for writing and rewriting monotonous code for generic products. Instead, developers work from a library of configurable components, using visual interfaces to build mission-critical software.

Metadata driven development approach manifests include; code generators with templates for various layered components, model driven architecture tools which use cartridges for generating platform specific models from a platform independent model, UML/XMI based tools for generating code. Low-code development platforms that are model-driven are rising in prominence. BPM (business process modeling) tools have evolved to meet the requirements of developing dynamically configurable systems that are flexible to meet requirements and support changes without redevelopment. BPM will allow development of software which is configurable for metadata and model driven design and development while Low-Code and No-Code Development Platforms allow Business Analysts and Users to develop applications according to the requirements..[21] Concepts like Configuration Driven Development (CDD) or Component Driven Development (CDD) with micro-frontend development should be incorporated to manage

[21] 70 Top Open Source and Free BPM Tools : The Best of Business Process Management Software in 2022 - Reviews, Features, Pricing, Comparison - PAT RESEARCH

the same given the limited resources available for software development and the projects to be managed.

As outlined above hybrid development methodology is proposed for the eSchool Upgrade project.The contractor will develop the new eSchool system and data systems primarily using conventional development systems and methodologies using the development tools outlined earlier in this document. A platform build, refactoring and migration using Domain Driven Design and Domain Specific Process Modeling methods with Java, using PostgreSQL for data is outlined for all main applications in the TOR. The system design should however plan for future enhancement and maintenance using low code and efficient development tools and methodologies and apply these methodologies to lower complexity modules where applicable. Open-source low-code tools are to be applied and they will be used in particular to support lower complexity sub-systems, particularly those that are data driven.

The following tools are proposed for future application and ongoing maintenance and should be built into the EA specifications and planning for the eSchool upgrade.

- BPM process automation, initially using Camunda Community Edition.
- The BPMN (Business Process Model and Notation) graphical representation methodology for specifying business processes in a business process model for ongoing system maintenance and upgrade. This may also be applied in development of main systems as well as certain sub-system or non-critical module design.
- The rapid application RAD development tools JHipster will also be applied in the development toolchain to achieve higher productivity.
- Qlik and Jasper reports are used successfully by EMIS and should be included as the main reporting solutions along with other Open Source reporting applications as applicable.
- Low code tools are recommended for less critical applications – AppSmith or nuBuilder are recommended
- Where a CMS is required Drupal may be considered

## Improved Data Systems to Support Analysis and Insights

**Data Management and Data Analysis**

Our analysis has also shown quite significant deficiencies in the EMIS data management, requiring both short-term basic fixes and medium term database integration and upgrade to meet the needs and requirements of the stakeholders and achieve their ambitions.

Meanwhile, extremely high expectations have been created worldwide about the potential of data analytics, data science and artificial intelligence to support decision making, develop insights on systems and behaviors, and assist in daily operational decision making. For this to succeed, highly efficient data management processes are required together with large volumes of accurate and authentic data that is relevant to the insights sought on the decisions being made.

To achieve the ambitions of MES and EMIS with data systems a step-by-step build up of databases and data skills is required as follows:

1. Improving some basic data management practices.
2. Data Integration and Streamlining.
3. Development of reporting and data visualization capabilities.
4. Development of data analysis skills and capacities to gain insights from the data.
5. Future data analytics and the application of advanced data science and AI.

The relatively basic steps outlined in the first steps above need to be taken together with an increase in capacity and skills at EMIS. The basic data administration and integration activities outlined in steps 1-3 above are completed, including significant improvements in data reporting and the use of dashboards and data visualization tools, before more advanced data engineering and data science investments are made. We estimate that these first three steps will take approximately three years to complete and together with the skills development proposed in step four and necessary prerequisites to the more advanced steps developing the data engineering and advanced data science capabilities. Expectations created around the application of AI and data mining are exaggerated and these steps cannot be taken without well managed, authentic and accurate data sets.

Today EMIS has a relatively large amount of administrative data available to it in the eSchool, eVet, eUni, QMS and other associated systems. However, this data is spread across multiple databases using different software and standards and there are some very basic issues including unreliable backups, the overwriting of historic data, and software licensing issues which present operational risks and need to be addressed immediately. There is however almost no authentic learning (or assessment) data available in Georgia today. Significant steps are required in the development of human capacities, software systems, the digitisation of education and the physical infrastructure required before the systems can be developed to provide this quality learning and assessment data. This is a long development path that will require significant investments and leadership across a five to ten year period, and will build on the necessary and more basic steps outlined above.

**Public Data Management Portal**

The implementation of a central Data Management Portal should also be considered in the medium to longer-term. Many governments have begun to put these in place to help gather, store, access, analyze, and share Internal and Public Data. The CKAN open source data management system (DMS) supports open data portals around the world for the Canadian, Australian and Singapore governments and many others.[22] Data management portals help organizations to gather, store, access, analyze, and share data easily. They help organizations to smartly organize internal data and put all the public-centric data in open data portal form and help public sector education institutes to maintain better transparency and data governance.

[22] CKAN open source data management system (DMS)

Some open source technologies that can be used to implement the same include; CKAN, DKAN, Truedat, and Dataverse. https://www.datopian.com/our-work/ Has a list of governments for whom they have implemented CKAN https://ckan.org/showcase.

**Data Security**

Georgia aims to align with EU standards and processes in society and in education. While not fully applied the GDPR provides a model against which the data privacy models can be designed in conjunction with the local laws and regulations applied. Informed consent to data processing is a very important part of the regulation. Currently Georgia generally follows US Law where a student's use of social media/networks is concerned with Terms of Use and Security Notices aligned to US Law. Generally students under age of 13 are not permitted to register and use open software communications or social platforms in Georgia without parental or guardian consent. GDPR regulations detail when and how to seek verifiable consent from a parent or guardian, and what responsibilities an operator has to protect children's privacy and safety online including restrictions on marketing to minors.

In our analysis a relatively good understanding, set of processes, and skills for the management of data security were found at EMIS. In addition, the application of DevSecOps methodologies in development will make new software modules more secure by embedding software quality management and design and testing for security in the development process for EMIS solutions. Applying DevSecOps each software delivery team is empowered to factor in the correct security controls into their software delivery.

We recommend that key personnel should achieve certification in secure data management and ISO/IEC 27001 Information Security Management, and continuous upskilling should be applied to data security practices. This presents a staffing risk as personnel may become more attractive for hiring by the private sector. However our general recommendation remains that EMIS should have a culture of continuous upskilling to be an attractive place to work as well as being more effective in its processes and procedures.

**Advanced Data Analytics and AI**

Our initial recommendations report summarized current research which clearly demonstrates that the world's most advanced education systems are still only experimenting with learning analytics and the application of AI for learning insights. The city of Helsinki in Finland is experimenting with Microsoft Azure to apply AI and Learning Analytics for Well-learning.[23] These experiments should be watched as the steps proposed above are taken to strengthen the data systems, data structures and skills at EMIS. As the application of AI progresses in our societies **principles for ethical, responsible and secure AI use are essential**, particularly when dealing with data on minors. A recent OECD report provides more information on the opportunities and challenges presented in pushing the frontiers of smart education technology[24].

[23] Video: AI and Learning Analytics for Well-learning, City of Helsinki Education Division, Dec 2020
[24] OECD Digital Education Outlook 2021: Pushing the Frontiers with Artificial Intelligence, Blockchain and Robots.

We therefore recommend that the short and medium term focus of EMIS is to strengthen the data administration, analysis and reporting skills as outlined above, while monitoring the leaders as they apply the smart education technology outlined.

### EMIS Organization Capacity Development

From the Business Analysis phase of this project there is a clear consensus that the EMIS team and the set of systems it supports are extremely valuable to the management of the national education system in Georgia. There is also a consensus that many elements of the system need to be modernized, made more sustainable. and updated to provide better data collection and analysis faster and more efficiently. The World Bank IIQP is a multi-component reform in the Georgia education system and stakeholders have stated that *"EMIS is a backbone for this."* EMIS provided valuable additional support in the pandemic. The EMIS team has *"ability, zeal and patriotism and make a very positive contribution to the country."* EMIS provides a very broad range of IT support systems, like a very large Corporate IT system, from student transport systems to textbook authorisation in addition to the core education data systems. The capabilities, capacity and systems the EMIS team support are an essential underpinning for the education systems reforms planned in Georgia but significant system upgrades and organization capacity and skill upgrades are required to support these objectives.

The current strengths in the existing EMIS team, a very positive sense of identity, the many good technical and administrative functions, systems & structures that are in place, the sense of pride in new positive projects such as eVet, and their role for the future of Georgia are valuable. However these strengths will be undermined if positive steps are not taken. The management team shows many signs of burnout facing multiple responsibilities without a secure or adequate technical resource base to deliver them all. EMIS also suffers from conflicting and rapidly changing requirements and priorities from multiple stakeholders. An improved governance and strategic roadmap process is recommended to address this.

EMIS is unable to maintain a large enough software development team to meet all the requirements for the multiple systems and support desired by MES and other stakeholders. This is due to intense competition and higher wages in private and international sectors, and to government budget, salary level and headcount restrictions. Three additional senior technical resources have departed from EMIS over the past months while this analysis was being carried out.

An initiative to identify and continuously develop critical skills, using an emerging and declining skills methodology, is necessary to prepare EMIS for its future charter. Key skills include technology leadership, software architecture, senior developers, data systems expertise and the development of skills working in the low-code/no-code methodology recommended. Highly experienced outsourcing programme managers are also essential to manage the strategic

outsourcing and partnerships recommended. A resource development plan focused on existing personnel is needed, to help them to transition to these high demand skills. This can be supported for example through the upskilling of lower and medium-tech EMIS employees, the longer term move to more cloud hosting could support the transition of system and network admin personnel into the new high demand areas, and the development of data analysis personnel with more data engineering and data science skills over time. Modern HR practices and system improvements should be put in place to support career progression, employee recognition and a positive working environment. A clear set of hiring priorities and upskilling priorities are outlined in the Skills Analysis and Upskilling section of this report.

EMIS personnel spend a lot of time supporting basic data entry, data validation and report generation tasks. Due to problems with data integrity, backups and data access the production of reports and data for stakeholders is often slow and time consuming. By taking the steps proposed for data entry, reporting automation and dashboard development, personnel freed from these roles can be retrained for higher value roles at EMIS as part of the organization development and training plan.

The technical skill shortage is partially compensated for by the use of the business analysis team and the project managers to design, prepare and help manage the development workstream. When done effectively this takes some pressure off the scarce and critical technical resources, thus increasing capacity and efficiency of those scarce constraint resources.

The improved governance structures proposed, together with the roadmap negotiation processes with stakeholders recommended in this analysis will help define and broker very clear agreed priorities. This clarity of direction and priorities will ensure the scarce resources are applied in the highest priority areas. Time wasted switching among rapidly shifting or unclear priorities and addressing lower priority requirements is reduced.

Strategic outsourcing of technology development, an actively managed transition to containerised modular solutions, the training in and implementation of agile development methodologies, increased use of low-code toolsets, and the hybrid-cloud hosting model recommended are essential to allow the organization to achieve more with fewer directly employed technical resources, and to develop the significant set of upgraded systems desired by stakeholders and the modernized and more efficient development methodologies recommended in this report. All of these approaches and others mentioned in this report are fully outlined in the accompanying final recommendations report and executive summary report from the overall consultancy project carried out.

Some additional functions supported by EMIS such as web and communications app support, regional technology and infrastructure support, and managing textbook approvals do not appear to have a negative impact on EMIS. Some of these extra activities may provide the organization a critical mass to help it deal with some of its core functions and charter. However the innovation team’s role and skills should be reviewed to support higher value innovations in Georgia's digital education and information systems.

The following figure outlines the six main tactics we recommended for the organization capacity improvement and development.


**Figure:** Six Main Tactics for Organization Streamlining & Development

Taking a broader view of the entire education system, there is a strong desire for digital transformation of education processes in Georgia to support better learning and teaching, improved student outcomes, and improved access to, and equality in education opportunities. There is also a need to better prepare the Georgian workforce for the 21st Century workplace, society and economy with the technical, interpersonal and independent learning skills required for this. This challenge is much broader than the EMIS technical team analyzed in this project. A strong and clearly chartered **cross-MES body and focus is needed**, chartered with National Digital Education Leadership to plan and lead Georgia's strategy. The absence of this leadership is causing significant disconnects in many aspects of the planning for digital education to support Georgia's future, and in planning the technical and data supports provided by EMIS.

## Summary of recommendations from the Organization Analysis Report

The following is a summary of our recommendations for the EMIS Organization Capacity and Staffing Development component of the consultancy project.[25] These recommendations are also integrated in the higher-level recommendations in this report. A list of critical hires and upskilling priorities are also included here from the same report.

### Unlocking the Potential of Digital Education in Georgia

1. Establish and empower a cross-MES body chartered with National Digital Education Leadership to plan and lead Georgia's strategy for Learning and Teaching with digital technologies.

[25] EMIS Organization Capacity and Staffing Analysis, (July 2022)

**EMIS Charter and Governance**

2. Establish an Independent Expert Steering Group to drive EMIS Strategic Roadmap and priorities with a balance of external experts, MES representatives and EMIS senior management.
3. Apply greater flexibility in the understanding and interpretation of legal requirements and constraints applied to EMIS processes.

**Skills Analysis and Upskilling**

4. Strengthen the senior technical leadership capacity at EMIS, including the appointment of a senior technical director to oversee all aspects of the technical platform development and operation.
5. Hiring and upskilling in key technical roles including software architecture, business analysis, data management and analysis, data science and project and programme management.
6. Significant strengthening of technical project management skills at EMIS.
7. Support for payscale flexibility for senior technical personnel to allow EMIS retain and develop the key personnel essential to fulfill its charter.
8. A review of practices where employees work for multiple employers to address potential conflict of interest or conflict for time and focus.
9. Put in place HR system improvements to support career progression, employee recognition and a positive working environment.

**Outsourcing Management**

10. Put in place a senior outsourcing programme manager at EMIS with experience in the outsourcing of large scale technical development.
11. A separation of the roles in procurement and outsourcing with the contracting and financial responsibilities for procurement remaining at the PMU while the tactical and strategic management of outsourcing performance is the responsibility of EMIS.
12. Very close collaboration between the EMIS outsourcing manager/director and the PMU procurement team is essential as effective management of the outsourcing process will become the most significant success factor or potential for serious failure at EMIS.

**Agile Software Engineering Practices**

13. Establish clear EMIS ownership and develop the skills required for the specification, management and future evolution of the Enterprise Architecture, Domain Model and Data Models for both Core and Peripheral EMIS systems.
14. Invest in SAFe Agile training throughout the organization.
15. Implementation of improved technical management disciplines including documentation, DevSecOps processes and software testing capacity.

**Data Management and Data Analysis**

16. Resolve short-term issues with data backup management and data licensing.

17. Implement the data integration and streamlining outlined in the main recommendations and the eSchool TOR.
18. Significantly strengthen EMIS skills in data management and analysis in the short and medium-term, including hiring one new data analysis professional, and significant improvement of data reporting and data visualization capabilities.
19. Consider a single data analysis and statistics department /division at EMIS under a single director.
20. In the longer term build data engineering and data science capacity to apply advanced data analytics and insights. This investment is premature until well structured, accurate and relevant databases are in place and the more basic analysis and reporting capacity is in place and delivering results.
21. Continuous upskilling should be applied to data security practices and key personnel should achieve certification in secure data management and ISO/IEC 27001 Information Security Management.

The following critical hires and upskilling priorities are proposed.

**Hiring Priorities** are recommended where we do not believe there is a high enough skill level in the existing EMIS team or enough capacity for internal skill development or upskilling.

1. A Senior Technical Director to lead the EMIS technical team development and deliver the technical roadmap.
2. Senior outsourcing programme manager with experience in partnership-based strategic outsourcing.
3. Senior software architect - recommend hire 1 + develop one more from existing staff to complete a team of 3.
4. An additional experienced Data Analyst with experience with reporting and data visualization tools to accelerate EMIS in the development of more advanced data analysis capacity.

Recognising the headcount and budget constraints that apply to EMIS we recommend the following **Upskilling Priorities** to build greater capacity in the current EMIS technical team.

1. In addition to the one existing senior architect at EMIS we propose an additional one is hired and **one existing staff member is upskilled to complete a strong software architecture team** to support the planned projects and EA management.
2. Put in place an **upskilling plan for the critical software resources** needed including software architects, business analysts, data administrators and analysts, software project managers, and technical/strategic outsourcing managers.
3. Protect EMIS from the ongoing risk of losing key software development team members to the private sector by putting in place a **continuous upskilling plan for all team members.** Make EMIS a great place to work and develop.
4. A team of three to four data analysts and support data analysis technicians should be developed. We recommend this is done by **upskilling existing personnel** and hiring one additional senior data analysis specialist.

5. With an effective training and development plan the data analysts can develop in the **medium and longer term to become the data engineers and advanced data scientists** required to take the third and final step recommended to create a data engineering and data science capability at EMIS in the medium to longer term.
6. Upskill extra **software testing staff** from the general EMIS team. Avoid diverting high skill staff to testing.
7. Implement a training plan for all key staff in the **SAFe5 Agile Methodology** and other Agile methodologies to support 'Fast Flow' development.
8. Continuous upskilling should be applied to **data security practices** and key personnel should achieve certification in secure data management and ISO/IEC 27001 Information Security Management.

### Agile Development Management

The software industry has matured, and best practice and innovative systems are continuously evolving for measuring processes, productivity, identifying risks, and aligning software development to organizations goals, needs, and requirements. Processes, checks and balances have been developed, in the form of Agile Project management (APM), Enterprise Architecture (EA) and Technology Business Management (TBM) using the SAFe5 Framework for Lean Enterprises[26]. We recommended that EMIS adopt this scaled Agile methodology in a phased manner and put in place a significant training program in the methodologies for all levels of the organization.

For the eSchool and follow-on development projects we recommend that the contractor and EMIS follow Architecture-driven Software Development following Agile and Software Engineering best practices based on the SAFe5 scaled agile framework for lean enterprises.

The SAFe framework outlines roles for Solution Managers, Solution Architects, Business Owners, Product Owners, and Agile Teams. Agile supports better business stakeholder driven project planning together with a lean development management process for efficiency and flexibility where tested components are continuously delivered and updated based on feedback in relatively short time periods. This reduces the many risks involved in large projects as robust tested modules are continuously delivered, and stakeholder input and review is built in right through the process by means of the business owner and product owner roles.

[26] SAFe and Technology Business Management (TBM)


**The SAFe5 Framework for Lean Enterprises**[27] proposes this organization model for business agility. It integrates the power of Lean, Agile, and DevOps into an operating system that helps enterprises deliver innovative products and services faster, more predictably, and with higher quality.[28]
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- This organization model can be used to organize the EMIS design and development teams.
- The role of enterprise architects and system architects in defining system architecture, domain and data models is outlined. Business owners and product managers are clearly identified who define the priorities for systems and modules.
- Agile teams deliver, test and fix software modules and upgrades rapidly and to high quality.

**A significant investment in training** for the EMIS team in the SAFE Agile model is recommended. This is included in the capacity building TOR document. Training in the Team Topology models referenced below is also recommended.

Team Topologies is a new and widely adopted approach to organizing agile business and technology teams. The referenced book **Team Topologies: Organizing Business and Technology Teams for Fast Flow**,[29] and the accompanying training provides an adaptive model for organizational design and team interaction. Team Topologies provides four fundamental team types; stream-aligned teams, platform teams, enabling teams, and complex-subsystem teams.

## Digital Technology for Learning and Teaching in Georgia

The Business Analysis Report for the Diagnostic Assessment of EMIS[30] identified that there is a strong desire across all the stakeholder organizations to move towards student centered competency-based and more activity-based teaching and learning models, as is the case in many countries today. In the IIQP and other initiatives introduced by MoES, there is a clear aim to introduce more active teaching, learning and assessment practices in the future. There is a commitment to invest more in teacher professional development and to raise the competences

[27] SAFe5 for Lean Enterprises
[28] https://www.scaledagileframework.com/
[29] Matthew Skelton, Team Topologies: Organizing Business and Technology Teams for Fast Flow
[30] Business Stakeholder Analysis Report, Consulting Services for Diagnostic Assessment of Education Management Information System (EMIS), Data Integration and Analytic Systems (December 2022)

of teachers in Georgia, so they are equipped with the confidence and competence to implement these practices. There is also a commitment to move away from centralized teaching and assessment approaches and very rigid curriculum structures, so that teachers can design learning experiences that are more appropriate for their local context.

This approach aligns with a move to change the school climate, from one that tends to be strict and restrictive, to one that is more a culturally aware democratic environment. This includes objectives to implement a more flexible national curriculum so that schools have more autonomy and agency to take ownership of implementation at the school level. This approach will undoubtedly allow schools to take more responsibility for creating learning experiences that are informed by their local context and meet the needs of their learners.

### A Modern Twenty-First Century Education System

There is a widespread realization that education systems need to evolve to meet the ever-changing needs of today's globally connected digital society. We live in a world where technological developments are transforming how we live and work. It is now essential that Education systems evolve to ensure learners are equipped with the knowledge and competences to thrive in the rapidly-changing, connected and technology rich 21st Century society and economy. In this increasingly connected world key competences such as communication, collaboration, problem-solving and critical thinking are to the fore in the workplace. Schools are focusing more and more on equipping learners with these competences through activity-led pedagogies such as cooperative, project and inquiry-based learning approaches, underpinned by investigative questioning and supporting critical thinking. These approaches require teachers to perform a very different role from the traditional *'sage on the stage'* model to one where they act more as a *'guide on the side'* or a facilitator of learning, requiring more empowered and confident professional teachers. In this new role they take ownership for designing and activating learning in their own classrooms. There is growing evidence that systems that embrace more active learning approaches[31] are more successful in producing more independent lifelong learners, and a more creative and collaborative workforce for the 21st Century.

These trends have significant implications for the manner in which digital systems are introduced for General Education in Georgia. The most important success factors in any digital education system implementation are a strong focus on human capacity development, together with support for the new teaching methods, and the support systems and infrastructure required to support this activity.

The European Commission Digital Education Action Plan (2021-27)[32] supports a holistic approach in the application of digital education to support better education processes and outcomes. It states that *'digital is now a horizontal policy consideration'* which has to be

[31] New Research Shows Learning Is More Effective When Active, Carnegie Mellon University, Oct 2021
[32] European Commission Digital Education Action Plan (2021-2027), April 2021 https://education.ec.europa.eu/focus-topics/digital/education-action-plan

incorporated in every aspect of education planning and implementation. It is no longer good practice to just invest in ICT infrastructure. This approach has failed in the past and often resulted in expensive technology and software systems lying unused in schools[33]. Thus there needs to be a more strategic approach, that considers a range of factors.

The European Commission outlines 6 enabling factors for successful digital education:

1. Tackling connectivity gaps.
2. Tackling equipment gaps.
3. Supporting education and training institutions by sharing knowledge on how to adapt and digitalise in an inclusive manner.
4. Addressing issues surrounding the accessibility and availability of assistive technologies.
5. Encouraging European Union (EU) Member States to foster closer dialogue between stakeholders from across the economy and between education and training institutions.
6. Encouraging Member States to develop guidelines for digital pedagogy.

This holistic approach builds from the six key factors that need to be in place to comprehensively implement quality digital education. From these 'sharing knowledge on how to adapt and digitalise', 'addressing issues surrounding the accessibility and availability of assistive technologies', and the development of 'guidelines for digital pedagogy' are among the factors that do not receive enough focus in the planning and implementation of digital education. These are particularly relevant to the approach we are proposing in Georgia.

We therefore propose that activity and project-based learning, the application of formative assessment approaches, and providing mentored and moderated learning experiences represent the best and most practical opportunities to better support learning with digital technologies in Georgia. We propose a steadily progressive plan to implement teaching models, systems and supports throughout Georgia. A holistic approach to professional development (TPD) and support for teachers is required. We propose a regional network of innovation and regional support centers, with support for infrastructure, training, software and systems, is established to support human capacity development and support the regions with new systems and approaches. This proposal is outlined in more detail later in this section. The European Commission Digital Education Action Plan (DEAP) is also urging member states to take such holistic approaches that link with other ministries, such as telecommunications and industry, to ensure that learners of all ages are prepared to live and work in a growing digital world, where they have the basic digital skills to safely live, work and play. However the most significant gap in current plans is the lack of the cross-MES body chartered with National Digital Education Leadership, with full support from all functions in the ministry is essential, to plan and lead Georgia's strategy for Learning and Teaching with digital technologies.

### Human Capacity Development

We have already outlined the need for a holistic approach to embed digital education practices effectively into the system. While ICT infrastructure is undoubtedly a key component, such approaches need to go well beyond the provision of digital technology or IT infrastructure and needs to focus on taking a holistic approach to transformation. What has been missing in many applications of technology is a clear and effective focus on enhancing the competency of

[33] Oversold and Underused — Larry Cuban | Harvard University Press

teachers and school leaders to engage in transformative educational practices. Georgian education requires significant investment in human capacity and in support infrastructures to underpin the introduction of such transformative practices.[34]

There is a need for teachers and school leaders to experience what digital education looks like and they need time, space and support to engage with new technologies and approaches and to try these out. Like their students, teachers need to engage in active learning experiences where they collaborate, problem-solve and engage in inquiry. There is a need to create spaces where schools can work with suitably qualified individuals, in areas such as active pedagogical approaches and digital technology, so teachers can engage in designing and implementing innovative teaching approaches using digital tools.

We are therefore proposing the network of innovation and support centers across Georgia we have previously outlined to support capacity development for teaching and administrative staff. These centers should be staffed with a range of experts; ranging from pedagogical experts, to digitally competent teachers, and technical staff. The centers should have access to a wide range of smart technologies that are suitable for use in schools[35]. Such spaces are there to help local schools to design and activate digital educational experiences to meet the needs of all learners in their locality. These centers will have the potential to promote innovative digital approaches by Georgian teachers so that students' have more engaging learning experiences. These innovative digital practices can then be recorded and shared more broadly with the network so that all schools and students can learn from their colleagues and apply similar approaches in their classrooms. We envision a network of support centers, consisting of regional nodes, supporting clusters of local schools so that over time there is an innovation network that collates and disseminates innovative digital education practices to all schools across the country.

Teaching is a *'practice profession',* based on an accumulation of knowledge and experience and continuous improvement of this practice. Therefore, the creation of these centers will help teachers to develop their new practices using a range of digital technologies, with support from colleagues. This approach will then further develop capacity within the system where teachers can train their colleagues. This helps develop a cascade model of support that will spread good pedagogical approaches supported by digital technology. Real progress comes from actively engaging teachers and increasing teacher competence and confidence through teacher professional development, and by providing a range of supports and resources so they can design and implement educational solutions that fit their context[36].

Digitally competent and confident teachers will:

- Take ownership of digital education in their classroom.
- Create engaging learning experiences using the digital content for their learners.
- Utilize formative assessment data to redesign their teaching, so that it is more inclusive for all learners
- Use learning data to create more personalized learning experiences for their students

[34] Digital competence: the vital 21st-century skill for teachers and students European School Education Platform.
[35] Highlights - OECD Digital Education Outlook 2021 - OECD (oecd-ilibrary.org)
[36] Slow Ed Tech (umb.edu)

Therefore, competent and confident teachers will make decisions in relation to what digital technologies to use, or not, and how these, and more traditional technologies (including paper and pens, field or outdoor activities) along with the pedagogical approaches to apply[37], to better support learning. There is a need to develop this technological knowledge in tandem with their pedagogical and content knowledge, so that they are constructively entangled or entwined. The Technological Pedagogical and Content Knowledge Framework (TPACK) captures this very nicely and is recommended as a guide for all future professional development activities[38].

### Direction for the Application of Digital Systems in General Education

From analysis of current and future practices within the Georgian education system it is clear that digital technology has a role to play in supporting:

- The traditional transmission instructional model to build a base of core content knowledge
- Knowledge construction, the constructivist learning and teaching model
- New pedagogical approaches, such as Activity, Project and Inquiry-based learning
- The use of Investigative questioning
- Formative Assessment models
- The development of key 21st Century skills, such as communication, collaboration, problem-solving, critical thinking

As already outlined there is growing evidence that systems that embrace more active learning approaches are more successful in producing more independent lifelong learners, and a more creative and collaborative workforce for the 21st Century. The European Commission Digital Education Action Plan (DEAP)[39] research is urging member states to link with other ministries, such as telecommunications and industry, to ensure that learners of all ages are prepared to live and work in a growing digital world, where they have the basic digital skills to safely live, work and play.

As we have outlined there is growing evidence that technology led solutions[40][41] in and of themselves are not enough and produce limited results. While the provision of digital infrastructure (i.e. devices, platforms etc.) and digital content (i.e. resources online) are important ingredients, they are not enough to transform educational systems[42].

Specifically we have seen that:

1. Providing screens of content, curated or randomly selected Open Content and simulations, has shown very limited results over the past 25 years.
2. MOOCs (Massive Open Online Courses) show disappointing or mixed results, some specialized MOOCs or MOOCs provided by the highest quality higher education institutions have shown value, but this is in relatively specialized situations.

[37] An Entangled Pedagogy: Looking Beyond the Pedagogy—Technology Dichotomy, Springer, April 2022
[38] http://www.tpack.org/
[39] Ibid
[40] Creating the "Right" Enabling Environment for ICT, The World Bank
[41] Avoiding solutionism in the digital transformation of education | Unesco Futures of Education
[42] 'Technology doesn't always make education better' | Jisc

3. Formative assessment solutions supported by technology show promising results and academic research that outlines strong potential for well implemented solutions.
4. Activity-based learning, student projects (PBL), and inquiry-based learning using the common desktop tools, digital resources and Internet research show the most positive results of the application of technology to support improved learning and outcomes.
5. Well moderated, mentored and facilitated distance support learning experiences show positive results where teachers have time to explore how to use digital tools in their context and where they have access to quality professional learning supports.

**Experience from the Covid-19 Pandemic**

The very significant disruptions to schools during the Covid-19 pandemic, the provision of digital tools helped schools to remain connected with their students and to meet them live online (synchronously) or to share learning resources with them asynchronously. Internationally many teachers and students used these tools for the first time during the pandemic. Teachers and students found them very useful and in many cases these new practices are becoming embedded and normalized. Now as we exit the pandemic, many countries are wondering how they can continue to use these tools to support teaching, learning and assessment practices. Many are considering using blended learning models and flipped classrooms, and technology provides opportunities to collaborate with other students and teachers when in school or at home. However, some of these gains have been overstated and there is less evidence of their application in Georgia due to the lower levels of infrastructure, broadband and teacher skills. The rollout of Microsoft365 to all schools was successful but inadequate bandwidth and a lack of computers with adequate power limited the benefits. Without a range of support and effective planning we believe these changes will not become lasting or sustainable.

**Leveraging and enhancing existing technologies and infrastructures**

We are therefore proposing a steadily progressive approach leveraging and improving on existing technologies and infrastructures, with a strong focus on teacher competencies and support, and the application of new activity-led pedagogies.

Investments have already been made in the schools and these include:

- Microsoft365 and Teams environment for schools.
- Internet connection has been put in place for almost all schools but in many cases the bandwidth is not enough to immediately support advanced processes.
- The TAO Testing formative assessment solution is being investigated.
- Existing regional support centers for schools, which could also support the start of the teaching training and technical support activities proposed here.

We recommend that the terms of reference (TOR) for the support of learning management in general education should seek to put in place a service provider to support the General Education department in the development of a more holistic set of learning system capacity based on the activities proposed below. A basic LMS system we believe will achieve very little, and alone without the leadership proposed from MES and the support systems proposed is likely to be an unused or wasted resource.

We therefore propose the following 6 principal areas for investigation and progress:

1. Leverage the existing investment in the Microsoft365 and Teams for education tool sets including the login and single sign-on management Microsoft365 provides. (The Google education toolset can also support this where applicable in private schools or other settings.)
2. Begin the development of formative assessment capacity, methodologies and toolsets.
3. Develop student Gradebooks/Journals through the implementation of School Information Systems (SIS) or similar functions in the eSchool platform to support the collection of high-level student results and teaching data.
4. Investigate the application and benefit of LMS technologies for general education, by means of a pilot initiative in the innovation centers.
5. Develop moderated and supported digital education experiences and distance learning support.
6. Establish the teaching and learning innovation center and regional network of technical support centers for schools as proposed.

The innovation and regional support centers should support a cost effective approach by focusing on the technologies that schools have available to them, and where teachers and support technicians already have experience. The overall plan should progress by steadily improving the skills, experience, support and infrastructure available to schools.

In addition some ministries also develop national portals and repositories of digital content, tools and resources which local schools can then reshare through Teams or other learning platforms they use. Such national portals can support the development of digital education by providing content, assessment resources, access to research libraries and much more. They can centrally support schools with access to quality approved resources. The development of such a resource platform could be considered and developed with support from the innovation and resource centers proposed.

**Learning Systems for General Education**

As outlined above a stand-alone LMS implementation for General Education is not recommended by the consultant at this point.[43] Solutions of this type have not succeeded in other general education systems with the exception of advanced school districts in the United States, private schools with very high maturity infrastructure and teaching practices, and in some leading schools particularly in Nordic countries. In most leading universities in western Europe LMS have become a backbone for learning progression management, content, assessment and third party learning solutions. However, in general technical environments and support systems have not been advanced enough in most European public or private schools to support this.

[43] Avoiding solutionism in the digital transformation of education | Unesco Futures of Education

Therefore the consultants propose a more holistic set of support services through the evaluation, piloting and support for a range of learning support systems for General Education in Georgia in support of the national public school system. The services proposed include:

- Support and training in the application and administration of the Microsoft 365 for Education toolsets, including the integration of this user environment with applicable learning software solutions for a pilot period.
- The selection of a suitable formative assessment software solution and the development of methodologies and training.
- A pilot of student Gradebooks/Journals through the implementation of School Information Systems (SIS) or use of similar functions in the eSchool platform to support the collection of high-level student results and teaching data.
- An investigation and test case of the application and benefit of LMS technologies for general education.
- Development of a process for moderated digital education experiences and distance learning support.
- Support to MoES for the establishment of a teaching and learning innovation center and initial regional network of technical support centers for schools based on the scope outlined below, including training for key personnel.
- Training in Pedagogical Technological Knowledge for teachers, school leaders and technicians to prepare them for the development and application of these methodologies in the classroom.

Without the human capacity, teacher support, technical and infrastructure support outlined in this document technology led solutions have been proven to fail in most cases.

**Moderated and supported digital education experiences**

Many education systems have developed networks of teachers to work with their colleagues to equip them with the skills and knowledge to redesign their classrooms to accommodate active learning approaches and digital technologies. For example Turkey has been involved in multiple European projects in recent years with European SchoolNet on the topic of future classrooms to develop the capacity of their teachers. Arising out of such projects they have also developed regional network hubs to support teachers in their use of digital practice. In their case they have cooperated with local regions, industry and schools to create vibrant spaces that support teachers in a range of pedagogical approaches that are relevant for today's classrooms.

In addition to supporting new digital approaches other countries, such as Ireland, Scotland and Wales, have developed new models of supplemental education designed to address teacher shortages in certain subjects, particularly subjects taught in minority languages including Gaelic.[44] These models of supplemental education have qualified teachers in one school teaching students online from a network of other schools. The teachers, known as e-Teachers,

[44] gov.ie - Independent evaluation of the Gaeltacht e-Hub Pilot Project

are timetabled to teach the students in the other school as part of the timetabled school day and the students are supported in their school by an e-Mentor. This model has expanded in recent years to now include subjects such as advanced mathematics, chemistry, physics, and modern foreign languages. Such models have the potential to offer a more diverse and quality education, at a distance, to students who would have access to suitably qualified teachers.

There is also evidence from Australia, New Zealand and Canada that online learning can provide students in remote parts of the country with subjects that are not available in their own school. These students may attend a small school where there is a shortage or lack of certain subject teachers. In such settings it is possible to supplement their face-to-face education with online classes that are delivered from another school or center. Such approaches require equipping the feeder schools, the schools where the 'expert teacher' resides, and the receiver schools, the schools where the students reside with the appropriate technology. They also require training on how to teach and learn online. It is most important that the 'expert teachers' receive specialized training in how to design and activate an online class so that students are engaged and motivated to learn. It is also important to have a 'mentor teacher' (called the e-Mentor in some of the projects) in each of the feeder schools to motivate and keep students focused, and look after the wellbeing of the students engaged in these practices. In a similar project in Ireland students from a cluster of 29 schools are taught online from the expert teacher's school and this model works really well. These teachers are referred to as e-Teachers and they are the class teacher responsible for teaching the curriculum and preparing students for their final state examinations[45]. We recommend that Georgia experiments with similar moderated distance learning processes to support teaching in small and regional schools where teachers are not available for more specialized or more advanced level subjects.

[45] Education Training Inspectorate

# Annex: SWOT Analysis

The following SWOT analysis was carried out by the consulting team in the fourth quarter of 2021 and was included in the initial recommendations report completed in March 2022.[46]

**Summary:**


The SWOT analysis identified **many strengths in the EMIS team and systems.** The key stakeholders stated clearly that EMIS are critical to the education reforms. In the business analysis phase a senior stakeholder stated that the EMIS team has *"ability, zeal and patriotism and make a very positive contribution to the country."* Modern development methodologies are used by the EMIS team and newly developed platforms including eVet and eUni provide a strong base from which to build around.

| Strengths: | Weaknesses: |
|---|---|
| • Good set of baseline systems across the main sectors of education<br>• Strong managers and dedicated team members<br>• Seen by stakeholders as critical to education reform<br>• New system upgrades in eVet & eUni<br>• EMIS has a strong sense of identity with many good technical and administrative functions, systems & structures<br>• EMIS stretches to cover a very broad range of functions and operations<br>• Sense of pride in new positive projects | • Multiple stakeholders with multiple priorities producing an unsustainable workload<br>• Lack of cross-organisation governance, priority decision making and direction setting across stakeholder groups<br>• Lack of data-driven prioritisation, change management processes and decision-making<br>• Many critical infrastructure challenges - broadband, access to technology in regions<br>• Unifying Architecture and Strategic Roadmap needed<br>• Lack of use of international data standards and frameworks<br>• Skills and practices in institutions & regions to support systems<br>• Lack of change-able organisation & processes at EMIS<br>• Databases have integration & sustainability issues<br>• Some systems need to be completed & integrated (e.g. eUni & RegAdmin)<br>• Political implications of data and reporting<br>• Large data entry workloads, and delays in report and data production |
| **Opportunities:** | **Threats:** |
| • New development framework no-code/low-code models<br>• Strategic outsourcing through partnership<br>• Cloud data hosting can provide greater data security, scalability and efficiency<br>• Adopting international best practices in development, hosting, data management and data standards<br>• Opportunity for more dynamic/agile and change-able systems to support business processes<br>• Development & capacity building opportunities for staff in new systems | • **Critical skill shortages** - particularly in key development skills, data management, data analytics<br>• Cybersecurity, privacy and data security<br>• Burnout of management and development teams |

**Figure:** Summary of SWOT Analysis Findings

**Strengths: Strong managers and dedicated team members**

EMIS has a good senior management team with a number of strong leaders and technical managers who are experienced with the operations, technologies and environment EMIS operates in. They are positively seen by stakeholders as critical to the education reforms

[46] Georgia EMIS Recommendations Phase Report (March 2022)

planned. The new system upgrades in eVet & eUni provide a good base for additional upgrades and enhancements.

The EMIS organization has a strong sense of identity with many good technical and administrative functions, systems & structures. EMIS stretches to cover a very broad range of functions and operations with a sense of pride in new positive projects.

**Challenges:**
EMIS operates in a complex and political arena. The OECD 'Reviews of Evaluation and Assessment in Education: Georgia' published in 2019 stated that *"Georgia does not have a strong culture of using evidence to inform policy-making."* EMIS has a very large circle of stakeholders with different requests and needs and sometimes conflicting visions. EMIS is also affected by international education projects implemented by MES that are supported by large International Donor Organizations such as World Bank, Asian development Bank, USAID which do not always have harmonious or integrated objectives or plans. The release of data and reports also has political dimensions which causes delays and extra workload. Stronger governance processes and a clear strategic roadmap management process will allow EMIS to create clear priority and resource-based decisions.

A **lack of EMIS participation in mid-level decision making processes** regarding strategy and policy directly affecting the organization results in confused, conflicting and changing direction. Therefore we are recommending the formation of an inter-organization **governing group** that analyze and prioritize the major initiatives of EMIS, and prioritize based on resource and technical consideration as well as stakeholder need. This process will inform MES regarding immediate and potential implications of policy changes, and support the proper resourcing and budget to deliver on changes in an effective manner.

This governance process and the setting of an **agreed strategic roadmap** will support the selection of the most effective strategy, sources of funding, help manage or avoid ad-hoc requests, and allow EMIS to meet targets on a more consistent basis. This forum will address and resolve difficulty in implementing and maintaining systems introduced within the International Projects to make these consistent with the overall vision, strategy and technology direction.

The analysis also identified a need for a more unified solution architecture and development planning methodology. The adoption of a distributed architecture using international education data standards will allow more mature institutions to efficiently provide data from their own management platforms. This distributed approach has also been proven to support and foster innovation as different solutions and approaches can be applied by different institutions and schools. This type of independence and academic freedom will allow new approaches to be tested and innovative approaches to be developed, within an environment that is supported by the international data standards.

Additional **weaknesses & challenges** include a lack of cross-organisation governance and strategic roadmap management process supporting data-driven decision-making and direction setting across stakeholder groups. There are many critical infrastructure challenges including broadband, access to technology in regions which result in a wide range of needs and organization capabilities.The skills, organizational capacities and support systems in the regions to support and provide data to EMIS systems are weak.

The international education data standards and frameworks for systems interoperability are not used at this point in the EMIS systems. The databases used to support EMIS systems have integration & sustainability issues spread among many different databases, using a range of database technologies. In addition to increased costs and resources required to technically maintain these diverse database systems, there are political implications of data and reporting and large data entry and verifications workloads which cause inefficiencies and delay report and data production.

**Opportunities:**

**Good set of baseline systems across the main sectors of education**
EMIS has supported and maintained a good set of baseline EMIS systems across the main sectors of education. The vocational education (eVet) system has been recently implemented based on a good modern development model and an upgrade to the higher education eUni system has begun using the same development methodology. The QMS system is currently meeting most needs but better data integration with the higher education data systems by means of the new eUni framework is needed. The eSchool general education system is due for a significant upgrade. Additionally there is a desire to extend the systems to support Preschool education, and to provide additional support to general education with a learning platform, particularly aimed at supporting regions with extra learning support, and to also increase the support for teacher professional development. Each system is supported by a database but there is a need for greater integration and streamlining of these databases.

The phased application of new no-code/low-code development frameworks, strategic outsourcing through partnership to deliver more results with scarce internal resources, and a transition to cloud and hybrid-cloud data hosting for greater data security, scalability and efficiency provide additional opportunities for EMIS to improve the systems. The development of a new data and domain model for the main EMIS systems, together with a modular replatforming of the systems and database streamlining will provide further improvement. Through this EMIS can build more dynamic/agile and change-able processes and create development & capacity building opportunities for staff in new systems and technical skills.

**Threats to EMIS:**
Three significant threats were identified in the analysis.

| | |
|---|---|
| 1. Critical skill shortages in the key technical skills required by EMIS to fulfill its charter | Developing and retaining all the key technical skills in software development, maintenance, and data management represents a very significant challenge for EMIS. Public sector salary levels are significantly lower than those available in the private sector in Georgia or on the international market. Strong technical leaders and managers, software architects and skills for new emerging areas including data analytics and low-code/no-code development methodologies are essential to the success of EMIS to deliver on it's very challenging charter. |
| 2. Cybersecurity, privacy and data security | Cybersecurity has become one of the biggest challenges and threats in the modern digital society. Nations are subject to criminal and geopolitical threats. Ransomware attacks on government and private sector data systems have become common, expensive and crippling. The privacy and security of minors, their families and schools requires strong procedures and methods. |
| 3. Burnout of management and development teams | The EMIS faces significant challenges, with a very broad brief in a highly political environment. The critical skills shortages and high level of transition to better rewarded positions in the private sector puts enormous stress on the organization. |

Approaches to help address these three threats are addressed by the following recommendations.

**Recommendation: Strengthen Governance, Change Management and Strategic Roadmap processes for overall EMIS prioritization and strategy setting.** Streamlining the planning and prioritization processes will help reduce the **levels of stress and burnout experienced by the management team.**

Other actions proposed in the additional recommendation below *'to carry out organizational capacity and capability analysis'* will also help address the challenges of scarcity of critical resources and team burnout and stress. The strategic outsourcing and streamlining the development platforms will also contribute to reduction in pressure on the software development team.

**Recommendation: Carry out organization capacity and capability analysis to fulfill EMIS charter and mission, with emerging and declining skills analysis.** This action together with those outlined above related to strategic outsourcing and streamlining the development platforms will support a strategic resource planning and training process.

**Recommendation: Review data security risks with the GDPR as guideline**, to reduce the risk of data breaches and ransomware attacks.

## Annex: Analysis and Recommendation Definition Methodology:

| | | |
|---|---|---|
| **Business Stakeholder Analysis** | ● Needs & objectives<br>● Business processes<br>● Organizations and processes | **Report Version 1.5 December '21** |
| **Technical Current State Analysis** | ● Current State Analysis<br>● Data structures & technical solutions and systems<br>● Capacity and resources to manage and operate | **Phase Completed Dec '21** |
| **Recommendations Development Phase** | ● Following analysis of the information gathered in the first two phases a set of technical, business, organizational, and operational recommendations will be made<br>● Stakeholder workshops will be carried out to validate the recommendations and direction<br>● Terms of Reference for procurement of service providers will be developed following the stakeholder workshops. | **Online Video Workshops March '22**<br><br>**Initial Recommendations Report March '22**<br><br>**Face-Face Workshops May '22** |
| **Follow-up project** | ● Learning Platform for General Education<br>● EMIS Organization and Resource Analysis | **Started Jan 2022**<br><br>**Amended agreement signed April '22**<br><br>**Updated organization analysis report completed in June 2022** |
| **Finalized Recommendations and TOR** | ● Following the workshops and stakeholder feedback | **Final reports delivered in July and August 2022** |

## Annex: Revised Deliverables

The following revised schedule of deliverables was agreed in an amendment to the agreement document signed in April 2022.

| **Deliverable Name** |
| --- |
| **R1 - Inception Report**: with a description of approach and methodology for executing the assignment, including a detailed action plan and working schedule.<br>Research instruments, including the sample questionnaires.<br>Report should be presented in two scenarios:<br>1. in case of international travel restrictions and<br>2. without the Covid-19 public health restrictions. |
| **R2 - Draft Report:** with findings on conducted assessments, including the lessons learned, draft recommendations on EMIS capacity building and data collection and analysis improvement for different types of levels, including policy-making on the operational level. |
| **R3 – Progress Report–**<br>**Report on conducted online workshops –** discussions on assessment findings and recommendations.<br>**Final recommendations** on EMIS capacity building and data collection and analysis improvement for different types of levels, including policy-making on the operational level.<br>**Draft TORs for the:** (i) Design and Development of EMS (Education Information Management system) for Early Childhood and General Education; (ii) Design and development Capacity Building of EMIS to Effectively Implement the Revised Charter, Structure, Scope, and Strategy Ensuring Relevant Data Collection, Generation, Analyses and Reporting for Entire Education System and Facilitating Evidence-Based Policy Decision-making |
| **R4 – Progress Report**<br>**Draft TOR for the:**<br>(i) Design and Development of Learning Management System (LMS) for General Education. |
| **R5 - Final Report on conducted workshop –** Presenting completed assessment findings, final agreed recommendations on EMIS capacity building and data collection and analysis improvement for different types of levels, including policy-making on the operational level.<br>**Final TORs for the:** (i) Design and Development of EMS (Education Information Management system) for Early Childhood and General Education; (ii) Design and Development of Learning Management System (LMS) for General Education. (iii) Design and development Capacity Building of EMIS to Effectively Implement the Revised Charter, Structure, Scope, and Strategy Ensuring Relevant Data Collection, Generation, Analyses and Reporting for Entire Education System and Facilitating Evidence-Based Policy Decision-making |