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1. Introduction

1.1 Background¹

In order to meet the Affordable Care Act’s (ACA) timelines and vision for a “single, streamlined eligibility and enrollment process”, Massachusetts developed a “single project approach” to coordinate development, procurement, and implementation of Health Insurance Exchange (HIX) and Integrated Eligibility System (IES) technology design and implementation. The overall project is now referred to as the “Massachusetts HIX/IES Project”.

To implement the information technology (IT) system that supports ACA implementation, the Commonwealth was awarded an Early Innovator Cooperative Agreement from the Centers for Medicare & Medicaid Services (CMS) beginning in February 2011. Massachusetts has been subsequently awarded Center for Consumer Information and Insurance Oversight (CCIIO) Establishment funds, as well as funding from Center for Medicaid & CHIP Services (CMCS) in December 2011 in the form of an Implementation Advance Planning Document (IAPD).

The Health Connector is independently operated by the Commonwealth Connector Authority (CCA) and is intended to serve as the common front door that citizens use to gain access to affordable health insurance and Medicaid. The Massachusetts Executive Office of Health and Human Services (EOHHS) administers, under the MassHealth Program, the state’s Medicaid Program.

The University of Massachusetts Medical School (UMMS) provides contract acquisition and contract management services for the systems integrator (SI) and independent verification and validation (IV&V) vendor contracts. The MA HIX/IES tri-party agreement defines the roles, responsibilities, obligations, and governance structure by and between the MA HIX/IES entities—CCA, MassHealth, and UMMS.

In July 2012, the Commonwealth awarded the SI vendor contract to CGI (as the prime contractor).

1.2 ACA Implementation in Massachusetts

The ACA requires that states implementing a Marketplace first determine eligibility for Medicaid based on current Modified Adjusted Gross Income (MAGI). If the applicant is ineligible for Medicaid, the state must then determine eligibility for subsidized coverage, also known as an Advance Premium Tax Credit (APTC), before offering unsubsidized coverage through a process that allows applicants to compare plans and enroll in the ones they prefer.

The Commonwealth has chosen to build a single web-based portal, the MA HIX/IES, which will make eligibility determinations and allow residents to shop for and enroll in plans offered by the Massachusetts health insurance marketplace, the Massachusetts Health Connector, and MassHealth.

¹ Information in the *Background* is based on input from Commonwealth staff.

Applicants considered eligible for Medicaid are enrolled in the MassHealth programs through a Medicaid Management Information System (MMIS). Applicants eligible for subsidized coverage and those who want to purchase unsubsidized plans may shop for and enroll in plans through the Massachusetts Health Connector.

In addition to determining program eligibility and supporting enrollment, the MA HIX/IES was to offer such key marketplace functions as plan management, financial management, Small Business Health Options Program (SHOP), customer service, outreach, and reporting.

1.3 MA HIX / IES Implementation Issues

The Commonwealth has faced and overcome significant challenges over the development life span to build the new HIX/IES. Unfortunately, the HIX/IES website was not fully operational on October 1, 2013, the federally mandated start of the initial health insurance marketplace open enrollment period in accordance with the ACA. The current MA HIX/IES system suffers from technology infrastructure and data stability problems. The limited functionality implemented to date demonstrates significant usability and performance issues. To ensure that Massachusetts residents who wish to obtain health insurance coverage can do so, the Commonwealth has implemented manual workarounds for many processes. Taken together, these workarounds have caused cascading effects across the Health Connector and MassHealth back office functions, including surges in Call Center activity and overloading of Health Connector and MassHealth staff. As of the date of this report, the Commonwealth has significant concerns with:

1. The quality of the HIX/IES system that has been deployed to date
2. The integrity of the underlying data model
3. The SI vendor's ability to deliver much needed core functionality in the near term

1.4 Scope of Work

The Commonwealth requested technical assistance from CMS, its federal partner, in evaluating the construction of the HIX/IES. CMS requested IT and systems engineering assistance from The MITRE Corporation (MITRE), operator of the CMS Alliance to Modernize Healthcare (CAMH) Federally Funded Research and Development Center (FFRDC). MITRE has developed substantive knowledge and understanding of the Commonwealth's systems development life cycle. MITRE has also provided technical guidance and assistance to the Commonwealth through its engagement with CMS in supporting and assessing various stages of development through gate reviews.

The scope of this engagement was to conduct a systematic review of the IT functions of the Commonwealth's HIX/IES. Specifically, the Commonwealth requested that this review include:

- A technical review that assessed the HIX/IES IT solution. This technical review included, but was not limited to, elements of:
 - Project structure, roles, and responsibilities
 - Project planning and execution

- IT governance/software life-cycle process
- Technical elements
- An approach for recovery that included:
 - Recommendations on near-term (30–45 days) and long-term fixes required to help restructure the HIX/IES IT organizational and governance processes

This engagement was not intended to constitute a comprehensive programmatic or technical review, but rather provide objective, independent insights into those areas where CMS and the Commonwealth noted their most critical concerns.

1.5 Purpose of This Document

This document provides the findings and recommendations from MITRE’s independent review and assessment of the Massachusetts HIX/IES. It documents the approach used for the analysis, which was based on inputs from the stakeholders from the Commonwealth of Massachusetts, SI vendor, IV&V vendor, and CMS.

The Commonwealth remains responsible for the disposition of recommendations presented here and for decisions related to program direction, contracts, and funding in working collaboration with CMS.

1.6 Approach

In conjunction with representatives from CMS, MITRE conducted the independent assessment from January 6–10, 2014. MITRE performed this independent review of the HIX/IES using 13 facilitated discovery sessions, a document review, and HIX/IES system demonstrations that covered the following program aspects:

- Project structure, roles, and responsibilities
- Project planning and execution
- IT governance/software life-cycle process
- Technical elements

MITRE facilitated initial discovery sessions with representatives of CCA, MassHealth, and UMMS to learn about the problems observed with the system. The team conducted additional sessions with the Commonwealth’s SI vendor, CGI, and representatives of the Commonwealth’s IV&V vendor, Berry-Dunn. The purpose of these sessions was to review the IV&V findings and obtain CGI’s perspective.

MITRE conducted more thorough follow-on sessions into 12 areas that had been identified as key areas of concern by the Commonwealth’s representatives. These sessions focused on specific details of the current state of the system and system development efforts. Following these sessions, MITRE reviewed documentation provided by the Commonwealth and developed a set of near- and long-term recommendations.

MITRE conducted all of the sessions in an open, non-judgmental atmosphere. All members were active participants and were encouraged to be candid and forthcoming. The sessions emphasized collecting and verifying root cause information, not on casting blame for the current state of the system. In general, the appropriate participants participated in the sessions, and demonstrated significant commitment, respect, and recognition related to the fluid nature of the session agendas and support for the ad hoc discussions that evolved.

2. Concerns Identified Prior to the Assessment

During initial level-setting discussions, the Commonwealth team—composed of representatives from the Massachusetts Health Connector, MassHealth, UMMS, and the IV&V vendor—expressed several concerns. Broadly speaking, these concerns involved system performance, lack of data integrity, lack of testing rigor, and areas where development was not complete. The SI vendor then joined the discussions. The following subsections present a brief list of composite topics identified by those present in these discussions.

2.1 Project Structure, Roles, and Responsibilities

- There is no chief architect currently within the SI vendor’s team who can maintain technical integrity across architectures that focus on specific areas.
- No single entity within the Commonwealth owns IT governance and there are no clearly identified roles, responsibilities, decision-making authorities, and accountabilities.

2.2 Project Planning and Execution

- Key decisions were not documented and maintained in a registry.
- Decisions were not explicitly made or well communicated to all parties, leading to uncertainty.
- Despite repeated reductions in scope over the lifespan of the project, the remaining scope was not ready on time.

2.3 IT Governance / Software Life-cycle Process

- The requirements development process took more time than was reasonable.
- The program does not have an approved, baselined set of requirements.
- There is no single source of scope and schedule for current requirements configuration control and implementation status. For example, an initial requirement might be used for baseline, a second version used for development, a third used as the basis of test cases, and a fourth version as the expectation of the Commonwealth.
- Test plans do not define the percentage of test coverage. The scope of testing is unclear. Risks associated with untested portions of the software have not been identified.
- There has been a lack of credible user testing.
- Problems with eligibility determination were identified but not raised during the development life cycle.

2.4 Technical Elements

- Required core functions are not working correctly, including but not limited to, Account Creation/Login and MassHealth Provider Search.
- The combination of a lack of data integrity due to a failure to capture and/or save data, a lack of data persistence, and a lack of data logging for analysis has resulted in the loss of records and led to data-related concerns.
- There are application intake system consistency and blocking issues (i.e., errors and inconsistent behavior preventing users from making it through the application process).
- APTC and the Cost-Sharing Reduction (CSR) calculations are not stored in the database.
- Because of a very poor user experience, certain users who submit unsubsidized applications abandon the Health Connector portal and pursue the purchase of insurance directly from issuers.
- There is an inconsistent use of standards, practices, and procedures and Service-Oriented Architecture (SOA) principles.
- The portal's intake layer leans too heavily on processing embedded within it instead of using calls to external services via the services bus.
- The portal layer is directly coupled to the data access layer without service abstraction and orchestration. In other words, data services are directly invoked through the portal, without use of other enterprise components.

3. Findings

This section presents the basic findings from MITRE's independent review during the week of January 6–10, 2014. At the time of this review, the Commonwealth had not yet implemented Release 1.1, which may have fixed some of the issues observed. The following subsections summarize the key findings for each area.

3.1 Project Structure, Roles, and Responsibilities

3.1.1 Commonwealth Team

Three organizations within the Commonwealth have HIX/IES responsibilities: the Health Connector, MassHealth, and the UMMS. There does not appear to be a consistent, unified vision for the system nor clear lines of accountability for implementing the vision. A number of organizations are involved with different priorities for the system. The IT project roles of the Health Connector, MassHealth, UMMS, and the systems integrator are not well aligned. Moreover, the project has not clearly defined the responsibilities for these roles, which compromises the performance of key functions necessary for accountability and project governance. At times, it has been necessary to elevate decision-making to the Secretariat's level. These factors have created management and oversight challenges that contributed to the issues now affecting the Massachusetts HIX/IES Project.

3.1.2 SI Vendor Delivery Team

There are significant issues with the organization of the SI vendor team structure and management. The following subsections (3.1.2.1–3.1.2.7) contain more detailed findings on the SI vendor team.

3.1.2.1 Program Management

There are challenges enforcing good project management and systems engineering processes and practices. There is little evidence that the SI vendor's project manager delegates to individual team leaders or demonstrates effective communication for actively planning, controlling, and executing a project of this scale.

3.1.2.2 Business Function Integration Leadership

The translation from the business requirements to technical components and the implementation of the design is most effectively done with business input. The challenges observed in correctly implementing the system (some manifesting themselves as data integrity issues) indicate the need for improved capability in this area. Some of these positions appear to exist within the SI vendor's structure; however, it is not clear that these staff were tasked to monitor and work with the development team to ensure alignment of the technical design with the customer's needs. Alternatively, they have not demonstrated an ability to accomplish this consistently.

3.1.2.3 Technical System Integration Leadership

Although the SI vendor appears to have technical architects, there is no clear indication who maintains the technical blueprints. As a consequence, the project has suffered from a lack of conformance to architectural standards and best practices.

3.1.2.4 Data Architecture Management

There are numerous instances where data elements apparently were used incorrectly. The SI vendor's current data management team does not appear to have sufficient depth to accommodate the complex data manipulation needs of the Commonwealth.

3.1.2.5 Quality Assurance

There does not appear to be sufficient rigor in applying Quality Assurance (QA) standards and policies. The SI vendor neither mandates nor enforces a requirement that all bugs in developed code are fixed for code reviews. The prerequisites for code promotion do not appear to include standard and complete testing of both ordinary and anomalous paths.

3.1.2.6 IT Process Leadership

The SI vendor currently has a number of processes documented, but these processes need to be more rigorously enforced. The present team does not appear to have sufficient depth to create and maintain processes and to communicate them appropriately.

3.1.2.7 User Interface Development Resources

There appear to be numerous shortcomings in the layout, labeling, and functionality of the input screens of the portal. This is an indicator that the SI vendor did not apply adequately proficient resources in this area.

3.2 Project Planning and Execution

3.2.1 Project Planning and Execution

The SI vendor's insufficient rigor in project planning during execution has created a number of risks to this project. The SI project team has not utilized the schedules, procedures, and templates developed during the earlier project phases.

3.2.2 Scope Management

The SI vendor indicated that it had taken on more work than it could accomplish within the timeframe available. The SI vendor had signed contract modifications, but those modifications did not resolve this issue. Despite repeated re-scoping efforts, the inability to manage scope changes and a lack of understanding of the impact of those changes has resulted in late deliveries.

3.2.3 Work Breakdown Structure

The program was organized around a complex set of work streams, which the SI vendor then mapped to workgroups. Although the project has discontinued the complex work stream-to-workgroup-to-function mapping, it appears this was a very late decision. The schedule seems to have been redrawn without sufficient risk assessment/adjustment and understanding of the impacts. At times, the SI vendor resources supporting one work stream were simultaneously required in another. These resources were sometimes unable to complete their work stream due to dependencies on work streams that were not started or completed.

3.2.4 Work Alignment

The SI vendor indicated that it had recently moved from a code development structure (one in which available coders were simply assigned to the next task within an area) to more of a functional development structure (where a team of coders would work toward providing end-to-end functionality). Despite the recent change, the SI vendor's previous heavily segmented development and lack of monitoring the dependencies generated an array of testing and timing problems.

3.2.5 Schedule

The project schedule has been spread across seven to nine Microsoft Project files, which do not appear to be integrated into a coherent integrated master schedule that could be used to find the critical path items and understand progress. In most cases, two separate documents show different dates for the same event. Planning for baselines of scope (requirements), schedule, and cost (at a minimum) has not been implemented. As a result, project execution has been seriously compromised. The SI vendor is working on creating a new integrated schedule.

3.2.6 Quality Assurance

There appear to be significant gaps in a prescribed Quality process for delivery, verification, acceptance, and sign-off on deliverables as outputs of work activities.

3.2.7 Communications

Project communication has been one of the greatest challenges on this effort. There does not appear to be a well-defined stakeholder map and a vendor Responsibility Assignment Matrix is missing.

3.2.8 Risk Management

Risks are generally identified later than they could have been discovered, reported, and mitigated. For example, a significant number of risks were not identified until late in the process by the IV&V vendor. Although risks are entered into a risk tracking system, Commonwealth and SI vendor senior management do not appear to use this risk list to manage and mitigate program risks.

3.3 IT Governance / Software Life-cycle Process

3.3.1 Requirements Management

The Commonwealth chose to use a three-dimensional matrix approach (work track, workgroup, and function) to drive the decomposition of business requirements. This allowed some segregation by organization, but resulted in complex overlaps of functionality where multiple tracks worked on the same functional area. The requirements are not fully traced to the technical life-cycle elements implementing the business requirement and there is no traceability from the requirements to the code. The project does not have a common requirements baseline. As a result, there are multiple versions of a unique requirement. Consequently, development of software, test case, stakeholder expectations, and test data creation are based on different requirements versions.

3.3.2 Change Management

A review of the change management process indicated that there is an understanding of the basic process for adding and removing scope, but risks and challenges may not have been fully assessed and considered prior to implementation of changes. Furthermore, there is no clear documentation of changed requirements, the current requirements baseline, linkage of changes to business architecture revisions, and linkage of the business architecture changes to technical solution changes.

3.3.3 Build / Release Management

The project lacks cohesive Build/Release Management processes for effectively implementing new functionality or fixing bugs. Tools for checking code quality appear to be available but not fully employed to ensure all bugs are fixed. It appears that the release notes do not provide a full explanation of fixes and the level of testing completed.

3.3.4 Design / Implementation

The SI vendor acknowledged that the technical design submitted to the Commonwealth did not provide enough detail to completely describe the functionality needed to build the system. The SI vendor provided an overview of its coding standards, but does not appear to be following the standards.

3.3.5 Testing

During the development and deployment phases of the system life cycle, there has been concern about which testing processes and standards are followed (at the unit level, integration level, regression level, performance level, and environment level). Since there is no traceability from the requirements to the technical components implementing the requirements, it is highly unlikely that all the technical implementation aspects of the design have been tested. For a system of this magnitude, integrated component testing promotes confidence that the system will be able to function in an end-to-end environment. Instead, the testing appears to use end-to-end-

scenarios that are more aligned with user acceptance testing (UAT) and do not allow for quick identification of problems, particularly when there have been problems with preceding steps.

3.4 Technical Elements

3.4.1 Architecture

The business functional architecture, process decompositions and interactions, and a systematic mapping of those processes to a business service component in a SOA are not fully apparent. The lack of alignment between the business and technical services has manifested itself throughout the software design and development processes. Data abstraction commonly achieved between the data layer and the presentation layer is absent, causing portal scalability and data integrity issues. On the positive side, the current technical platform supports tools that are capable of SOA as a design principle.

3.4.2 Software Design

Within a project of this magnitude, it is imperative to appropriately translate the details of the business functions in print or in person—through subject matter experts (SME)—to a software team. This was not fully accomplished and resulted in improper understanding of functions, integration, traceability, cross-functional dependencies, and orchestrating of appropriate handoffs between functional components. The SI vendor's technical detailed design documents are deficient. Error handling through design implementation is lacking and clearly demonstrated by the system's inability to handle catastrophic errors. There appear to be numerous cases throughout the website where the system is not trapping errors and providing user-friendly explanations. For example, the system indicates that it supports Internet Explorer 7 and higher; however, the system does not work with Internet Explorer 11 and does not provide sufficient explanation to the user about the incompatibility. There is evidence of design flaws that can cause basic deadlocks and issues with Web user session handling and management in the system, resulting in a frustrating user experience.

3.4.3 Data

It appears there were numerous instances where data elements were incorrectly used. The SI data team created a data dictionary, but it is not clear that there is enough information/access for the SI vendor to code it correctly. During the evaluation of the program determination functions, MITRE discovered that some data had not been correctly saved. Several issues were identified that contributed to this:

- Data had not been mapped into the correct fields in the database
- When reinitiating a session or recovering from a timeout, the previously input data had not been brought into the session and some data was not persisted, even though it appears the data structure included a place for this data. There are numerous, systemic data management issues that contribute to the overall system performance issues.

3.4.4 Integration

It appears the project has a deficiency in integration leadership, planning, specifications, and oversight. SI vendor teams had difficulties with integrating solution components and doing meaningful integration testing. The SI vendor teams constructed functions and capabilities for the system in silos, a well-known cause of integration problems.

For example, the Security Architecture, including Access and Identity Management services, was designed and constructed as a technical enterprise service meant to work in concert with the Portal, serving protected content such as account creation, security attribution, and login. These two enterprise services were not designed and appropriately integrated or tested, resulting in account creation without appropriate security attributes.

3.4.5 Infrastructure

There appears to be deficiency in the operational controls and processes for infrastructure management. For example, there is a lack of tools to perform application monitoring, and there is no systematic review of the automated logs that are kept.

4. Recommendations

MITRE respectfully submits the following near- and longer-term recommendations for the Commonwealth of Massachusetts. The recommendations are grouped by categories without any implied priority.

4.1 Near Term (30–45 days)

1. Establish one full-time senior government executive accountable for the success of ACA program planning and execution for the Commonwealth.
2. Draft a governance model that defines clear roles and responsibilities, and stand up governance bodies.
3. Develop an integrated program structure that includes leaders for the Health Connector, MassHealth, and UMMS and a small program management office (PMO). Include a specific technical structure as part of the program. The structure should include a project technical manager and best practice technical resources [dedicated SMEs, Chief Architect, Chief Engineer, Data Architect, QA/Quality Control (QC), etc.]
4. Decide on next steps relative to the current system based on three primary options, as follows:
 - **Option #1:** Engage a new SI vendor and start over by building a new system.
 - **Option #2:** Engage a new SI vendor and continue incrementally improving the current system.
 - **Note:** Options 1 and 2 are predicated on creating a transition plan and transferring responsibilities from the current SI vendor to one that has proven past performance success in Health Insurance Marketplace implementations constructed on the Commonwealth’s preferred platform (Oracle).
 - **Option #3:** Segment the current system into distinct technical segments and then re-engineer each segment as required to complete the system.
 - **Note:** Option 3 could be accomplished using a combination of the current SI vendor and additional vendors with expertise to complete the re-engineering.
5. Execute the contract actions required to implement the option chosen.
6. Place baseline requirements under configuration control.
7. Identify and prioritize program risks.
8. Draft and execute a twelve (12)-week Program Plan.
9. Create an overall, high-level program road map.
10. Produce and maintain an Integrated Master Schedule.

4.2 Beyond 45 Days to Completion

1. Execute PMO responsibilities
 - Finalize and socialize the program road map
 - Develop and adhere to agreed-upon program management norms and processes
 - Exercise rigor in the governance model and contractor oversight
 - Continuously manage risk
2. Improve SI /development program management and technical performance.
 - Ensure adherence to the Integrated Master Schedule
 - Ensure Change Control, Risk Management, and QA/QC processes are fully integrated into planning and fully exercised during execution
 - Monitor and incentivize strong contractor technical performance in requirements management and traceability, system design and development, change management, system build/release management, and system testing across all testing environments (unit testing through integration testing and UAT)
3. Develop a long-term Commonwealth operations strategy.
 - As the program matures, develop a long-term Operations and Maintenance Plan
 - Integrate long-term operational functions as appropriate into existing or new Commonwealth offices

Acronyms

ACA	Affordable Care Act
APTC	Advance Premium Tax Credit
CAMH	CMS Alliance to Modernize Healthcare
CCA	Commonwealth Connector Authority
CCIO	Center for Consumer Information and Insurance Oversight
CMCS	Center for Medicaid & CHIP Services
CMS	Centers for Medicare & Medicaid Services
CSR	Cost-Sharing Reduction
EOHHS	Executive Office of Health and Human Services
FFRDC	Federally Funded Research and Development Center
HIX	Health Insurance Exchange
IAPD	Implementation Advance Planning Document
IES	Integrated Eligibility System
IT	Information Technology
MAGI	Modified Adjusted Gross Income
MMIS	Medicaid Management Information System
QA	Quality Assurance
QC	Quality Control
SHOP	Small Business Health Options Program
SME	Subject Matter Expert
SOA	Service-Oriented Architecture
UAT	User Acceptance Testing
UMMS	University of Massachusetts Medical School